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COMPUTING GEOGRAPHICAL ACCESS TO HOSPITALS IN TWO COUNTRIES

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NLM 2016 Informatics Training Conference, Columbus, OH
June 28th, 2016

“significant role in emergency department utilization in children”

(Ludwick A, 2009)

“impairs timely diagnosis and treatment of breast, colorectal and lung cancer”

(Scoggins JF, 2012)

“decreased odds of rheumatoid arthritis diagnosis”

(Polinski JM, 2014)

“decreased likelihood of receiving radiation therapy for rectal cancer”

(Lin CC, 2016)

“not associated with higher inpatient mortality among time-sensitive conditions”

(Hsia RY, 2012)

“the evidence is inconclusive”

(Syed ST, 2013)

“no evidence that hospital closures were associated with worse outcomes”

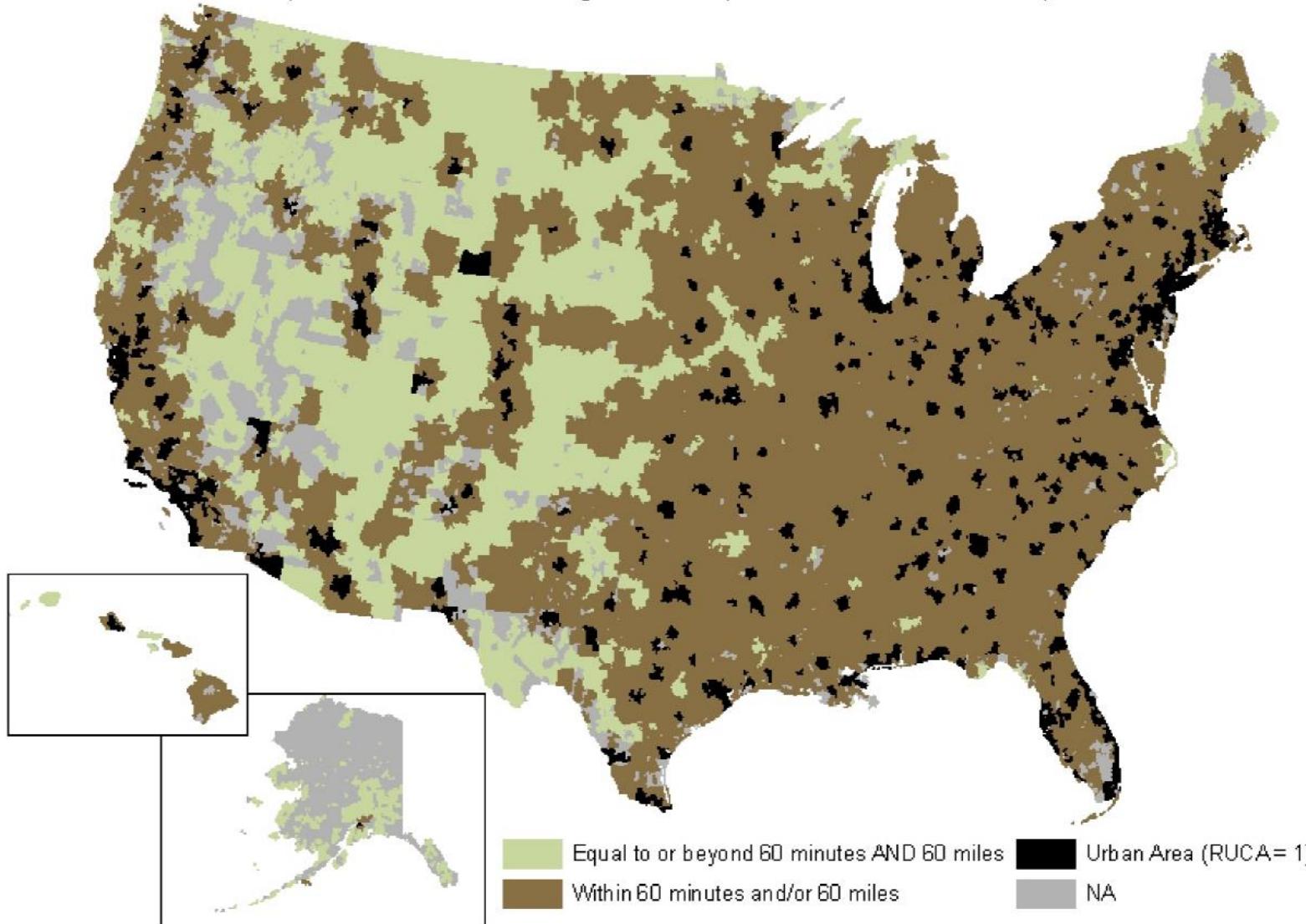
(Joynt KE, 2015)

Research questions

1. What is the current state of geographical access to hospitals?

Travel Distance to Nearest Hospital

(short-term non-federal general hospital with at least 75 beds)

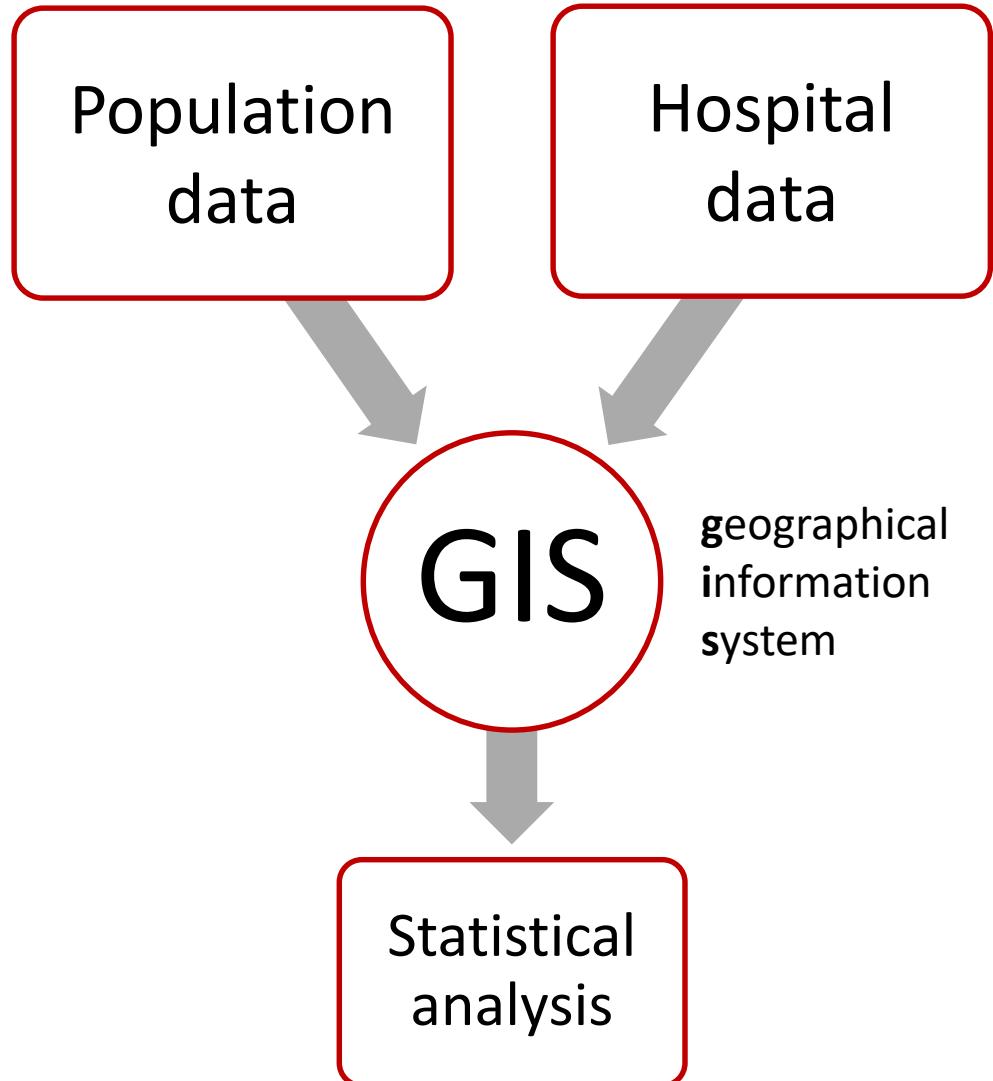


*the U.S. census is done once
every 10 years, i.e. this is based on
the census of year 2000*

(Center for Rural Health,
Univ. of North Dakota,
2006/2002)

Research questions

1. What is the current state of geographical access to hospitals?
2. Are there disparities in geographical access?
3. *Are there relationships between geographical access and hospital utilization?*



United States



American Hospital
Association

1.16 billion
queries!

here

Maps &
Analyses

?

Brazil



Instituto Brasileiro de Geografia e Estatística



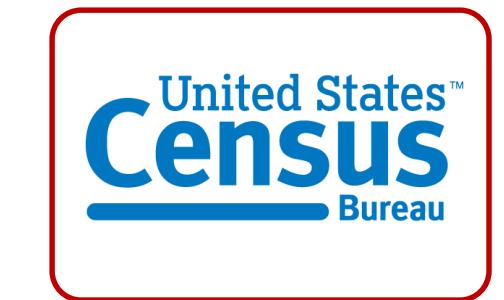
DATASUS
Departamento de Informática do SUS

1.58 billion
queries!

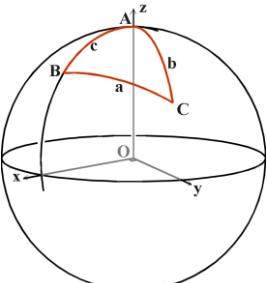
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Maps &
Analyses

United States



Haversine
distance



Google Cloud Platform

Brazil

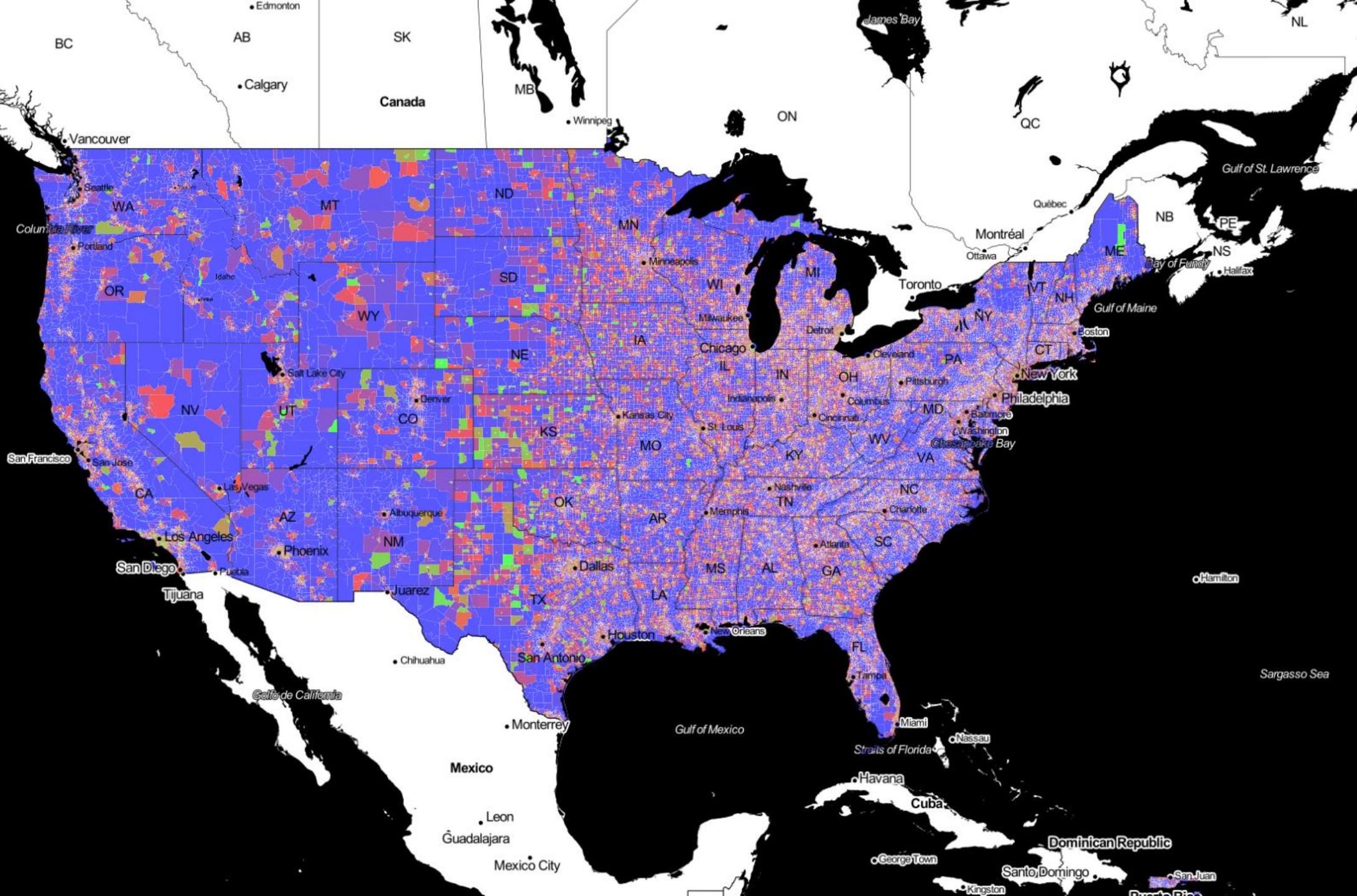


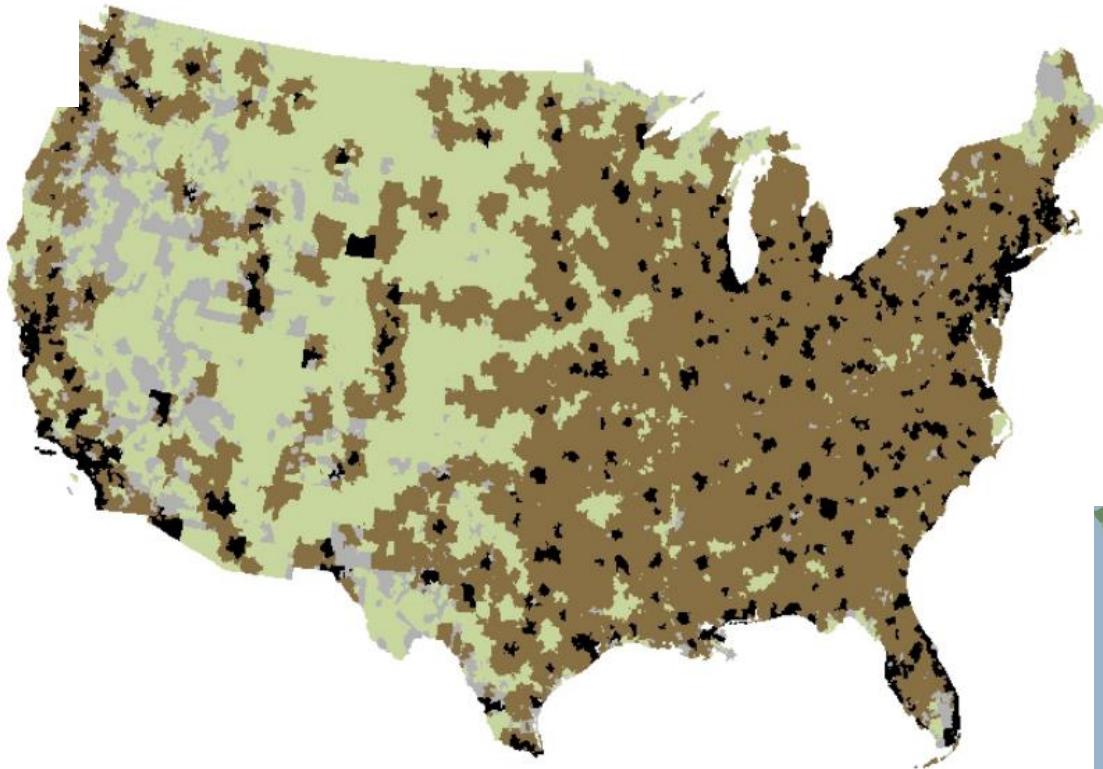
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Maps &
Analyses



Maps &
Analyses



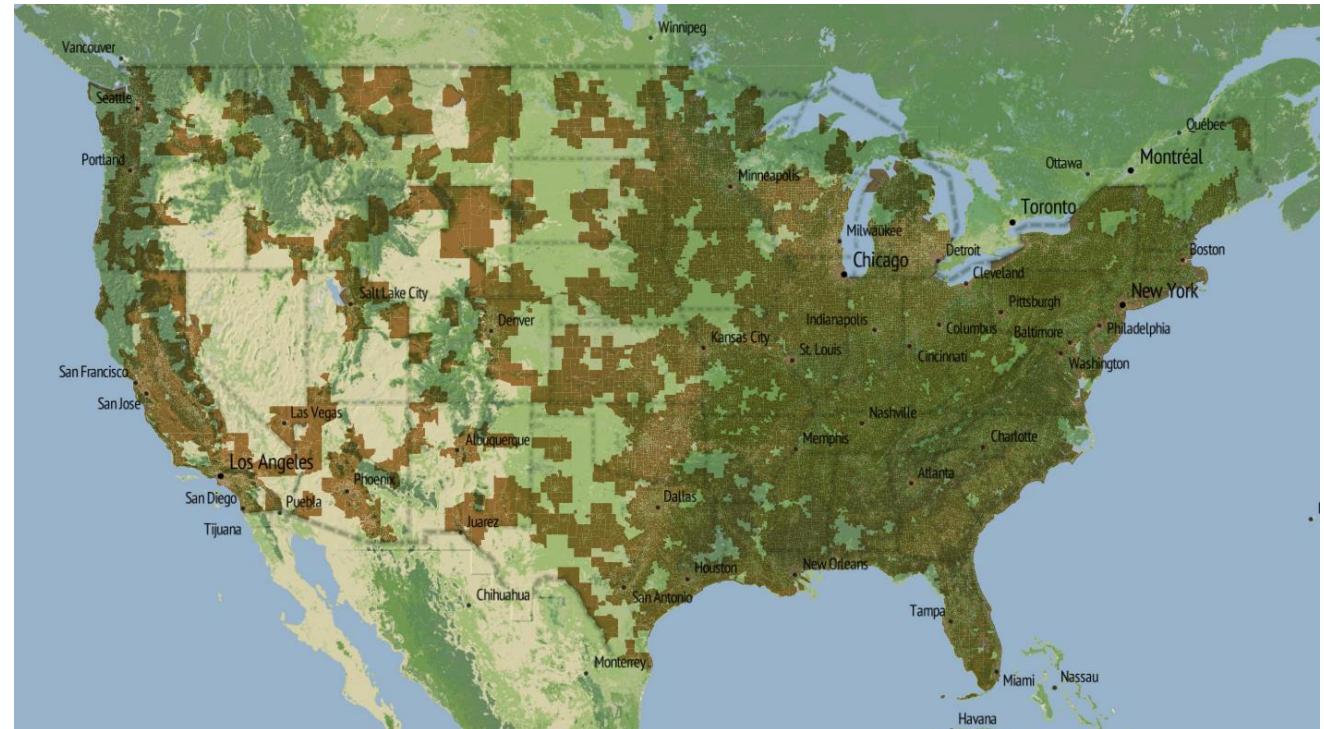


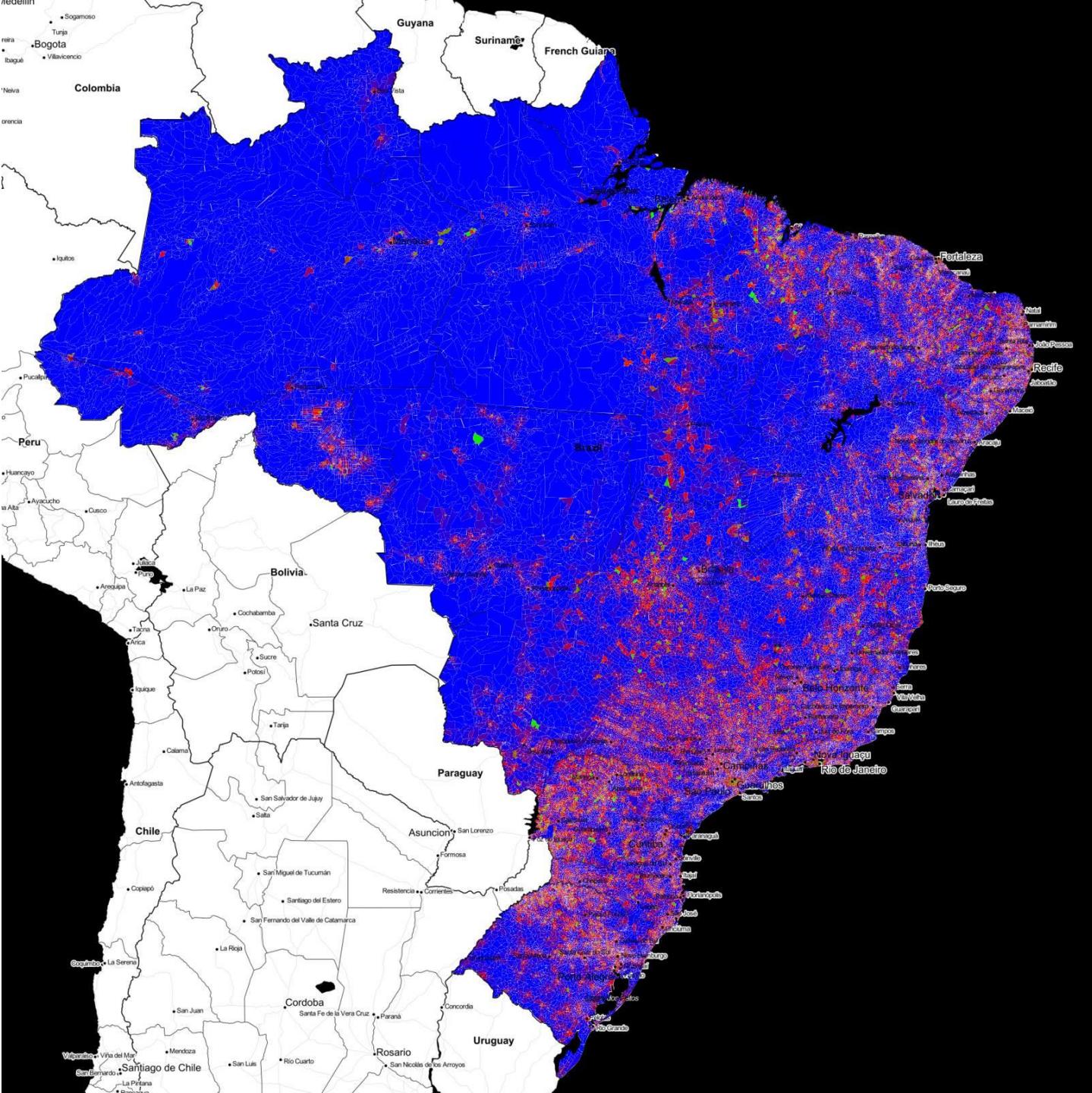
2014:

- **4,926** community hospitals
- Population > 60 minutes:
6,914,589 ($\downarrow < 1\%$)

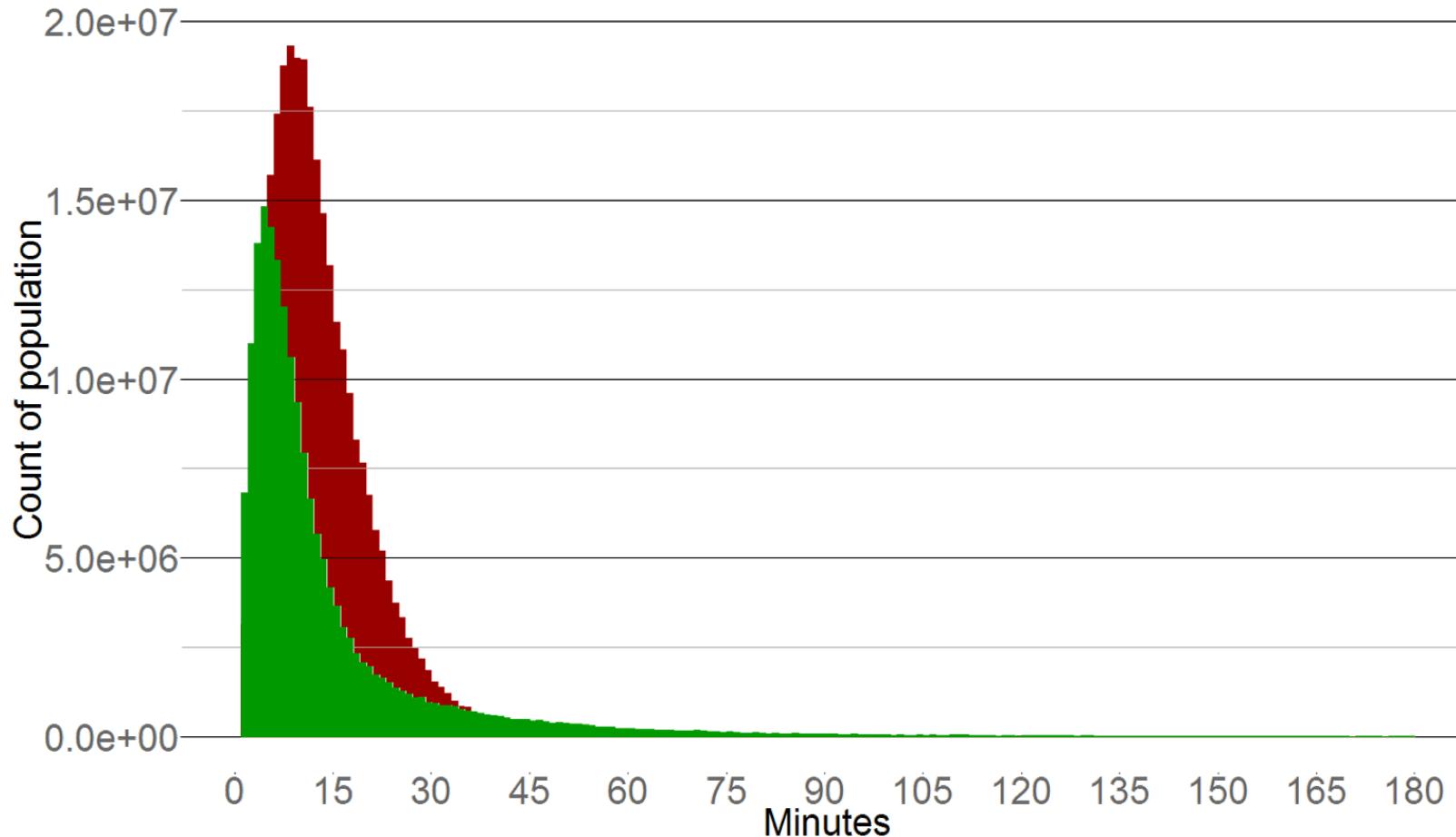
2002:

- **4,927** community hospitals
- Population > 60 minutes:
6,971,386





USA & Brazil: Travel time to nearest community hospital



United States:

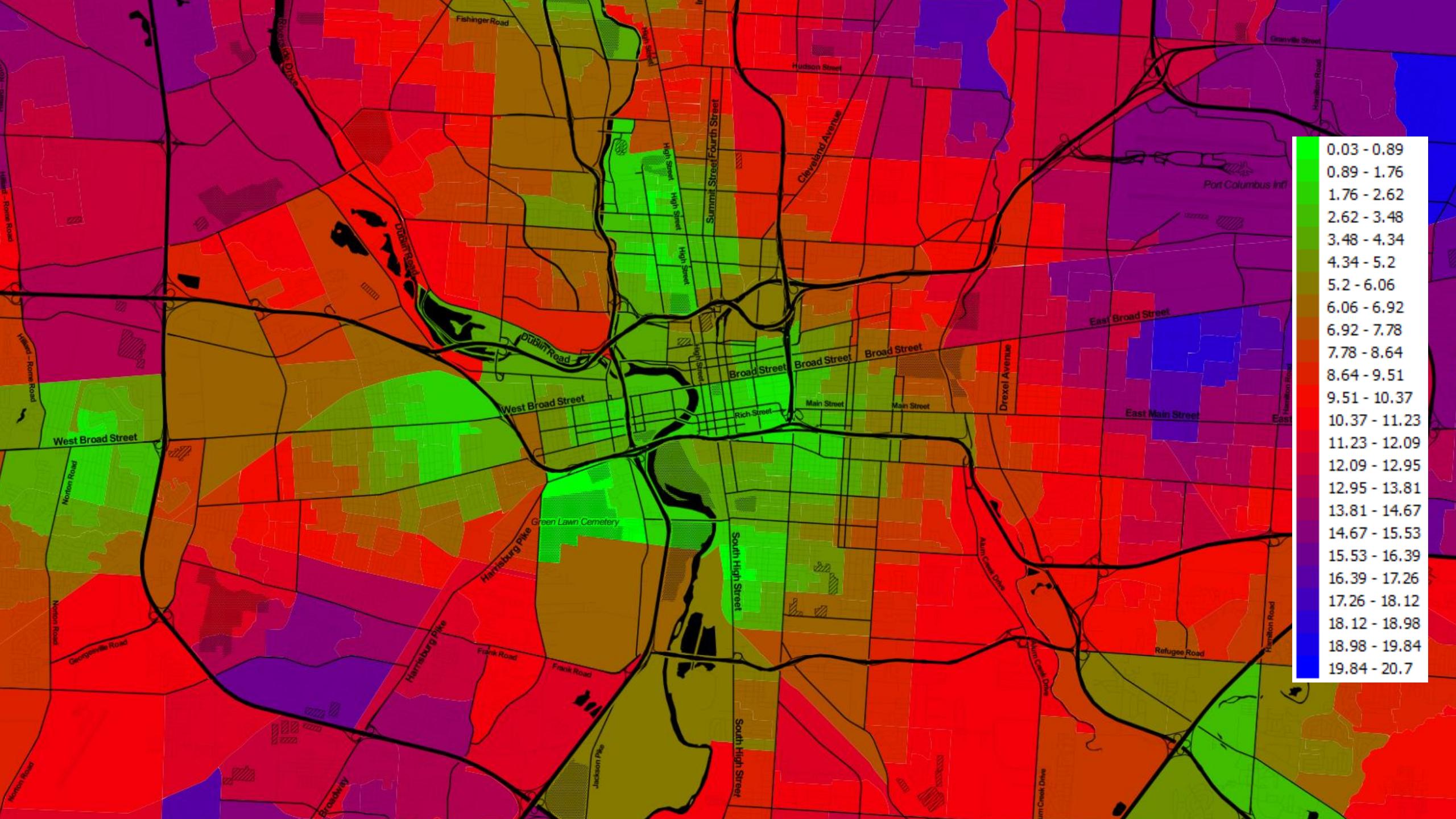
Median car travel time:
11.05 minutes

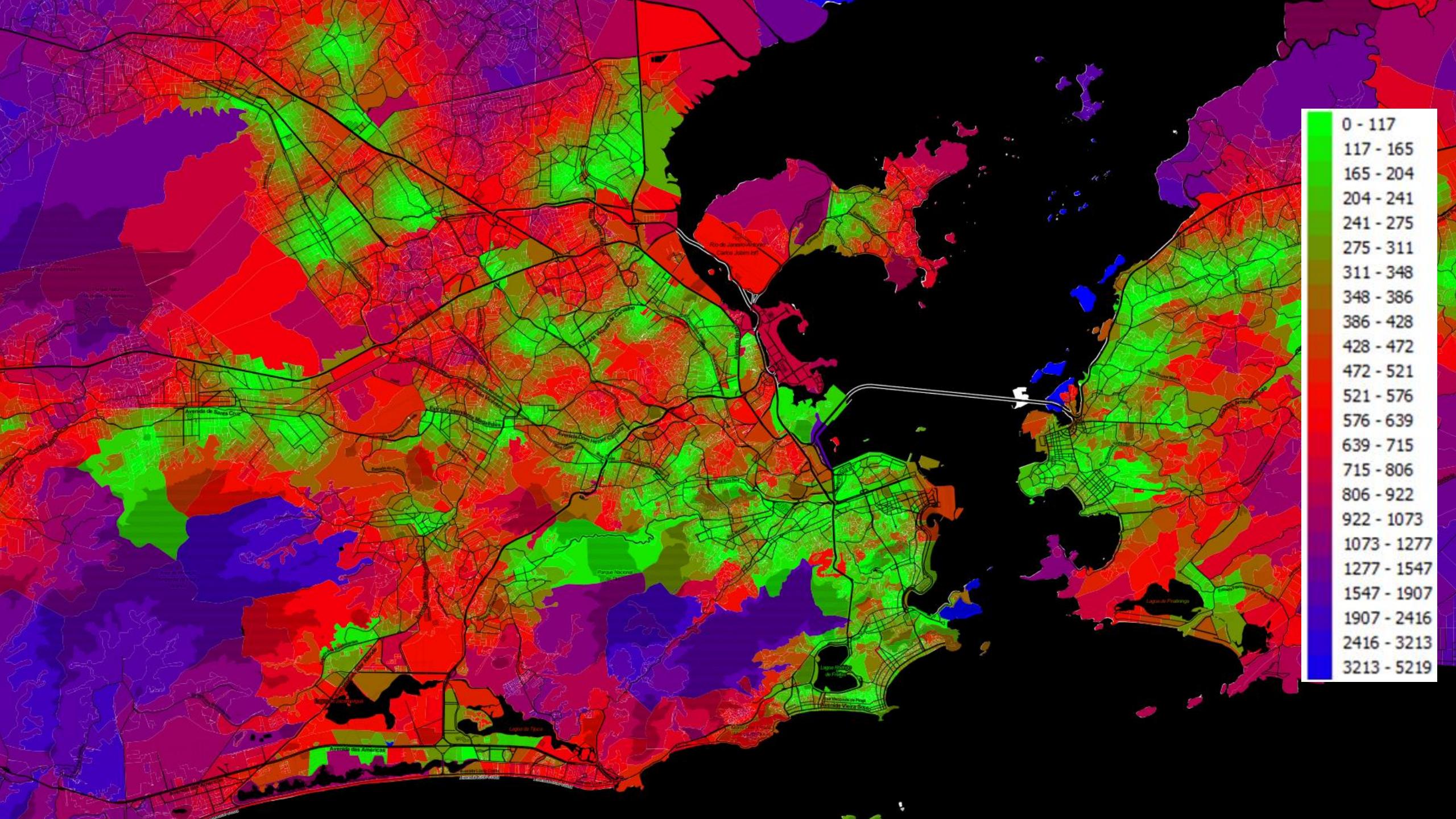
Population > 60 min:
6,914,589 (2.27%)

Brazil:

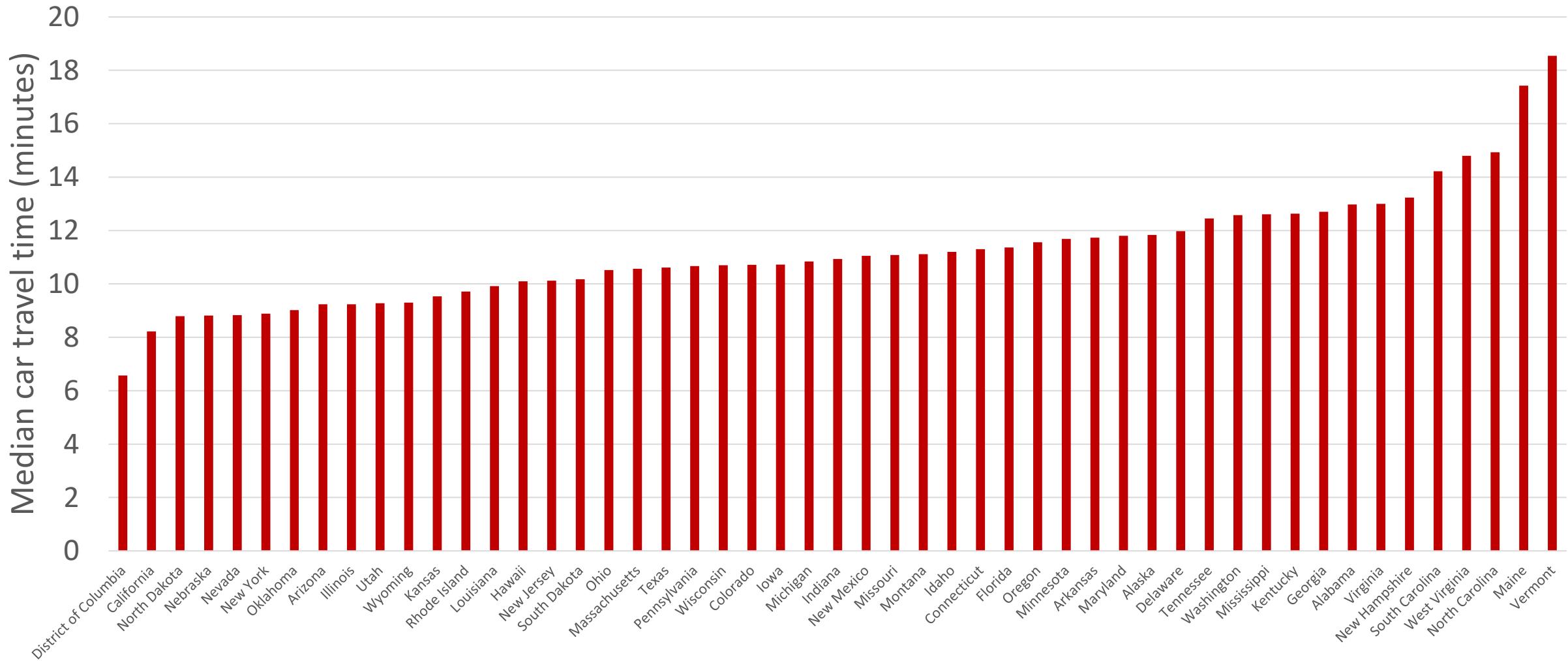
Median car travel time:
9.52 minutes

Population > 60 min:
9,400,150 (4.95%)

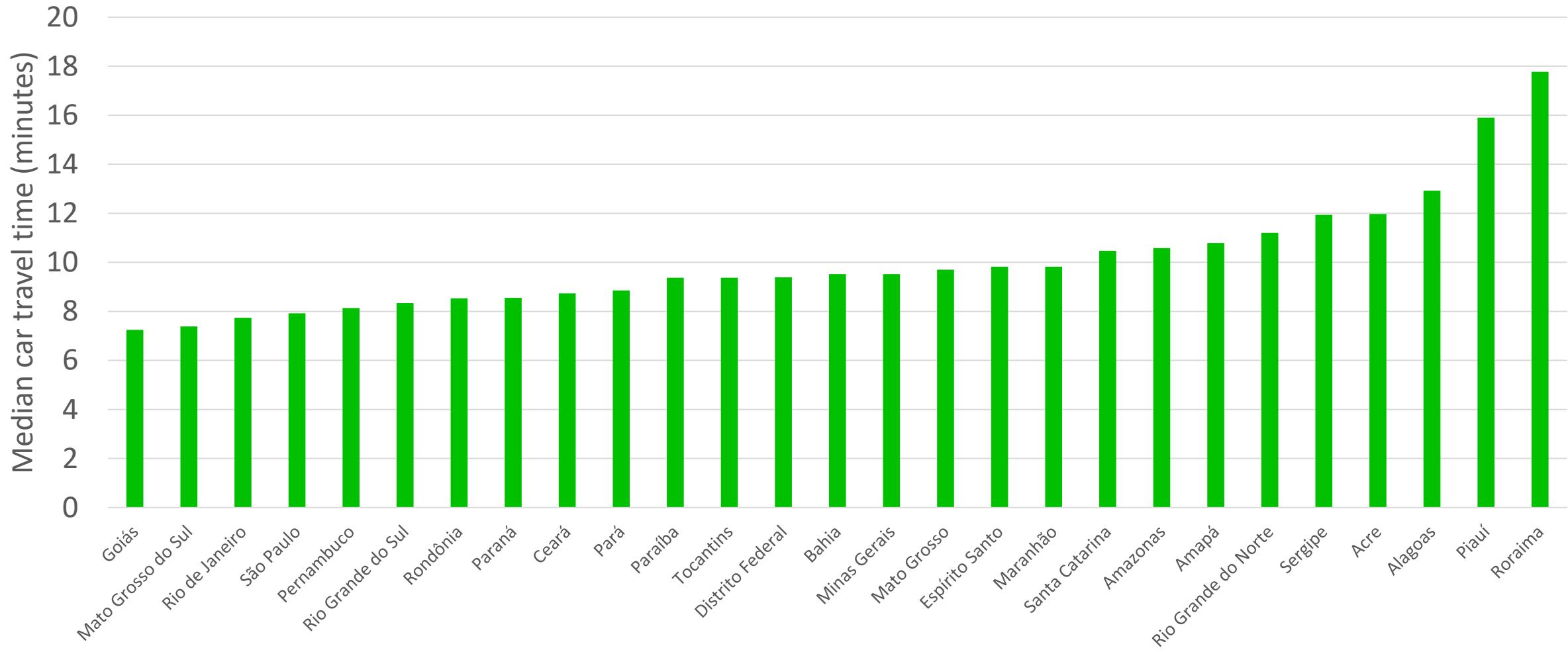




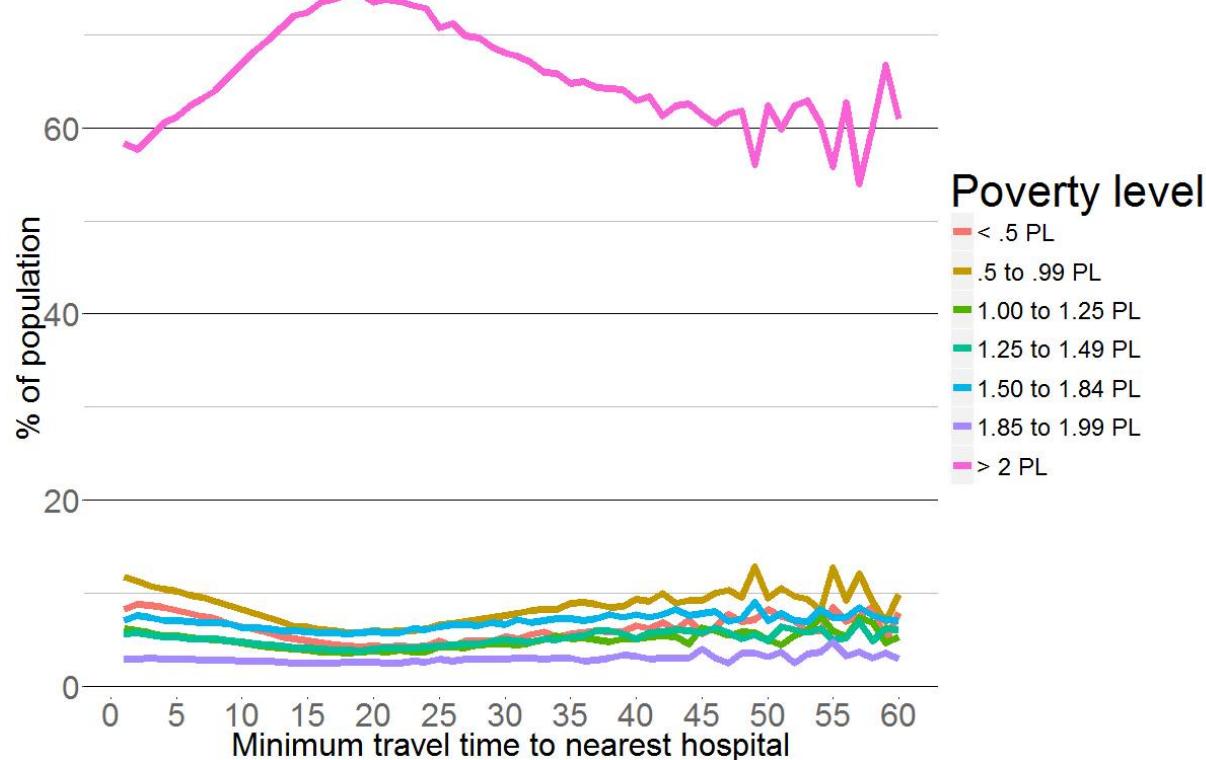
USA: Median car travel time to nearest community hospital (minutes)



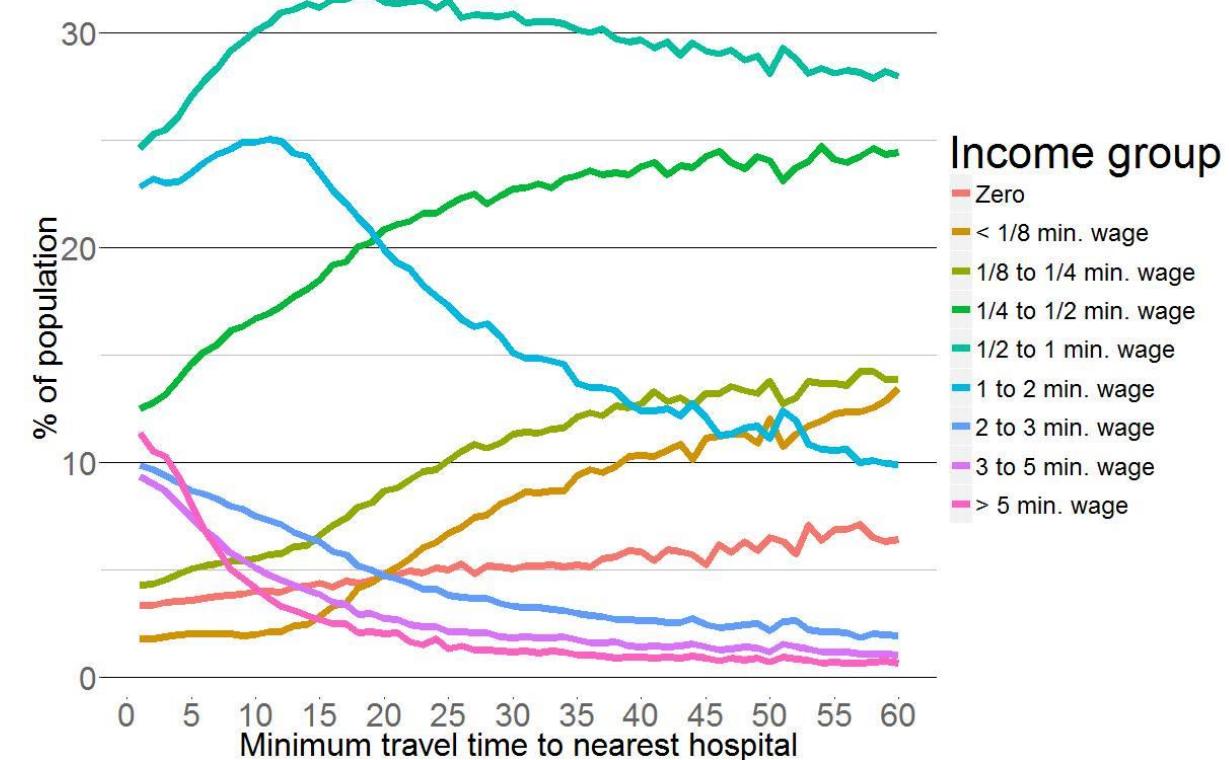
Brazil: Median car travel time to nearest community hospital (minutes)



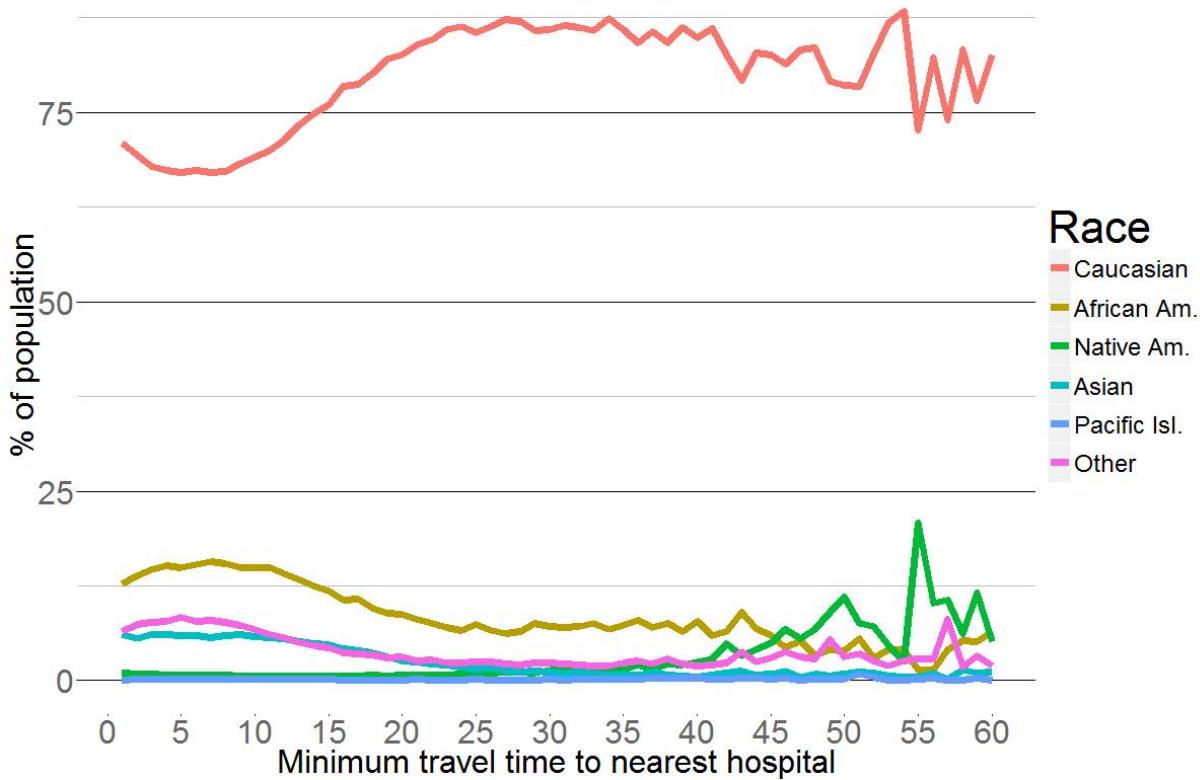
USA: Geographical access to hospitals according to poverty level



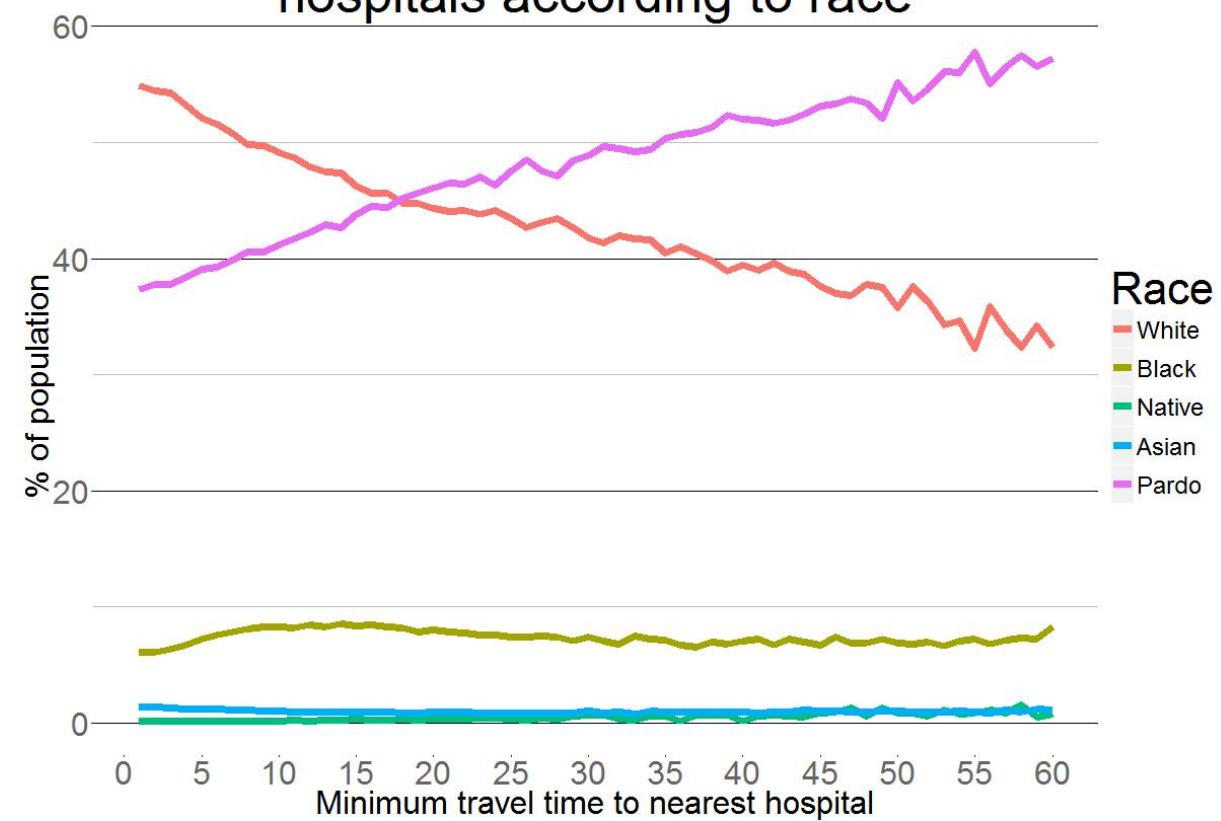
Brazil: Geographical access to hospitals according to income per capita



USA: Geographical access to hospitals according to race



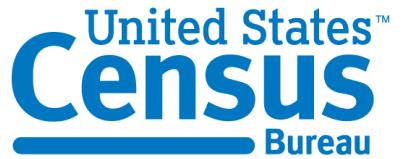
Brazil: Geographical access to hospitals according to race



United States: Emergency room admissions

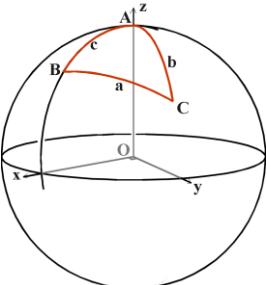
	2.5%	97.5%	p-value
Total population	0.2707931	0.305682	<2e-16
Avg. travel time	-21.70501	-16.8838	<2e-16

United States



American Hospital
Association

Haversine
distance



Google Cloud Platform

Maps &
Analyses

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here

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Analyses

FUTURE WORK

Trends over time:

- American Community Survey: **2009 → 2014**

Where are the best locations for building new facilities?

- **Fermat-Weber** problem.

Thank you for your attention!

Source code:

<https://github.com/fabkury/drithop>

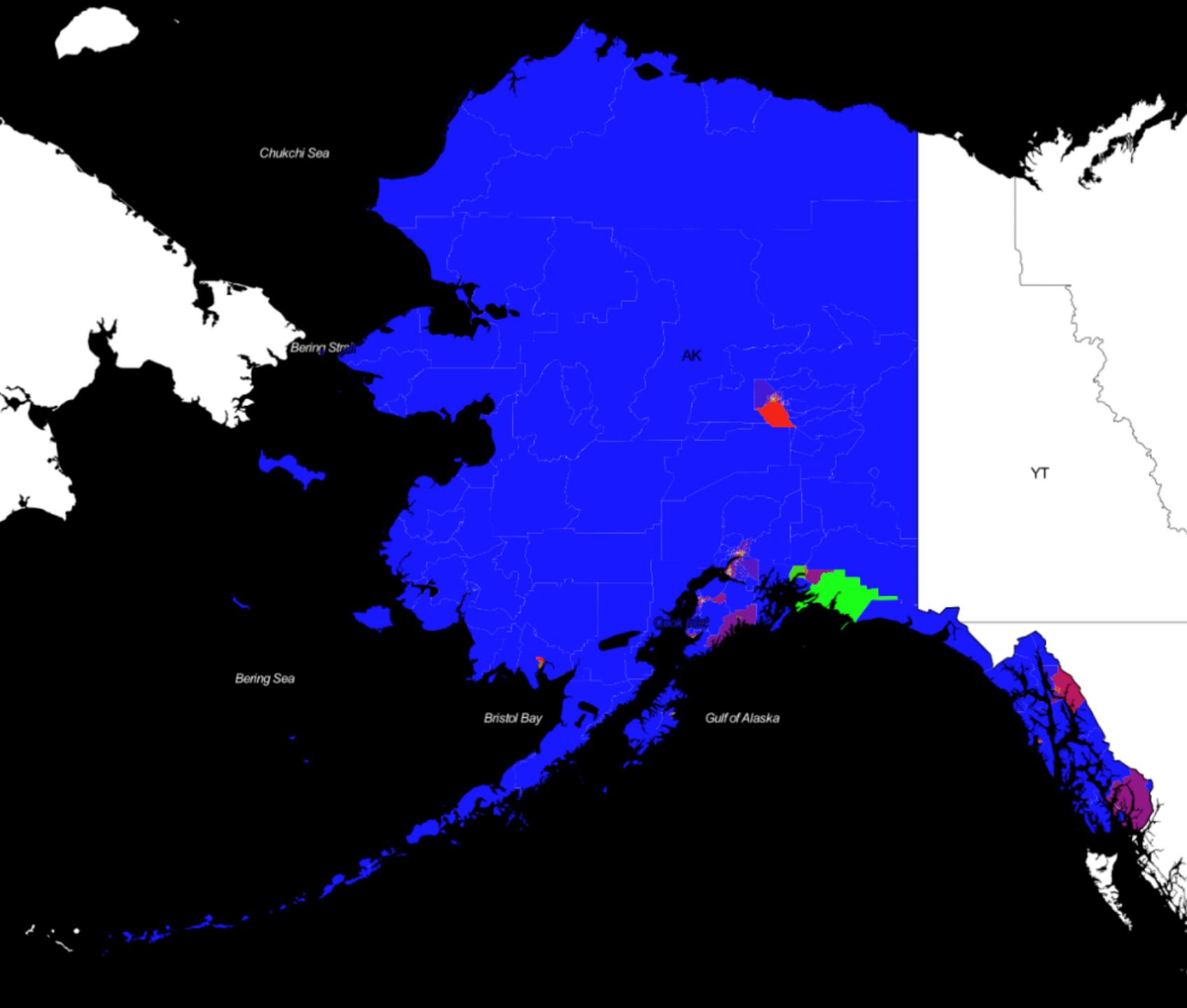


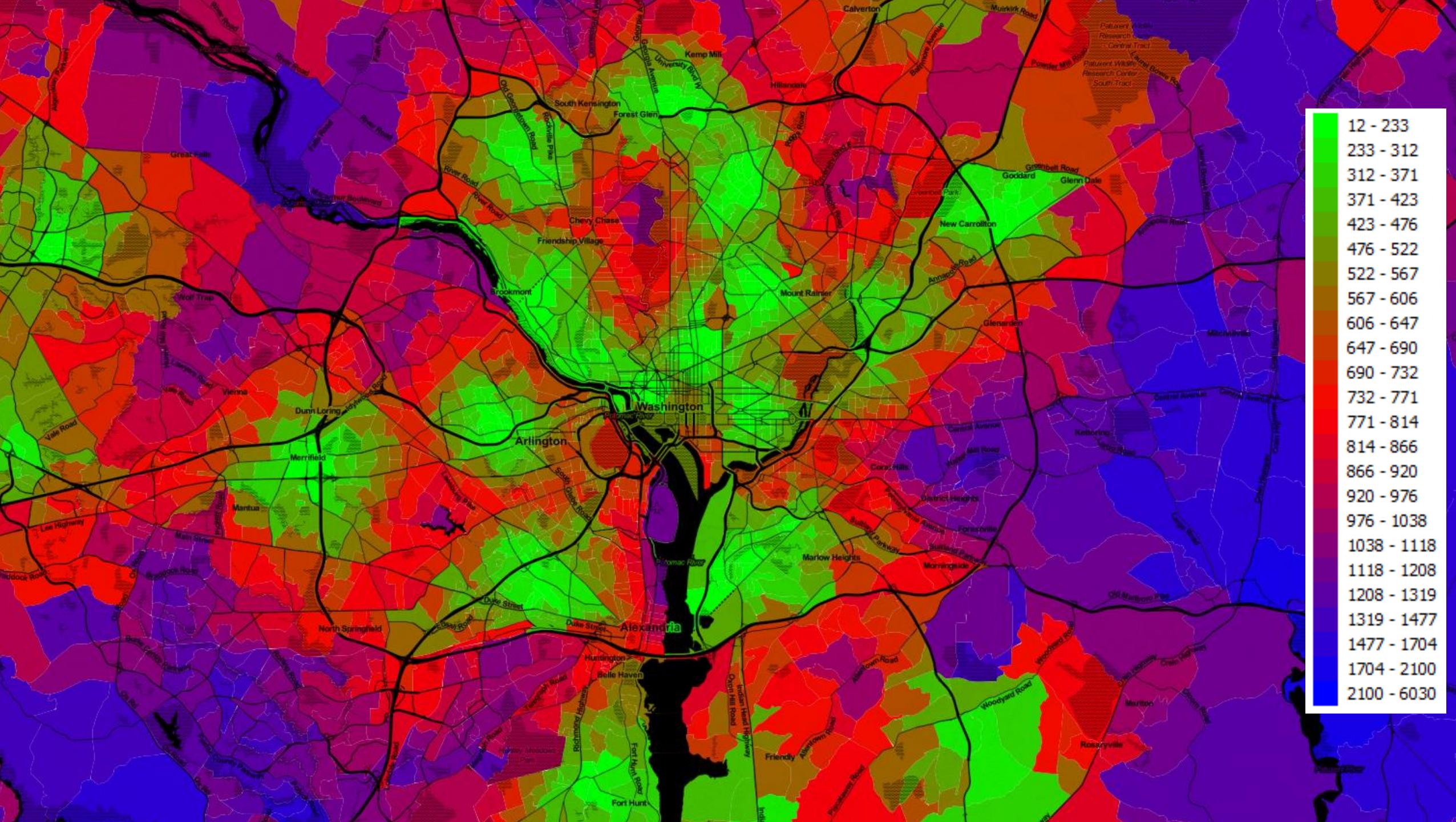
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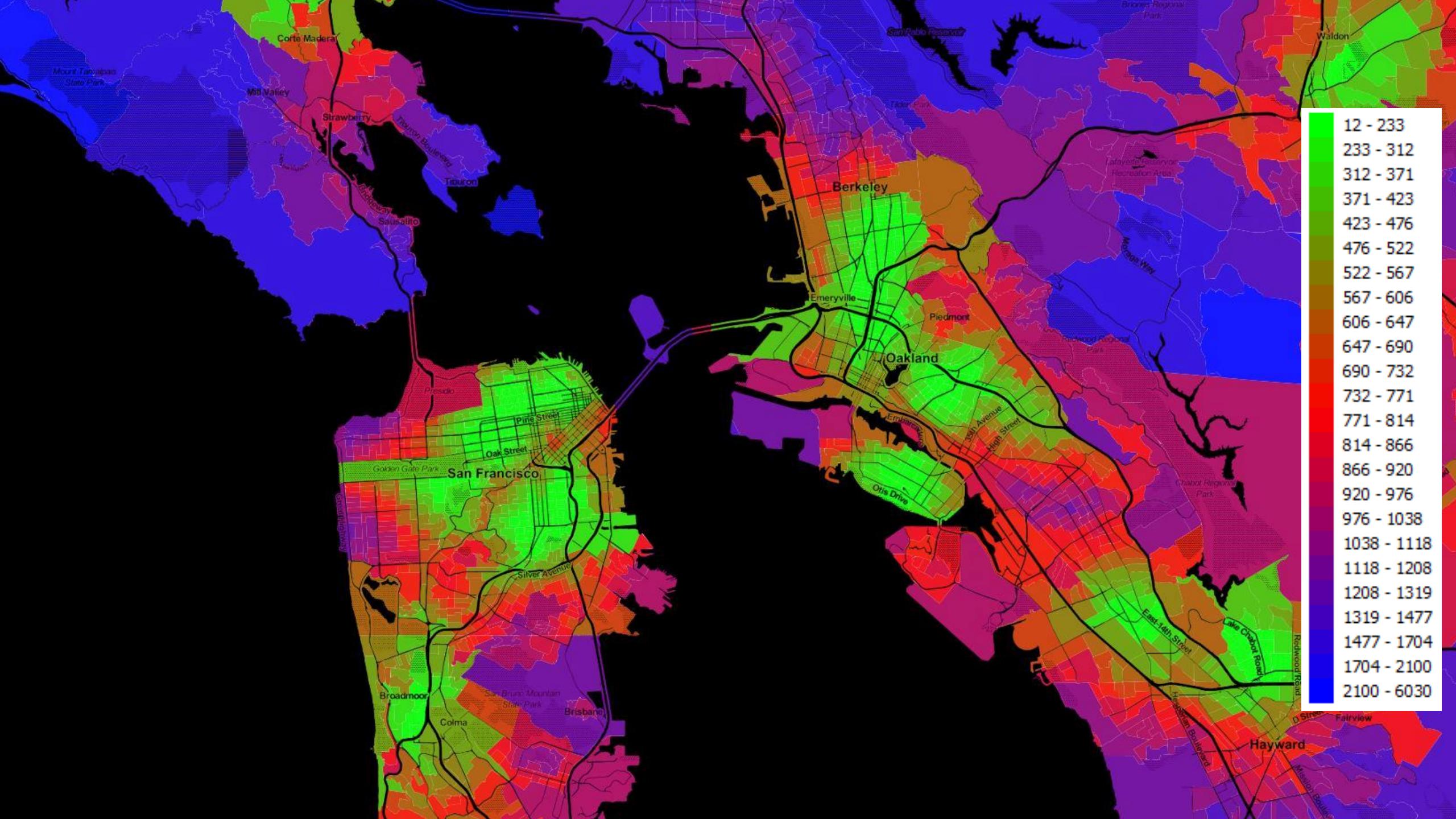


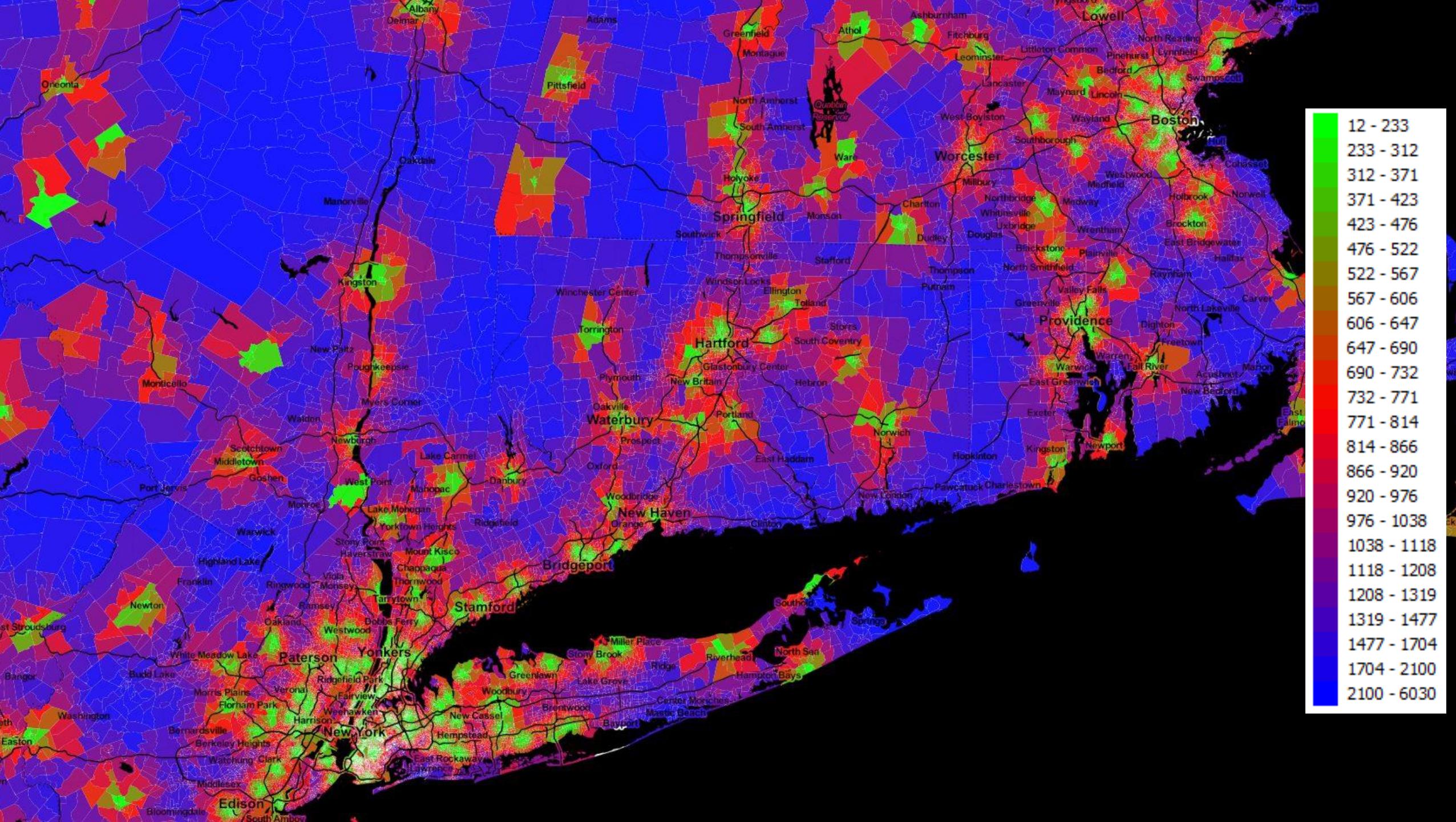
Community hospitals in Alaska, 2010

Just in case you were wondering...

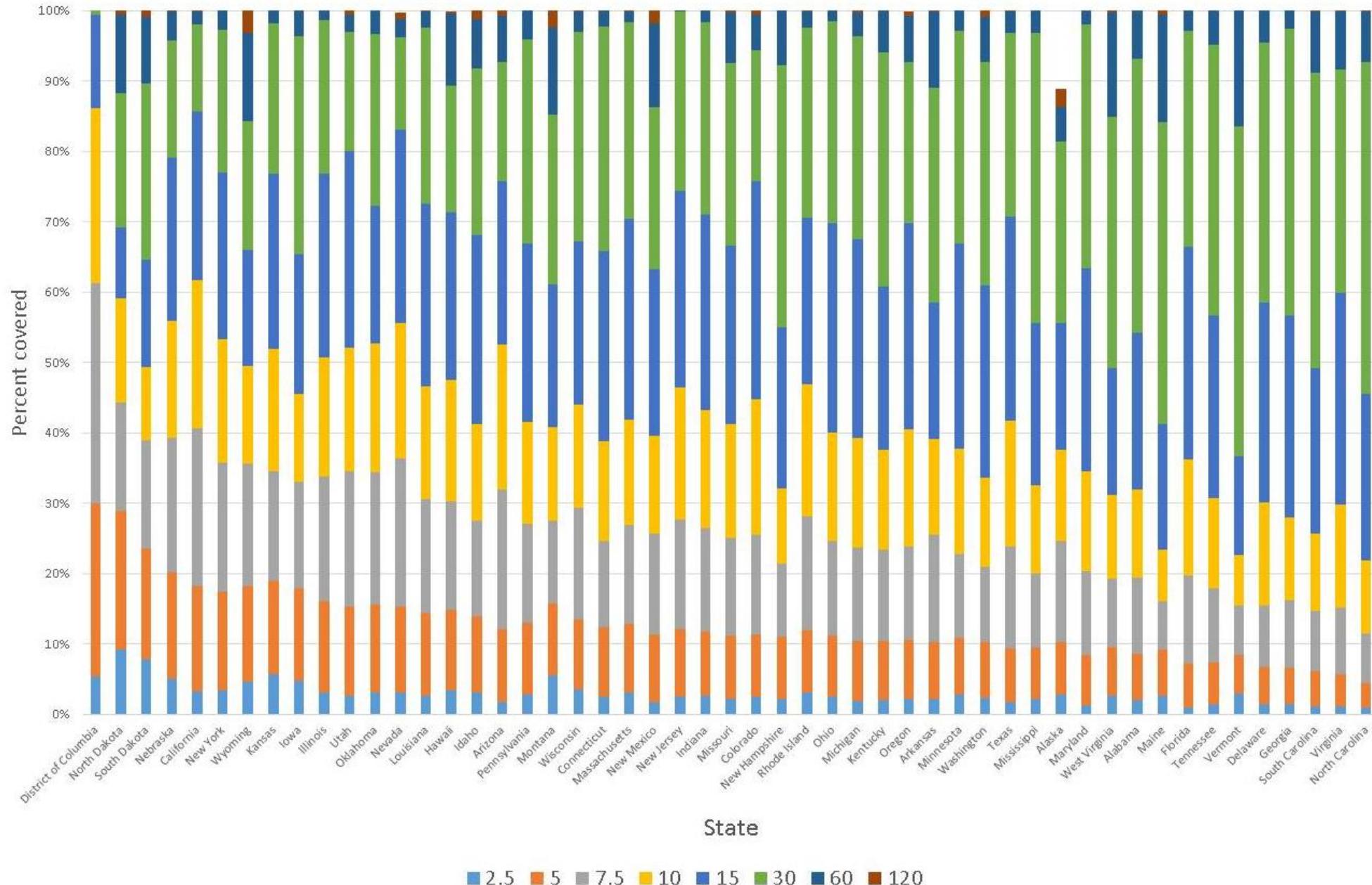




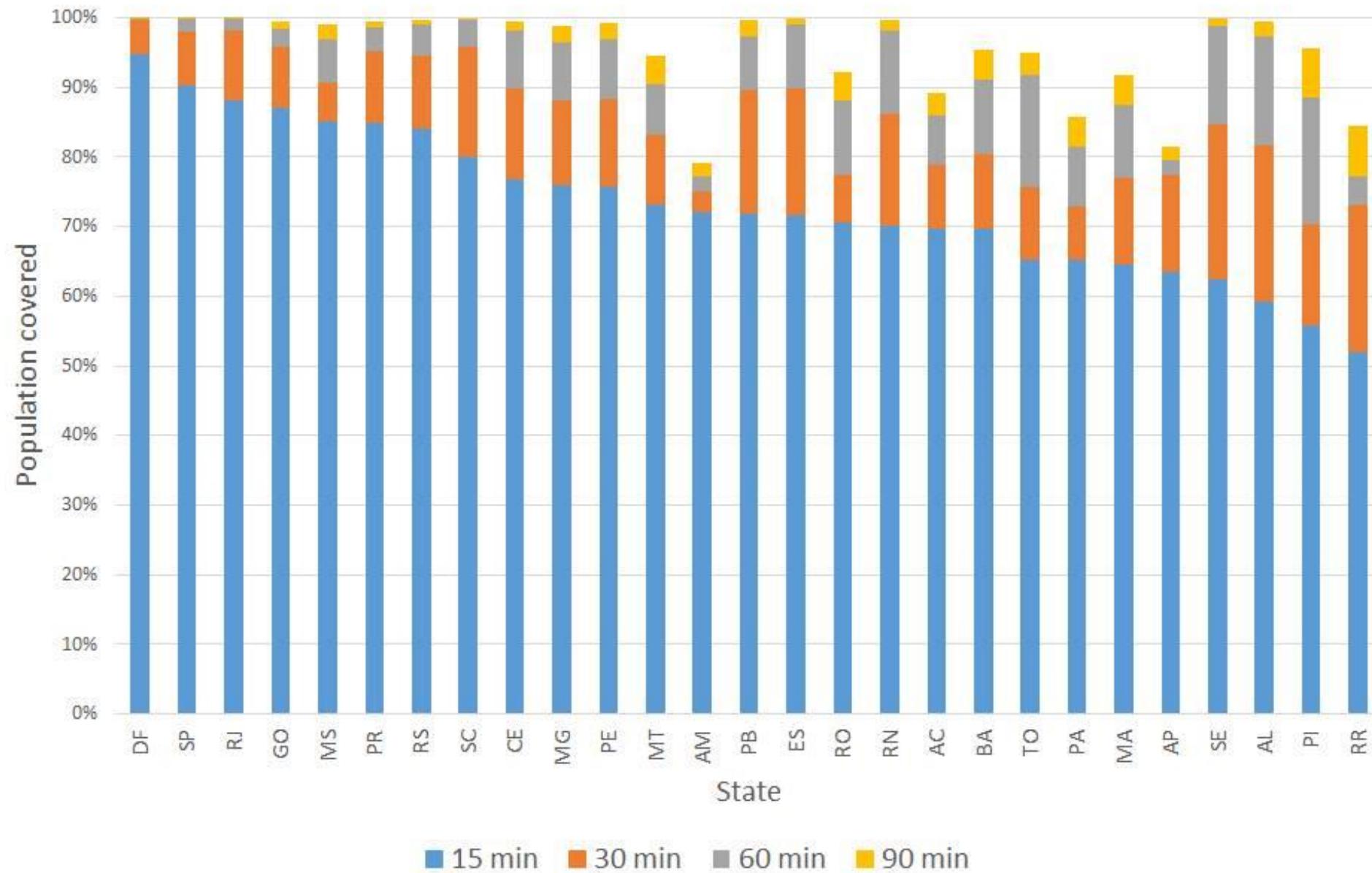




U.S. Population Access to Any Hospital According to Driving Time In Minutes



Brazil: Population access to any hospital according to driving time



LIMITATIONS

- Data cost, availability, and access.
- GIS coverage.
- Different census data models between countries.

CONCLUSIONS

- Finest granularity possible as per the data publicly available.
- Web-based Geographical Information System:
 - self-updating,
 - traffic conditions in urban centers,
 - *historical data available.*

CONCLUSIONS

- USA demonstrated geographical saturation and negligible change in the past 14 years.
- Blurred ethnic or socioeconomic disparities in USA at nationwide level.
- Brazil demonstrated clear disparities at nationwide level.