

Identifying Dental Shortage Areas in the United States

Darby Cobb, Phuridej Jaitrong, Ujjawal Madan, Wilson Pu, Aidan Worswick

Summary

Quality oral healthcare is the greatest unmet healthcare need for children in the US [1]. Publicly insured children are 50% more likely to lack access to healthcare in one or more areas than children covered privately [2]. We created a web portal that identifies dental shortage areas for children who are eligible for public insurance (CHIP, Medicaid). The identification of shortage areas will aid policy makers in focusing their efforts.

Data

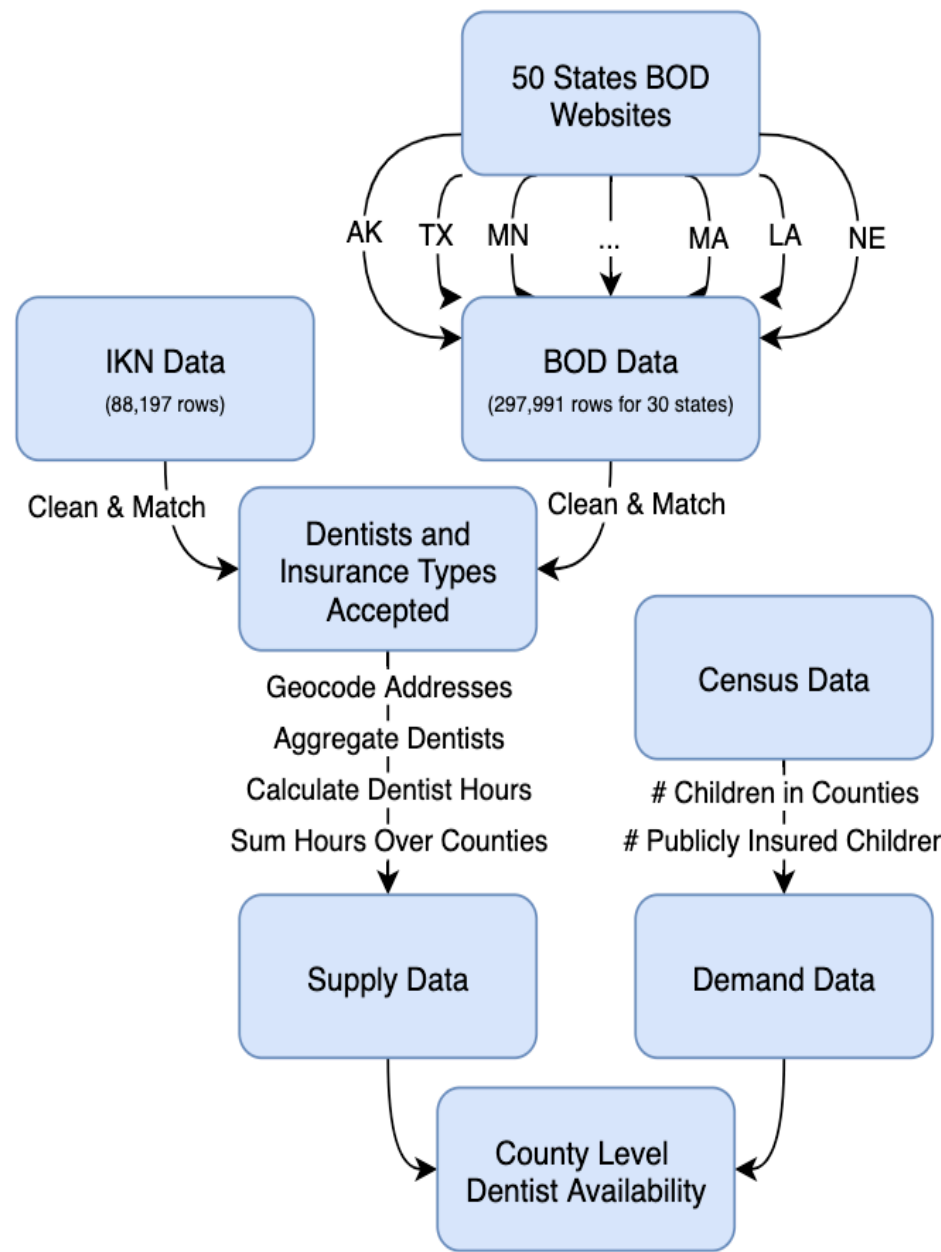
The data was provided by a Health Analytics Georgia Tech research group.

Sources: IKN, Board of Dentistry (BOD), Census

- IKN: 88,197
- Board of Dentistry: 297,991

Total Size: 386,188 rows, 0.25 GB

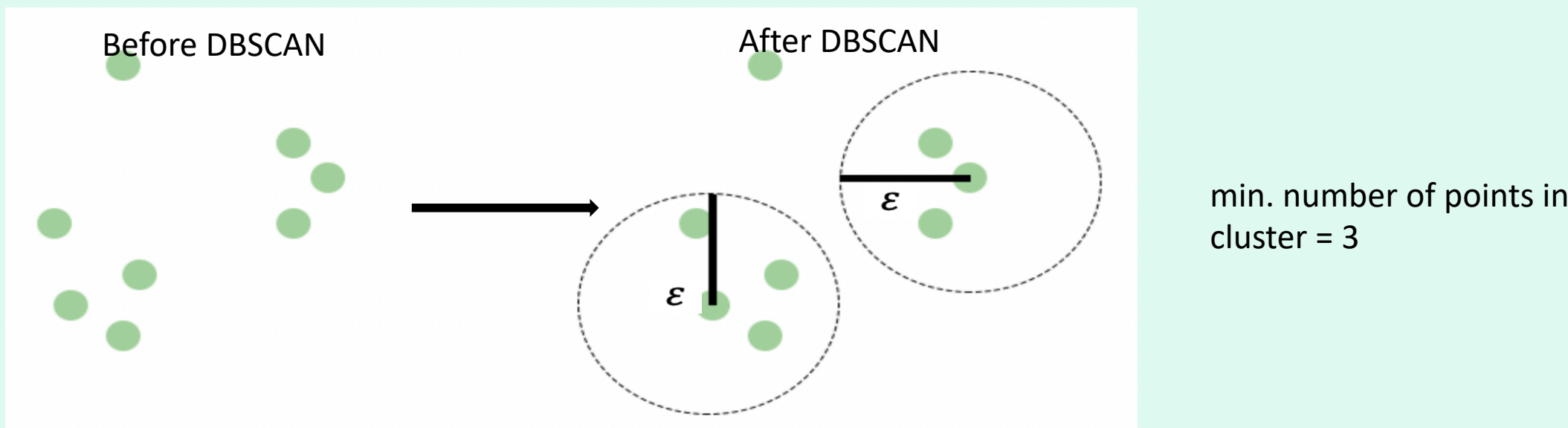
Features: Dentist Information, Insurance Types Accepted, Specialty Information, Provider Type, etc.



Clustering Similar Counties in a State

DBSCAN: How it works

Density-Based Spatial Clustering Applications with Noise (DBSCAN) detects arbitrarily shaped clusters. DBSCAN has two main parameters: the size of the epsilon neighborhood, and the minimum number of points required to form a cluster. A cluster is formed when more than the minimum number of points are within the point's epsilon neighborhood.



How It Solves Our Problem

Shortage areas can be easily grouped based on their dentist distributions (dentists that accept public insurance, number of pediatric dentists, etc.). Policy makers can then observe groups of areas where children are highly likely to lack access to quality dental care because they will be able to target similarly affected areas with policies that are tailored to the group's circumstances.

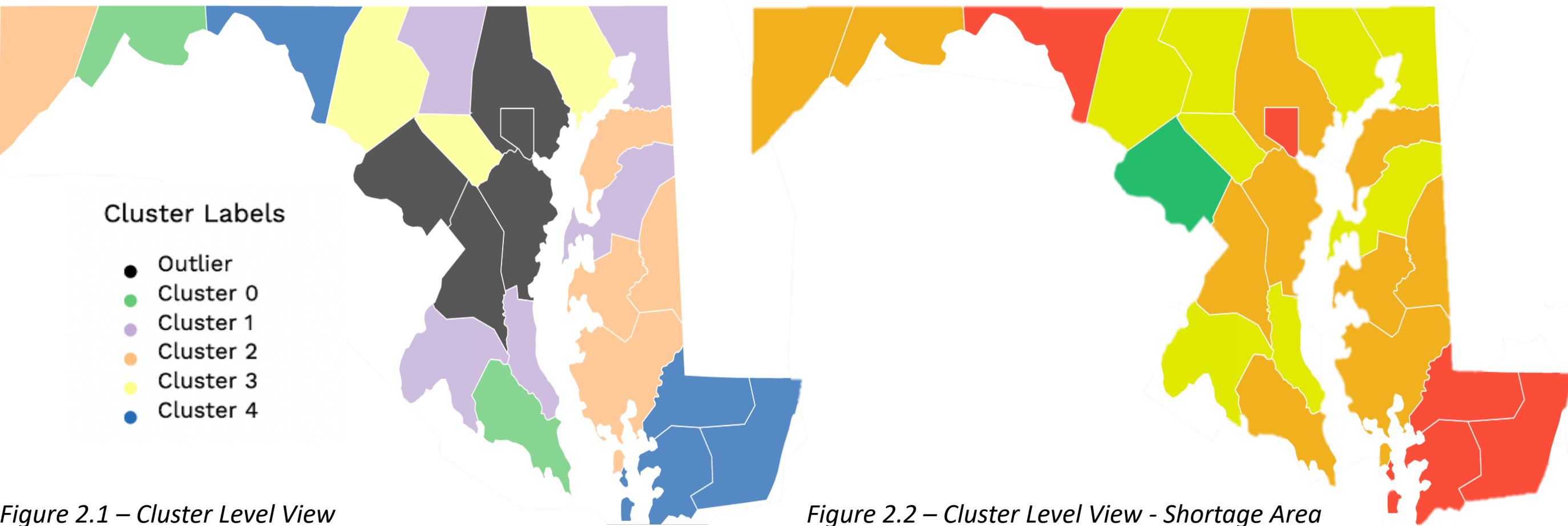
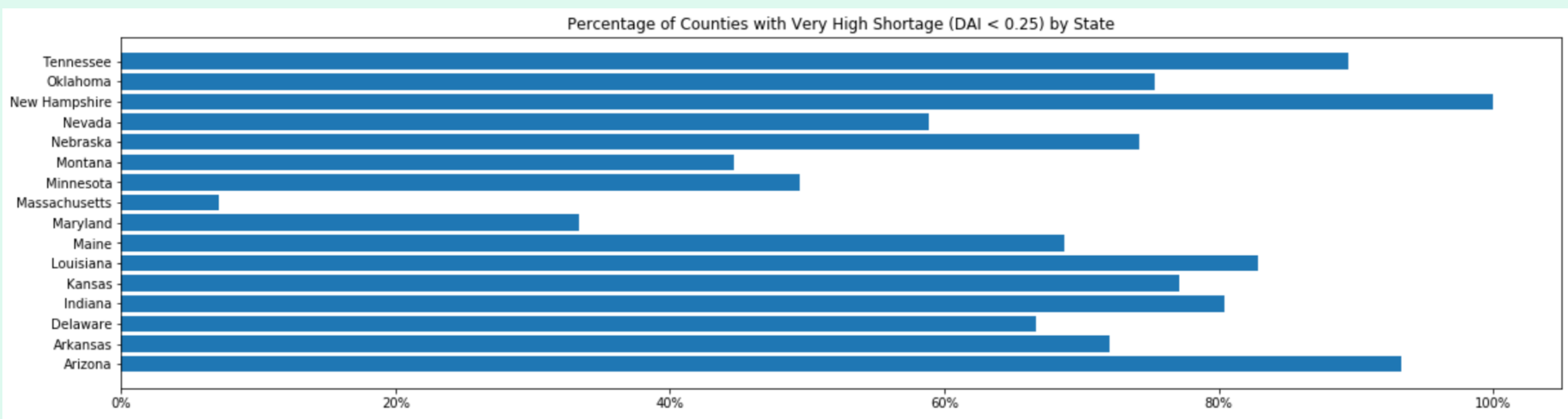


Figure 2.2 – Cluster Level View - Shortage Area

Evaluation

Our ideal measure of success is the impact this will have on policy-making. While we are not able to quantify the impact our project will have at this stage, we conducted an informal user study of four users. Health analytics researchers at Georgia Tech were asked to evaluate our dental care shortage area portal across a variety of usability metrics.

The overall rankings and subjective feedback are quite positive and encouraging, results of which are below.



The graph above shows the percentage of counties that have Very High shortages (DAI < 0.25) for each state. Based on the graph, we found that Massachusetts has a very healthy supply of dentists for children on public insurance. This is helpful information for policy makers in high shortage states like Arizona as they can look at what policies MA has put in place to achieve a better DAI and use those as best practices for implementing new local policy.

Why We Care

- ✓ Improving dental hygiene is necessary for overall health-care outcomes
- ✓ Quantifying the severity of dental care shortages will aid policy makers in locating areas in most need
- ✓ Closing the gap of unequal access to dental healthcare due to income levels will lead to greater societal health and economic prosperity

Identifying Shortage Areas

We define a shortage area as any county whose demand for dental care services greatly exceeds supply. Dentist hours are determined based on the 2010 national average of dentists work hours: 35.2 hours a week for 42 weeks a year. Each child requires two visits and thus, two hours of dental care per year.

Supply: the total number full-time equivalent dentists who accept public dental insurance for children (CHIP or Medicaid) in each county per year.

Demand: the number of full-time equivalent dentists required in each county to provide two hours of dental care per year to all children in the county who do not have private dental insurance.

Dentists demanded is estimated as:

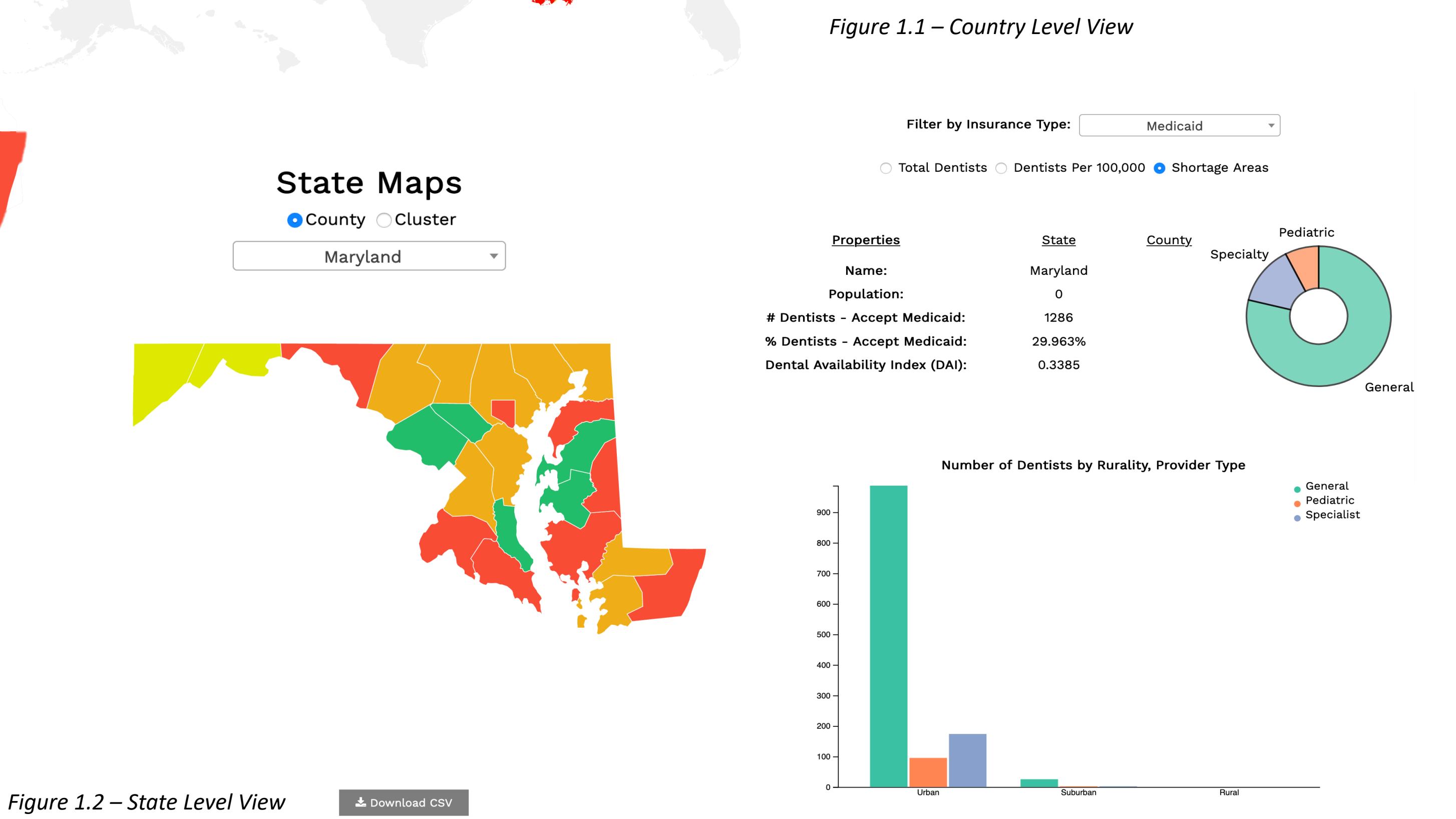
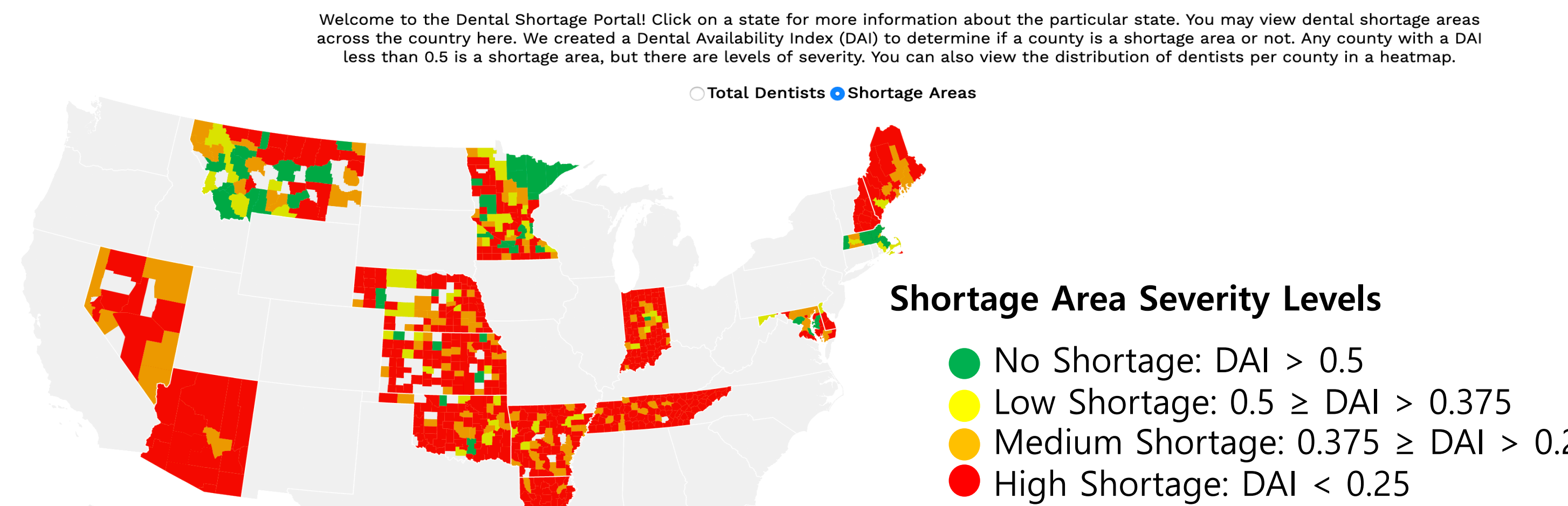
$$\frac{2 * [Number\ of\ Children\ on\ Public\ Insurance + Number\ of\ Uninsured\ Children]}{35.2 \frac{hours}{week} * 42 \frac{weeks}{year}}$$

The dentist supply consists of multiple different dentist specialties (general, pediatric, and specialist). General and pediatric dentists spend 22% and 84% of their time on children's preventative dental healthcare, respectively.

We then created a Dentist Availability Index (DAI) based on the ratio of supply of dentists to demand of dentists.

$$DAI = \frac{Number\ of\ General\ Dentists * 0.22 + Number\ of\ Pediatric\ Dentists * 0.84}{Number\ of\ Dentists\ Demanded}$$

Shortages of Dentists per County in the US



Results

- ❖ Successfully built a framework for a user-friendly interactive application with key summary statistics for each county (and cluster) policy makers have been demanding
- ❖ Increased accuracy in quantifying shortage levels by creating a Dental Availability Index
- ❖ Developed more efficient data pipeline that can easily add new states given correctly formatted data and visualized the degree of shortage severity for counties in 16 states
- ❖ Generalized counties using DBSCAN with similar dentist distributions to recommend more broad areas for policy makers to target
- ❖ Enabled further research that can now be conducted to look further into both causes of shortage areas and specific policy recommendations

[1] Paul W. Newacheck, Dana C. Hughes, Yun-Yi Hung, Sabrina Wong and Jeffrey J. Stoddard Pediatrics April 2000, 105 (Supplement 3) 989-997;; [2] National Center for Health Statistics. Health, United States, 2015: With Special Feature on Adults Aged 55-64. Hyattsville, MD: National Center for Health Statistics; 2015. <https://www.cdc.gov/nchs/data/abus/abus15.pdf>.; [4] Jones, E. (2013). Improving Dental Care Access for Low-Income Populations. Wright State University, Dayton, Ohio