Thematic Analysis of the Integration of Community-Specific Conventions in COVID-19 Vaccine Distribution Policies to Enhance Vaccine Accessibility and Equity

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Ann Li

Spring 2024

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Rider W. Foley, Department of Engineering and Society

Vaccine Distribution for COVID-19 Herd Immunity

With a 21% increase in the number of COVID-19-related hospitalizations at the beginning of the new year, the pandemic is still far from over in the United States (The New York Times, 2024). The current hope for controlling the spread of the pandemic is to achieve herd immunity through vaccinations. As defined by the World Health Organization (2020), herd immunity occurs when a sufficient proportion of the population has developed immunity through vaccination or previous infection, restricting the disease's propagation. Given the socioeconomic consequences of social distancing and the ethical issues regarding intentional pathogen exposure, vaccinations emerge as an invaluable strategy for controlling the spread of COVID-19.

Experts such as Dr. Anthony Fauci predict that the COVID-19 herd immunity threshold may need to be as high as 90% (McNeil, 2020). According to the Centers for Disease Control and Prevention (2023), the nation's primary vaccination rate has just reached 69.5%, of which only 17% of people have received the latest COVID-19 vaccine booster. Therefore, herd immunity remains greatly compromised since the population is still at risk for carrying and transmitting the COVID-19 pathogens.

To improve vaccine uptake, technologically inspired approaches driving successful vaccine distribution strategies can be examined in the state of Virginia. In January of 2021, Virginia had the lowest percentage of administered vaccines. The National Association of State Chief Information Officers (2021) outlined the development of data pipelines connecting statewide vaccine systems and local health district dashboards. These pipelines consolidated 35 disparate efforts across health districts into a unified vaccine campaign that provided insight into vaccine distribution equity. With the growth of COVID-19 health infrastructure, the state quickly rose to 11th place in the United States rankings for vaccination efficiency. This story of success

motivates Virginia-centric studies on improving vaccine distribution in hopes of extrapolating pandemic response methods to facilitate the nationwide recovery from COVID-19.

Despite the overall success of vaccine campaigns at the state-level, vaccine accessibility and equity remain significant challenges for marginal demographics everywhere. Calculations by Andrews et al. (2022) show that vaccine inequity and health outcome disparity is correlated to vulnerability: vulnerable populations have less access to vaccines. Found at the center of vaccine deserts, refugee, immigrant, and migrant communities suffer from a lack of transportation options to reach clinics and face conflicts between clinic and work hours (Ndugga et al., 2021). Black and Hispanic communities also have lower vaccination rates because the local minority communities were not integrated into the vaccine development and distribution process (Strully et al., 2021).

Vaccine distribution policies that fail to account for the lifestyle and background of minority groups exacerbate the disproportionate impact of the COVID-19 pandemic on these communities. Therefore, it is critical to investigate the extent to which po`licymakers consider the conventions of minorities in vaccine distribution strategies to improve the accessibility of vaccines for disadvantaged demographic groups.

Vaccine Distribution Concerns and Infrastructure Context

There are many factors underlying low vaccine uptake in the United States. Public discourse has shifted attention towards vaccine hesitancy, the politicization of healthcare, and cultural resistance (Peters, 2022). These complex and nuanced social transformations can often detract from the issue of vaccine accessibility. However, it is important to recognize that these factors only underscore the importance of prioritizing vaccine equity and accessibility.

Because a lower vaccination rate is often attributed to hesitancy, policymakers have been known to deprioritize the top-down allocation of accessible vaccines to hesitant populations. As a result, the potential facility locations in counties consisting of more than 42.2% Black residents were less likely to be converted to COVID-19 vaccine centers than the facilities in counties consisting of less than 12.5% of Black residents (Hernandez et al., 2022). From this example, it is important to recognize that this assumption of hesitancy is self-reinforcing as the inequity gap widens due to a lack of accessible vaccine resources for these groups. As such, vaccine accessibility remains a major barrier to marginalized communities and the perceptions of vaccine hesitancy only intensify the issue.

Moreover, it has been found that the politicization of vaccines intentionally targets vulnerable populations. For instance, a survey of voices in online spaces found that well-grounded medical racism concerns in Black communities were exploited to spread deliberate disinformation on vaccine compliance to further political agendas (Diamond et al., 2022). The deliberate exploitation of cultural concerns has reduced the ease in which marginalized communities can engage with vaccine resources. It is critical to focus on improving vaccine accessibility for marginal populations, regardless of the socially perceived degree of vaccine hesitancy.

Because Virginia has shown clear improvement of vaccine distribution efficiency due to growing COVID-19 health infrastructure, it serves as a good case study for vaccine distribution developments. There are two key COVID-19 infrastructure developments in Virginia that seek to improve vaccine uptake for minority groups by targeting human conventions: mobile vaccination clinics and human mobility data.

Extending upon traditional vaccination efforts, Virginia has deployed mobile vaccination clinics that can travel from location to location to reach populations with weaker local health

infrastructure. Mayfield et al. (2023) found that mobile vaccination clinics have the potential to improve vaccine accessibility for minority communities. Black and Hispanic populations in Mecklenburg County, North Carolina receive a larger proportion of their vaccines from these clinics. As such, mobile vaccination clinics are part of a broader strategy to improve the healthcare system by catering to the "rhythm of life of community members" (Mayfield et al., 2023).

The gathering of human mobility data also reflects the same strategy of catering towards the conventions of individuals and communities. Over the years, Virginia's data-driven approaches have also yielded increased infrastructure support for integration with SafeGraph, a data analytics provider that tracks mobility location data (i.e. home, work, market, recreation, etc.) for individuals based on anonymized cell phone data (Masters, 2021). Altogether, these two infrastructural developments are pioneers for a vaccine distribution process that focuses on engaging marginalized communities by considering their routine practices.

Infrastructure Framework for Vaccine Distribution

The relationship between vaccine distribution technology and the social interpretation of equitable accessibility can be analyzed through the framework of *infrastructure*. As introduced by Star (1999), the term "infrastructure" is often seen as a system of technical parts that lie dormant in the background until they are called upon by human users. However, the framework of *infrastructure* emphasizes that infrastructure is inseparable from the concept of human organization. Technical systems take on different meanings and values in relation to different human practices. *Infrastructure* presents a strong relational focus on the role technological systems play as a part of human organizations.

There are nine defining dimensions of *infrastructure.* The aspect *links with conventions of practice* describes the reciprocal nature of the feedback loop between technology and social conventions. Core to human organization, infrastructure has the potential to both reflect human practices and shape them. This principle is especially important when considering the weaknesses of vaccine distribution policies in accounting for pre-existing human conventions. Studying the transit-based spatial accessibility to COVID-19 vaccination sites at the census tract level in the Chicago Metropolitan Area, Liu et al. (2023) found that the inner city has a lower spatial accessibility score, which also coincides with an increased density of minority Black and Hispanic populations in these areas. These groups find vaccination sites at car-centric locations inaccessible because of the different *conventions of practice* pertaining to the mobility patterns of these minority communities. When policymakers overlook the differences in the conventions of different groups, they produce policies that pose barriers to vaccine accessibility and perpetuate vaccine inequity.

When examining the issue of low vaccine uptake, Peters (2022) concluded that it is critical to address specific groups, enhance access to vaccines, and embed vaccine knowledge in routine practices to improve vaccine uptake. These recommendations also showcase the relevance of considering *conventions of practice* in vaccine distribution approaches. By focusing on the integration of policies with routine practices particular to specific groups, vaccine distribution policies can lower physical and cultural accessibility barriers for vulnerable populations. Preliminary studies on vaccine distribution policies also support Peters' conclusion: when computational algorithms consider mobility and demographic data, they produce vaccination site recommendations for minority populations that are significantly different from the standard approaches (Mehrab et al., 2022). From this perspective, the incorporation of human conventions

into vaccine distribution methodologies facilitates improvements in accessibility for underserved populations.

Incorporating human conventions into preexisting vaccine distribution infrastructure can pose a major challenge. The tenet *built on an installed base* describes the tendency of infrastructure to inherit from and preserve the fundamental structure of preceding legacy versions. The challenges of integrating new developments can be seen in the disparate focuses within technical research and policymaking for vaccine distribution. Although the development of mobile vaccination clinics removes many conventional constraints associated with vaccine distribution, algorithmic studies such as Shukla et al. (2022) still constrain their vaccine sites to local pharmaceutical infrastructure. While there are new resources available to improve vaccine distribution procedures, they are under-utilized in key fields of research and poorly integrated into the existing infrastructure base.

Built on an installed base can also apply to the human and social base of COVID-19 vaccination infrastructure. It is critical to consider the social components of vaccine development, testing, outreach, and policymaking as part of the infrastructure. Because many demographic minorities have suffered from histories of medical racism, this existing human infrastructure must also be extended to encompass the local minority groups and rebuild trust. Strully et al. (2021) surveyed 31 health professionals working closely with marginal populations in New York. They concluded that integrating communities into the vaccine campaign through well-established cultural centers and community leaders is crucial to the development of sustainable and equitable vaccines. The initiative to extend the flexibility of vaccine site deployment requires extensive reworking of both the technical and social infrastructural base.

By examining the vaccine distribution process through the lens of *infrastructure*, we can systematically evaluate the extent to which current policies and technical research address *links with conventions of practice* and grow off *built on an installed base.* Because both dimensions are bottlenecks for vaccine uptake, successful policies must integrate the human conventions of vulnerable demographics and build upon the infrastructural base to strengthen pandemic response.

Thematic Analysis of Vaccine Policies

Referencing Langdon Winner's phrase "pandemic artifacts have politics", Hofmänner (2023) presents the disparity in vaccine accessibility leading to vaccine inequity as a failure of policy. This prompts the question: Do policymakers successfully integrate client-specific conventions into vaccine distribution infrastructure to enhance vaccine accessibility for disadvantaged demographic groups?

This research question contains three sub-questions. First, which disadvantaged demographic groups are identified and targeted by policymakers? Second, how are the client-specific conventions utilized in accordance with Star's *infrastructure* tenet of *links with human conventions*? Third, how do policymakers integrate these conventions into vaccine distribution infrastructure in terms of *built on an installed base*?

To address these questions, I examined 27 monthly Department of Health Plan for Equitable Distribution of COVID-19 Vaccine reports to the Virginia General Assembly from January 2021 to March 2023 (see Appendix A). With these reports, I conducted a thematic analysis to identify the contexts in which themes of *diversity*, *human conventions*, and *policies* appear. I filtered through all the words in the reports and compiled a set of relevant keywords to represent each

theme (see Appendix B). I created a script to extract all the sentences containing a keyword and manually filtered the results to omit all irrelevant statements.

For each thematic group, I compared the trajectory of the subcategories throughout the pandemic response. Then, I examined the textual data for each subcategory to analyze the evolution of ideas, statements, and general sentiments expressed for these three themes. The three themes capture how Virginia's COVID-19 responses align with Star's *infrastructure* framework. *Diversity* yields insight into the demographic communities that received attention during Virginia's COVID-19 pandemic response. *Human conventions* relates to Star's *links with conventions of practice* tenet by extracting the cases in which pandemic response catered to the conventions of communities identified under the diversity theme. Finally, *policies* showcases how policymakers shaped COVID-19 pandemic response infrastructure to target marginalized demographics and improve vaccine equity. This theme has a dual purpose: it highlights the role of pandemic response infrastructure in executing human conventions, and it depicts the extent to which policymakers were constrained by the tenet *built on an installed base* when developing infrastructure to combat the COVID-19 pandemic.

Thematic Coding Results

The VDH identified race, age/sex, and urban-rural disparities as vaccine equity concerns, but the age/sex demographics of concern were under-represented in the reports. While policymakers successfully incorporated mobility conventions into technical infrastructure through mobile vaccine sites, they were unable to do so for cultural and lifestyle conventions. The incorporation of mobility conventions into the infrastructural base was a successful component of the vaccine campaign. However, the flawed data collection base and unstable

policy base hindered policymakers' ability to create sustainable policies for equitable vaccine distribution among underserved demographic groups.

Analyzing the Prevalence of Marginalized Demographic Groups

I analyzed mentions of diversity and demographic groups in the VDH reports to examine which groups received focus. Figure 1 depicts the number of matching statements for each demographic theme.

Ever since July 2021, the VDH has identified that the following vaccine disparities are "especially concerning: 1) race; 2) age and sex; and 3) urban-rural divides" [7-10, 14-27]. When examining the language of the reports, it appears that the demographic themes that receive the most focus (see Appendix C) do not align with the groups suffering from vaccine inequity. This raises the question: To what extent were policymakers discussing the relevant demographic groups of concern?

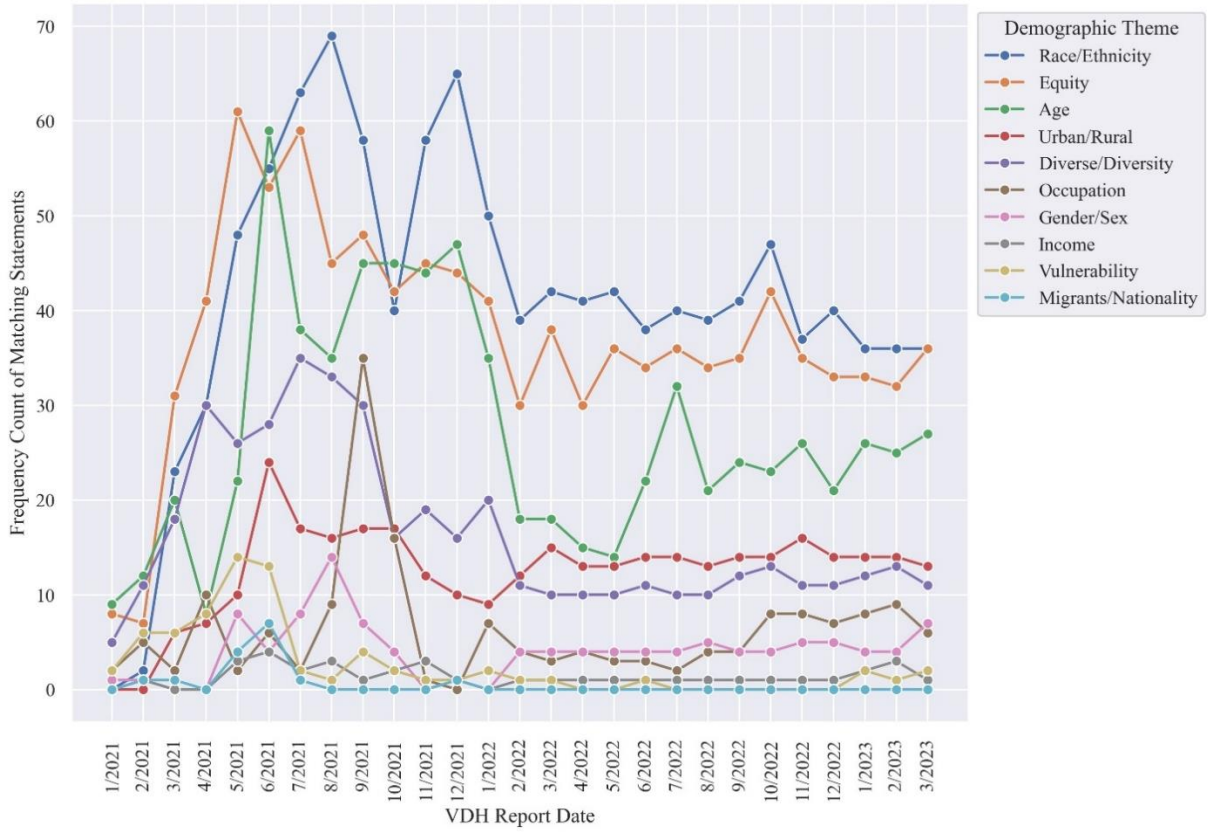

Figure 1. The number of statements that match keywords for broad diversity and specific demographic group themes from thematic coding.

According to Figure 1, policymakers consistently covered topics of race. Statements of age focused on the elderly or the youth. However, the age group of 30-39, which had the largest number of COVID-19 cases, did not receive as much focus in the reports [17-23]. Though the theme of urban-rural divides was less prominent, it still occupied a steady niche in the reports.

Critically, mentions of sex and gender were grossly under-represented in the reports despite being one of the main areas of vaccine disparity. The LGBTQ+ community was mentioned: “LGBTQ people of color were twice as likely to contract the virus than White cisgender people” [7]. Yet, this issue faded from discussion without any resolution. Despite being acknowledged as an underserved demographic group, immigrants/migrants/refugees have little

presence in the report. While it is commendable that the COVID-19 vaccine equity discourse addresses systemic health inequities, it is concerning that there are still many undermined demographic groups that do not receive consistent focus throughout the pandemic.

Analyzing the Appeals to Human Conventions

The VDH reports also provide a rich source of content regarding the human conventions of different communities in Virginia. Human convention keywords include culture-specific words such as religion, mobility words relating to access and transportation, and other lifestyle habits such as occupational experiences. Table 1 provides the number of statements from all reports that match each subcategory, and Appendix D discusses a temporal breakdown of the human convention themes.

Table 1. The number of statements across all reports that contain themes on human conventions.

	Cultural Conventions	Mobility Conventions	Lifestyle Conventions
Count	248	333	303

Concerning the tenet *links with human conventions*, movement is the convention most effectively ingrained in vaccine distribution infrastructure. Across the reports, the VDH identified movement as a relevant theme for LTCF residents, disabled/homebound individuals, communities limited by transportation, rural regions, and young children. The rapid development of walk-in clinics, same-day registration, home-use testing kits, drive-thru clinics, and partnerships with transportation providers such as Uber/Lyft targeted movement conventions [4-7, 12-14, 17, 20]. Virginia also integrated mobility into the technical infrastructure by establishing community vaccination clinics (CVCs) to reach vulnerable populations [4-7, 10, 15] and deploying mobile health units that were able to travel between locations and offer more

targeted flexibility [4, 6-9, 11, 15, 23, 25]. These infrastructural developments emphasize that pandemic response efforts purposefully integrated mobility conventions into vaccine infrastructure.

Compared to the theme of movement, cultural and lifestyle conventions were more volatile throughout the pandemic. As seen in Table 2, while some cultural conventions directly targeted places of worship and minority communities, most efforts were poorly oriented towards demographics of sex and occupation. On the other hand, lifestyle conventions focused on the reasons for vaccine disparity by age (children and the elderly) and urban/rural divides. Contrary to the local health districts' focus on cultural conventions, policies targeting lifestyle conventions took the form of vaccine mandates to target educational institutions and federal/state workers. But when the state leadership changed, mandate efforts were discarded, and no alternative approach arose to take its place. These two conventions illustrate that policymakers were unsuccessful at integrating the cultural and lifestyle practices of marginalized communities with vaccine distribution infrastructure in a targeted and sustainable approach.

Table 2. Frequency of demographic theme keyword occurrences in convention statements.

	Racial/Ethnic	Urban/Rural	Age	Sex	Occupation
Cultural Conventions	58	42	93	6	15
Lifestyle Conventions	50	55	106	5	39

ANALYZING THE EVOLUTION OF PANDEMIC RESPONSE INFRASTRUCTURE

Vaccine infrastructure is constructed upon multiple bases: data (see Appendix E), technical infrastructure, and policies. Initially, the technical infrastructure for vaccination clinics was embedded in existing pharmaceuticals such as CVS/Walgreens [1]. As the vaccine supply increased and inequity became a prominent topic, efforts shifted to community vaccination

centers (CVCs) for larger-scale administration [4, 6]. The VDH reported, “CVCs are . . . designed to provide vaccine access to vulnerable communities and not as a replacement for existing sites or other avenues for vaccinations” [4]. Thus, CVCs became an extension of the preexisting base, embodying Star’s *built on an installed base* tenet.

Unlike CVCs, mobile units were seen as a new phase of technical infrastructure, able to serve the community’s needs by traveling between locations. The VDH reported, “As the state continues to disband large-scale community vaccination centers, increased mobile vaccination units located at places of interest . . . will play a significant part in reducing vaccination inequity” [7]. While mobile units could not substitute for CVS/Walgreens clinics, they supplanted CVCs instead of operating concurrently. Appendix F highlights the same trend in the deployment of COVID-19 testing infrastructure. The evolution of technical vaccine infrastructure has shown that new development extends off existing base infrastructure. However, in January of 2023, mass vaccination centers and mobile testing sites began to close across local health districts [25]. The temporal nature of the pandemic response presented an interesting circumvention of *built on an installed base* as the infrastructure was dismantled over time.

Pandemic response infrastructure is also built upon a base of policies that highlight the inner workings, beliefs, and conflicts within a society. Figure 2 shows the trends of three themes—laws, actions, and political influences—across the monthly reports. Actions such as hosting free walk-up vaccine clinics, partnering with local community leaders for outreach, and distributing free testing kits during risk spikes were strongly present across the reports [3-8, 12-14, 17, 20, 25-26]. Themes of legal actions and policies were much more volatile and sharply dropped after 2021. The evolution of vaccine mandates presents an interesting case of this trend.

Starting in August 2021, vaccine mandates were presented as an effective method to increase vaccine uptake while circumventing vaccine hesitancy. There were vaccine mandates for health workers, city/state workers, and school staff. But these mandates faced local and federal pushback. With the transition to a Republican governor in January 2022, vaccine mandates became a relic of the past as "Governor Youngkin emphasized his stance that Virginia will not mandate the COVID-19 vaccine" [23-27]. Similarly, the VDH reports, "the Biden Administration withdrew its mandate following the Supreme Court's decision to block it" [14-21, 23-27]. Due to this fluctuating base of vaccine mandates, pandemic response policy developments were not sustainably rooted in infrastructure. With the end of vaccine mandate actions, the VDH reports did not introduce any new actions to target vaccine hesitancy and increase vaccine uptake. Instead, the pandemic was silenced by an end to the evolution of policy.

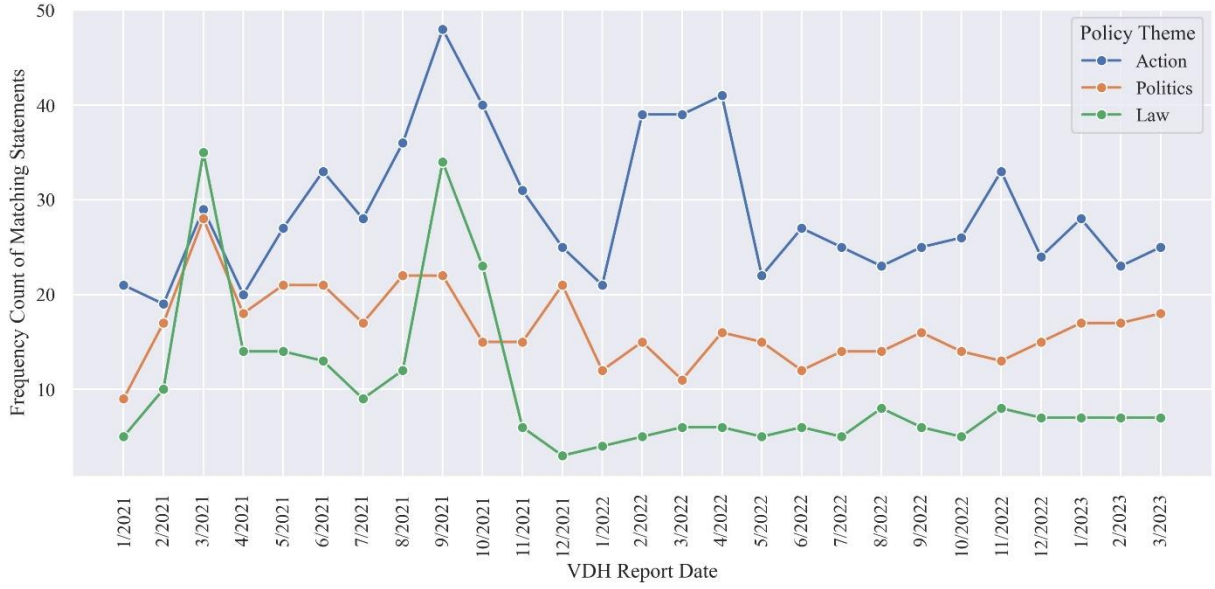

Figure 2. The number of statements from each monthly VDH report that contain keywords indicative of pandemic response policies.

Discussion

Policymakers succeeded in integrating mobility conventions into vaccine distribution infrastructure through CVCs and mobile vaccine/testing units to form *links with human conventions*. Because cultural conventions were targeted through the actions of local communities and health districts, these conventions were not as embedded in the infrastructural base as mobility conventions. Vaccine distribution infrastructure was *built on an installed base* consisting of data gathering, technical infrastructure, and societal policies. Developments targeting mobility conventions were grafted onto the technical infrastructural base to extend the flexibility and accessibility of vaccine sites. However, the infrastructural base was dismantled to optimize resources as the demand for vaccines decreased. Changes in political leadership, public opinion, and social values resulted in volatile vaccine policies that were under-enforced and eventually overturned. Ultimately, while policymakers were successful in integrating mobility conventions into vaccine distribution infrastructure, the unstable infrastructural base led to shortcomings in detecting marginalized groups and establishing sustainable vaccine equity policies.

Framework Implications: A Time-Dependent Infrastructure

The relationship between vaccine distribution infrastructure and *built on an installed base* has implications for Star's *infrastructure* framework. Because of the transitory nature of the COVID-19 pandemic response and limited resources, the vaccine distribution base was unstable and prone to changes. Incremental developments such as CVCs and mobile units were designed to complement mass vaccination sites. As the demand for vaccines declined, the infrastructural base became obsolete and was eventually dismantled, leaving extensions such as mobile units

unable to fill to void. With a constantly fluctuating target audience, shifting external contexts of the pandemic, and rapidly developing societal responses, vaccine distribution infrastructure for COVID-19 lies in an unexplored area of *infrastructure* wherein the infrastructure is a function of time. Successful vaccine distribution infrastructure facilitates widespread immunity, thereby eliminating the demand for further vaccinations. Pandemic response might require a flexible infrastructural definition that emphasizes adaptability over long-term permanence.

Recent Vaccine Developments and Updates

This study examined all available VDH vaccine equity reports in the Virginia Legislative Information System. The last available report, released in March 2023, mentioned Virginia's return to normalcy. Since then, many equity dashboards have been removed from the public eye. Free COVID-19 testing has been discontinued, mass vaccination sites and CVCs have been closed, and contact tracing efforts have been ceased. A year has passed, but infections continue to spread in waves, impacting the same communities, schools, and workplaces at both a societal and an individual level. In January 2024, the World Health Organization reported that the number of COVID-19-related hospitalizations increased by 40% globally in the last month (WHO, 2024). And behind this statistic, vaccines remain a concerning issue. According to the VDH (n.d.), the total vaccination rate in Virginia during 2023-2024 is 11.5% and only 21% of the population has received the bivalent COVID-19 booster recommended by the CDC. Overall vaccination rates in the U.S. fall far below the estimated proportion required for herd immunity.

Research and Result Limitations

The thematic analysis of VDH reports is limited by the subjective categorization of themes based on keywords. Subjective judgement also plays a role in determining the relevance of the statements to the examined theme. Keyword-based systems can be flawed, potentially overlooking relevant statements with multi-word terms like “African American” and “Native American”. Therefore, comparisons of frequency counts must be offset with the understanding that counts reflect the subjective biases and nuances in the keyword determination process. Additionally, the research scope was limited to state-level reporting, which selectively chose what to include from the federal and local health district levels and cannot provide insight into the thoughts of policymakers. Nonetheless, these results still highlight an important component of understanding vaccine distribution through the framework of *infrastructure* and contemplating the role of temporal infrastructure in pandemic response.

Self-Reflection

In reflection, I felt like the results were too dependent on the thematic coding process, wherein only the established categories and themes were examined. This subjectivity and dependency prompted concern over the possibility of human error and bias. I would have liked to conduct a more strategic keyword categorization process that relied less on subjectivity and personal bias. Additionally, I wish I knew of a more organized approach to track the disappearance of minority groups, discrepancies in classifying age demographics, and changes in risk factors in different counties without knowing the nature of the change beforehand. During this process, I found it difficult to pinpoint what to include in the results without cherry-picking specific cases.

The multidimensional analysis of the COVID-19 pandemic response ties into my research domain. I worked on a research group funded by state and federal-level health grants and collaborated extensively with the VDH. The directions determined by big-picture policymaking and their respective concerns shape our engineering practices. While this can guide research efforts to advance relevant societal problems, it can also be risky when the research inherits the limitations and constrained infrastructural base from state/federal policymakers. Evaluating the extent to which this broad political guidance reflects the core problems allows engineering practices to target the most critical issues without being misled by existing constraints.

Conclusion

Four years after the first identified case, COVID-19 remains a global health crisis. The sociopolitical debates surrounding vaccine equity, conflicts of social values, and challenges in effective action have illustrated the importance of establishing a robust pandemic response infrastructure to manage COVID-19 and future epidemics. It is critical to analyze pandemic response as a form of *infrastructure* and understand that policies in pandemic response reflect the broader societal system. Assessing both the flaws and successes of pandemic response efforts as a reflection of societal issues allows for more directed research goals, such as improving data collection for minorities that face systemic inequities. Future work can contribute to the analysis by interviewing policymakers to understand the rationale behind their decisions, examining different states, focusing on local health districts, or conducting global comparisons to diversify the scope of understanding of the United States' pandemic response system. Only by understanding pandemic response infrastructure in the context of human organizations can we hope to construct sustainable health infrastructure to prepare for future crises.

References

Andrews, K., Ohannessian, M., & Berger-Wolf, T. (2022). Modeling access differences to reduce disparity in resource allocation. *Equity and Access in Algorithms, Mechanisms, and Optimization*, 1–11. https://doi.org/10.1145/3551624.3555302

Centers for Disease Control and Prevention. (2023, May 11). *COVID Data Tracker - COVID Vaccinations in the United States*. Centers for Disease Control and Prevention. https://covid.cdc.gov/covid-data-tracker/#vaccinations_vacc-people-booster-percent-pop5

COVID-19 Data in Virginia. (n.d.). Virginia Department of Health; Virginia Department of Health. Retrieved February 16, 2024, from https://www.vdh.virginia.gov/coronavirus/see-the-numbers/covid-19-in-virginia/

COVID-19 Epidemiological Update – 19 January 2024. (2024, January 19). World Health Organization; World Health Organization. https://www.who.int/publications/m/item/covid-19-epidemiological-update---19-january-2024

Department of Health. (2021). *RD124 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March 1, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD124/PDF

Department of Health. (2021). *RD125 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February 5, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD125/PDF

Department of Health. (2021). *RD149 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - April 1, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD149/PDF

Department of Health. (2021). *RD185 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - May 1, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD185/PDF

Department of Health. (2021). *RD230 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - June, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD230/PDF

Department of Health. (2021). *RD24 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January 4, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD24/PDF

Department of Health. (2021). *RD278 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - July, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD278/PDF

Department of Health. (2021). *RD351 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - August, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD351/PDF

Department of Health. (2021). *RD413 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - September, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD413/PDF

Department of Health. (2021). *RD507 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - October, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD507/PDF

Department of Health. (2021). *RD639 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - November, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD639/PDF

Department of Health. (2021). *RD778 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - December, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine).

Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD778/PDF

Department of Health. (2022). *RD208 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD208/PDF

Department of Health. (2022). *RD209 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD209/PDF

Department of Health. (2022). *RD303 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - April, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD303/PDF

Department of Health. (2022). *RD304 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - May, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD304/PDF

Department of Health. (2022). *RD305 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - June, 2022* (Reports to the General Assembly; Virginia

Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD305/PDF

Department of Health. (2022). *RD49 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD49/PDF

Department of Health. (2022). *RD498 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - September, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD498/PDF

Department of Health. (2022). *RD539 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - July, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD539/PDF

Department of Health. (2022). *RD540 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - August, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD540/PDF

Department of Health. (2022). *RD627 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - October, 2022* (Reports to the General Assembly;

Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD627/PDF

Department of Health. (2022). *RD871 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - November, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD871/PDF

Department of Health. (2023). *RD165 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - December, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD165/PDF

Department of Health. (2023). *RD166 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD166/PDF

Department of Health. (2023). *RD167 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD167/PDF

Department of Health. (2023). *RD168 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD168/PDF

Diamond, L. L., Batan, H., Anderson, J., & Palen, L. (2022). The polyvocality of online COVID-19 vaccine narratives that invoke medical racism. *CHI Conference on Human Factors in Computing Systems*, 1–21. https://doi.org/10.1145/3491102.3501892

Hernandez, I., Dickson, S., Tang, S., Gabriel, N., Berenbrok, L. A., & Guo, J. (2022). Disparities in distribution of COVID-19 vaccines across US counties: A geographic information system–based cross-sectional study. *PLOS Medicine*, *19*(7), Article e1004069. https://doi.org/10.1371/journal.pmed.1004069

Hofmänner, A. (2023). Postscript: Vaccine crumbs and science and technology studies. *Science, Technology and Society*, *28*(1), 83–87. https://doi.org/10.1177/09717218221102502

Liu, D., Kwan, M.-P., Kan, Z., Song, Y., & Li, X. (2023). Racial/ethnic inequity in transit-based spatial accessibility to COVID-19 vaccination sites. *Journal of Racial and Ethnic Health Disparities*, *10*(4), 1533–1541. https://doi.org/10.1007/s40615-022-01339-x

Masters, K. (2021, October 15). Anonymized cell phone data is helping Virginia's local health officials select mobile vaccine sites. *Virginia Mercury*. https://www.virginiamercury.com/2021/10/15/anonymized-cell-phone-data-is-helping-virginias-local-health-officials-select-mobile-vaccine-sites/

Mayfield, C. A., Priem, J. S., Inman, M., Legare, T., Snow, J., & Wallace, E. (2023). An equity-focused approach to improving access to COVID-19 vaccination using mobile health clinics. *Healthcare*, *11*(2), Article 100690. https://doi.org/10.1016/j.hjdsi.2023.100690

Mehrab, Z., Wilson, M. L., Chang, S., Harrison, G., Lewis, B., Telionis, A., Crow, J., Kim, D., Spillmann, S., Peters, K., Leskovec, J., & Marathe, M. (2022). Data-driven real-time strategic placement of mobile vaccine distribution sites. *Proceedings of the AAAI Conference on Artificial Intelligence*, *36*(11), 12573–12579. https://doi.org/10.1609/aaai.v36i11.21529

McNeil, D. G., Jr. (2020, December 24). How much herd immunity is enough? *The New York Times*. https://www.nytimes.com/2020/12/24/health/herd-immunity-covid-coronavirus.html

National Association of State Chief Information Officers. (2021, August). *From Pre-Pandemic Plan to Virginia's Vaccine Administration: The Paradigm Shift in How Virginia Values Data*. National Association of State Chief Information Officers. https://www.nascio.org/wp-content/uploads/2021/08/VA-NASCIO2021FINALv2.pdf

Ndugga, N., Artiga, S., & Pham, O. (2021, January 13). *Immigrant access to COVID-19 vaccines: Key issues to consider.* KFF. https://www.kff.org/racial-equity-and-health-policy/issue-brief/immigrant-access-to-covid-19-vaccines-key-issues-to-consider/

Peters, M. D. J. (2022). Addressing vaccine hesitancy and resistance for COVID-19 vaccines. *International Journal of Nursing Studies*, *131*, Article 104241. https://doi.org/10.1016/j.ijnurstu.2022.104241

Shukla, S., Fressin, F., Un, M., Coetzer, H., & Chaguturu, S. K. (2022). Optimizing vaccine distribution via mobile clinics: A case study on COVID-19 vaccine distribution to long-

term care facilities. *Vaccine*, *40*(5), 734–741. https://doi.org/10.1016/j.vaccine.2021.12.049

Star, S. L. (1999). The ethnography of infrastructure. *American Behavioral Scientist*, *43*(3), 377–391. https://doi.org/10.1177/00027649921955326

Strully, K. W., Harrison, T. M., Pardo, T. A., & Carleo-Evangelist, J. (2021). Strategies to address COVID-19 vaccine hesitancy and mitigate health disparities in minority populations. *Frontiers in Public Health*, *9*. https://doi.org/10.3389/fpubh.2021.645268

Track COVID-19 in Virginia. (2023, March 22). *The New York Times*. https://www.nytimes.com/interactive/2023/us/virginia-covid-cases.html

World Health Organization. (2020, December 31). *Coronavirus Disease (COVID-19): Herd immunity, lockdowns and COVID-19.* World Health Organization. https://www.who.int/news-room/questions-and-answers/item/herd-immunity-lockdowns-and-covid-19

Appendix A: Numbered List of VDH Report References (Ordered by Date)

[1] Department of Health. (2021). *RD24 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January 4, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD24/PDF

[2] Department of Health. (2021). *RD125 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February 5, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD125/PDF

[3] Department of Health. (2021). *RD124 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March 1, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD124/PDF

[4] Department of Health. (2021). *RD149 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - April 1, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD149/PDF

[5] Department of Health. (2021). *RD185 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - May 1, 2021* (Reports to the General Assembly;

Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD185/PDF

[6] Department of Health. (2021). *RD230 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - June, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD230/PDF

[7] Department of Health. (2021). *RD278 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - July, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD278/PDF

[8] Department of Health. (2021). *RD351 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - August, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD351/PDF

[9] Department of Health. (2021). *RD413 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - September, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD413/PDF

[10] Department of Health. (2021). *RD507 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - October, 2021* (Reports to the General Assembly;

Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD507/PDF

[11] Department of Health. (2021). *RD639 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - November, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD639/PDF

[12] Department of Health. (2021). *RD778 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - December, 2021* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2021/RD778/PDF

[13] Department of Health. (2022). *RD49 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD49/PDF

[14] Department of Health. (2022). *RD208 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD208/PDF

[15] Department of Health. (2022). *RD209 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD209/PDF

[16] Department of Health. (2022). *RD303 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - April, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD303/PDF

[17] Department of Health. (2022). *RD304 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - May, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD304/PDF

[18] Department of Health. (2022). *RD305 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - June, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD305/PDF

[19] Department of Health. (2022). *RD539 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - July, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD539/PDF

[20] Department of Health. (2022). *RD540 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - August, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD540/PDF

[21] Department of Health. (2022). *RD498 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - September, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD498/PDF

[22] Department of Health. (2022). *RD627 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - October, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD627/PDF

[23] Department of Health. (2022). *RD871 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - November, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2022/RD871/PDF

[24] Department of Health. (2023). *RD165 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - December, 2022* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine).

Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD165/PDF

[25] Department of Health. (2023). *RD166 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - January, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD166/PDF

[26] Department of Health. (2023). *RD167 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - February, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD167/PDF

[27] Department of Health. (2023). *RD168 - Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine - March, 2023* (Reports to the General Assembly; Virginia Department of Health Plan for Equitable Distribution of COVID-19 Vaccine). Virginia's Legislative Information System. https://rga.lis.virginia.gov/Published/2023/RD168/PDF

Appendix B: Thematic Category Breakdowns

The keywords for each theme were organized into subcategories. *Diversity* encompassed (i.) a broad overview of diversity/demographics; (ii.) race/ethnicity; (iii.) age; (iv.) occupation; (v.) urban/rural lifestyle; (vi.) immigrant/refugee/migrant; (vii.) income; (viii.) vulnerability; (ix.) gender/sex; and (x.) equity. *Human conventions* included (i.) broad conceptual language; (ii.) culture; (iii.) movement; and (iv.) lifestyle. *Policies* involved (i.) legislation; (ii.) actions; and (iii.) political references.

Appendix C: Analysis of the Prevalence of Demographic Themes

Overall, the most prominently mentioned demographic groups pertain to race and ethnicity. According to the thematic coding results, policymakers tend to consistently cover topics of race. They present visualizations of vaccine rates across racial groups, focusing on the vaccination rates and vaccine hesitancy of Hispanic and Black populations. This subcategory has the highest number of matching statements than any other subcategory group across the VDH reports for nearly every month. Secondly, equity is also a highly prevalent topic across the reports, with peaks in the early months and remaining relatively stable over time. This trend illustrates that throughout the pandemic, the theme of equity has always been a consistent and constant priority. Thirdly, the subcategory of age has also been the subject of many statements, though its relevance has fluctuated with a couple of sharp peaks and drops throughout the months. While the number of statements concerning age demographics varies greatly between reports, they occupy a large presence across the spectrum. Initial reports in 2021 focused on the vaccination of elderly communities through long-term care facilities (LTCFs) and nursing homes [1-3]. As the vaccine developed, attention shifted towards vaccinating children and students [5-27]. However, the least vaccinated age group was neither the elderly nor the youth, but rather people ages 30-39 [17-23]. Yet, this age group did not receive as much focus in the reports.

The theme of urban-rural divides was less prominent, though it still occupied a steady niche of content in the reports. The discussion revolved around the dual combination of higher risk and vaccine hesitancy in rural regions for every new COVID-19 variant [8-10, 12-16, 20]. Compared to the previously identified groups, the demographics based on sex/gender, immigrants/migrants/refugees, occupation, and income are less prevalent in the VDH reports. The fact that these groups have a low presence in the VDH reports can be a sign that they are

also being overlooked at local district levels, whether it is due to a difficulty in collecting data on them or competing priorities.

Appendix D: Interpreting the Temporal Progression of the Theme of Human Conventions

The keywords relating to human conventions can be grouped into four subcategories: conceptual words relating to the broad theme of conventions culture-specific words such as religion, mobility words relating to access and transportation, and other lifestyle habits such as occupational experiences. For all four subcategories, there is a clear peak in frequency from April 2021 to July 2021. However, starting in October 2021, the presence of all subcategory conventions converged to a baseline of approximately 8 mentions per report. While this may seem to suggest that the targeting of client-specific conventions ceased being a priority, Figure 2 depicts that the reports still contain a significant amount of action-oriented language and statements involving community outreach and integration. Therefore, this decline in Figure D1 may rather be a sign that the focus on the underlying issues impacting disproportionate COVID-19 health burdens waned after the first year of the pandemic. Furthermore, reports contained less research and analysis of client-specific conventions particular to specific underserved communities. While there were still actions relating to local community outreach and engagement, these actions were less explicitly oriented around the theme of conventions.

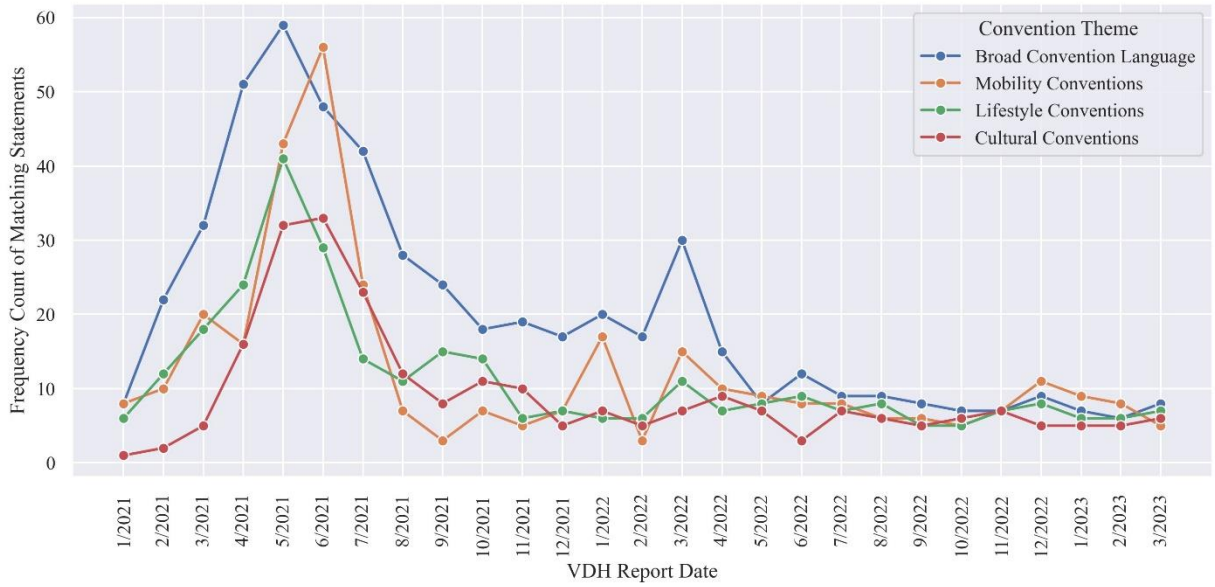

Figure D1. The number of statements that contain keywords indicative of themes of convention for each monthly VDH report.

Appendix E: Data as a Base for Infrastructure

Policymakers utilize data as a base to identify marginalized groups, track the equity of vaccine distribution, and monitor the success of different approaches. Although data collection has remained a challenge throughout the pandemic, the imputation of racial/ethnic data has allowed the VDH to assess vaccine equity for these minorities [9]. On the other hand, data gathering issues for Native Americans [16], immigrants/migrants/refugees [5], and the LGBTQ+ community [7] have reduced their representation in discussions of vaccine equity. This flawed base leads to a disregard for overlooked marginal groups and renders it difficult to target these underserved communities through policymaking.

Appendix F: Movement Conventions in Covid-19 Testing Infrastructure

The evolution of vaccine clinics to accommodate mobility conventions is observed in the development of COVID-19 testing infrastructure. As the pandemic persisted and vaccination rates stabilized with minimal growth, policymakers turned towards a focus on COVID-19 testing to reduce the impact of the pandemic with the arrival of new variants. Because the COVID-19 burden was disproportionately accrued by marginalized and vulnerable demographics, testing strategies were directed toward these groups to mitigate the risk and infection spread. Initial testing sites were diversified with the establishment of community testing centers (CTC+), which targeted hard-to-reach communities [15]. Next, the VDH reported, "As part of its efforts to address inequities, VDH is transitioning their community testing centers to a mobile clinic model to be able to reach areas that have low access to testing" [16]. Thus, the same pattern of development was captured in both vaccine and testing infrastructure. To target vaccine inequity, policymakers integrated infrastructure with mobility conventions through the form of community centers and mobile units. These developments were integrated as extensions atop the preexisting infrastructural base, illustrating a strong accordance with the *infrastructure* tenet *built on an installed base*.