Virginia's New
RURAL HEALTH
DATA COMMONS

Supporting the 2022-2026 Virginia Rural Health Plan
New Health-Related Datasets, Metrics, and Visualizations

NACCHO – July 2022

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University of Virginia

UVA BIOCOMPLEXITY INSTITUTE

VDH VIRGINIA DEPARTMENT OF HEALTH

Virginia's Rural Health Data Commons

AGENDA

- Virginia Rural Health Plan
- A Data Commons to Support the Plan
- Our Approach to Building the Data Commons
- Features of the Deployed System
- Brief Overview of Novel Health-Related Datasets and Metrics
  - Broadband Access
  - Adequacy of Prenatal Care
  - Mental and Physical Healthy Days
  - New Food Insecurity Measure (In-Development)
- A Deep-Dive into understanding Catchment Areas, the basis of many new datasets

Virginia Rural Health Plan

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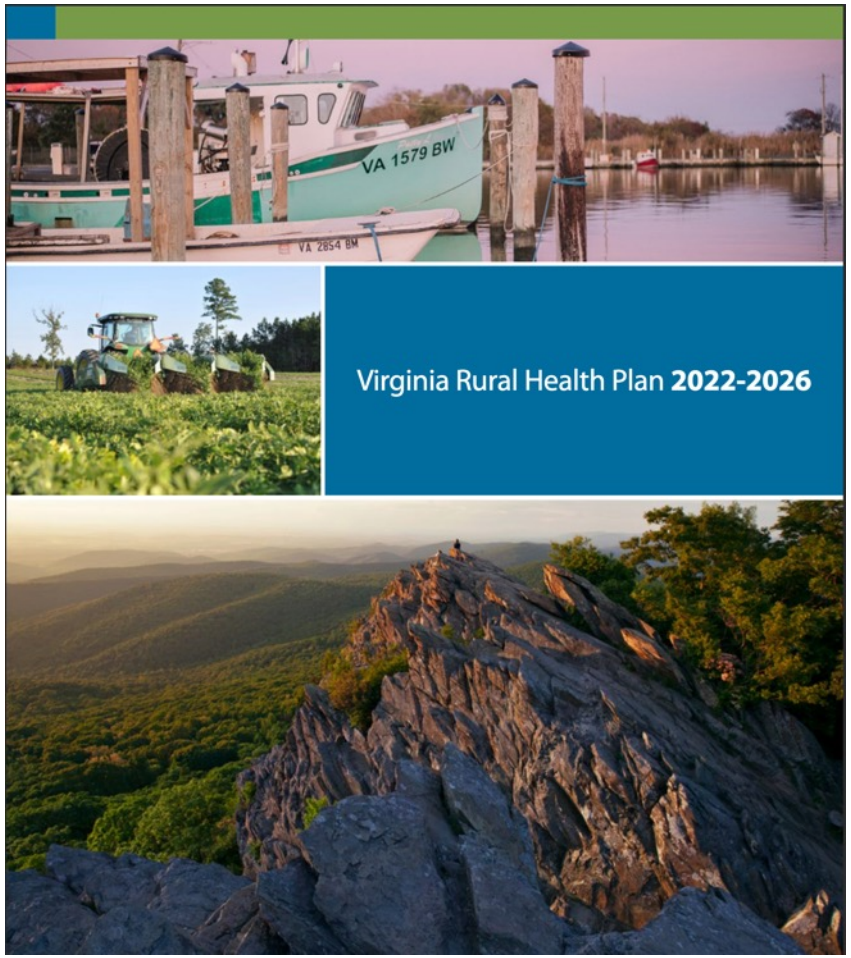
Virginia's Rural Health Plan

Priority Metrics to Support Decision-Making

The Virginia State Office of Rural Health

- The Virginia State Office of Rural Health (VA-SORH) was established in 1991 to create, fund, and support quality and sustainable rural healthcare infrastructure throughout the Commonwealth of Virginia.
- The goal of the 2022-2026 Virginia Rural Health Plan is to showcase the resiliency and highlight the assets of the Commonwealth's rural communities.
- Want to visualize trends of key metrics in a public-facing, interactive dashboard which will be accessible to partners, stakeholders, policy-makers and the public on the VA-SORH website.



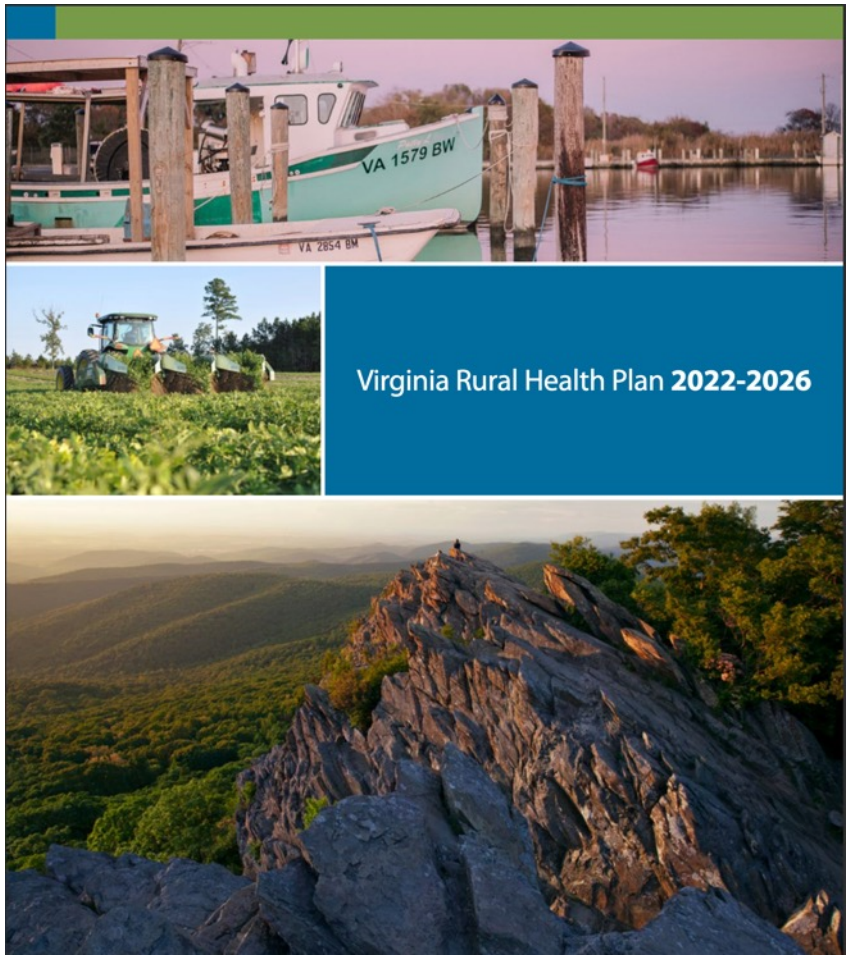
Source: https://www.vdh.virginia.gov/content/uploads/sites/76/2022/01/Virginia-Rural-Health-Plan_Book_POST_1-24-22_LR.pdf

Virginia's Rural Health Plan

Priority Metrics to Support Decision-Making

The Virginia State Office of Rural Health has chosen seven priority areas and respective metrics to study and monitor longitudinally

1. **Education**
   - Child Readiness via Third Grade Standards of Learning Reading Assessment
2. **Broadband**
   - Percentage of Households with Broadband
3. **Nutrition and Food Security**
   - Rates of Food Security
   - Rates of Food Insecurity among Households with Children
4. **Healthy Moms and Babies**
   - Adequacy of Prenatal Care Utilization via Kotelchuck Index
5. **Access to Health Care Services**
   - Rates of Avoidable Hospitalizations per 100,000 Residents
6. **Behavioral Health, Substance Use Disorder and Recovery**
   - Rates of Emergency Department Visits for Overdose (All drugs)
7. **Employment/Workforce Development**
   - Earnings/Income per Job
   - Employment Rates per Census Tract



Source: https://www.vdh.virginia.gov/content/uploads/sites/76/2022/01/Virginia-Rural-Health-Plan_Book_POST_1-24-22_LR.pdf

A Data Commons to Support the Plan

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VISION

WHAT IS A DATA COMMONS?

An open knowledge repository that co-locates data from a variety of sources, builds and curates data insights, and provides tools designed to track issues over time and geography allowing governments and community stakeholders to learn continuously from their own data.

Key features:

- Data sources, collected and created
- Maps reflecting multiple geographies
- Composite metrics
- Navigation and capability to statistically explore the data
- Data download via web or API
- Metadata

RURAL HEALTH DATA COMMONS

PURPOSE

INTENDED AUDIENCE

- General public
- Virginia government: elected officials and agency personnel
- Community stakeholders and leaders: local government, NGOs, business and industry
- Researchers: universities, institutes, think tanks
- Health professionals

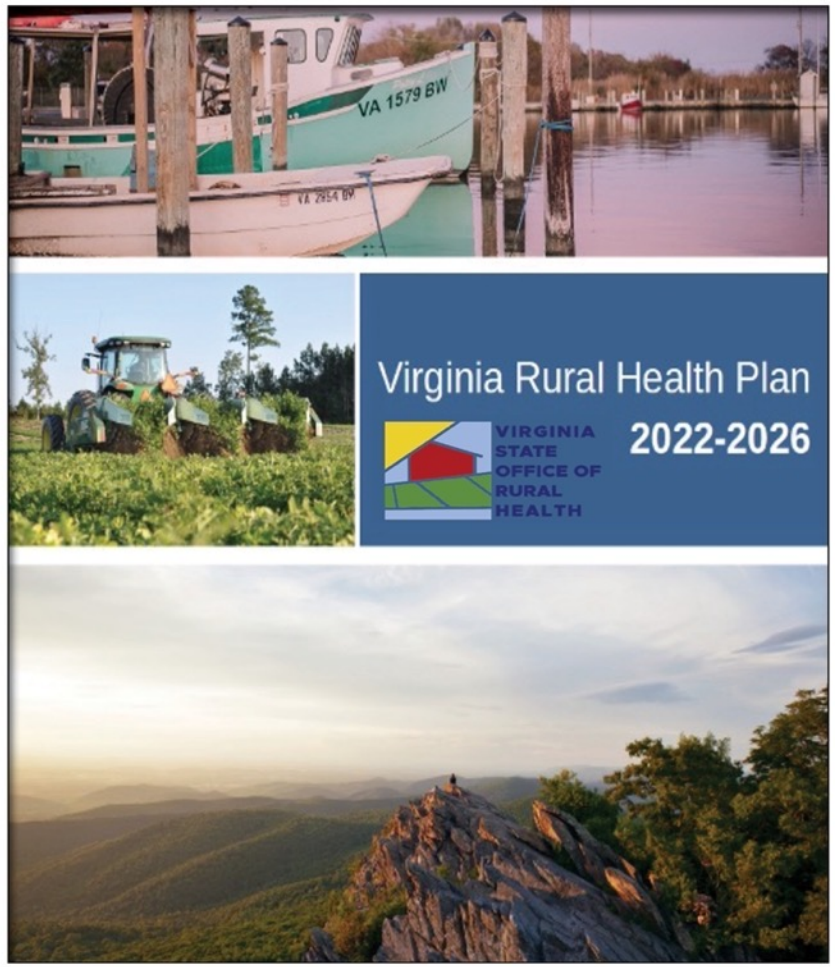
A Data Commons allows multiple audiences to explore issues relevant to their communities.

RURAL HEALTH DATA COMMONS

PURPOSE

BRING VIRGINIA RURAL HEALTH PLAN TO LIFE

- **AMPLIFY**
  understanding of priority areas
- **PROVIDE**
  opportunity to explore current data insights to dive deeper into regions, communities, or neighborhoods
- **CREATE**
  a sustainable tool with current data ingested over time
- **SUPPORT**
  multiple audiences



RURAL HEALTH DATA COMMONS

Our Approach to Building the Data Commons

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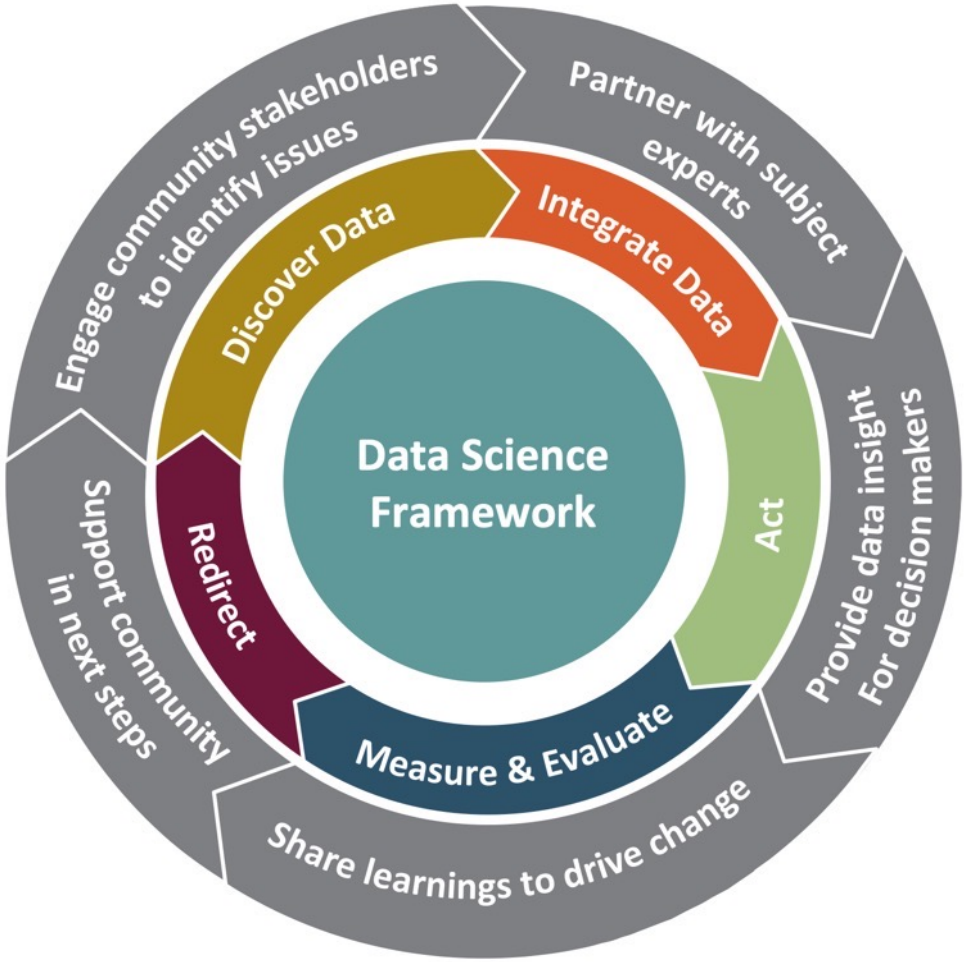
PROJECT APPROACH

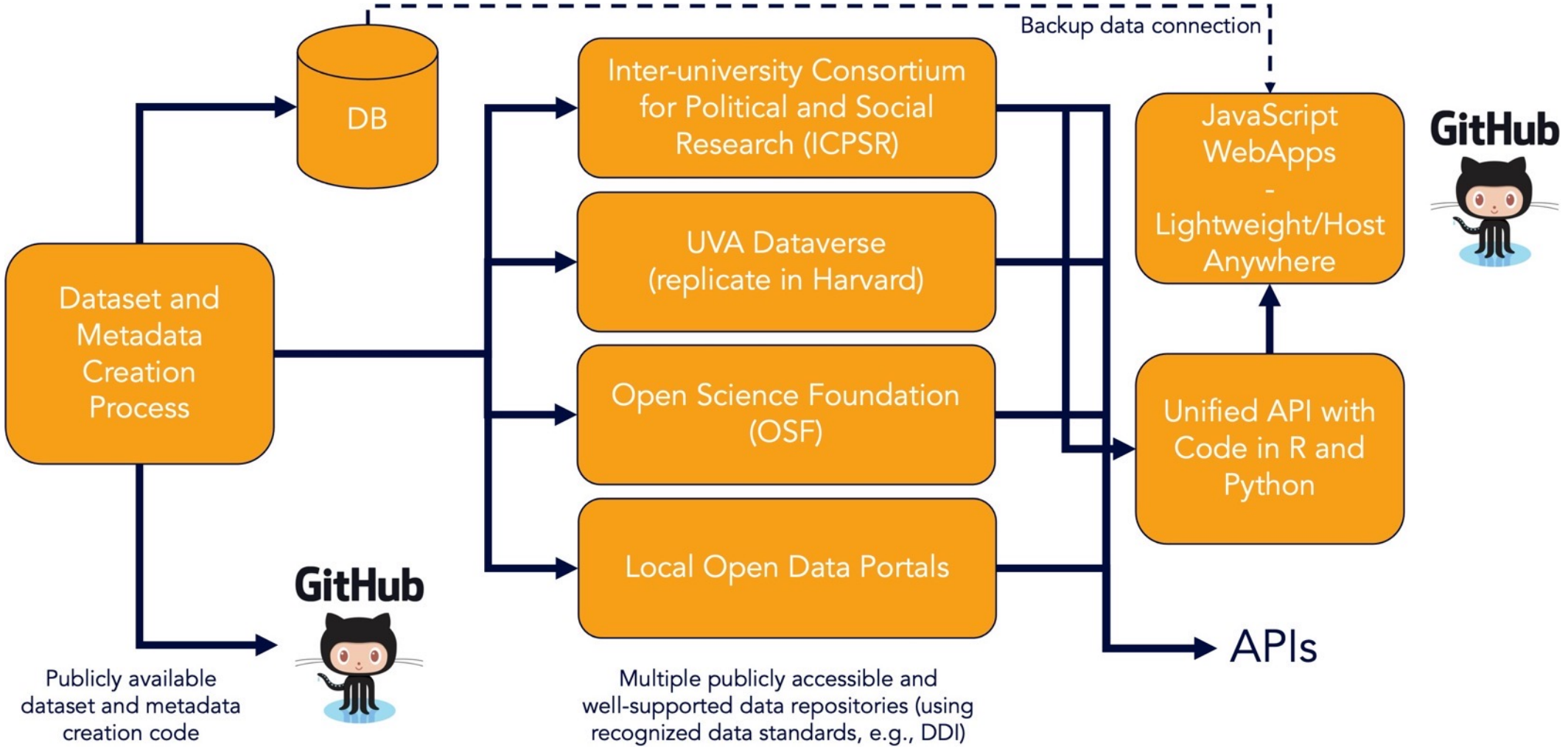
Iterative Process with Decision Makers Getting to Required Data & Metrics

- **Community Learning Through Data Driven Discovery (CLD3)**
- **CLD3** goes beyond traditional organizing aspects of collective action programs and supports communities in building capacity for data-informed decision making.
- Outer wheel: continuous interaction and communication across stakeholders
- Middle wheel: data-driven learning process
- Frontier: between the outer and middle wheels is active collaboration between all partners
- Inner circle: rigorous research framework to guide the data science



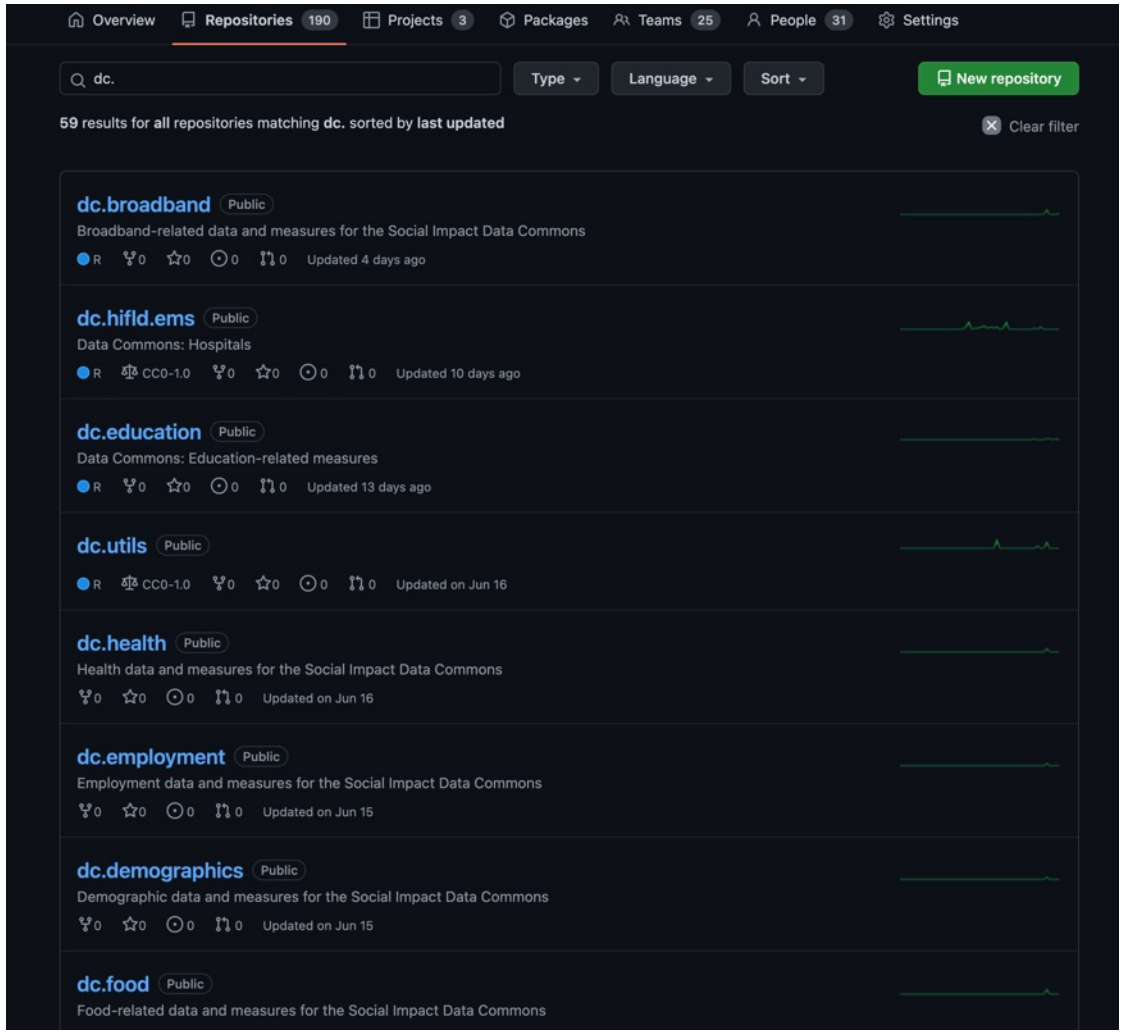
DATA COMMONS GENERALIZED ARCHITECTURE

Modular, Sustainable, Expandable



Features

Open sourcing of all dataset creation code



Features

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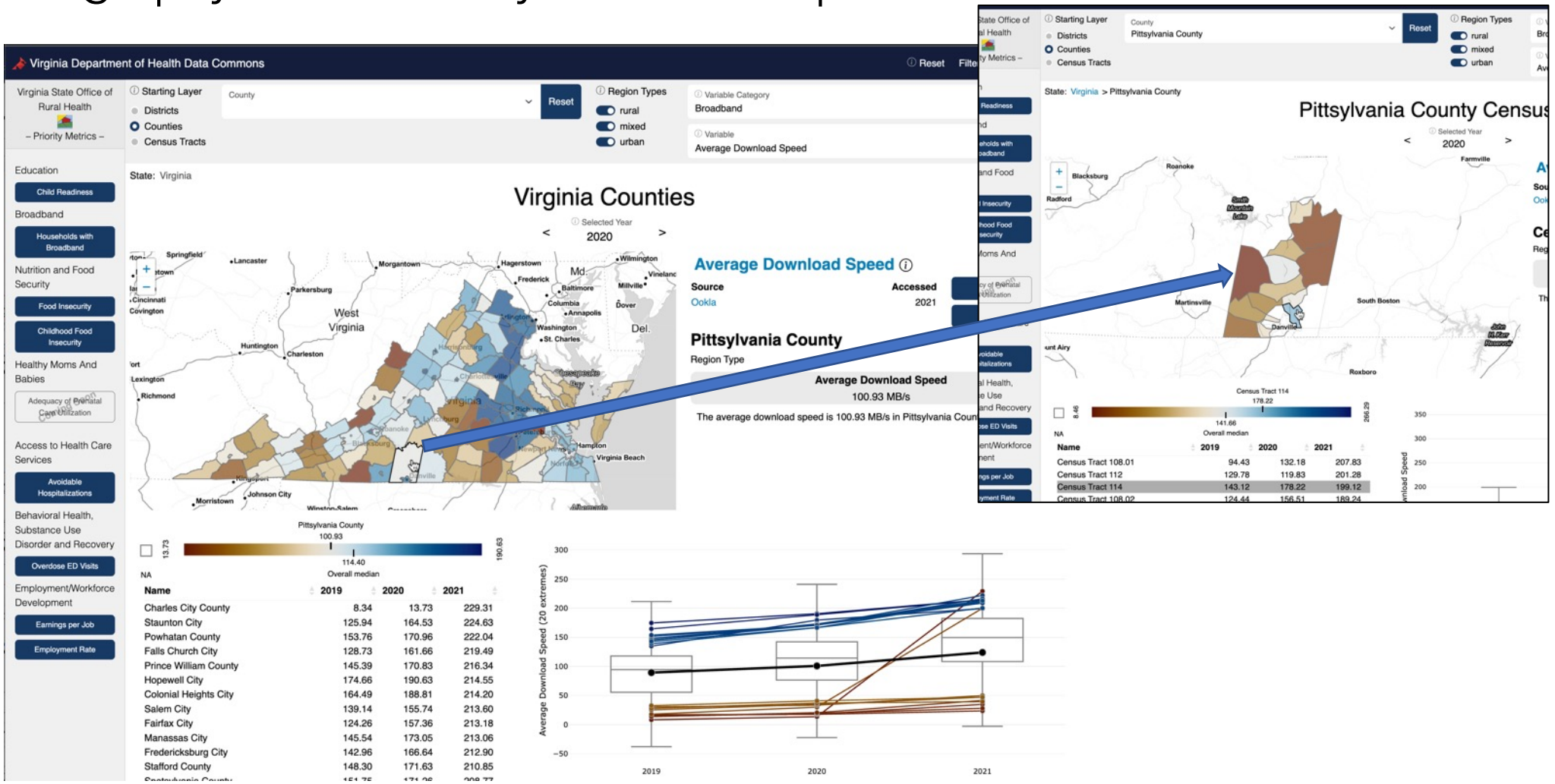
System Features

- Feature priority metrics
  - Also include datasets that help set a larger context
- Definitions and additional resources for metrics
- Filtering to the dataset you want for download
  - Including by rural/urban
- Provide and API for programmatic connection
- Geography below county-level where possible
- Visualize change over time
- Ranking tables for comparison
- Open sourcing of all dataset creation code

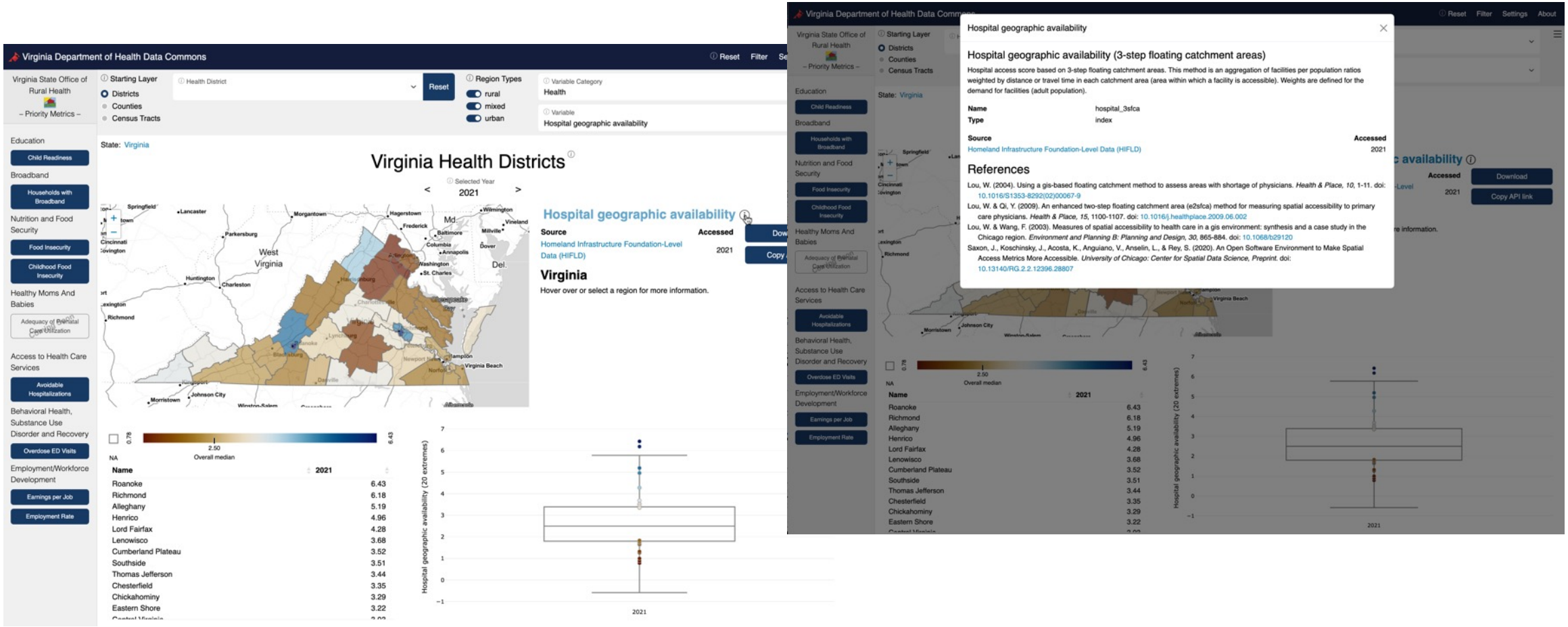
Features

Geography below county-level where possible



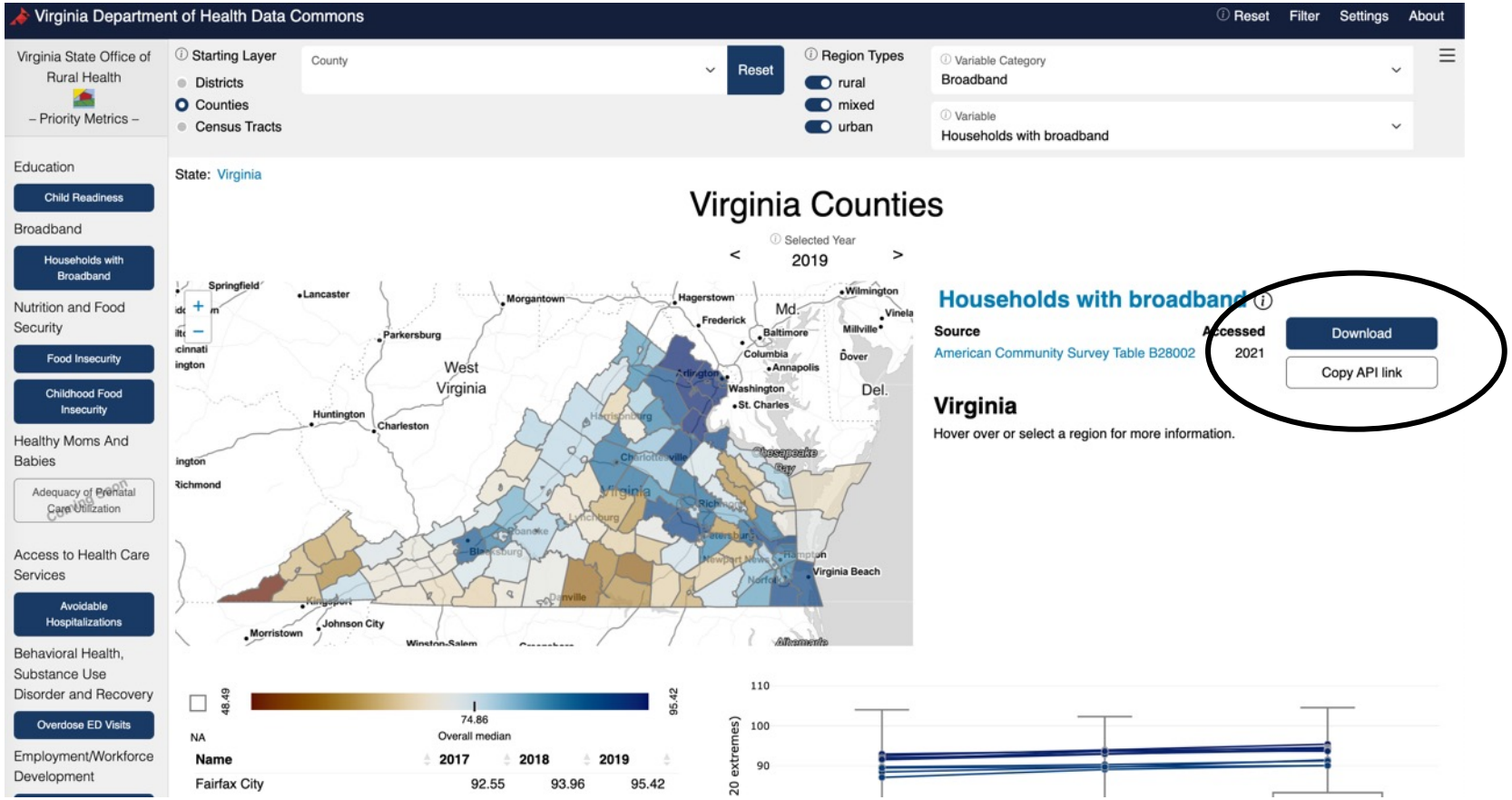
Features

Definitions and additional resources for metrics



Features

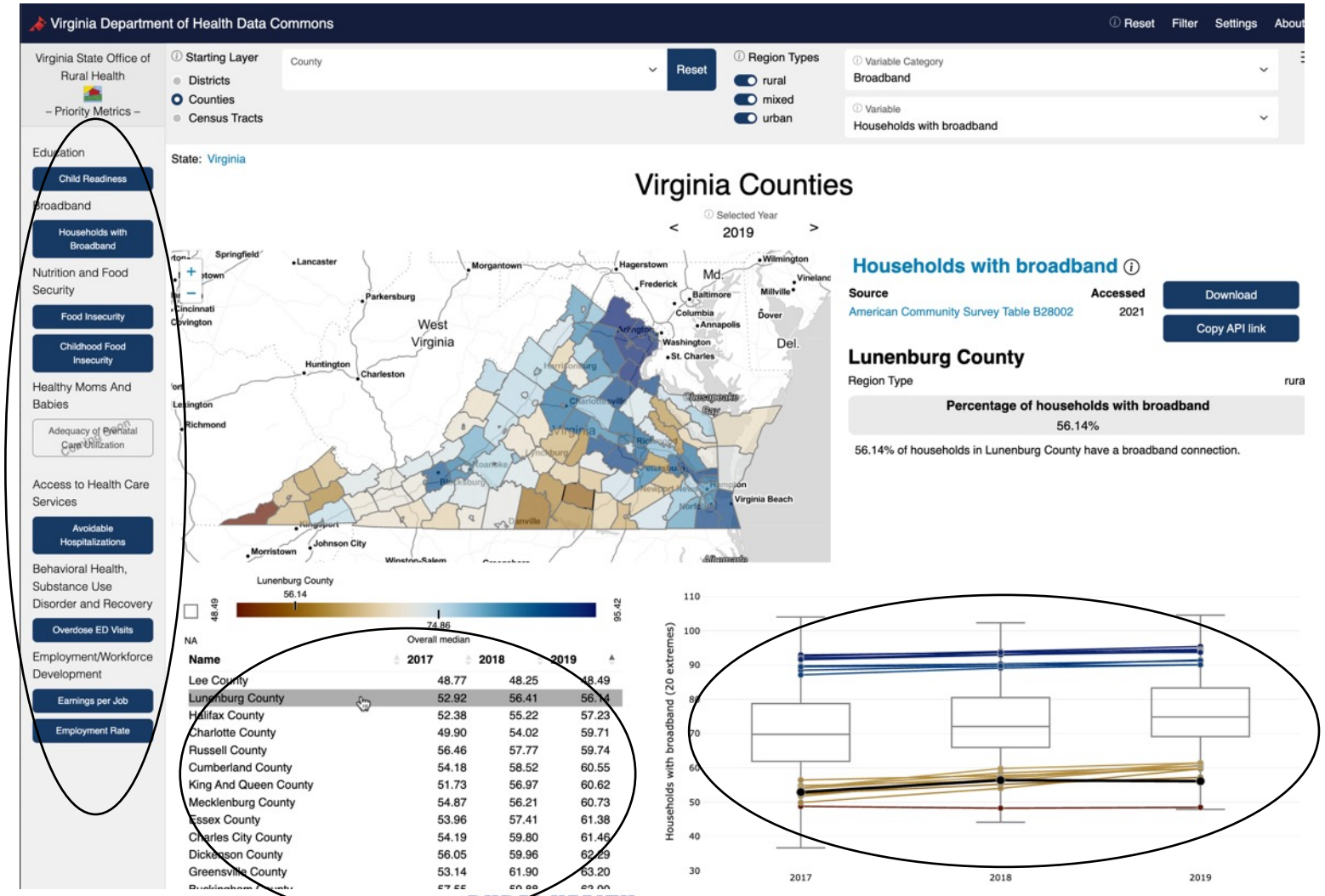
Download or API

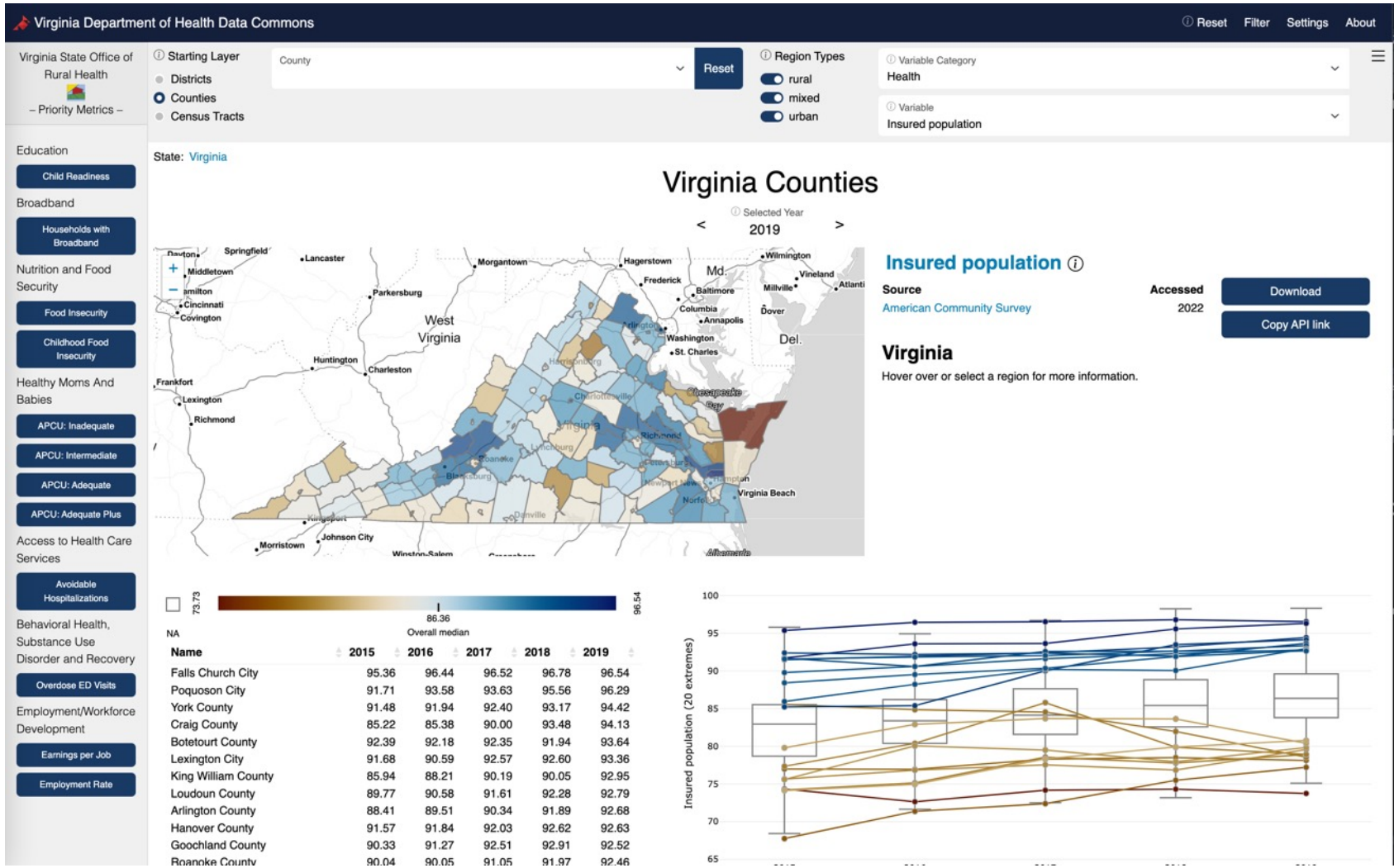


- https://vdh-data-commons.netlify.app/api?include=broadband_withoutint_compdev:perc_hh_with_broadband&dataset=county&id=-1&time_range=2017,2019&type=rural,mixed,urban

Features

Priority Metrics, Change Over Time, Ranking





https://uva-bi-sdad.github.io/vdh_rural_health_site/

New Metrics

Broadband

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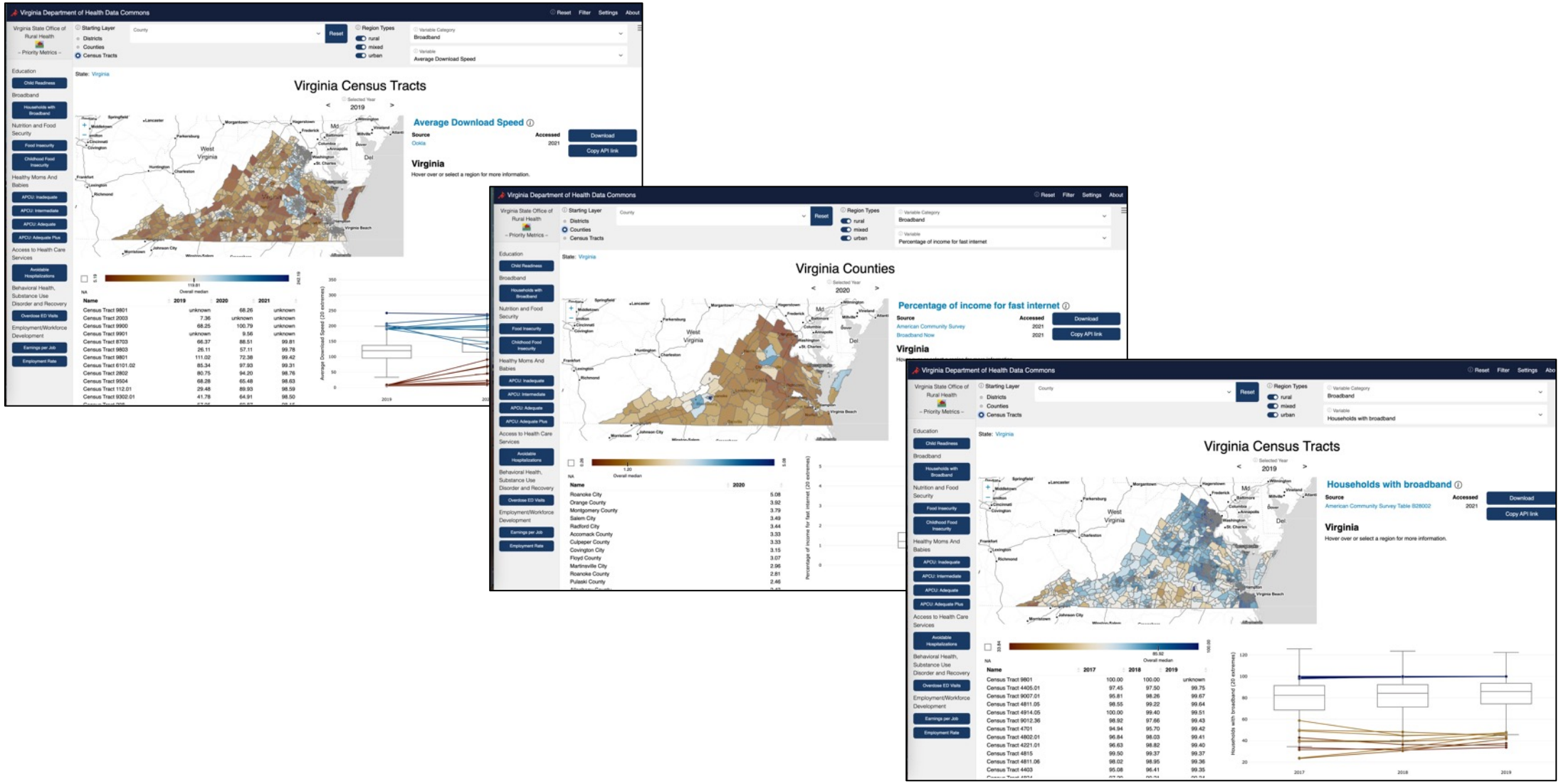
Access to Broadband



New Metrics

Kotelchuck

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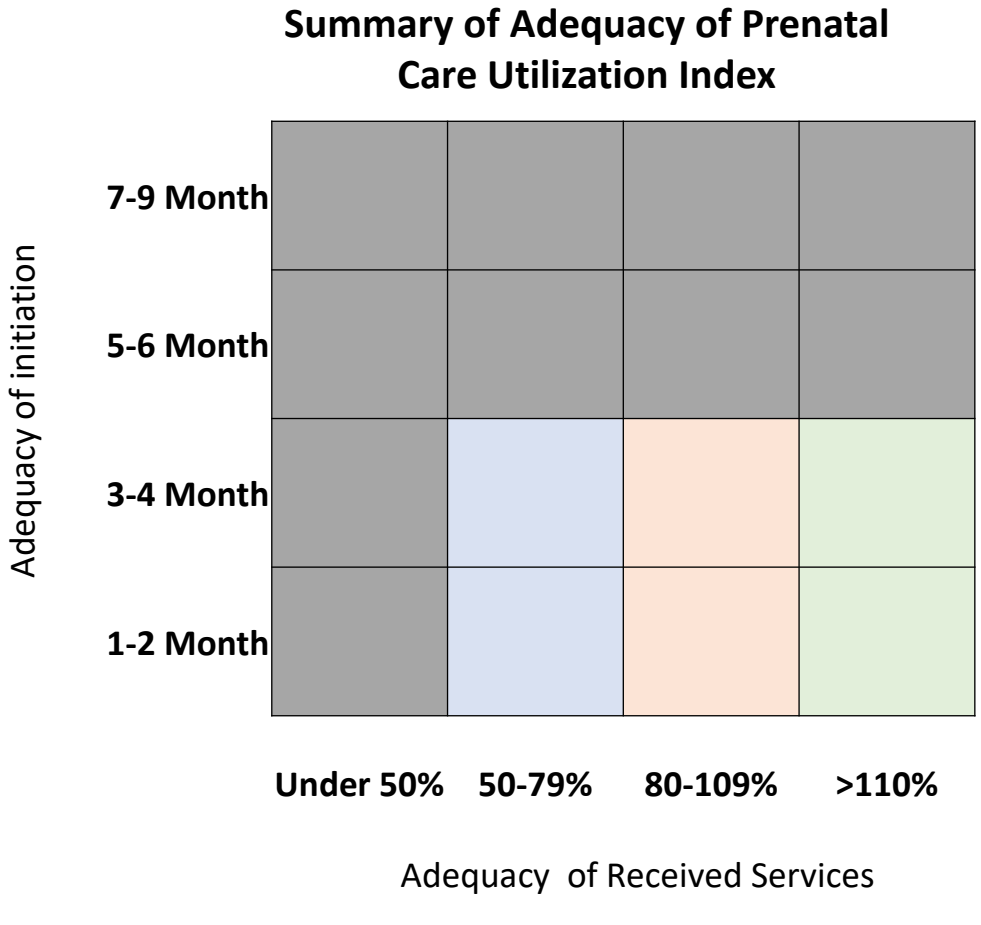
Adequacy of Prenatal Care Utilization Index
(Kotelchuck Index)

APNCU Index attempts to characterize prenatal care utilization on two independent and distinctive dimensions:

1. Adequacy of Initiation of Prenatal Care and
2. Adequacy of Received Services (once prenatal care has begun).

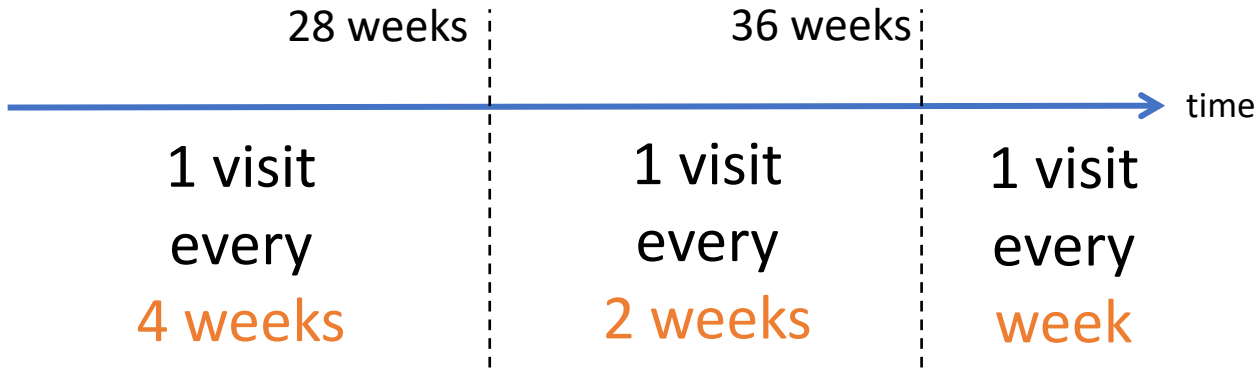
$$\text{Adequacy of received services} = \frac{\text{Received visits}}{\text{Ideal visits}}$$



Kotelchuck Index

It is not just the number of visits to Prenatal Care …

… It matters when visits start



Recommendation of the American College of Obstetricians and Gynecologists

The Adequacy Prenatal Care Utilization Index (APNCU), Virginia, 2020

Adequacy of initiation

	< 50%	50-79%	80-109%	>110%
10	0.0%	0.0%	0.0%	0.0%
9	0.2%	0.2%	0.1%	0.1%
8	0.3%	0.5%	0.3%	0.2%
7	0.2%	0.6%	0.5%	0.5%
6	0.3%	0.7%	0.8%	0.7%
5	0.3%	1.1%	1.6%	1.2%
4	0.5%	1.9%	3.9%	2.5%
3	0.9%	6.3%	17.2%	10.2%
2	0.8%	8.5%	21.9%	10.4%
1	0.2%	1.5%	1.8%	1.1%

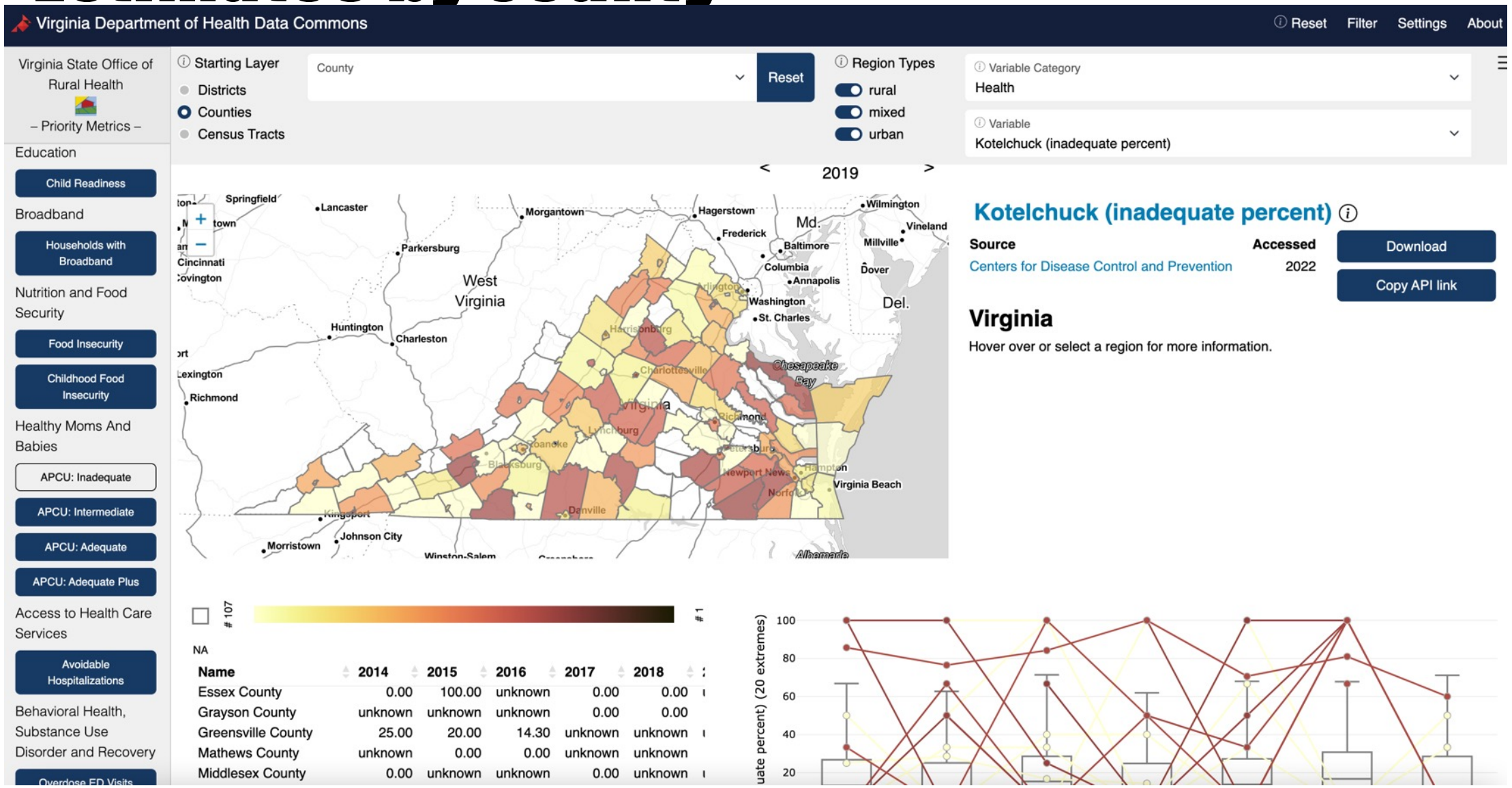
Adequacy of Received Services

Summary, Virginia, 2020

Inadequate	12.8%
Intermediate	18.2%
Adequate	44.8%
Adequate Plus	24.1%

Source: CDC-NCHS

Estimates by county



New Metrics

Mental and Physical Health

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Mental and Physical Health

Poor physical health: Percentage of population self-reporting poor physical health in over 14 days of the previous month.

Poor mental health: Percentage of population self-reporting poor mental health in over 14 days of the previous month.

We used the Virginia Behavioral Risk Factor Surveillance Survey (BRFSS)
- data on individuals is not available at the Census tract level -

Variables used for prediction

1. Gender - individual
2. Fraction of pop in poverty - county
3. Fraction of pop in the labor force - county
4. Fraction of pop with less than a high school - county

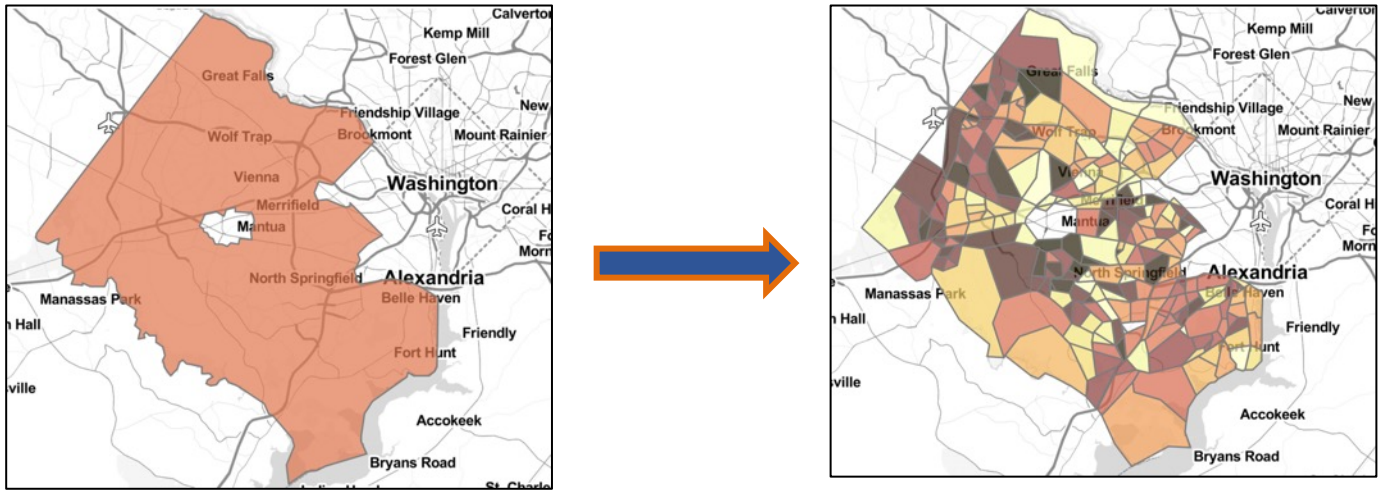
For 3 different groups: Age, Race, County

Assumption: impact of county level variable

↓

linearly transformed to the census tract

Example for Fairfax County, VA

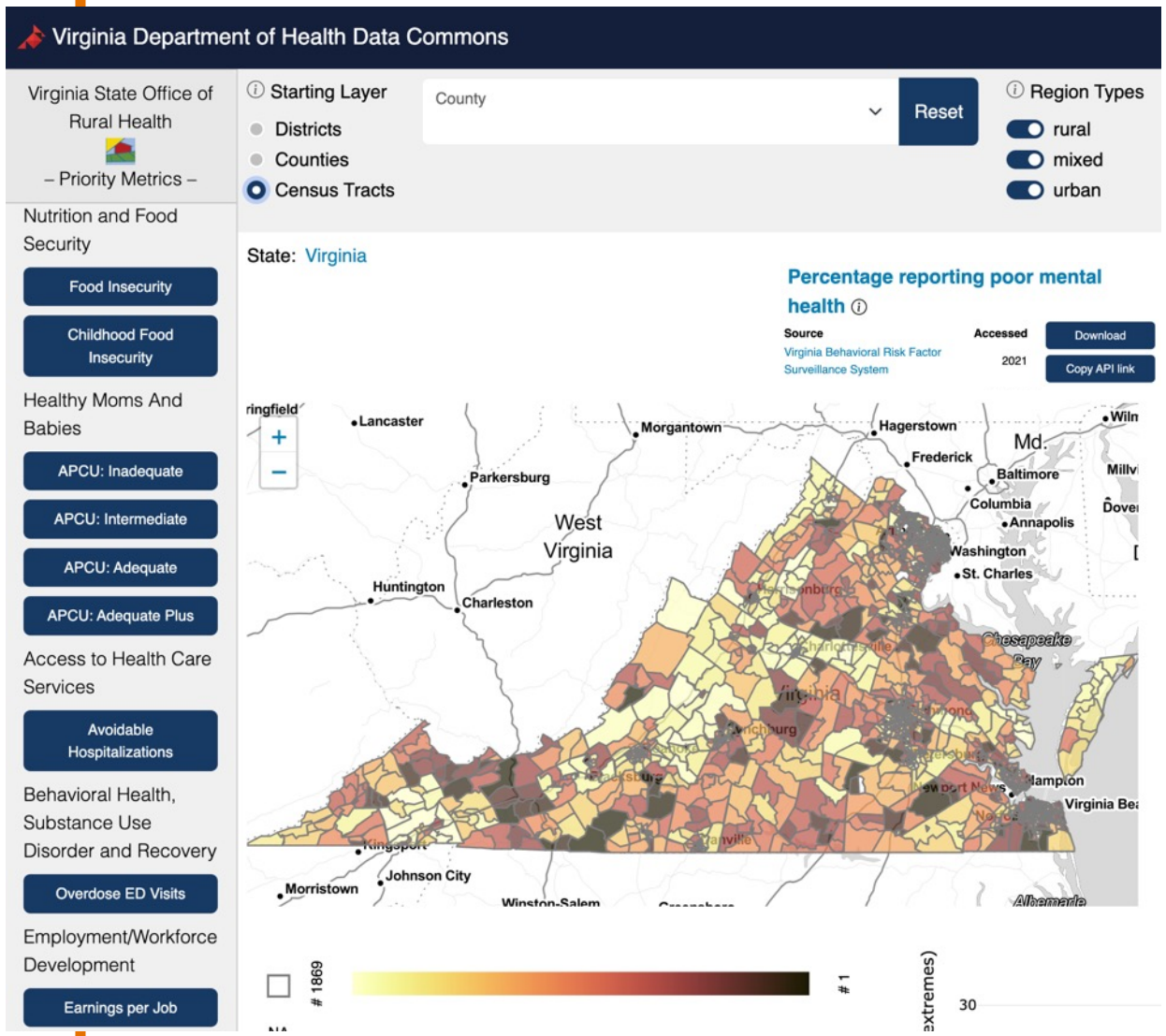


Prior distribution: 2011 BRFSS

To predict each Census tract for 2015 - 2019

References: Zhang et al. (2014), Liu, Gelman, and Zheng Liu et al. (2015)

Estimates


Virginia Department of Health Data Commons
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Food Insecurity
Childhood Food Insecurity
Healthy Moms And Babies
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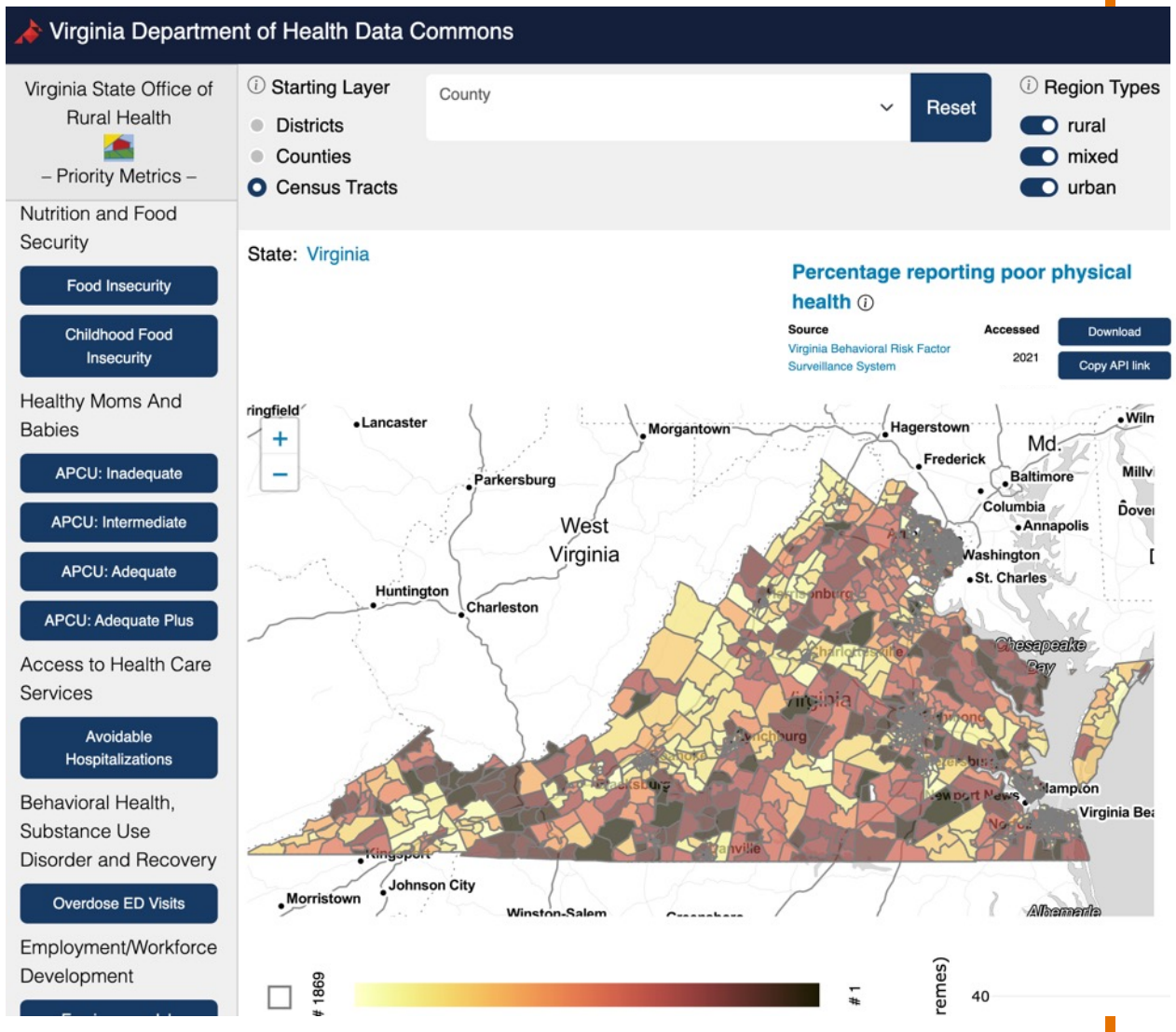
APCU: Intermediate
APCU: Adequate
APCU: Adequate Plus
Access to Health Care Services
Avoidable Hospitalizations
Behavioral Health, Substance Use Disorder and Recovery
Overdose ED Visits
Employment/Workforce Development
Earnings per Job
Starting Layer
Districts
Counties
Census Tracts
County
Reset
Region Types
rural
mixed
urban
State: Virginia
Percentage reporting poor mental health
Source
Virginia Behavioral Risk Factor Surveillance System
Accessed
2021
Download
Copy API link
West Virginia
Lancaster
Morgantown
Hagerstown
Frederick
Baltimore
Columbia
Annapolis
Washington
St. Charles
Parkersburg
Huntington
Charleston
Chesapeake Bay
Virginia Beach
Morristown
Johnson City
Winston-Salem
1869
1
30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New Metrics

Catchment Areas

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Floating Catchment Areas

Cesar Montalvo

Social and Decision Analytics Division, Biocomplexity Institute

NACCHO – July 2022

Floating Catchment Areas

The floating catchment area (FCA) is a method that identifies spatial accessibility to a specific service, for example, hospitals, supermarkets, schools, etc.

FCA defines the service area by a threshold travel time while accounting for the availability of physicians by their surrounded demands. (Luo et al., 2003)

How many **providers / doctors / grocery stores** are available per **person / consumer / region** ?

Typical Ratio supply-demand

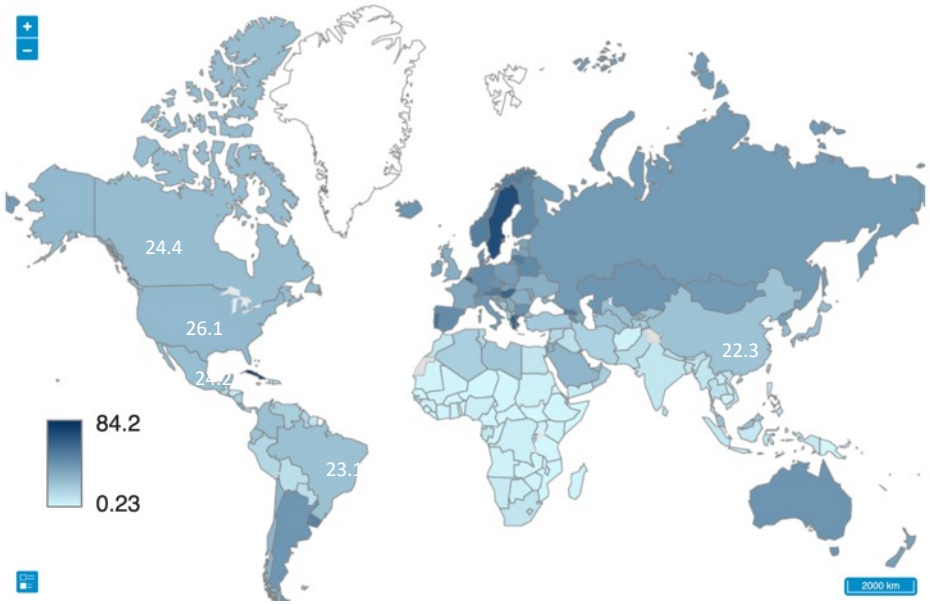
$$R_A = \frac{\text{provider}}{\text{demand}}$$

For example:

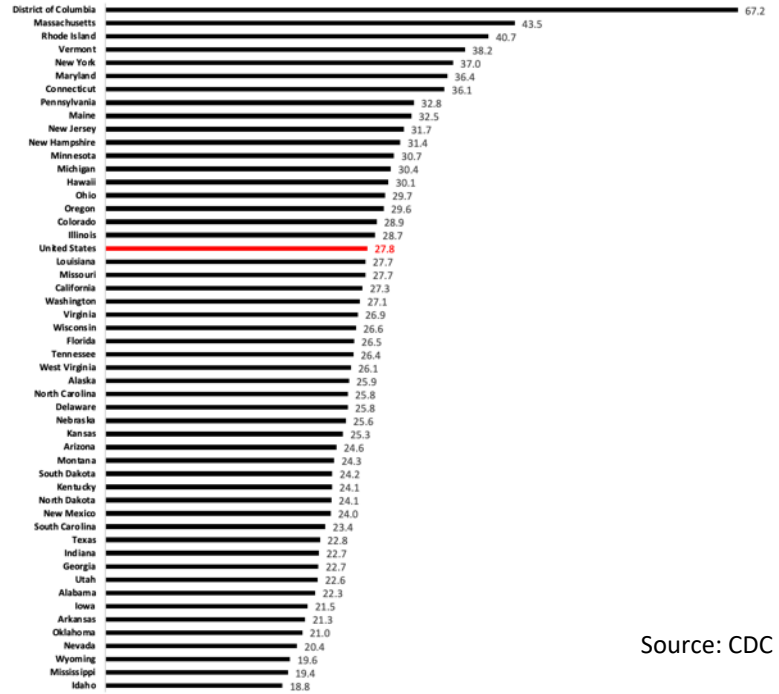
26.9 physicians per 10 K people in VA (NCHS, 2021)

20.5 Police Officers per 10 K people in VA (BLS, 2021)

Medical Doctors per 10,000 people - 2020



Physicians per 10,000 resident population - 2018



Source: CDC

Source: World Health Organization

Floating Catchment Areas

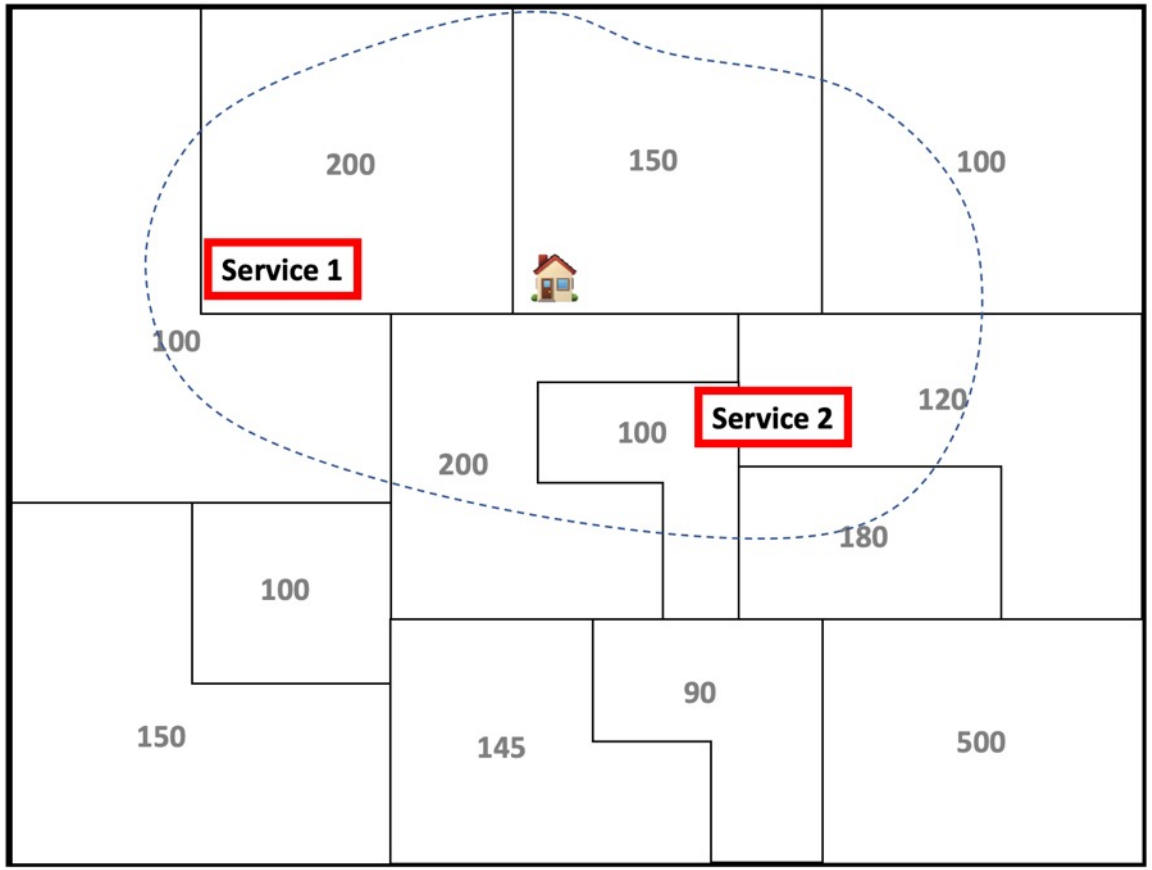
Definition: FCA accounts for the availability of physicians (providers) by surrounded demands (population) within the service area that is determined by a threshold travel time

Three models

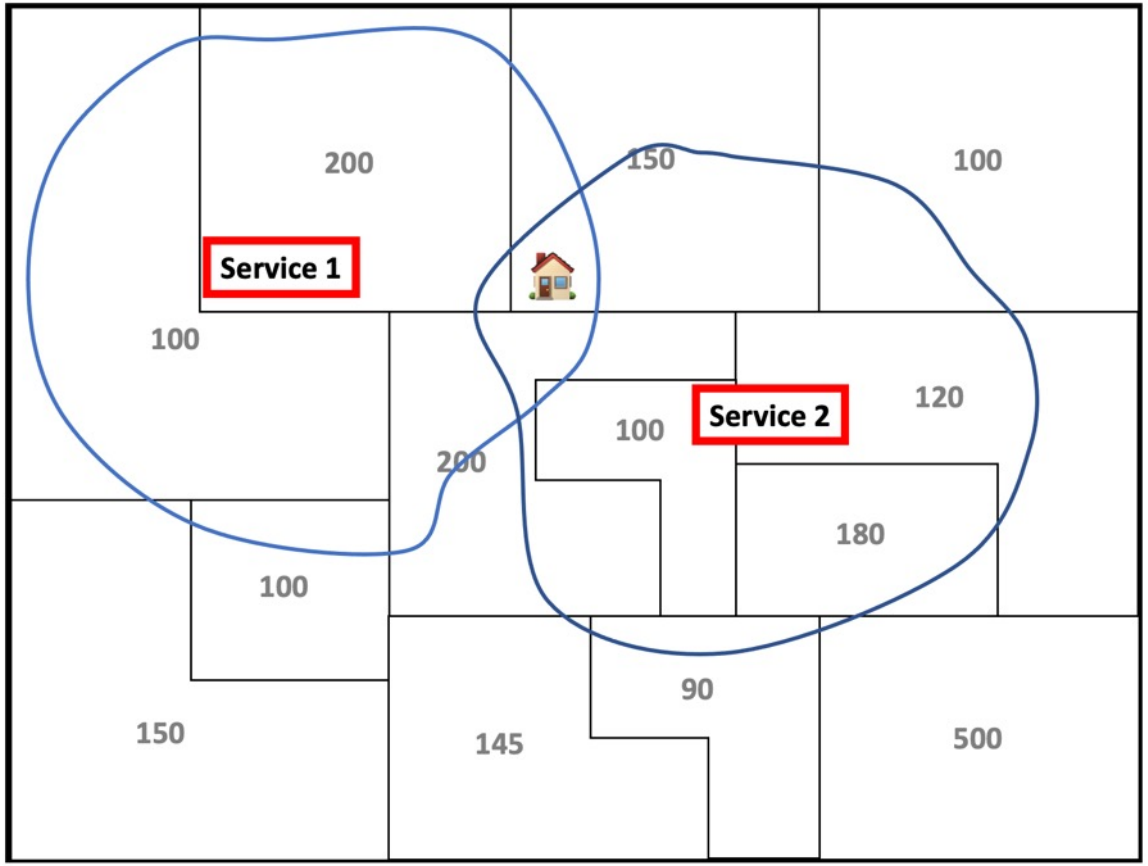
Two-Stage FCA	Enhanced Two-Stage FCA	Three-Stage FCA

Two-Stage FCA

Providers in my area

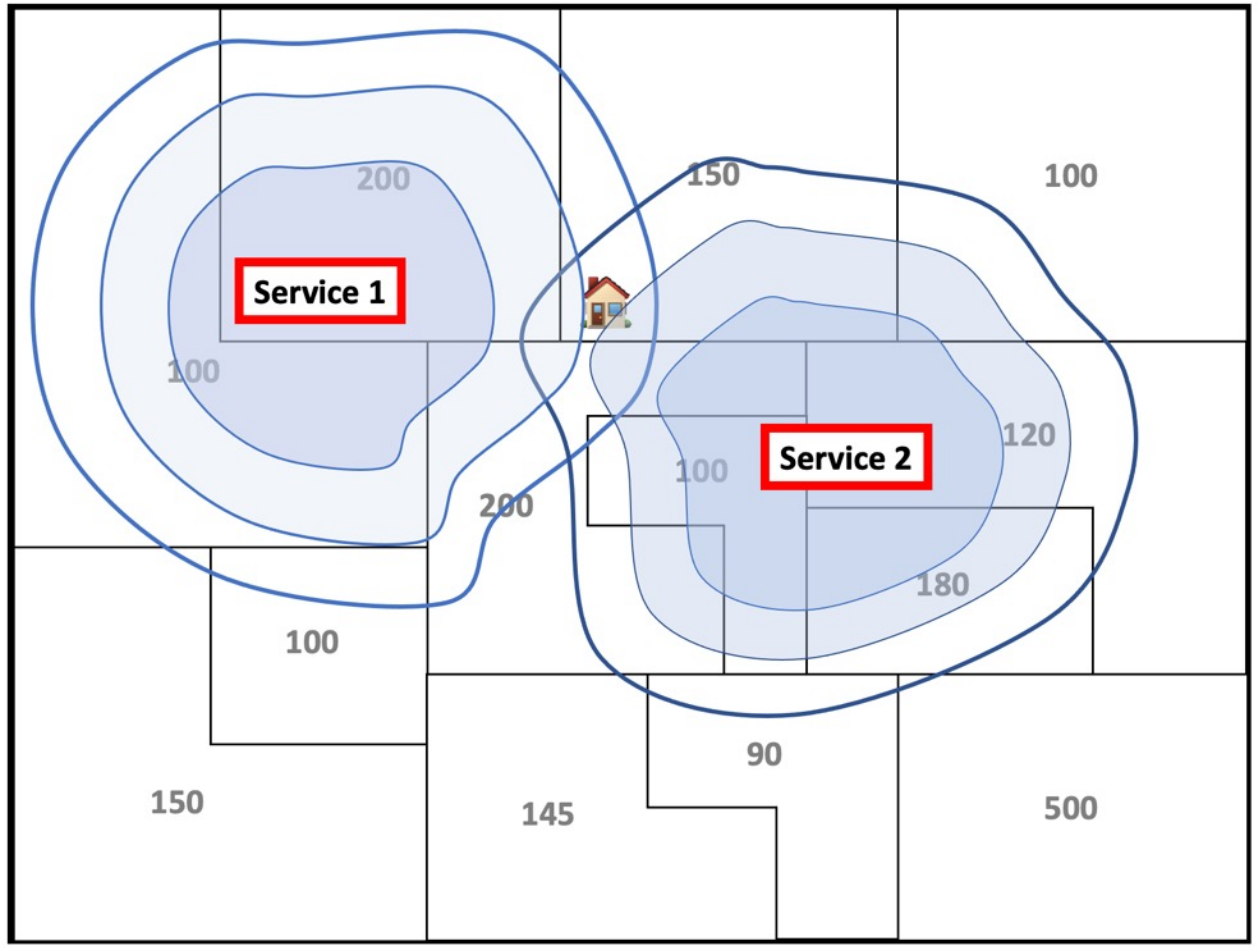


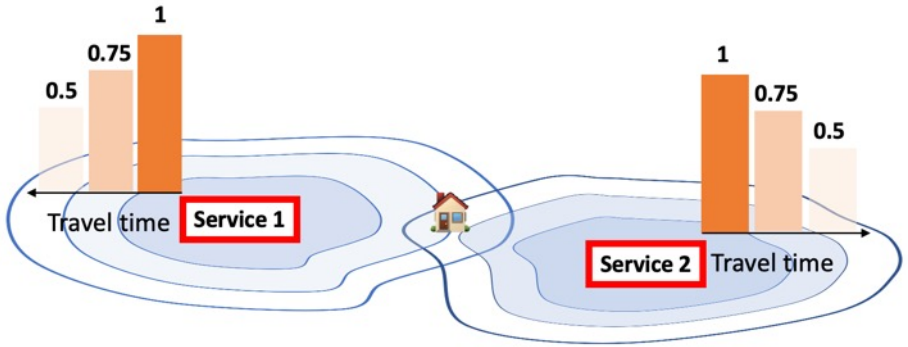
Providers serve broader area



Enhanced Two-Stage FCA

Proximity of providers

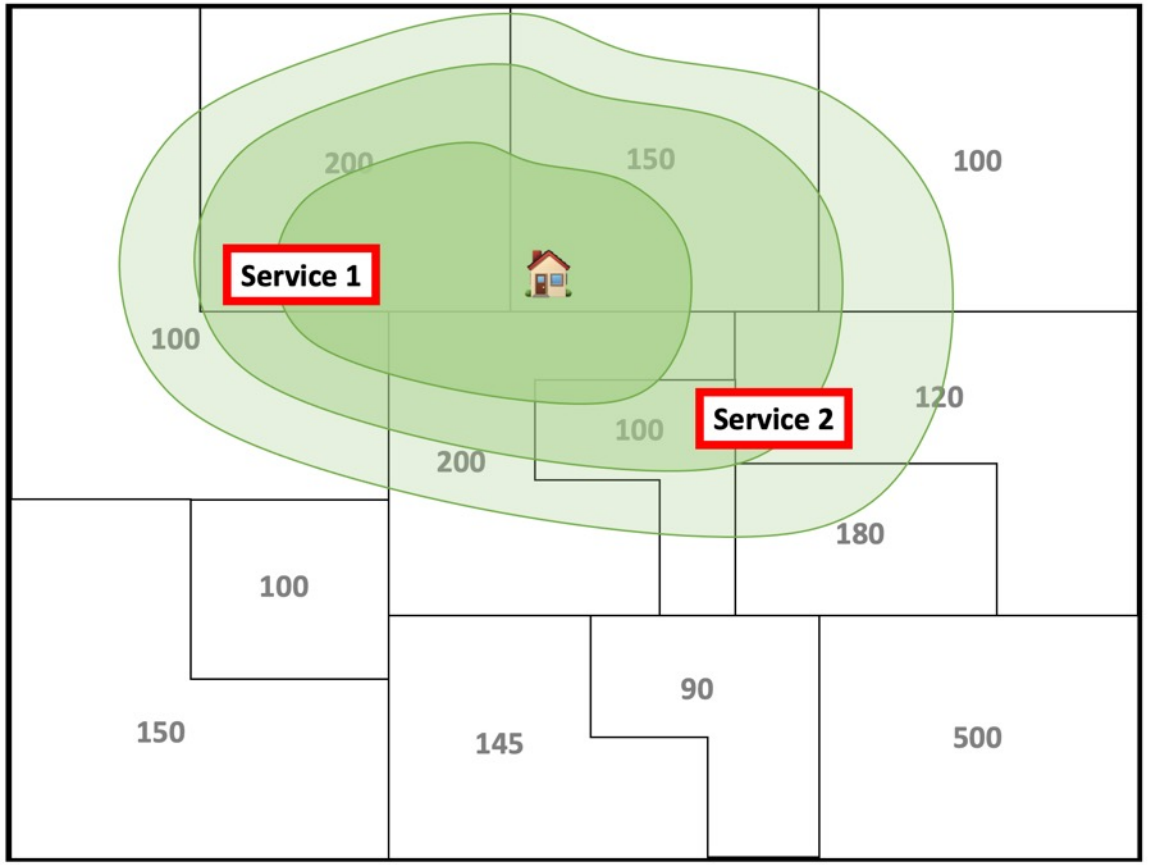




Proximity is weighted by travel time

Three-Stage FCA

Probability of provider's selection



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Probability of selecting a provider given the accessibility of the area

Data Ingestion

WebMD

All Results

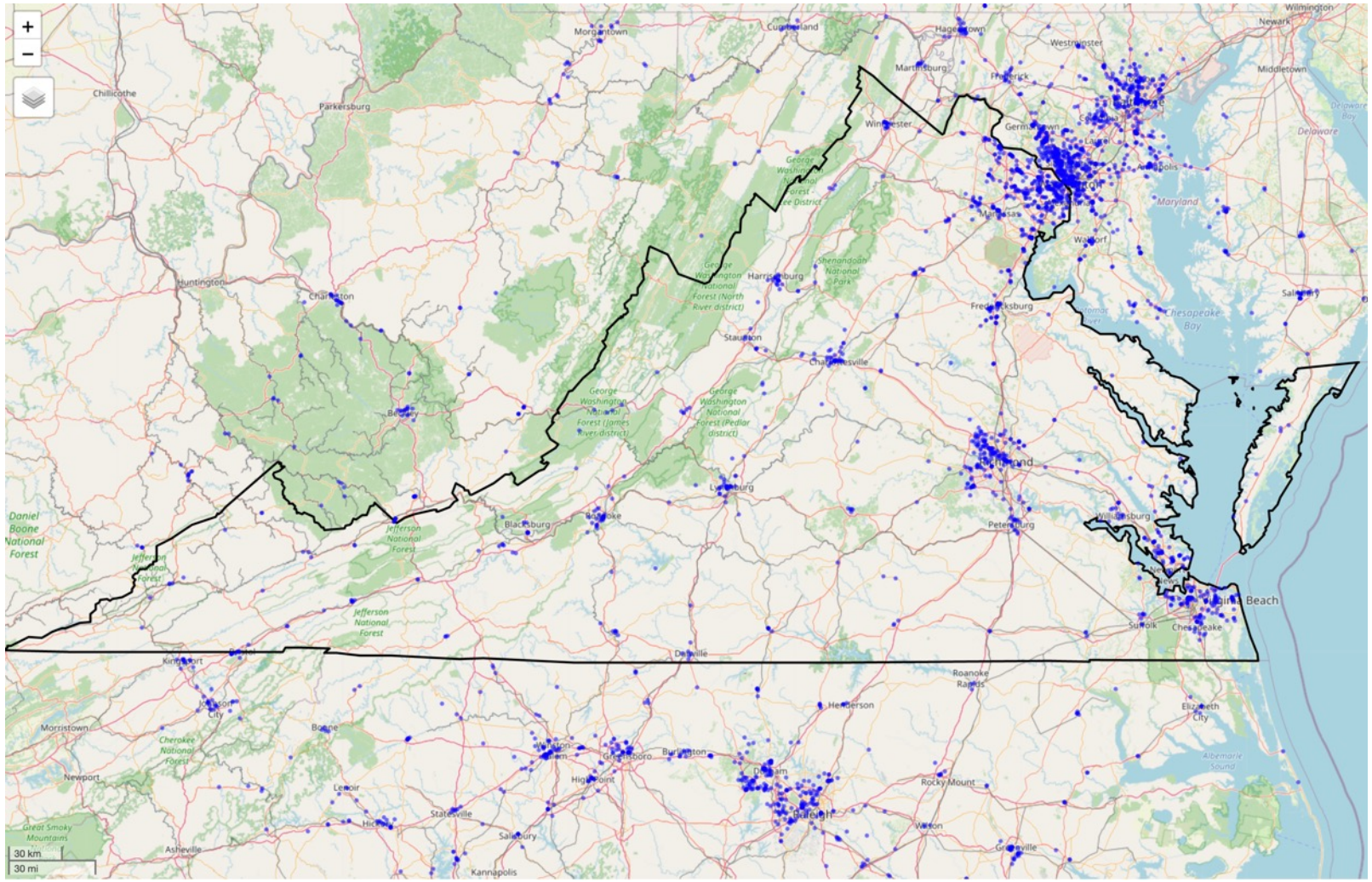
Dr. Mohamad Sami Jaafar, MD
Internal Medicine/Pediatrics, Ophthalmology, Optometry
★★★★½ (86)
44 Years Experience
2150 Pennsylvania Ave NW, Washington, DC 20037 2.06 miles
Dr Mohamad S. Jaafar is currently Professor of Ophthalmology and **Pediatrics** at the George Washington University and Chief of the Division of Ophthalmology at Childrens National Medical ... Read More

Dr. Mary Elizabeth Latimer, MD
Child Neurology, Internal Medicine/Pediatrics, Neurology
★★★★½ (58)
37 Years Experience
1101 30th St NW Ste 320, Washington, DC 20007 1.66 miles
Dr. Latimer graduated from the Tufts University School of Medicine in 1985. She works in WASHINGTON, DC and 1 other location and specializes in Child Neurology, Internal Medicine/**Pediatrics** ... Read More

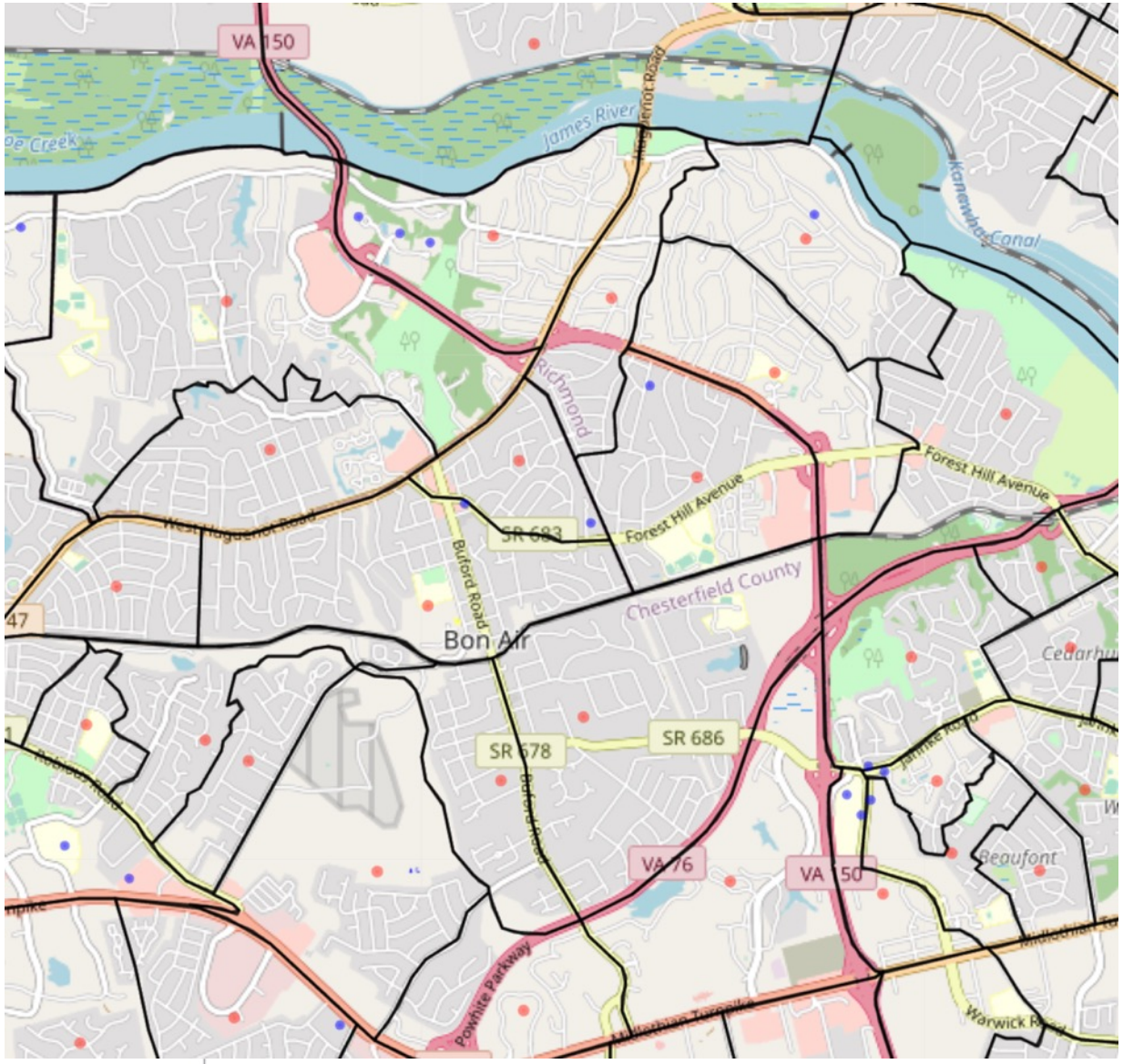
EM

Dr. Ezra Marcelo Morgan, MD
Family Medicine, Pediatrics
★★★★☆ (34)
28 Years Experience
1515 N COURTHOUSE RD STE 140, ARLINGTON, VA 22201 0.05 miles
"One of the best PCPs I've ever had. Very knowledgeable and takes the extra time to explain his diagnosis to his patients. He diagnosed a middle ear issue that my supposedly high ... Read More"

Pediatrics in Virginia (including radius from 5 different cities)



Travel time



Block group centroid

Physicians

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11
516500115004	467.6	200.7	209.0	214.7	207.9	207.9	207.9	214.7	158.8	207.5	214
517100043003	483.7	222.9	231.2	236.9	230.1	230.1	230.1	236.9	181.0	229.8	236
511990510002	433.4	166.5	174.8	180.5	173.7	173.7	173.7	180.5	130.2	173.4	180
510594327021	441.1	21.7	30.0	35.7	28.9	28.9	28.9	35.7	144.6	28.6	35
515102003032	445.4	15.6	23.9	26.8	16.5	16.5	16.5	26.8	153.8	16.2	26
515102013002	451.4	24.3	29.5	24.0	12.8	12.8	12.8	24.0	162.0	9.6	24
515102001052	446.0	17.4	24.5	24.9	14.6	14.6	14.6	24.9	154.7	14.3	24
516003002003	424.9	11.3	16.8	24.1	24.5	24.5	24.5	24.1	158.3	32.9	24
517100022001	483.7	216.8	225.1	230.8	223.9	223.9	223.9	230.8	174.8	223.6	230
510594811031	427.2	27.3	18.9	27.4	32.9	32.9	32.9	27.4	173.8	41.7	27
510411004101	397.4	144.8	153.1	158.8	152.0	152.0	152.0	158.8	133.3	151.7	158
517100056022	481.3	214.4	222.7	228.4	221.5	221.5	221.5	228.4	172.4	221.2	228
510594713012	433.0	11.0	9.7	16.1	16.3	16.3	16.3	16.1	164.6	25.1	16

Physician location

Block group centroid

Example: Richmond

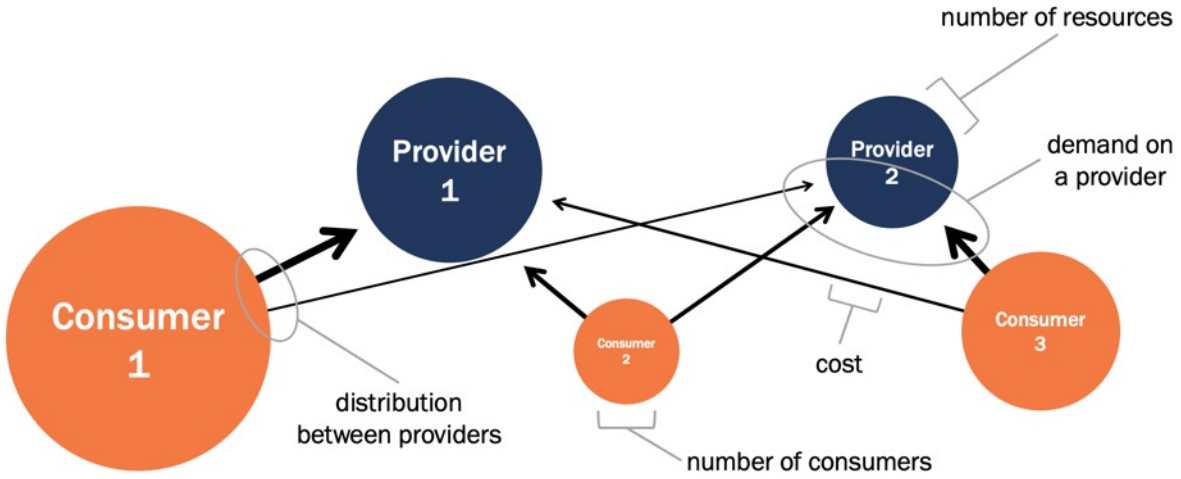
R Package – catchment_ratio

R Implementation: `catchment`

Complete introduction: uva-bi-sdad.github.io/catchment/articles/introduction.html

```
> remotes::install_github("uva-bi-sdad/catchment")
> catchment::catchment_ratio(consumers, providers, cost)
```

Information



Limitations:

- Information of physicians – Active records?
- Travel distance: Block group (centroid) – physicians
- Geographical availability → Accessibility

New Metrics

A New Method to Estimate Food Insecurity

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Food Insecurity Alternative Quantification

1 Using the seed distribution of a County/City

Household Size

Income Bracket	1	2	3	4	5	6	7
Less than $10,000	2518	3357	1915	1799	766	262	147
$10,000 to $14,999	1119	1492	851	800	341	116	66
$15,000 to $24,999	2704	3605	2057	1932	823	281	158
$25,000 to $34,999	3450	4600	2624	2465	1050	359	202
$35,000 to $49,999	5595	7459	4255	3998	1703	582	328
$50,000 to $74,999	9977	13302	7589	7129	3037	1037	584
$75,000 to $99,999	10537	14048	8014	7529	3208	1095	617
$100,000 to $149,999	18649	24864	14184	13325	5677	1939	1092
$150,000 to $199,999	14080	18772	10709	10061	4286	1464	824
$200,000 or more	24710	32945	18794	17656	7523	2569	1447

2 … and Census Tract level information (target)

Income bracket	Number Households
Less than $10,000	60
$10,000 to $14,999	397
$15,000 to $24,999	197
$25,000 to $34,999	230
$35,000 to $49,999	81
$50,000 to $74,999	10
$75,000 to $99,999	34
$100,000 to $149,999	9
$150,000 to $199,999	28
$200,000 or more	50

Household Size	Number
1	94
2	18
3	115
4	94
5	244
6	87
7	444
1	1096

4 Cost-of -Living

3 We estimate Census Tract distributions to identify households at risk of Food Insecurity using **Iterative Proportional Fitting**

Example for a Census tract in Virginia

	Household Size							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**total**
Less than $10,000	1	3	2	2	1	0	0	**9**
$10,000 to $14,999	1	3	2	2	1	0	0	**9**
$15,000 to $24,999	3	9	5	5	2	0	1	**25**
$25,000 to $34,999	7	18	9	10	4	0	2	**50**
$35,000 to $49,999	2	6	3	4	1	0	1	**17**
$50,000 to $74,999	15	42	21	24	9	1	4	**116**
$75,000 to $99,999	12	34	17	19	7	1	3	**93**
$100,000 to $149,999	33	89	44	51	18	2	8	**245**
$150,000 to $199,999	12	32	16	18	7	1	3	**89**
$200,000 or more	59	162	80	93	33	4	14	**445**
total	**145**	**398**	**199**	**228**	**83**	**9**	**36**	1,098.00

Food Insecure Population

Food Insecure At-Risk Population

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Source: ACS

References:

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Acknowledgements

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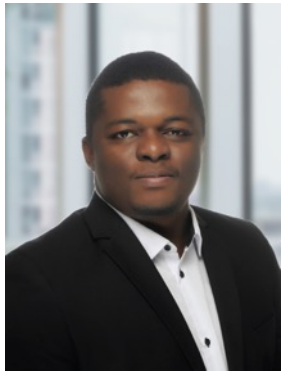

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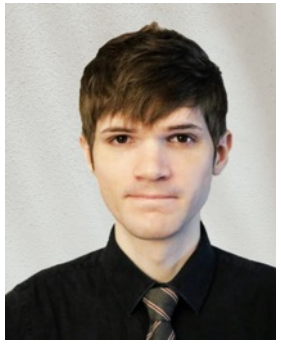

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