THE UNIVERSITY OF TENNESSEE HEALTH SCIENCE CENTER

Using Ontology-based Inference for Intervention Evaluation and Policy Planning

Arash Shaban-Nejad, PhD, MPH

UTHSC-ORNL Center for Biomedical Informatics
Population Health Intelligence (PopHI) Lab

LeBonheur Children's Hospital
Methodist Healthcare Family

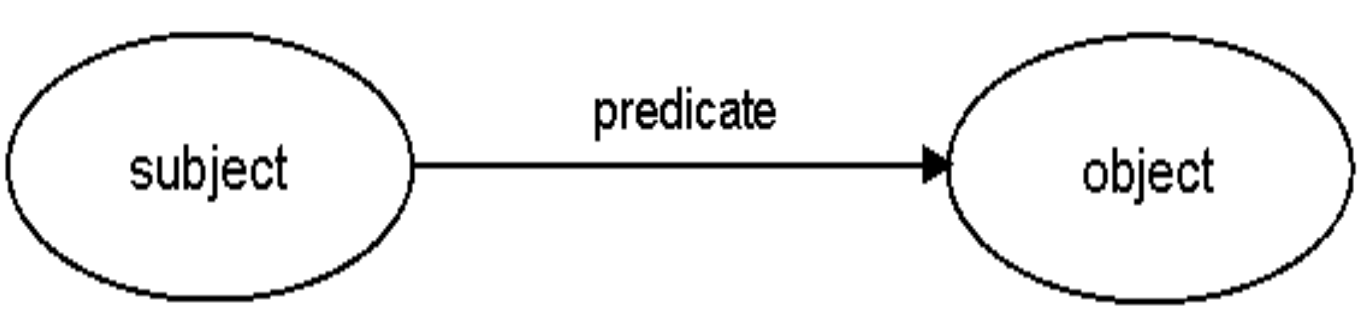
OAK RIDGE National Laboratory

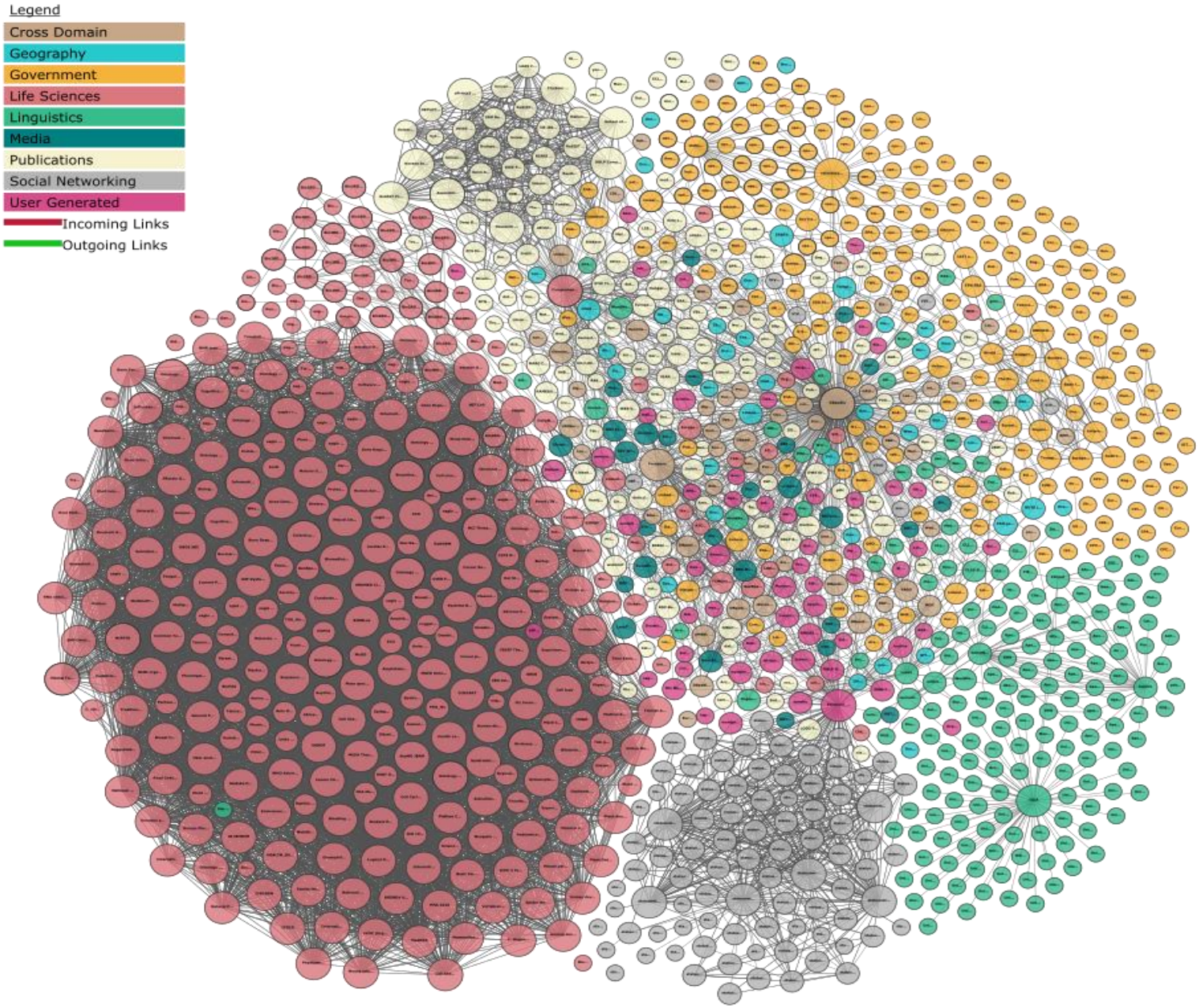
Semantic [Health Data] Analytics

From Data to Insight

through using ontologies to analyze contextual knowledge

Resource Description Framework (RDF) Triples





"Linking Open Data cloud diagram 2017, by Andrejs Abele, John P. McCrae, Paul Buitelaar, Anja Jentzsch and Richard Cyganiak. http://lod-cloud.net/"

Semantic [Health Data] Analytics

Semantically connected (large volume of) data

- What? Who? When?

Statistical/qualitative Analysis

Processing unstructured data to find patterns

Explanatory and Predictive modeling

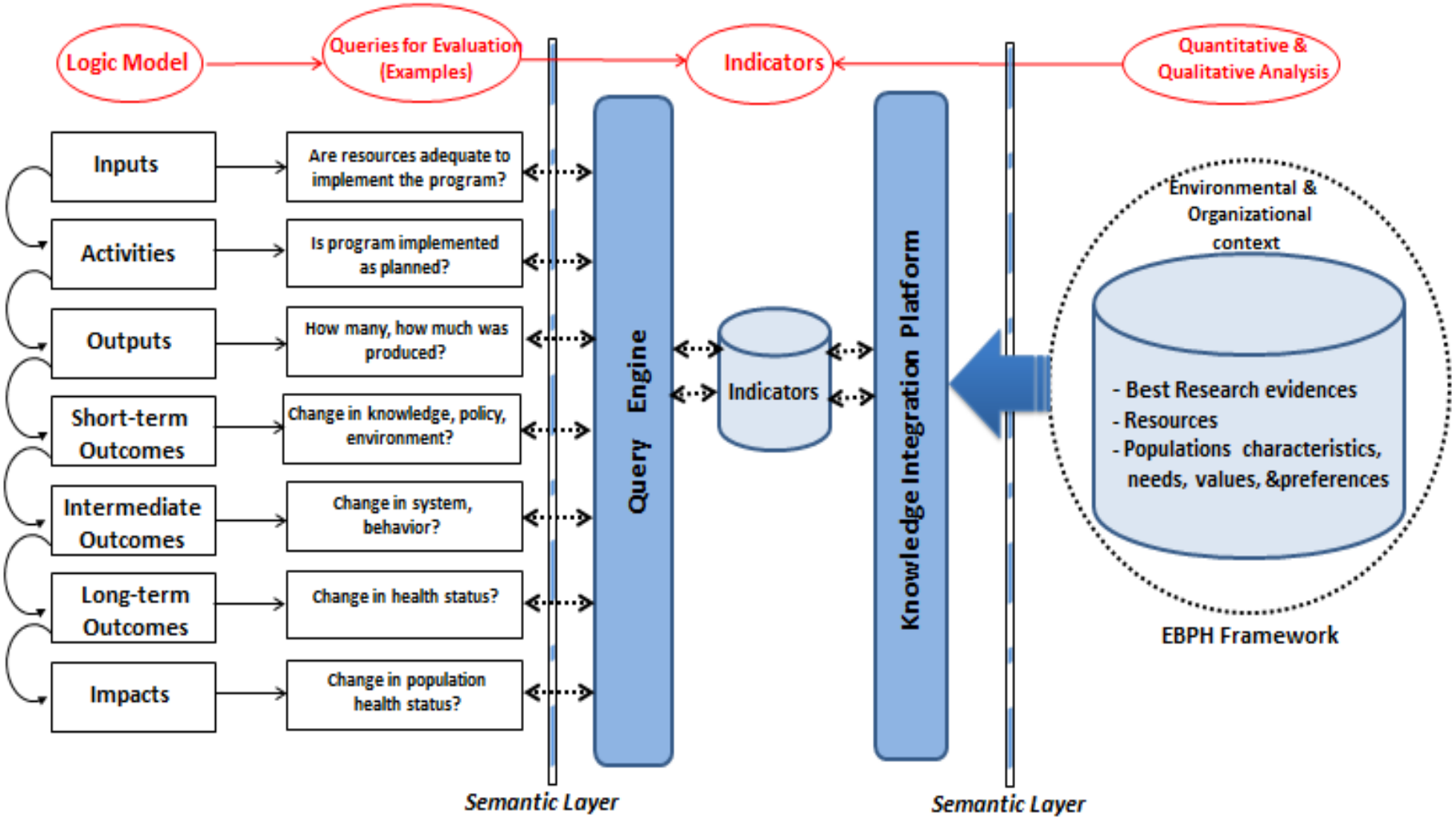
- How? [Why?]

How to Evaluate Policies?

Semantic Querying

- How population patterns and path of exposure affect the health of population?
- How different variation in patterns of practice in services (e.g. cancer screening) can affect health of population?
- How change in patterns of distribution of goods or services can change health of a population?

POLicy EVAlUation & Logical Testing (*POLE.VAULT*)



Shaban-Nejad et al. A Semantic Framework for Logical Cross-Validation, Evaluation and Impact Analyses of Population Health Interventions. Stud Health Technol Inform. 2017;235:481-485.

HOUSING Policy & Health Outcome

Memphis Blight Elimination Consortium

POLICYMAP

MEMPHIS PROPERTY HUB

Neighborhood Preservation Incorporated

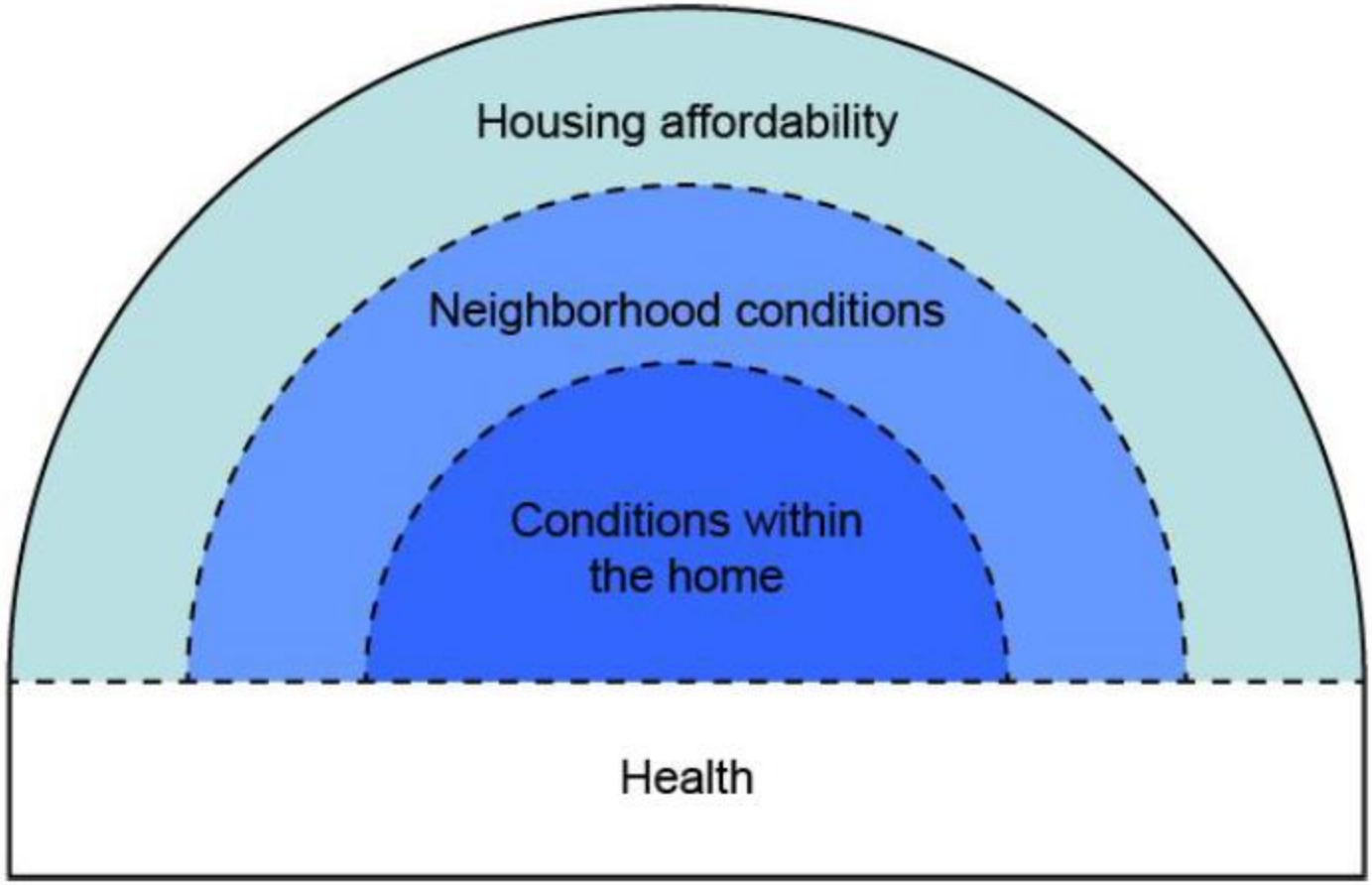
INNOVATE MEMPHIS
Delivering Civic Solutions

THE UNIVERSITY OF TENNESSEE HEALTH SCIENCE CENTER

MEMPHIS
the CITY of MEMPHIS

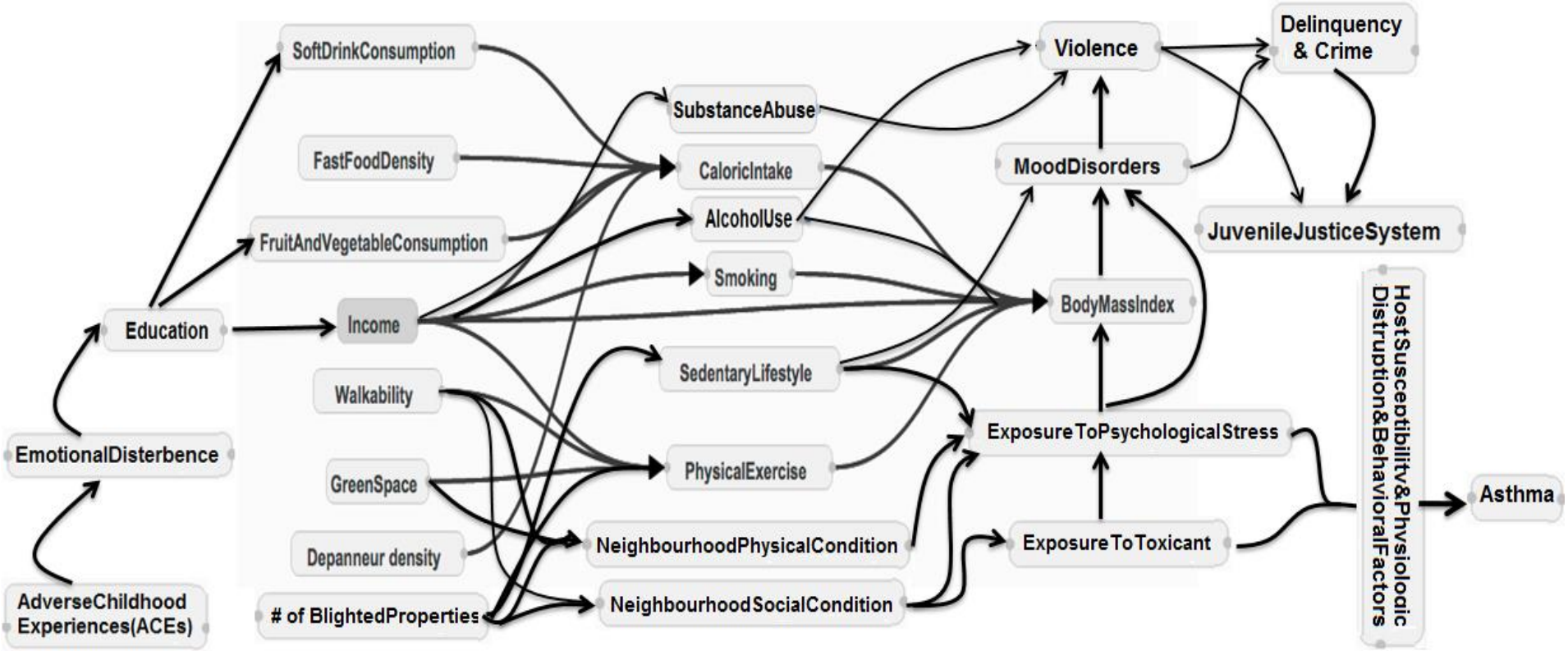
THE UNIVERSITY OF MEMPHIS

Housing Factors that Influence Health



Source: Braverman et al. (2011); Copyright 2011, Robert Wood Johnson Foundation.

Health Outcome



Designing a Logic Model

Example: A Proposed Logic Model Related to Healthy Homes

Program Focus	Inputs	Activities	Outputs	Short Term Outcomes	Mid-Term Outcomes	Long-Term Outcomes
Asthma Healthy Homes Pilot	Health Department Staff Home Visiting Programs Home Inspectors Community Organizations Advocacy Organizations Rental Property Owners Pest Management Professionals Contractors Elected Officials Clinicians Health Insurers Foundations Funding Equipment Supplies	Educate families about environmental triggers in the home Conduct visual assessments Provide supplies for dust control and pest management Interventions including integrated pest management (IPM), moisture control, lead hazard reduction, etc. Refer families to smoking cessation programs Refer families to housing rehab services to address issues beyond program scope Refer housing units to code enforcement	Number of home visits completed Number of referrals to partner organizations Counts of supplies delivered Number of visual assessments for pests, mold, and moisture completed Number of homes receiving specific interventions such as IPM Number of housing inspections for housing code violations	Increased use of mattress and pillow covers, IPM supplies after one month Improvement in family Knowledge, Information, and Behavior (KIB) scores in one month Increase number of units where family limits smoking in the home	Reduction in counts of pests in units after three months Reduction in the reported number of symptom days after 3 months Reduction in the number of asthma triggers Reduction in ER and hospitaliztions at 12 months Increased number of units enrolled in housing rehab programs	Reduction in mold and moisture conditions observed at 12-month visual assessment Families show long term improvement on KIB scores Health insurers reimburse or pay for home visits and low cost environmental interventions Property owners adopt preventive policies

http://portal.hud.gov/hudportal/documents/huddoc?id=hhpgm_final_ch6.pdf

CDC Community Health Improvement Navigator

Database of Interventions

SELECT **Filters**

Clear all filters

TARGET RISK FACTORS

- [ ] Tobacco Use and Exposure
- [ ] Physical Inactivity
- [ ] Unhealthy Diet
- [x] High Cholesterol
- [x] High Blood Pressure
- [x] Diabetes
- [x] Obesity

TARGET POPULATIONS

- [x] Racial/Ethnic Minorities
- [x] Low Income
- [ ] Children/Adolescents
- [ ] Families
- [ ] Adults
- [ ] Older Adults
- [ ] Men
- [ ] Women
- [x] Urban
- [ ] Rural

TARGET OUTCOMES OR INDICATORS

- [ ] Tobacco Use and Exposure
- [ ] Physical Activity
- [ ] Healthy Food/Beverage Intake
- [ ] Cholesterol/Lipid Level
- [ ] Blood Pressure
- [ ] Hemoglobin A1c/Glycemic Control
- [ ] Body Mass Index/Weight
- [ ] Health Care Costs
- [ ] Mortality
- [ ] Treatment Adherence

INTERVENTION SETTINGS/LOCATIONS

- [ ] Business/Worksite
- [ ] School
- [ ] Childcare Facility
- [ ] Faith-Based Setting
- [ ] Community
- [ ] Pharmacy
- [ ] Clinic
- [ ] Hospital
- [ ] Telehealth

INTERVENTION TYPES

- [ ] Access to Care
- [ ] Screening
- [ ] Disease Management
- [ ] Counseling
- [ ] Education
- [x] Program
- [ ] Point-of-Decision Prompt
- [ ] Financial Incentive/Offset Costs
- [ ] Healthy Food/Beverage Provision
- [ ] Campaigns
- [ ] Media/Marketing
- [ ] Changing Physical Environment
- [x] Policy

Four ACTION Areas

SOCIOECONOMIC FACTORS	PHYSICAL ENVIRONMENT	HEALTH BEHAVIORS	CLINICAL CARE
4 RESULTS	9 RESULTS	3 RESULTS	0 RESULTS

- [x] Reviews (more info)
- [x] Individual Studies (more info)

FILTER BY ACTION AREA: Showing All Go

Showing 1 to 10 of 12 results Previous Next

REVIEWS
Mixed-Use Development

REVIEWS
Zoning Regulations: Land Use Policy

REVIEWS
Housing Programs and Policies: Tenant-Based Rental Assistance Programs

REVIEWS
Multi-Component Obesity Prevention Interventions

INDIVIDUAL STUDIES
A community intervention reduces BMI z-score in children: Shape Up Somerville first year results.

REVIEWS
Access to Places for Physical Activity

REVIEWS
Farmers' Markets/Stands in Low Income Neighborhoods

REVIEWS
Increase Green Space/Parks

REVIEWS
Joint Use Agreements

Showing all 9 results

ASSETS: PEOPLE OR ORGANIZATIONS

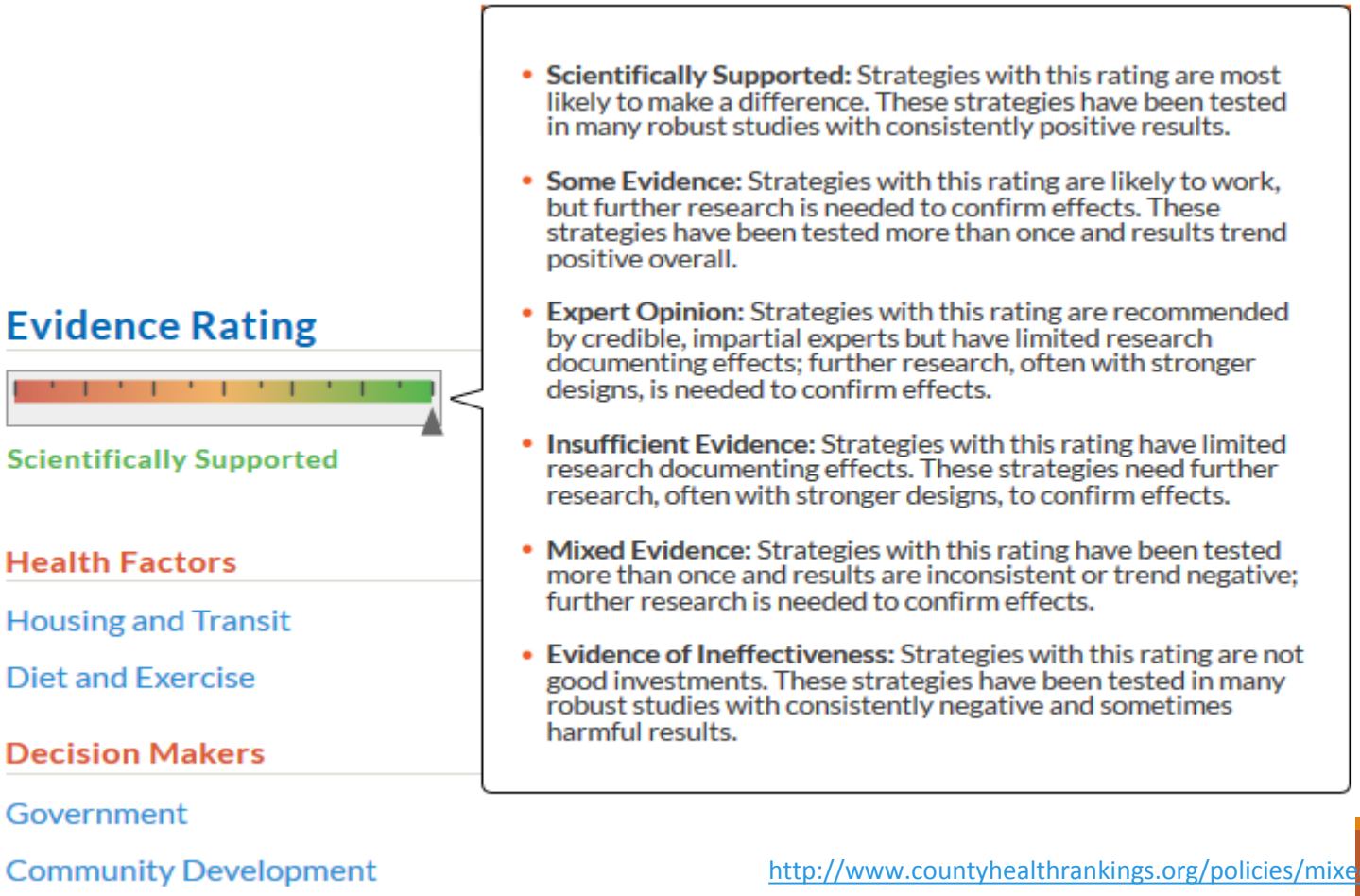
- [ ] Residents/Community Health Workers
- [ ] Hospitals/Clinicians/Healthcare Workers
- [ ] Payors/Insurers
- [x] Health Department/Public Health Officials
- [x] Policymakers/Local Council Members
- [ ] Local Businesses/Nonprofit Organizations
- [ ] Voluntary Associations
- [x] Researchers/Evaluators

ASSETS: PHYSICAL OR VIRTUAL SPACE

- [ ] Local Institutions
- [ ] Parks/Community Common Space
- [ ] Website/Community Listerv
- [ ] Media: Radio/TV/Print
- [ ] Transportation
- [x] Housing Development/Urban Planning

Mixed-use development

Definition. Mixed-use development supports a combination of land uses within a project (e.g., residential, commercial, recreational, etc.) as opposed to developing an area for a single purpose. Mixed-use development projects can be site-specific, neighborhood-based, or regional, and can be incorporated into several types of projects including new development, redevelopment, brownfields, and Smart Growth initiatives. Mixed-use development is sometimes implemented through zoning regulations that require it in specific areas or throughout a municipality.



http://www.countyhealthrankings.org/policies/mixed-use-development

Expected Beneficial Outcomes (Rated)

- Increased physical activity

Other Potential Beneficial Outcomes

- Increased active transportation
- Improved health outcomes
- Reduced vehicle miles traveled

Evidence of Effectiveness

There is strong evidence that design and land use policies, including mixed-use development, increase physical activity (CG-Physical activity, Brownson 2006, Saelens 2008, CDC MMWR-Khan 2009).

People walk and ride bicycles more often in mixed-use development areas, which have higher densities and incorporate places to work, shop, or play within residential areas (Brownson 2006, CDC MMWR-Khan 2009). Walking for transportation increases with variety in land use, residential density, and shorter distances to non-residential destinations (Saelens 2008, EPA-Kramer 2013). Mixed use development and Smart Growth strategies can also be used in rural and suburban areas to sustain and promote active living (Dalbey 2008, Dunham-Jones 2009). Children living in Smart Growth neighborhoods appear to engage in more physical activity with friends, within walking distance of their homes, and in green spaces than those living in conventional neighborhoods (Dunton 2012).

Public health and community development partnerships promoting mixed-use development can help to improve community health outcomes (Cassidy 2011). Mixed-use development can also reduce vehicle miles traveled (VMT), which helps improve air quality (EPA-Kramer 2013, Salon 2012).

Implementation Examples

Mixed-use development is happening across the country, often as part of Smart Growth projects. In 2015, the US Environmental Protection Agency granted its National Awards for Smart Growth Achievement to Jackson, TN; Hamilton, OH; and Newark, NJ for their innovative use of mixed-use development (US EPA-Smart growth).

Non-profit organizations can support site-specific mixed-use development projects throughout a region, for example, the East Bay Asian Local Development Corporation in Oakland, CA and the greater East Bay area (EBALDC-Healthy neighborhoods). Individual organizations can also support efforts around the country, as in the Congress for New Urbanism (CNU-Building places). The Smart Growth Network, a partnership of non-profit, business, and government organizations, also supports mixed-use development and smart growth projects throughout the US (SGO-Smart growth).

Via Verde in the Bronx, NY is an example of a mixed-use development housing project (Via Verde-Green living).

Implementation Resources

ALBD - Active Living by Design (ALBD). Increasing physical activity and healthy eating through community design.

LHC-Toolkit 2009 - Leadership for Healthy Communities (LHC). Action strategies toolkit: A guide for local and state leaders working to create healthy communities and prevent childhood obesity. Princeton: Robert Wood Johnson Foundation (RWJF); 2009.

MA-Mixed-use - Massachusetts Executive Office of Housing and Economic Development (EOHED). Mixed-use development/transit oriented development.

WI DOA-Gilman 2007 - Gilman J, Stoll L, Schuette A, et al. Wisconsin comprehensive planning: Implementation guide toolkit. Stevens Point: Center for Land Use Education, Wisconsin Department of Administration (DOA), Global Environmental Management Education Center (GEM), University of Wisconsin Extension; 2007.

NACCHO-Community Design - National Association of County & City Health Officials (NACCHO). Healthy community design toolkit.

US EPA-Trip generation - US Environmental Protection Agency (US EPA). Mixed-use trip generation model.

ICMA-Mishkovsky 2010 - Mishkovsky N, Dalbey M, Bertaina S, Read A, McGalliard T. Putting Smart Growth to work in rural communities. Washington, DC: International City/County Management Association (ICMA); 2010.

LHC-Rockeymoore 2014 - Rockeymoore M, Moscetti C, Fountain A. Rural Childhood Obesity Prevention Toolkit. Leadership for Healthy Communities (LHC). 2014.

WFC-Resources - Walk Friendly Communities (WFC), Pedestrian and Bicycle Information Center. Resources.

SGO-Resources - Smart Growth Online (SGO). Smart growth resources.

ULI-Building healthy places - Urban Land Institute (ULI) and Building Healthly Places Initiative. Building Healthy Places Toolkit: Strategies for Enhancing Health in the Built Environment.

LISC-Affordable housing - Local Initiatives Support Corporation (LISC). Helping neighbors build communities: Affordable housing.

+ Citations - Evidence

Brownson 2006* - Brownson RC, Haire-Joshu D, Luke DA. Shaping the context of health: A review of environmental and policy approaches in the prevention of chronic diseases. Annual Review of Public Health. 2006;27:341–70.

CG-Physical activity - The Guide to Community Preventive Services (The Community Guide). Physical activity.

Cassidy 2011 - Cassidy A. Health policy brief: Community development and health: Organizations promoting jobs, housing, and better conditions in low-income neighborhoods also focus on health. Health Affairs; November 10, 2011.

CDC MMWR-Khan 2009 - Khan LK, Sobush K, Keener D, et al. Recommended community strategies and measurements to prevent obesity in the United States. Morbidity and Mortality Weekly Report (MMWR). 2009;58(RR-07):1-26.

Saelens 2008 - Saelens BE, Handy SL. Built environment correlates of walking: A review. Medicine & Science in Sports & Exercise. 2008;40(7 Suppl):S550-66.

Dalbey 2008* - Dalbey M. Implementing smart growth strategies in rural America: Development patterns that support public health goals. Journal of Public Health Management and Practice. 2008;14(3):238-43.

Dunton 2012 - Dunton GF, Intille SS, Wolch J, Pentz MA. Investigating the impact of a smart growth community on the contexts of children's physical activity using Ecological Momentary Assessment. Health & Place. 2012;18(1):76–84.

EPA-Kramer 2013 - Kramer MG. Our built and natural environments: A technical review of the interactions among land use, transportation, and environmental quality. Washington, DC: US Environmental Protection Agency (EPA); 2013.

Salon 2012* - Salon D, Boarnet MG, Handy S, Spears S, Tal G. How do local actions affect VMT? A critical review of the empirical evidence. Transportation Research Part D: Transport and Environment. 2012;17(7):495–508.

Dunham-Jones 2009 - Dunham-Jones E, Williamson J. Retrofitting suburbia. Washington, DC: Urban Land Institute; 2009.

Related Policies & Programs

- Places for physical activity
- Safe Routes to Schools
- Streetscape design
- Zoning regulations for land use policy

MAPS TABLES REPORTS 3-LAYER MAPS DATA LOADER CITING Arash

POLICYMAP Location 38103

My Data | Demographics | Incomes & Spending | Housing | Lending | Quality of Life | Economy | Education | Health | Federal Guidelines | Analytics

DATA LAYERS | DATA POINTS | SUBSCRIBER SHARED DATA

Health Status
- Chronic Conditions
- Infectious Disease
- Cancer
- Perceived Health Status

Vital Statistics
- Birth and Prenatal Care
- Mortality

Health Insurance
- Healthcare Insured & Uninsured Populations
- Medicare

Access to Medical Care
- Preventative Care
- Facilities
- Health Professionals
- Emergency Room Visits

Local Foods & Businesses
- Farmers' Markets
- Food Access
- Fast-food and Takeout Restaurants
- Beer, Wine, and Liquor Stores

Risk Factors
- Overweight & Obesity
- Physical Activity
- Fruit and Vegetable Consumption
- Alcohol and Tobacco Use
- Seatbelt Use

Federal Programs
- Medically Underserved Areas
- WIC and SNAP

Health Facilities
- Hospitals
- Nursing Facilities
- Nurse Practitioner-Led Clinics
- Community Health Centers
- Retail-Based Healthcare
- Mental Health Treatment Facilities
- Drug and Alcohol Treatment Facilities

Food and Grocery Retail Access
- Grocery Retail Locations (2013)
- Farmers' Markets
- SNAP Retail Locations
- Reinvestment Fund Study of Limited Supermarket Access (LSA) Areas (2014)

There are currently no shared Health point datasets.

HEALTH NEWS

Elevating Opioid Awareness with PolicyMap

Our Medicare Data is in Good Health!

New Drug Overdose Death Data from the CDC

QUICK 3-LAYER MAPS

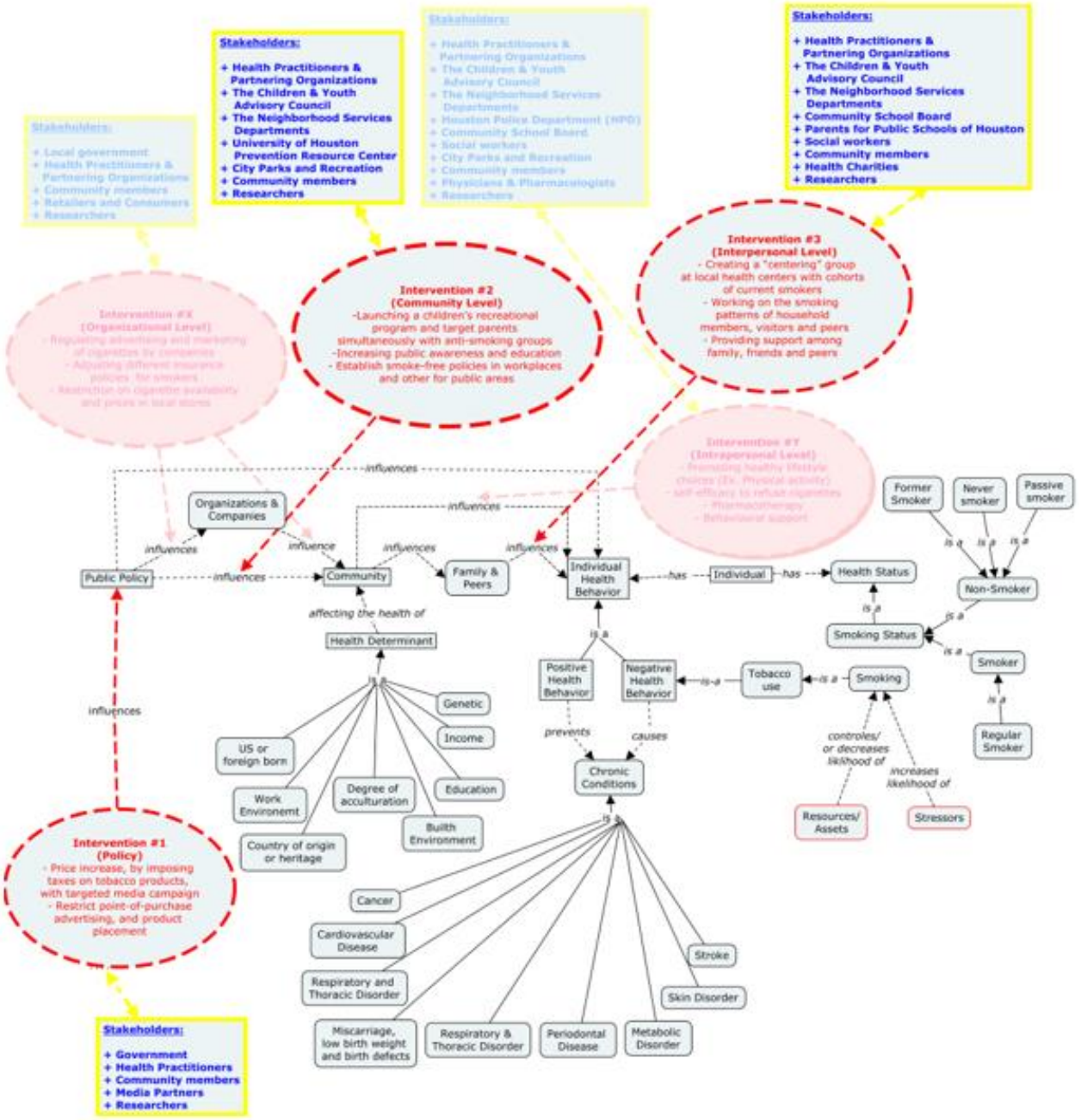
Where in Georgia are there lots of hospital visits by people without insurance?

Where in California are people physically active, but still suffering from heart disease?

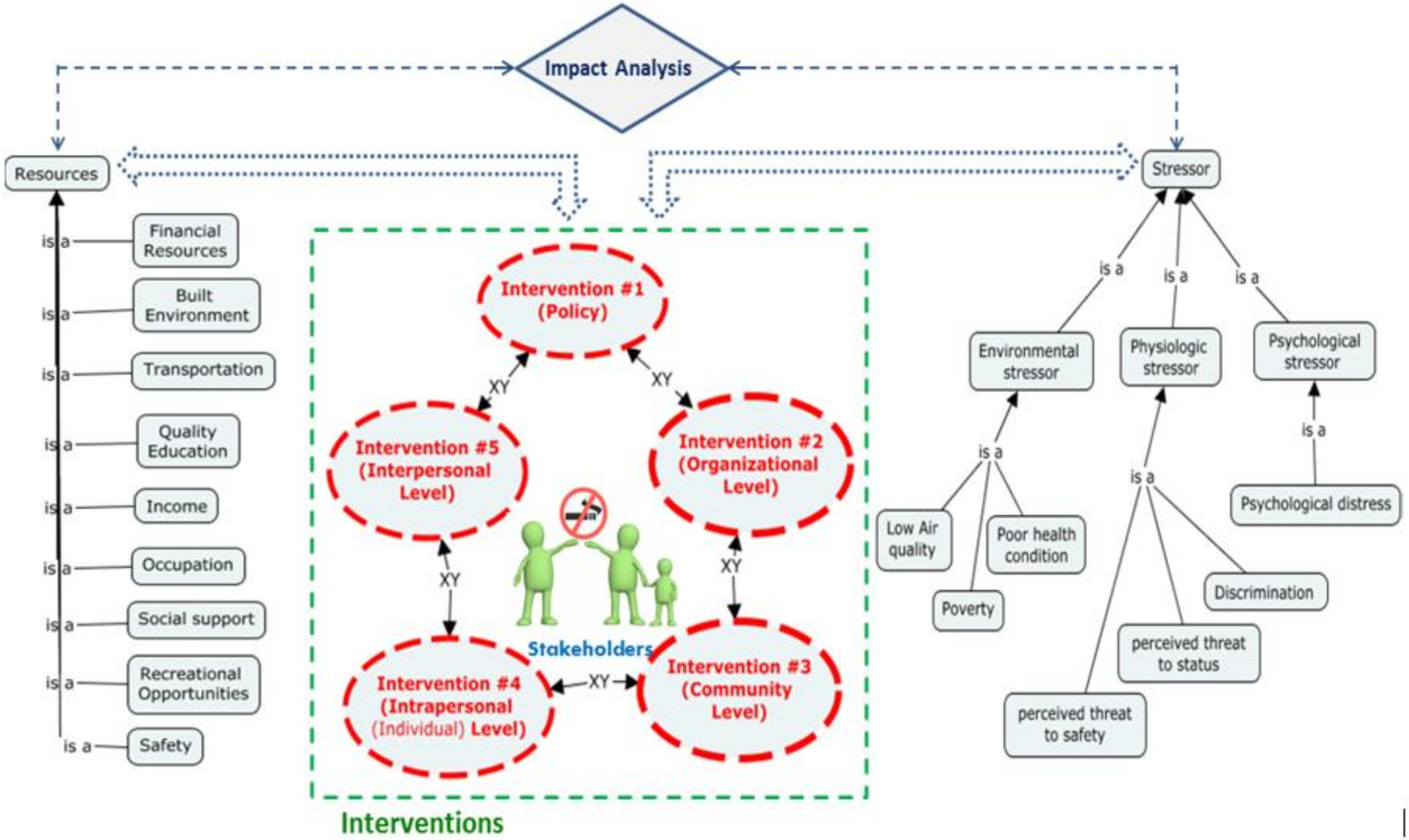
Want more Data?

Multilevel/Networked Interventions

Multilevel Interventions for Smoking cessation



Shaban-Nejad, Arash (2018)



Interaction between Interventions, Resources/Assets and Stressors

Shaban-Nejad, Arash (2018)

Evidence-Based Analysis

PDQ® Levels of Evidence

Levels of Evidence for Adult and Pediatric Cancer Treatment Studies

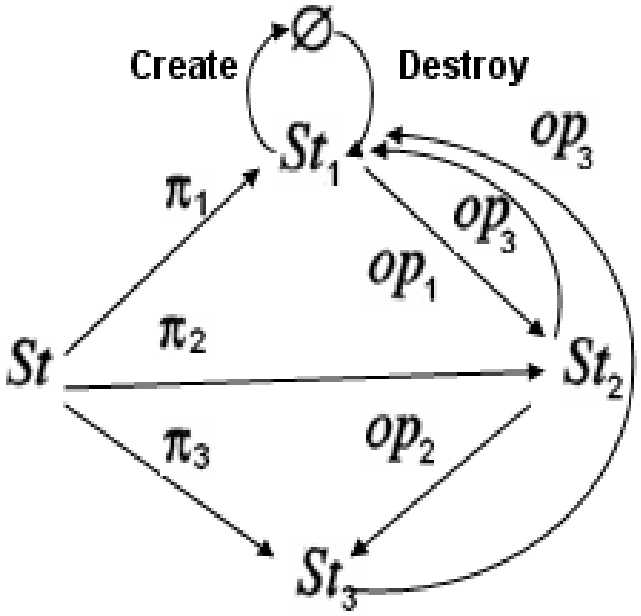
Levels of Evidence for Cancer Screening and Prevention Studies

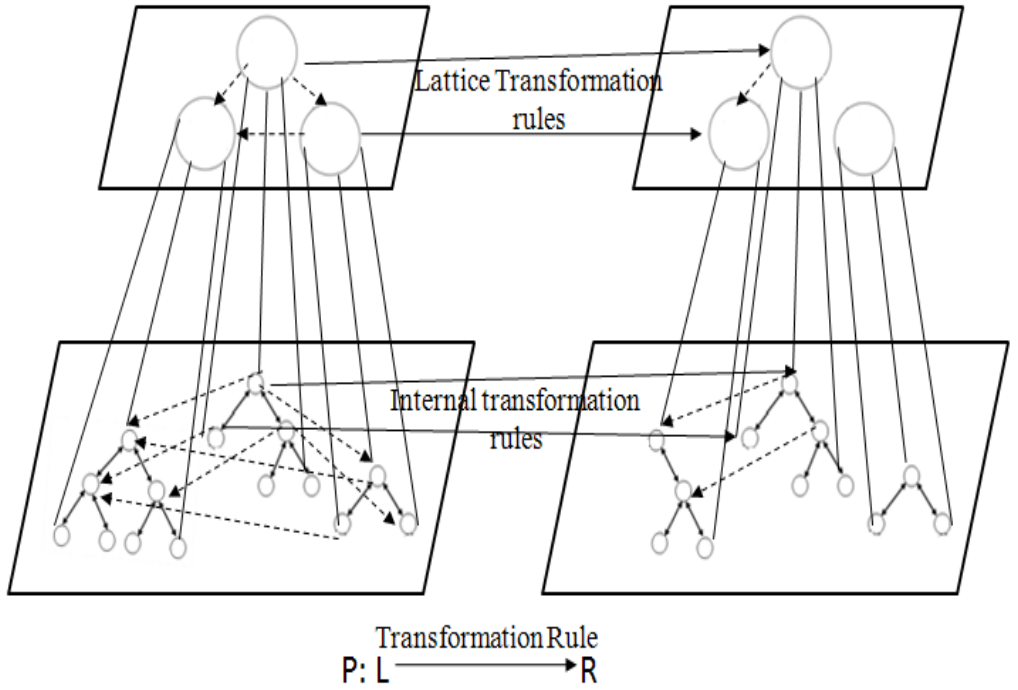
Levels of Evidence for Cancer Genetics Studies

Levels of Evidence for Supportive and Palliative Care Studies

Levels of Evidence for Human Studies of Cancer Integrative, Alternative, and Complementary Therapies

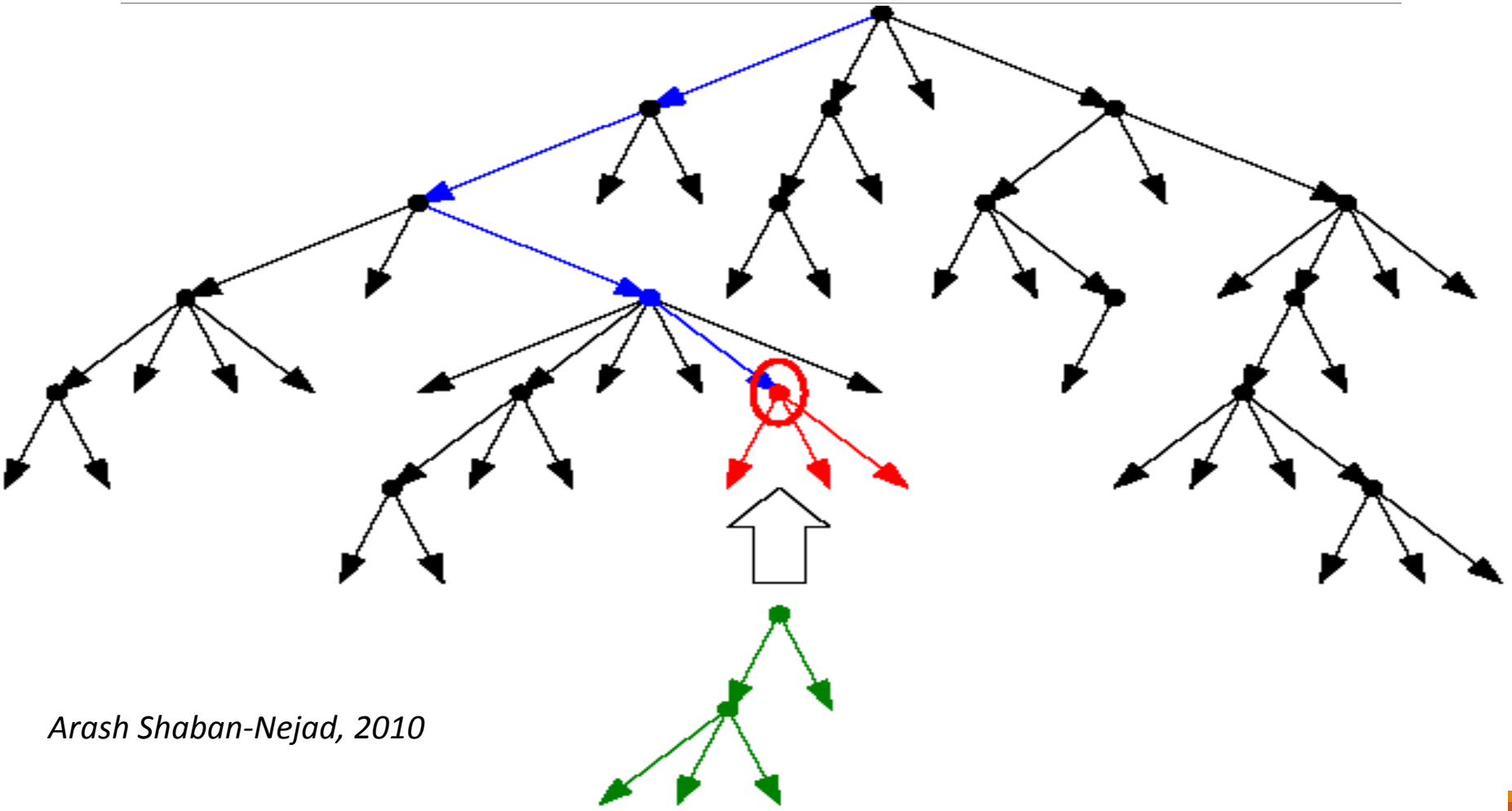
Formal representation and Inference of/about Changes





Arash Shaban-Nejad, 2010, 2015

Tracking Transitions Between States



Arash Shaban-Nejad, 2010

Key Points

- Evaluation of interventions relies on consistent integrated datasets
- Need for alignment, matching, merging, and integration
- Semantic [BigData] analytics can help

Challenges:

- Need for Integrating individual level and group level Evidence
- Trade off between expressivity and computability

Acknowledgements

ashabann@uthsc.edu

Questions?