COVID Vaccination Dashboard for the US

FINAL PROJECT REPORT

INTERFACULTY DEPARTMENT OF GEOINFORMATICS - Z_GIS
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IP-SDI

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PROJECT INFORMATION

Project		
Acronym	USCVD	
Title	COVID Vaccination Dashboard for the US	
Period	Start: 20/03/2021	Start: 29/06/202021

ROLES AND RESPONSIBILITIES

NAME	**ROLE**	**RESPONSIBILITIES**
Yuan Wang	Manager, senior engineer	Collect and manage the raw data and database, publish the Web service, implement and maintain the dashboard
Nianhua Liu	Manager, senior engineer	Design the project, collect and manage the raw data and database, edit the metadata, create and publish the reports
Barbara Hofer	Consultant	Support the project and provide tutorials to the engineers
Manfred Mittlböck	Consultant	Support the project and provide tutorials to the engineers

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1. FINAL PROJECT SUMMARY

The Covid Vaccination Dashboard for the US (USCVD) is a configurable web app that provides a real-time, open-source, location-aware, and interactive data visualization and analytics platform in order to better monitor the spread of the Covid-19 pandemic as well as the progress of the coronavirus vaccination coverage among all the states of America. The live feed used for this dashboard is from Data on COVID-19 (coronavirus) by Our World in Data, which is updated daily and includes data on confirmed cases, deaths, hospitalizations, testing, and vaccinations as well as other variables of potential interest. The dashboard is implemented as a spatial data infrastructure (SDI) through ArcGIS Geoportal and will be easily and openly accessed by users all over the world.

1.1 Content Summary

Project purpose, benefits and target group description

With the aim of controlling the spread of infection, it is very critical to keep the public, the scientific community, government leaders, and officials in the health care sector informed about the progress of the coronavirus pandemic and the vaccination coverage. To achieve this, the COVID vaccination dashboard contains interactive maps and visuals that show the progress of the US COVID vaccination program by state and give a picture of the pandemic on a national level. The rest of the dashboard contains the information on vaccination guidance and various relevant resources. It can:

- make the public realize and understand the severity of the situation and arouse people's awareness and preparedness towards covid-19
- help government leaders and officials in the health care sector to have a more intuitive impression of the spread and distribution of the epidemic, so as to make more timely and reasonable decisions
- provide the scientific community with a handy tool which is potentially beneficial to various research topics

Project objectives

USCVD is a visualization web app based on ArcGIS platform. Combined with the daily data including confirmed cases, deaths, hospitalizations, testing, and vaccinations. A gauge could reveal the vaccination rate. With more and more vaccinations, we could see the effect by the decreasing trend.

1. Data integration from github Data on COVID-19 (coronavirus) by Our World in Data
    - Automated downloading from github API, inserting the data into a Database, publishing the service through ArcGIS enterprises.
2. Web map
    - Displaying the Vaccination providers, vaccinated rate within the selected AOI
    - Displaying the vaccination sites detail as Popups in a map
    - Being able to filter the data by latest data or last seven days
    - Searching for specific events through state name

Target Group

- The public
- The scientific community
- Government leaders
- Officials in the health care sector

1.2 Frame of the project

Dates			
Time period			
Start:	20.03.2021	End	29.06.2021
Important Dates			
1	20.03.2021	Project Start	
2	20.03.2021	Project definition and design	
3	15.04.2021	Data collection and management	
4	10.05.2021	Data publishment	
5	10.06.2021	Dashboard implementation	
6	15.06.2021	Quality assurance	
7	29.06.2021	Project End	

1.3 Work Breakdown Structure

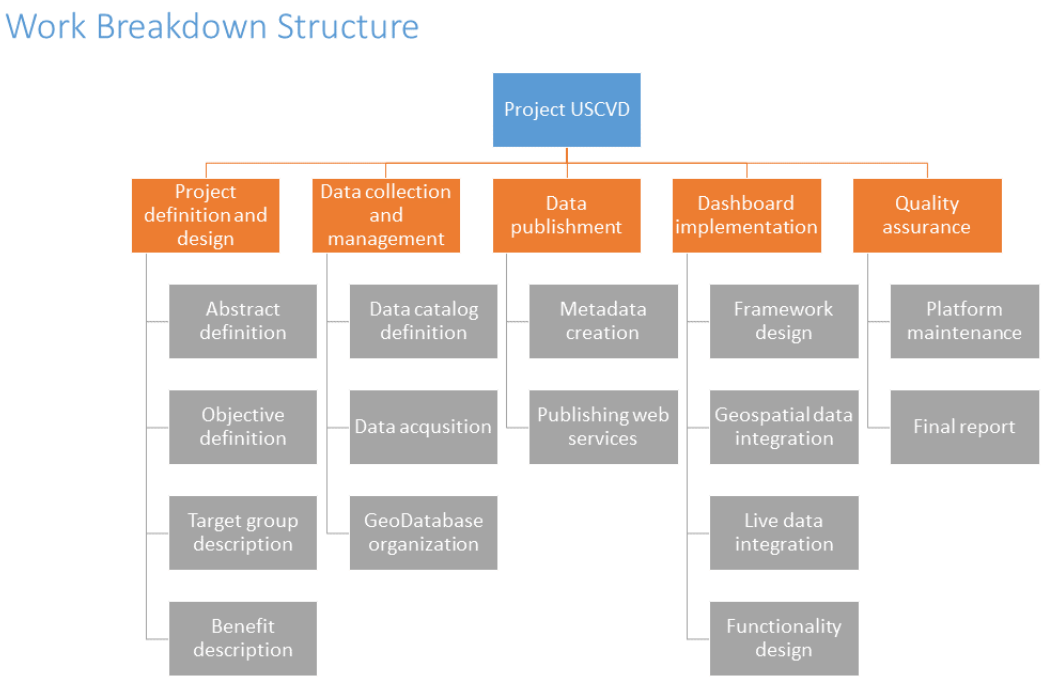


Figure 1 Work breakdown Structure

1.4 Key Milestone and Gantt Chart

Milestone	Name	Date Completion
M1	Project Start	20/3/21
M2	Project definition and design	30/3/21
M3	Data collection and management	15/4/21
M4	Data publishment	10/5/21
M5	Dashboard implementation	10/6/21
M6	Quality assurance	15/6/21
M7	Project End	29/6/21

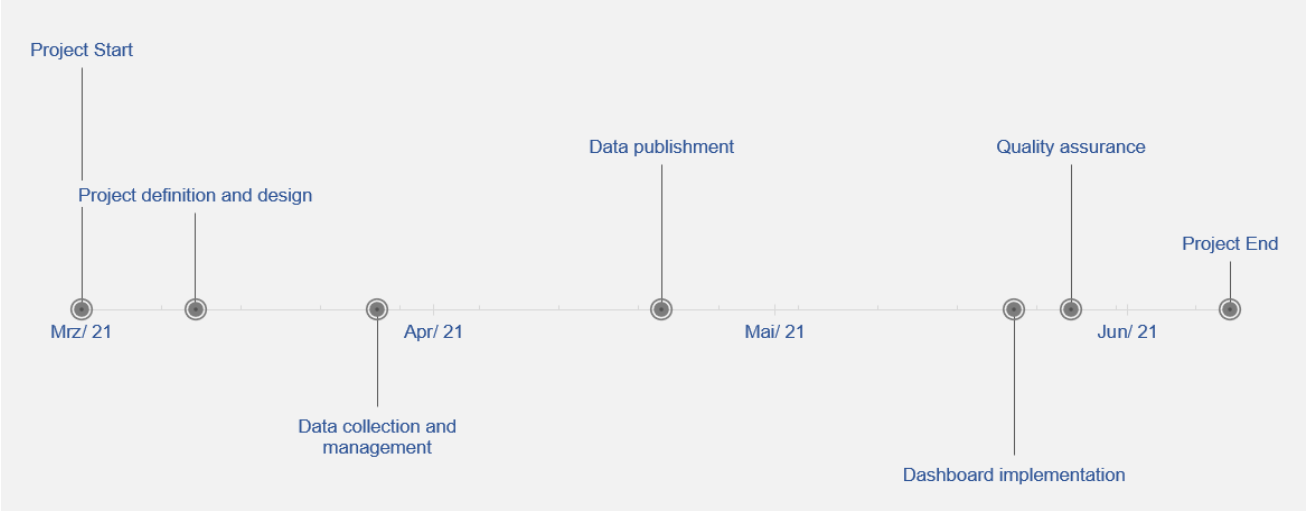


Figure 2 Milestones

Tasks	Responsible	Start	End	Days	Status
Project definition and design					
Abstract definition	Yuan W.	3/20	3/20	0	Complete
Objective definition	Nianhua L.	3/20	3/30	10	Complete
Target group description	Yuan W.	3/20	3/30	10	Complete
Benefit description	Yuan W.	3/20	3/30	10	Complete
Data collection and management					
Data catalog definition	Nianhua L.	4/1	4/4	3	Complete
Geosptial data acqusition	Yuan W.	4/4	4/10	6	Complete
Live data API collection	Nianhua L.	4/4	4/10	6	Complete
GeoDatabase organization	Nianhua L.	4/10	4/15	5	In progress
Data publishment					
Metadata creation	Yuan W.	4/15	4/25	10	Not started
Publishing web services	Nianhua L.	4/25	5/10	15	Not started
Dashboard implementation					
Framework design	Nianhua L.	5/10	5/13	3	Not started
Geospatial data integration	Yuan W.	5/13	5/22	9	Not started
Live data integration	Nianhua L.	5/13	5/28	15	Not started

Figure 3 Gantt Char

2. FINAL PROJECT IMPLEMENTATION

2.1 Geospatial Data Acquisition

Searching for the live data including daily new cases, deaths, vaccination and provider data of Covid-19 in the US.

US confirmed cases and deaths:

The data comes from the COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). The cases & deaths dataset is updated daily. Note: the number of cases or deaths reported by any institution—including JHU, the WHO, the ECDC and others—on a given day does not necessarily represent the actual number on that date. This is because of the long reporting chain that exists between a new case/death and its inclusion in statistics. This also means that negative values in cases and deaths can sometimes appear when a country corrects historical data, because it had previously overestimated the number of cases/deaths. Alternatively, large changes can sometimes (although rarely) be made to a country's entire time series if JHU decides (and has access to the necessary data) to correct values retrospectively.

Hospital locations in the US:

This feature class/ shapefile contains Hospitals derived from various sources (refer SOURCE field) for the Homeland Infrastructure Foundation-Level Data (HIFLD) database.

This feature class/ shapefile contains locations of Hospitals for 50 US states, Washington D.C., US territories of Puerto Rico, Guam, American Samoa, Northern Mariana Islands, Palau, and Virgin Islands. The dataset only includes hospital facilities based on data acquired from various state departments or federal sources, which has been referenced in the SOURCE field. Hospital facilities which do not occur in these sources will be not present in the database. The source data was available in a variety of formats (pdfs, tables, webpages, etc.) which was cleaned and geocoded and then converted into a spatial database. The database does not contain nursing homes or health centers. Hospitals have been categorized into children, chronic disease, critical access, general acute care, long term care, military, psychiatric, rehabilitation, special, and women based on the range of the available values from the various sources after removing similarities. In this update 123 additional hospitals were added and 26 additional helipads were identified.

Covid-19 Vaccination Provider Locations in the United States:

This dataset is updated daily. All information is sourced from public information shared by health departments, local governments, and healthcare providers. This view layer includes COVID-19 vaccine provider locations sourced by GISCorps volunteers from the providers themselves or from government entities, either via their websites, official communications, or Survey123 form submissions from providers. This feature layer view contains information about locations where government agencies and healthcare providers are directing members of the public to access COVID-19 vaccination. It only includes locations that have been publicly shared by agencies or providers. Some providers may have been authorized as vaccine points of distribution but have not yet received vaccine doses. In other cases, some providers may have received doses but do

not have current vaccine availability. For sites that offer both COVID-19 testing and vaccination, the start date likely refers to the date they started offering COVID-19 testing. Creation dates do not reflect the date a provider began vaccinating.

2.2 Live Data API Collection and Integration

Search and collect the open API live data from Github and CDC. Refine, standardized the data in Node-Red and insert in Postgresql. Node-RED is a flow-based development tool for visual programming. Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions.

Figure 4 Node-Red

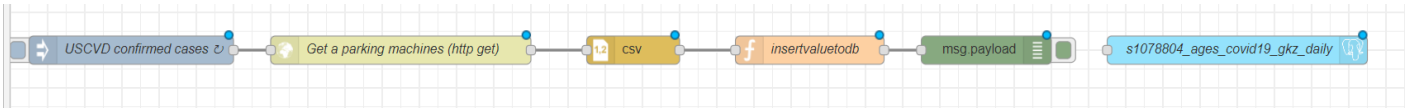


Figure 5 Node-Red data working flow

Cumulative Cases and Deaths CSV API

United States COVID-19 Cases and Deaths by State over Time API

US state-level vaccination data API

Coding examples: Insert the value to PostGIS database

```
var district = msg.payload.Bezirk;
var district_id = msg.payload.GKZ;
var population = msg.payload.AnzEinwohner;
var covid19_count = msg.payload.Anzahl;
var covid19_death = msg.payload.AnzahlTot;
var covid19_7d_count = msg.payload.AnzahlFaelle7Tage;
var phenomenon_date = new Date().toISOString().split(".")[0] + new
Date().toISOString().split(".")[1].slice(-1);
var insertStatement = "";
var deleteStatement = "";
var updateMviewStatement = "";
insertStatement += "INSERT INTO s1078806.s1078806_ages_covid19_gkz_daily (district,
district_id,population, covid_19_count, covid_19_death, covid_19_7d_cases, date) VALUES ('" +district +
"'," + district_id + "," + population + "," + covid19_count + "," + covid19_death+ "," + covid19_7d_count + ",'"
+ phenomenon_date + "');";

msg.payload = insertStatement;

return msg;
```

2.3 GeoDatabase Organization

Organize Geospatial data in PostGIS. Manage and transit the data from Table to Views.

Figure 6 PostGIS

Created and operate the SQL command file for the table of the daily-confirmed cases by states, table of the daily vaccinations by state, the view of the confirmed cases for the latest date and the last 7 days, the views of the vaccinations for the latest date and the last 7 days.

Coding examples: Input the data in PostGIS with different data form

```
CREATE TABLE s1078804_covid19_USCVD_daily
(
id SERIAL,
phenomenon_date date,
state_US character varying(50) COLLATE pg_catalog."default",
fips integer,
cases integer,
deaths integer
);
```

2.4 Publishing Web Services

In the logical tier, connect and register the data in ArcGIS pro. Publish the Web Feature Service to ArcGIS server.

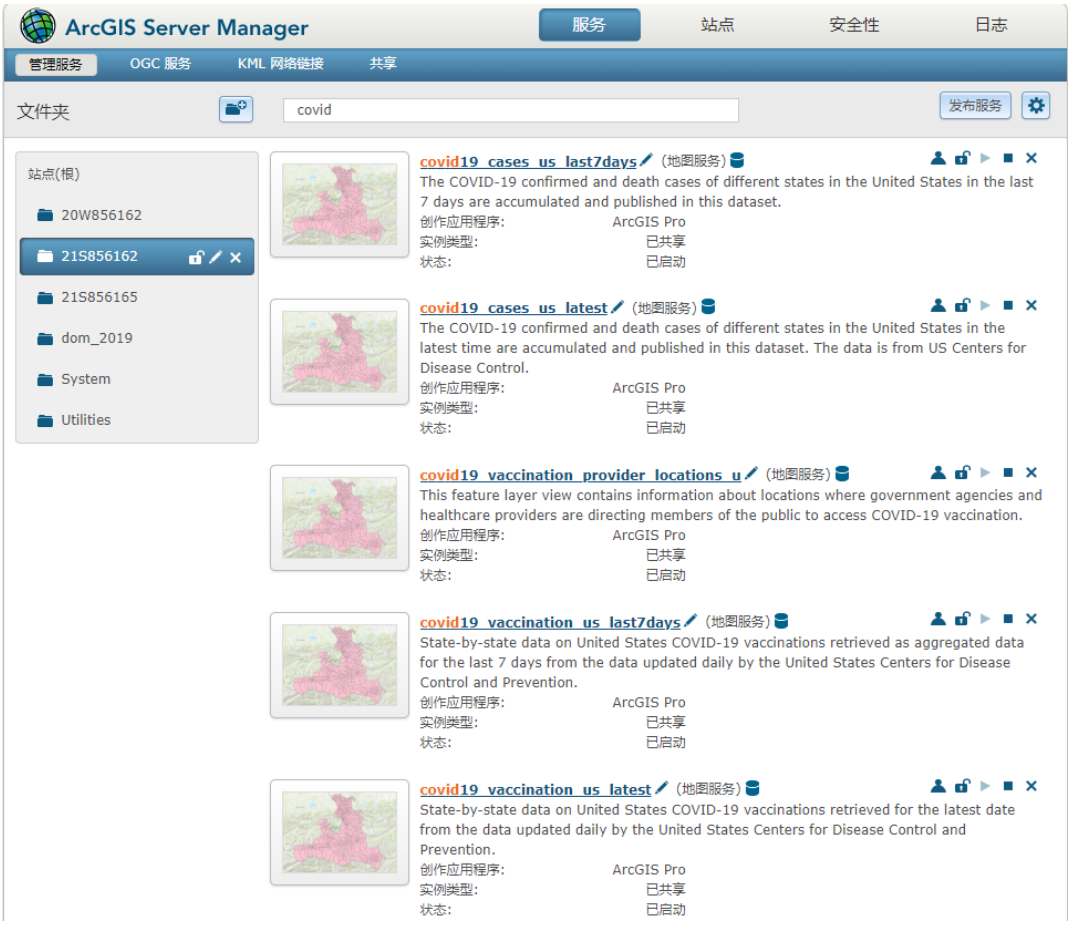


Figure 7 ArcGIS Server Manager page after publishment

2.5 Metadata Edit

Editing metadata in Open Source Geonetwork 4.

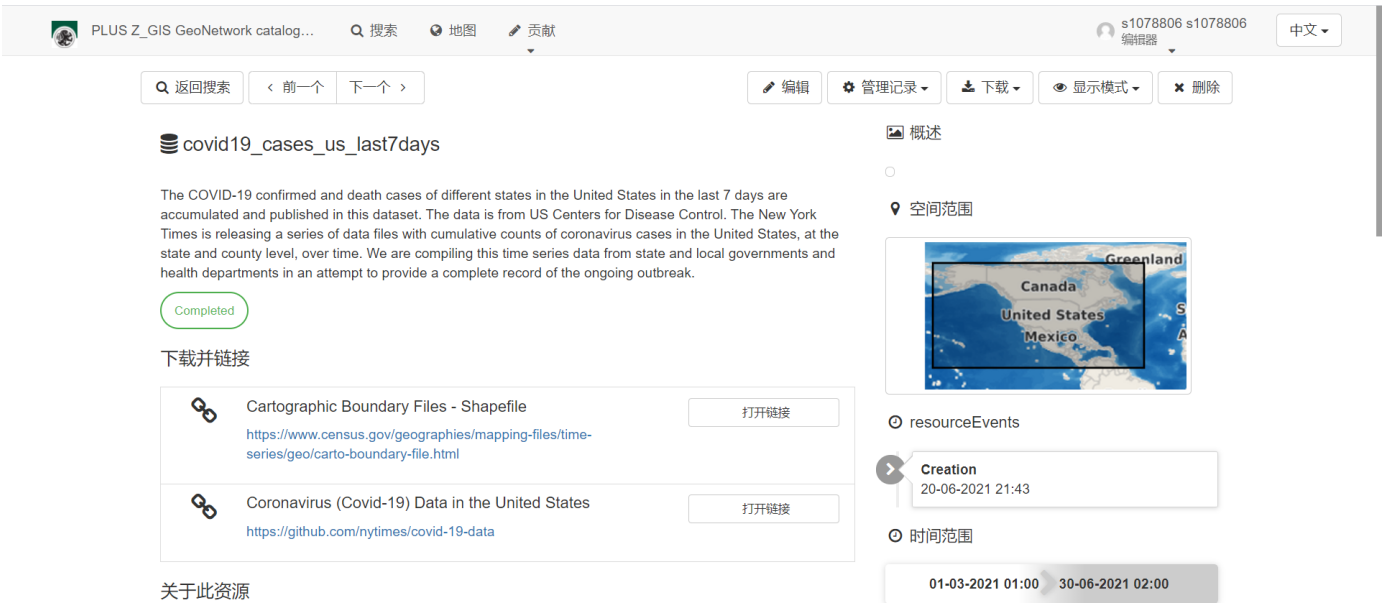


Figure 8 Example results of editing metadata

2.6 Web Map Creation

In presentation tier, Embed created feature class in a web map using Z_GIS ArcGIS Enterprise Portal.

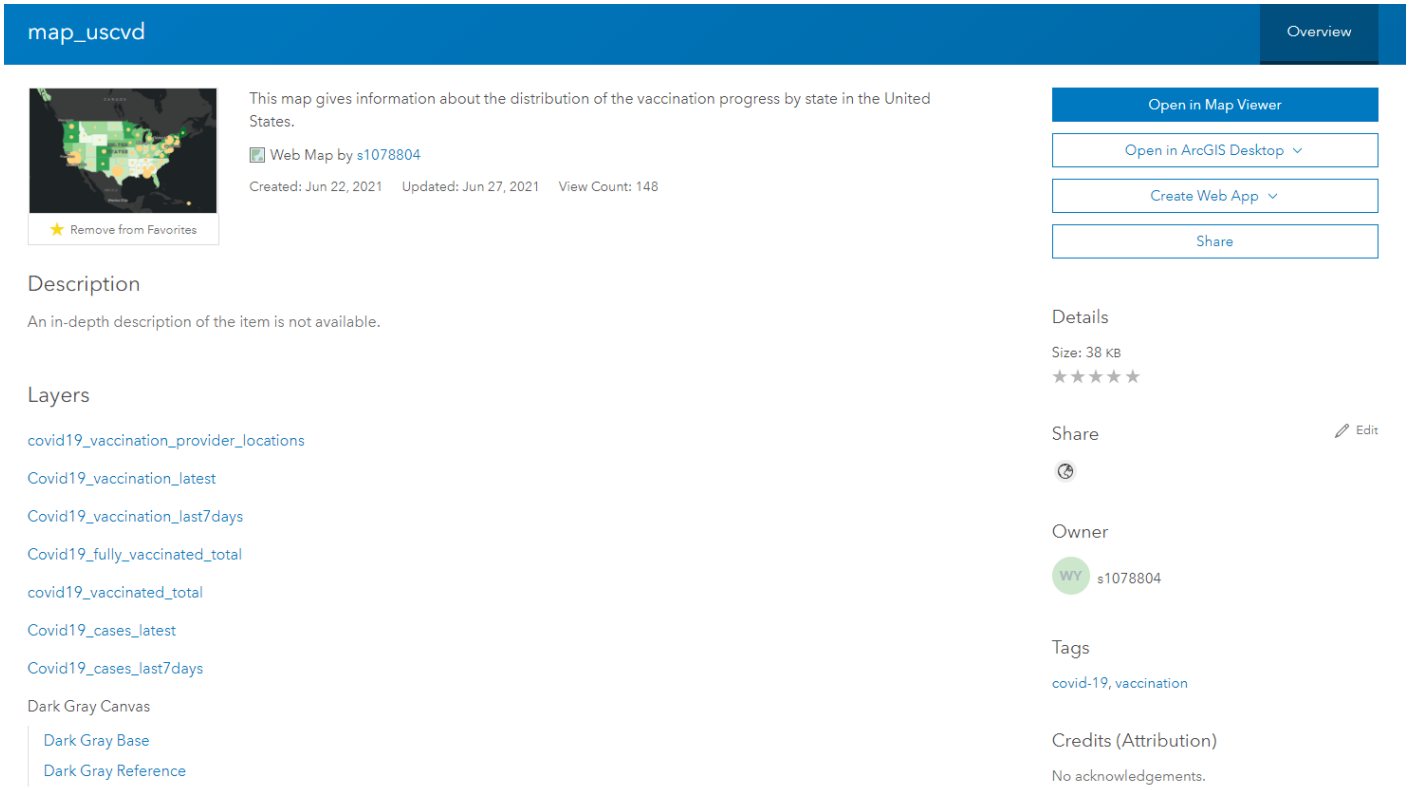


Figure 9 USCVD Web map basic information

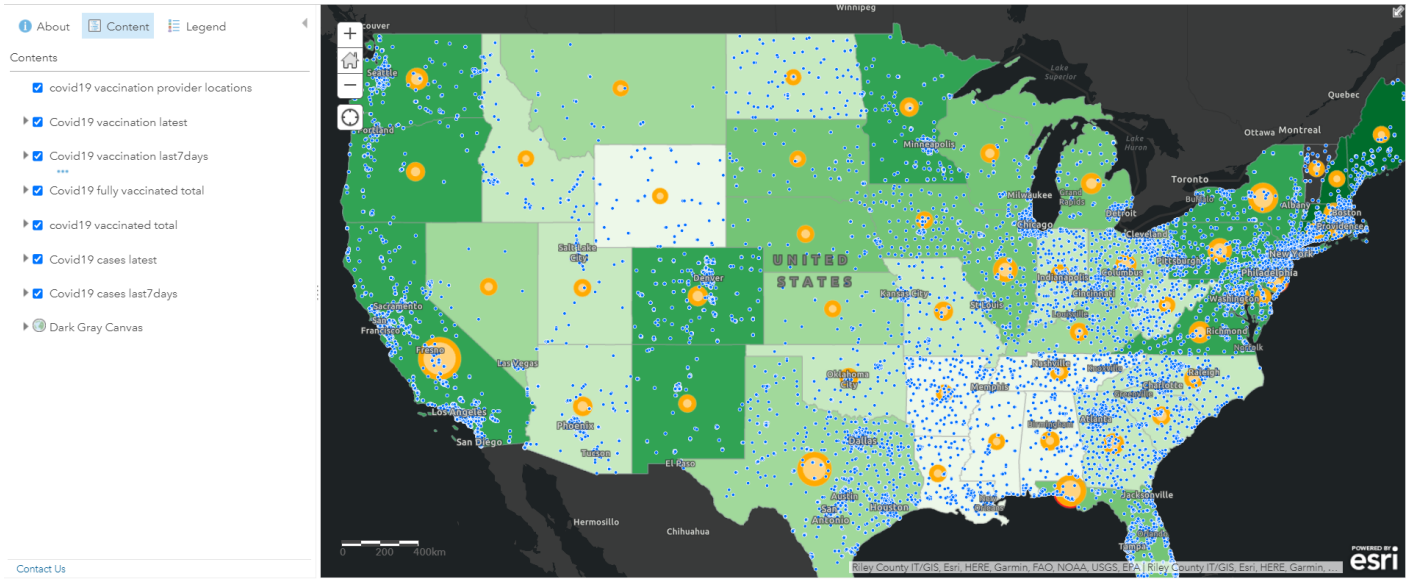


Figure 10 USCVD Web map overview

2.7 ArcGIS Dashboards Creation

Creating USCVD web app using ArcGIS Dashboard Geoportal.

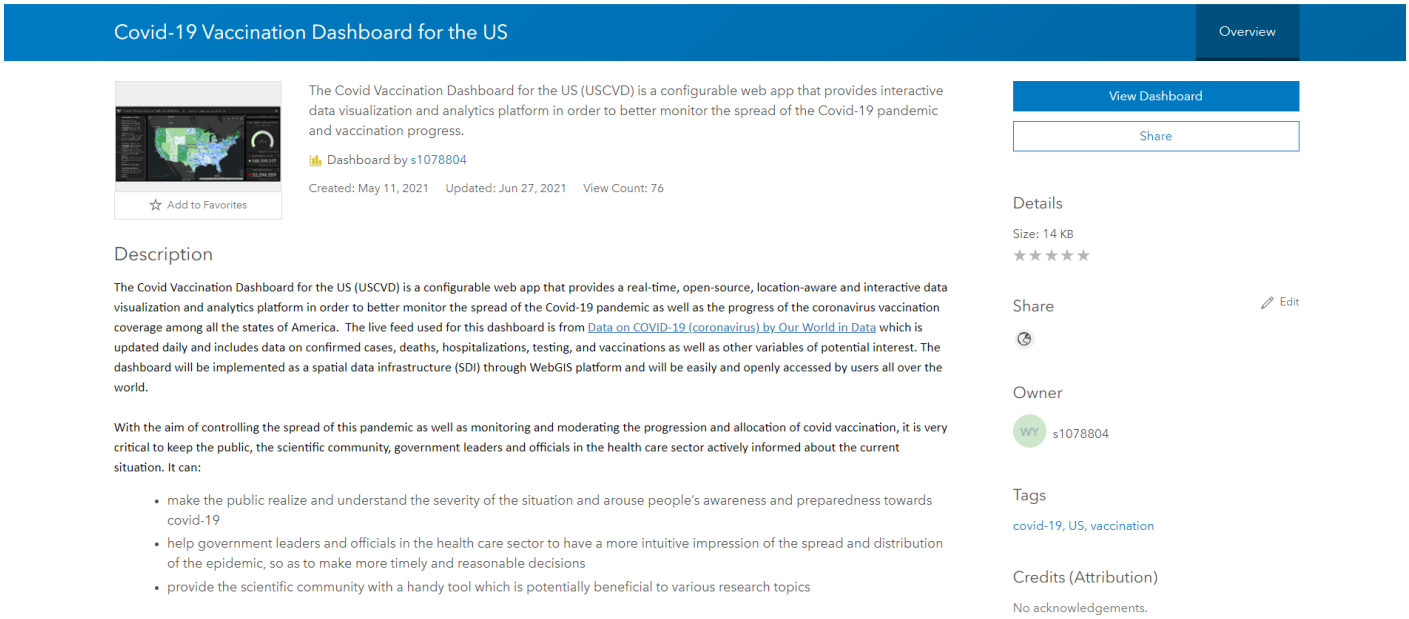
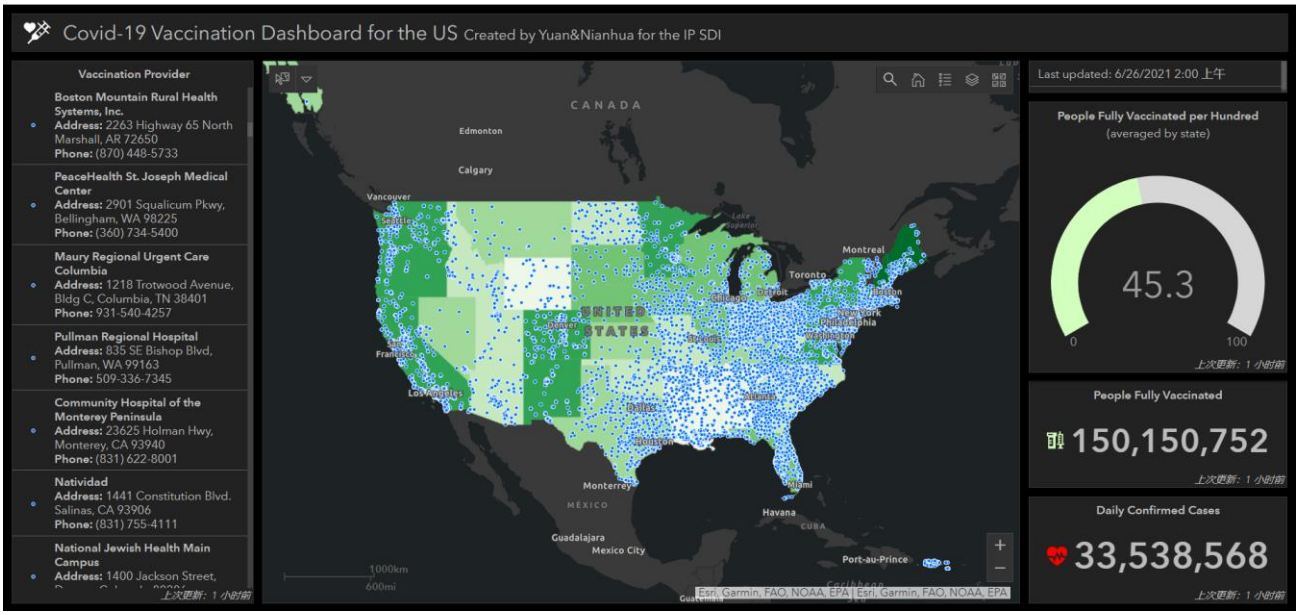


Figure 11 USCVD Dashboard basic information

Structure



Dashboard overview

The whole Dashboard contains into five main parts and other small tools:

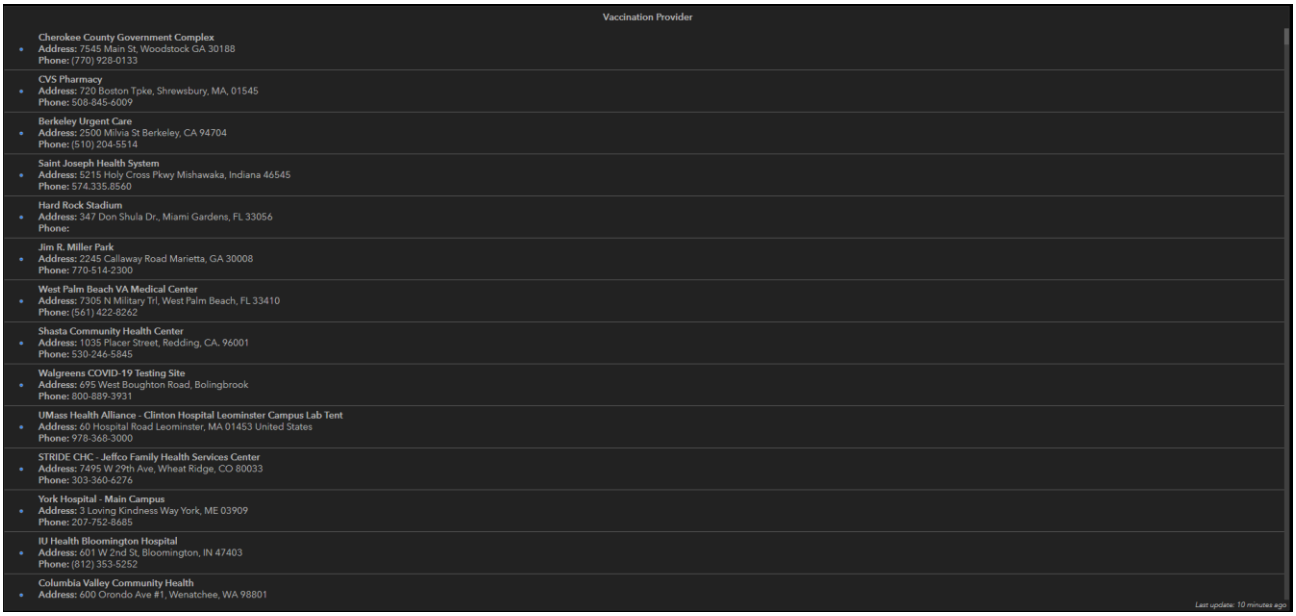
1. Title and creators
2. Vaccination Provider information panel
3. Main Map extent
4. Vaccinated rate gauge

5. Vaccinated and Confirmed cases panel

Other small tools:

1. Time bar
2. AOI selection tool
3. Zoom in/out tool
4. Searching tool
5. Menu tool
6. Legend tool
7. Layer tool
8. BaseMaps tool

Vaccination Provider information panel



Vaccination Provider list

From the Vaccination Provider list panel, three key information is listed here, including name of the Vaccination Provider, address and Phone number.

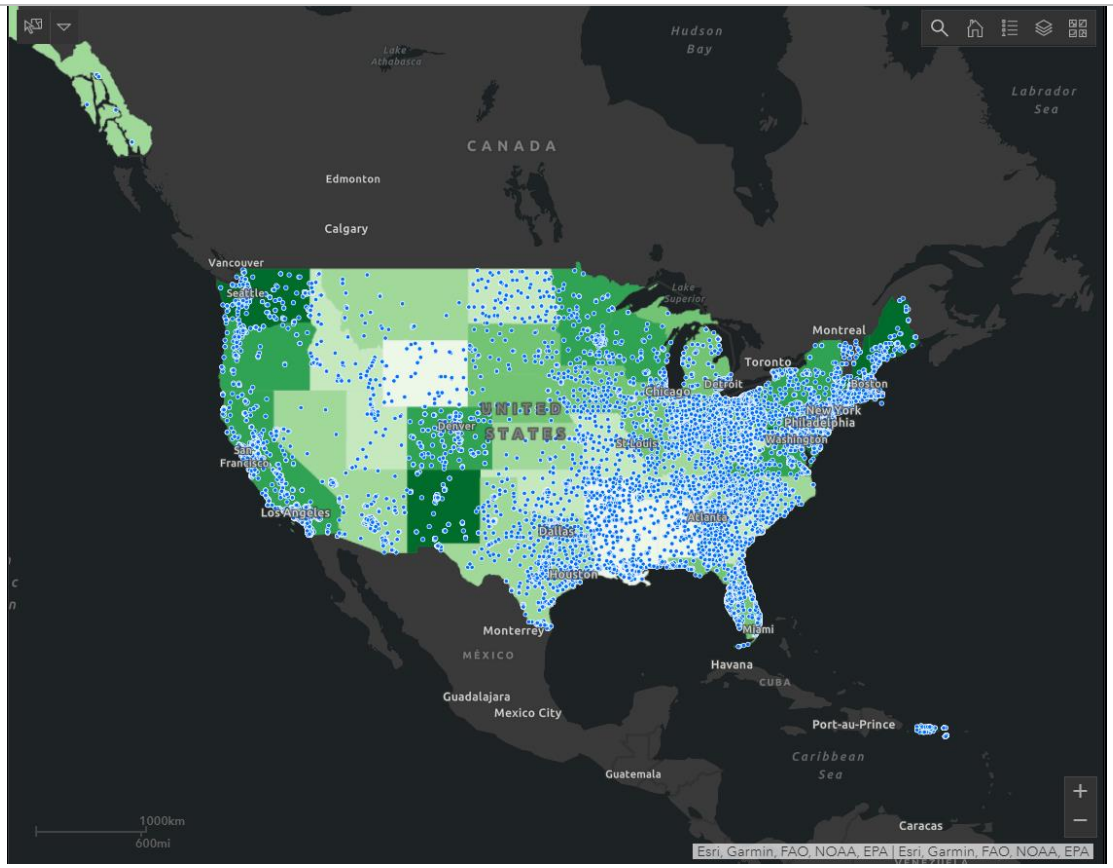
If the user zoom in or zoom out the map, the list will be changed according to the scale of the map.

If the user clip one of the vaccination provider, the map will zoom in to this service provider automatically and the detail information will pop-up in the map as follows:

Vaccination Provider detail information pop-up

The detail information includes: name of Covid-19 Vaccination Provider, Address, Municipality, Agency, Agency Type, Phone, Agency URL, Open Hours, Comments, Instructions, Vehicle Capacity, Daily Testing or Vaccination Capacity, Status, Drive-through, Appointment Required, Referral Required, COVID-19 Testing Services Offered, Call first, Virtual Screening, Local Health Department URL, State, Data Source, County, Start Date, End Date, Type of Test, Vehicle Required, Facility Type, Offering same-day diagnostic (not antibody) results, Offering Take-Home Tests, Wheelchair, Accessibility Support, Vaccination URL, Minimum Age - Vaccination

Main Map extent

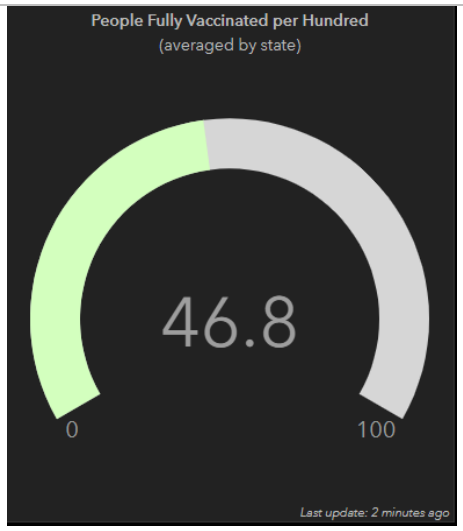


Main Map extent

The main map reveals the options being selected, according to the user selected AOI. Users could zoom in and zoom out to change the map scale. Other information will change with the map scale. The main map contains six small tools:

1. Zoom in/out tool
2. Searching tool
3. Menu tool
4. Legend tool
5. Layer tool
6. BaseMaps tool

Vaccinated rate gauge



People Fully Vaccinated per Hundred (averaged by state)

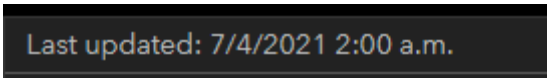
This gauge is a direct visualization tool for users to know about the Vaccinated rate. The gauge will renew according to the Map scale and the user selected Area of Interest.

Vaccinated and Confirmed cases panel

People Fully Vaccinated and Daily Confirmed Cases

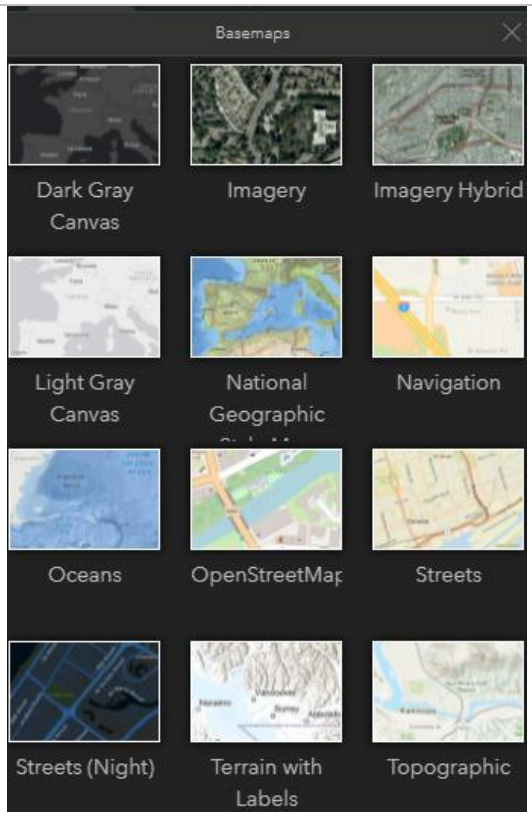
The total number of the people who is being vaccinated and the total confirmed cases are shown in this panel, which will also change according to the Map scale and the user selected Area of Interest.

Other tools



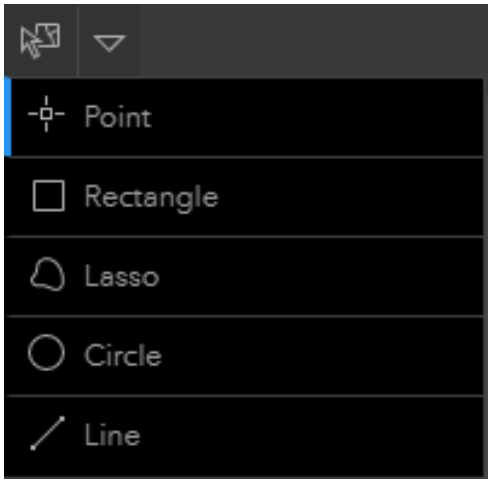
Last Updated Time Bar

Every time when users enter the dashboard, the latest updated time of the dashboard will be shown in the time bar in the format: Day/Month/Year Time



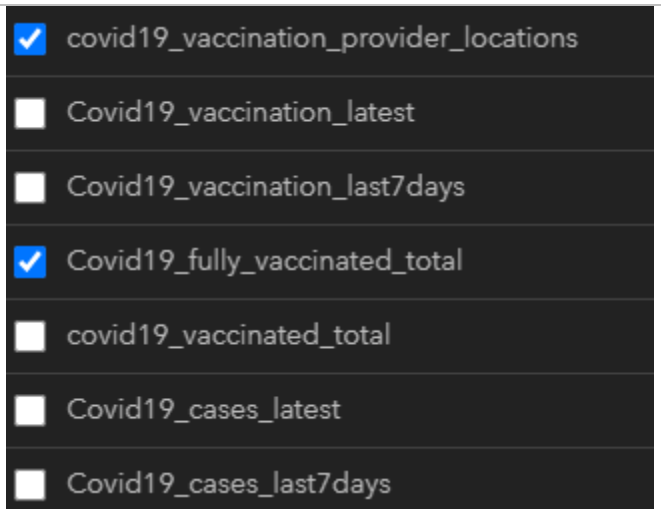
Basemaps selection

The default Basemap is Dark Gray Canvas. Users could change the Basemap according to their personal interest.



AOI selection tool

Users could select the Area of Interest by Point, Rectangle, Lasso, Circle, and Line selection tool. The Vaccination Provider, Vaccinated rate gauge, Vaccinated and Confirmed cases panel will be renewed according to the user selected AOI.



Layers

There are seven layers in this dashboard, which could fulfill different need from the users. However, it's suggested that don't open all the layers at the same time. Otherwise, the dashboard will be crashed down easily.

3. PROJECT RESOURCES

Gitlab:

Repository

Issues

ArcGIS Server Manager:

Service Folder

ISO 19139 compliant metadata files:

covid19_cases_us_last7days

covid19_cases_us_latest

covid19_vaccination_provider_locations_us

covid19_vaccination_us_last7days

covid19_vaccination_us_latest

SQL command file:

create_table_confirmed_cases.sql

create_table_vaccination.sql

create_view_cases_latest.sql

create_view_cases_last7days.sql

create_view_vaccination_latest.sql

create_view_vaccination_last7days.sql

WFS URL:

covid19_cases_us_last7days

covid19_cases_us_latest

covid19_vaccination_provider_locations_us

covid19_vaccination_us_last7days

covid19_vaccination_us_latest

USCVD Geoportal:

Web map

Dashboard