



Division of Public Health
College of Human Medicine
MICHIGAN STATE UNIVERSITY

Community participatory and interdisciplinary mapping approaches to drive health equity solutions

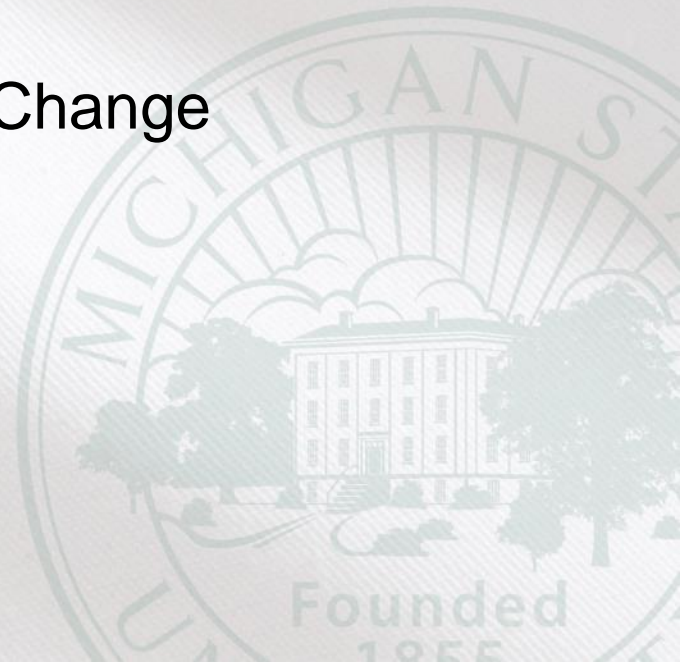
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Methodology Core Director, Flint Center for Health Equity Solutions

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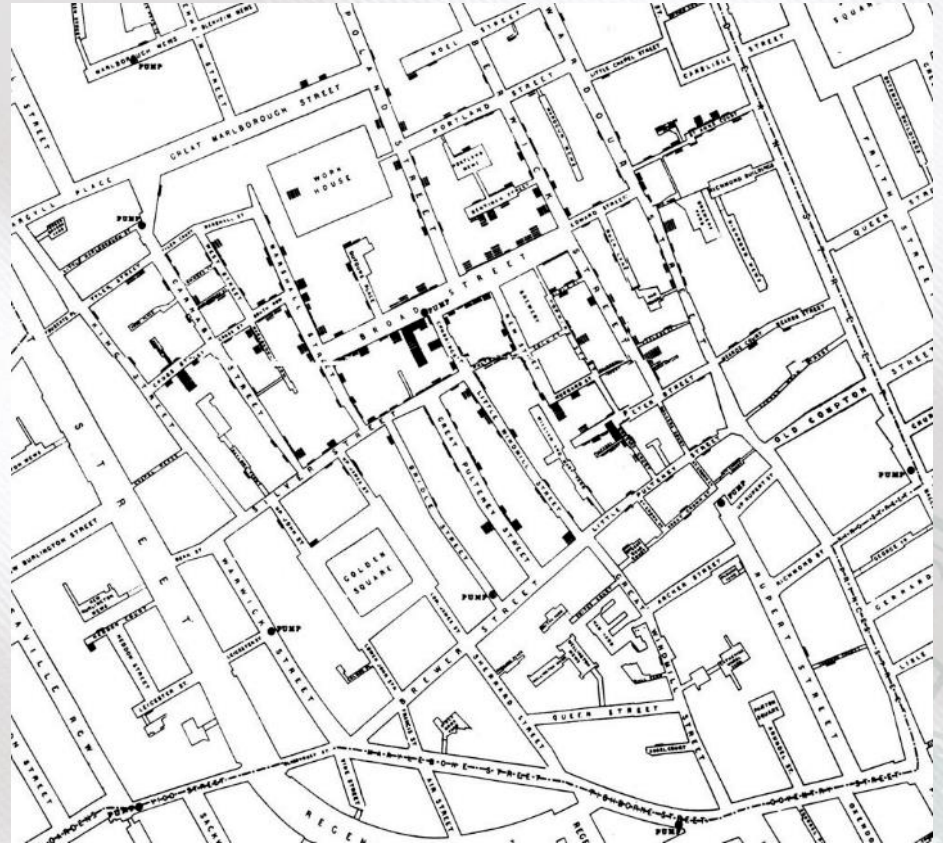
> Outline

- The Role of a Geographer in Public Health Research
- The Purpose of Participatory Mapping
- Creating a Neighborhood Index for Health Promotion
- Usefulness for Interventions/Policy Change



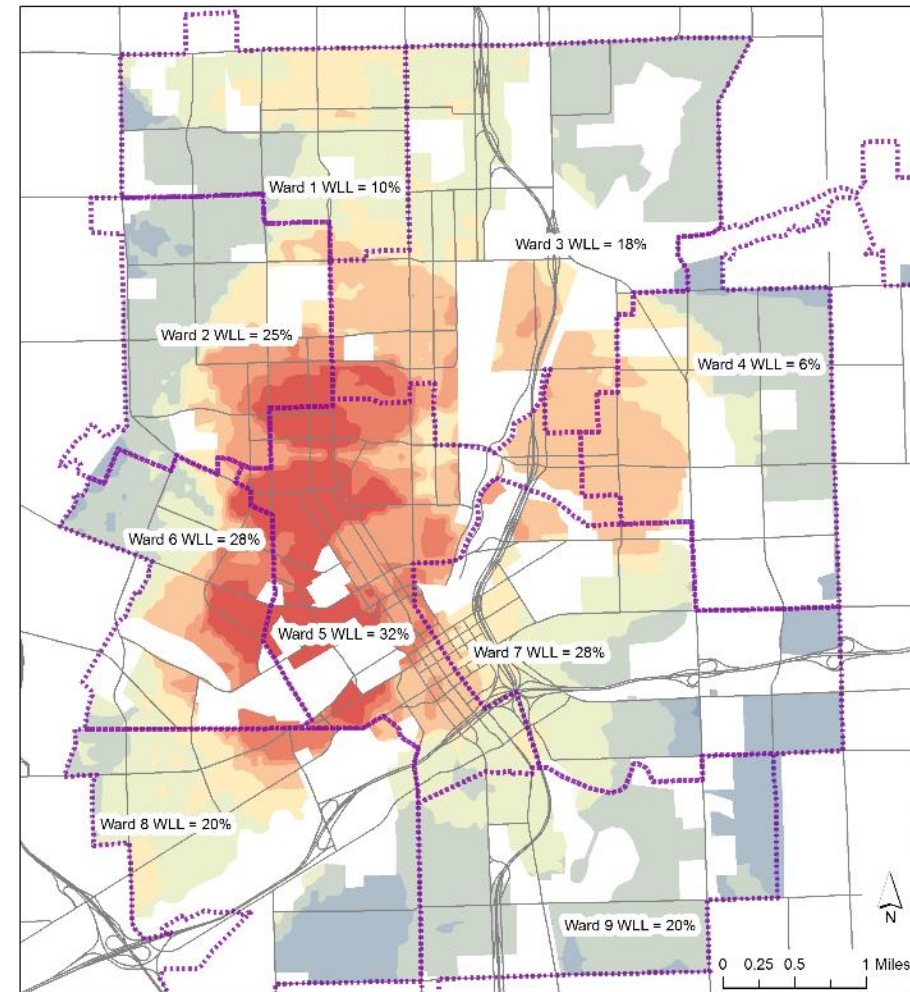
➤ The Role of a Geographer

- Think John Snow
- Simple tools to identify cluster of cholera cases
- Problems are often more sophisticated, require special expertise

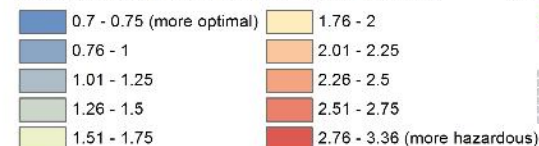


➤ A role I've had

- Identification of clusters of elevated blood lead levels
- Helped raise awareness of the Flint Water Crisis
- Demonstrated what Dr. Mona already knew but couldn't visualize without a geographer



Predicted BLL based on Ordinary Kriging ($\mu\text{g}/\text{dl}$)



*Non-residential zones screened from results

Flint City Wards
Major Streets

*Ward Labels indicate % of ward where any water sample exceeded 15 ppb



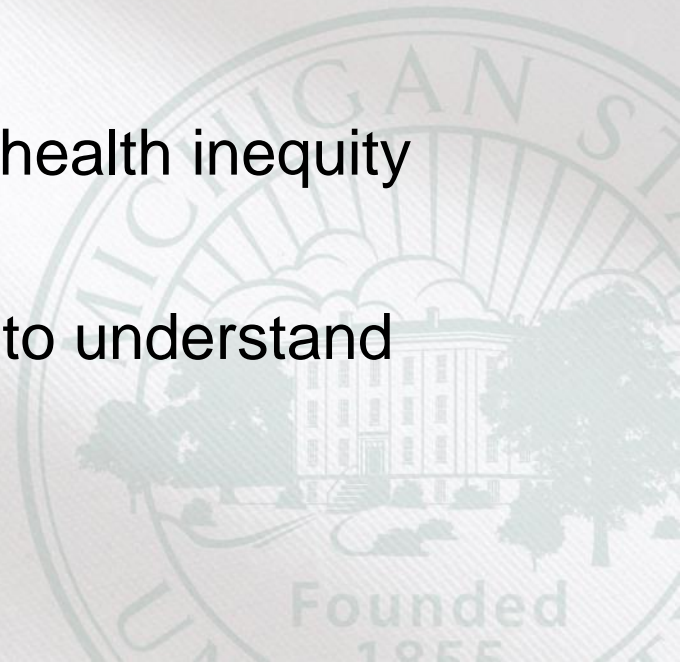
➤ Data-driven urban planning

- Planning is increasingly participatory
- Maps are a visual aid for understanding planning problems
- Methods exist for scientifically putting opinions into map form for decision-making



➤ The Purpose of Participatory Mapping

- Within cities, neighborhoods are highly variable: some are more pathogenic than salutogenic...how to measure?
- Geospatial Healthfulness: *aspects of the built environment that contribute to good health*
- Could be underlying determinant in health inequity
- Impending interventions drive need to understand confounding factors



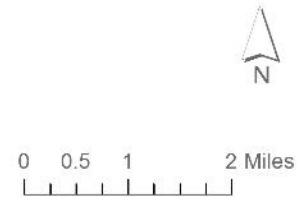
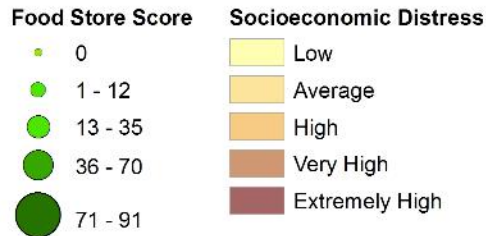
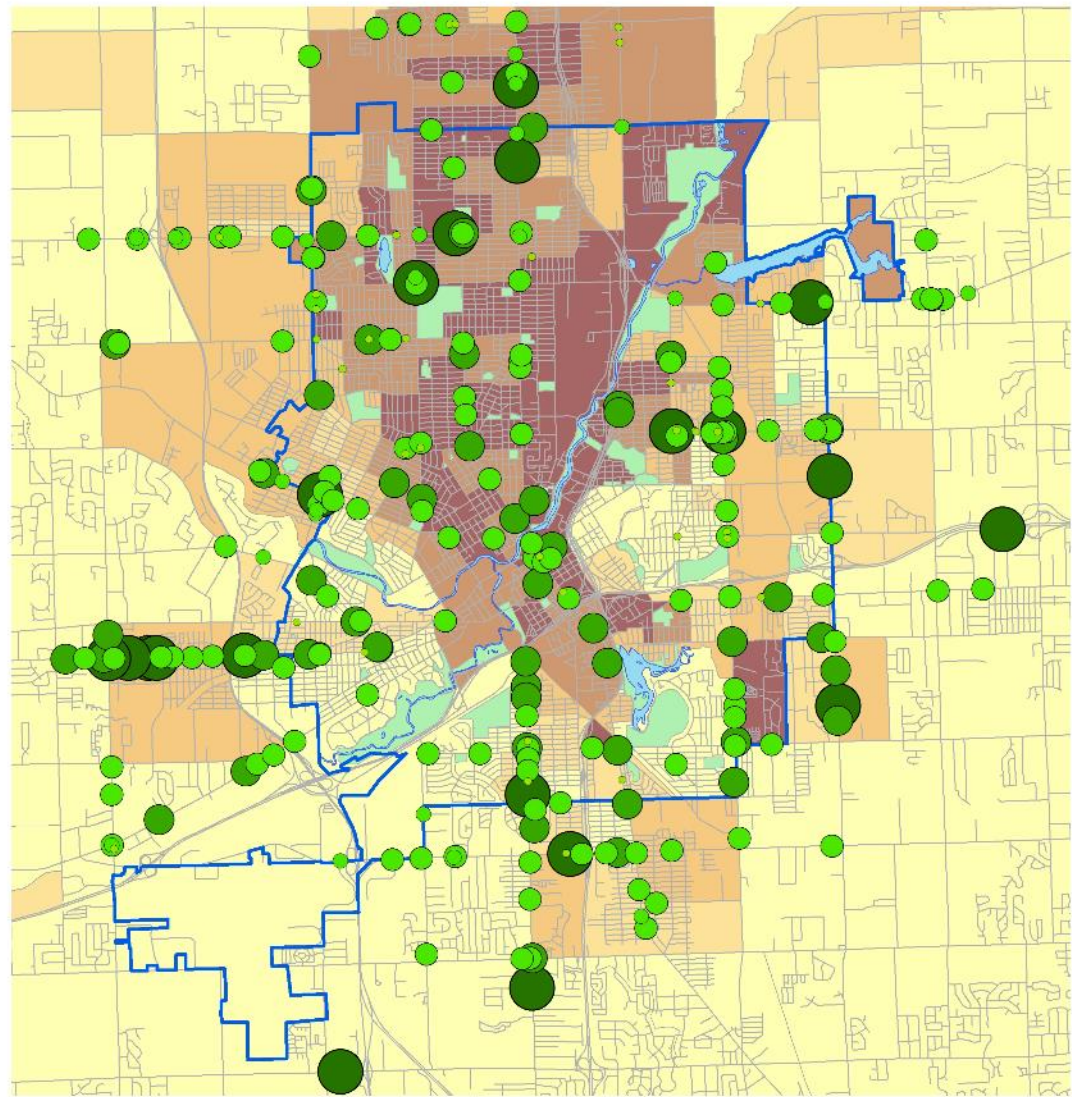
> The data

- GIS layers for social/built environmental variables
 - Amenities (schools, healthy food)
 - Environmental issues (lead, industrial land)
 - Greenspace (gardens, parks)
 - Housing (condition, vacancies)
 - Infrastructure (roads, streetlights)
 - Social (crime, health issues)



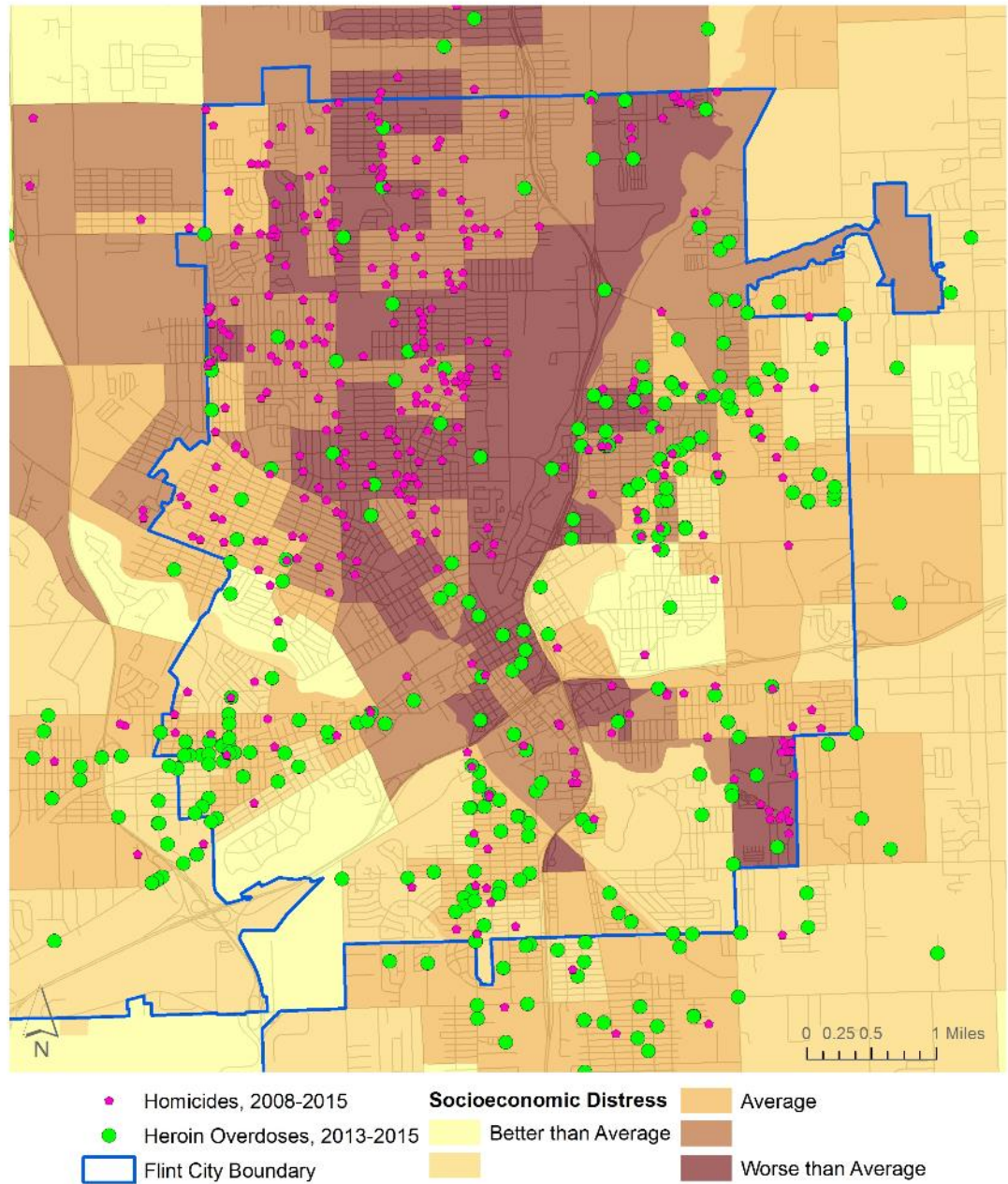
Example 1

- Socioeconomic distress (background)
- Healthy food access (green dots)



Example 2

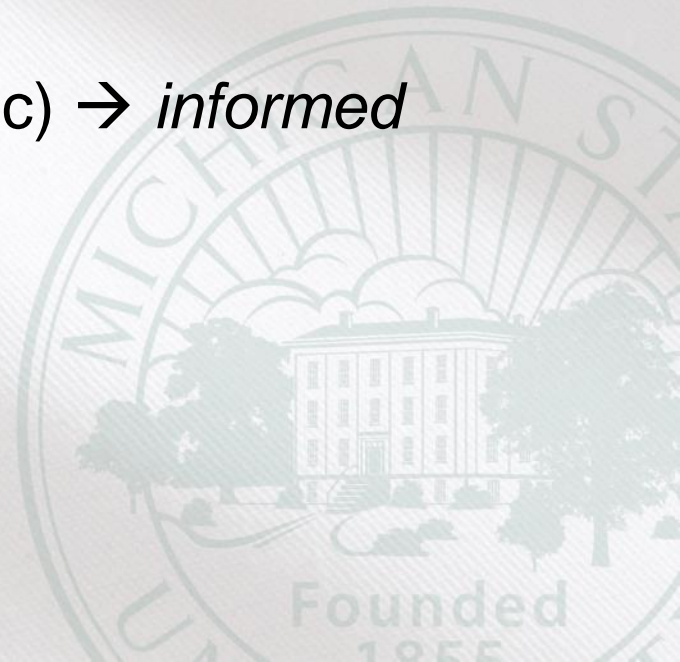
- Heroin overdose deaths (green)
- Homicides (pink)



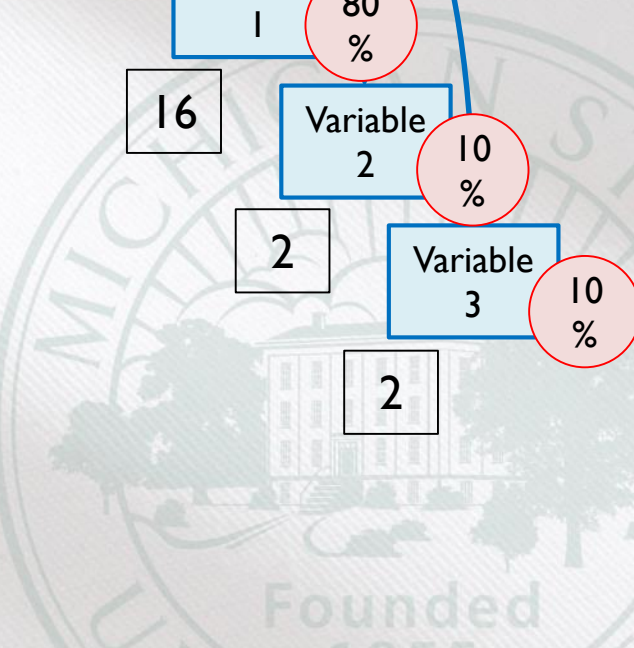
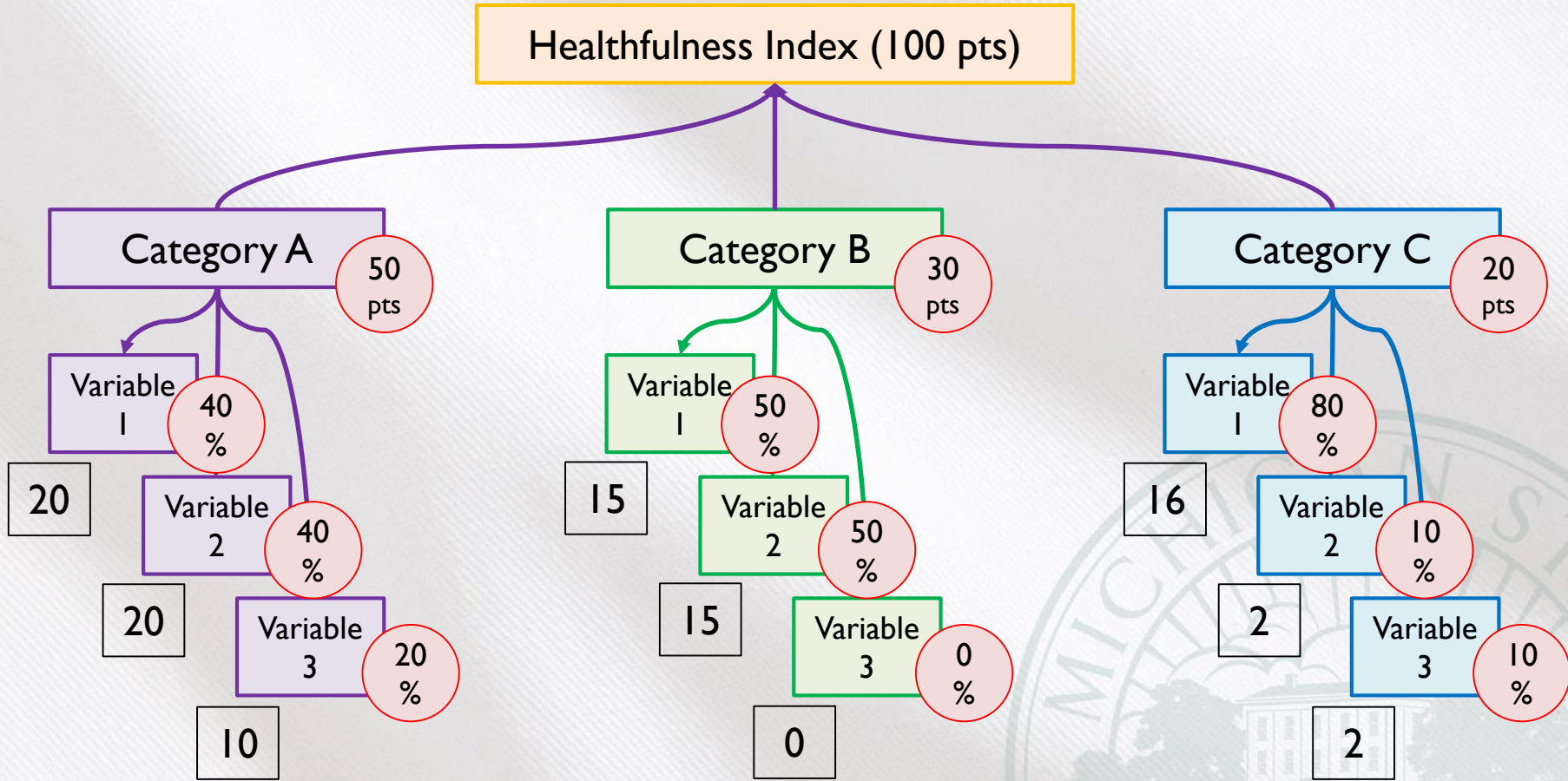
> A Neighborhood Index of Health

How do we combine these variables?

- Unweighted ($a + b + c$) → imprecise
- Researcher-defined weights ($6a + .5b + 3c$) → wonky?
- Expert-defined weights ($2a + 3b + 4c$) → *informed*



Method: Analytic Hierarchy Process



➤ Sample: Inside/Outside Experts

- Community: consortium partners, community PIs
- Academic: research staff, academic PIs
- Informed variable inclusion
- Participated in one or both surveys
- Project 1: $n = 7$
- Project 2: $n = 7$
- *Sample size not an issue in AHP



Boiling It All Down

- Pairwise ranking of variables in 'round-robin' format (entered into matrix)

$$A = \begin{bmatrix} a_{11} & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \dots & a_{nn} \end{bmatrix}$$

<u>Intensity of Importance</u>	<u>Definition</u>
1	Equally important
3 (1/3)	Moderately more important
5 (1/5)	Strongly more important
7 (1/7)	Very strongly more important
9 (1/9)	Extremely more important

- Derivation of weight assignment from eigenvector of priority vector
- Consistency index derived from maximum eigenvalue

$$\lambda_{\max} = \sum_i \sum_j a_{ij} * w_i$$

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

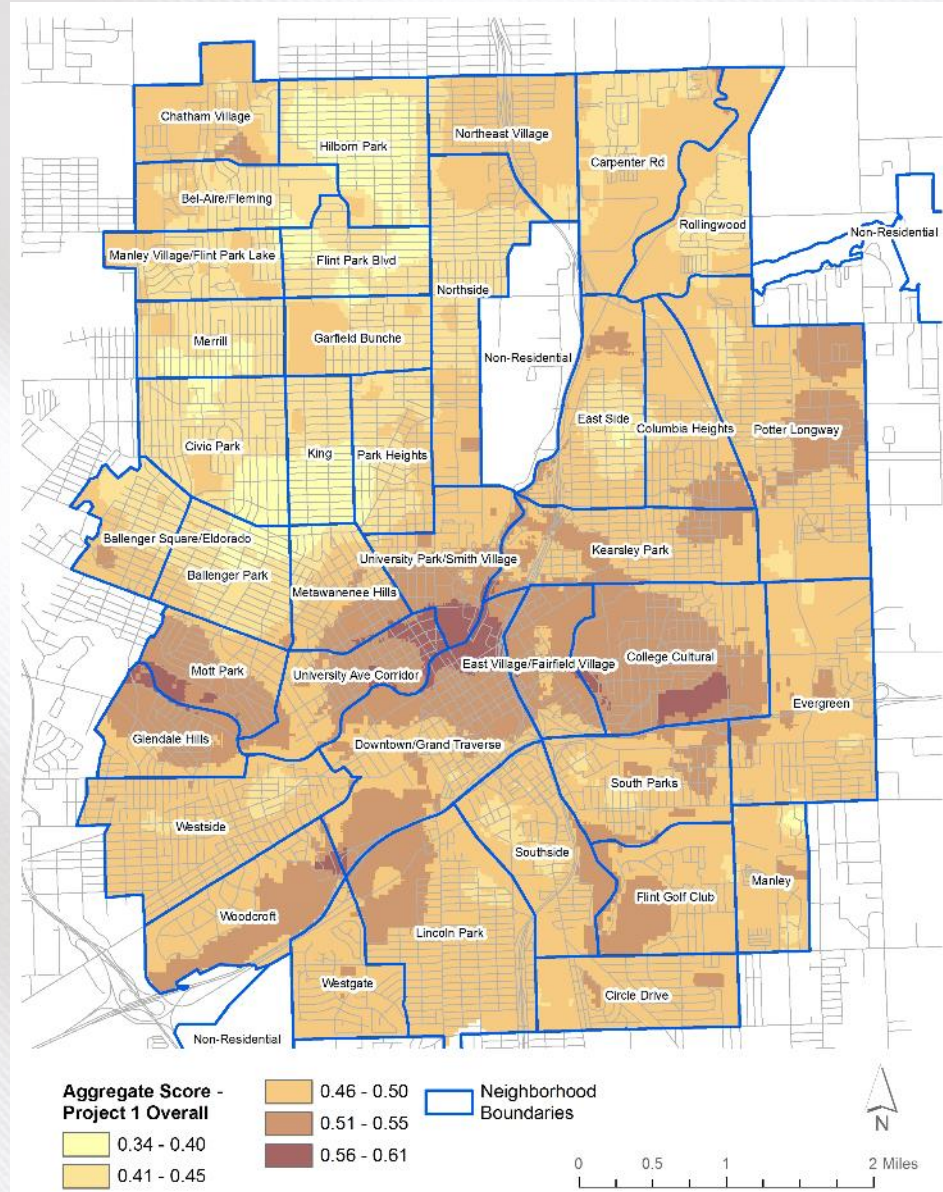


Results: Variable Weights

Category/Variable	Project 1			Project 2		
	Community	Academic	Total	Community	Academic	Total
Amenities	20.3	23.7	22.2	14.0	19.7	17.8
Churches	1.5	4.0	2.9	2.0	3.6	3.1
Food Distribution	6.0	6.9	6.5	n/a	n/a	n/a
Food Stores	2.8	4.3	3.6	4.9	4.3	4.5
Pharmacies	2.7	2.2	2.4	2.1	1.9	2.0
Doctor's Offices	3.2	3.9	3.6	2.1	4.6	3.8
Schools	4.2	2.5	3.2	2.9	5.3	4.5
Environment	19.6	13.0	15.9	23.0	15.4	17.9
Brownfields	15.6	7.8	11.3	10.5	5.5	7.1
Blood Lead Levels	n/a	n/a	n/a	9.2	5.5	6.7
Soil Lead Levels	3.9	5.2	4.6	3.3	4.5	4.1
Greenspace	13.3	11.9	12.5	8.8	8.5	8.6
Community Gardens	4.2	2.6	3.3	2.5	2.2	2.3
Community Greening	5.5	2.5	3.8	3.5	3.8	3.7
Parks	3.5	6.8	5.4	2.7	2.5	2.6
Housing	13.0	17.3	15.4	20.8	18.1	19.0
Demolitions	4.2	5.8	5.1	4.8	2.3	3.1
Foreclosures	3.9	5.0	4.5	4.9	3.6	4.1
Housing Condition	n/a	n/a	n/a	7.3	7.0	7.1
Vacancies	4.8	6.5	5.7	3.8	5.2	4.7
Infrastructure	13.5	14.8	14.2	15.3	11.0	12.4
Bus Stops	1.5	2.9	2.2	5.6	7.5	7.3
Water System	8.8	7.5	8.1	9.7	3.5	5.1
Land Use Mix	3.3	4.4	3.9	n/a	n/a	n/a
Social Issues	20.4	19.2	19.7	18.1	27.2	24.2
Crime	12.3	8.9	10.2	5.6	7.0	6.4
Heroin Overdoses	n/a	n/a	n/a	3.1	11.8	9.2
Distress	8.1	10.4	9.5	9.5	8.5	8.5

Results: Composite Maps

- General ‘healthfulness’ of each neighborhood
- Idea: ability to change behavior is influenced by neighborhood healthfulness
- May be easier in darker shaded neighborhoods

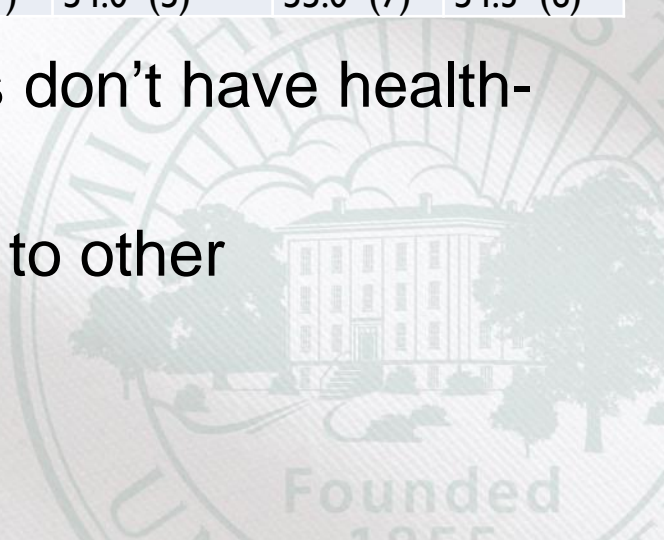


Results: Neighborhood Scores

- Each neighborhood gets an aggregate score
- Highest scoring neighborhoods below

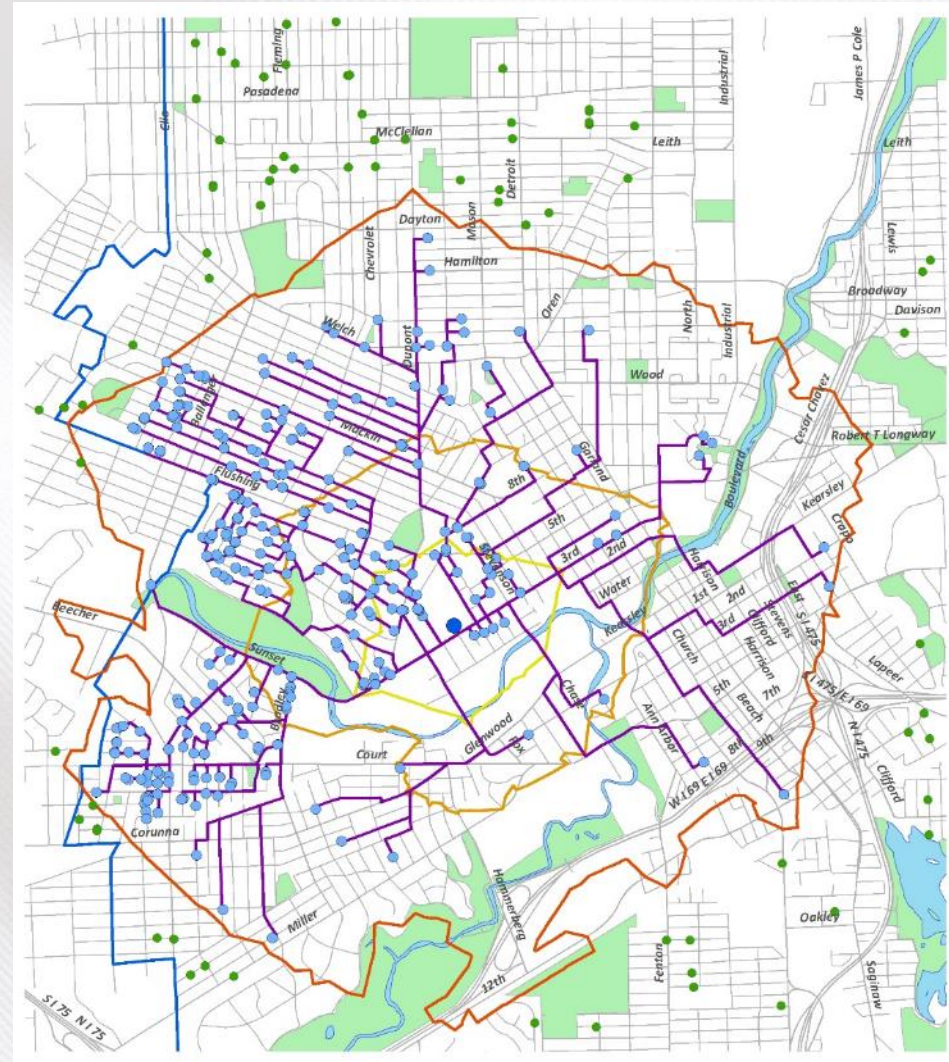
Neighborhood	Project 1 Score - FGHI1			Project 2 Score - FGHI2		
	Community	Academic	Total	Community	Academic	Total
College Cultural	52.8 (2)	52.9 (1)	52.4 (1)	55.7 (2)	56.8 (4)	56.0 (3)
East Village/Fairfield Village	51.3 (4)	51.5 (3)	50.8 (4)	54.7 (4)	57.0 (3)	56.0 (4)
Glendale Hills	50.8 (5)	51.2 (5)	50.4 (5)	52.8 (8)	53.9 (9)	53.3 (9)
Mott Park	51.6 (3)	51.2 (4)	50.8 (3)	52.2 (14)	56.6 (5)	54.9 (5)
University Ave Corridor	52.9 (1)	51.9 (2)	51.8 (2)	55.4 (3)	59.5 (1)	58.0 (1)
University Park/Smith Village	50.6 (6)	50.0 (6)	49.6 (6)	56.1 (1)	57.6 (2)	56.9 (2)
Woodcroft	49.8 (7)	48.9 (8)	48.7 (7)	54.0 (5)	55.0 (7)	54.3 (6)

- *Doesn't mean other neighborhoods don't have health-promoting qualities
- But shows we need to pay attention to other neighborhoods with fewer amenities



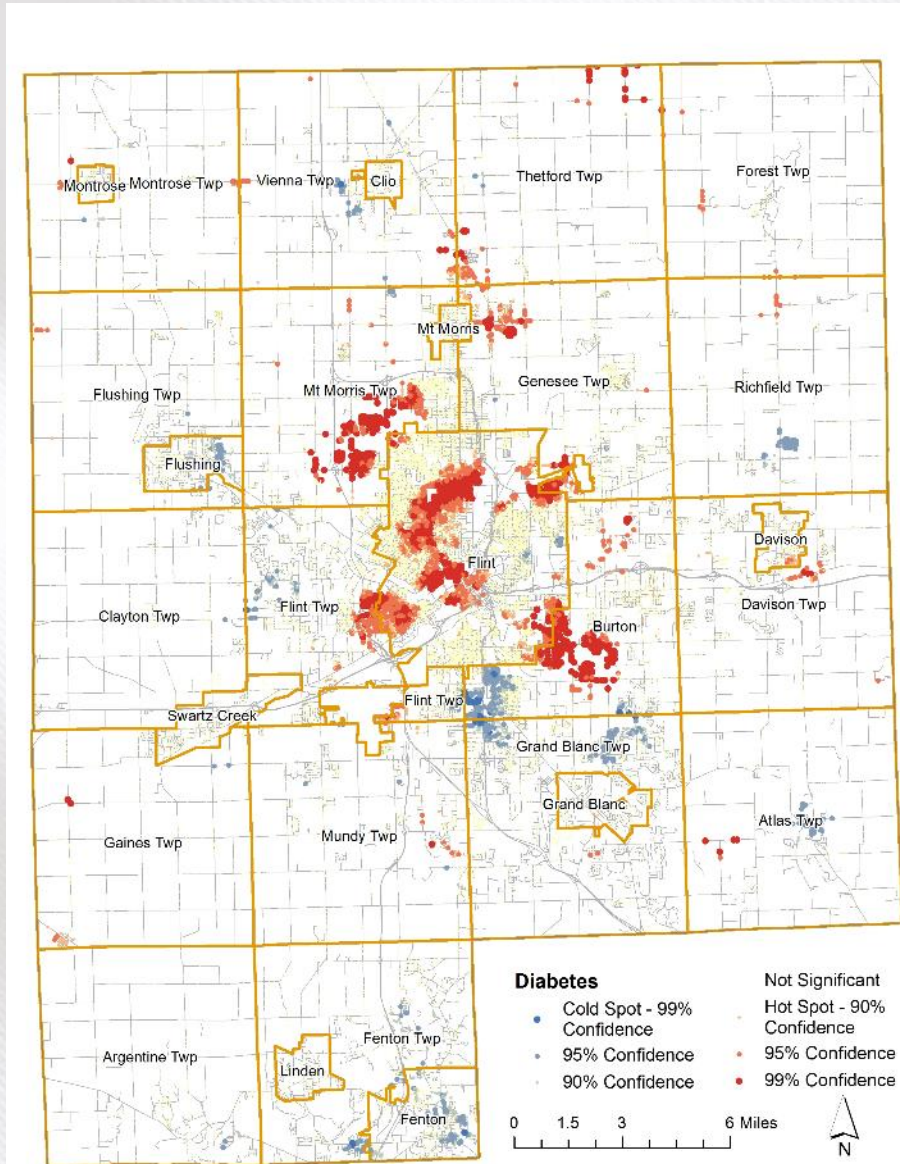
Next Steps

- Need to link people to their neighborhoods
- How does this metric actually relate to behavior change?
- What can we do to improve healthfulness scores in low-scoring neighborhoods?



Next Steps

- Link with other health data
- Find new partners
- Expand participatory mapping to include other domains



➤ Thank you! How to find me...

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- In real life...

