GIS as a tool for bridging Public Health, Healthcare and the Community

UCLA CENTER FOR HEALTHIER CHILDREN FAMILIES & COMMUNITIES

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Director

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GIS Unit Chief

Please note that everyone will be muted upon joining the webinar to avoid background noise.

Please ask your questions via Zoom’s chat feature, submit the questions to: “everyone.” The questions will be addressed in order of submission. Thank you.

If you have any questions please send an email to Carla, calvarado@nas.edu
GIS as a tool for bridging Public Health, Healthcare & the Community

UCLA Center for Healthier Children Families and Communities

Neal Halfon MD MPH : Center Director/Professor of Pediatrics, Public Health, Public Policy
efren aguilar : GIS Unit Chief/Nerd/Change Agent

May 15, 2019
Action Collaborative on Bridging Public Health, Health Care & Community
**SYSTEMS INNOVATION & IMPROVEMENT**

We work with local, state, and national partners to develop responsive systems of care and to bridge the gap between what we know and what we do.

**TRAINING & MODEL PROGRAMS**

We provide interdisciplinary training to health professionals preparing them to reshape health services and policies in order to improve children’s long-term development.

**RESEARCH & EVALUATION**

We study how both risk and protective factors influence children’s outcomes, and apply the latest knowledge to programs, community systems, and state and national policy.

**POLICY**

We provide analysis that are crucial to creating policies that optimize early childhood outcomes and manage chronic disease. We collaborate with policymakers in California, Washington, D.C., the UK, Canada, and Australia.

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**Center for Healthier Children, Families & Communities**
CHCFC - Current Projects

**All Children Thrive** is a network of people and places working together to identify the strategies and policies that can help all children thrive.

**ACT California** is transforming cities into microenterprise of social innovation, creating the conditions where families flourish and children thrive.

**Transforming Early Childhood Community Systems** is a national initiative to improve school readiness of children by measuring and mapping developmental progress.

The **Gross Domestic Potential** Project aims to create a new measurement framework for how we as a nation measure the opportunities, capabilities and potential of a child across the life course and determine what investments communities should make to maximize this potential.

**Moving Health Care Upstream** is a collaborations with Nemours to design new ways of engaging health systems in addressing social and developmental determinants of health.

**Life Course Research Network** is a collaborative network of researchers and MCH professionals committed to improving health and reducing disease by advancing life course health development research.
CHCFC Books, Reports, & Technical Assistance Manuals
What Underpins Our Work
Growing Adversity

• Our human ecosystem is radically changing very quickly

• Deep changes are disrupting families, communities and the developmental scaffolding that kids need to flourish and thrive (kids as the canaries in the global coal mine of change)

• Symptomatic, piecemeal solutions are costly ineffective, disheartening, and often self defeating

• Need a systems approach, working at scale, using a comprehensive strategy, with the purpose of a social movement
Traditional Cause of Adversity in Childhood

- Poverty, social isolation, marginalization, exclusion and inequality
- Racism, discrimination,
- Family dysfunction, conflict, & despair
- Untreated, uncontrolled mental health problems
- Drug, alcohol and other substance abuse issues
- Natural disasters, extreme weather events
- Unforeseen & uncontrollable family separations, divorce
- Death of parents, family member
Deep Drivers of New Forms of Adversity

• **Change of age** (economies/production ecosystems)
  • agriculture > industrial > IT

• **Major disruptions in our social ecosystems**
  • cultural forms, value streams, production models, relationship to environment/planet

• **Accelerators of change**
  • Globalization X Technology X Climate Change
  • Other Megatrends – urbanization, inequality, migration

• **Speed of change accelerating** (faster than we can adapt to; disease and disability due to adaptive failures)

• **Mismatches** -- Human development > Family Development > Community Development > Economic Development

• **Disruptive conflicts**, changing lifecourse pathways, instability, insecurity, are here to stay
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Lack of data on a number of indicators means that the following countries, although OECD and/or EU members, could not be included in the league table of child well-being: Australia, Bulgaria, Chile, Cyprus, Israel, Japan, Malta, Mexico, New Zealand, the Republic of Korea, and Turkey.
Changing Pattern of Childhood Morbidity

• Increase in chronic health problems (40%)
  • Not Hemophilia, Cancer, Congenital Heart Disease

• Growing prevalence of mental health disorders (22+%),
  • Problems of adaptation, evo-devo mismatches

• Greater appreciation of role and impact of neuro-developmental health problems – learning, language (10-17%)

• Growing number of children with multiple conditions (co-morbidities)
  e.g. asthma, obesity, ADHD
  • Syndemics?
Applying GIS to Population Health Measurement and Sense-making

Measurable Developmental Outcomes
Crime
Access to Supportive Services
Socio-Economic Conditions
Built Environments
Strong Neighborhood Relationships
Socio-Historical Context
Topography

Examples of Spatial Factors Impacting Early Childhood Development

Child 1
Child 2
Child 3
Opening Remarks: Orienting Thoughts

• Introduction: Why Place Matters (Exercising Your Spatial Reasoning)
• Definitions/Challenges
• Case Studies
  • Early Development Instrument - *Teasing through the complexity of social and physical environments and their cumulative effects using a population health outcome measure*
  • Reproductive Health Mapping - *An epidemiological survey using spatial statistics to assess patterns of congenital anomalies*
Introduction: Why Does Place Matter?

• It’s Complex\(^1\)
  - Environmental influences are varied and include social and physical factors
  - These individual factors interact with each other and sometimes mediate or exacerbate outcomes (Relationships are complex)
  - The strength of the influence changes over the life-course (inter-generational, prenatal, perinatal, infancy, early childhood, etc.)

• It’s Difficult to Measure
  - Policy changes can interrupt surveillance efforts
  - Causation is hard to prove

Definitions to Help Us Make Sense

• Environments: Encompass the places and situations/circumstances that have an effect on an individual (chemical, biological, physical, psychosocial, genetic, and epi-genetic)
  • Social Environments: Refer to socio-political contexts that interact to effect health outcomes (economy, culture, family structure...)
  • Physical Environments: Refer to physical eco-systems that interact to effect health outcomes: (e.g. weather, soil, water, climate, topography, atmosphere...)
  • Combined these constitute a Spatial Environment

• Population Health Measures: Quantifiable measures of the health outcomes of a group of individuals within a specific spatial environment

• Geographic Unit of Analysis (GUA): The geographic scale data are aggregated for analyses
Challenges with Analyzing Spatial Patterns Modifiable Areal Unit Problem – (MAUP)

• Errors associated with aggregating data into certain geographic areas (think gerrymandering)
• Can bias tests influenced from boundary selection
“Everything is related to everything else, but near things are more related than distant things.”

- Waldo Tobler

Printed in March 1812, this political cartoon was drawn in reaction to the newly drawn state senate election district of South Essex created by the Massachusetts legislature to favor the Democratic-Republican Party candidates of Governor Elbridge Gerry over the Federalists. The caricature satirizes the bizarre shape of a district in Essex County, Massachusetts, as a dragon-like "monster". Federalist newspaper editors and others at the time likened the district shape to a salamander, and the word gerrymander was a blend of that word and Governor Gerry's last name.
Why use GIS to map population health data

• Maps provide stakeholders multiple levels of comparison
  • By geography to identify population health patterns
  • To socio-economic indicators to help understand the reasons for observed outcomes
  • To service data to identify where there are service gaps

• Over time maps can track results of policies and place-based initiatives contributing to children’s development

• Vector vs Raster? It depends
  • Vector data are points, lines, & polygons – eg. Assets, Roads, City Boundaries
  • Raster data are pixels (grid cells)
Before we map our data...

• We partner with local lead agencies to help cultivate/advance the spatial thinking of residents to...
  • Act as context experts to facilitate sense-making and analysis
  • Inform the shaping of neighborhood boundaries used to analyze their data
  • Participate in the policy discussion that impact their community well-being

• We help cultivate/advance the spatial thinking of community service providers to...
  • Facilitate community dialogues to interpret their results
  • Integrate these data with their program evaluation data
Defining the Community in Community Systems – Geographic Unit of Analysis

• **GUA** – are the basic geographic boundaries that either define a neighborhood or can be aggregated to better define a neighborhood

• **Core Consideration**
  • Local community data should be presented in ways that residents as well as local elected officials, service providers, and community researchers can use easily for various planning and evaluation activities
  • A certain level of flexibility is required for comparability across various secondary data sources like the US Census, Health and Education sector data, and other data providers
  • This requires an acceptance of a certain level of uncertainty – that’s okay
Why neighborhood level data are important

• Most data that drives policy for children and families is at the county or city level
  • These geographies are often too large to detect important variations that occur at the neighborhood level
  • These geographies may not reflect the community’s daily lived experiences
• To conduct effective community planning, it is necessary to look at data for smaller geographic areas that are relevant to the community (i.e. neighborhoods)
• Community defined boundaries are more likely to reflect the day-to-day reality of residents
• Community members are connected by similar experiences and many important aspects of life are organized around their neighborhood
Neighborhood Boundaries

- Distinct geographic areas that community members and local policy makers recognize as their community/neighborhood.
- Often related by some level of social interaction and shared institutions.
- Though a neighborhood sometimes comprises a small area, for the purposes of mapping we recommend that neighborhoods be large enough to align with important data sets like the US Census.
Criteria Shaping Neighborhood Boundaries

• Boundaries must be contiguous. – e.g. should be no gaps between the shapes and, they must not overlap.
• Boundaries should be appropriate size – e.g. should be large enough to represent a distinct community and yet small enough to illustrate variability between places.
• Boundaries should be useful for local planning (e.g. whenever possible should respect political jurisdictions)
• Boundary should follow census lines to maximize data analysis options – e.g. neighborhood boundaries can be created by clustering census shapes.
• The shapes must cover the entire study area.
Lifecourse Health Development

Readiness to learn

- Parent education
- Emotional Health Literacy
- Reading to child
- Appropriate Discipline
- Health Services
- Toxic Stress
- Lack of health services
- Poverty
- Lack of health services
- Toxic Stress
- Lack of health services

EDI = Early Development Index

Spatial Effects on Human Development
Complex and Dynamic Interactions

Examples of Spatial Factors Impacting Early Childhood Development

- Crime
- Access to Supportive Services
- Socio-Economic Conditions
- Built Environments
- Strong Neighborhood Relationships
- Socio-Historical Context
- Topography

Measurable Developmental Outcomes
Power of Images to Explain Complexity and Equity
So what does this tell us?
What are the implications then for making sense of population health outcomes?

Performance on EDI

- On-Track
- At-Risk for being Vulnerable
- Vulnerable

Community Contextual Factors
Case Study 1: Early Development Instrument

Teasing through the complexity of social and spatial factors and their cumulative effects using a population measure
Before we begin - Let’s step backwards – just so we can have a more precise conversation

• First we’ll start with a brief review of our population health outcome (EDI)
• Then we will discuss the EDI in relation to community measures of risk (Neighborhood Risk Index)
• Then we will compare the two
Early Development Instrument

• Developed at the Offord Center for Child Studies

• Population focus
  • Provides a community-level measure of children’s health, development, and school readiness
  • Informs place-based efforts to optimize healthy development for all young children as the foundation for community development
About the EDI Domains

• Physical health
  – Absence of disease, access to appropriate nutrition, necessary gross and fine motor skills

• Social competence
  – General standards of acceptable behavior, cooperation with others, showing respect for adult authority, communicate feelings and needs

• Emotional maturity
  – Curiosity about world, eagerness to try new things, ability to reflect before acting

• Language and cognitive
  – Abilities with reading, writing and numbers, shape recognition, interest in books

• Communication skills
  – Understanding verbal communications, ability to communicate experiences, wishes and feelings
Power of Comparing a Population Measure with Community Contextual Data

Community Contextual Factors → Neighborhood Risk Index → Population Health Outcomes → Early Development Index
Neighborhood Risk Index

- Percent Single Parent
- Percent Poor Families with Children
- Percent 25+ no High School Diploma
- Percent 25+ BA or Higher
- Percent 16-19 not School/Work
- Percent Head of Household on Public Assistance
- Percent Head of Household with Wage Income
- Percent Head of Household Interest, Dividend or Rent Income
- Percent 18+ Limited English
- Percent Owner-occupied Housing

https://doi.org/10.1016/j.acap.2017.05.009
Neighborhood Classification

- All census tracts from counties where we have collected EDI were classified into 4 groups
  - Zero: No Vulnerability Factors
  - Low: 1-2 Vulnerability Factors
  - Medium: 3-5 Vulnerability Factors
  - High: 6-10 Vulnerability Factors
Neighborhood Risk Index Performance by EDI Domain

- **Phys. Health & Well-being**
- **Social Competence**
- **Emotional Maturity**
- **Language and Cognitive Development**
- **Comm. Skills and Gen. Knowledge**
- **Vulnerable 1+ Domains**

- **Proportion of Children Vulnerable on EDI**
  - Zero: No Vulnerability Factors
  - Low: 1-2 Vulnerability Factors
  - Medium: 3-5 Vulnerability Factors
  - High: 6-10 Vulnerability Factors
Mapping Neighborhood Risk Index with the EDI

Census tracts performing poorer than expected on the EDI Negative Deviance

Census tracts performing better than expected on the EDI Positive Deviance

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Westchester, New York (Neighborhoods are performing as expected based on community context)
Hidalgo, Willacy and Cameron Counties (Distinct Patterns of Overperforming and Underperforming Census Tracts)
Revised Analyses Can Incorporate Expected Outcomes Based on Local Context
Revised Analyses Can Incorporate Expected Outcomes Based on Local Context – and can incubate learning across similar communities
Case Study 2: Reproductive Health Mapping

An epidemiological survey using spatial statistics to assess patterns of congenital anomalies
Background

• In the United States, between 2 to 4 percent of children are born with birth anomalies

• With over 100,000 births per year across 88 cities in Los Angeles County in both highly diverse neighborhoods and homogenous ethnic enclaves

• No longer a birth defect monitoring database in Los Angeles County

• So we used the vital statistics birth file to understand the relationship between place and birth outcomes
Mothers are threatened by a number of environmental and chemical exposures

- Carbon Monoxide
- Ozone
- Aerosolized Chemicals
- Industrial Waste
- Pesticides
And these exposures differ across various places in Los Angeles County.
Unfortunately, sometimes these exposures result in congenital anomalies.
Congenital Anomalies Coded in Vital Stats

- Anencephaly
- Meningomyelocele/Spina bifida
- Cyanotic congenital heart disease
- Congenital diaphragmatic hernia
- Omphalocele
- Gastroschisis
- Limb reduction defect
- Cleft palate and cleft lip
- Down’s syndrome
- Suspected chromosomal disorder
- Hypospadias
- Aortic stenosis
- Pulmonary Stenosis
- Atresia
- Additional and unspecified congenital anomalies not listed
Hot Spot Analysis of Rates of Births with Congenital Anomalies (2006-2010) by PUMA in Los Angeles County
### Relative Risk by Race/Ethnic Groups for Births with Congenital Anomalies within Hot Spots

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Special Thanks

- Children’s Bureau of Southern California
- Doris Duke Charitable Foundation
- First 5 LA
- First 5 Orange County
- Pop Change Learning Community
- Transforming Early Childhood Community Systems Communities
- The David and Lucile Packard Foundation
- The Iris Cantor Women’s Center