

Martha's Vineyard Response to COVID-19: An After-Action Review

June 27, 2023

Over the last three years, the Martha's Vineyard community lived and worked through COVID-19. Thousands of islanders have been infected while healthcare, public health, educational, and social service institutions were pushed to the limits. In response, the Vineyard mounted an aggressive testing program, imposed restrictions on gatherings, required mask use, and implemented a successful vaccination effort.

With the goal of preparing for future health emergencies, we conducted an "after-action review" of the Island's collective response to the pandemic. The purpose was to enable key stakeholders to review the Island community's response to the COVID-19 pandemic and to identify opportunities and determine local action steps for improvement. The discussion examined what went well, what could have been done better, and strategies to inform future public health crises responses on Martha's Vineyard and beyond.

The meeting was convened by the Martha's Vineyard Hospital on March 6, 2023, from 10 am to 4 pm. It included 16 participants, chosen to represent organizations and perspectives such as the Martha's Vineyard Hospital, Island Health Care, town health agents, school officials, social service organizations, and business owners (see participant list in Appendix 1). Discussions were facilitated by Professor Michael Stoto of Georgetown University, a summer resident, and supported by students from Georgetown and Yale.¹ To encourage an open and honest dialog, participants were asked to focus on the system rather than individual performance, and to search for root causes. The meeting was conducted under the Chatham House Rule, meaning that comments are not attributed to specific participants.

The meeting began with a review of the timeline of major events and epidemiology to set the context. Subsequently, the discussions were organized around four major aspects of the pandemic response: (1) public health measures to control infections (business closures, mask mandates, etc.); (2) testing, contact tracing, cluster investigation, and surveillance; (3) school policies (opening/closing, social distancing, testing, mask requirements, etc.); (4) vaccination (logistics, priority setting, outreach, mandates, etc.). Meeting participants engaged in active dialogue about the key components of the COVID-19 response, and as a result, identified positive themes, challenges, and opportunities for change in the future. A summary of lessons learned and action steps from the meeting are detailed below.

Overview of epidemiology and public health response

Through the end of February 2023, there were approximately 7,000 cases of COVID-19 reported on Martha's Vineyard. This includes positive tests for Vineyard residents and visitors, repeat infections, over-the-counter tests reported to Island boards of health, and other cases not included in the Massachusetts Department of Public Health (MDPH) database.

During this period, 68 patients were admitted to Martha's Vineyard Hospital and 12 were transferred off-Island for medical care. Particularly in the later periods, some of these cases were individuals admitted for other health issues who coincidentally tested positive for COVID-19. There was only one death, which occurred during the Omicron wave in February 2022. This represents an exceptionally low mortality rate; if the state or national mortality rate

¹ This report was prepared by Chelsea Viglas, Samantha Schlageter and Michael Stoto.

had applied to the Vineyard's population, one would have expected on the order of 60 deaths. An aggressive effort by MVH to ensure the effective treatment of those who were infected likely contributed to this outcome.

Figure 1 displays information for COVID-19 cases from March 8, 2020, through September 2, 2022. This analysis reveals four distinctly different COVID-19 epidemics on Martha's Vineyard. In the first period (March 8 – October 18, 2020) the number of reported cases was quite low. Period 2 (October 19, 2020 – June 6, 2021) and period 3 (June 7 – September 26, 2021) correspond to the national Alpha and Delta waves respectively. In period 4 (September 27, 2021 – September 2, 2022) self-reported over-the-counter (OTC) tests results made up an increasing portion of the reported cases. Appendix 2 analyzes the epidemiological patterns in more detail.

Table 1 summarizes the major milestones in the Vineyard's public health response in each of these phases. The public health response is described in the sections below, and in more detail in Appendix 3.

During the spring and summer of 2020 there were relatively few cases (2 per week), many of which were related to off-island travel, and short chains of transmission. This is true even though the number of cases in Massachusetts as a whole was high relative to most of the U.S. during April and May of 2020. During this period, the public health response was focused on community restrictions, testing and contact tracing.

Most of the Island's cases were diagnosed after October 17, 2020. The average number of cases grew to 43 cases per week in period 2, and there were substantially more clusters and chains of transmission (those involving more than two individuals) than earlier. The Brazilian community was especially hard hit in period 2. Although this community makes up approximately 20% of the Island population, at least 33% of the cases in Period 2a (October 1, 2020 – March 6, 2021) and 58% in period 2b (March 7 – June 6, 2021) occurred in this group. The higher proportions of younger and male cases in period 2 probably reflects the younger age distribution of the Brazilian population. The schools reopened in Period 2, with mandatory testing and mask use, as well as other restrictions. Vaccination efforts began in period 2b.

The epidemiologic pattern was quite different in period 3 (June 7 – September 26, 2021). The average number of cases per week decreased to 29 in period 3. The proportion of cases that were seasonal residents or visitors in period 3 (essentially the summer season) was 39.8%, compared to 7.6% in Period 2. Clusters were common in period 3, and all but one was associated with a restaurant or bar. These patterns in residency and vaccine status and clusters are consistent with the health officers' observation that many of the summer 2021 cases were in young adults, often from other countries, who did seasonal work in restaurants and bars, and typically were not vaccinated.

The average number of cases per week increased again to 82 in period 4 as the Omicron variants hit the Vineyard as well as the rest of the country. However, because many on the island were vaccinated and these variants were relatively mild, the number of serious cases did not increase proportionately. During this period, home tests became common, and self-reported results made up 43% of the positive tests in period 4. In period 4, much of the attention turned toward relaxing testing and mask use in the schools.

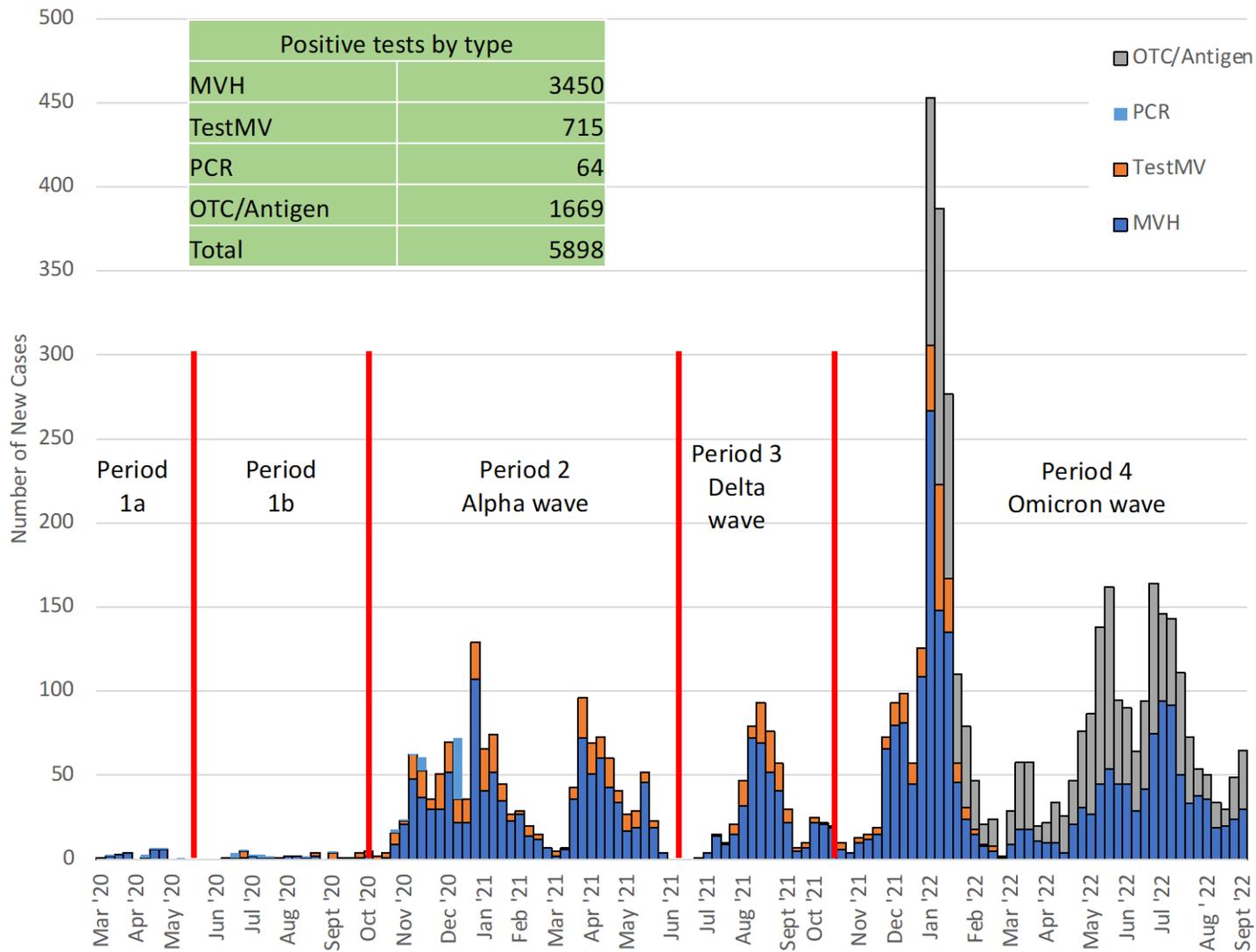


Figure 1. Martha's Vineyard epi curve by test type, March 8, 2020 – September 2, 2022.

Table 1. Milestones in the public health response to COVID-19 on Martha's Vineyard, March 8, 2020 – September 2, 2022.

Milestones	Period 1a (Spring 2020)	Period 1b (Summer 2020)	Period 2 (Fall 2020 / Winter 2021)	Period 3 (Summer 2021)	Period 4 (Fall 2021/ Spring 2022)
Public health measures to control infections	<ul style="list-style-type: none"> • Business closures • Construction restrictions • Local adaptation of state restrictions 	<ul style="list-style-type: none"> • Phased relaxation of restrictions • Mask mandates • Mandatory quarantine for out-of-state arrivals 		<ul style="list-style-type: none"> • Mask advisory in public • Mask mandates in government buildings 	
Testing, contact tracing, cluster investigation, and surveillance	<ul style="list-style-type: none"> • Testing begins at MVH • Contact tracing begins at IHC 	<ul style="list-style-type: none"> • Test MV opens • Daily/weekly surveillance reports begin 	<ul style="list-style-type: none"> • Contact tracing expands beyond IHC • Clusters emerge, especially in the Brazilian population 	<ul style="list-style-type: none"> • Clusters emerge in bars and restaurants 	<ul style="list-style-type: none"> • Test results include home tests
School policies	<ul style="list-style-type: none"> • Schools closed 	<ul style="list-style-type: none"> • Schools reopen in fall on staggered schedule • "Mandatory" surveillance testing in spring 		<ul style="list-style-type: none"> • "Voluntary" testing, Test-to-Stay • Mask requirements dropped in spring 	
Vaccination			<ul style="list-style-type: none"> • Vaccine mandates • Outreach • Vaccination bus 	<ul style="list-style-type: none"> • Vaccination program shifts attention to boosters 	
Hospital	<ul style="list-style-type: none"> • Press briefings, county-wide huddle initiated • ICS opened 	<ul style="list-style-type: none"> • Mask mandates • Single, screened entrance • Alternative ED 	<ul style="list-style-type: none"> • Vaccine administration 		
			<ul style="list-style-type: none"> • Monoclonal therapies 		<ul style="list-style-type: none"> • Oral medication

Public health measures to control infections (business closures, mask mandates, etc.)

A number of different public health measures were employed to control infections as the COVID-19 pandemic unfolded. In period 1a (spring 2020) business closures, construction restrictions, local adaptation of state restrictions and subsequently phased relaxation of restrictions occurred. In period 1b (summer 2020) phased relaxation of restrictions continued in addition to mask mandates and mandatory quarantine for out-of-state visitors arriving on the island. Finally, in period 3 (summer 2021) mask advisories in public places and mask mandates in government buildings presented themselves. For additional details, see Appendix 3.

In response to the state-wide COVID-19 public health emergency, a collective island-wide response emerged to aid in controlling infection rates with full participation from all six towns. Many persons involved in response efforts filled various roles and contributed in ways that exercised their strengths. Some businesses, for instance, provided housing assistance to individuals impacted by COVID-19 who lived in communal homes and those living in close quarters. This type of housing support allowed these individuals to quarantine separately. The Vineyard's tight-knit community allowed roles and responsibilities to be easily defined and provided awareness around ownership of key activities. Working informally proved to be a successful strategy for the island community (e.g., informal networks and chain of commands were formed organically).

Throughout the pandemic, but especially in the first year, uncertainty was rampant – about the health risks of the virus, what should be done to protect oneself and one's family, the likely social and economic impacts, the most effective public health measures, and what would happen in the future. Seeing the problems that were playing out in the New York area and other parts of the Northeast, many residents were fearful, and didn't know whom to trust.

In response, clear communication remained a positive theme throughout the COVID-19 response with the Island community consistently deciphering communications from government agencies and disseminating information through trusted Martha's Vineyard channels.

Prescriptive state and federal policies were beneficial in the sense that they did not require all local health officials to be expert epidemiologists. On the other hand, on the Vineyard and elsewhere, general policies had to be adapted to local conditions. While this was accomplished during the COVID-19 pandemic, the need for adaptation was expected to be an issue in future events. To address this, participants recommended that a standardized and streamlined process for addressing public health crises be developed prior to the onset of future emergencies.

Maintaining control over transportation to and from the Island is an area of opportunity for future response efforts. Airline companies and the Steamship Authority had their own policies and procedures in place that the Island had to work around. However, both the airlines and the Steamship Authority proved to be helpful in transporting patients to and from the island to receive care on the mainland. The Steamship Authority was particularly instrumental in providing support for the vaccination bus and transporting patients in need via ambulance.

During the pandemic, a number of groups came together spontaneously. For example, the hospital opened its daily and later weekly emergency-management meetings to the health agents, representatives of community service organizations, and others as needed. The early

meetings included as many as 50 participants, and communication was inclusive rather than territorial. Going forward, however, a consistent governance structure and meeting forums are needed as key components in the development of a new emergency plan for situations the island is likely to face in the future (e.g., weather events, pandemics, etc.).

The response efforts were largely built upon personal relationships, which was both a strength and a weakness when we evaluated the Island's collective response to COVID-19. This observation presents an interesting opportunity for the Vineyard to continue its culture of cooperation with perhaps new leadership roles in the future. A pragmatic and objective approach to identifying future leaders would be most beneficial. Identifying a dedicated "island coordinator" and having a tactical blueprint would allow the Island to seamlessly follow a "flow chart" for crisis management purposes.

Testing, contact tracing, cluster investigation, and surveillance

The testing, contact tracing, cluster investigation and surveillance efforts began at Martha's Vineyard Hospital and contact tracing began at Island Health Care in period 1a (spring 2020). In period 1b (summer 2020), TestMV (an island-wide public-private testing site) opened to offer additional testing resources to support rising testing volume and daily / weekly surveillance reports were initiated. In period 2 (fall 2020 - winter 2021) contact tracing expanded beyond Island Health Care. Clusters began to emerge in the Brazilian population in period 2 which were identified by contact tracing efforts. Furthermore, contact tracing also uncovered clusters that had emerged in local bars and restaurants across the Island in period 3 (summer 2021). Finally, island-wide test reporting began including at-home test results. See Appendix 3 for more detail on these activities.

Creative testing campaigns were successful and ever evolving (and also helped facilitate vaccination, as described below). Drive-through testing at TestMV was a safe and convenient approach to servicing a large volume of persons (both islanders and visitors). Digital solutions, including the use of QR codes, made testing registration and at-home reporting (e.g., stickers on home testing kits) timely and accessible. Overall, these testing, contact tracing, cluster investigation and surveillance efforts enabled the island community to further understand and control the spread of COVID-19.

One of the challenges was that CDC and state testing guidance was constantly changing with respect to who should be tested and how the testing should be administered. Additionally, the Vineyard grappled with how testing would be funded (e.g., federal / state funding, private funding, etc.) and how the funding source might impact testing operations. Age restrictions on testing presented added logistical and financial challenges for children. The testing volume was significant during peak COVID-19 seasons resulting in delayed testing results; Martha's Vineyard Hospital experienced challenges keeping pace with testing volume in the early stages of the COVID-19 response. Resource constraints including the availability of supplies and supply chain concerns with respect to testing was a common theme that persisted during the pandemic.

Collaboration among the boards of health from Oak Bluffs, Edgartown, Tisbury, West Tisbury, Aquinnah and Chilmark was successful in reporting daily and weekly case data, providing a transparent look at risk factors across the island. Many participants described the regular reporting as a mechanism to instill confidence and safety amongst community

members. This collaboration, however, relied on a collection of different databases, some developed *ad hoc*, designed to serve different purposes. Consequently, the documentation was not as robust as it might have been. For the future, it would be useful to start now to develop a unified, island-wide surveillance and case management database using standardized criteria.

Building trust was especially important among vulnerable community members (e.g., undocumented persons). Certain communities experienced significant concerns around seeking treatment for fear of job loss, income loss, or reports to the authorities. One family member's decision to seek treatment might hinder the entire household's ability to continue earning income; this factor presented additional testing and contact tracing complexities in certain populations. The island's cooperative and non-invasive approach to supporting the needs of vulnerable populations was admirable.

Communication resources for the Brazilian community were robust and included small forums for front-line workers such as house cleaners and contractors. Additionally, a specific forum created for Portuguese-speaking parents of school children was created to encourage open lines of communication. A video developed for the Brazilian population helped to communicate and educate them about testing and vaccination programs. The Community Ambassador Partnership (CAP) provided translation support to the Brazilian population and aided in recording test kits results that contributed to a deeper look into the epidemiology of the community.

School policies

Events pertaining to school policies were at the forefront of the COVID-19 response efforts. School closures persisted until schools began reopening in period 2 (fall 2020 - winter 2021). Additionally, pool surveillance testing within schools was mandatory in period 2. As mandatory requirements phased out – voluntary testing policies (e.g., “Test-to-Stay”) were developed in period 4 (fall 2021 - spring 2022). Mask requirements were dropped in the spring of period 4. For additional details, see Appendix 3.

As in many parts of the United States, managing the health concerns within the Martha's Vineyard Public Schools was challenging. The roles of educators shifted drastically to become healthcare professionals, which is outside of their core competencies. School nurses became health officials to implement surveillance contact tracing and enforce regulations. Many felt they were at the intersection of science and politics.

MVYPS testing requirements and protocols provided a sense of safety and security within the island community. Many islanders expressed sentiments of fulfilling their civic responsibility by participating in weekly school testing. Testing in the school system also contributed to a proactive approach to monitoring and surveilling COVID-19. It allowed public health officials to anticipate and prepare for increases in COVID-19 cases, instead of simply reacting once a spike had already happened.

MVYPS could benefit from developing a re-opening plan with flexible parameters and modifiers instead of operating within a rigid framework. The school system spent an inordinate amount of time drafting extremely detailed re-opening plans that quickly became outdated as state-wide COVID-19 protocols changed over time. A more generic re-opening plan framework could be developed for future emergency response situations and likely reduce the amount of administrative time and money spent on planning.

Policy making practices and decision-making frameworks within the school system were challenging to navigate during the COVID-19 pandemic. Changes to policies and procedures needed to be voted on three times before a final decision was made; preventing school administrators from making agile decisions in a fast-paced environment (e.g., COVID-19 guidance was changing rapidly). School policy guidance provided by the Massachusetts Department of Elementary and Secondary Education (DESE) lagged behind the development of local plans which created additional work for MVYPS and presented local planning and implementation challenges. There is certainly an opportunity to communicate more closely with DESE and proactively discuss strategies to address this problem for future public health emergencies.

Vaccination

Vaccination programs began in period 2 (winter - spring 2021). There were complications with Massachusetts' approach to vaccinate individuals that did not necessarily fit the needs of the island community. Interagency burden sharing also presented itself in period 3 – organizations including Martha's Vineyard Hospital, Island Healthcare, Health Agents, and a Vaccination Bus contributed to vaccinating individuals seeking services. Managing priorities and demand for vaccinations was a challenge in period 2. Vaccine mandates began in period 3. Vaccine outreach, vaccine hesitancy and shifting to vaccine boosters began in period 3 and continued into period 4 (fall 2021 - spring 2022). For additional details, see Appendix 3.

Multiple healthcare organizations on the island provided a comprehensive vaccination program. This interagency approach fostered collaboration that reduced the burden on individual organizations. Martha's Vineyard Hospital played a leadership role in disseminating and organizing vaccines (which was a novel approach for them). From December 2021 through March 2023, more than 50,000 vaccine doses were administered to hospital staff and Island residents. Island Health Care provided its allocation of vaccine to the hospital to enable a unified approach. This arrangement provided excellent vaccine scheduling flexibility to islanders including special accommodations for marginalized populations.

A multi-cultural video that aimed to promote widespread vaccination gained traction throughout the pandemic and contributed to increased vaccination rates overall. In addition to local efforts, Massachusetts deployed two National Guard representatives to assist during the Omicron wave for approximately 8-10 weeks.

As a result of these efforts, Martha's Vineyard (Dukes County) experienced the highest vaccination rate in Massachusetts. Many of the individuals opting for vaccination had not historically received vaccination for other illnesses (e.g., flu shots).

Working against vaccine "mis-" and "dis-information" was a persistent difficulty throughout the COVID-19 response. Supply and demand issues related to vaccination were ongoing challenges for the Island. The hospital typically did not know how many vaccines they would receive until Thursday night before a Friday delivery. The uncertainty about vaccine quantities at any given time made it challenging to manage vaccine logistics (e.g., appointment volume and availability). Communications specific to vaccination needs could have been more effective in understanding the unique population patterns on the Island. Dialogue between the Massachusetts Department of Public Health and local Vineyard representatives during the

height of COVID-19 could have been more timely. For future emergencies, better communication is needed.

Conclusions

Since March 2020, the Martha's Vineyard community has lived and worked through the COVID-19 pandemic. Especially in the first year, businesses were closed and workers were unemployed, gatherings were restricted, summer events cancelled, masks were required, and schools operated remotely. Uncertainty and fear were rampant. Nevertheless, the Island mounted an aggressive testing program and later a vaccination campaign that achieved high rates. As a result of these and other *ad hoc* solutions, the economic losses were less than initially feared. Although thousands of islanders were infected over three years, the island's case load, hospitalizations, and deaths were significantly lower than the rest of the country. Perhaps equally as important, the Island did not tear itself apart over shutdowns and restrictions as happened in many other communities.

The primary reason for this relatively successful outcome was the "collective whole" response to the COVID-19 pandemic, with buy-in and cooperation from key stakeholders across the Island. To an unprecedented degree, the six towns coordinated their public health policies, and businesses cooperated. Social service organizations stepped-up to assist families impacted by the restrictions. Martha's Vineyard Hospital and Island Health Care worked together with the town health agents and others to develop island-wide testing and later immunization programs. Volunteers were instrumental in these efforts. All of these organizations also made special efforts to reach out to underserved populations, especially the island's Brazilian community. Social scientists refer to this as "social capital" (Putnam, 2022), but locally it is often called the Vineyard's "island spirit."

The Vineyard faced unique circumstances due to the seasonal economy and surge of summer visitors and workers. Furthermore, as an island community, access to healthcare and public health services provided directly by the state such as mass vaccination sites were limited. Guidance from the state regarding public health matters such as business restrictions had to be adapted. This was especially true for the schools, which developed their own testing protocols.

In response to these challenges, a number of *ad hoc* solutions developed organically. For example, Island Health Care collaborated with the health agents, and with private sector support, established an island-wide testing program that allowed the hospital to focus on testing symptomatic individuals and supported island-wide contact tracing operations. Rather than relying solely on state disease reporting procedures, the boards of health cooperated to produce weekly and at times daily surveillance reports. These actions were enabled by regular communications among the players and trust between islanders and health institutions.

In their review of successful "collective impact" efforts in health and social services, Kania and Kramer (2011) identify five critical components of community efforts: (1) a common agenda, (2) mutually reinforcing activities, (3) a shared measurement system, (4) continuous communication, and (5) a background support organization. During the pandemic, the Vineyard clearly had a common agenda and adopted a set of mutually reinforcing activities. Throughout the pandemic, stakeholders from diverse backgrounds were able to find common ground in developing strategies to keep the island safe. To some degree, this response was driven by fear. But just as importantly, there was a degree of trust that all were acting in the

interest of the entire community. The involvement of numerous volunteer organizations with overlapping membership was also critical.

Although future emergencies will require their own unique approaches, the COVID-19 experience highlighted two areas that require work now to enable future success. One is the development of a shared measurement system, Kania and Kramer's third component. As noted above, the Vineyard's regular surveillance reports were critical, but the Vineyard's "system" relied on a collection of databases designed for different purposes, so it was not as robust as it might have been. Nonetheless, the local health agents actively worked toward having a common measurement system, as they quickly realized that the state database, MAVEN, was not sufficient for the island's unique needs. For the future, it would be useful to start now to develop a unified, island-wide data system that supports surveillance, case management, and other needs.

Kania and Kramer's fourth critical component is continuous communication. Rather than having an emergency operations center like many communities do, the Vineyard's communication strategy was largely ad hoc. The hospital, for example, opened up its meetings to the health agents and others as necessary. Similarly, the school administration set up regular meetings involving the health agents, school nurses, and medical advisors from the hospital. Personal relationships, as well as the fact that many individuals "wear many hats" – as one finds in a small community – were also critical for sustaining continuous communication.

The final component in achieving collective impact is a background support organization, which provides for communication and shared measurement that ensures mutually reinforcing activities around a common agenda. There is no such organization on the Vineyard. Similarly, although many individuals provided critical leadership, there was never a single emergency response leader. Rather, the Vineyard adopted a kind of "swarm leadership" (Marcus, 2019) that was also successful in the San Francisco Bay Area's initial response to the pandemic (Aragon, 2021).

The Vineyard's interlocking organizations and personal connections will always be a strength, and it doesn't seem likely that a formal background support organization can be set up. Nevertheless, developing a more clearly articulated approach to coordination and communication in advance of the next public health emergency would be useful, especially as the relationships formed during the COVID-19 pandemic fade, and as new public health officials take office.

References

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Appendix 1. Participants²

Alexis Babaian, *Inter-Island Public Health Excellence Project*
Brittany Baron, *Martha's Vineyard Hospital*
Doug Best, *D. Best Construction*
Amy Houghton, *Tisbury School Committee*
Fernando Lana, *Dukes County Case Investigation Team*
Marina Lent, *Chilmark Board of Health*
Anna McCaffrey, *Chilmark Board of Health*
Cynthia Mitchell, *Island Health Care*
Leah Palmer, *Martha's Vineyard Public Schools*
Matt Poole, *Edgartown Board of Health*
Suzanne Robbins, *Martha's Vineyard Hospital*
Kathleen Samways, *Island Health Care*
Claire Seguin, *Martha's Vineyard Hospital*
Sheryl Taylor, *Martha's Vineyard Public Schools*
Maura Valley, *Tisbury Board of Health*
Betsy Vanlandingham, *Dukes County Case Investigation Team*

Project staff

Michael Stoto, Georgetown University
Chelsea Viglas, Yale School of Public Health
Samantha Schlageter, Georgetown University
Molly Houghton, Emory School of Public Health
Rachel Vargas, Martha's Vineyard Hospital

² Only the participants' primary affiliation is listed. Many have additional formal or informal roles in the Vineyard public health "system"

Appendix 2. Epidemiology of COVID-19 on Martha's Vineyard

Through the end of February 2023, there were 4,346 cases of COVID-19 reported in Dukes County,³ of which the island makes up the overwhelming majority. According to the weekly reports prepared by the boards of health in Oak Bluffs, Edgartown, Tisbury, West Tisbury, Aquinnah and Chilmark, there were approximately 7,000 cases on the Vineyard. The larger number includes positive tests to residents of other counties, repeat infections, over-the-counter tests reported to island boards of health, and other cases not included in the Massachusetts Department of Public Health (MDPH) database.

During this period, 68 patients were admitted to Martha's Vineyard Hospital and 12 were transferred off-island for medical care. Particularly in the later periods, some of these cases were individuals admitted for other health issues who coincidentally tested positive for COVID-19. There was only one death, which occurred in February 2022 during the Omicron wave.⁴ This represents an exceptionally low mortality rate; if the state or national mortality rate had applied to the Vineyard's population, one would have expected on the order of 60 deaths.

One factor that partially explains the small number of individuals suffering serious health consequences, despite caseloads comparable to other places, is that the Vineyard's public health system did better than most communities in identifying cases. Given the extensive testing and effective contact tracing efforts described above, it seems likely that the ratio of actual infections to reported cases was closer to 1.0 than the national ratio of 4.3.⁵ A more complete, i.e. larger, estimate of the denominator helps to explain the lower hospitalization and fatality rate among reported cases.

Another likely factor in the low mortality rates was an aggressive effort by MVH to ensure the effective treatment of those who were infected. This included the implementation of treatment guidelines developed by Mass General Brigham to identify patients who were at higher risk for increased risk progression that would require hospitalization or have factors associated with increased severity of COVID-19. In addition, MVH coordinated the island-wide administration of monoclonal antibodies and antivirals, and by May 2022 became a state-designated distribution site. Starting in February 2022, MVH administered more than 700 courses of Paxlovid and other antivirals.

Figure 1 displays information for COVID-19 cases from March 8, 2020 through September 2, 2022, when the weekly reports ceased. More than half of the cases, 3,450, tested positive at the Martha's Vineyard Hospital (MVH). Relatively more tests were performed at TestMV and other sites, but since symptomatic individuals were directed to the hospital, one would expect a larger proportion of the tests to have a positive result.

Based on the weekly reports, Figure 1 shows that the number of cases according to the date they were reported. This analysis reveals four distinct phases to the pandemic on the

³ Peyton Lee and Katrina Dolendo contributed to this analysis.

⁴ *New York Times* database. <https://www.nytimes.com/interactive/2021/us/dukes-massachusetts-covid-cases.html>

⁵ Hospital Reports Its First Death From Coronavirus, Julia Wells, Vineyard Gazette, February 8, 2022 <https://vineyardgazette.com/news/2022/02/08/hospital-reports-its-first-death-coronavirus>

⁶ <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/burden.html>

island. In the first period (March 8 – October 18, 2020) the number of reported cases was quite low. This stands in contrast to Massachusetts and other northeastern states, in which case numbers were relatively high, especially in the early part of this period. Period 2 (October 19, 2020 – June 6, 2021) and period 3 (June 7 – September 26, 2021) correspond to the national Alpha and Delta waves respectively. Period 2 is analyzed in more detail below. In period 4 (September 27, 2021 – September 2, 2022) self-reported over-the-counter (OTC) tests results made up an increasing portion of the reported cases.

More data on the characteristics of the cases is available from the database used by the contact tracers through September 26, 2021, when a different system was introduced. Based on these data, Figure 2 illustrates how the proportion of cases that are members of the Brazilian community has evolved. This category includes individuals who report their primary language as Portuguese and/or who report Brazilian ethnicity. Excluding the “unknown” responses, the proportion of cases that were members of the Brazilian community was approximately 10% in Period 1, increased to 33% in period 2a and 58% in period 2b. Figure 2 also includes the large clusters that were identified in periods 2 and 3. In the summer of 2021 (period 3), relatively few of the cases (10%) were in the Brazilian population, but the clusters were associated with bars and restaurants.

Using the same detailed data base, Figure 3a indicates that slightly more than half of the cases in periods 1 and 2a were in individuals under age 40 (58% and 56% respectively). This proportion grew to 70% in period 2b, then dropped to 60% in period 3.

Figure 3b shows that in period 1 at least 32% of cases had an identified off-island connection (either they had been off the island themselves or had been in contact with someone who had been during the infectious period). After October 16, 2020, the proportion with an identified off-island connection decreased to 17% in period 2a and to 15% in period 2b, increasing only slightly to 26% in period 3.

Figure 3d shows that permanent residents made up the vast majority of cases in periods 2a and 2b (88% and 97% respectively, excluding the “unknown” responses). Seasonal residents made up 57% of the cases in period 1, which included the summer of 2020, but only 29% of the cases in period 3, which included the summer of 2021.

Based on the weekly reports for periods 1, 2 and 3, 32% of cases were linked to at least one other case. There were 19 clusters (cases linked to others not in their household) ranging in size from 3 to 19; all occurred after mid-October 2020. Including cases linked to others in the same household, 6% of all cases were linked to 5 or more other individuals. Clusters with ≥ 5 cases are labelled on Figure 2 according to the week they occurred.

Analysis

Since March 2020 there have been four distinctly different COVID-19 epidemics on Martha’s Vineyard. During the first spring and summer there were relatively few cases (2 per week), many of which were related to off-island travel, and short chains of transmission. This is true even though the number of cases in Massachusetts as a whole was high relative to most of the U.S. during April and May of 2020.

The vast majority of the island’s cases were diagnosed after October 17, 2020. The average number of cases grew to 43 cases per week in period 2, and there were substantially more clusters and chains of transmission extending beyond two individuals than earlier.

The Brazilian community was hit especially hard in period 2. Although this community makes up approximately 20% of the Island population, at least 33% of the cases in period 2a and 58% in period 2b were from this group. The higher proportions of younger and male cases in period 2 probably reflects the younger age distribution of the Brazilian population.

There are a number of possible reasons for this pattern. First, as the winter weather returned, people spent more time indoors. Second, many in the Brazilian community have jobs that put them at higher risk of infection and tend to live in larger households. Third, the more highly transmissible Alpha variant of SARS-CoV-2 arrived on the Island. The combination of these factors naturally leads to the larger clusters, longer transmission chains, and higher incidence rates that occurred starting in October 2020.

The pattern was quite different in period 3 (June 7 – September 26, 2021). The average number of cases per week decreased to 29 in period 3. The proportion of cases that were seasonal residents or visitors in period 3 (essentially the summer season) was 39.8%, compared to 7.6% in period 2. Also during this period, 27% of the cases reported to local public health officials were not in the state's MAVEN database because they did not have a Massachusetts address. Adding these to the individuals in MAVEN who identified as seasonal residents or visitors, 56.1% of period 3 cases were not permanent residents.

Clusters were common in period 3, and all but one (a supermarket) were associated with a restaurant or bar. These patterns in residency and vaccine status and clusters are consistent with the health officers' observation that many of the summer cases were seasonal workers in restaurants and bars, young adults, often from other countries, and typically not vaccinated.

The average number of cases per week increased again to 82 in period 4 as the Omicron variants hit the island as well as the rest of the country. However, because many on the island were vaccinated and these variants were relatively mild, the number of serious cases did not increase proportionately. During this period, home tests became common, and self-reported results made up 43% of the positive tests in period 4.

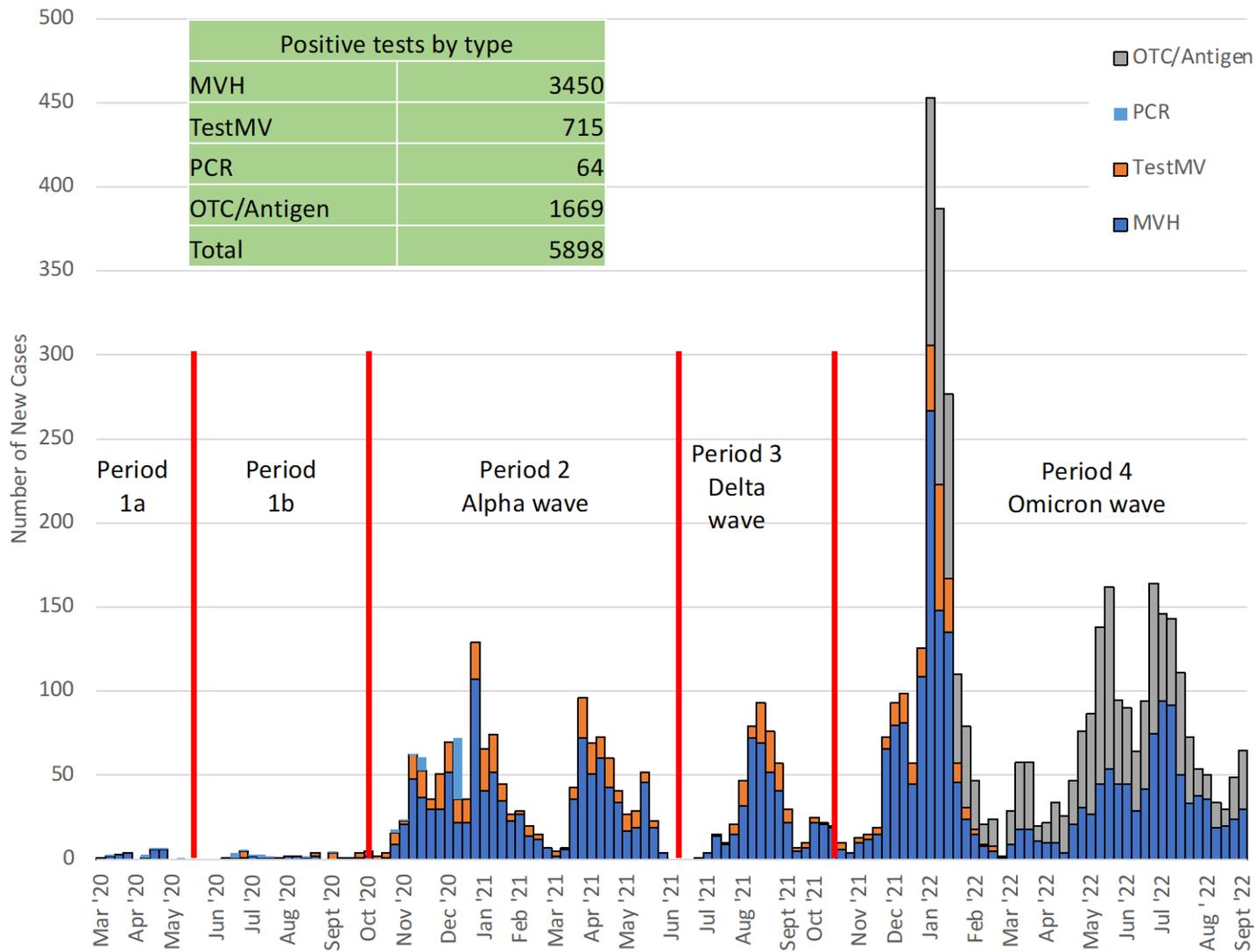


Figure 1. Martha's Vineyard epi curve by test type, March 8, 2020 – September 2, 2022.

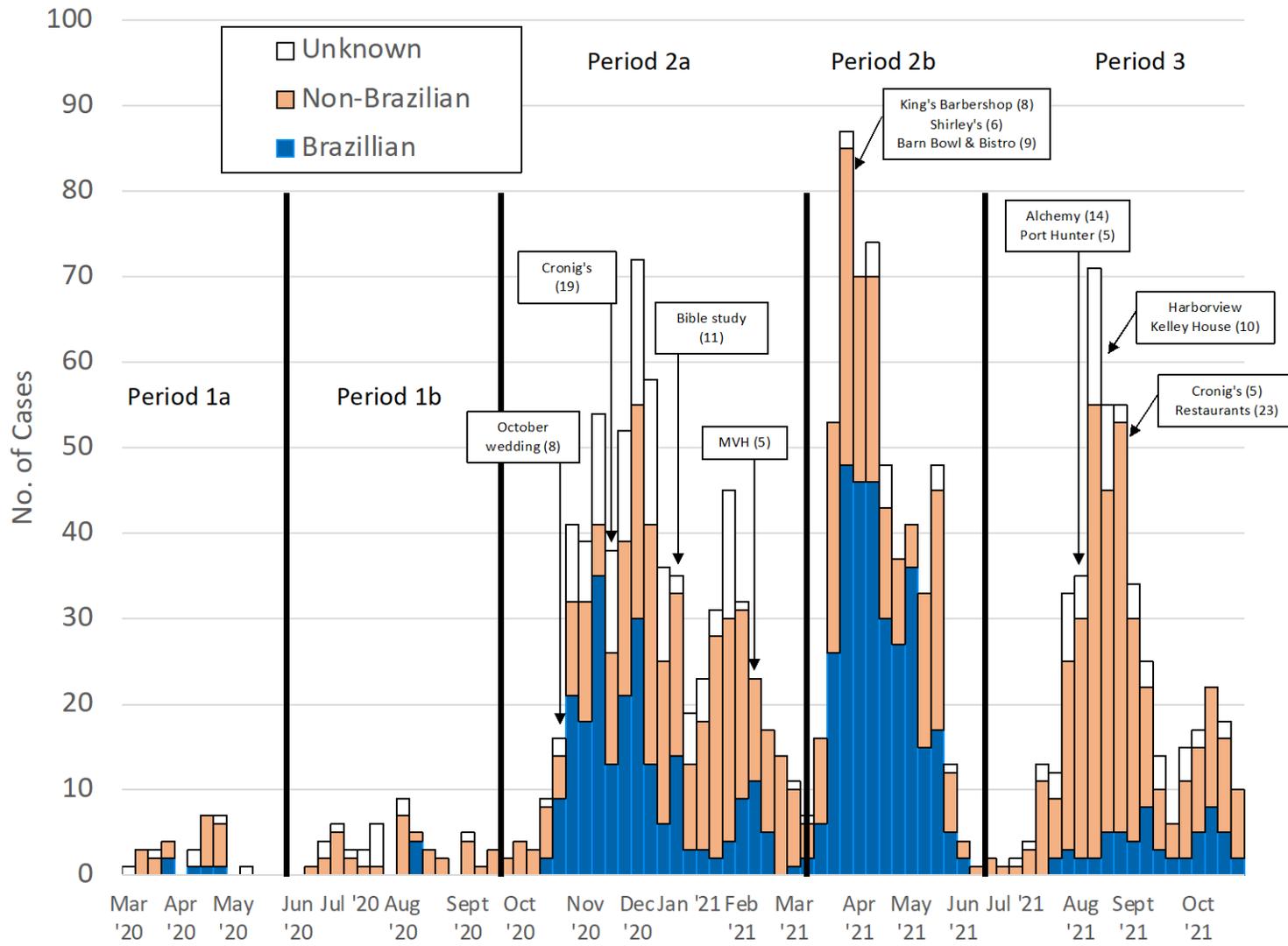


Figure 2. Martha's Vineyard epi curve by ethnicity, March 8, 2020 – September 26, 2021.

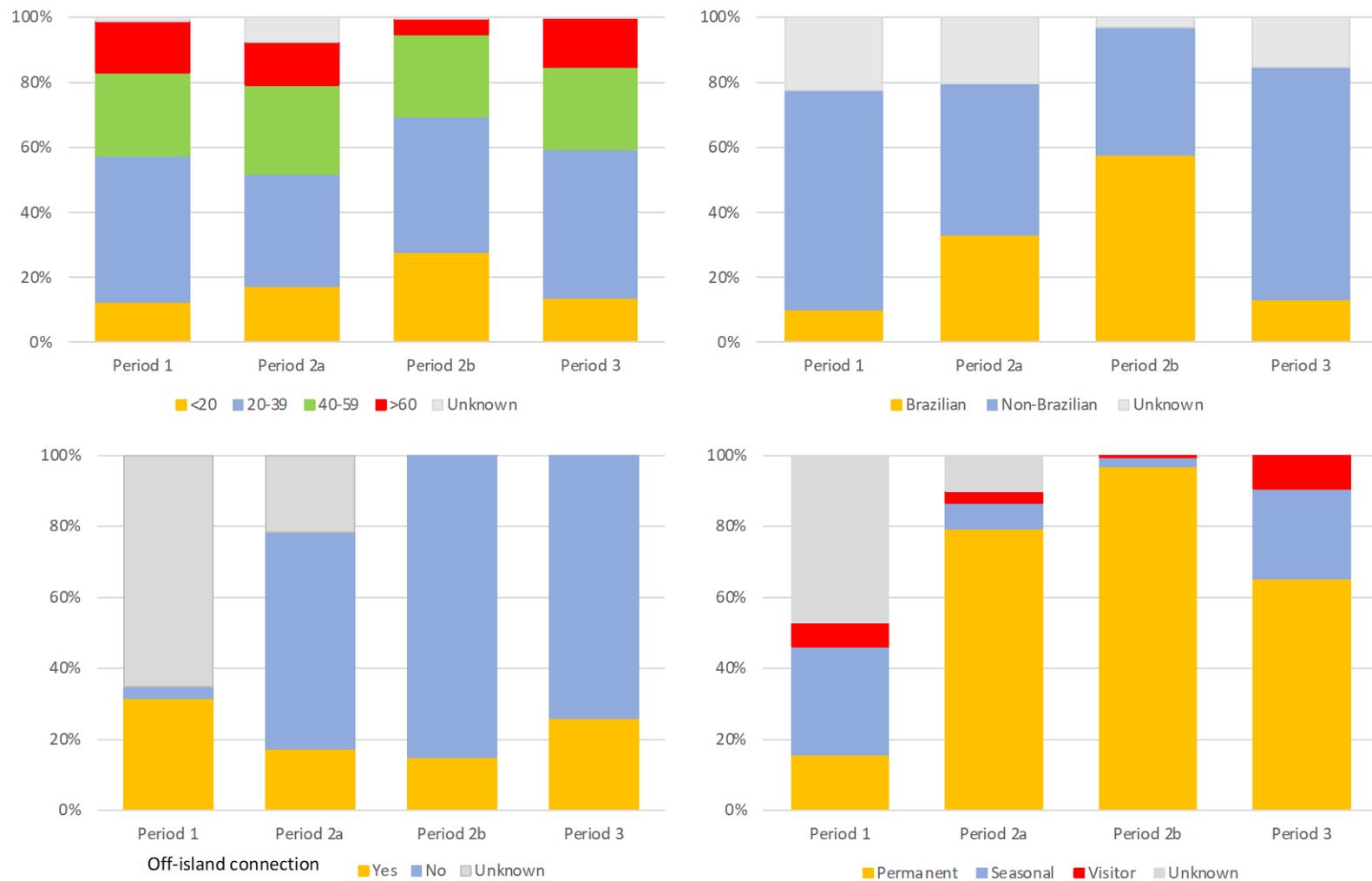


Figure 3. Distribution of confirmed and probable COVID-19 cases by (a) age, (b) ethnicity, (c) off-island connection, and (d) type of resident, Martha's Vineyard, March 8, 2020 – October 29, 2021. Periods defined as follows: Period 1: March 8 – October 18, 2020; Period 2a: October 1, 2020 – March 6, 2021; Period 2b: March 7 – June 6, 2021; Period 3: March 7 – October 29, 2021.

Appendix 3. The Martha’s Vineyard Public Health System Response to COVID-19

When the threat of the pandemic became clear, the island’s public health “system” rallied to manage the crisis. This consisted primarily of testing, surveillance contact tracing, implementation of community restrictions, and vaccination.

Community restrictions

When the threat of the pandemic became clear in March 2020, the Vineyard responded, following state guidelines, by closing non-essential businesses and schools and canceling many summer activities. Social service agencies rallied to support vulnerable residents put out of work. And concerned by credible projections about caseloads that could overwhelm a hospital staffed for the off-season, the Martha’s Vineyard Hospital urged summer residents to stay away.

As the spring progressed, the focus shifted to re-opening for the summer season, but doing so safely. For sure, tensions emerged between the business community and health authorities implementing state guidelines, but they were resolved reasonably quickly. For instance, the state regarded construction as an essential service, but conditions on the Island (in particular the fact that many workers rode together in trucks to the worksites) required additional restrictions that were negotiated between the boards of health and business owners. The Community Ambassador Partnership Program was formed during this period to better communicate with the Brazilian community.

During the summer of 2020, the focus shifted to enforcing social distancing policies, balancing public safety with the requirements of the hospitality industry. Although some felt the Island should have a uniform mask requirement, policies were developed town-by-town, depending on conditions. Fortunately, visitors kept coming longer into September and October than in previous years, allowing the business community to recoup some of their losses.

Taking advantage of high vaccination rates in Massachusetts and on the Vineyard, most community restrictions were lifted in June 2021, before the summer season. In July, however, a major outbreak fueled by the Delta variant occurred in nearby Provincetown, Massachusetts among a highly vaccinated group. Providing evidence that even vaccinated individuals can transmit the Delta variant, this led the Centers for Disease Control and Prevention (CDC) to recommend indoor mask use in places experiencing “substantial” or “high” coronavirus transmission rates, including Dukes County. Shortly afterwards, Island health officers issued a joint statement strongly recommending indoor mask use regardless of vaccination status. In late August, 2021, five of the six town boards of health voted to institute a mask mandate for indoor public spaces.

⁷ Marina Lent and Molly Houghton contributed to this analysis.

Testing

COVID-19 testing was conducted primarily in three sites: Martha's Vineyard Hospital (MVH), TestMV, and the Martha's Vineyard Public Schools (MVPS), primarily using PCR testing. The Wampanoag Tribe of Gay Head/Aquinnah conducted its own testing program. Starting in January 2022, "at-home" rapid antigen tests became available and the results incorporated into the island's surveillance system. As described below, more than 86,000 tests were administered through September 2021, and nearly 6,000 positive test results were reported through September 2, 2022.

Martha's Vineyard Hospital

Martha's Vineyard Hospital (MVH) purchased antigen test kits early, before supply chain issues arose. The hospital started testing symptomatic individuals and contacts in March 2020 and continued throughout the pandemic using a medically-collected nasopharyngeal swab. In April 2020, the hospital began to routinely test all patients coming in for procedures and performed surveillance testing for inpatients. Additionally, the hospital opened a drive-thru testing tent using a Department of Public Health (DPH) waiver. Through September 2021, 26,000 tests were administered.

TestMV

TestMV was established as the Island was emerging from the restrictions of the first months of the pandemic, and opening for the 2020 summer season. Operated by Island Health Care, TestMV served as a free alternative with no red tape to Martha's Vineyard Hospital for people without symptoms or who didn't want to go to the hospital. It was intended to serve residents concerned that they might have been infected, especially front-line workers whose work exposed them to others on a regular basis. It helped individuals know whether they could safely visit vulnerable friends and relatives or go back to work, and provided peace of mind to many. In August 2020, TestMV helped visitors from out of state avoid a 14-day quarantine requirement.

TestMV was initiated when Steve Rusckowski, the CEO of Quest Diagnostics and a summer resident of Edgartown, was approached by Select Board Member Mike Donaroma and attorney Ron Rappaport. As the island's only federally-qualified healthcare center, Island Health Care (IHC) had access to federal pandemic funds and was asked to be the provider. Martha's Vineyard Bank provided an initial grant of \$100,000 so tests could be free to everyone, including the uninsured. The town boards of health, as well as other individuals and organizations provided additional financial and in-kind support.

TestMV opened on June 1, 2020 as a drive-thru testing center at the Regional High School, using a medically observed nasal self-swab. It later moved to the West Tisbury School and the Agricultural Society grounds. It closed its doors on March 31, 2022 after conducting nearly 48,000 tests. On its busiest day, just before Thanksgiving 2020, TestMV conducted 438 tests.

During the first summer, TestMV had 43 clinical volunteers, including 9 doctors, 17 nurses and 12 EMTs, and 58 non-clinical volunteers who were runners, traffic managers and data enterers. Over the course of its operation, more than 135 individuals volunteered to help.

Martha’s Vineyard Public Schools

Starting in January 2021, as students and teachers transitioned back into the building after spending the fall of 2020 completely remote, MVPS began surveillance testing of a random sample of students and staff using a pooled, self-administered saliva test. The goals were to instill confidence that returning to in-person learning was safe as well as reducing transmission of COVID-19 within the schools and community. This program was funded by Martha’s Vineyard Bank and MVYouth. Every individual who came back to in-person learning was required to participate in this program; those who did not wish to be tested could opt to continue remote learning. This program randomly selected one-third of the school population to be tested weekly, except for high school athletes who were tested every week during their season. Individuals who tested positive were removed from the pool for 90 days, as recommended by Mirimus, the company that conducted the pool testing. This program utilized a saliva test that was to be administered at home and returned to school. Pool results were received 24-48 hours after, individuals were notified only if they were in a positive pool. During this program, being in a positive pool produced more anxiety than in the following program. MVPS did not have access to rapid tests, although sometimes the positive pools would all be tested with a rapid to try to determine the positive.

From an administrative perspective, testing programs in the 2021-2022 academic year were quite different as they were funded by the state and followed a protocol determined by a state contracted lab. This program included three components: (1) weekly pool testing, (2) Test-to-Stay, and (3) symptomatic testing. Participation in this program was not required as there was no longer a remote learning option available. Like the previous program, athletes were required to test weekly if they wanted to participate in practice and games. The goal of this program was to prevent spread within the school and community while adding an additional level of safety. Weekly pool testing continued, although it transitioned to a nasal swab that was done under the supervision of testing staff during the school day. The Test-to-Stay program was intended to keep ‘close contacts’ in school as long as they were negative. Individuals who were exposed to COVID-19 while in school were offered to rapid test upon arrival to school for the following 5 days. If negative, they could return to school as normal. If positive, they were sent home. In addition, we offered symptomatic antigen testing for individuals who presented with symptoms while at school. Individuals who did not consent to the Test-to-Stay or symptomatic testing were required to follow quarantine guidelines.

Starting in January 2022, the Test-to-Stay program was discontinued and at-home testing was added. Individuals could opt into receiving a rapid test to conduct at home once a week. They were to report to their school nurse and through a Google form if their kit turned positive. This did not count for the weekly testing requirement for athletes.

Overall, as summarized in Table 1 and Figure 4, from January 2021 through June 2022, a total of 4,540 pools were tested and 265 were positive. This led to 11,185 individuals in these pools being tested, with 267 being positive. In addition, there also were 85 positive results in symptomatic individuals, 100 based on rapid tests, and 8 from the Test-to-Stay program.

Table 1. School testing program results

Pool testing program	Positive results
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	Samples tested	Positive Results	Individual	267
Pools	4,540	265	Symptomatic	85
Individual	11,185	267	Rapid test	110
<i>Total</i>	<i>15,725</i>	<i>532</i>	Test-to-Stay	8
			<i>Total</i>	<i>470</i>

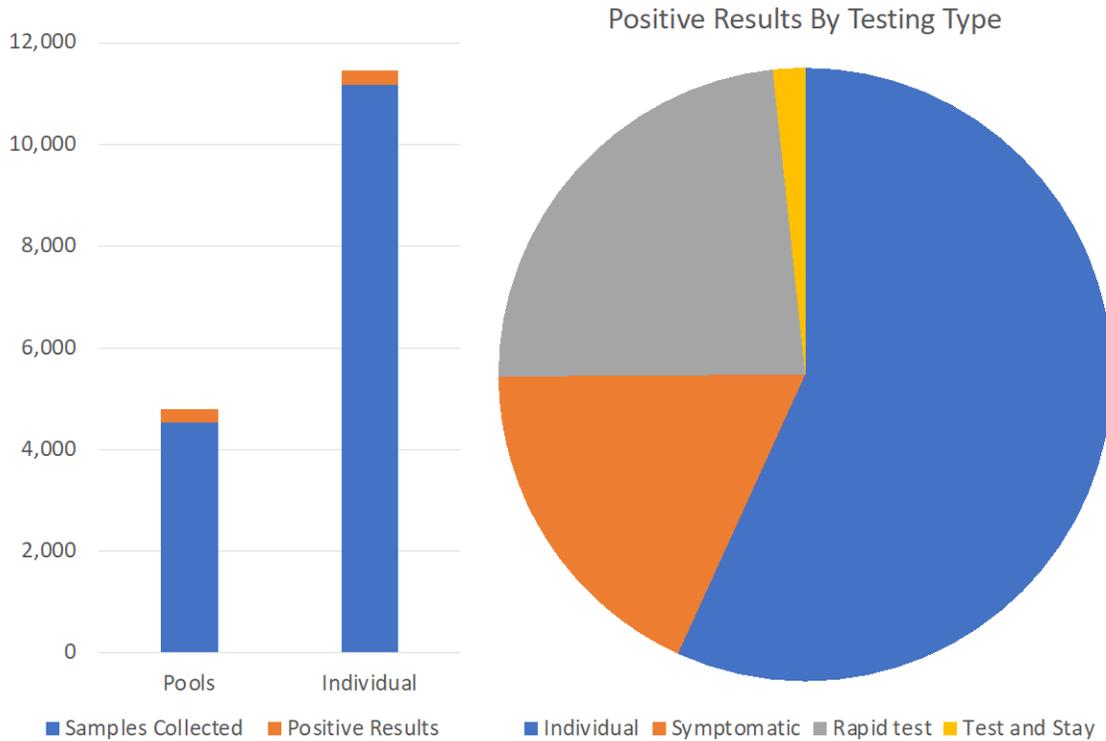


Figure 4. School testing program results

Rapid antigen tests

Starting in January 2022, large shipments of federal “at-home” rapid antigen tests were made available through IHC. The boards of health developed a self-reporting website and put stickers on every box of tests encouraging people to write in the date of each positive test, their date of birth, and contact information. This enabled health officials to communicate with at least some of the positive cases testing independently at home.

Testing overview

Table 2 indicates the number of positive test results by site and type of test.

Table 2. Number of positive test results by site and type of test through September 2, 2022.

Site and test type	Number of positive results
MVH	3,450
TestMV	715

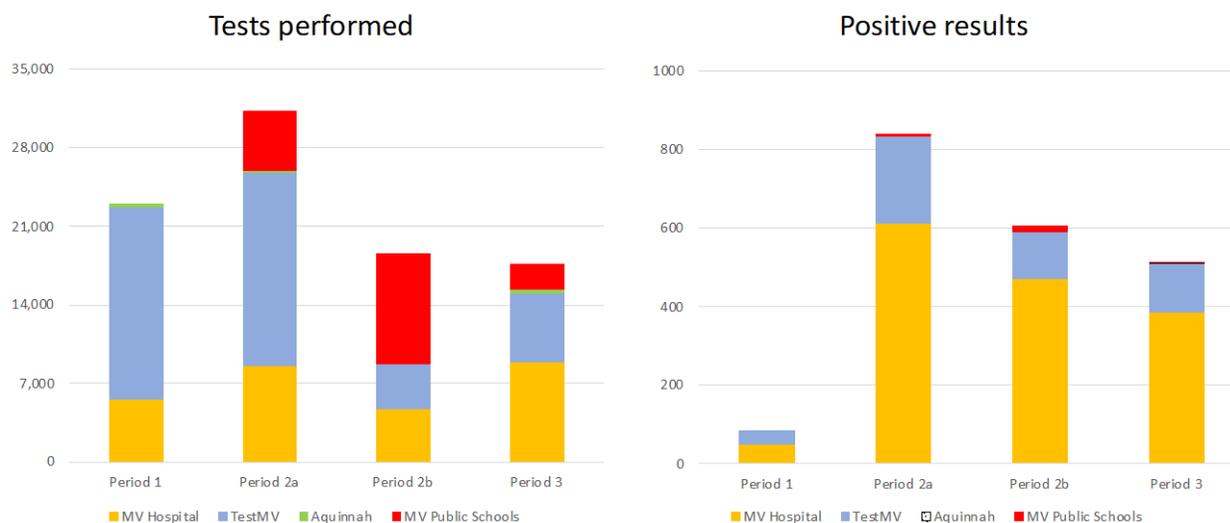
PCR	64
OTC/Antigen	1,669
Total	5,898

Through September 24, 2021 (after which the weekly reporting format changed), a total of 86,240 tests were administered on the island, primarily at TestMV (43,462) and MVH (26,000). The number grew from 719 tests per week in the summer of 2020 (Period 1) to 1,562 per week in Period 2a (October 18, 2020 – March 6, 2021) and 1,445 per week in Period 2b (March 7 – June 5, 2021). The number only tapered to 839 per week in Period 3 (June 15-September 24, 2021), when vaccination became the primary public health intervention.

As the primary testing site for individuals with symptoms, test positivity rates at MVH were high relative to the other sites (Table 3 and Figure 4). During the study period, 5.5 PCR tests per Vineyard resident were performed, which compares favorably to per capita rates of 3.4 for Massachusetts and 1.4 for the United States (6).

Table 3. Test positivity rate by test site and time period, March 7, 2020 – September 24, 2021. Note: the test positivity rate is the proportion of all tests performed that had positive results.

Test site	Period 1: March 7 - October 17, 2020	Period 2a: October 18, 2020 - March 6, 2021	Period 2b: March 7 - June 14, 2021	Period 3: June 15 - September 24, 2021
MV Hospital	0.89%	7.12%	9.98%	5.14%
TestMV	0.20%	1.29%	2.99%	2.18%
Aquinnah	0.00%	0.70%	7.14%	1.00%
MV Public Schools	0.00%	0.08%	0.14%	0.00%



Notes: Martha’s Vineyard Hospital used a medically-collected nasopharyngeal swab, TestMV used a medically observed nasal self-swab, and Aquinnah and Martha’s Vineyard Public Schools used a self-administered saliva test. All used PCR testing.

Figure 4. COVID-19 tests (a) performed on Martha’s Vineyard and (b) positive results by test site, March 7, 2020 – September 24, 2021.

Contact tracing

In Massachusetts, case investigation and contact tracing are the responsibility of the individual towns. Prior to the pandemic, and for the summer of 2020, the boards of health’s public nursing program, a contract with Island Health Care, provided these services. In the fall of 2020, as it became evident that case numbers were rising rapidly, health agents developed a contact tracing team, made up of the public nursing program, public health staff, and volunteers. The contact tracers sought to interview individuals who tested positive at any site and others diagnosed by symptoms – the cases – to ensure they had access to necessary health care and remained in isolation. Initially, this required daily calls for up to 10 days, until the state-wide requirements were reduced to a release call on Day 10. The cases also were asked to identify others with whom they might have been in contact with during the infectious period (2 days prior and 10 days after symptom onset or a positive test). The tracers then called the contacts and asked them to quarantine for 10 days, and to be tested.

The contact tracing program also contributed to the island’s surveillance activity. Confirmed cases were entered into the state’s MAVEN database and also into an island-specific database to capture cases and contacts whose residence was elsewhere. In addition, the contact tracing team coordinated with the hospital, TestMV, the schools, and the boards of health to produce daily and weekly updates on Island cases, as described in the next section. The contact tracing team also helped health officials understand disease transmission dynamics on the Vineyard, including identifying large clusters of cases.

The number of cases grew in the fall and was as high as 72 in the first week of January 2021 and 84 in the first week of April 2021. From November 2020 onward, an average of 2.46 contacts were identified per case, ranging from 0 to 19.

Initially the work of two part-time IHC nurses, the public health response, including the contact tracers (including some who spoke Portuguese), interpreters, health agents, school nurses, coordinator and others grew dramatically. The team was active 7 days a week. There were approximately 2 full-time equivalents working during phase 1, and this grew to more than 6.5 in phase 2 and 8 in phase 3. Almost 30 individuals were involved at some point.

From the start, the contact tracing team strove for cultural competence, not just language competence. Agents conducted active outreach directly to the Brazilian community, and our ongoing collaboration with the Community Ambassador Program, a non-profit developed in response to the pandemic, and other non-profit service agencies on the Island, has become a productive ongoing public health partnership.

Surveillance

Up to date information on the number of infections and other factors is critical for managing a public health emergency, but providing that information on the Vineyard during the pandemic was challenging. Separate reports from the testing sites and towns were not sufficient to provide island-wide situational awareness. The Massachusetts Department of Public Health's COVID-19 dashboard was useful, but focused on data from the six towns individually rather than the island as a whole. Some weeks one town but not its neighbors would be in the "red zone," but if the cases were distributed over the whole island community the situation would not be as dire as the official reports suggested. Sources such as the *New York Times* provided data for Dukes County, which is close to the Vineyard's population, but did not pick up nuances such as individuals tested twice. None of these sites included individuals diagnosed – and presumably infected – on the island whose permanent residence was elsewhere.

To address this information gap, the Vineyard testers, contact tracers, and health agents collaborated to issue daily and more detailed weekly epidemiology reports for the whole island, which provided a clearer picture than the town-by-town reports from the state health department. Later, these reports were expanded to include results from all of the Island's testing operations. Appendix 2 uses this data to summarize the evolution of the pandemic on the Island.

Vaccination

The Vineyard's vaccination program started in December 2021, when Martha's Vineyard Hospital began vaccinating its staff and in waves of state defined high risk community members; front line caregivers, first responders, and high-risk patients with certain pre-existing conditions in coordination with state and Mass General Brigham guidance. However, there were challenges in matching vaccine supplies from the state and federal governments to the Island's needs. The state's primary approach to vaccination was large-scale points of distribution, none of which were located on the Vineyard.

Between December 17, 2020 and March 3, 2023 over 50,000 vaccine doses were administered at Martha's Vineyard Hospital. The hospital deployed vaccines using the statewide strategy where healthcare workers and high-risk individuals, including those with comorbidities associated with severe COVID-19 and individuals aged 65 and older, were prioritized for vaccination. Large scale vaccination efforts took place in the hospital lobby, in an

adjacent heated covered tent structure and through up to two pop-up drive-through clinics. At its peak in April-July 2021 nearly 600 patients were vaccinated in a day requiring 12 hospital employees to staff. Additionally, the hospital deployed 3 clinical staff to vaccinate 70 homebound residents. The scale and speed of the highly protective vaccine deployment efforts were unprecedented for the hospital.

As a federally-qualified health center, Island Health Care received an allotment, but collaborated with MVH, the Wampanoag Tribe, and the town health agents to arrange for the hospital to be the primary single vaccination administration site for the Island. Although appointments originally were as challenging to get on the Island as anywhere in the country, this arrangement made the effort more efficient and effective. In May and June, IHC collaborated with the state health department to arrange for a mobile vaccine bus to visit the Vineyard, which helped with outreach to the Brazilian community.

As a result of these efforts, 84% of eligible Dukes County residents age 12 or older were fully vaccinated as of June 1, 2021 (5), compared to 59% in Massachusetts and 52% in the United States. This level of coverage has continued throughout the pandemic. In April, 2023, 88% of the Dukes County population were fully vaccinated, and 75% of those 65 and over had received a booster. This compares favorably with Massachusetts (82% and 75% respectively) and the U.S. as a whole (68% and 67% respectively).