



Populations with Limited Access to Mental Health Care

Analysis of health professional shortage areas in the United States

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Background

Millions of American have a mental health condition and seek professional help every year. For some communities in the U.S., access to mental health care is not always available. Although people in vulnerable situations are more likely to struggle with a mental health condition, they experience more barriers to receive the medical help they need.



Background

The Health Resources and Services Administration (HRSA) is an agency dedicated to address the gap of access to medical services for underserved populations.

This agency identifies geographic areas, populations, and facilities that have a shortage of healthcare personnel in the areas of primary care, dentistry, and mental health. These are referenced as **HPSA**, Health Professional Shortage Areas and they are eligible to receive federal assistance.



Understanding the Current Situation

Problem

Adults living in vulnerable conditions are almost three times more likely to have a psychiatric disorder.

This year younger adults, racial/ethnic minorities, essential workers, and unpaid adult caregivers reported having experienced worse mental health outcomes, increased substance use, and elevated suicidal ideation.

Impact

Untreated mental health conditions can lead to disease, isolation, withdrawal from activities, job loss, and substance abuse.

The National Alliance on Mental Health estimates that untreated mental illness costs the country up to \$300 billion every year due to losses in productivity.

Objective

The goal of this project is to explore the data available for HPSAs* and identify trends and key factors that can be useful for future programs and policies to address the need of the population.

*HPSA, Health Professional Shortage Areas

Data Analysis

Data Analysis Steps

Data Collection

- HPSAs from 1973 to 2020 for the US and territories. Source: Health Resources and Administration.
- Total Covid cases from Jan 19 to Dec 01, 2020. Source: USA Facts website.
- Data for total populations in the US. Source: US Census Bureau

Data Cleaning

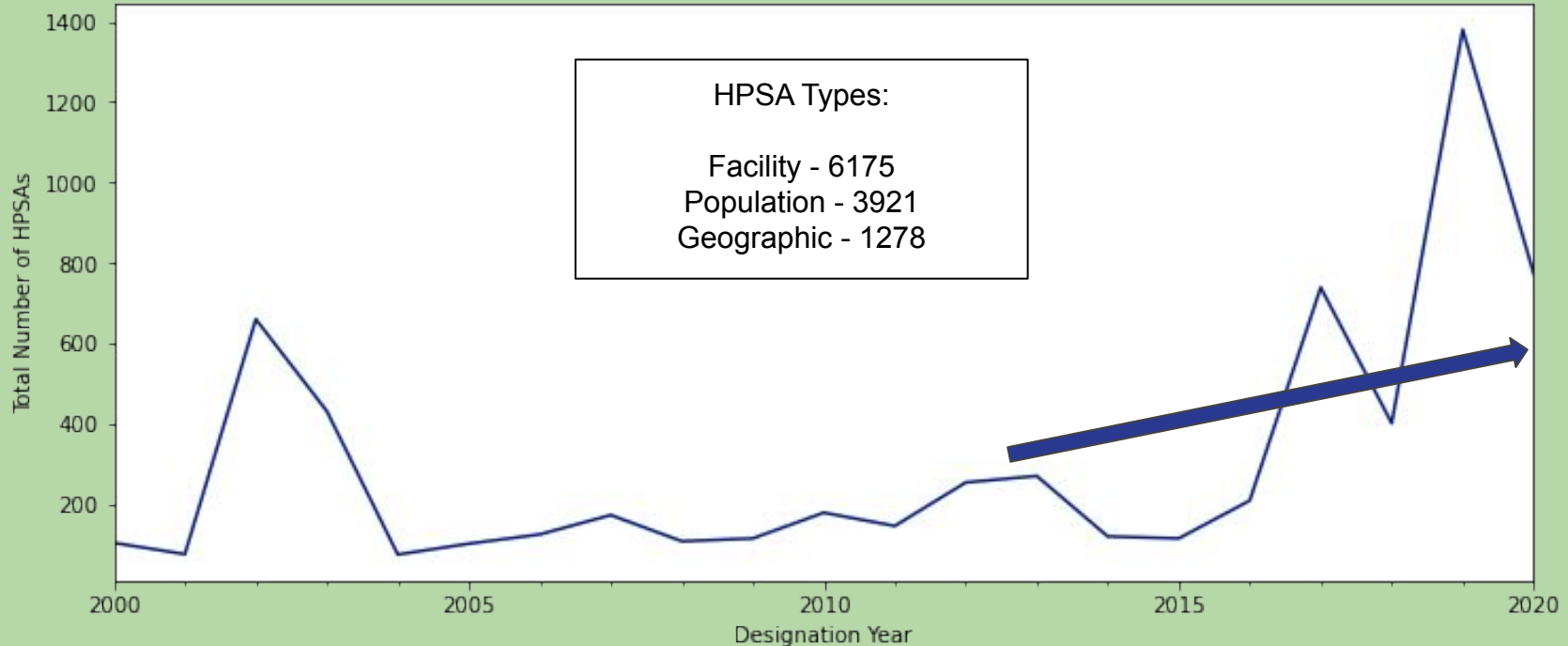
- Removed columns in dataset without significant information. Addressed null values.
- Data scope 1978-2020
- Combined HPSA data for multiple census tracts.
- For covid data, broke down data by county. Calculated new covid cases by county and day.

Exploratory Analysis

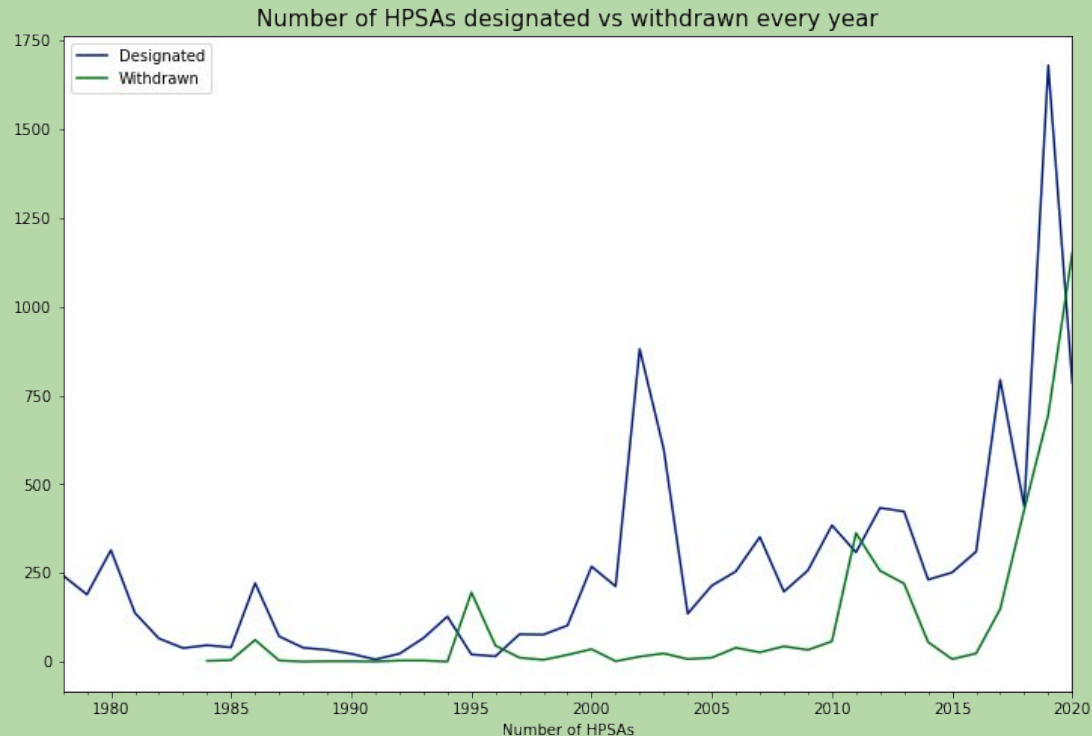
- Used Python libraries for visualizations.
- Identified trends in states and counties.
- Trends over time.
- Impact due to Covid-19
- Trends by type of shortage area

Findings : Number of HPSAs over time

Number of HPSAs designated every year



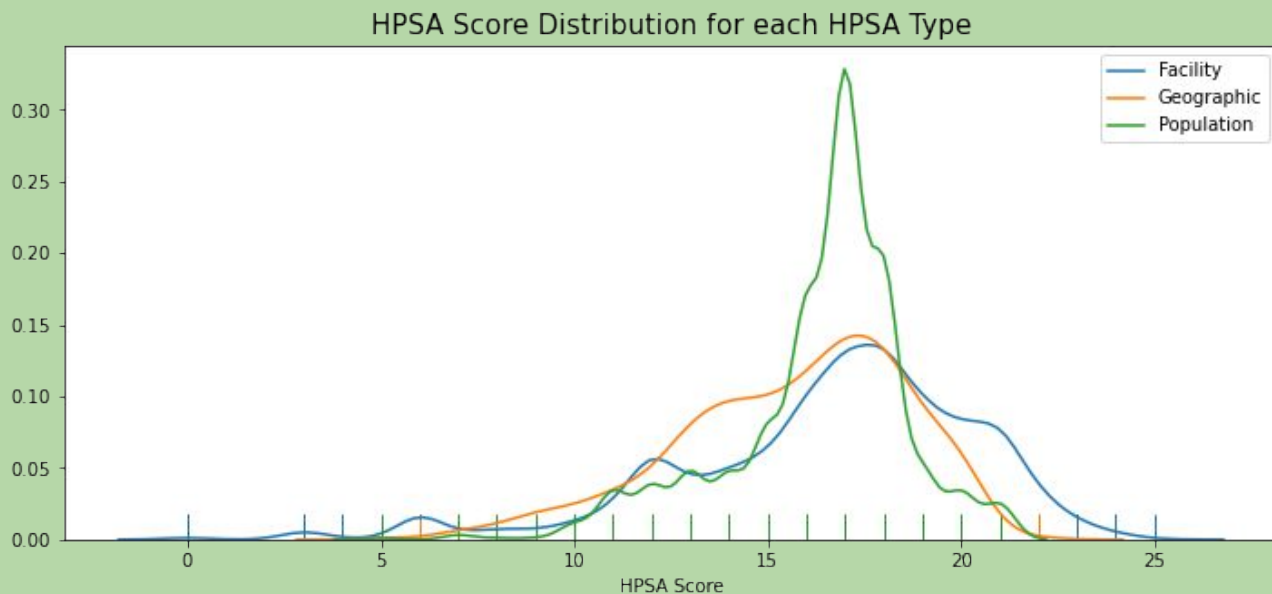
Findings : Designations vs. Withdrawals over time



The number of areas withdrawn from the HPSA list is lower than the number of designations for almost every year.

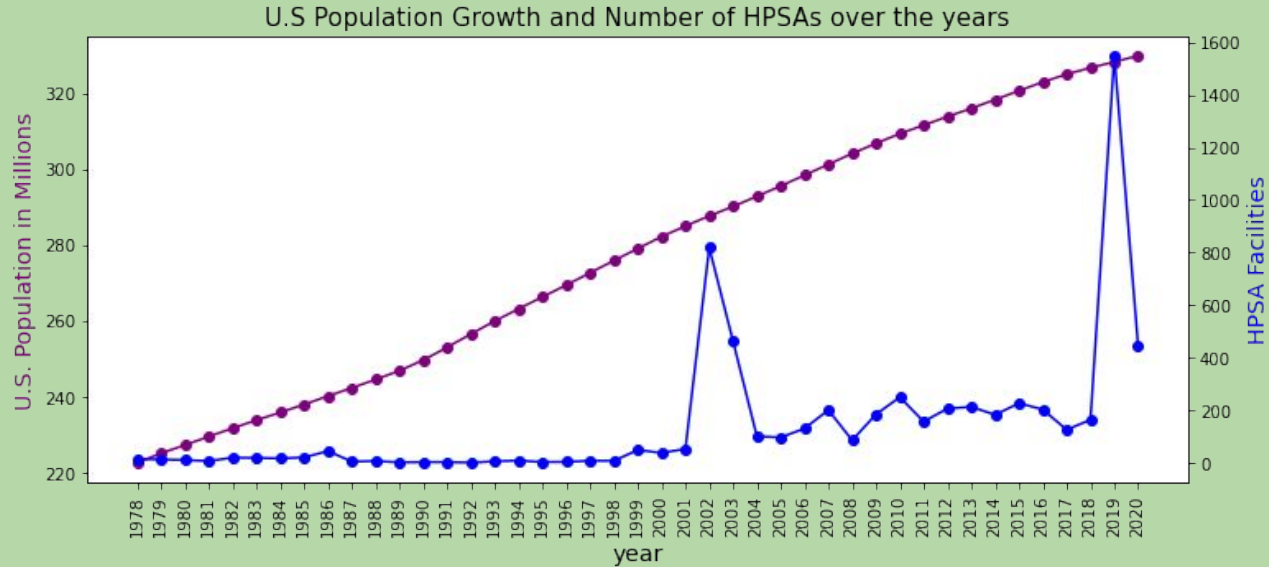
Findings: Degree of Shortage by HPSA category

The Health Professional Shortage Area (HPSA) Score is assigned to determine priorities for assignment of clinicians. The scores range from 0 to 26 where the higher the score, the greater the priority.



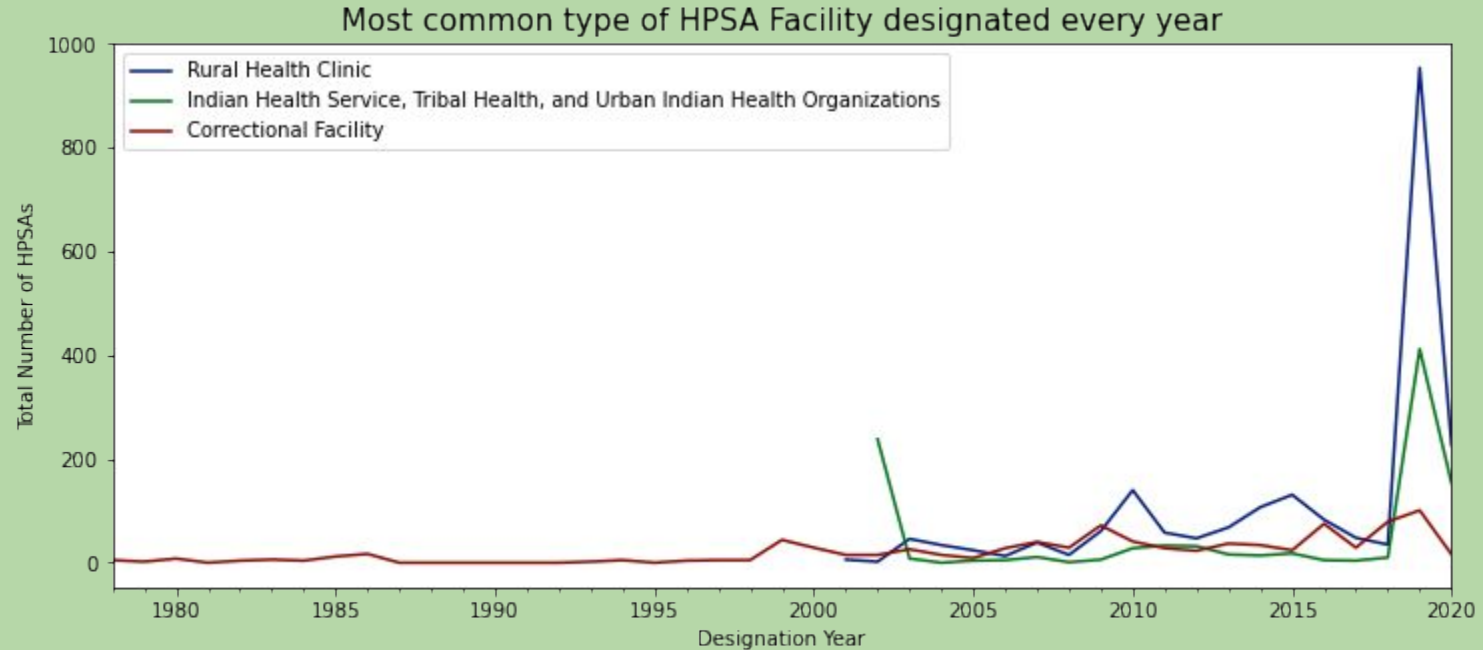
All HPSA types have approximately the same mean ~ 17. More variation in scores for Facility and Geographic types.

Findings: Trends of HPSA Facility Designations over Time



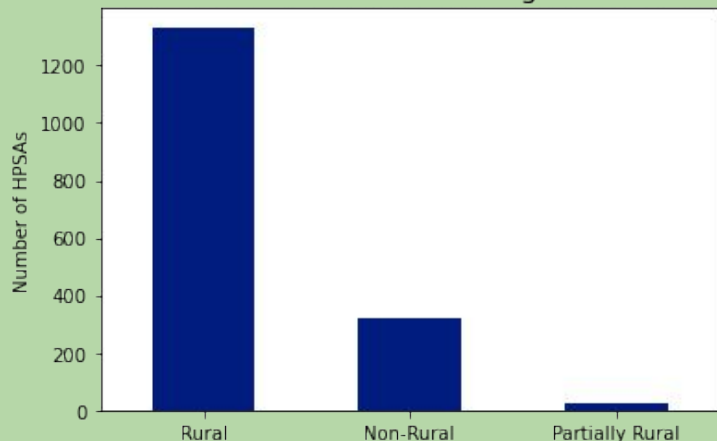
What does this look like geographically: [Facility HPSAs over time](#)

Findings : Type of HPSA facility over time

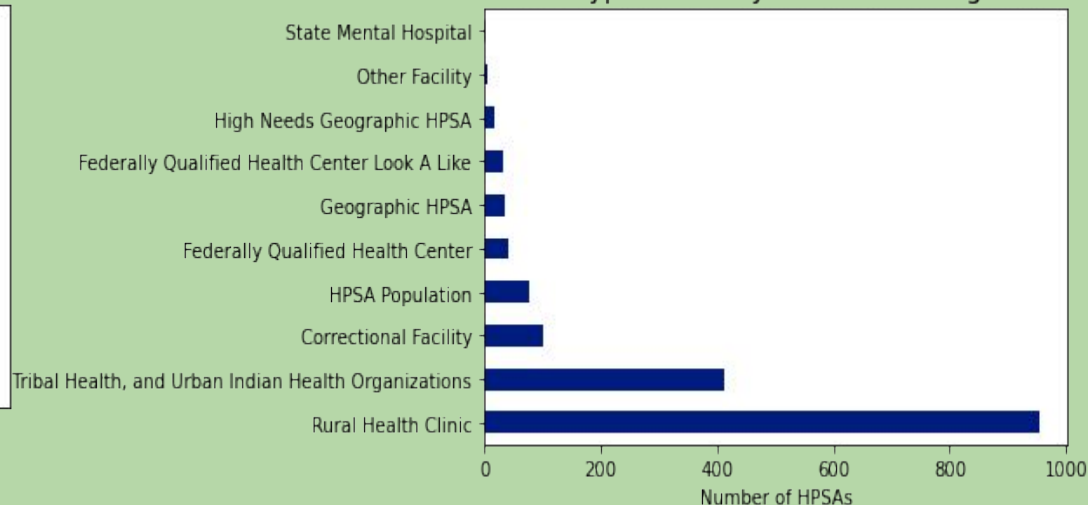


Findings for 2019

Rural status for the HPSAs designated in 2019

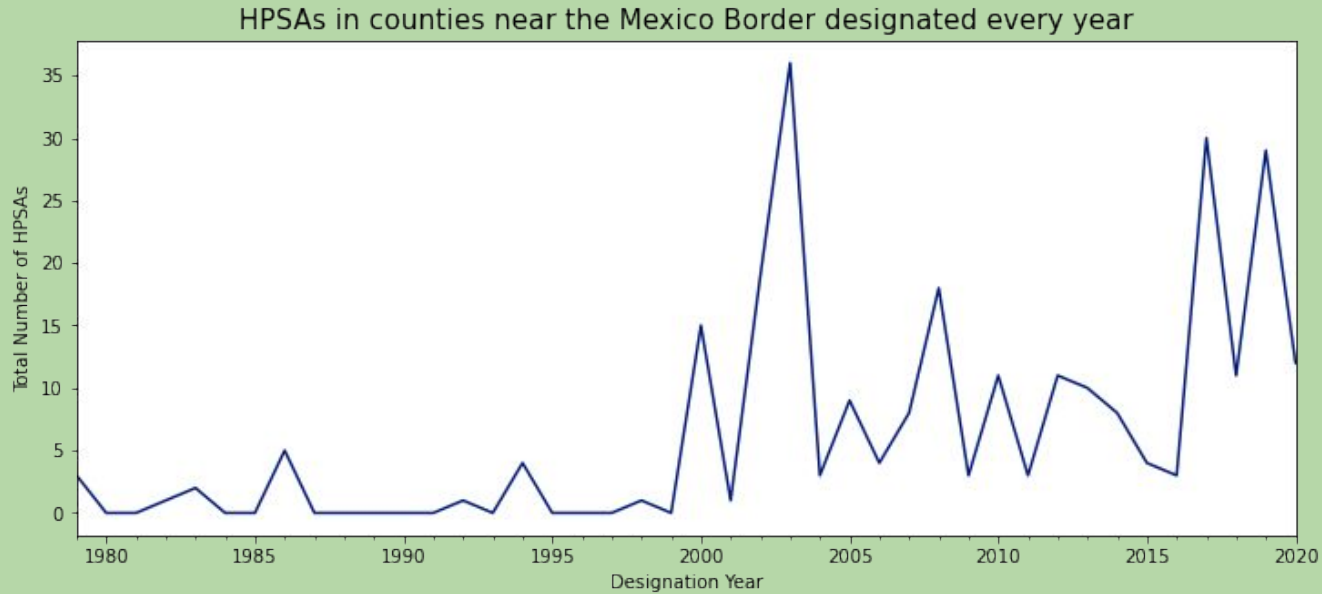


Most common type of facility for HPSAs designated in 2019



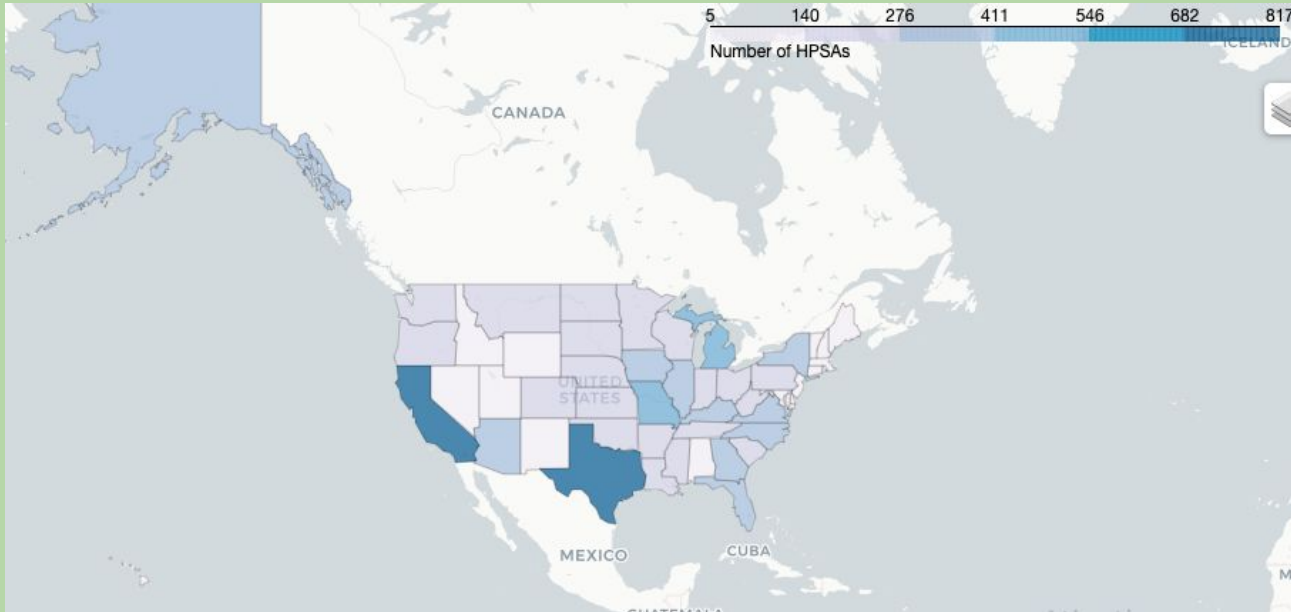
Mental health disorders are similar between rural and urban residents, however, access to mental health care is significantly less in rural areas.

Findings: HPSAs in counties near the Mexico border



The number of HPSAs in counties near the Mexico border is relatively small but it has been increasing with two spikes in the last 4 years

Findings: What states have more HPSAs?

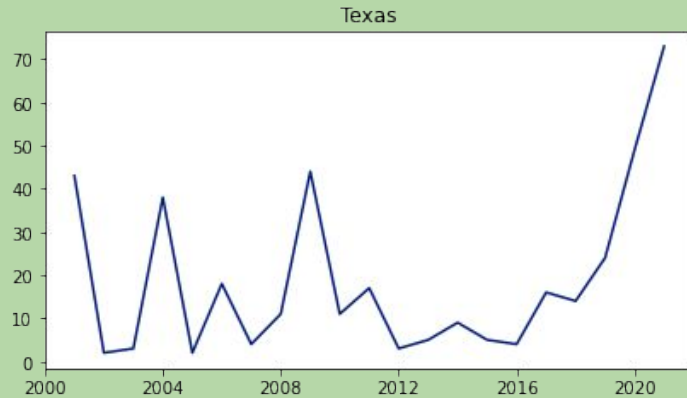


States with the most number of shortage areas:

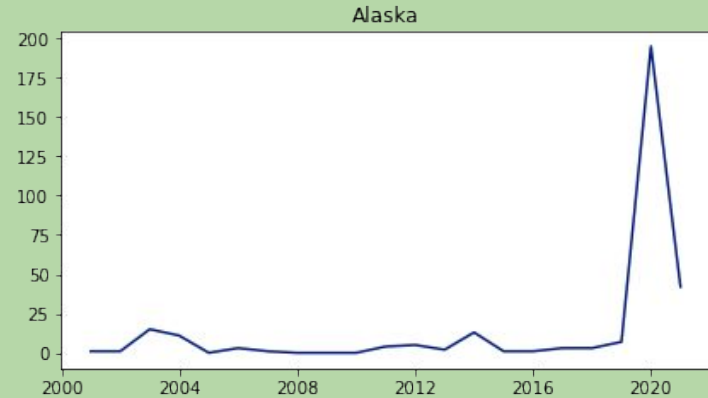
- California,
- Texas
- Alaska
- Missouri
- Michigan

Findings: Trends in States

Number of HPSAs in Each State

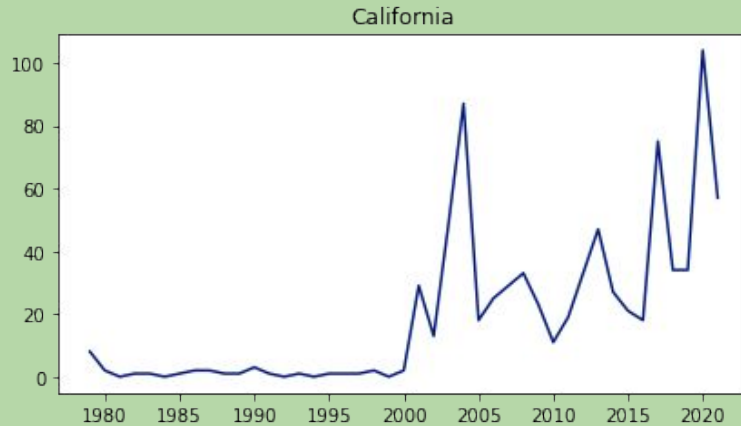


Texas:
The number of HPSA has been increasing for the last years

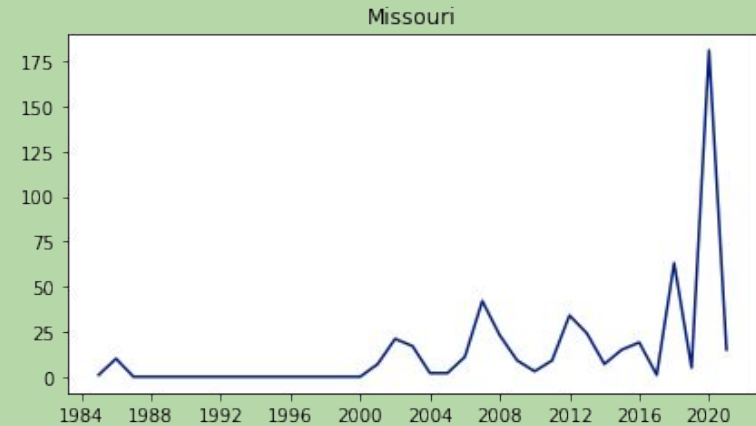


Alaska:
In 2019, 195 Indian Health Service, Tribal Health, and Urban Indian Health Organizations were designed as HPSA

Findings: Trends in States

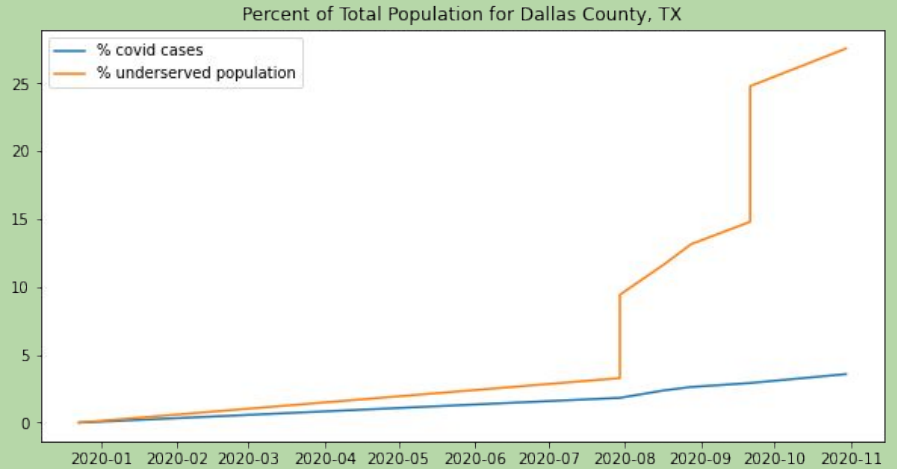
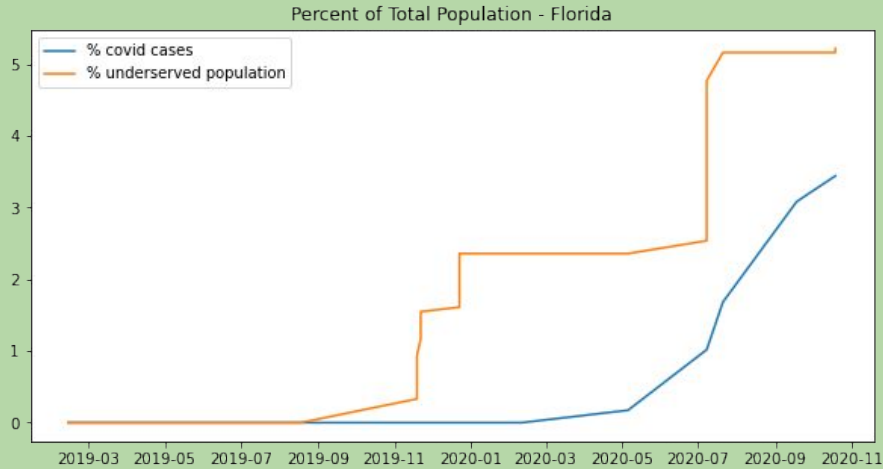


California:
The number of HPSA has been
increasing for the last years



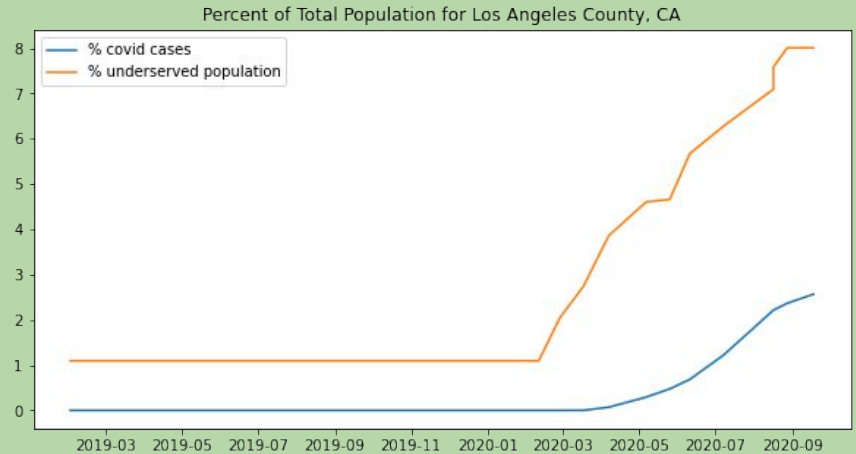
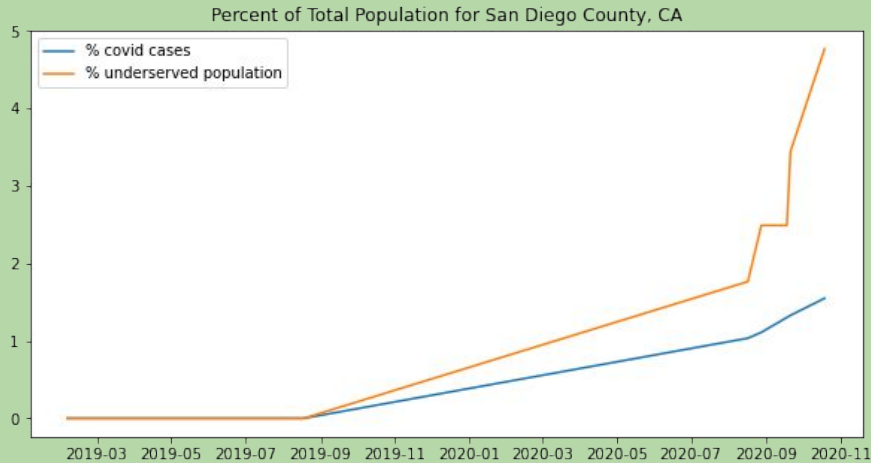
Missouri:
In 2019, 176 Rural Health Clinics
were designated as HPSAs

Findings: Impact due to Covid



Increases in the number of designated underserved populations increased this year in areas severely hit by the pandemic.

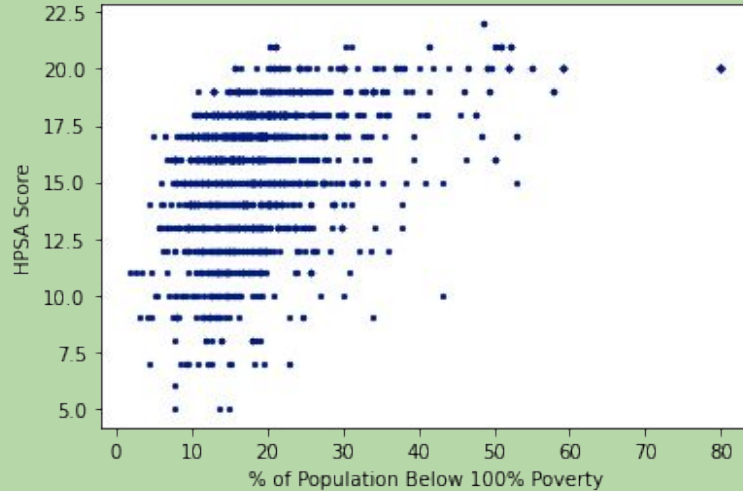
Findings: Impact due to Covid



Increases in the number of designated underserved populations increased this year in areas severely hit by the pandemic.

Findings: Key Factors

Positive Correlation for Poverty levels and Shortage Areas



People living below the poverty level were nearly 2.5 times more likely to have depression than those at or above the poverty level.



Modeling

Binary Classification Model to predict which HPSAs are withdrawn from the designated list

Modeling Steps and Results

- Target: Predict if an HPSA remains Designated or it is Withdrawn
- Baseline is 65% - the majority class(Designated)
- Used the data collected and cleaned to build and train multiple models in Python.
- Logistic Regression, Adaboost, and Random Forest classification models were built and optimized using GridSearch to find the best hyperparameters.
- Five models were built for each type of model, and the test data performance and variability was evaluated using cross-validation.
- Confusion matrices were calculated for each model and the metrics compared.

Classifier Model Evaluation

Model	Accuracy	Sensitivity	Specificity	Precision
Logistic Regression	0.79	0.53	0.92	0.76
Adaboost Model	.80	.50	0.94	0.80
Random Forest	0.83	0.72	0.89	0.76

The Random Forest classification model was selected. This model had 83% accuracy to predict if an HPSA would be withdrawn from its designation or not.

Interpreting the coefficients from the Logistic Regression Model

Machine learning features:

```
Index(['HPSA Score', 'State Population',  
      'Designation Type Federally Qualified Health Center',  
      'Designation Type Federally Qualified Health Center Look A Like',  
      'Designation Type Geographic HPSA', 'Designation Type HPSA Population',  
      'Designation Type High Needs Geographic HPSA',  
      'Designation Type Indian Health Service, Tribal Health, and Urban Indian Health Organizations',  
      'Designation Type Indian, Tribal and Urban Indian Organizations',  
      'Designation Type Other Facility',  
      'Designation Type Rural Health Clinic',  
      'Designation Type State Mental Hospital', 'HPSA Status Withdrawn',  
      'State Name Alaska', 'State Name Arizona', 'State Name Arkansas',  
      'State Name California', 'State Name Colorado',  
      'State Name Connecticut', 'State Name Delaware',  
      'State Name District of Columbia', 'State Name Florida',  
      'State Name Georgia', 'State Name Hawaii', 'State Name Idaho',  
      'State Name Illinois', 'State Name Indiana', 'State Name Iowa',  
      'State Name Kansas', 'State Name Kentucky', 'State Name Louisiana',  
      'State Name Maine', 'State Name Maryland', 'State Name Massachusetts',  
      'State Name Michigan', 'State Name Minnesota', 'State Name Mississippi',  
      'State Name Missouri', 'State Name Montana', 'State Name Nebraska',  
      'State Name Nevada', 'State Name New Hampshire',  
      'State Name New Jersey', 'State Name New Mexico', 'State Name New York',  
      'State Name North Carolina', 'State Name North Dakota',  
      'State Name Ohio', 'State Name Oklahoma', 'State Name Oregon',  
      'State Name Pennsylvania', 'State Name Puerto Rico',  
      'State Name Rhode Island', 'State Name South Carolina',  
      'State Name South Dakota', 'State Name Tennessee', 'State Name Texas',  
      'State Name Utah', 'State Name Vermont', 'State Name Virginia',  
      'State Name Washington', 'State Name West Virginia',  
      'State Name Wisconsin', 'State Name Wyoming',  
      'Rural Status Not Applicable', 'Rural Status Partially Rural',  
      'Rural Status Rural', 'Rural Status Unknown',  
      'U.S. - Mexico Border County Indicator Y', 'covid_yr_indicator_yes',  
      'Designation Geographic', 'Designation Population'],  
      dtype='object')
```

Model coefficients transformed:

```
np.exp(logreg.coef_)
```

```
array([[0.29530204, 1.0348917 , 0.8255651 , 1.30622663, 1.15831064,  
        0.95872809, 0.91391105, 1.00848255, 1.58045159, 1.41064133,  
        1.59367629, 1.14467851, 0.70964405, 0.88341019, 1.15870436,  
        0.95772312, 0.96552334, 0.95592018, 0.97156997, 0.98571445,  
        1.08829438, 1.0117361 , 1.01103796, 0.87704106, 0.85175201,  
        1.00312664, 1.03640043, 0.85773959, 1.28626972, 0.98986763,  
        0.91339935, 1.10367341, 1.04282129, 1.0161219 , 0.90591818,  
        1.03045371, 1.02736772, 0.96138105, 0.89900748, 1.11787361,  
        0.96256127, 0.94259587, 1.02086228, 1.05424467, 1.03857024,  
        0.94978148, 0.9698268 , 1.02491262, 0.95252249, 0.92700462,  
        0.95974534, 0.97525338, 1.01891287, 1.16956463, 0.96088089,  
        1.06069211, 0.95707749, 1.07508004, 1.15145451, 0.99898951,  
        1.137094 , 1.03769841, 0.9246175 , 1.04049961, 1.02327296,  
        1.00746391, 1.04337111, 0.95944487, 0.39628104, 1.06331146,  
        0.95872809]])
```

An increase of 1 in Designation Population means that an HPSA is 0.96 times as likely to be withdrawn from the designated list.



Conclusion and Next Steps

Conclusions and Next Steps

- A Random Forest classification model with an accuracy of 83% was built to predict if a HPSA would be removed from the designated list.
- This analysis is exploratory. It is important to understand the needs of psychiatrically underserved populations and the information for all states.
- Provide information about trends to programs that can address the gap to medical care such as: reviewing of hospital and state licensing requirements for psychiatrists.
telepsychiatry and improvements in training of the mental health workforce

Resources

1. Health Resources and Services Administration, <https://nhsc.hrsa.gov/about-us>
2. “Doctors facing burnout could see job repercussions for seeking antidepressants”, Dr. Yalda Safai. December 10, 2020, <https://abcnews.go.com/Health>
3. “Challenges and Opportunities to Meet the Mental Health Needs of Underserved and Disenfranchised Populations in the United States”, Francesca Mongelli, M.D., Penelope Georgakopoulos, Dr.P.H., Michele T. Pato, M.D. Published Online:24 Jan 2020 <https://doi.org/10.1176/appi.focus.20190028>
4. “For people in underserved communities, getting mental health care is a struggle”. <https://blackbearrehab.com/blog/for-people-in-underserved-communities-getting-mental-health-care-is-a-struggle/>
5. Centers for Disease Control and Prevention, <https://www.cdc.gov/nchs/fastats/mental-health.htm>
6. National Alliance of Mental Illness, [https://www.nami.org/getattachment/Get-Involved/NAMI-National-Convention/Convention-Program-Schedule/Hill-Day-2017/FINAL-Hill-Day-17-Leave-Behind-all\(1\).pdf](https://www.nami.org/getattachment/Get-Involved/NAMI-National-Convention/Convention-Program-Schedule/Hill-Day-2017/FINAL-Hill-Day-17-Leave-Behind-all(1).pdf)
7. U.S Population by Year, <https://www.multpl.com/united-states-population/table/by-year>