



2021

From Pre-Pandemic Plan to Virginia's Vaccine Administration: The Paradigm Shift in How Virginia Values Data

Data Management, Analytics & Visualization Category

Project Dates: January 2021 - April 2021



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EXECUTIVE SUMMARY

State governments across the country found that a strong response to the COVID-19 pandemic wasn't enough. The real measure of state performance and how the road to recovery would be paved came in the form of vaccine administration.

In January 2021, Virginia ranked [*last in the country*](#) for vaccine supply used and it wouldn't be until Commonwealth Chief Data Officer, Carlos Rivero, and his team came in with a data-driven approach that things would turn around. The unique challenge with the COVID-19 vaccine was that the responsibility of execution and coordinating clinics lived with the local health districts (LHD), but the vaccine administration performance needed to be driven at the Commonwealth level. The LHDs needed an effective way to gather the right data so clinics could be efficiently coordinated and minimize waste. Additionally, Virginians needed a simple, easy way to pre-register for the vaccine and schedule their appointments. None of these things were going to be possible without a consolidated system and data-driven approach that would provide intelligence to multiple stakeholders not just across the organization, but also vertically through operational and executive levels.

The CDO and his team initiated an unparalleled effort to consolidate data from the LHD systems in record time so the statewide pre-registration system could launch and the individual-level registration data could be delivered back to LHDs to administer the vaccine. The final step in this process was for the LHDs to record the immunizations into the health department's authoritative system that was also consolidated into the CDO's infrastructure. This level of data sharing, system consolidation, and intelligence is unprecedented in the Commonwealth and it was accomplished in a matter of weeks. This work is ultimately what allowed Virginia to move from last place in the nation to grazing the top 10 and maintaining that position since February. Furthermore, the capability of the CDO's team and infrastructure that was demonstrated and proven during the vaccine administration led to a paradigm shift in the way Virginia values data and harnesses it to drive the business of government. The magnitude of the potential this has on the Commonwealth did not go unnoticed and was made evident by an Act to amend and reenact § [2.2-203.2:4](#) of the Code of Virginia to permanently establish the Virginia Data Advisory Commission, Data Governance Council, Executive Data Board, and [Office of Data Governance and Analytics](#) led by the CDO.



THE CONCEPT

Flying blind at breakneck speed

Virginia communities were reeling from pandemic fatigue while many state and local government agency employees felt depleted after managing the initial response to COVID-19 throughout 2020. Even though emergency-use vaccines offered a ray of hope, the immense effort associated with 'getting shots in arms' proved to be another unprecedented challenge with breakneck execution timelines. In January 2021, there was no visibility into the Commonwealth of Virginia's vaccine administration performance including the efficient use of limited and valuable resources resulting in very low vaccination rates being reported. Rates so low that [Virginia was ranked last in the country for percentage of distributed vaccines that have been administered](#). Lives were at stake and without a change in course, the Commonwealth would continue to fly blind and Virginia's vaccine supply would be administered haphazardly at best.

The pre-pandemic data-driven plan

That started to change on January 25, 2021 when Commonwealth CDO, Carlos Rivero, was called to engage in the vaccine administration effort. He learned what the current approach was, developed a strategic plan, leveraged the data analytics infrastructure previously developed, and established a data-driven approach to turn Virginia's vaccine administration and ranking around. Since his appointment in August 2018, the CDO had been building the processes and technology to bring data assets together at the individual level, including personally identifiable information (PII), and make them shareable with multiple stakeholders in a secure and appropriate way - *a holy grail goal every state strives toward*. The CDO leveraged the data governance and technology infrastructure work already done by the Virginia Longitudinal Data System (VLDS) to inform the development of the Framework for Addiction Analysis and Community Transformation (FAACT). FAACT addressed Virginia's opioid epidemic and proved the value of data sharing. The CDO continued to expand data governance, sharing, and analytics within the Commonwealth with the development of the Workforce Referral Portal. This work was pivotal in giving displaced or laid-off constituents an online portal to access workforce services. Previously, these services required the job seeker to physically visit one of 56 Career Service Centers that were now closed due to the pandemic.

The FAACT platform successfully supported the Commonwealth's COVID-19 response, including health system and COVID-19 testing performance management, but there was a component missing to support vaccine administration. Fortunately, the CDO was able to leverage all of the processes, procedures, methodologies, technologies, and relationships developed during the previous two years to create a solution supporting the state's vaccine administration efforts.

From local silos to Commonwealth consolidation

Initially, each of the 35 LHDs were tasked with developing their own COVID-19 vaccine pre-registration system that collected similar data, but in many different ways due to the lack of standardization and coordination. To more efficiently manage the vaccine administration, a statewide pre-registration system was needed along with the ability to provide the data back to the LHDs to establish, coordinate, and populate clinics. The CDO and his team swiftly began work to centralize the data already being collected. The data was consolidated from a systems perspective but gave Virginians multiple ways to connect either through the web application online or through a call center. Within the first week, the new centralized system pre-registered 500,000 people which is almost half of the pre-registrants collected by the LHDs during the entire previous 6 weeks.

The data pipeline between the statewide pre-registration system and the Virginia Health District Dashboards allowed the Commonwealth to gain granular visibility into whether the vaccines were being administered equitably along with oversight of how the LHDs and localities in those districts were performing. For the Commonwealth of Virginia, it wasn't only about the number of vaccines administered, but about who was receiving the vaccines. The purpose of shifting from 35 disparate efforts across every health district to a unified vaccination effort was to efficiently monitor and manage the performance of the vaccine administration program by providing access to data and intelligence to as many stakeholders as possible, minimize the impact on existing infrastructure, and ensure equitable distribution of the emergency-use vaccines.

IMPLEMENTATION

The clock was ticking on how to efficiently get vaccines distributed throughout the state and into the arms of Virginians. The agile project management approach allowed for quick iterations, constant communication, and a high level of responsiveness to stakeholder needs as efforts were coordinated across multiple teams.

The tools in the toolbox

Fortunately, the 2020 NASCIO award-winning FAACT framework infrastructure was already in place to support this initiative including the cloud-based secure data sharing platform, the data warehouse in AWS, and the distributed dashboard environment. Virginia Health District Dashboards were developed to support the COVID-19 testing intelligence and now the vaccination data could be added. The first task at hand after the meeting on January 25, 2021 was for the CDO to learn more about the vaccine administration process and its stakeholders. It quickly became clear that not having a centralized system to manage the pre-registration process was a significant challenge that needed to be addressed. In addition, providing the LHD stakeholders with the data and actionable intelligence to create and operate vaccination clinics as well as identify, notify, and schedule appointments for phase-eligible Virginians became a top priority.

The team

The LHD staff were considered end users and beneficiaries of the dashboards with their management team serving as stakeholders for the much needed intelligence. In between the LHDs and the Virginia Department of Health (VDH) were health district liaisons who served a critical role as messengers, translators, and advocates for why connecting the dots between LHD needs and Commonwealth vaccine administration goals were the key to success. The CDO added the pre-registration and vaccine administration data to the existing Virginia Health District Dashboards containing COVID-19 testing performance metrics by locality. District Directors used this dashboard extensively to determine which localities were meeting or exceeding the state's COVID-19 testing requirements and goals (2 - 4% of the population tested, respectively).

The CDO and LHD liaisons embarked on a virtual roadshow to demonstrate what data was now available and how to leverage the intelligence to manage their vaccine supply and clinic administration. Prior to the dashboards, vaccine administration data was not accessible to health district staff without a direct account in the Virginia Immunization Information System (VIIS). Furthermore, no programmatic access was available until the CDO's team established API access to the data. The constant stakeholder and end-user engagement with the LHDs was incredibly important to building the awareness, trust, and adoption of the available tools that ultimately led to success. Supporting LHD stakeholders, facilitating communication, and coordinating community outreach helped to create a unified voice across the Commonwealth.

Agency staff from VDH, Virginia Department of Emergency Management (VDEM), the Health Equity Working Group, and the Governor's Office were key collaborators and advocates for the project with the VDH Information Technology team providing oversight for the statewide pre-registration system developed by SpringML on the Google Cloud Platform. The CDO's team provided oversight of the data and intelligence pipeline with support from DB Driven and Qlarion, Inc.

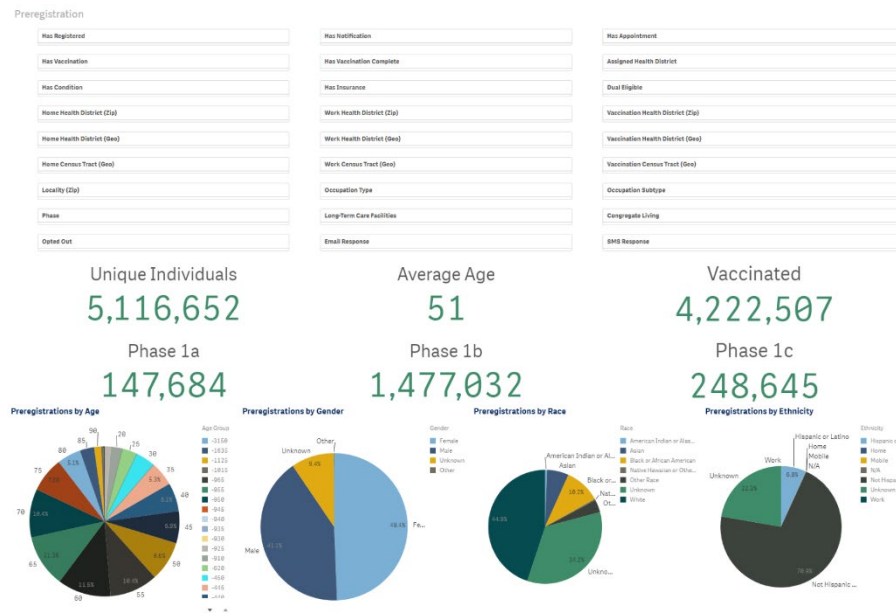
How the bus was built

Typical implementation times for a project like this are months and sometimes years. The CDO's team had *weeks*. The experience of working on the vaccine administration effort could be likened to building the bus while designing it and taking on passengers at the same time. The first pre-registration Virginia Health District Dashboard training began on February 10, 2021 and the statewide pre-registration system launched February 17, 2021.

Since the CDO already had a data warehouse developer, data engineer, and dashboard developer from Qlarion, Inc. tasked with supporting the COVID-19 testing dashboards, this team only needed to be redirected to provide the stakeholders with actionable intelligence through the dashboards and accompanying graphical query tool. However, the task of consolidating, cleaning, standardizing, curating, and integrating data from the disparate data systems required the support of an additional team from DB Driven. This team had been operating the CDO's entity matching environment known as the Commonwealth of Virginia Entity

Resolution for Enterprise Data (CoVERED) in support of the CDO's data sharing priorities. This environment was used to match data records for individuals across the multiple vaccine pre-registration systems.

Figure 1: Virginia Health District Dashboard



The data consolidation effort took place over the weekend of February 13-14, 2021 in which 90 different data systems from 35 LHDs were consolidated in less than 72 hours. The result was 1.8 million records pared down to 1.2 million unique individuals. Once the pre-registration system launched on February 17, the data consolidation effort involved a continuous refinement over the next 6 weeks which ultimately resulted in a data reconciliation effort that found 49,000 additional records for individuals that needed to be added to the statewide database.

Repeatable processes with reusable components

The desire for an optimal constituent journey was at the heart of how the processes and technology were leveraged. The constituent journey involved several steps:

- Virginians register for the vaccine in the statewide pre-registration system
- CDO team operates the Vaccine Demand Analytics component creating the intelligence the LHDs use
- The LHD sets up clinics to meet the demand using the Virginia Health District Dashboard to identify eligible individuals to invite
- Using the dashboard, individual records are selected, exported, and uploaded to the notification system to be invited to the appropriate clinic via email, SMS, or phone call to set up an appointment
- The clinic administration platform confirms and schedules the appointment
- The individual receives the vaccine and the clinic records the vaccine administration data into VIIS

The Commonwealth of Virginia took a holistic look at the entire journey, mapped the individual demand signals, and met that demand by managing the distribution of vaccines to thousands of providers. The CDO's team had to consider the multiple pre-registration systems, the notification system, the immunization information system, and 3 different scheduling and clinic administration systems before making all these datasets accessible to the LHDs and other stakeholders such as the The Virginia Emergency Support Team (VEST) Unified Command, VDEM, VDH, Health Equity Working Group, and the Governor's Office Executive Team. In addition, the Health Equity team provides ongoing oversight of this process ensuring outreach efforts support diverse communities registering in the statewide system and health districts are [administering the vaccine equitably](#).

There are 133 localities governed by 35 health districts culminating in over 230 unique users that actively use the dashboards every day to pull names of individuals to populate vaccine clinics. The graphical query tool for the database started with 6 attributes when the dashboards launched and now has 34 attributes (see Figure 1) the LHDs can use to query the database of over 5 million people (over half the Virginia population). This level of data sharing is directly attributable to the [Commonwealth Data Trust](#), the legal framework developed by the CDO in collaboration with the Office of the Attorney General. The data trust is a leading practice for data sharing allowing stakeholders, organizations, and vendors supporting the vaccination effort to quickly and securely share the data to execute their missions. This initiative builds on cloud capabilities making data accessible to a wide

range of users with minimal expenditure of financial and human resources to the Commonwealth by leveraging common, consistent approaches. In a nutshell, the CDO team was building repeatable processes with reusable components. Many localities programmatically connected to the data supporting the dashboards via the cloud-based API to build their own solutions. While the dashboard supports the operational requirements to invite and schedule clinic appointments, providing localities access to the API allows IT departments to develop customized solutions for their health department staff. One example of this is the application the City of Norfolk, Virginia created (see Figure 2). This application allows city staff to identify communities where vaccine administrations have been lagging, guiding the implementation of mobile clinics.

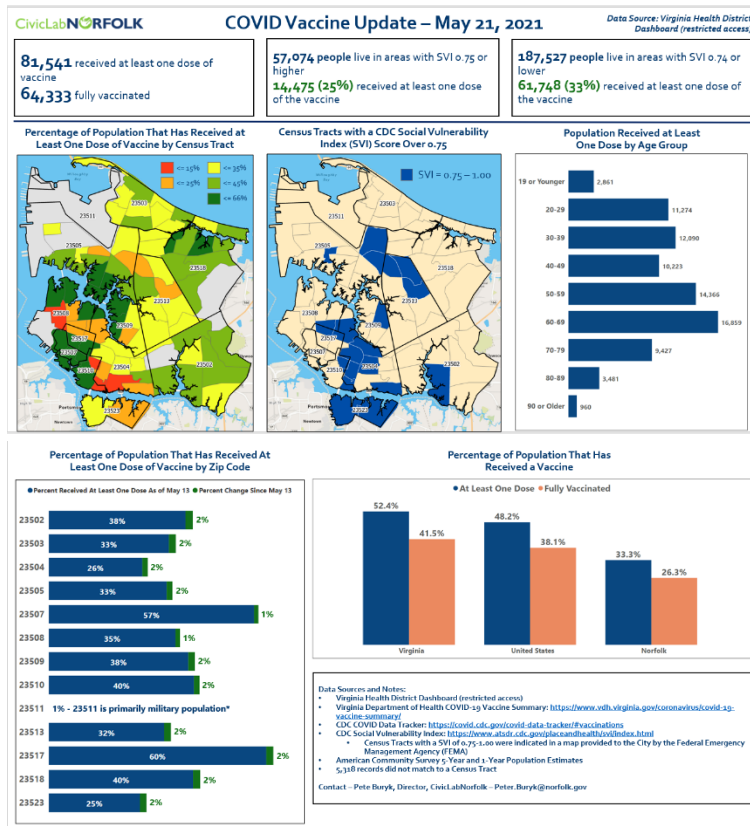


Figure 2: Norfolk, Virginia application

THE IMPACT

In January 2021, [Virginia was ranked last in the country for percentage of distributed vaccines administered](#). In February, Virginia neared the top 10 and [continues to hover around the #12 spot](#) since the launch of the Virginia Health District Dashboards. The Virginia Emergency Support Team (VEST) Unified Command, VDEM, VDH, Health Equity Working Group, and the Governor’s Office Executive Team are able to monitor the Commonwealth’s vaccine administration performance due to the data-driven approach that provided visibility into how to maximize efficiency and mitigate issues. The end product of a consolidated system where everyone has access democratized data access and provided full transparency into the administration of vaccines and performance down to the locality. In addition, the work allowed [vaccine data to be published into the Virginia Open Data Portal](#) for constituents to view. Virginia not only had an unparalleled level of integrated data, but the data was made accessible to operational, tactical, and strategic teams.

Analytics teams from Virginia Commonwealth University, Old Dominion University, University of Virginia, and Deloitte Touche Tohmatsu Limited were engaged in developing models to guide decisions on health equity, manage vaccine supplies and inventory, and determine where Community Vaccination Centers (CVC) should be located and how many doses should be allocated to meet the demand in the area. Through the analysis, it was determined that mobile CVC’s were preferable to permanent clinics in order to serve different communities based on need thus reducing cost and potential waste of scarce resources while increasing responsiveness to Virginians that most needed the vaccine.

The right data to meet the demand

The impact of putting all the tools in the CDO’s toolbox to work for the vaccine administration effort was felt at both the state and local levels. VDH noticed some glaring issues that needed to be addressed during the early stages of the vaccine administration: vaccine supply, inventory management, and distribution; priority groups and equity-based access to vaccines; and operational support for LHDs. VDH needed appropriate data to meet the demand with efficiency. Suresh Soundararajan, CIO for VDH, said, “Virginia’s CDO and his team helped us through this effort by consolidating and curating pre-registration data from 35 different data sources with different formats into a standard entity. They also linked this data with the vaccine administration data. In addition, they also assisted us with building a dashboard for our local health departments that could pull these pre-registration data based on priority groups and equity based criteria.” He also commented, “The data from this dashboard assisted us a great deal to invite citizens for vaccine appointments and we were able to invite over 600,000 people based on this list. Without this effort from our CDO, it would have been very difficult to administer vaccines keeping our focus on equity and priority groups.”

Data to drive equitable vaccine distribution

Data has been a critical piece of Virginia's vaccination efforts. With a focus on equitable vaccine distribution, Vanessa Walker Harris, MD, Commonwealth Deputy Secretary of Health and Human Resources pointed out, "Through the work of the CDO and his team, the Virginia Emergency Support Team (VEST) has used data to track our progress in vaccinating Virginians as a whole and specific populations that we know have been disproportionately impacted by COVID-19, such as the Black and Hispanic/Latino communities and persons who are medically fragile or disabled." Data sharing across state agencies, such as DMAS and VDH, allowed for the identification of Medicaid members who could be reached for vaccination by allowing their personal care attendants to be vaccinated at the same time. "This data sharing was made possible through the Commonwealth Data Trust established by the CDO. The dashboards created for LHDs allowed the team to keep a close eye on meeting benchmarks to vaccinate eligible Virginians (recently adjusted to align with goals established by President Biden to vaccinate 70% of eligible persons by July 4th), while focusing especially on the elderly and Black and Hispanic/Latino communities," commented Deputy Secretary Walker Harris. The data directed the Commonwealth's targeted communications and outreach efforts to these communities. VEST members have easy access to the vaccination data through the Virginia Health District Dashboards and it is a *key resource for decision making*. As Commonwealth efforts have now shifted from demand outstripping vaccine supply to supply being more than enough to meet demand, the data is essential to understanding what populations remain undervaccinated, down to the local community level.

Local data intelligence led to action

The City of Norfolk utilized the Virginia Health District Dashboard daily as it tracked how many residents were pre-registered and vaccinated. When leadership within the City needed to know what specific communities and demographic groups were lagging behind state and national vaccine take-up rates, data from the Virginia Health District Dashboard provided valuable insights that led to action. Some of these actions included targeted neighborhood outreach, opening vaccine clinics in specific neighborhoods of need, and even calling residents who did not have access to a computer. In addition, data from the dashboard directly supported the City's case for requesting federal assistance, and over the past two months FEMA has set up a clinic at a strategic location in Norfolk to vaccinate hundreds of residents daily. The data and insights from the dashboard continue to inform Norfolk leadership as vaccines become available for younger age groups, and through the summer the City will look to age-related data to see how take-up rates are tracking among high school students. "These analytics and subsequent action steps could not have been possible without the data standardization and sharing provided by the CDO's team," noted Carl Larsen, Data Analyst for the CivicLabNorfolk.

Eliminating manual data entry

At the county level, Bedford County demonstrated how local and state government can adapt and work well together for the greater good of the community. In early March 2021, the Bedford County Government was tasked to coordinate, contact, schedule, and vaccinate residents that met the COVID-19 Phases 1b and 1c criteria for their locality. The scope grew as the expectation included hosting 500+ and 1,000-person vaccine clinics. Over a three-month period, Bedford County successfully hosted eight vaccine clinics and vaccinated over 2,500 residents. Elizabeth Lo, Bedford County's IT Director, commented, "After each vaccine clinic, the CDO's Team rolled out new functionality for localities to significantly streamline the registration and documentation of vaccination data. The integration between systems eliminated the need for manual data entry from localities." During these challenging times, the vaccination partnership between the Commonwealth and Bedford County is an exemplary case of collaboration, continuous process improvement, and technology being harnessed to address an unprecedented global health crisis.

The pandemic provided the opportunity for the plan, processes, infrastructure, and data sharing strategy already in flight to be demonstrated in a way that led to a paradigm shift in the way Virginia values data as an enterprise asset, not just a technology by-product. Consequently, it is being used to drive the business of government and the results are tangible. The value of bringing data assets together at the individual PII level and making them shareable with multiple stakeholders in a secure and appropriate way has been proven. With this shift in data use and demonstrated ability, the newly formed Office of Data Governance and Analytics is poised to be a pioneer in transforming the way state government harnesses the power of data and how it is delivered across the Commonwealth of Virginia.