Population Health Management:
Using Geospatial Analytics to Enable Data-Driven Decisions

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Volume vs Value Based Care Delivery

- Affordable Care Act of 2010
- IHI Triple Aim of 2012

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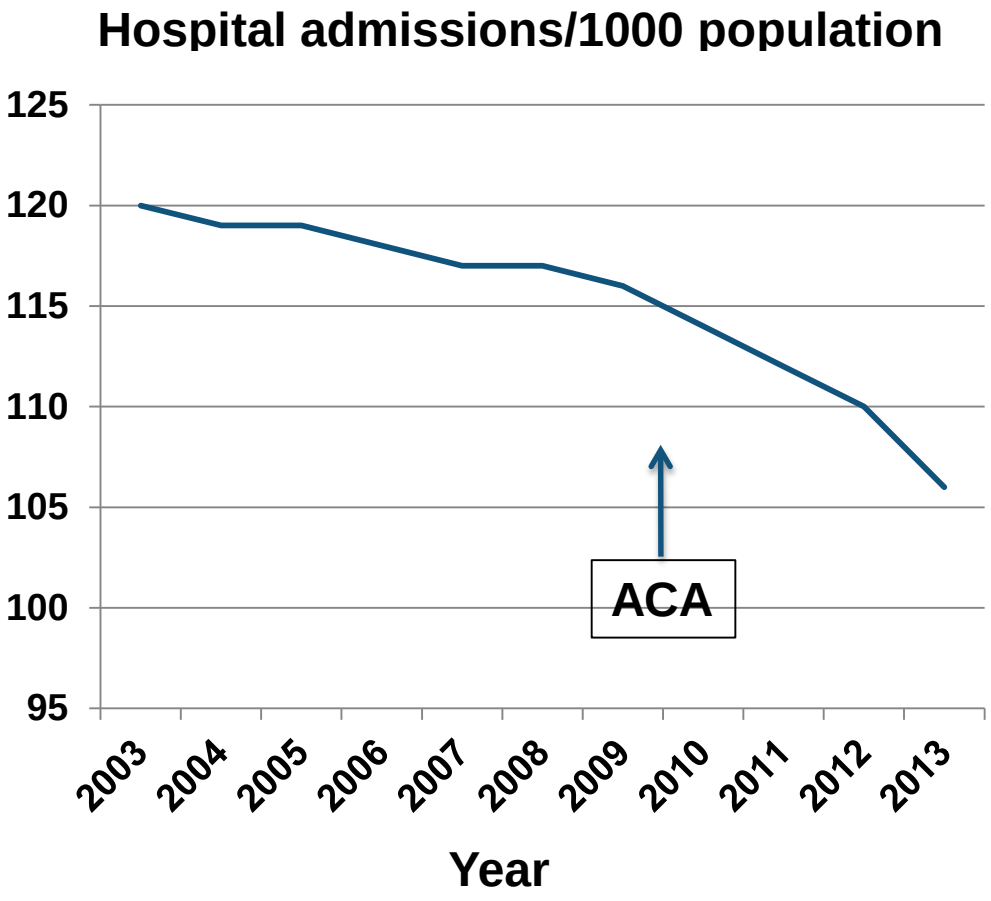
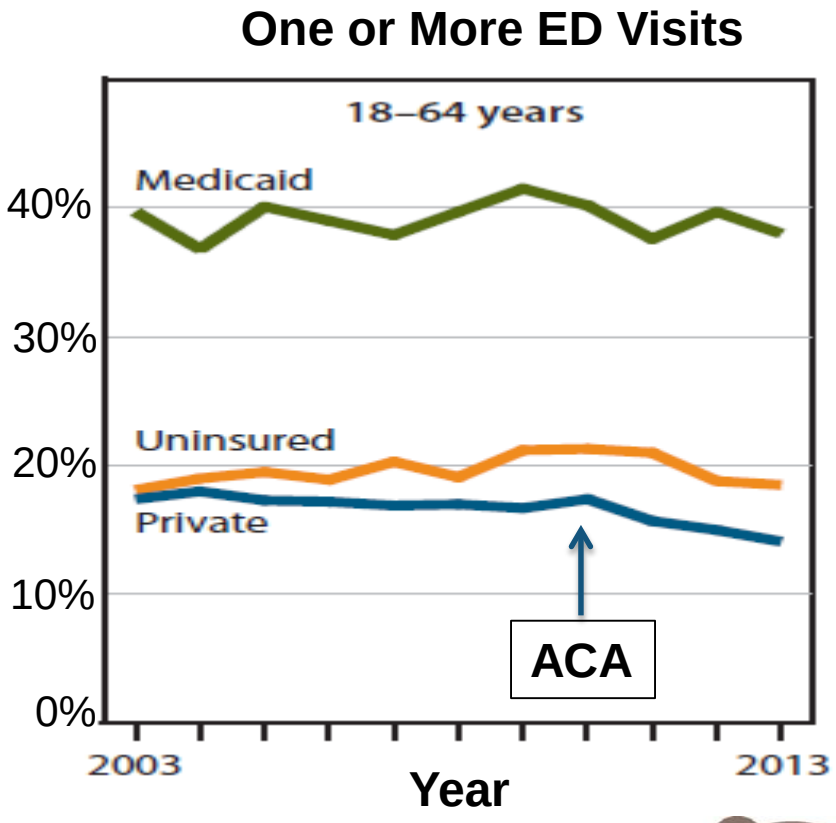
Hospital Admissions & ED Visits

5,686 hospitals in US





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IHI Triple Aim

Promote Health
Primary Care Medical Home
Keep patients out of the hospital
Avoid ED Visits

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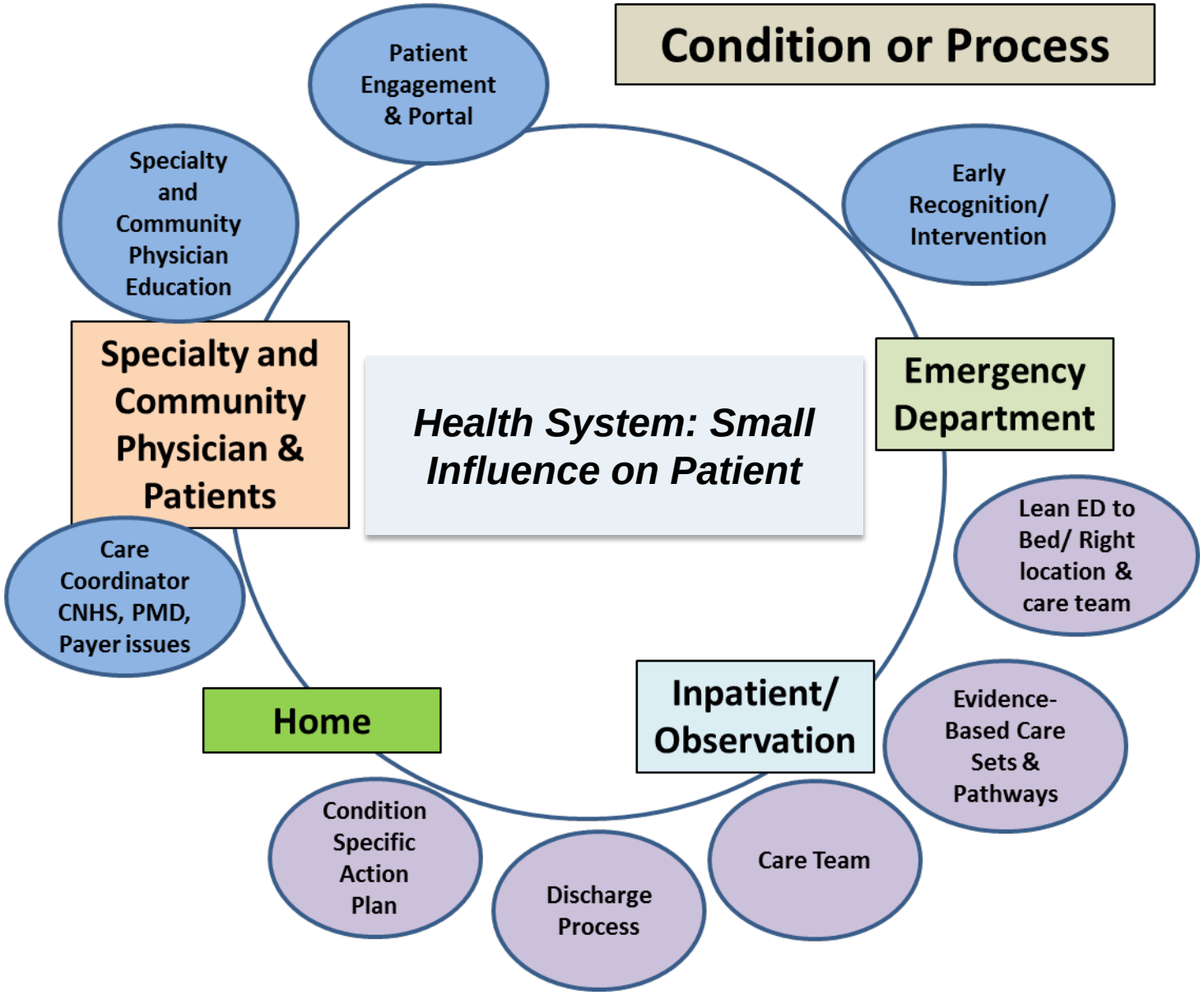
Healthcare Cycle



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Healthcare Cycle

- Healthcare encounters impact a small fraction of health factors, others include:
  - Diet
  - Exercise
  - Med compliance
  - Pollution
  - Climate
  - Genetics
  - Socioeconomics
  - Race
  - Gender
  - Stress
  - Relationships
  - Substance Abuse
  - Etc…

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Why Geospatial Analytics?

- Healthcare conditions have geographic & environmental variation
- Many co-variables effect the expression of health and disease
- Understanding geographic & co-variable distribution can impact targeting of epidemiology, prevention, treatment & research efforts

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Geospatial Analytics & EHR
(Crime Reports)

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Geospatial Analytics & EHR
(Military Applications since 2009)

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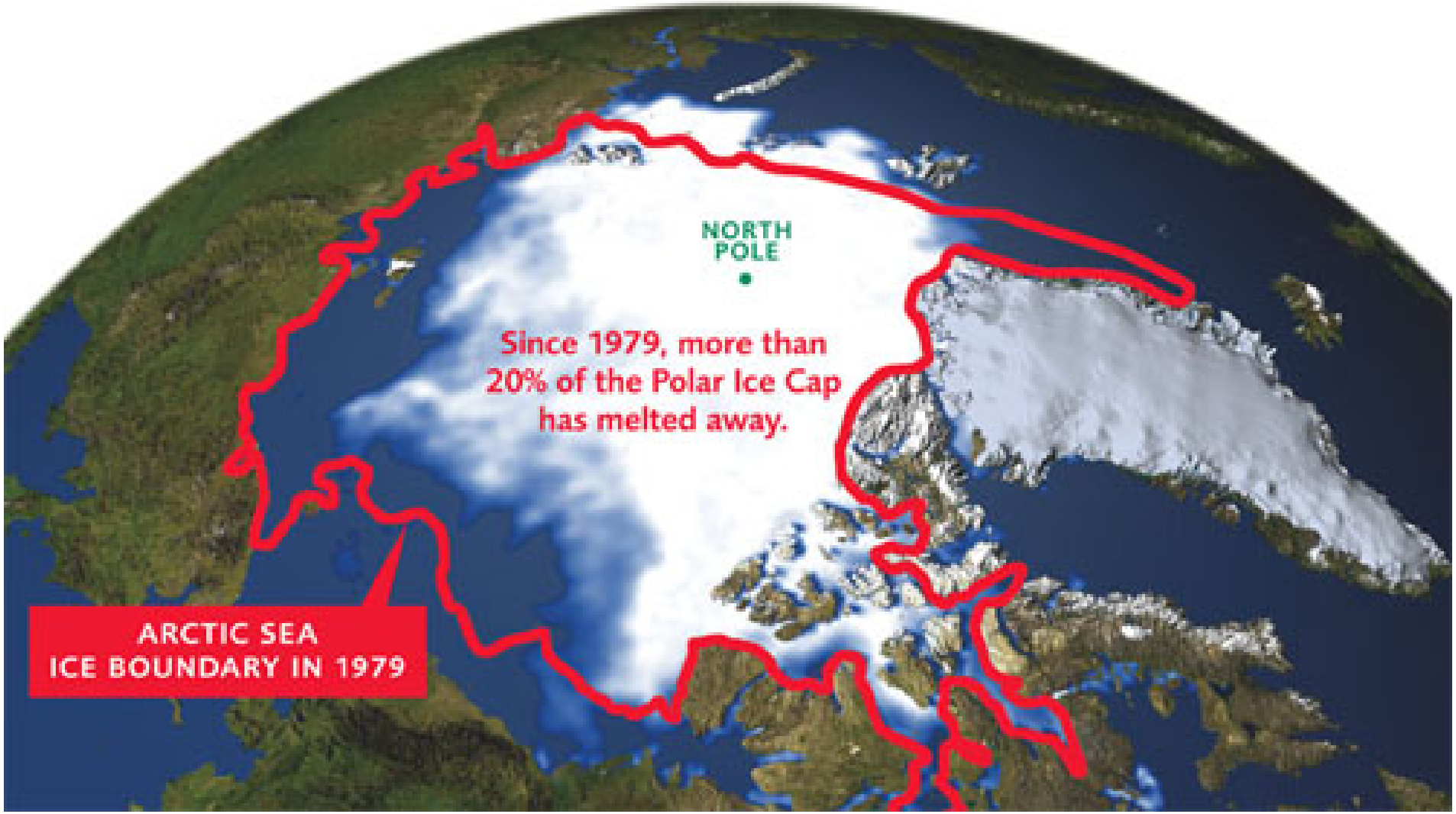
Geospatial Analytics & EHR
(Geology/Geography)



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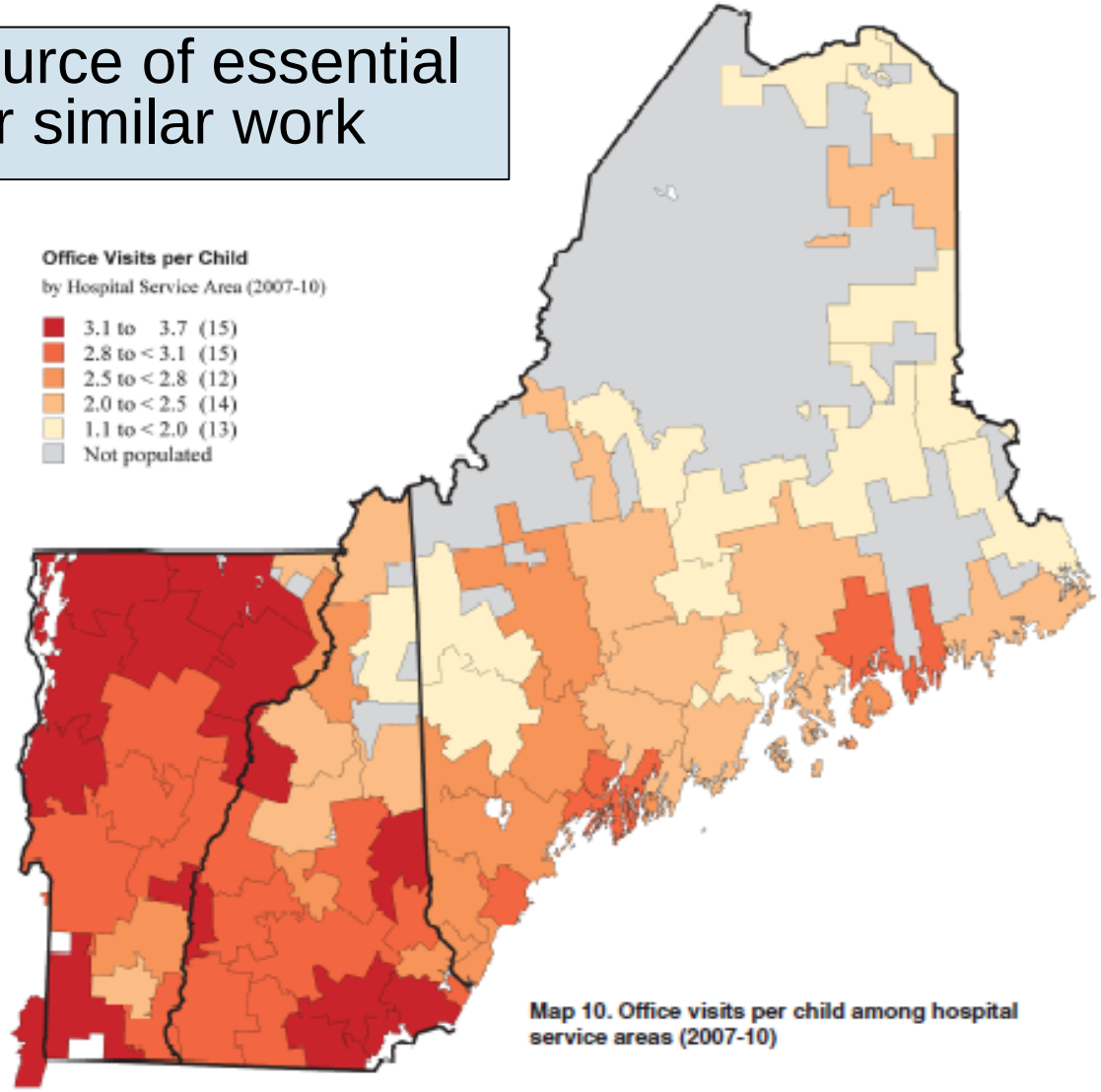
Geospatial Analytics & EHR
(Healthcare)

EHR represents rich source of essential health data to power similar work



Map 10. Office visits per child among hospital service areas (2007-10)

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EHR-Rich Granular Data

Cerner
McKESSON
Epic
Greenway
eClinicalWorks

- Blood Pressure
- Weight
- Hemoglobin
- Chest x-ray
- Age
- Gender
- Cost
- Triage to Doc Time
- Blood Culture
- BMI
- Heart Rate
- Medications
- Allergies
- Immunizations
- Procedures
- Address
- Insurance
- Race

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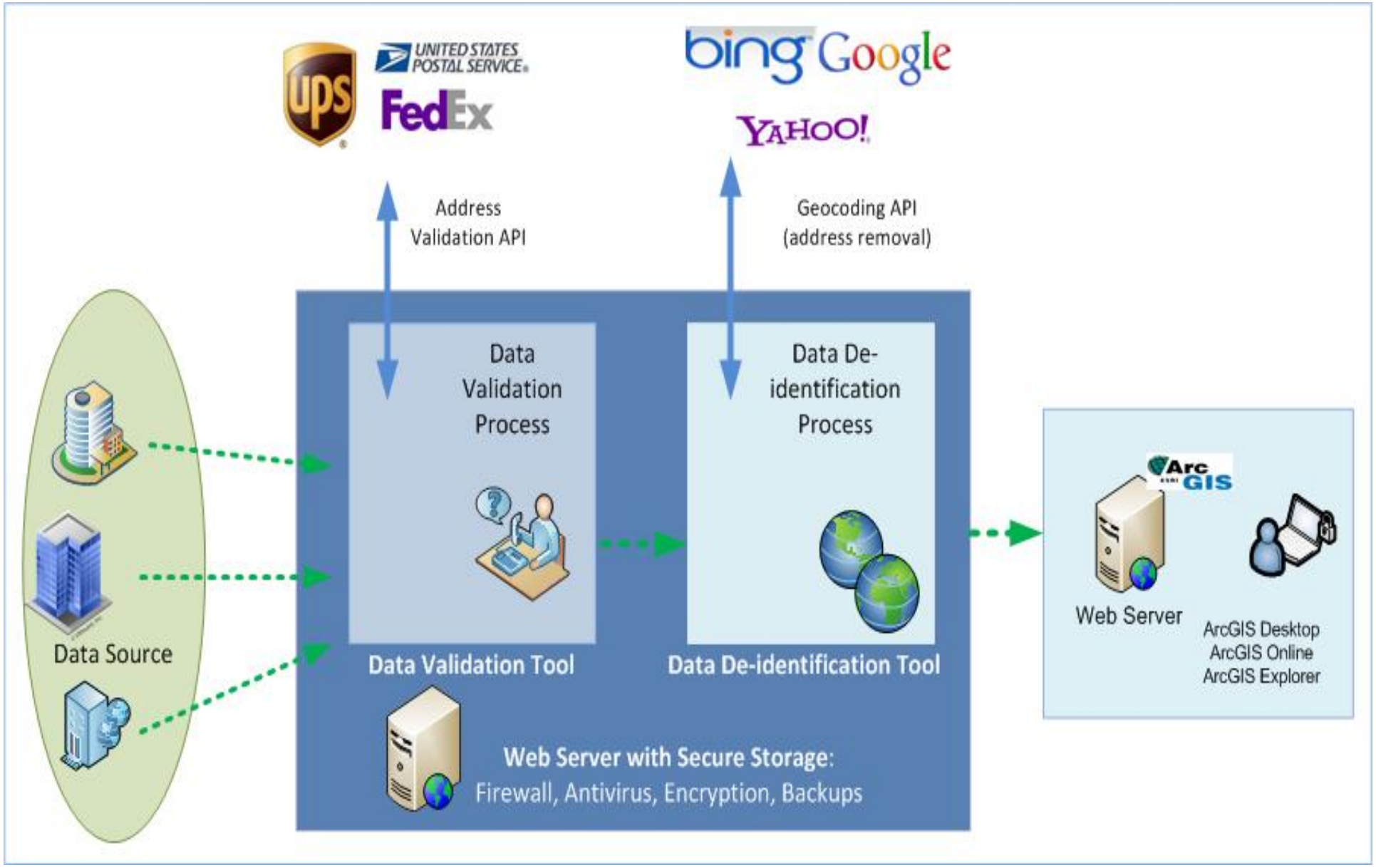
Health Data Processing



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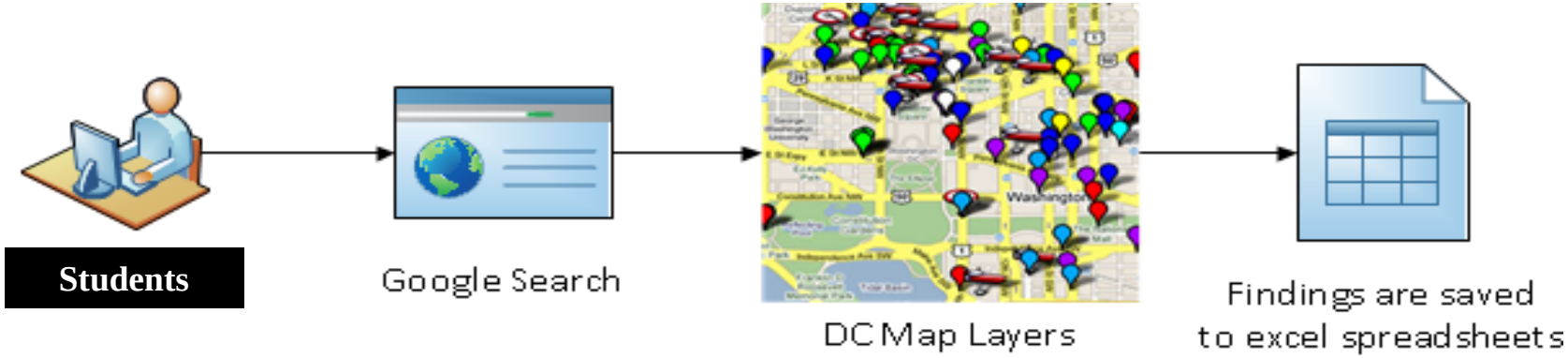
Environmental Data Gathering



Restaurants	Groceries	Education	Health Services	Demographics
• Dining • Take out • Fast Food	• Delis • Convenience Stores • Supermarkets	• Elementary Schools • Middle Schools • High Schools	• Clinics • Hospitals	• Population Data • Economic Data

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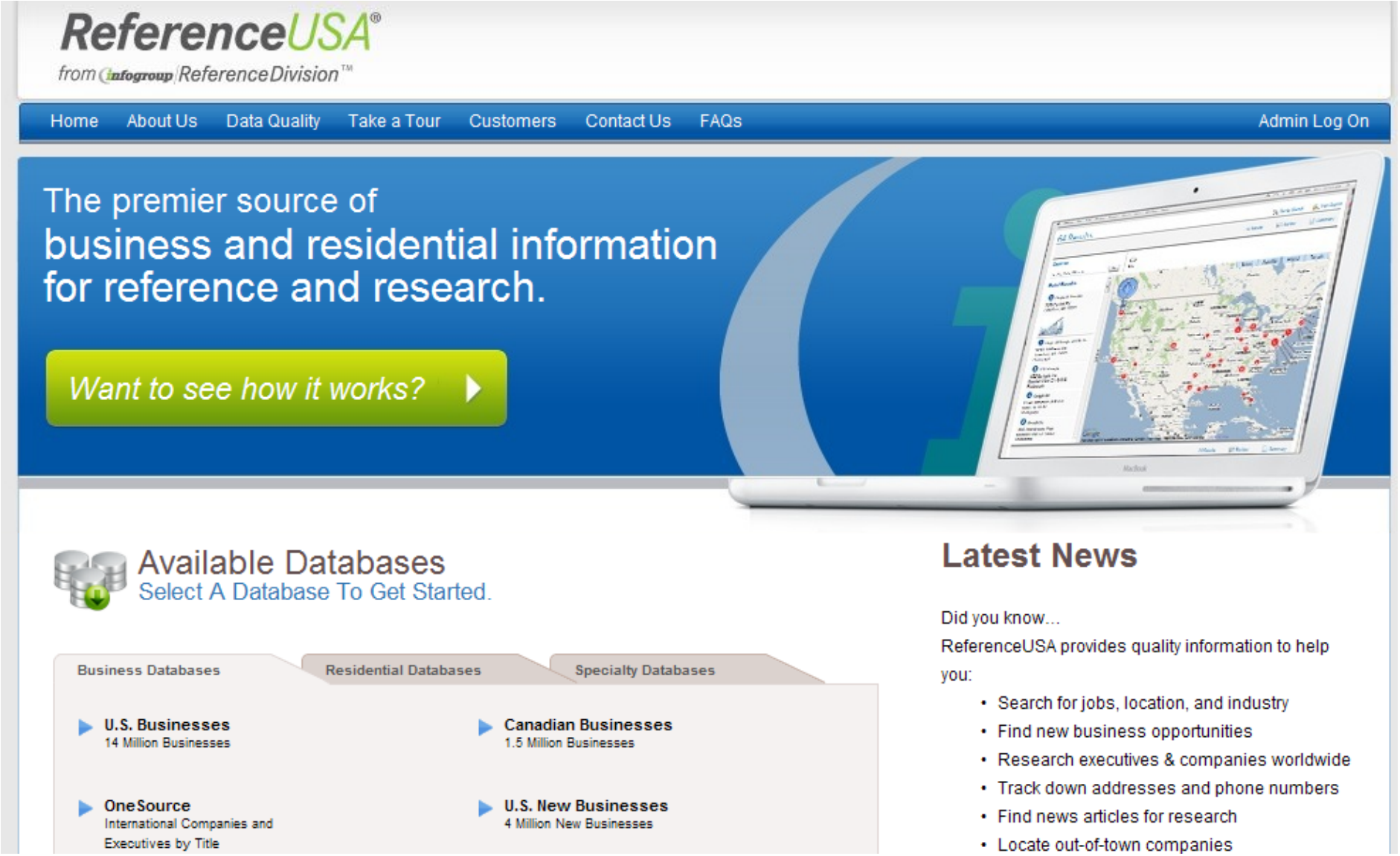
Other Available Data



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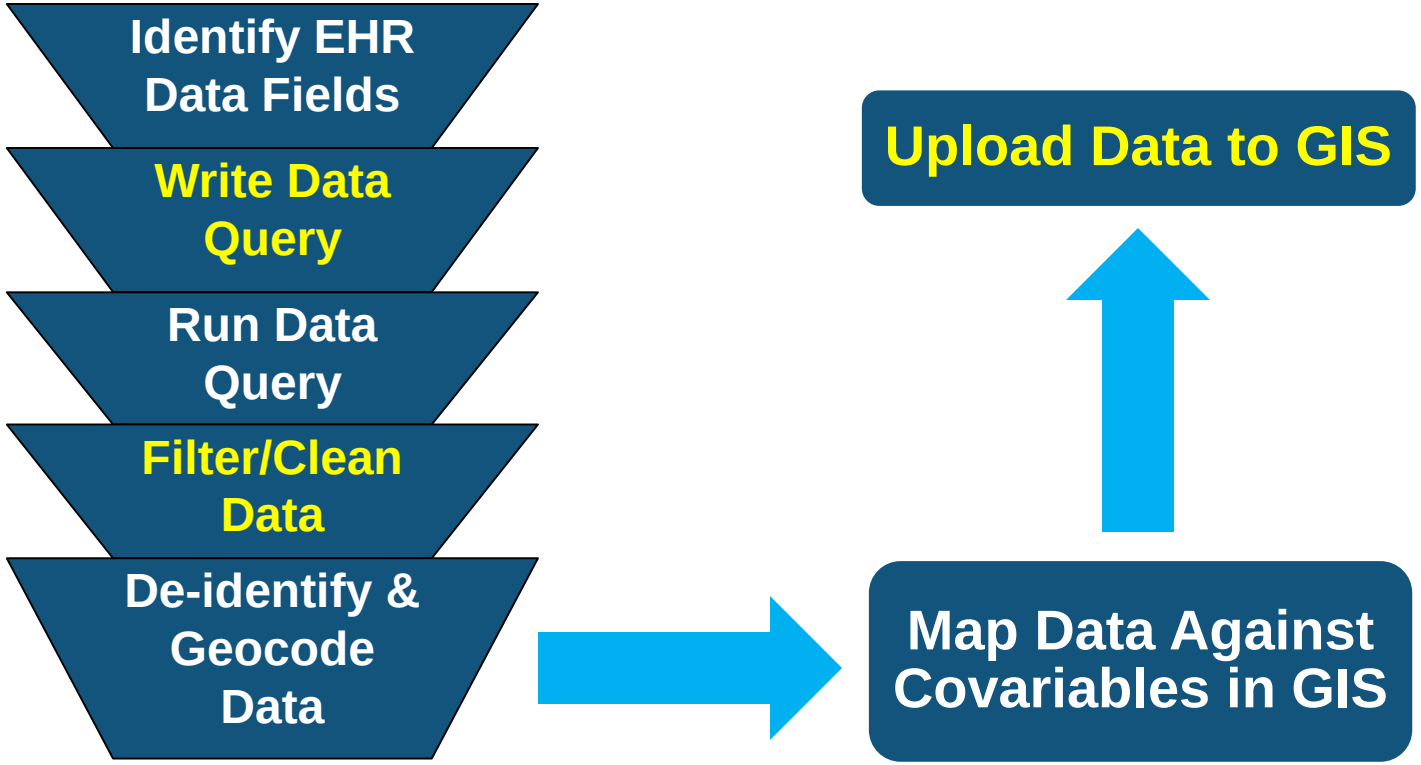
GIS Methodology Applied to EHR



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Representative Conditions

Burns in Infants

Childhood Obesity

Sickle Cell Disease

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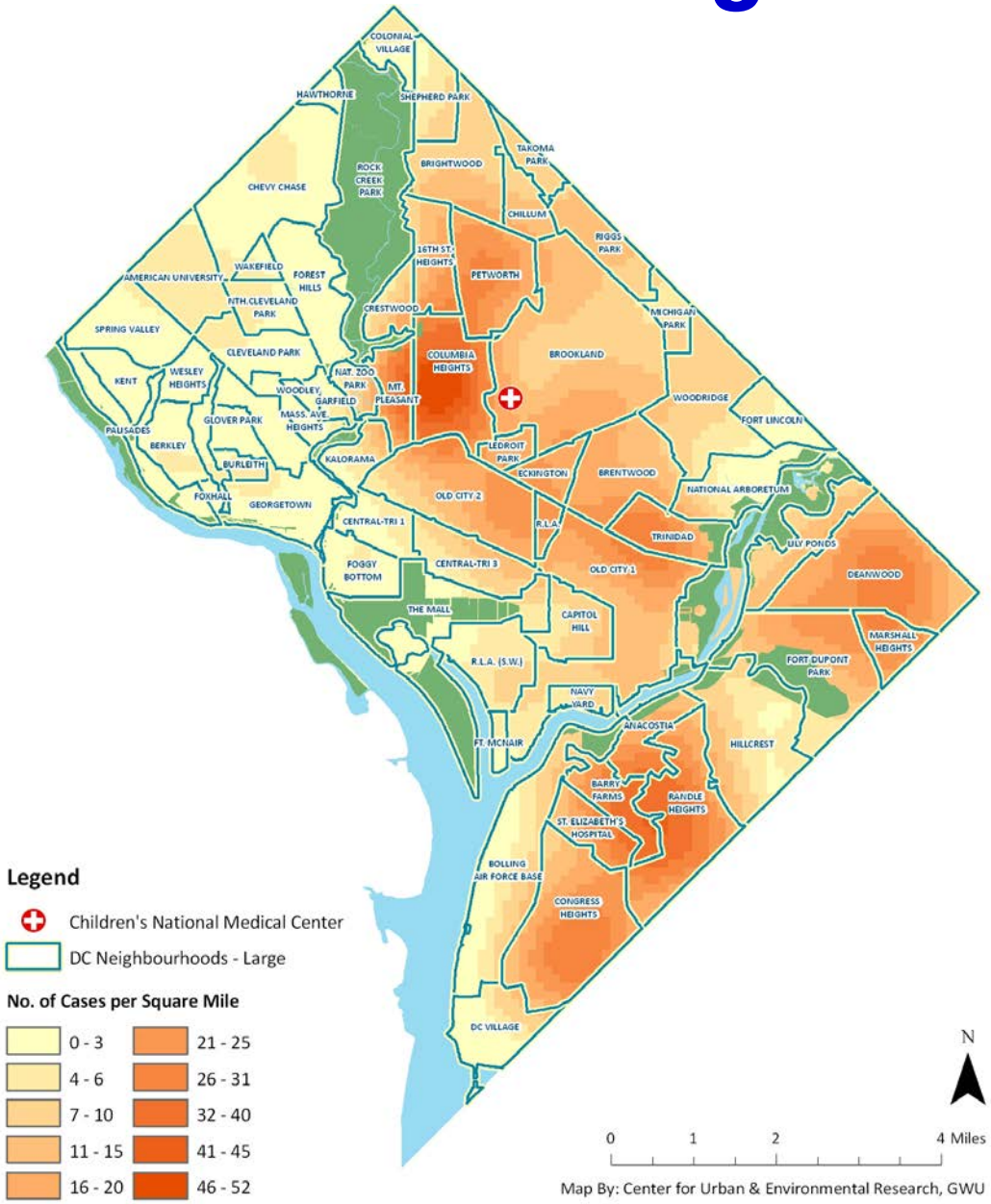
Epidemiology: Burn Injuries in Infants

Lorch M, et al. Pediatric Emerg Care 2011;27:1022-6

- Studied factors determining ED disposition of infants sustaining burn injuries
- 344 patients treated in the ED – Analyzed EHR data, environmental & socioeconomic variables
- Scalds (53.2%) & contact burns (39.8%) were most common
- Race played significant role in mechanism & severity of burn
- Focal geographic distribution

Burn Data – DC Neighborhoods



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Childhood Obesity

- Patients presenting to Children's National Inpatient, Inner City Clinics & Suburban Clinics
- Weight, Height, Gender, Race, Age & Address extracted from 3-regional EHRs
- Primary extract cleaned, de-identified & analyzed
- CDC BMI percentile equations applied

Percent of Regional Population

3.2 million Children in VA, MD, DC

400,000 Immediate Population (12.5%)

49,713 unique patients (12.4%)

EHR Data Extraction

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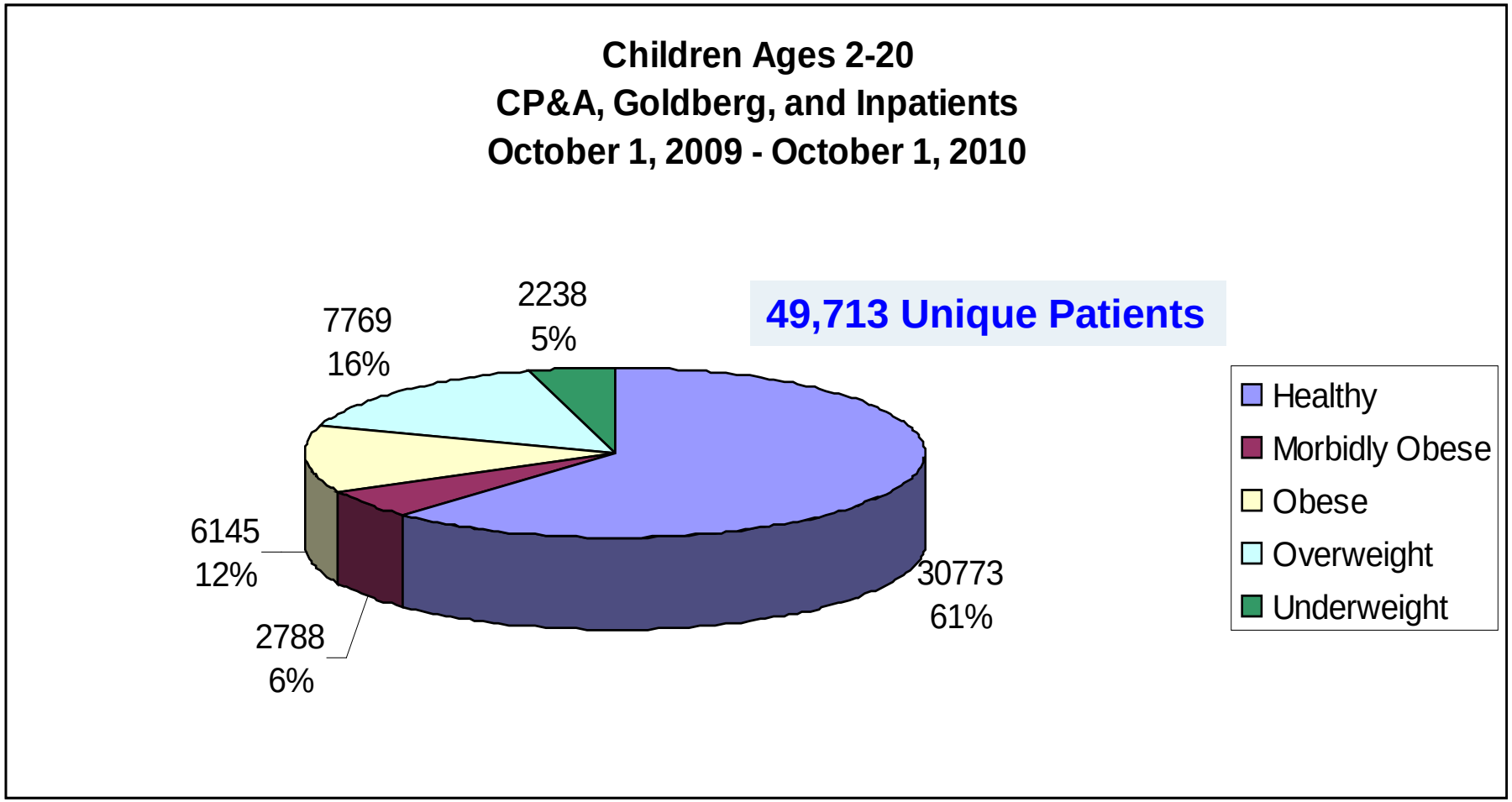
Results - Total Population



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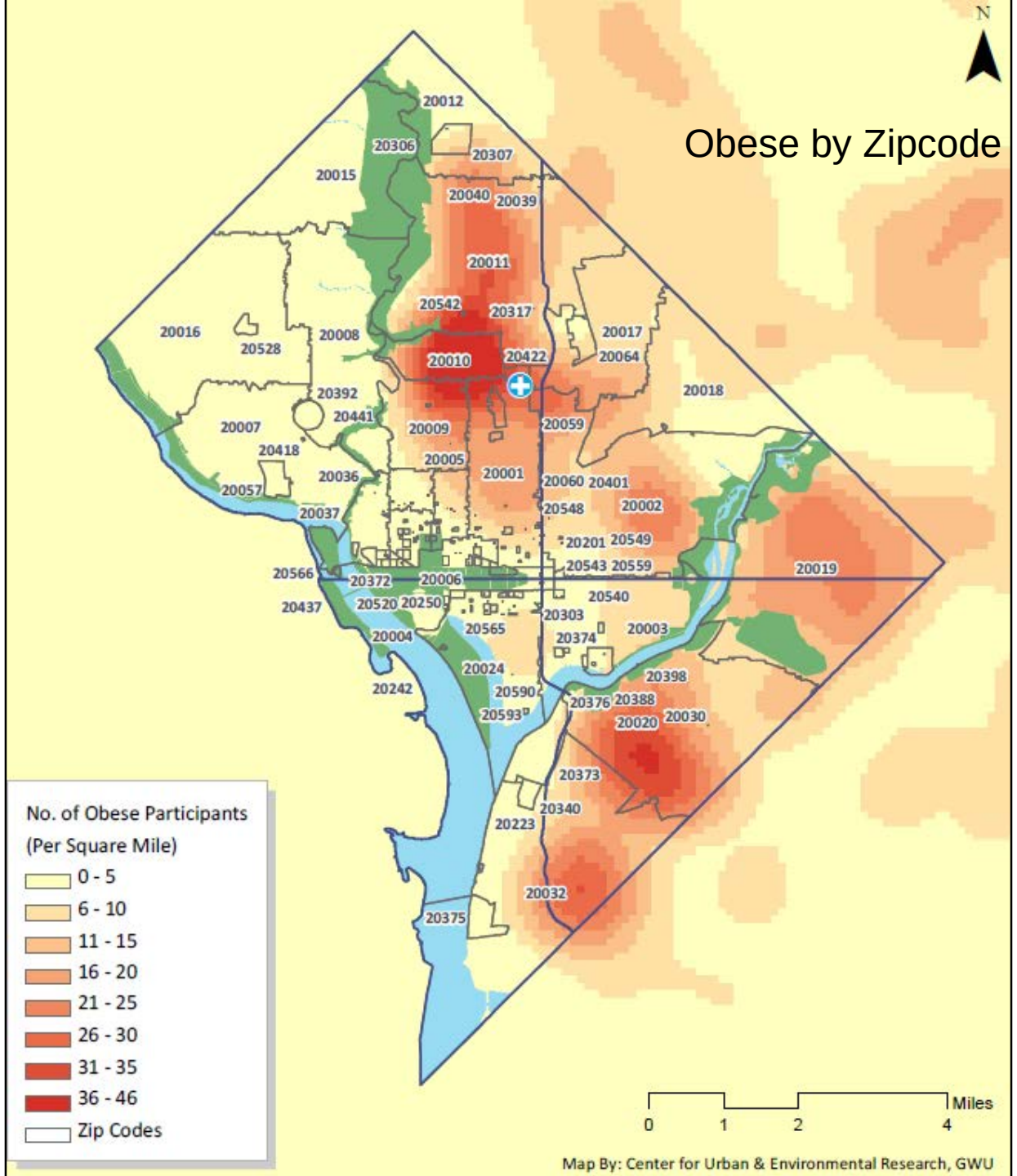

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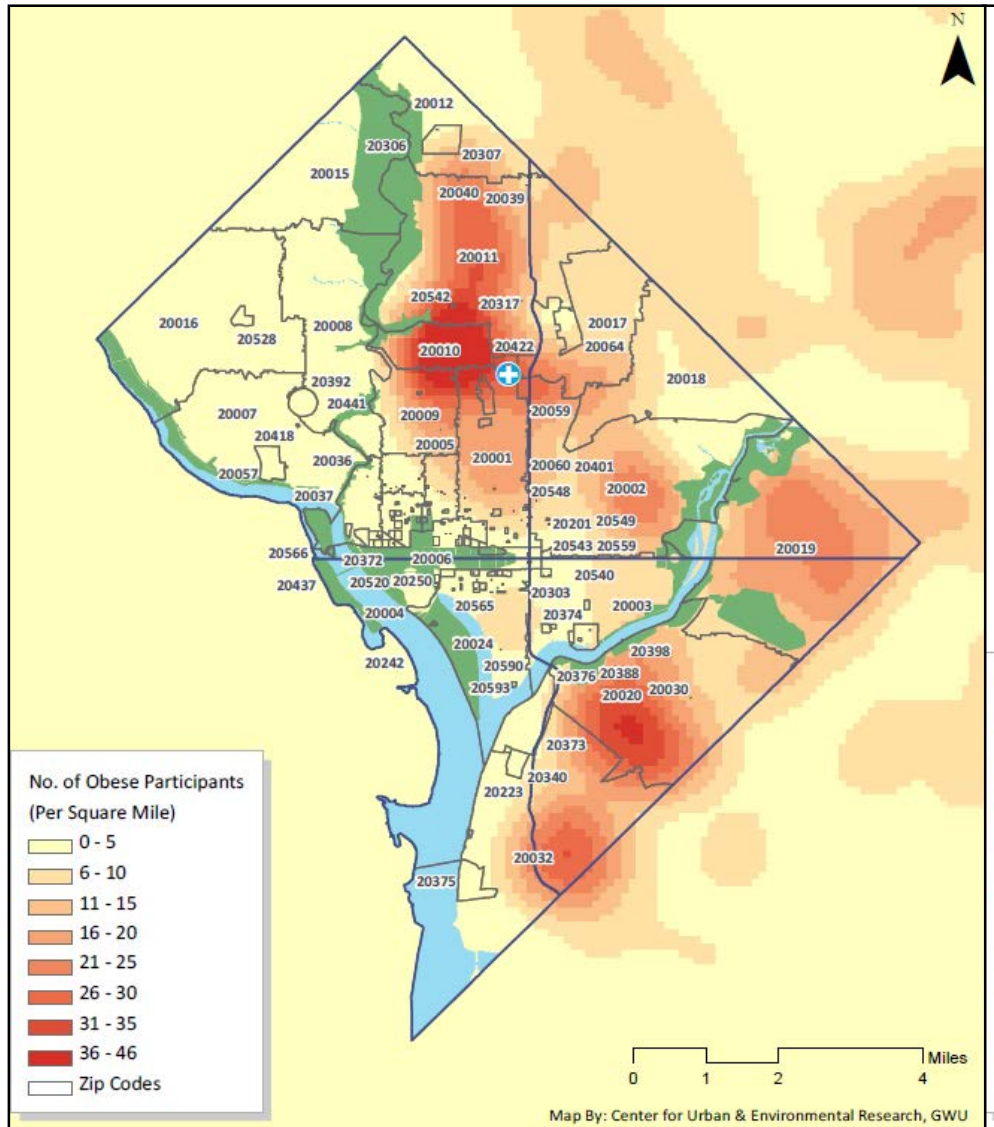
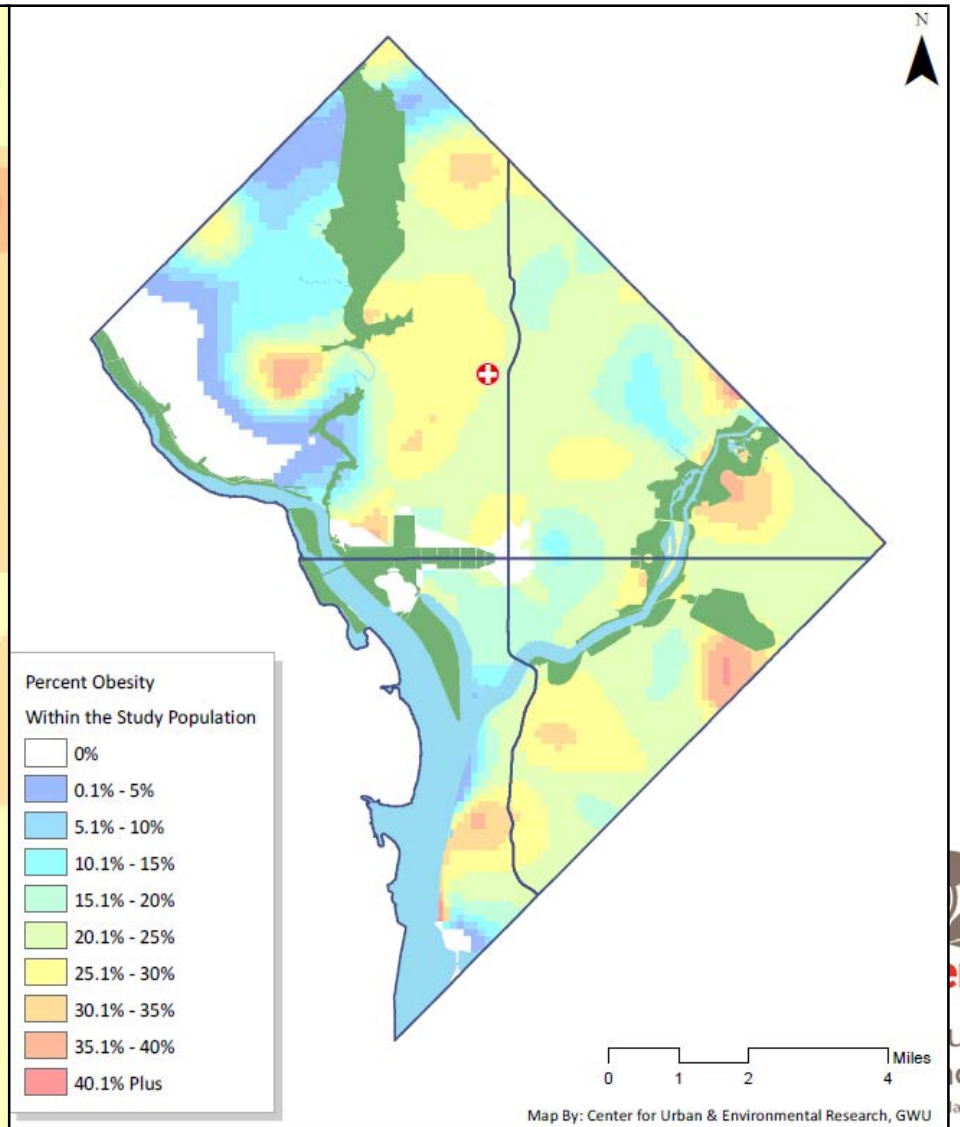
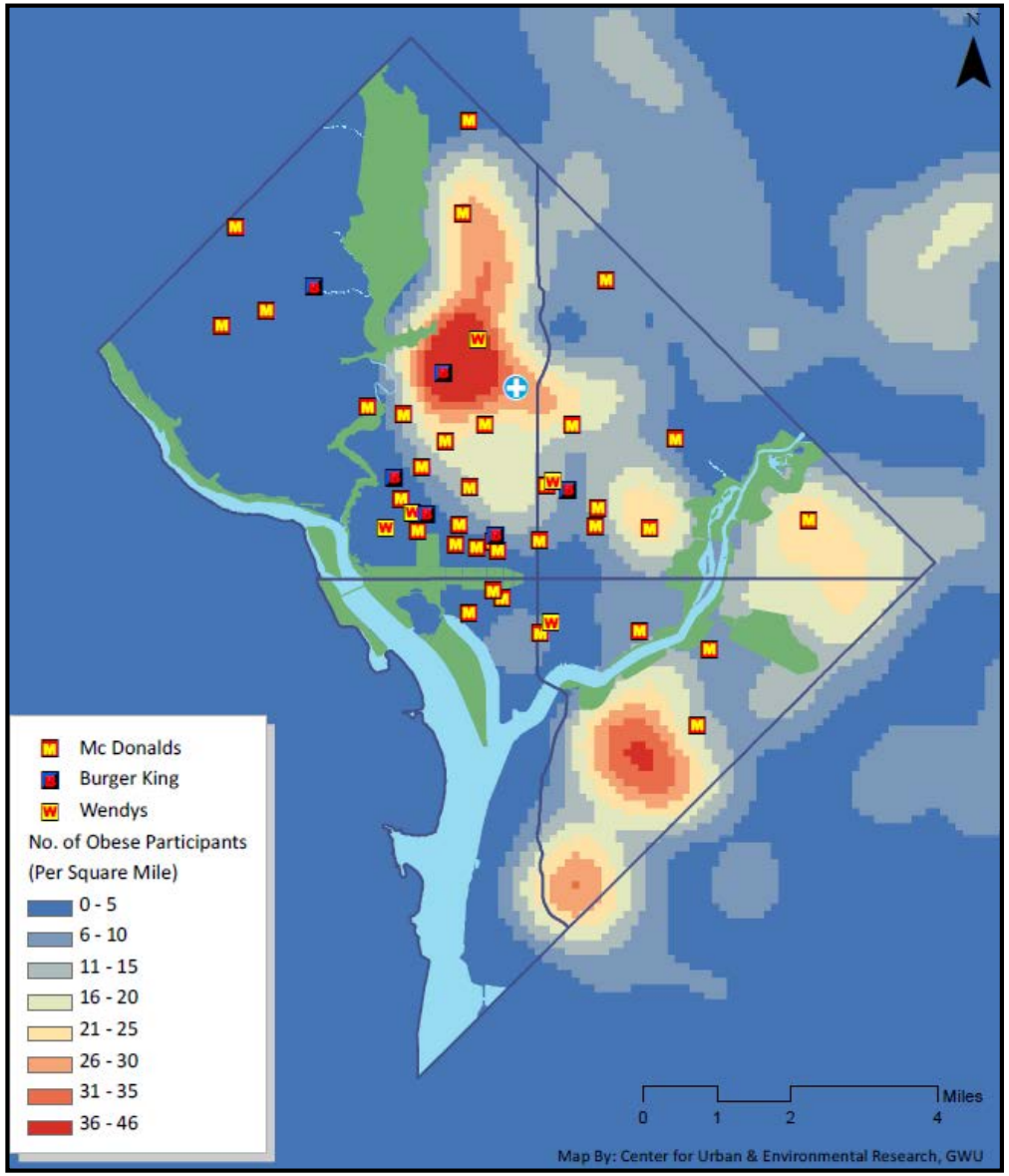
Obesity Cases



Obesity Rates



Fast Food Overlay



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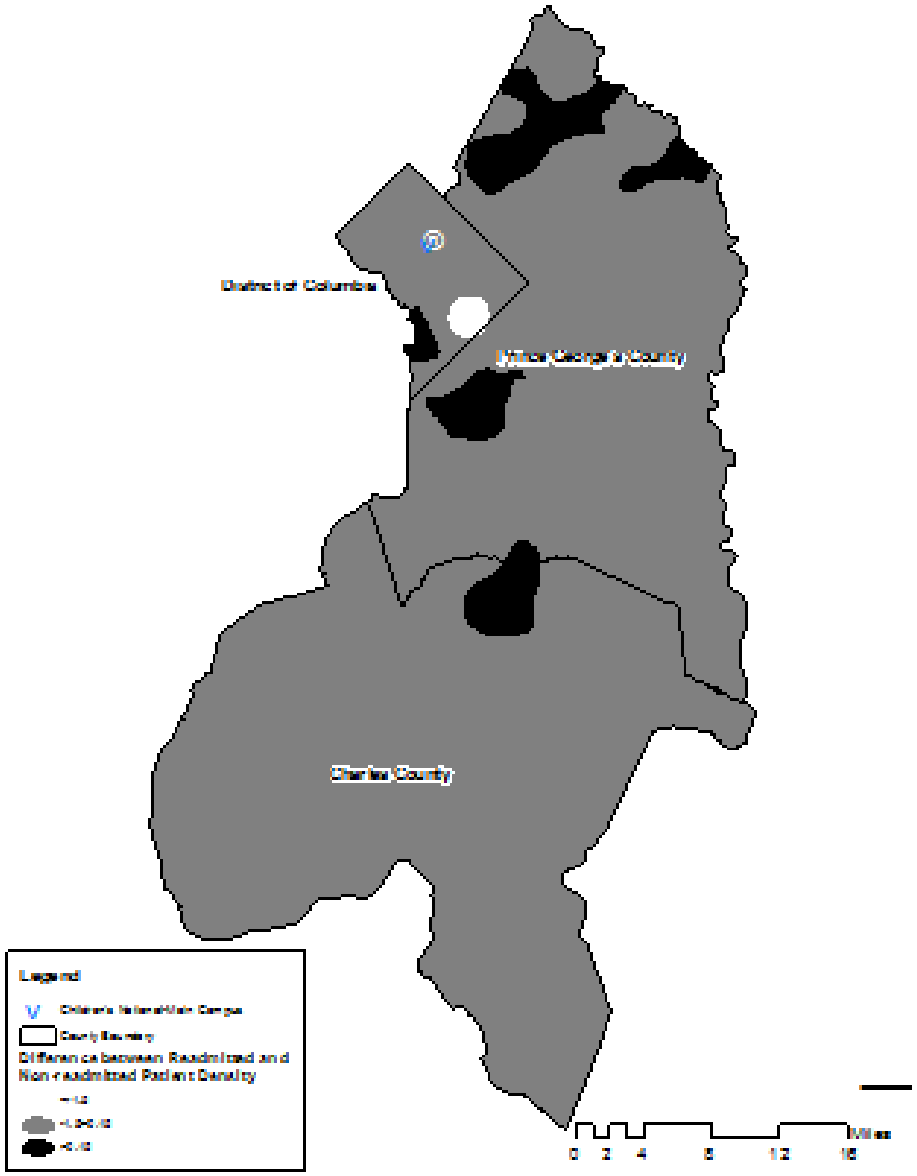
Sickle Cell Disease Readmission

- Retrospective analysis using EHR-derived data on children with SCD-related pain crises
- Readmissions described, geospatial analysis conducted
- Models constructed to obtain readmission risk factors
- 373 subjects, 125 with at least one 30-day readmission compared to no readmission group.
- Readmission risk factors: Older, decreased LOS, increased pain scores, >3 hospitalizations in 1-year

McMillan, JE, et al. Hosp Pediatr 2015;5:423-31

Readmitted Patients with Sickle Cell Disease



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Conclusions

- Improved health & achieving the Triple Aim cannot rely solely on encounters with healthcare organizations.
- Care model redesign must harness other factors beyond the healthcare system in addition to EHR data.
- Geospatial analytics is an important tool to bring qualitative & quantitative information forward to augment traditional approaches to healthcare analytics.

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? Questions ?

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