Data-Driven Approaches for Maximizing Social Equity of Public Health Outbreak Response

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Biocomplexity Institute

VDH Virginia Department of Health

Background and Motivation

- Inequalities in **access to care and deployment strategies** can exacerbate existing health disparities
- For COVID-19, there are **pockets of under-vaccinated populations** such as in rural areas and in specific demographic groups
  - Such groups may be more susceptible to severe outcomes
- Using **anonymized and aggregate mobility data** one can identify optimal sites for increasing access to healthcare interventions

Data Sources

- **SafeGraph**
  - Anonymized geolocation data aggregated from smartphones
  - Weekly estimates of visits from Census Block Groups (CBGs) to Places of Interest (POIs)
  - Limitations: Under-reporting, noise, lack of demographic information
- **Census Data (American Community Survey)**
  - Population of demographic groups at CBG level
  - Limited information about combined demographic groups
  - Imputed using synthetic population developed by **UVA-BI**
- **Virginia Department of Health**
  - Vaccine uptake information per census tract

SAFEGRAPH

AMERICAN COMMUNITY SURVEY
U.S. CENSUS BUREAU

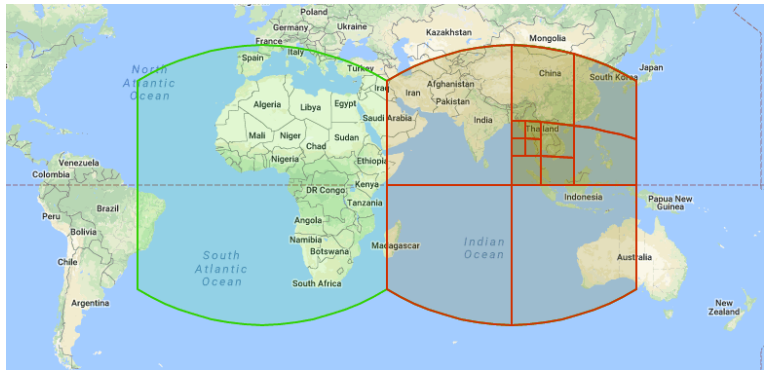
UNIVERSITY of VIRGINIA
BIOCOMPLEXITY INSTITUTE

VDH VIRGINIA DEPARTMENT OF HEALTH

Spatial units

S2 Geometry

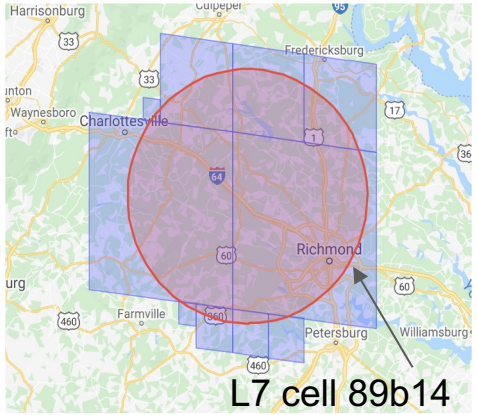
Hierarchical covering of geographical areas



https://s2geometry.io/

Cell level	# in VA*	Typical size
…		
L7	41	2000 mi^2
L8	124	500 mi^2
L9	409	125 mi^2
…		
L13	14718	0.49 mi^2
L14	25376	0.12 mi^2
L15	40215	0.03 mi^2
…		

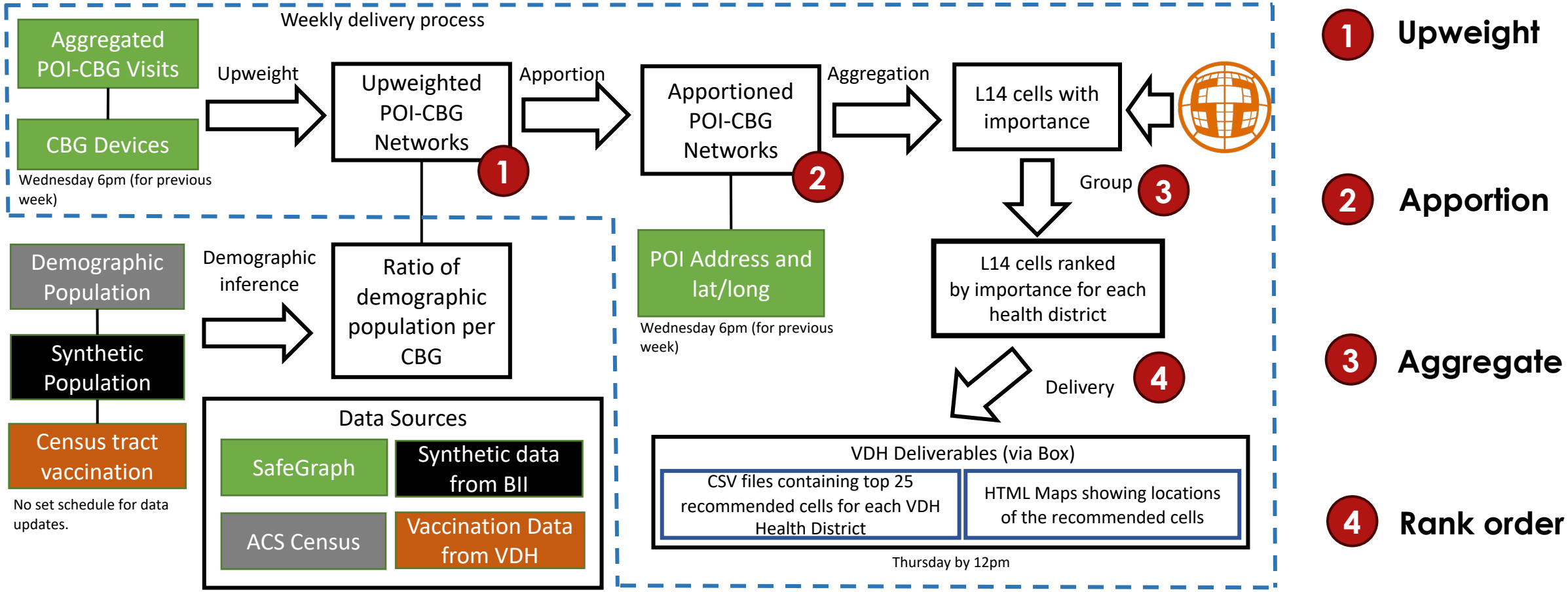
* Only counting cells for which we have at least one SafeGraph POI



- L8 cells: Approximately county-magnitude
- L14 cells: Contains 10-30 POIs

L14 Cells are recommended as potential site areas instead of specific POIs

Overall Approach



Weekly Delivery

Rank & LocationWeight
The LocationWeight is estimated # of visits to POIs in the L14 from the target group. Rank indicates the order from most- to 25th most-visited

HighlyVisitedAddress
This is the address of the POI in the L14 that sees the most visits. It is not target group-specific, and is provided to make it easier to find the L14 on the map.

Population Group
For a targeted file, these will all be the same value.

VDH District

S2 Key (L14)

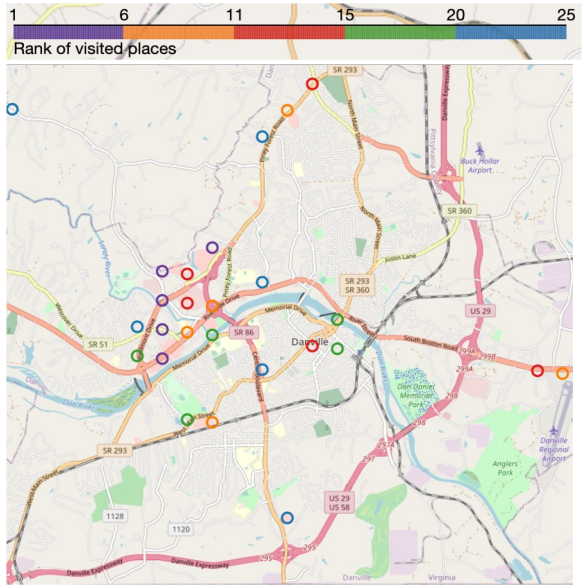
County

AreaMostVisitedDay
This is the day of the week when most visitors go to this S2 location. This is not target group-specific.

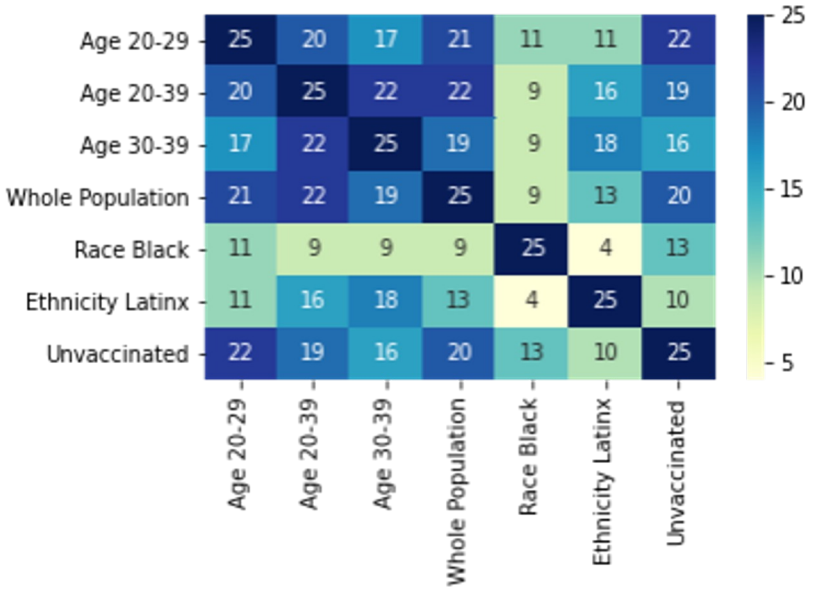
Lat and Lon
This is the latitude and longitude for the center of the L14. It is not correlated with any POI.

Locality	District	PopulationGroup	LocationID	Rank	LocationWeight	AreaMostVisitedDay	HighlyVisitedAddress	Lat	Lon
Accomack County	Eastern Shore	Age 20-30	89ba2b57	1	1803.143328082850	Friday	25274 Lankford Hwy, Onley, VA, 23418	37.69859002302910	-75.72261157704770
Accomack County	Eastern Shore	Age 20-30	89ba2b55	2	1205.0544615398000	Saturday	25220 Lankford Hwy, Onley, VA, 23418	37.69787383662480	-75.71679619566070
Accomack County	Eastern Shore	Age 20-30	89ba2caf	3	1141.5397338167300	Friday	26036 Lankford Hwy, Onley, VA, 23418	37.68816806789660	-75.72261157704770
Accomack County	Eastern Shore	Age 20-30	89b96839	4	887.9978110045220	Saturday	6528 Maddox Blvd, Chincoteague, VA, 23336	37.92906943111980	-75.36162225660980
Accomack County	Eastern Shore	Age 20-30	89b96849	5	825.5952348697430	Saturday	6243 Maddox Blvd, Chincoteague, VA, 23336	37.93499525773350	-75.36745158210710
Accomack County	Eastern Shore	Age 20-30	89bbd4ad	6	715.71804886495	Friday	25102 Lankford Hwy, Onley, VA, 23418	37.70236765102210	-75.71098058028420
Accomack County	Eastern Shore	Age 20-30	89bbd5fd	7	690.4133579895380	Saturday	20474 Lankford Hwy, Parksley, VA, 23421	37.75927241946280	-75.62371839295130
Accomack County	Eastern Shore	Age 20-30	89b9683b	8	641.1610563261370	Saturday	6691 Maddox Blvd, Chincoteague, VA, 23336	37.92833102584800	-75.35579270811400
Accomack County	Eastern Shore	Age 20-30	89b9703d	9	622.7739255129530	Saturday	7003 Lankford Hwy, Oak Hall, VA, 23416	37.94660696712150	-75.54222675618490

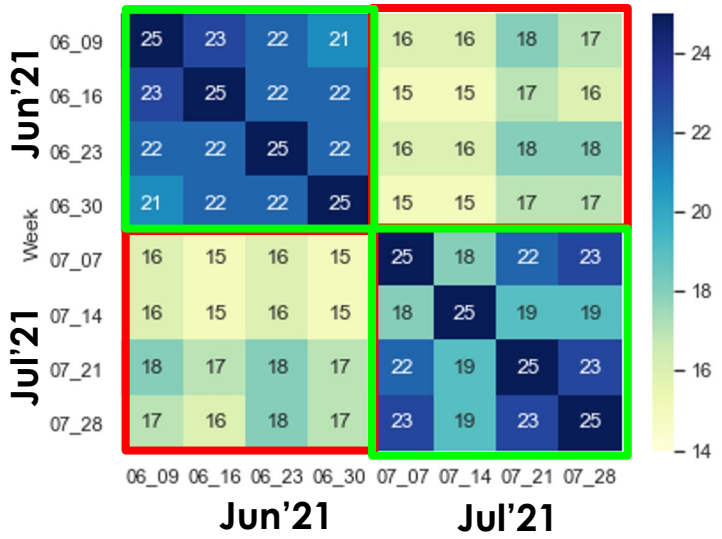
Example:
Ethnicity Latinx



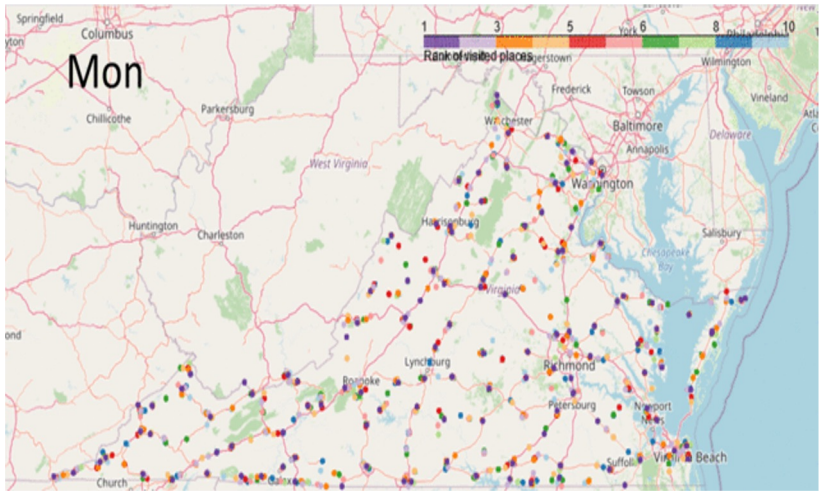
Analyses



Number of common areas in top-25 across age groups



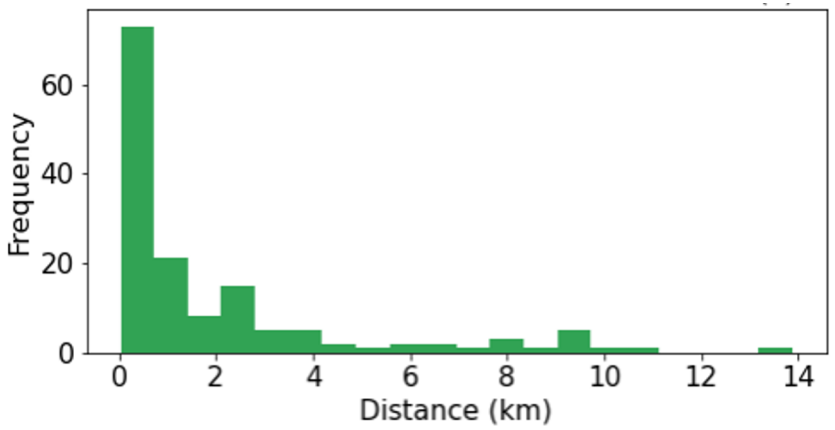
Similarity in top-25 across weeks



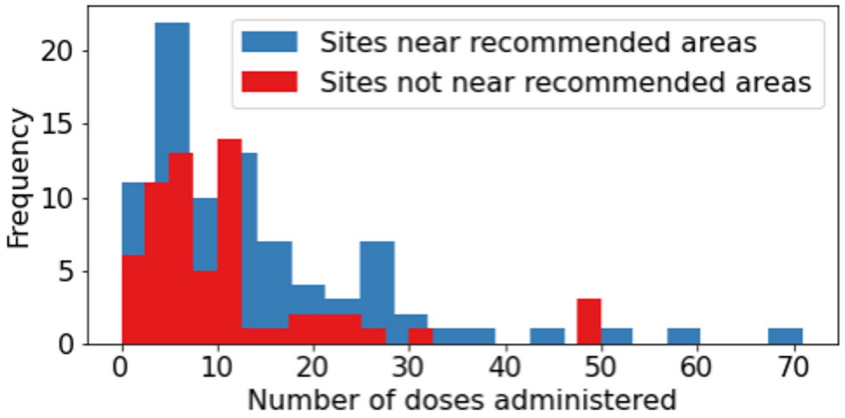
Busiest locations by day of week (and time of day)

Utility validation

Distance between each VDH-deployed site and the nearest recommended site



Comparing doses administered at near sites vs far sites



From: [redacted]@vdh.virginia.gov>
Sent: Friday, October 22, 2021 9:11 AM
To: [redacted]
Subject: [EXT] Re: Real World Mobility Data Use [redacted]

"The UVA mobility data has been beneficial for planning in our new mobile vaccine unit program. We use this data to support vaccination efforts through our local health districts. The data allows us to pinpoint our populations with the lowest vaccine uptake and not be stagnant in offering vaccination services. We now have the data to target 5-10 places in a week if we do not get good enough participation at our standard mobile vaccine sites to take the mobile units out and target populations with the lowest vaccination uptake. We use the UVA mobility data to focus vaccination efforts on these target groups while also providing additional accessible and convenient locations to be vaccinated. Using the UVA's mobility data gives us the unique advantage of being able to bring the vaccine to members of the commonwealth instead of them seeking out where to get vaccinated, an advantage that will contribute to the fight against Covid-19."

Respectfully,

[redacted]

CVC/Mobile Program Manager
Virginia Department of Health
[redacted]

VDH testimonial

More details: Z. Mehrab et al., "Data-Driven Real-Time Strategic Placement of Mobile Vaccine Distribution Sites", The Thirty-Sixth AAAI Conference on Artificial Intelligence (AAAI-22)