Using GIS and Health Indicators To Develop a Conceptual Framework For Assessing Community Risks: The Case For Maternal Infant, and Early Childhood Home Visiting Program (MIECHV)

Khaleel S. Hussaini Ph.D. & Wesley Kortuem B.A.
Bureau Chief Public Health Statistics & Senior GIS Analyst
Bureau of Public Health Statistics
Overview

- Use of geographical information systems known popularly as ‘GIS’ has proliferated in many fields including public health.

- GIS has been used to “describe” “quantify” “explain” variations in disease (geographical and environmental) at small-area-scale.

- GIS has also been used to link diverse layers of population and environmental information to characterize different dimensions of health care need for small areas (community health profiles).
Issues

- Defining a “small-area” or a “community” to generate a health profile.
- Use of appropriate GIS techniques to aggregate data for statistical use.
- Use of appropriate health indicators to describe spatio-temporal, politico-legal, socio-economic variations.
- And keeping it meaningful, simple, and useful.
Community Health Assessment

- The core elements of a comprehensive assessment is a strong substantive analysis of needs and system capacity, and a clear linkage of priorities to those needs as well as strategic priorities of the organization.

“...the process is as important as the product itself”
Assessment Framework

Assess Health Needs

Assess Capacity

Match Needs & Capacity

Set priorities & performance objectives

Further in-depth studies of specific needs

Strategic plan and allocation of resources
## Match Needs and Capacity

<table>
<thead>
<tr>
<th>NEED</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>Continue intervention programs</td>
</tr>
<tr>
<td>Low</td>
<td>Excess capacity- move resources to meet other needs</td>
</tr>
</tbody>
</table>
The Stake!!!

- 1.9 million dollars as formula grant from Affordable Care Act (ACA) for the first year;

- If you compete…upto $45 million over next five years;

- Stakeholders – Department of Health Services, Department of Economic Security, Department of Education (i.e. Head Start) and many others…

- Getting it right the first time…!

- Maternal Infant Early Childhood Home Visiting (MIECHV)
Arizona’s Response to ACA

- Establish a structure of collaborative decision making at the state and local level with one state agency taking the lead to facilitate a State Level Steering Committee.

- Arizona Department of Health Services (ADHS) convened Inter Agency Leadership Team (IALT) including Department of Economic Security (DES), Department of Education (DOE) and First Things First (FTF).

- IALT to work collaboratively on application, defining unit of analysis (i.e. “community”), defining sources of “data” (i.e. indicators), defining methodology of selecting communities, and defining methodology of selecting evidence-based programs.
Purpose of MIECHV

- To strengthen and improve the programs and activities carried out under Title V
- To improve coordination of services for at-risk communities
- To identify and provide comprehensive services to improve outcomes for families who reside in at-risk communities
Legislated Participant Outcomes

Demonstrate improvements and/or reduction in...

1. prenatal, maternal, and newborn health, including improved pregnancy outcomes;

2. child health and development, including the prevention of child injuries and maltreatment and improvements in cognitive, language, social-emotional, and physical developmental indicators;

3. parenting skills;

4. school readiness and child academic achievement;

5. crime or domestic violence;

6. family economic self-sufficiency;

7. coordination of referrals.
Requirements

- premature birth, low-birth weight infants, and infant mortality, including infant death due to neglect, or other indicators of at-risk prenatal, maternal, newborn, or child health
- poverty
- crime
- domestic violence
- high rates of high-school drop-outs
- substance abuse
- unemployment
- child maltreatment
More Assessment Requirements

- Assessment of the quality and capacity of the current home visiting capacity;

- Coordinate with assessment required under section 505(a);

- Communitywide strategic planning and needs assessments conducted in accordance with section 640(g)(1)(C) of the Head Start Act;

- Inventory of current unmet needs and current community-based and prevention-focused programs and activities to prevent child abuse and neglect, and other family resource services operating in the State required under section 205(3) of the Child Abuse Prevention and Treatment Act.
And other million requirements…

- Eligible families who reside in communities in need of such services, as identified in the statewide needs assessment.

- Low-income eligible families, pregnant women who have not attained age 21, a history of child abuse or neglect or have had interactions with child welfare services, history of substance abuse or need substance abuse treatment; users of tobacco products in the home, have children with low student achievement, children with developmental delays or disabilities and that include individuals who, are serving or formerly served in the Armed Forces, including such families that have members of the Armed Forces who have had multiple deployments outside of the United States.
Arizona on the MAP

- 15 counties;
- Borders with Mexico;
- Large landmass with tribal areas;
- 90% or more in two counties
1st Challenge

- Counties typically represent the state well.

- Next step down in the US Census hierarchy is Census Tracts, but with 1107 tracts in Arizona the option is far too small.

- Create a spatial unit that represents the communities of the state and provides population numbers conducive to statistical analysis.
Defining “community”

- Bureau of Public Health Statistics created the Community Health Analysis Areas (CHAAs) for surveillance of various diseases.

- CHAAs are built from US Census 2000 Block Groups by aggregating them in a way that closely matches existing community boundaries such as cities, planning areas and Indian Reservations.

- Since CHAAs are built from Census Block Groups all data available at the Block Group can be aggregated to a CHAA.

- Street and address level and zip code level data can be added.
Community Health Analysis Areas

- A typical CHAA contains approximately 21,500 residents and vary widely in population, from 5,000 to 190,000 persons.

- Tribal communities are an exception to the CHAA definition and are each considered an individual CHAA. There are a total of 126 CHAAs in Arizona.

- Geocoding was implemented for all datasets containing address information using the Centrus Desktop geocoding software.

- ~ 80 to 90% of records could be assigned to a CHAA either from an exact address geocode and/or a geocode with a census geography accuracy of at least Block Group.
The Rules for CHAA Boundaries

• A population of each CHAA is to have a minimum of 5,000 people and a maximum of 200,000 people.

• To represent a community political boundaries.

• To reside within one county.

• When possible every Native American reservation is represented by its own CHAA.
  - A county boundary can be crossed to preserve the boundaries of a community or Indian reservation.
  - A community population can be less than 5,000 if the community is an Indian reservation or if the community can only reach 5,000 when it combines with an Indian reservation or crosses county lines.

• CHAAs were created by combining census block groups around a political boundary.
Defining and selecting indicators

- Reliable and valid
- Precise and measurable
- Relevant to program (i.e. home visiting)
- Easily accessible and available
- Available over time
- Cost-effective
<table>
<thead>
<tr>
<th>#</th>
<th>Indicator</th>
<th>MIECHV SIR Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Percent Preterm</td>
<td>●</td>
</tr>
<tr>
<td>2</td>
<td>Percent LBW</td>
<td>●</td>
</tr>
<tr>
<td>3</td>
<td>IMR rate</td>
<td>●</td>
</tr>
<tr>
<td>4</td>
<td>Percent below poverty</td>
<td>●</td>
</tr>
<tr>
<td>5</td>
<td>Total Crime Index per 100,000</td>
<td>●</td>
</tr>
<tr>
<td>6</td>
<td>Non-fatal injuries for women of childbearing age 15-44 assaults per 100,000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>●</td>
</tr>
<tr>
<td>7</td>
<td>School dropout rates</td>
<td>●</td>
</tr>
<tr>
<td>8</td>
<td>Binge drinking by youth&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Alcohol use by youth&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Marijuana use by youth in last 30 days&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Rx use by youth in last 30 days&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Illicit drug use by youth in last 30 days&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Cigarette use by youth in last 30 days&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Unemployment rate</td>
<td>●</td>
</tr>
<tr>
<td>15</td>
<td>Negligence per 1000</td>
<td>●</td>
</tr>
<tr>
<td>16</td>
<td>Physical abuse per 1000</td>
<td>●</td>
</tr>
<tr>
<td>17</td>
<td>Sexual abuse per 1000</td>
<td>●</td>
</tr>
<tr>
<td>18</td>
<td>Child maltreatment per 1000</td>
<td>●</td>
</tr>
<tr>
<td>19</td>
<td>Zero to 18 years injuries per 1000&lt;sup&gt;*&lt;/sup&gt;</td>
<td>●</td>
</tr>
<tr>
<td>20</td>
<td>Teen birth rate&lt;sup&gt;*&lt;/sup&gt;</td>
<td>●</td>
</tr>
<tr>
<td>21</td>
<td>Percent of Women who initiated prenatal care by 1st trimester&lt;sup&gt;*&lt;/sup&gt;</td>
<td>●</td>
</tr>
</tbody>
</table>

Notes: Indicators 1 through 5 and 14 through 18 were consistent with the MIECHV definitions.

<sup>a</sup> Proxy indicator for domestic violence as data on domestic violence was unreliable, unavailable at community level. Non-fatal injuries for women of childbearing age 15-44 years was defined using ICD-9-CM codes 800.00-909.20, 910.00-994.90, 995.50-995.59, 995.80-995.85, 909.4, 909.9), and the first listed valid E-Code was among the following ICD-9-CM External Cause of Injury Codes: E960-E969, E979, E999.1.

<sup>b</sup> Substance use measures identified in SIR was not specific about women and/or women of childbearing age. Further, because data at community level was unavailable and/or unreliable, Arizona utilized substance use measures for youth that was available at community level.

<sup>c</sup> Cigarette use was not specified in SIR and Arizona included this indicator as another measure of alcohol, tobacco, and other drug use measures (ATOD).

<sup>*</sup>These additional indicators were key maternal and child health indicators specific to Arizona.
Methodology

- The analytic strategy to identify “at risk communities” was based on ranking methodology.

- Ranks a state, a census block, or a community (typically a geographic unit) on identified risk and/or capacity indicators by estimating the average rank.

- The average ranks are typically grouped into quartiles and/or quintiles, which can then be displayed as a statistical map (GIS map) to describe geographical variations.

- Each CHAA was ranked on all of the 21 indicators. These indicators were averaged to produce an overall risk score for each CHAA. Higher scores indicated higher risk.
Results

- The overall risk profile was distributed normally ($Mdn = 62.96; M = 62.97; SD = 13.79$) with a minimum rank score of 29.76 and a maximum of 94.57.

- Further, Shapiro-Wilks test indicated that the distribution of the overall risk score was normal ($W = 0.99; p = 0.57$).
Risk profile of 126 Community Health Analysis Areas (CHAAs)
Profile of 31 High Risk Communities

1. White Mountain Apache
2. Tucson Central
3. Coolidge
4. Holbrook
5. Winslow
6. Tucson SE
7. Casa Grande
8. San Carlos Apache
9. Tucson N Central
10. Tucson E Central
11. Apache Junction
12. Graham Co. S
13. Hopi Nation
14. Green Valley
15. Tucson SW
16. Globe/Hayden
17. Continental
18. Payson
19. Camelback East
20. Alhambra
21. Yavapai Co. NE
22. Central City
23. Duncan/Morenci
24. Tucson W
25. Bullhead City
26. Quartzsite/Salome
27. Glendale Central
28. Ajo
29. San Manuel
30. Fort Mohave
31. Bisbee
Scatter-plot of Risk and Capacity

Average Risk Score vs. Average Capacity Score

Cities and Locations:
- Apache Junction
- Continental
- Tucson SE
- Duncan/Morenci
- Green Valley
- Payson
- Graham Co. S
- Tucson N Central
- Winslow
- Casa Grande
- Yavapai Co. NE
- Globe/Hayden
- Marana
- Kingman
- Ajo
- Prescott Valley
- Holbrook
- Parker
- Douglas
- Yuma
- Yuma E
- Somerton
- Chandler SE
- Scottsdale N
- Flagstaff W
- Yuma S
- Mesa S
- Mesa N
- Flagstaff W
- Desert View/North
- Eloy
- Yuma NW
- Gilbert W
- Gilbert E
- Ahwatukee Fothil
- Williams
- Surprise
- Eloy
- Fountain Hills
- Goodyear
- Yavapai Co. S
- Bagdad
- Prescott
- Mesa Central
- St. Johns
- Encanto
- Scottsdale S
- North Mountain
- Tucson E
- Flagstaff-Rural
- Paradise Valley V
- Salt River
- Estrella
- Salt River
- Avondale
- Salt River	
- Glendale W
- Gila River
- Cordes Junction
- Bullhead City
- Mesa E
- Maricopa
- Maricopa Co. W
Conclusion

- AZ received $1.79 million + Competitive funds close $9.0 million.

- Helped prioritized communities for intervention.

- A lot of other steps to present the findings of needs assessment and selection of communities and evidence-based programs were carried out.

- Use of this technique also facilitated development of evaluation – both programmatic and system wide evaluation.