GIS Mapping of Social Determinants of Health as a Tool to Facilitate Community Collaborations

Gene W. Matthews, JD  
Alisahah J. Cole, MD  
Matthew C. Simon, MA  
Kasey Decosimo, MPH

2017 Annual State Health Director’s Conference  
Raleigh, NC  
January 19, 2017
Presenters

Gene W. Matthews, JD
Director, Network for Public Health Law -Southeastern Region,
Senior Fellow, UNC Gillings School of Global Public Health

Alisahah J. Cole, MD
System Medical Director of Community Health,
Carolinas HealthCare System

Matt C. Simon, MA, GISP
Technical Assistance, NC Institute for Public Health

Kasey Decosimo, MPH
Training, NC Institute for Public Health
## Agenda

<table>
<thead>
<tr>
<th>Session</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome and Intro (Gene)</td>
<td>5 min.</td>
</tr>
<tr>
<td>The Carolinas HealthCare Story (Dr. Cole)</td>
<td>10 min.</td>
</tr>
<tr>
<td>CHIS Project (Kasey)</td>
<td>5 min.</td>
</tr>
<tr>
<td>SDOH Mapping Project and other resources (Matt)</td>
<td>20 min.</td>
</tr>
<tr>
<td>Open Discussion</td>
<td>20 min.</td>
</tr>
</tbody>
</table>
Three “Take Home” Messages

1. Hospitals & healthcare systems are moving into Social Determinants of Health (SDOH)

2. GIS mapping technology is rapidly improving and becoming more available to show SDOH at census tract levels

3. GIS/SDOH mapping is a powerful new tool to assist communities addressing their health needs and to develop new coalitions
North Carolina Institute for Public Health (NCIPH)

- Service arm of the Gillings School of Global Public Health at UNC-Chapel Hill
- Since 1999 has served as a bridge between academia and partners in community organizations and government agencies

Deliver training, conduct research and provide technical assistance to transform the practice of public health for all
Context of One New Collaboration

- NC Community Health Improvement Collaborative (CHIC) 2007→present
- Increasingly focused on CHNA implementation by non-profit hospitals
- April 2016 Carolinas Healthcare System (CHS) requested assistance on SDOH
- NCIPH found value of GIS mapping to assist CHS in community health improvement efforts and to develop community partnerships
Social Determinants of Health (SDOH)

Conditions in the environment in which people live, work, play, and worship that affect a wide range of health and quality of life outcomes.
Increasing Focus on Social Determinants of Health (SDOH)

- There is growing interest in addressing the SDOH as well as health care policy reforms to increase the efficiency and quality of care while improving health outcomes.

- Hospitals are “anchor” institutions and can be a natural source of collaboration, leadership, and community support for broader health initiatives.

THE CAROLINAS HEALTHCARE SYSTEM STORY
Community Health Strategy: Building Healthier Communities through HealthCare Culture Transformation

Alisahah Cole, MD
System Medical Director

Community Health Steering Committee

- Obesity
- Mental Health
- Tobacco
- Access to Care
- Social and Economic
Carolinas HealthCare System Primary Enterprise Hospital Locations

1. Carolinas HealthCare System Anson
2. Carolinas HealthCare System NorthEast
3. Carolinas HealthCare System Cleveland
4. Carolinas HealthCare System Kings Mountain
5. Carolinas HealthCare System Lincoln
6. Carolinas Medical Center
7. Carolinas Medical Center-Mercy
8. Carolinas HealthCare System University
9. Carolinas HealthCare System Pineville
10. Carolinas HealthCare System Stanly
11. Carolinas HealthCare System Union
Healthcare Focus on SDOH

In community health improvement, growing interest in shifting the primary focus on clinical care and also addressing health behaviors, social and economic factors, and physical environment.

Current Landscape: National Non-Profit Hospital Sample

- Clinical Care, 73%
- Health Behaviors, 19%
- Social and Economic, 8%
- Physical Environment, 0%

April 2014, Public Health Institute

Where the CDC and RWJF Want To Go...
Community Health Improvement Study (CHIS) Process

• **What:** conduct a study of health factors and social determinants of health in each market
• **Why:** inform the work of community outreach and community health teams by identifying the barriers to health
• **How:** market sub teams will hold 3 meetings to review qualitative and quantitative data and prioritize health and social focus areas
• **Outcome:** Provide the information necessary for the system to identify health and social focus areas for 2017-2019
Why a Community Health Improvement Study (CHIS)?

- Compile market level data and community input to determine **census tract target areas**
- Help identify priority health and Social Determinants of Health (SDOH), by market, that impact communities throughout the CHS footprint for **collective health impact and outcomes**
- Inform the development of collaborative **strategy and action plans** that address health and SDOH across CHS footprint
Purpose of Engaging the LHD

- LHD is the expert
- We reviewed each county’s CHA to better understand the coordination of community partners focusing on health and social determinants
- Validate data and findings
- Learn new trends and request opinions
- We also want to learn how CHS can be more collaborative on addressing health and SDOH across the region
<table>
<thead>
<tr>
<th>Social Determinants of Health</th>
<th>Anson</th>
<th>NorthEast</th>
<th>Cleveland</th>
<th>Lincoln</th>
<th>CMC Main + Mercy</th>
<th>CMC University</th>
<th>CMC Pineville</th>
<th>Stanly</th>
<th>Union*</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowded Households</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Food Access</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Households Living in Rental Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Households with No/Limited English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Housing Costs (rental)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Lack of Health Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Poverty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Median Household Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Single Parent Households</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Unemployment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

The Social Determinants of Health recommended by Market Facilities for the Carolinas HealthCare System Social and Economic focus area include (in order of priority, top four bolded):

1. Poverty (6)  
2. Lack of health insurance (5)  
3. Educational attainment (4)  
4. Food access (4)  
5. Transportation (3)  
6. Unemployment (3)  
7. Housing costs (rental) (1)  
8. Households with no/limited English (1)  
9. Single-parent households (0)  
10. Households living in rental housing (0)  
11. Household income (0)  
12. Crowded households (0)
COLLABORATIVE PROJECT
Why Map SDOH?

• Understand the “upstream” social and economic factors that influence health in service area
• Identify needs and communities where CHS can leverage community benefit investments to address SDOH
  – Shifting from clinical care to address health behaviors and socioeconomic factors
# Key SDOH Indicators

<table>
<thead>
<tr>
<th>Economic Stability</th>
<th>Neighborhood and Physical Environment</th>
<th>Education</th>
<th>Food</th>
<th>Community and Social Context</th>
<th>Health Care System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>Housing</td>
<td>Literacy</td>
<td>Hunger</td>
<td>Social integration</td>
<td>Health coverage</td>
</tr>
<tr>
<td></td>
<td>Transportation</td>
<td>Language</td>
<td></td>
<td>Support systems</td>
<td>Provider availability</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>Early childhood education</td>
<td>Access to healthy options</td>
<td>Community engagement</td>
<td>Provider linguistic and cultural competency</td>
</tr>
<tr>
<td></td>
<td>Parks</td>
<td>Vocational training</td>
<td></td>
<td>Discrimination</td>
<td>Quality of care</td>
</tr>
<tr>
<td></td>
<td>Playgrounds</td>
<td>Higher education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walkability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Health Outcomes
- Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations
**CHIS Process**

**June 2016:** development of 10 Market Teams

**August 2016:** CHS finalized establishment of a new strategic area: Community Health

**August – September 2016:** Market Teams met with LHDs to seek input and enhance the understanding of the public health process in assessing community health needs, priorities, and action plans

**September 2016:** CHS worked with NCIPH to map SDOH across the region and CHS conducted focus groups and reviewed findings from recent focus groups from LHDs

**October 2016:** Market Teams reviewed health and SDOH highlights and provided recommendations for the Social and Economic system focus area
SDOH Data Analysis Request

• Create maps of SDOH data for 10 county region
  – 10-12 SDOH indicators
  – Included food desert data

• Develop index of all indicators to identify communities of high need

• Summarize and review data at a county and regional level
What Are Others Doing?

Examples:

• Mecklenburg LHD CHA (2013)
• Orange County LHD – areas of concentrated poverty (2014)
• CTG (2014) Health Needs Index
SDOH MAPPING TOOL
Mapping SDOH

• 12 SDOH indicators at the neighborhood level (Census Tracts)
  
• Created index to summarize all indicators into a single variable (shown to the right)

• Interactive web map

http://arcg.is/2bUNr4a
Mapping SDOH, cont.

- Identified indicators based on literature review

- Selected indicators available from the U.S. Census
  - American Community Survey 5-year estimates (2010-2014)

- Food desert data from USDA (2010)
Selected SDH Domains and Indicators

Social & Neighborhood
- Individuals with < HS education
- Households with no/limited English
- Single-parent households
- Low access to food sources

Economic
- Median household income
- Individuals living below federal poverty line
- Unemployed individuals
- Uninsured individuals

Housing & Transportation
- Households living in rental housing
- Households paying >30% of income on rent
- Households without transportation
- Crowded households (>1 person/room)
SDOH Index

• 12 standardized SDOH measures inform 3 indicators:
  – Economic
  – Housing & Transportation
  – Social Resources

• Indicators given equal weight
  – Regardless of number of census variables within indicator
    • Census variables may be ‘diluted’ within indicator if many variables

• SDOH index is mean value of the 3 indicators
  – < 0 indicates better than average score (low need)
  – > 0 indicates poorer than average (high need)
**SDOH Index = Mean of Domain Scores**

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>Economic Domain</th>
<th>Housing &amp; Transportation Domain</th>
<th>Social &amp; Neighborhood Domain</th>
<th>SDOH Index (Mean of Domains)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
</tr>
<tr>
<td>Cleveland 9507</td>
<td>0.166</td>
<td>-0.165</td>
<td>-0.069</td>
<td>-0.023</td>
</tr>
<tr>
<td>Cleveland 9509</td>
<td>1.209</td>
<td>1.641</td>
<td>0.264</td>
<td>1.038</td>
</tr>
<tr>
<td>Cleveland 9511</td>
<td>0.786</td>
<td>0.860</td>
<td>0.184</td>
<td>0.610</td>
</tr>
<tr>
<td>Cleveland 9512</td>
<td>0.667</td>
<td>0.784</td>
<td>-0.159</td>
<td>0.430</td>
</tr>
</tbody>
</table>

**SDOH Index indicates the degree to which social determinants within a given tract are above or below the ‘regional’ average**
DEMO
Limitations

• U.S. Census Bureau’s American Community Survey data is based on a sample
  – Although using best data available, samples are subject to sampling variability
  – Data normally published with a 90% confidence interval or a "margin of error"

• Index
  – Summary of complex socioeconomic phenomenon in a single number
Other Mapping Platforms

• Durham’s Neighborhood Compass
  • http://compass.durhamnc.gov/

• National Platforms
  – Community Commons
    • https://www.communitycommons.org/maps-data/
  – UDS Mapper from Health Landscape
    • http://www.udsmapper.org/
  – FactFinder  https://factfinder.census.gov/
State Center for Health Statistics Resources

• Health and Spatial Analysis Branch
  – Dianne.Enright@dhhs.nc.gov
  – (919) 715-4473
  – http://healthstats.publichealth.nc.gov/

• North Carolina Health Atlas
  – County-level, sub-county available on request
  – Small numbers
Group Discussion and Questions


Extra stats slides
Variable Standardization Methods

- Indicator variables created as proportion of individuals (or households) with [X] in tract
- $z$-scores ($z$) create a standard metric for comparing different indicators
  - Based on estimate ($x$), CHS regional mean ($\mu$), & standard deviation ($\sigma$): $z = \frac{x - \mu}{\sigma}$
  - Measures the deviation of a tract estimate from the overall mean
  - Allows for comparison across different variables
  - Maintains overall trend
## Economic Domain:

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>Median Income (HH) est</th>
<th>Median Income (HH) z-score</th>
<th>Living in poverty (%)</th>
<th>Living in poverty (%) z-score</th>
<th>Unemployed (%)</th>
<th>Unemployed (%) z-score</th>
<th>Uninsured (%)</th>
<th>Uninsured (%) z-score</th>
<th>Domain Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland 9507</td>
<td>$44,805</td>
<td>0.422</td>
<td>14.7%</td>
<td>-0.156</td>
<td>12.4%</td>
<td>0.158</td>
<td>17.9%</td>
<td>0.241</td>
<td>0.166</td>
</tr>
<tr>
<td>Cleveland 9509</td>
<td>$19,126</td>
<td>1.412</td>
<td>43.7%</td>
<td>2.283</td>
<td>18.5%</td>
<td>1.174</td>
<td>15.7%</td>
<td>-0.034</td>
<td>1.209</td>
</tr>
<tr>
<td>Cleveland 9511</td>
<td>$28,238</td>
<td>1.061</td>
<td>33.6%</td>
<td>1.430</td>
<td>12.1%</td>
<td>0.111</td>
<td>20.3%</td>
<td>0.541</td>
<td>0.786</td>
</tr>
<tr>
<td>Cleveland 9512</td>
<td>$33,017</td>
<td>0.877</td>
<td>27.3%</td>
<td>0.906</td>
<td>17.2%</td>
<td>0.954</td>
<td>15.4%</td>
<td>-0.069</td>
<td>0.667</td>
</tr>
</tbody>
</table>

## Housing & Transportation Domain:

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>Living in Rental Housing (%)</th>
<th>&gt;30% income on rent (%)</th>
<th>No Transportation (%)</th>
<th>Crowded HH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
</tr>
<tr>
<td>Cleveland 9507</td>
<td>28.5%</td>
<td>-0.307</td>
<td>50.5%</td>
<td>0.065</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.8%</td>
<td>0.163</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.9%</td>
<td>-0.582</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.165</td>
</tr>
<tr>
<td>Cleveland 9509</td>
<td>67.4%</td>
<td>1.522</td>
<td>74.9%</td>
<td>1.558</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>22.9%</td>
<td>2.290</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.1%</td>
<td>1.195</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.860</td>
<td>1.641</td>
</tr>
<tr>
<td>Cleveland 9511</td>
<td>57.4%</td>
<td>1.049</td>
<td>66.8%</td>
<td>1.061</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15.1%</td>
<td>1.187</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.0%</td>
<td>0.146</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.784</td>
<td>0.860</td>
</tr>
<tr>
<td>Cleveland 9512</td>
<td>47.2%</td>
<td>0.573</td>
<td>65.6%</td>
<td>0.987</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12.2%</td>
<td>0.781</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.9%</td>
<td>0.794</td>
</tr>
</tbody>
</table>

## Social & Neighborhood Domain:

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>&lt; HS Education (%)</th>
<th>No/Limited English (%)</th>
<th>Low Food Access (%)</th>
<th>Single Parent HH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
<td>z-score</td>
</tr>
<tr>
<td>Cleveland 9507</td>
<td>19.2%</td>
<td>0.514</td>
<td>0.0%</td>
<td>-0.659</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75.2%</td>
<td>0.419</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.4%</td>
<td>-0.548</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.069</td>
</tr>
<tr>
<td>Cleveland 9509</td>
<td>22.2%</td>
<td>0.831</td>
<td>0.0%</td>
<td>-0.659</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95.0%</td>
<td>0.956</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12.1%</td>
<td>-0.071</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.264</td>
</tr>
<tr>
<td>Cleveland 9511</td>
<td>15.5%</td>
<td>0.140</td>
<td>2.1%</td>
<td>-0.200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80.0%</td>
<td>0.550</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14.5%</td>
<td>0.247</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.184</td>
</tr>
<tr>
<td>Cleveland 9512</td>
<td>12.5%</td>
<td>-0.168</td>
<td>2.8%</td>
<td>-0.047</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>55.4%</td>
<td>-0.116</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10.3%</td>
<td>-0.307</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.159</td>
</tr>
</tbody>
</table>
How to compare 2 different variables?

- **Percent uninsured**
  - 507 tracts
  - *Mean*: 15.8%
  - *Std Dev*: 8.0%
  - *Range*: 1.6% - 47.6%

- **Percent paying high housing cost**
  - 507 tracts
  - *Mean*: 44.7%
  - *Std Dev*: 15.1%
  - *Range*: 0.0% - 80.3%
Z score standardization

• Percent uninsured
  • 507 tracts
  • Mean: 0
  • Std Dev: 1
  • Range: -1.78 – 3.98

• Percent paying high housing cost
  • 507 tracts
  • Mean: 0
  • Std Dev: 1
  • Range: -2.95 – 2.36
Sample z-score calculation

• Cleveland Co., Tract 9509
  – % households with no transportation:
    – Tract Mean ($x$): $286 / 1,250 = 22.9\%$
    – Regional Mean ($\mu$) = 6.7\%
    – Regional Std Dev ($\sigma$) = 7.1\%
    – z score formula: $z = \frac{x - \mu}{\sigma}$
    – $z = (0.229 - 0.067)/0.0707 = 2.29$

  – **Translation:** In Tract 9509, the % households with no transportation are more than 2 standard deviations higher than the mean