

Geospatial Analysis and Other Epidemiological Tools and Resources for Assessing and Improving Community Health and Health Equity

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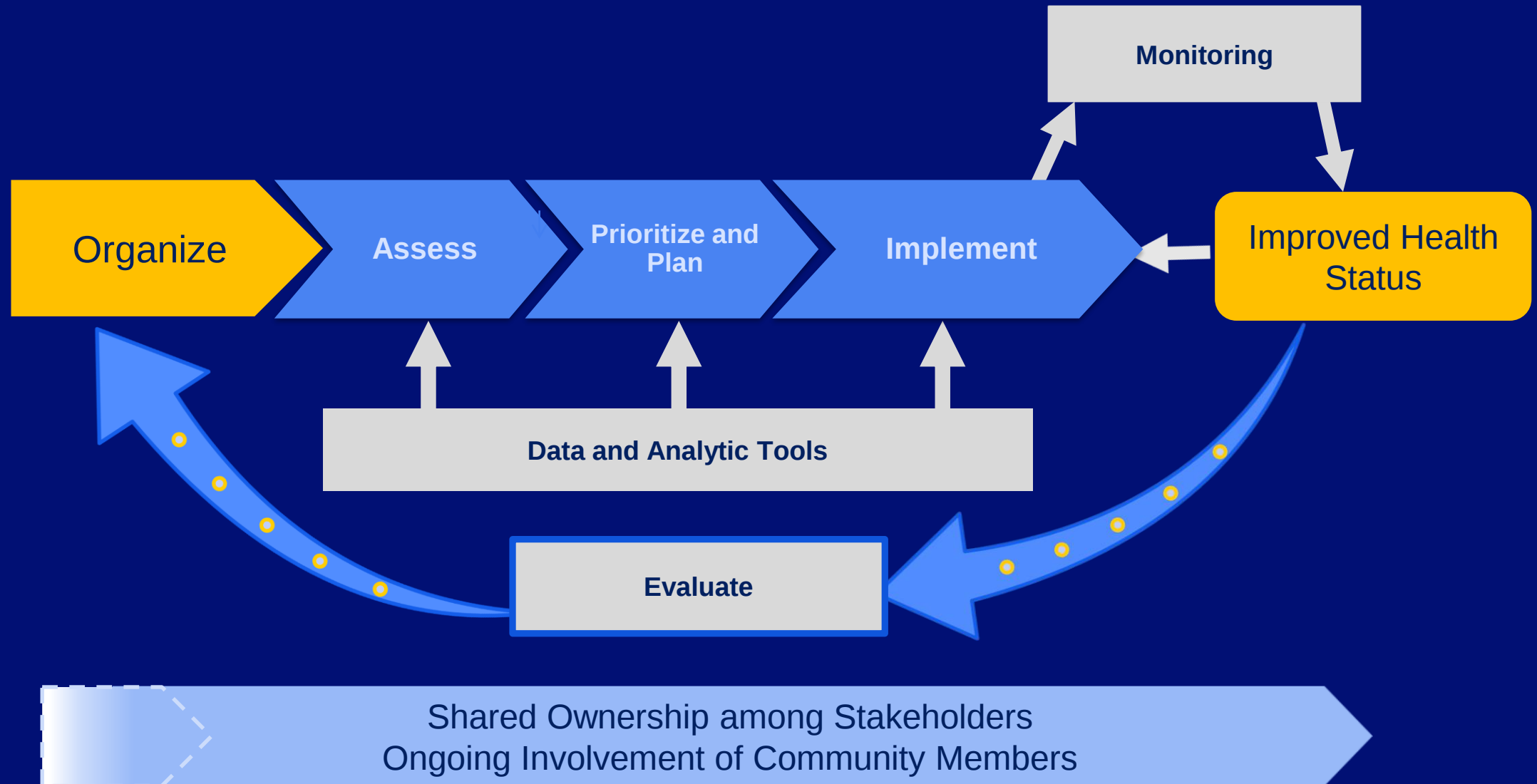
Division of Public Health Information Dissemination



Common Elements for the Community Health Improvement Process

1. Prepare and organize
2. Engage the community
3. Develop a goal or vision
4. Conduct community health assessment
5. Prioritize health issues
6. Develop/implement community health improvement plan
7. Monitor process & short-, medium-term outcomes
8. Evaluate process, outcomes, and impact

Community Health Improvement Process



Community Health Improvement Data Driven Steps



- Profile Characterizes (1)
 - Current Health Status
 - Disparities
 - Modifiable Health Determinants
 - Community Perspectives
 - System Assets and Resources

Community Health Improvement Data Driven Steps

Best Practices (2)

❑ Secondary data analysis

- Compare indicators to benchmarks (peer communities, national & state averages, HP 2020)
- Examine trends
- Identify most prevalent, severe and important outcomes and determinants

❑ Community opinions

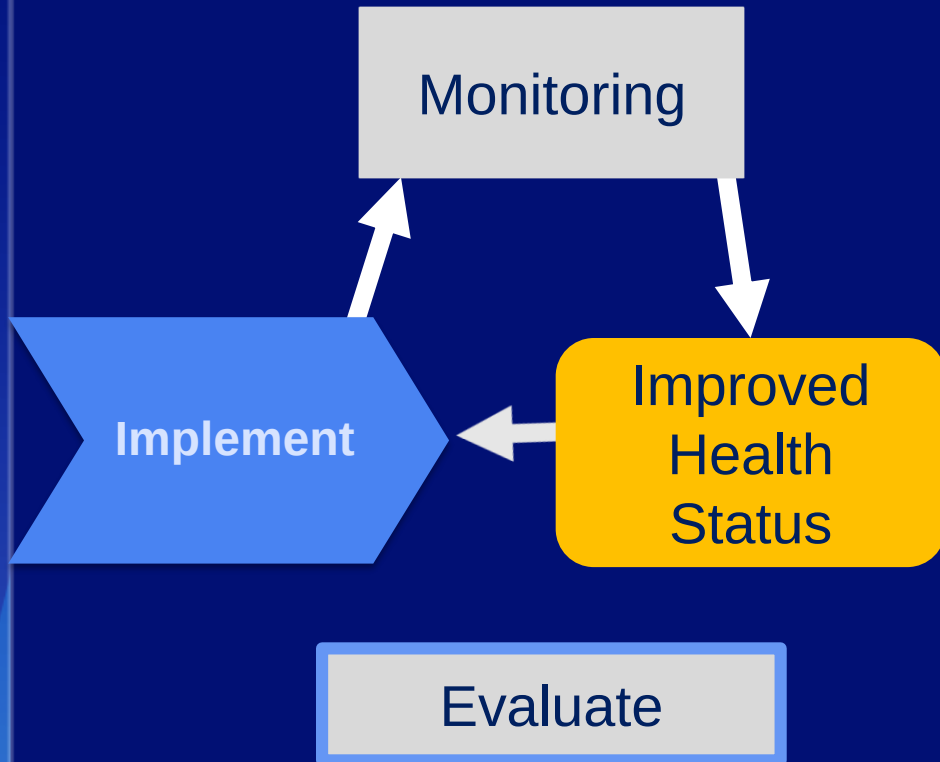
- Primary data (qualitative and quantitative)
- Key informant interviews, town halls, listening sessions, and surveys

❑ Assess health disparities

- Examine secondary data by sex, race/ethnicity, SES, and geography

❑ Assets of the Health System and Community

Community Health Improvement Data Driven Steps



□ On-going monitoring

- Process, outputs, short-, medium-term outcomes

□ Formal evaluation (3)

- Process - determines whether program activities have been implemented as intended.
- Outcome - measures program effects in the target population.
- Impact - assesses program effectiveness in achieving its ultimate goals.

Community Health Improvement National Drivers

- ❑ Internal Revenue Service (IRS) requirements for tax-exempt hospitals *every 3 years* (n>3,000)
- ❑ Affordable Care Act Hospital Readmissions Reduction Program (n>3,000)
- ❑ National voluntary public health department accreditation every 5 years (PHAB) (n~2,400)

Final 2014 IRS CHNA Regulations

- ❑ The hospital must “solicit” and “take into account” input from a state or local health department and members of medically underserved, low-income, and minority populations
 - Medically underserved include “populations experiencing health disparities or at risk of not receiving adequate medical care as a result of being uninsured or underinsured or due to geographic, language, financial, or other barriers”. (4)
- ❑ Health needs may include “financial and other barriers to accessing care, preventing illness, ensuring adequate nutrition, or social, behavior and environmental factors that influence health in the community”. (4)
- ❑ CHNA’s must “include an impact evaluation of the actions taken by the hospital on significant health care needs it identified in its previous CHNA”. (4)

Voluntary Public Health Accreditation Requirements

- ❑ Identify populations with inequitable share of poor health outcomes. (5)
- ❑ Document the development and implementation of health promotion strategies. (5)
 - Evidence-based, rooted in sound theory, practice-based evidence, and/or promising practice.
 - Focus on social and environmental factors (such as air quality or the built environment) that create poor health, discourage good health, or encourage individual behavioral factors that impact negatively on health.

Voluntary Public Health New *Reaccreditation* Requirements

- ❑ Health department will select topic and report:
 - A specific measurable objective
 - Benchmark data source
 - Target
 - Baseline data
 - Updated data
 - Data source for the measurement report
 - Whether the objective is included in the CHA, CHIP, strategic plan, or PHAB standard or measure

Voluntary Public Health New Reaccreditation Requirements

□ Health department:

- Will report on 5 – 10 outcomes with reaccreditation
- Will report on the same outcomes with each annual report (Section III, submitted with Section II)
- May add outcomes to report on with the Annual Reports if health department and community revise objectives they are tracking

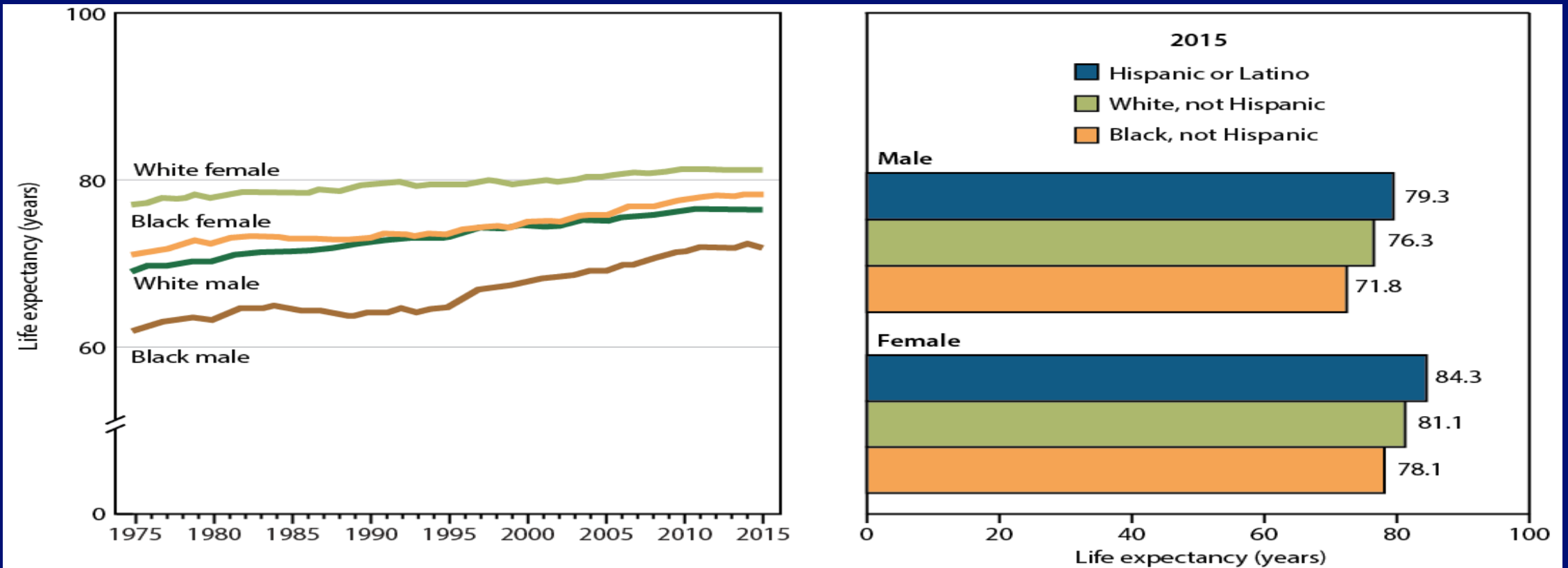
IDENTIFY POPULATIONS WITH DISPARITIES

Identifying Populations with Health Disparities

- ❑ National Center for Health Statistics (NCHS) Methodology (6)
- ❑ Analyze health outcome data by race/ethnicity, sex, socio-economic status
 - Disparity—The quantity that separates a group from a specified reference point on a particular measure of health that is expressed in terms of a rate, percentage, mean, or some other quantitative measure.
 - Reference population group— When comparisons are made between population groups, the more favorable group rate should be used as the reference point (lowest rate).

NCHS Example

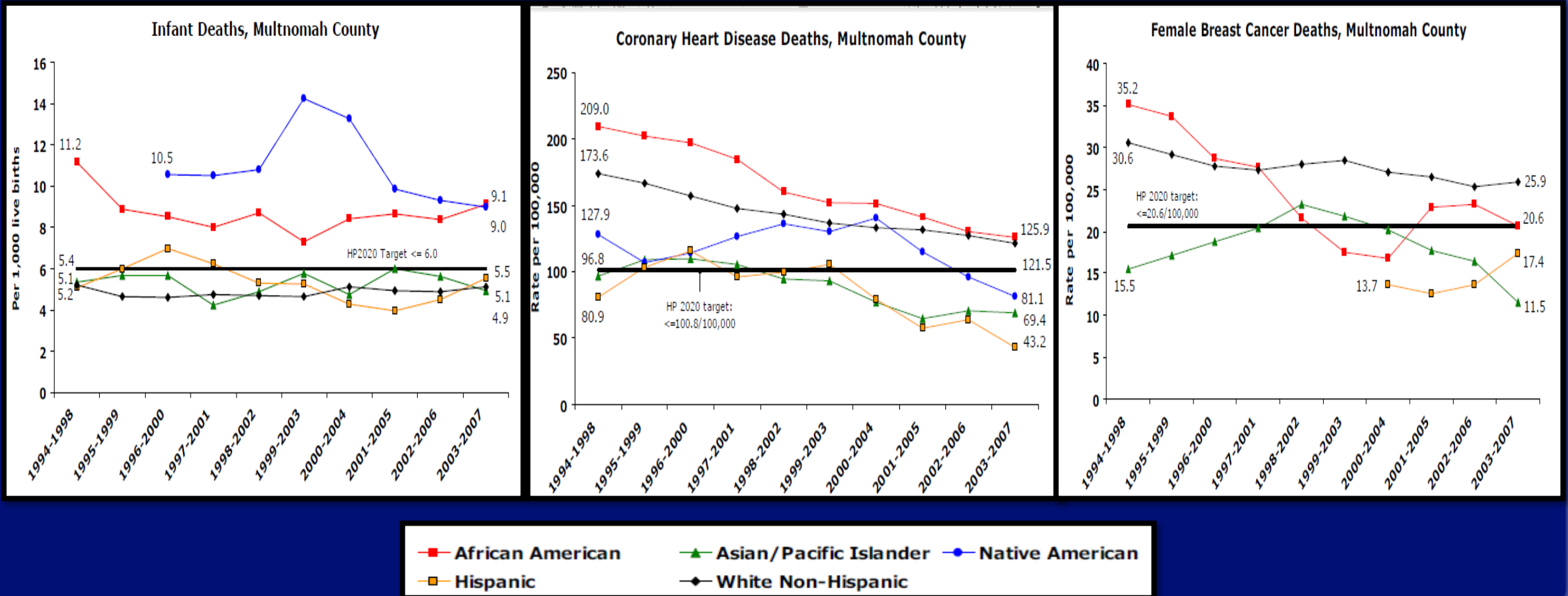
Life Expectancy data by race, ethnicity, and sex. (7)



NOTE: Life expectancy data by Hispanic origin were available starting in 2006 and were corrected to address racial and ethnic misclassification. (7)

Multnomah County Examples

Trends in select mortality data by race and ethnicity. (8)



Addressing Local Health Disparities: Principles

- ❑ Profound and persistent local geographic disparities are primary drivers of national- and state-level health disparities. (9-10)

- ❑ Addressing disparities requires new approach
 - Shift away from primary focus on medical or behavioral interventions (11)
 - Develop locally relevant and timely neighborhood-level health outcome and determinant indicators (12)
 - Focus local interventions on underlying health determinants (e.g., housing, economic development, and environment) (12)

Locally Relevant Neighborhood Data

❑ Aggregate Population Health Indicators

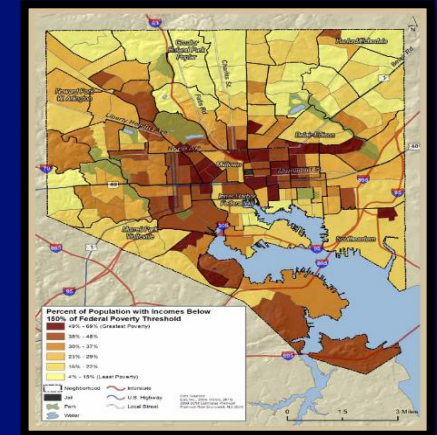
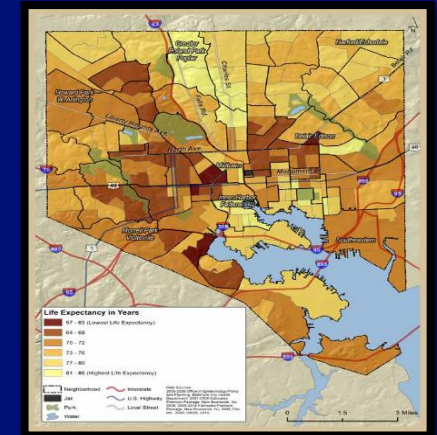
- Single summary measure commonly used to describe the overall health status of a population (9-11) (13)
- Examples:
 - Life expectancy
 - Premature mortality
 - Infant mortality

❑ Types of Health Determinant Indicators

- Proxy or surrogate indicator: single measure summarizing the area's key socioeconomic and environmental conditions that has been validated effective in detecting local socioeconomic gradients in health (13-15)
- Examples:
 - Area-based poverty (percentage of persons below the federal poverty level)
 - Educational attainment (percentage of persons aged ≥ 25 years with no high school diploma)
- Composite measures (e.g., indices): theory-based, validated mathematical aggregation of individual indicators reflecting multi-dimension concepts such as area-based deprivation or opportunity (14-16)
- Examples:
 - Economic hardship index
 - Child opportunity index

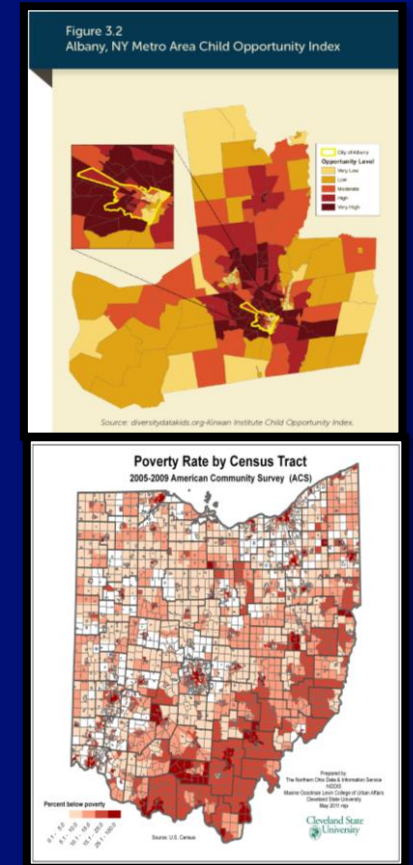
Addressing Local Health Disparities: Approach 1

- ❑ Examine geographic variability in sub-county aggregate measures of population health
 - Census tracts
 - Zip Codes
- ❑ Identify, address, and monitor underlying determinants driving geographic variations using one of more of the following methods (13)
 - Identify determinants based on scientific literature
 - Visually examine maps of outcome(s) and indicators
 - Conduct empirical testing results
 - Simple regression
 - Multi-level logistic regression



Addressing Local Health Disparities: Approach 2

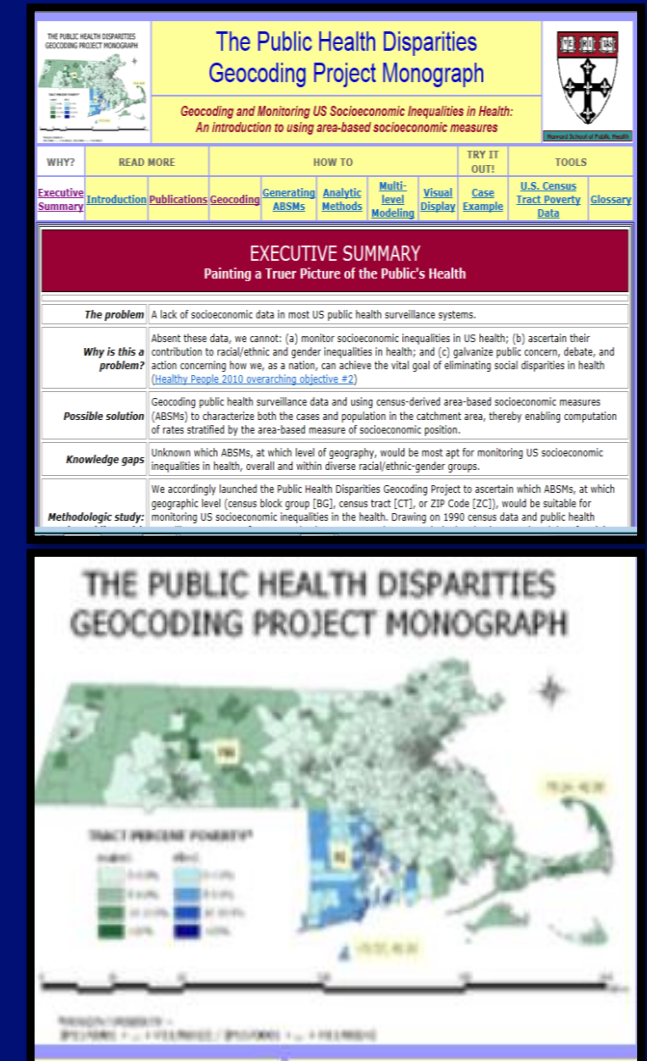
- ❑ Examine geographic variability in underlying health determinants (social, economic, and environmental factors) to identify disadvantaged and more privileged areas (14-15)
 - Single proxy indicator
 - Dashboard of key single indicators
 - Composite index
 - Census tracts or Zip Codes
- ❑ Implement targeted actions on determinant indicator(s) in disadvantaged areas (13-14)
 - Monitor and report resulting changes in indicators over time



APPROACH 1 EXAMPLE: AREA-BASED SOCIOECONOMIC STATUS (SES) AND MORTALITY DATA

Area-based SES

- ❑ Harvard Geocoding Projects I & II (Nancy Krieger) 1998 – 2005
www.hsph.harvard.edu/thegeocodingproject/
- ❑ MA and RI 1990 Data
 - Top 5 Leading Causes of Death and Cancer Sites, HIV, Homicide
 - Explored different area sizes and SES measures
- ❑ Results: Census Tract (CT) Poverty detected disparities (15)
 - Missed by other measures (e.g., education, wealth, unemployment, SES indices) and geographic units (zip codes)
 - As large or larger than those by race/ethnicity
 - Within race/ethnic groups.
- ❑ Recommended CT % of residents living below federal poverty level for routine data analysis. (15)
 - <5%, 5-9.9%, 10-19.9%, >20%



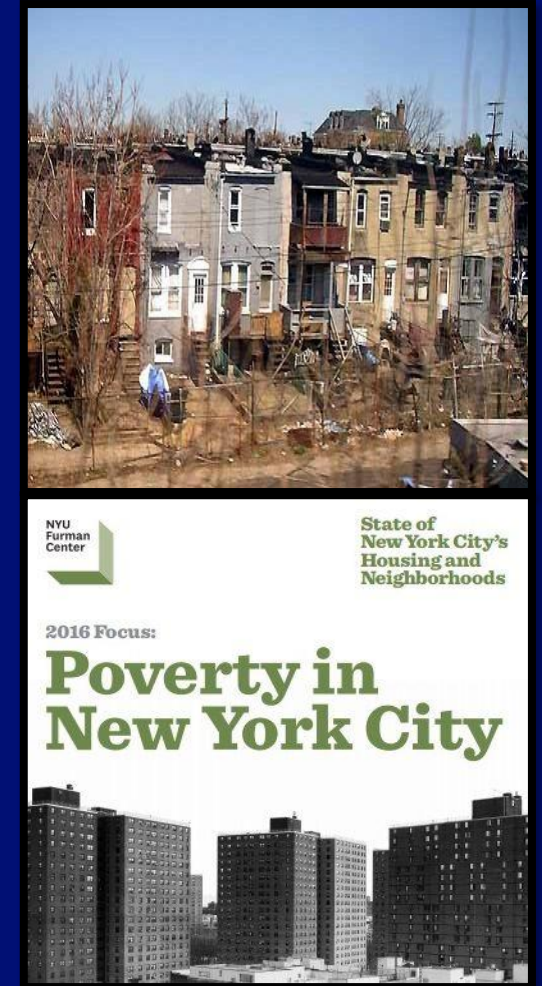
Area-based SES Council of State and Territorial Epidemiologists (CSTE) Pilot: ~~Harvard Geocoding Project~~

❑ CSTE Disparities Pilot Project

- 11 States and localities
- Multiple health outcomes

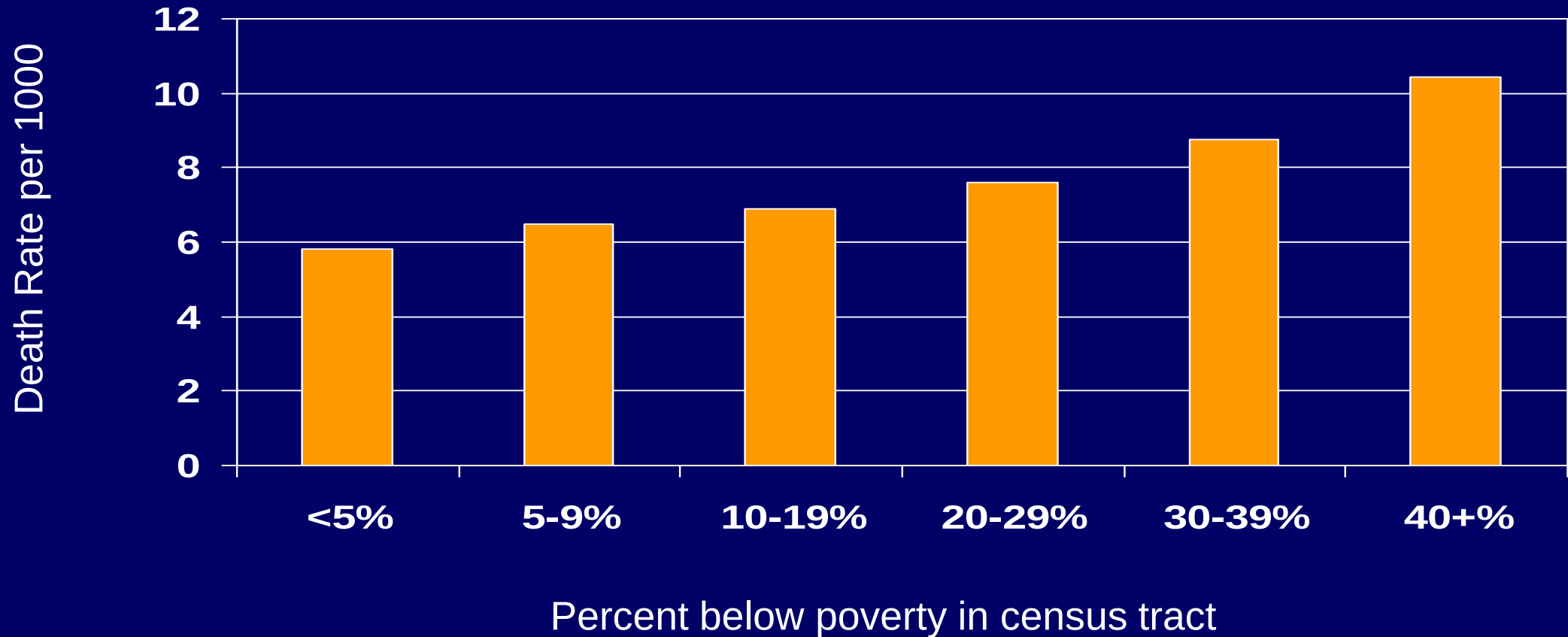
❑ CT > 20% in poverty

- Consistently associated with greatest disparities
- Reflect confluence of neighborhood risk factors including *unemployment, deteriorated housing, violent crime, material resource access, behavioral factors, access to care, and pollution* (17)



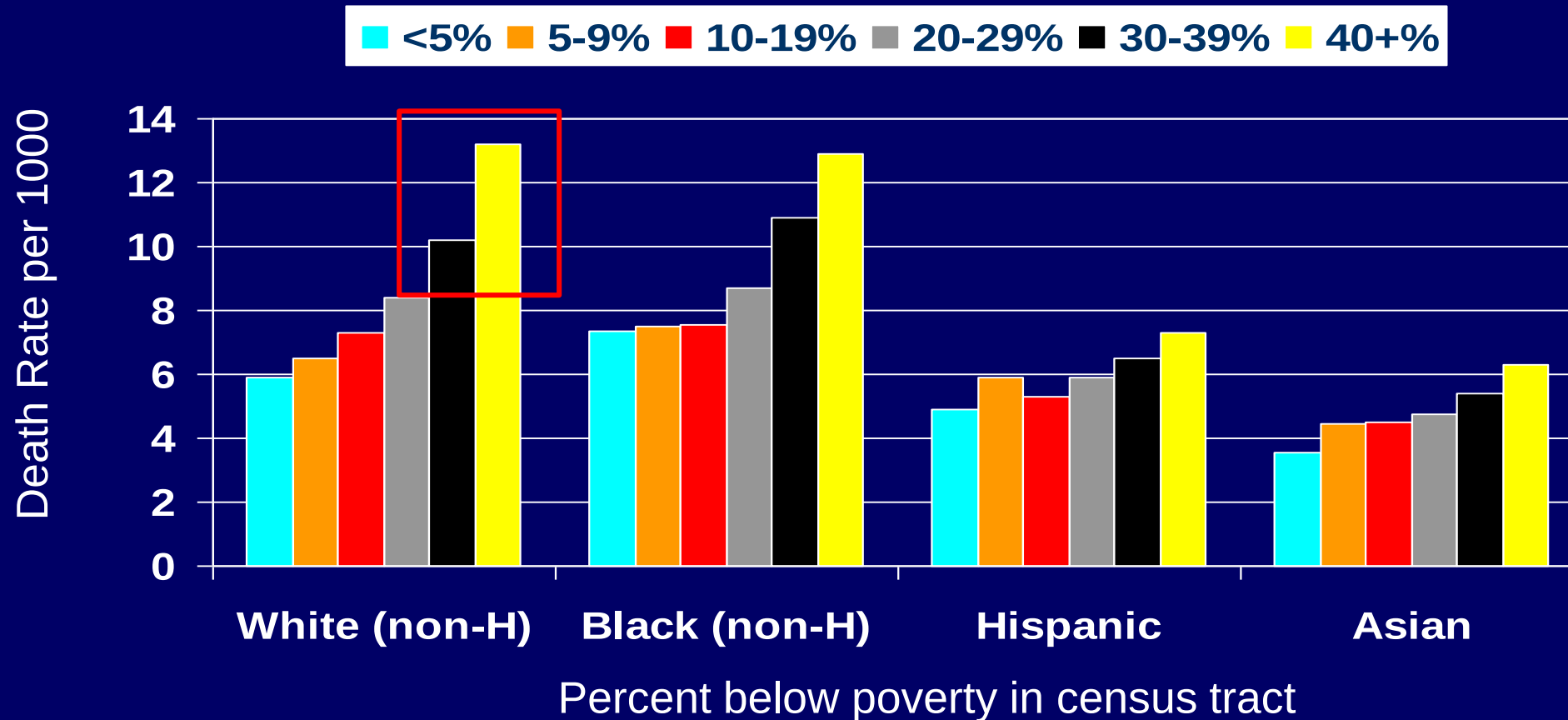
CSTE Pilot: New York City Example¹⁶

Age-adjusted Mortality Rate by % in census tract who live below poverty, NYC, 2000 (18)



CSTE Pilot: New York City Example¹⁹

Age-adjusted Mortality Rate by % in census tract who live below poverty by race/ethnicity, NYC, 2000 (18)



Area-based Poverty Indicator

❑ Advantages (16)

- Easily understood
- Data widely available and easily accessible
- Meaningful across geographies and over time
- Best captures area-level economic deprivation
- Validated with many health outcomes

❑ Disadvantages (16)(17)

- Masks myriad causes of health inequalities (unemployment, crime, low education)
- May lead to insufficient or misdirected policies and actions

Economic Hardship Index (EHI)

- ❑ Developed by Brookings Institution in 1976 [19]
 - Compare central cities to surrounding suburbs
 - Compare central cities to one another

- ❑ Composite measure of 6 individual variables
 - Crowded housing (percentage occupied by housing units with more than 1 person per room)
 - Poverty (percentage of persons living below the federal poverty level)
 - Unemployment (percentage of persons over the age of 16 years who are unemployed)
 - Education (percentage of persons over the age of 25 years without a high school education)
 - Dependency (percentage of the population under 18 or over 64 years of age)
 - Income (per capita income)

Economic Hardship Index (EHI)

- ❑ Local EHI strongly associated with a range of health outcomes
 - Life Expectancy (13)(20-21)
 - Childhood Obesity (22-23)
 - Diabetes Hospitalizations (21)

- ❑ Advantages (24)
 - Summarizes complex or multi-dimensional conditions
 - Are easier to interpret than trying to find a trend in many separate indicators
 - Facilitates comparisons between geographic areas and over time
 - Raises awareness of influence of multiple health determinants
 - Data widely available and easily accessible

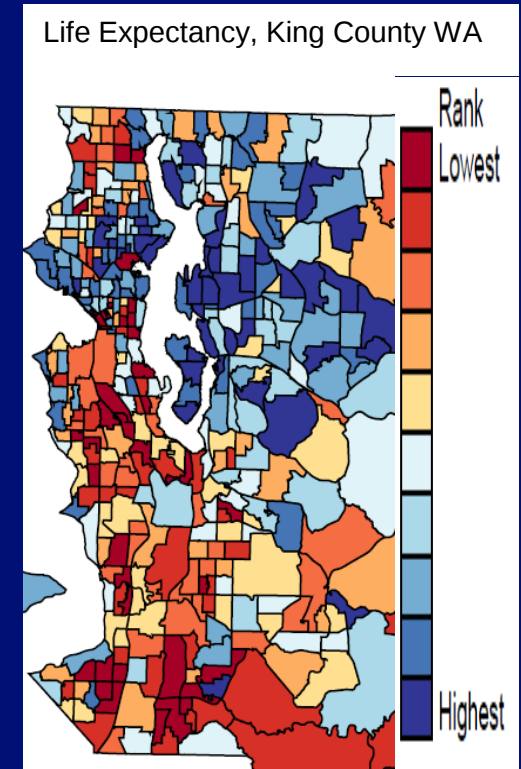
- ❑ Disadvantages (16)(22)(24)
 - EHI not developed to assess health disparities
 - May not appear as actionable as single indicators
 - If poorly constructed, may send misleading policy messages

APPROACH 2 DETERMINANT EXAMPLE: HEALTH ECONOMIC INDEX AND OTHER DETERMINANT INDICATORS IN FLORIDA

CASE STUDIES ASSESSMENT OF APPROACHES 1 AND 2

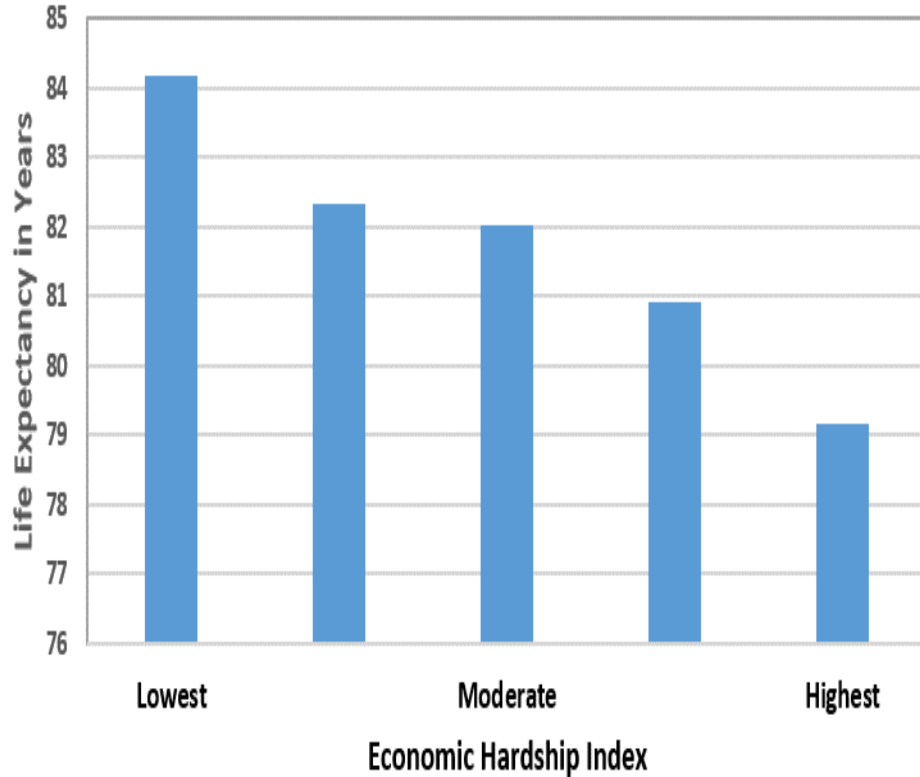
Assessment of Associations with Life Expectancy

- Assessed associations using 2008 – 2012 data
 - King County, WA Census Tract Life Expectancy
 - Percent population below the federal poverty level
 - Economic Hardship Index (EHI)
 - Individual EHI indicators
 - Simple regression analyses
 - Correlation strength and direction (r)
 - Goodness of fit (R^2)

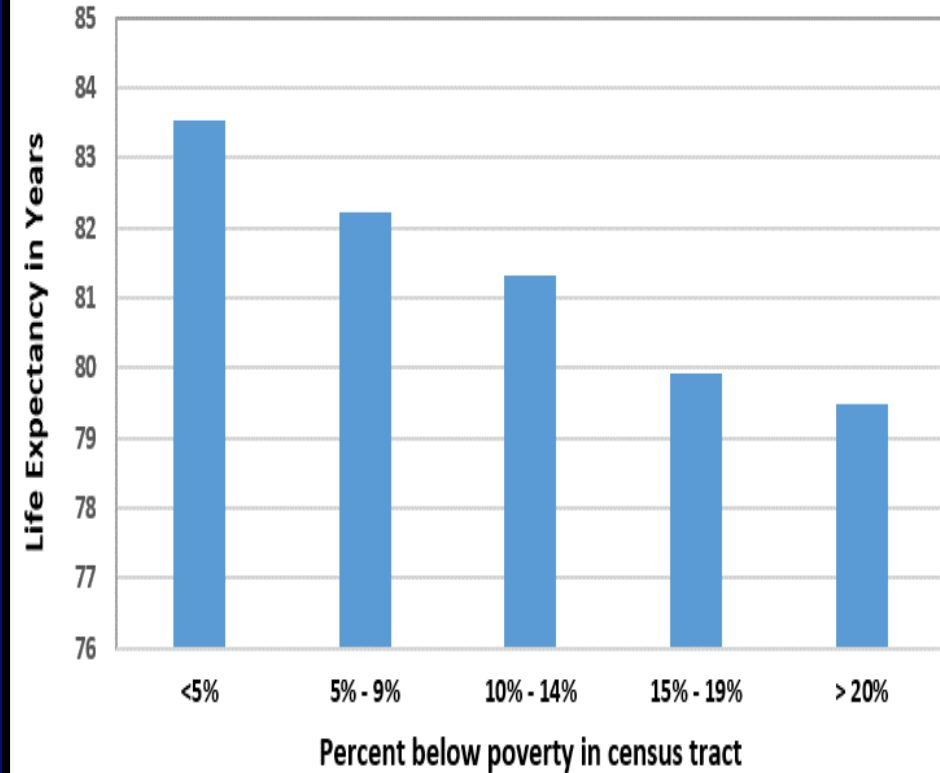


King County, WA Results

Life Expectancy by Economic Hardship Quintiles
King County, WA Census Tracts (2008 - 2012)

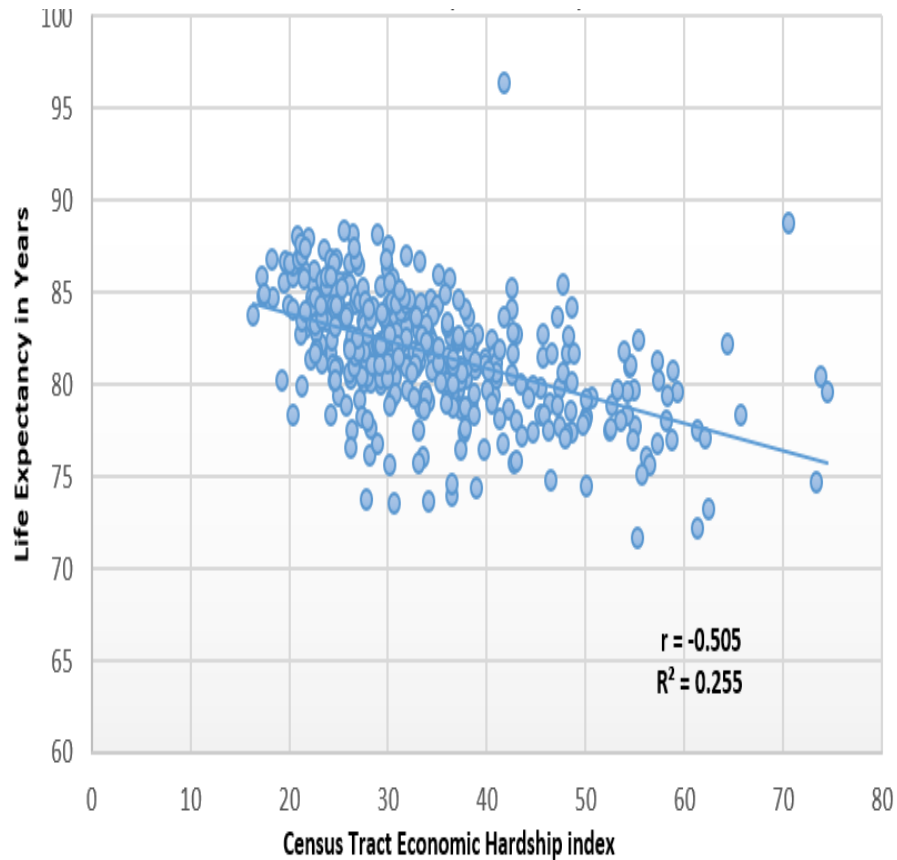


Life Expectancy by Area-based Poverty Level
King County, WA Census Tracts (2008 - 2012)

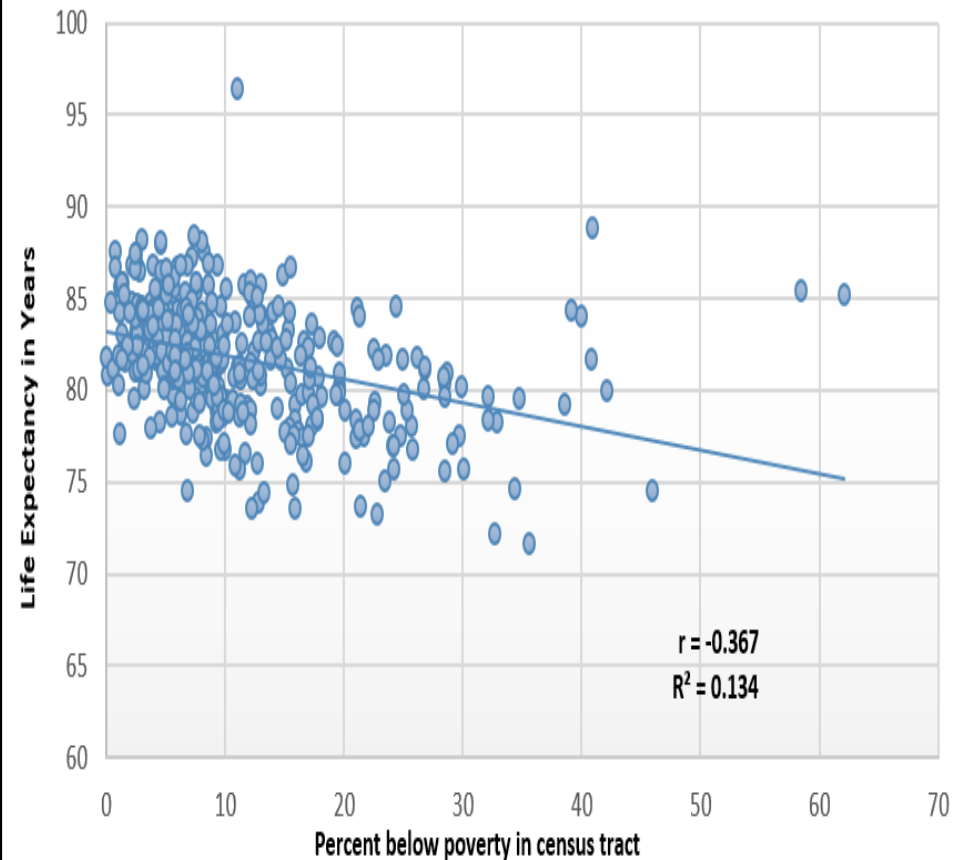


King County, WA Results

Association of Life Expectancy and Economic Hardship Index
King County, WA Census Tracts (2008 – 2012)

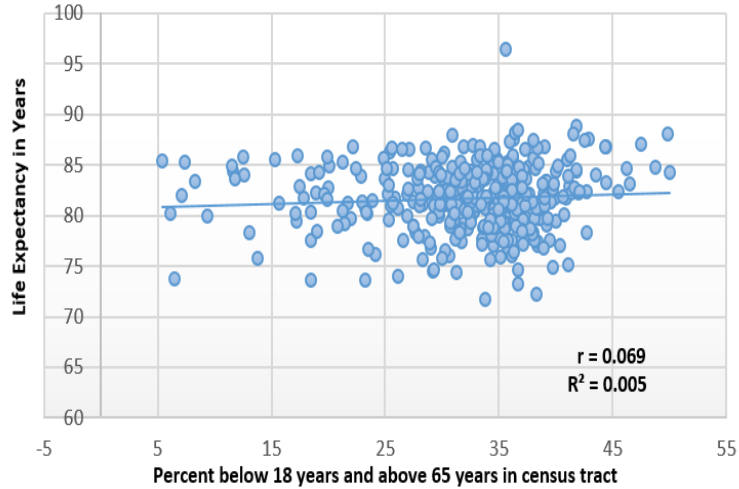


Association of Life Expectancy and Poverty
King County, WA (2008 – 2012)

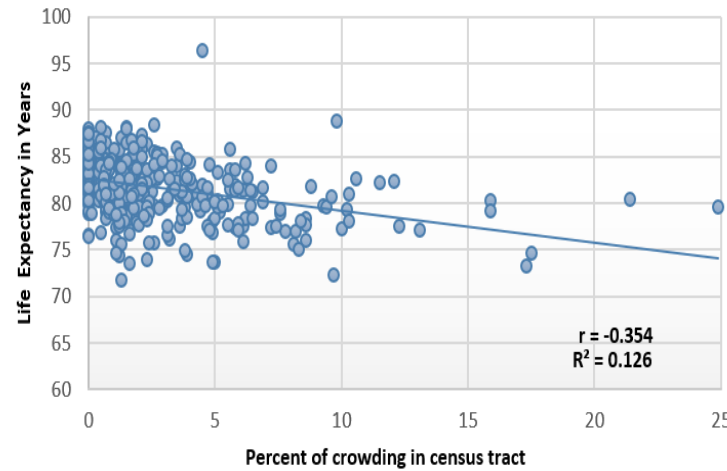


King County, WA Results

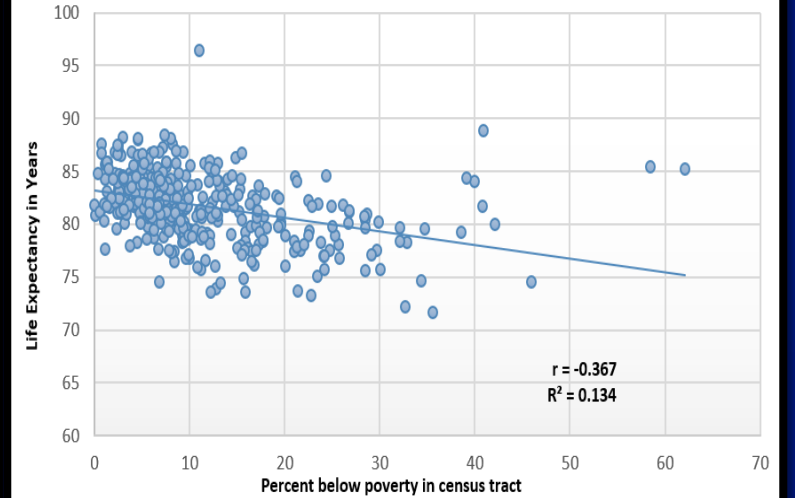
Life Expectancy and Dependency
Census Tracts (2008 – 2012)



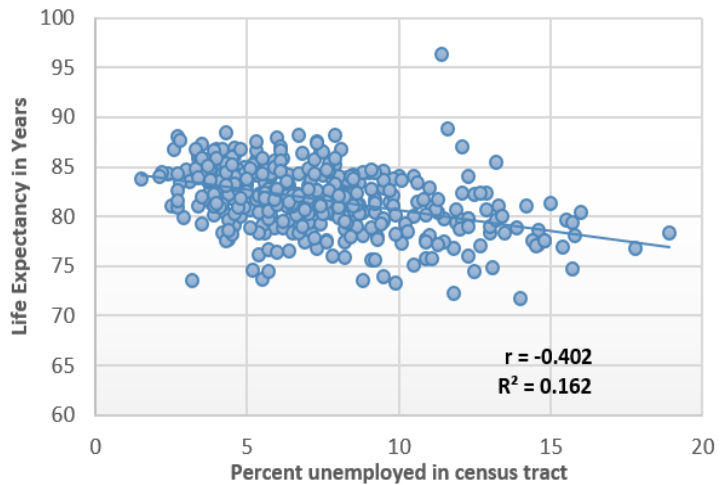
Association of Life Expectancy and Crowding
Census Tracts (2008 – 2012)



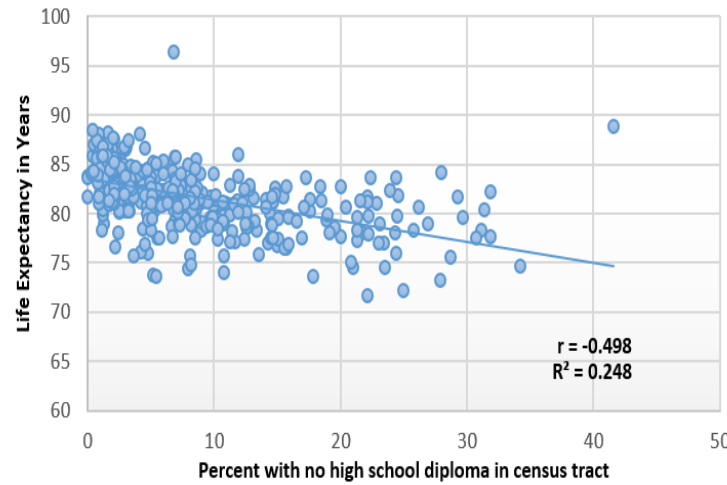
Association of Life Expectancy and Area-based Poverty
Census Tract (2008 – 2012)



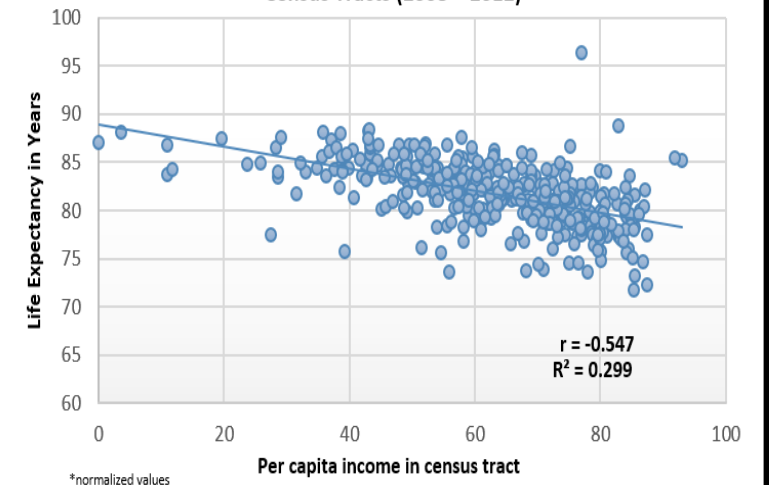
Life Expectancy and Unemployment
Census Tracts (2008 – 2012)



Life Expectancy and Educational Attainment
Census Tracts (2008 – 2012)

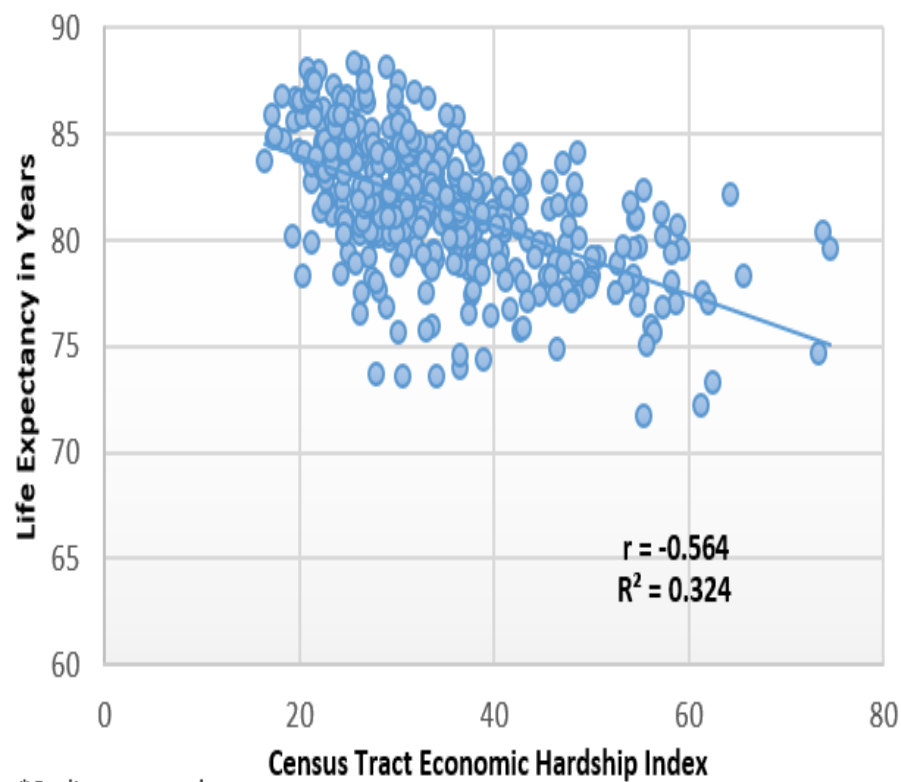


Life Expectancy and Income*
Census Tracts (2008 – 2012)



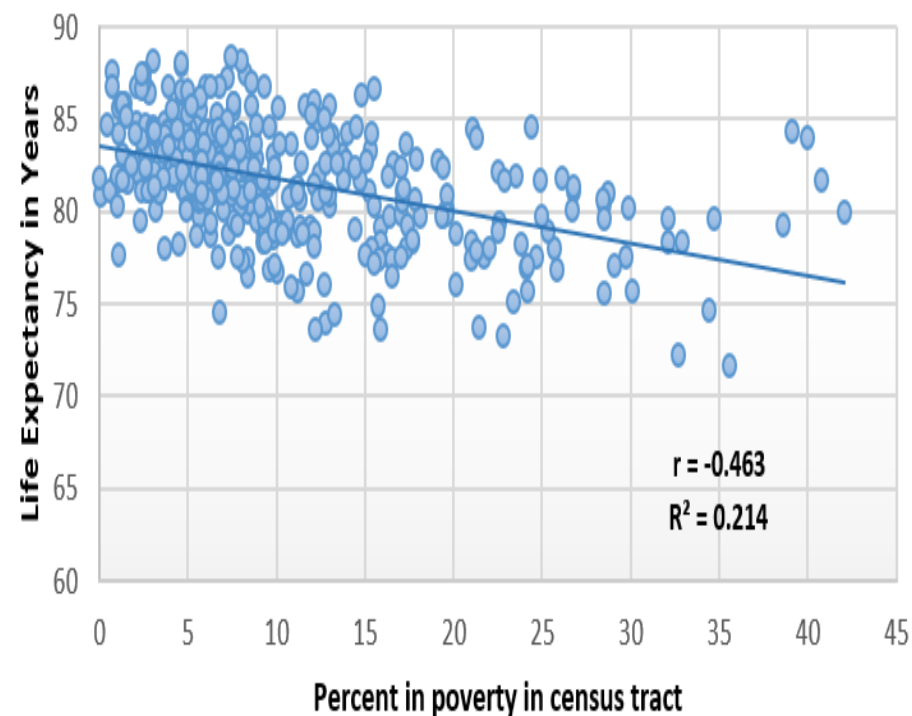
King County, WA Associations After Outliers Removed

Association of Life Expectancy* and Economic Hardship* Census Tracts (2008 - 2012)



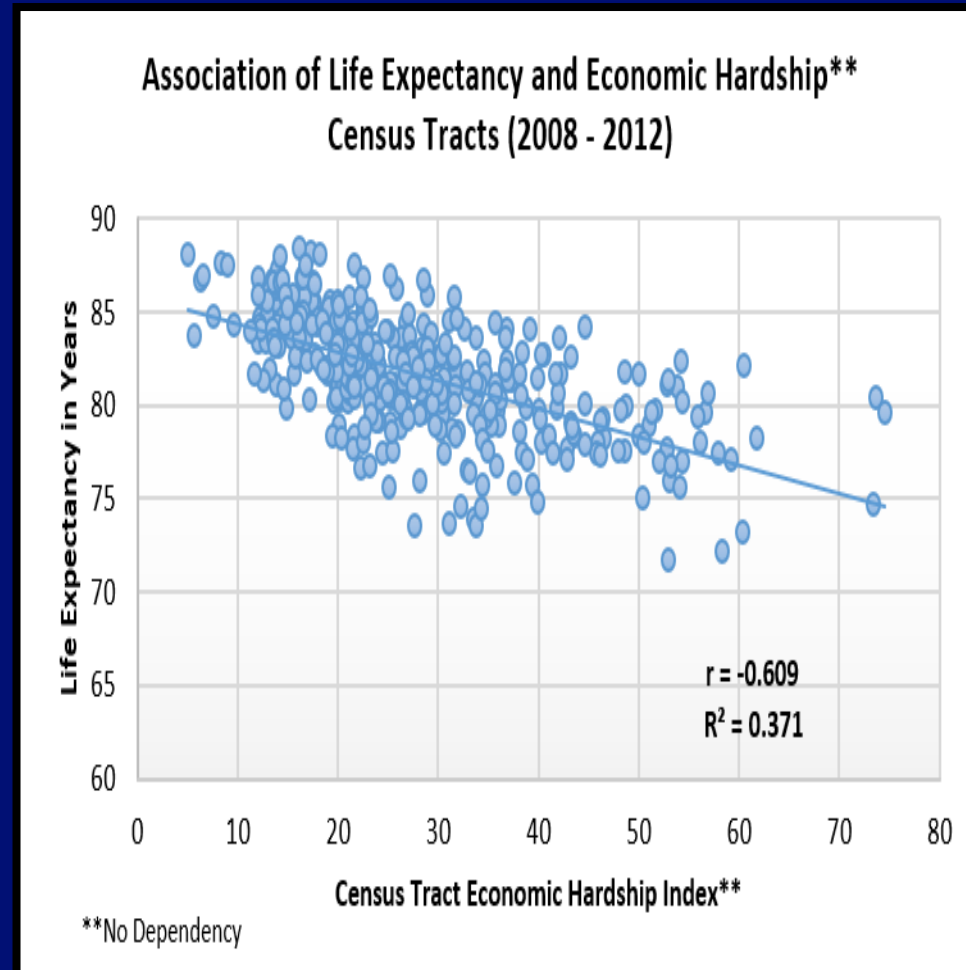
*Outliers removed

Association of Life Expectancy* and Poverty* Census Tracts (2008 - 2012)



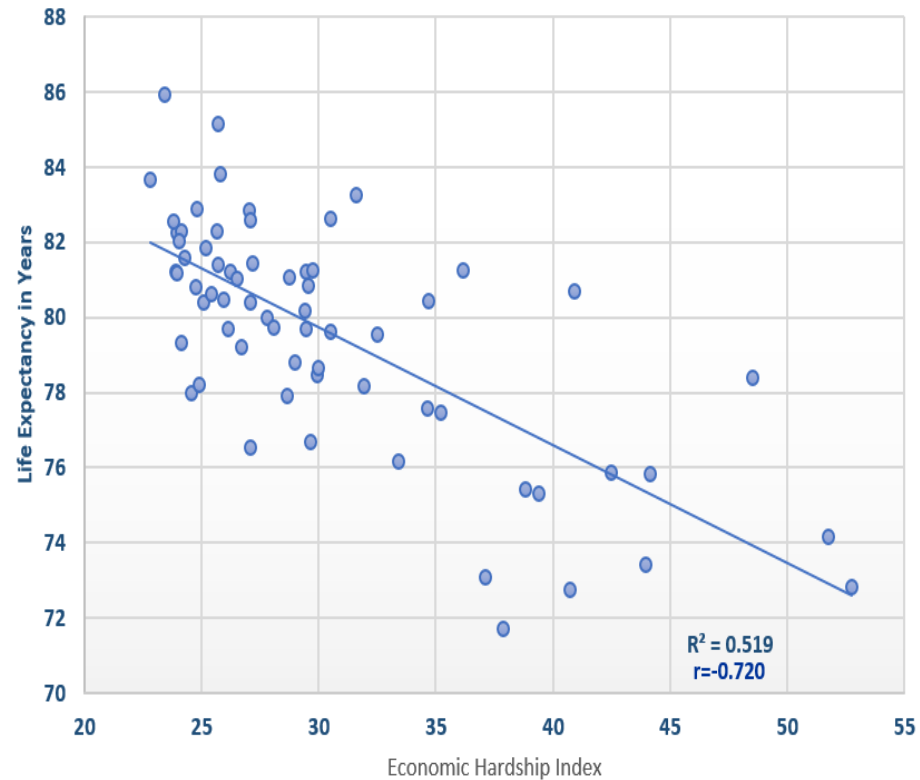
*Outliers removed

King County, WA Association of Life Expectancy and Economic Hardship (No Dependency Variable)

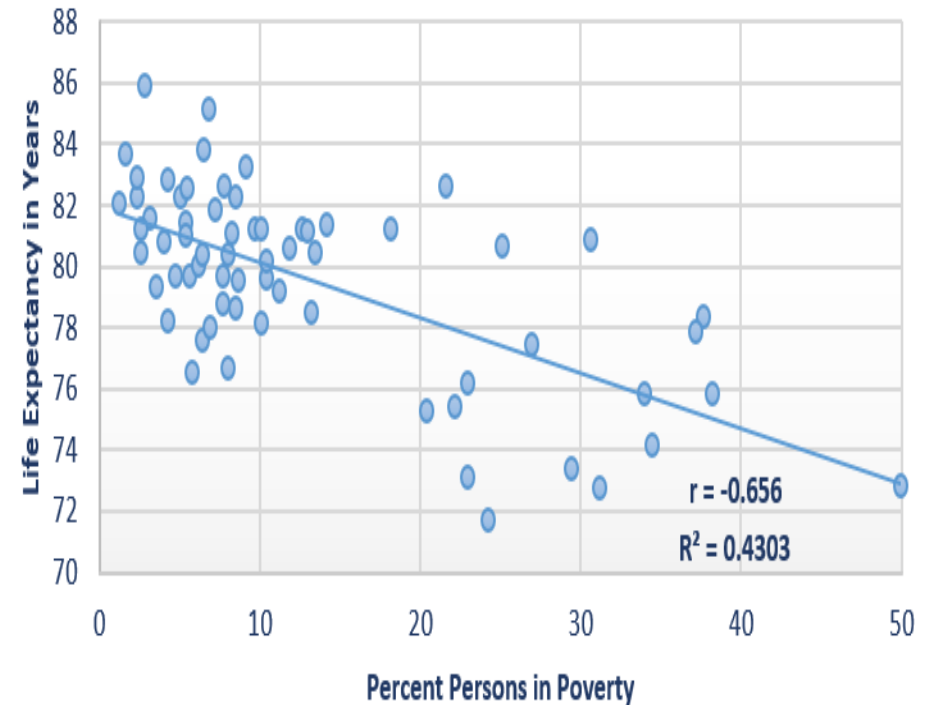


Albany County, NY Results

Association of Life Expectancy and Economic Hardship
Albany County, NY (2008 - 2012)

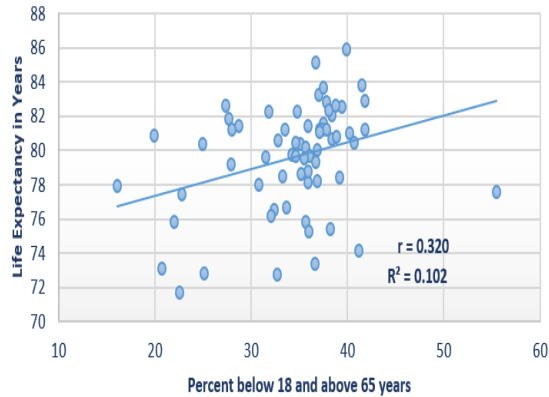


Association of Life Expectancy and Poverty
Albany County, NY (2008 - 2012)



Albany County, NY Results

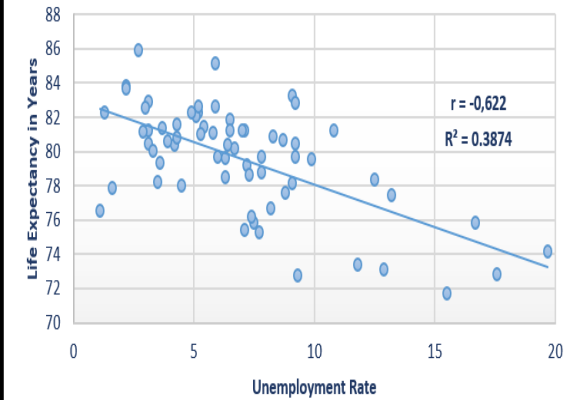
Association of Life Expectancy and Dependency
Albany County, NY (2008 - 2012)



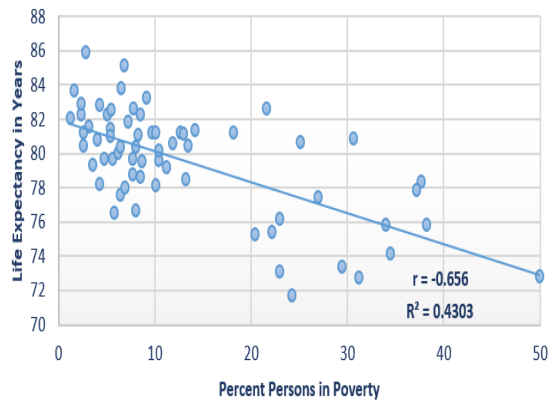
Association of Life Expectancy and Crowding
Albany County, NY (2008 - 2012)



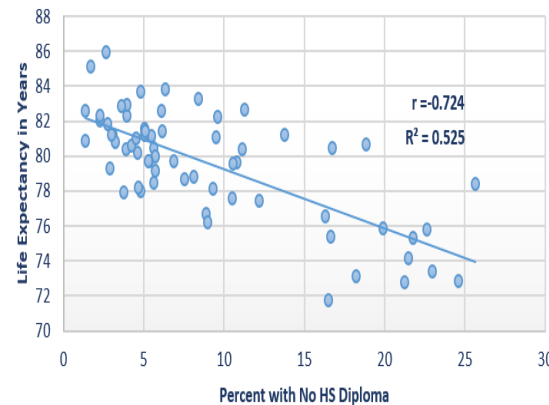
Association of Life Expectancy and Unemployment
Albany County, NY (2008 - 2012)



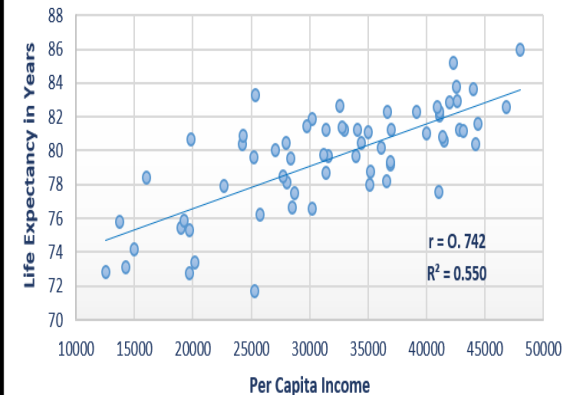
Association of Life Expectancy and Poverty
Albany County, NY (2008 - 2012)



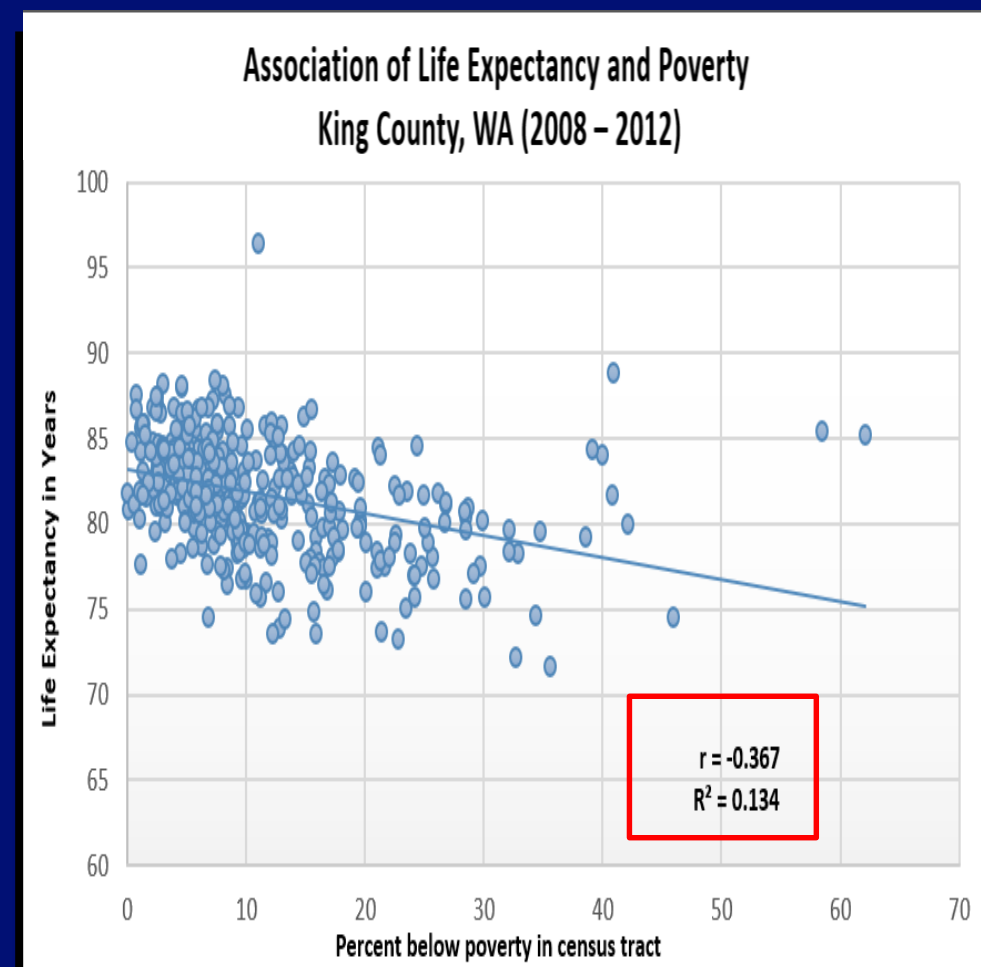
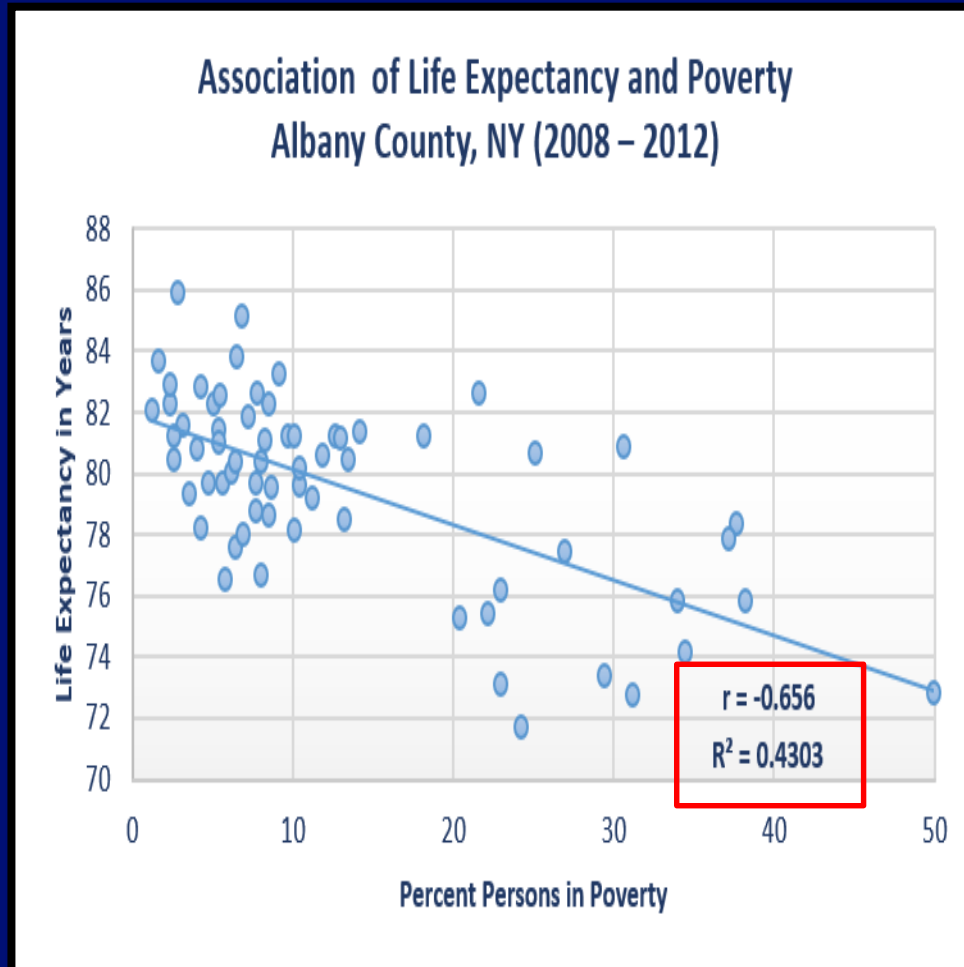
Association of Life Expectancy and Educational Attainment
Albany County, NY (2008 - 2012)



Association of Life Expectancy and Per Capita Income
Albany County, NY (2008 - 2012)



Comparison of Albany and King County Associations of Life Expectancy and Area-based Poverty



Results Summary

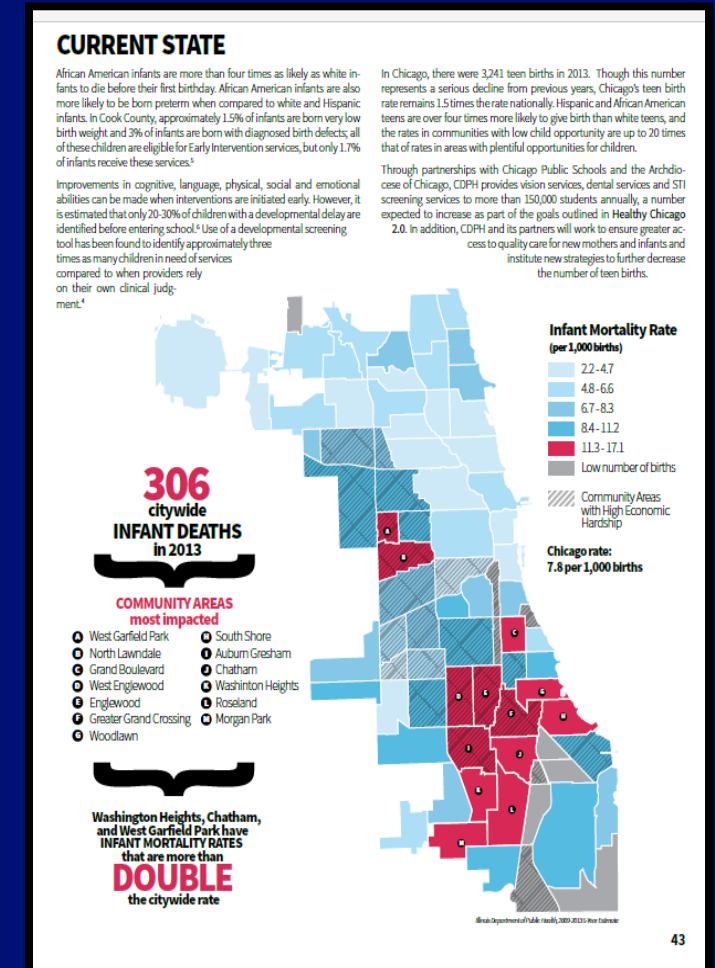
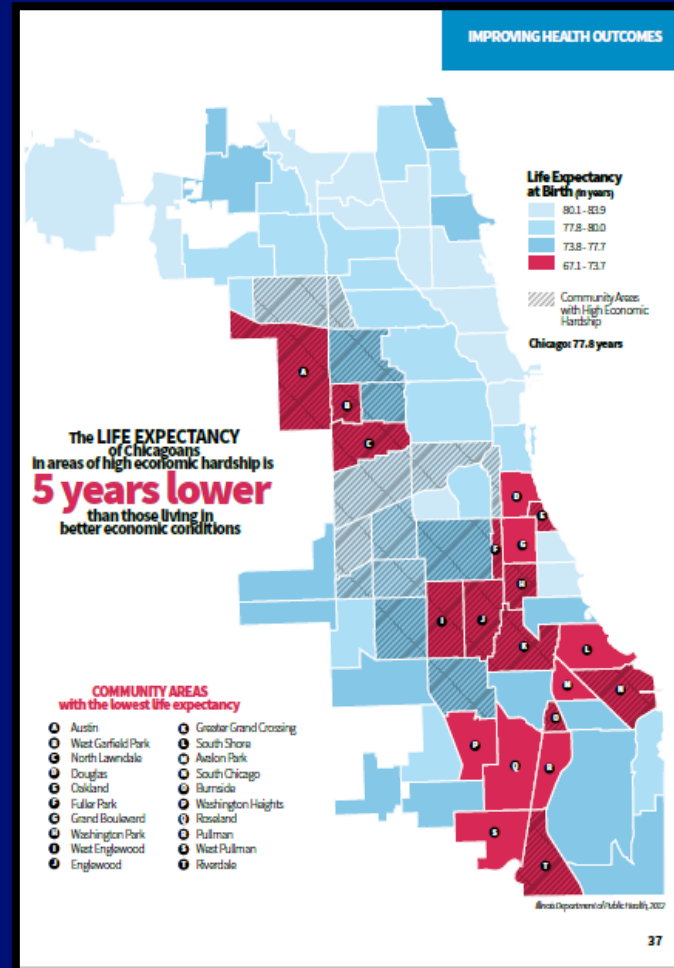
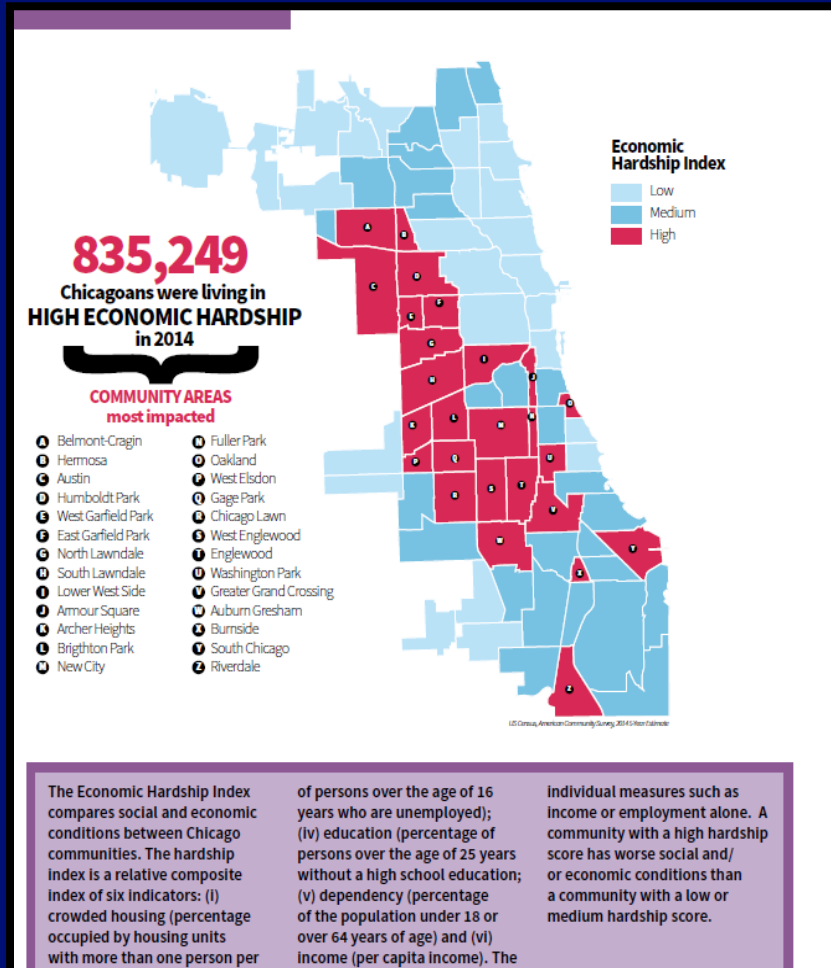
- ❑ Life Expectancy is negatively associated with area-based poverty and economic hardship
 - Association with the economic hardship index (EHI) was stronger and a better fit compared to percent of population in poverty
 - Transformed income indicator was most strongly associated with life expectancy and explained more of the variation than EHI or other individual indicators.
 - Educational attainment, unemployment, and the income indicator associations with life expectancy were stronger than area-based poverty in King County
 - Removing the EHI Dependency variable, which had contrary associations with life expectancy, strengthened the association and fit.

Results Summary

- ❑ Life Expectancy in King County, WA is negatively associated with area-based poverty and economic hardship.
 - Association with the economic hardship index (EHI) was slightly stronger and a better fit compared to percent of population in poverty
 - EHI was more strongly associated with life expectancy and explained more of the variation than any individual EHI indicator
 - Educational attainment and unemployment associations were slightly stronger than area-based poverty
 - Two EHI indicators had contrary associations with life expectancy
 - Dependency
 - Per capita income

2 Approaches: Potential Pitfall

- Consider choosing only one index or indicator for identifying areas for action



Addressing Geographic Disparities Summary

- ❑ Determinant associations vary by outcomes and across geographic areas
- ❑ Simple empirical tests can identify strongest associations and best fit
- ❑ Considerations for selecting determinant measures(16)
 - Be feasible, capitalizing on existing, timely, routinely collected data
 - Have face validity, reflecting the concept(s) they intend to measure
 - Be based on the best available scientific and contextual evidence
 - Foster understanding of the problem and potential solutions
 - Be actionable
 - Foster public and multi-sector engagement

SELECTING IMPACTFUL COMMUNITY-LEVEL INTERVENTIONS

Identifying Community Health Interventions

❑ Community Specific Considerations

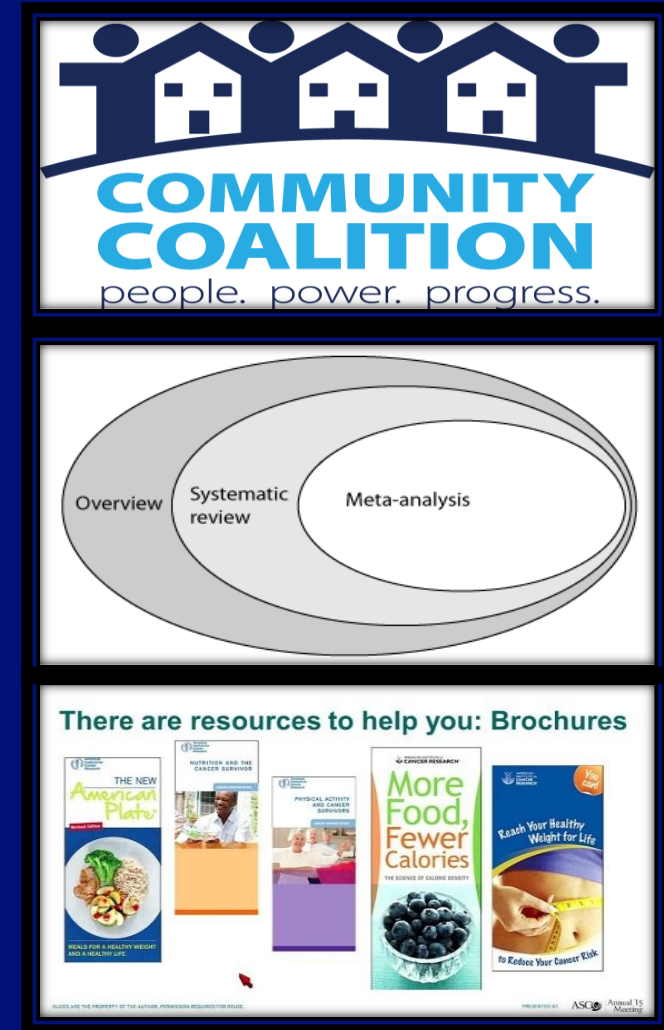
- Community support & engagement
- Motivated/willing mandatory multi-sector partners
- Sustainability of intervention/strategy

❑ Scientific Evidence Considerations

- Potential public health impact & return on investment
- Addresses health disparities/equity
- Potential negative consequences

❑ Practical Considerations

- Delivery Capacity
- Sustainability
- Available guides, TA resources, model programs
- Available monitoring data
- Adequate evaluation resources, expertise, data



Assigning Intervention Levels of Evidence

- ❑ Evidence level $\neq$ expected magnitude of benefit (impact)
- ❑ Evidence level = degree of confidence that intervention will be beneficial
- ❑ Evidence level resources
 - [Guide for Community Preventive Services](#) (The Community Guide)
 - [County Health Rankings & Roadmaps: What Works for Health](#) (CHR&R)

Impact = Reach (actual) x Intensity x Effect

❑ Definitions of Reach (25-26)

- ❑ Potential Reach (0-100%): Percentage of the population who have access to the new or enhanced environment or system
- ❑ Actual Reach (0-100%): Percentage of the population who receive or participate in the intervention
- ❑ For a few interventions:
 - Potential Reach = Actual Reach (e.g., Smoke-free Indoor Air, Enhanced Physical Education in School)
- ❑ For many interventions:
 - Potential Reach > Actual Reach (e.g., Parks, Corner Stores, Farmers' Markets)



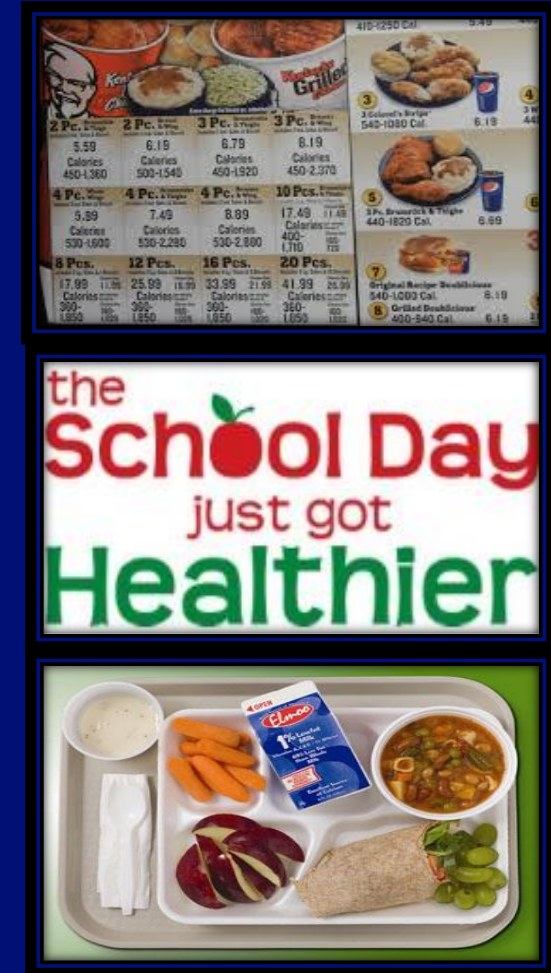
Impact = Reach (actual) x Intensity x Effect

□ Definition of Intensity (26)

- Strength or “dose” of the intervention
 - Frequency
 - Comprehensiveness
 - Duration

□ Which has higher intensity?

- Menu labeling in community fast food restaurants
- vs
- Healthy free breakfast, snacks, and lunches in K=12 schools



Impact = Reach (actual) x Intensity x Effect

□ Definition of Effect (26)

- Magnitude (and significance) of change on each associated health outcome (benefit) that was examined in existing scientific body of literature.

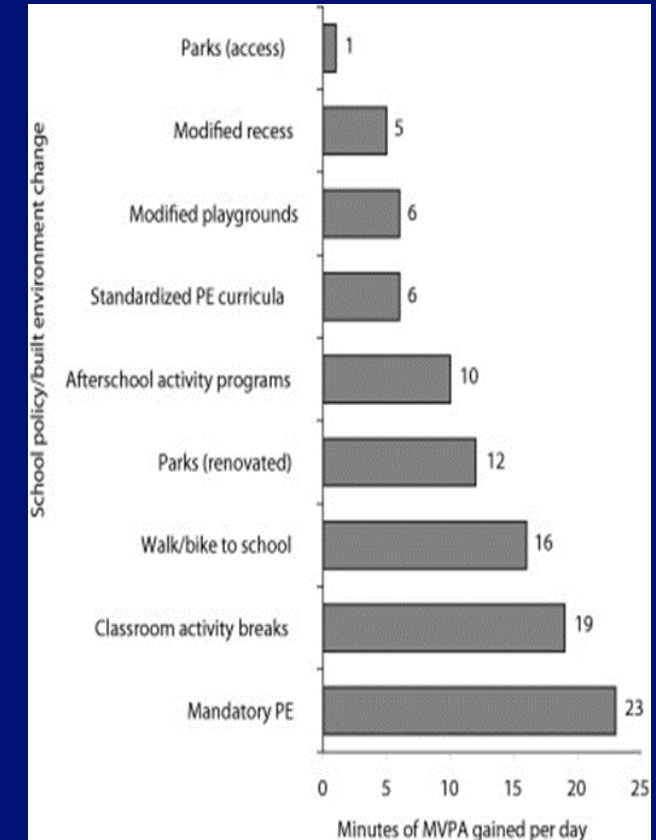
□ Example:

- A 20% increase in tobacco unit price would be associated with a 3.6% median reduction in the proportion of adults who use tobacco.



Estimated Energy Expenditures for School-Based Policies and Active Living: Systematic Review and Comparative Assessment

- ❑ Minutes of physical activity resulting from school-based policies and built environment changes (85 articles) (27)
 - Access to parks (1 minute)
 - Modified recess (5 minutes more than traditional recess)
 - Modified playgrounds (6 minutes)
 - Standardized Physical Education (PE) (6 minutes > traditional PE)
 - Standardized Physical Education (PE) (6 minutes > traditional PE)
 - Afterschool activity programs (10 minutes);
 - Renovate parks (12 minutes)
 - Renovate parks (12 minutes)
 - Walk/bike to school (16 minutes)
 - Classroom activity breaks (19 minutes)
 - Classroom activity breaks (19 minutes)
 - Mandatory physical education (23 minutes)



**NEW RESOURCE FOR IDENTIFYING HIGH IMPACT, COST
EFFECTIVE INTERVENTIONS**



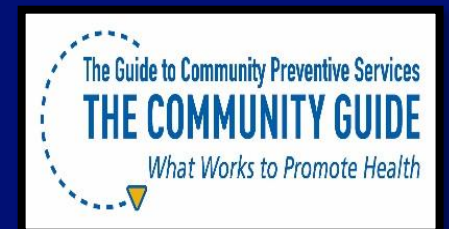
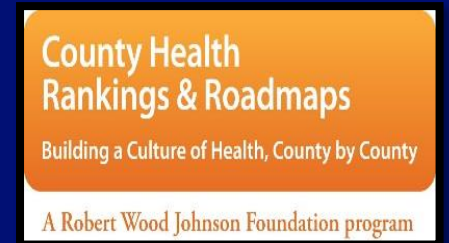
HEALTH **IMPACT** IN 5 YEARS

**The new CDC population health initiative
to improve health in 5 years or less**

Office of the Associate Director for Policy
Division of Community Health
Centers for Disease Control and Prevention

Initial List Identification Methods

- ❑ Earned the highest evidence rating from:
 - County Health Rankings and Roadmaps What Works for Health site
(n=144 “Scientifically Supported”)
 - The Guide to Community Preventive Services
(n=120 “Recommended”)
- ❑ Excluded Clinical Interventions
- ❑ Excluded duplicate interventions
- ❑ CDC subject matter experts proposed additional interventions for consideration

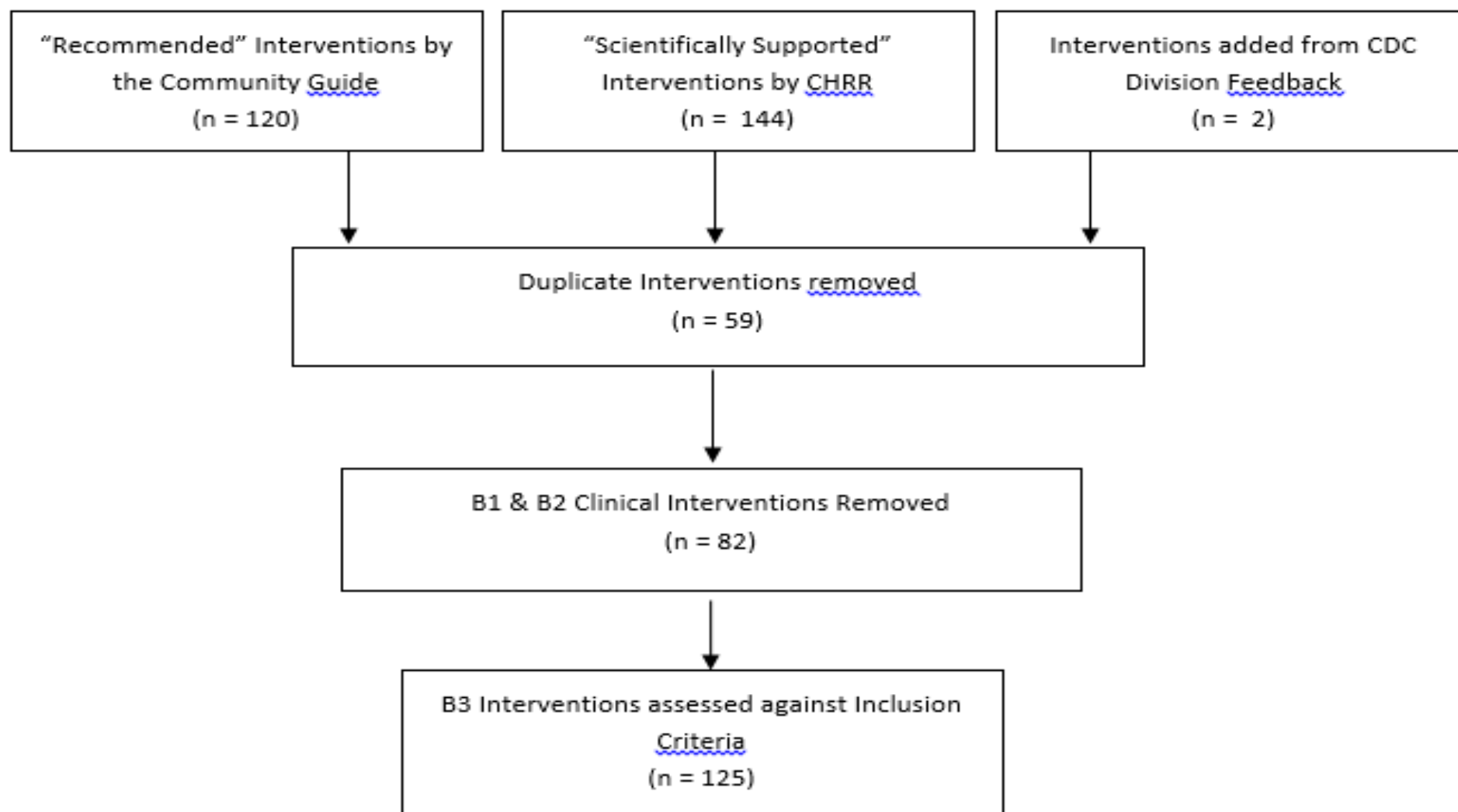


Identification

Screening

Eligibility

Figure 1. HI-5 Initiative: “Bucket 3” Study Selection Flow Diagram



HI-5 Intervention Selection Methods

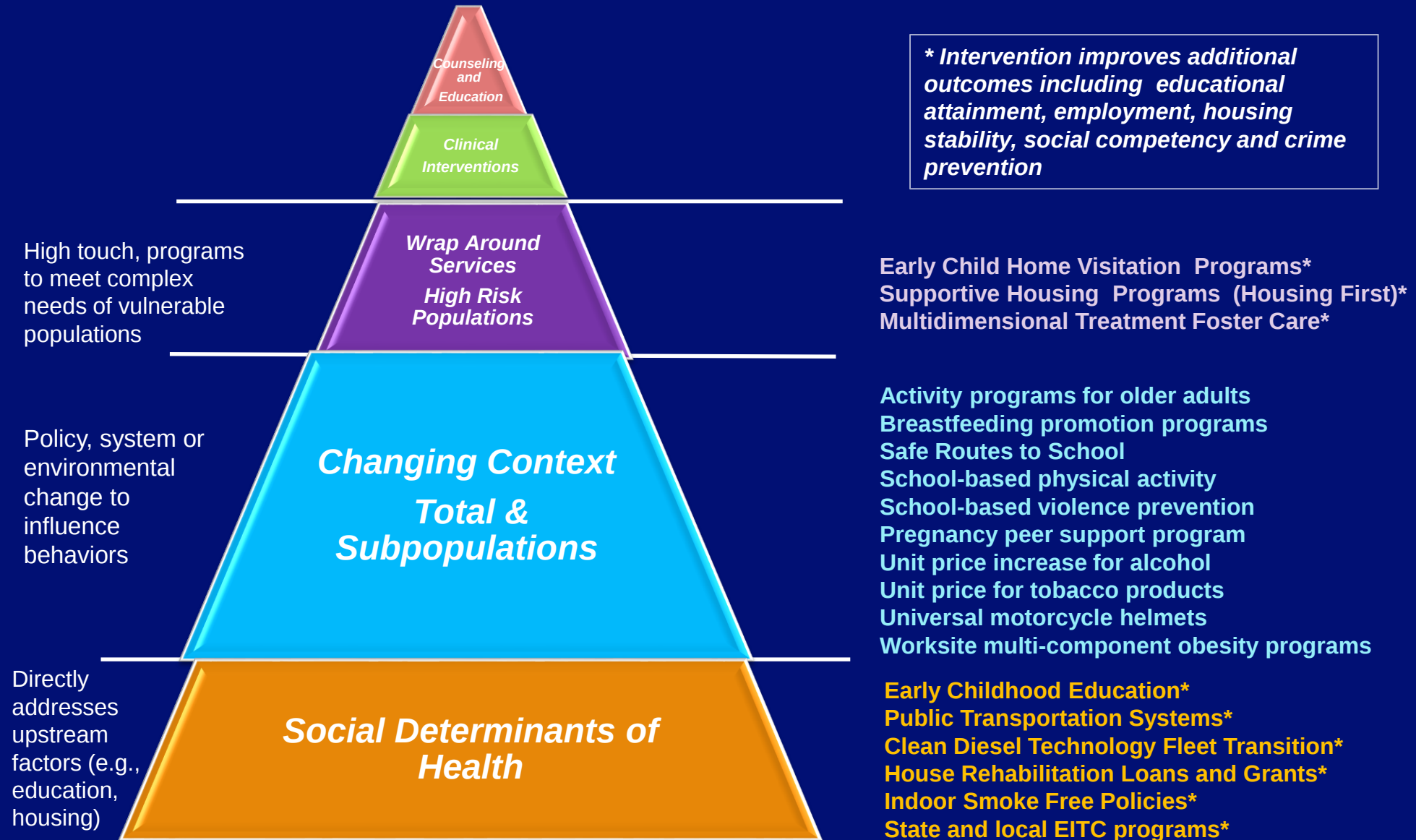
Initial list assessed against the following criteria:

1. Health outcome: Highest level of evidence one or more health outcomes.
2. Measurable improvement in 5 years: Demonstrated with available measure of health outcomes or widely accepted interim measure causally linked to health (e.g., smoking).
2. Saturation: Interventions excluded if implemented in more than half (>50%) of states. This threshold was later changed to >85%.
3. Cost data: Economic evidence showing cost savings or cost-effectiveness.

HI-5 Intervention Selection Methods

- ❑ Additional exclusion criteria:
 - Evidence of potential harm not easily addressed.
 - Additional information assessed: Estimated total potential morbidity or mortality reductions at scale.
 - Demonstrated effective in addressing disparities.

Initial Interventions Mapped to Health Pyramid



Subsequent Applied Criteria

❑ Health outcome evidence criteria:

- Community Guide Review
- Systematic review or individual studies include:
 - 3 experimental studies (RCTs) or 3 quasi-experimental studies with matched concurrent comparisons
 - Strong designs
 - Statistically significant positive findings

❑ Level of Implementation

- Included interventions implemented through policy
- Excluded interventions implemented through programs

- School-Based Programs to Increase Physical Activity
- School-Based Violence Prevention
- Safe Routes to School
- Motorcycle Injury Prevention
- Tobacco Control Interventions
- Access to Clean Syringes
- Pricing Strategies for Alcohol Products
- Multi-Component Worksite Obesity Prevention

Counseling
and Education

Clinical Interventions

Long Lasting
Protective Interventions



Changing the Context

Making the healthy choice the easy choice

- Early Childhood Education
- Clean Diesel Bus Fleets
- Public Transportation System
- Home Improvement Loans and Grants
- Earned Income Tax Credits

Social Determinants of Health

HI-5



HEALTH **IMPACT** IN 5 YEARS

HI-5 INTERVENTION EXAMPLES

Smoke Free Multi-Unit Housing

❑ Public Health Issue: (28)

- Each year, among non-smokers second-hand smoke (SHS) exposure causes:
 - ~ 34,000 heart disease-related deaths
 - > 8,000 deaths from stroke
 - > 7,300 lung cancer deaths
- SHS spread from units, common areas, decks
 - Air vents, hallways, electrical outlets, ceiling cracks, holes in walls
- U.S. residents of multi-unit housing (MUH)
 - ~ 70 of 80 million in MUH without smoke-free policies
 - ~ 45% higher cotinine levels among children living in MUH
- Public Housing
 - 88% MUH
 - 52% are older adults & disabled residents; 43% are children



Smoke-free Policies: Indoor Air

Scientifically Supported (evidence-based) Intervention

- Community Guide Systematic Review (29)
 - 82 studies
 - Strong evidence of effectiveness
- Expected Health Benefits
 - 50% reduction in proportion of people exposed to SHS
 - 3.8 percentage point increase in smoking cessation
 - 5.1% reduction in CVD-related hospital admissions
 - 20.1% reduction in asthma-related hospital admissions
- Economic Analysis
 - No adverse impact: restaurants, bars, businesses catering to tourists
 - Health care savings \$700 - \$1,297 per person
 - \$18M annual cost savings for MUH in CA
 - Cleaning; Repairs; Maintenance



Estimated Annual Cost-Savings: Subsidized & Public Housing (28)

<u>Cost Type</u>	<u>Subsidized Housing</u>	<u>Public Housing</u>
SHS-Related Health Care	\$341 million	\$101 million
Renovation Costs	\$108 million	\$ 32 million
Smoking-Attributable Fires	\$ 72 million	\$ 21 million
TOTAL	\$521 million	\$154 million



Evidence-based Intervention Resources

❑ Live demonstrations:

- [Health Impact in 5 Years \(HI-5\)](#)
- [Guide to Community Preventive Services \(The Community Guide\)](#)
- [County Health Rankings and Roadmaps: What Works for Health](#)

Questions?

For more information please contact Centers for Disease Control and Prevention

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E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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