



# Geographic Information Systems (GIS) in Public Health: Supporting the Needs of People in Preparedness, Response, and Recovery

2015 Esri National Security Summit | July 19, 2015

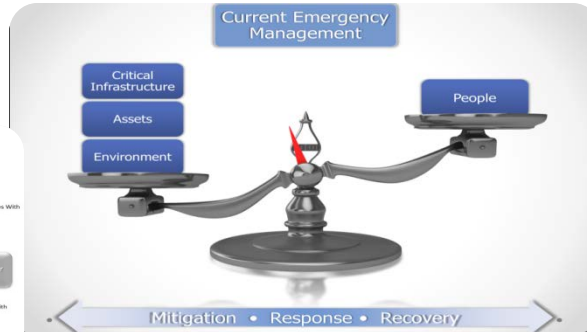
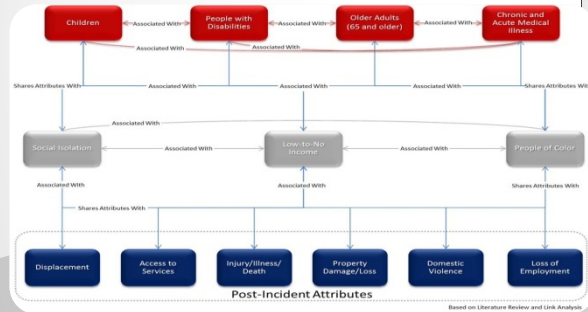
Dr. S. Atyia Martin, CEM | [www.AtyiaMartin.com](http://www.AtyiaMartin.com) | [atyia@live.com](mailto:atyia@live.com)

# Overview

## Current Emergency Management Challenge

## Public Health & Medical Intelligence

### Social Determinants of Vulnerability



**Public Health**  
Prevent. Promote. Protect

## Community Resilience

# Current Emergency Management

Critical Infrastructure

Assets

Environment

People



← Mitigation • Response • Recovery →

# RESEARCH GOAL

Develop a framework that emergency planners in cities can use to incorporate social vulnerability into mitigation, response, and recovery.

## PHASE I:

Develop the Framework

What are social factors of vulnerability that appear most frequently in the literature?

What are the relationships between these social factors and others?

## PHASE II:

Apply the Framework

Does the frequency and interrelationship represented in the literature exist in the City of Boston?

Which areas of Boston do we need to focus on for targeted mitigation, response, and recovery planning?

# Social Vulnerability

Economic  
Disadvantage

Language &  
Literacy

Medical Issues  
& Disabilities

Age

Isolation

At or Below Poverty Level  
Homeless  
Working Poor



# Social Vulnerability

Economic  
Disadvantage

Language &  
Literacy

Medical Issues  
& Disabilities

Age

Isolation

Limited Ability to Read, Speak,  
Write, or Understand English  
Cannot Read or Have Low  
Literacy



# Social Vulnerability

Economic  
Disadvantage

Language &  
Literacy

Medical Issues  
& Disabilities

Age

Isolation

Physical, Mental,  
Cognitive, or Sensory  
Medically-Dependent



# Social Vulnerability

Economic  
Disadvantage

Language &  
Literacy

Medical Issues  
& Disabilities

Age

Isolation

Infants and  
Children  
Older Adults





# Social Vulnerability

Economic  
Disadvantage

Language &  
Literacy

Medical Issues  
& Disabilities

Age

Isolation

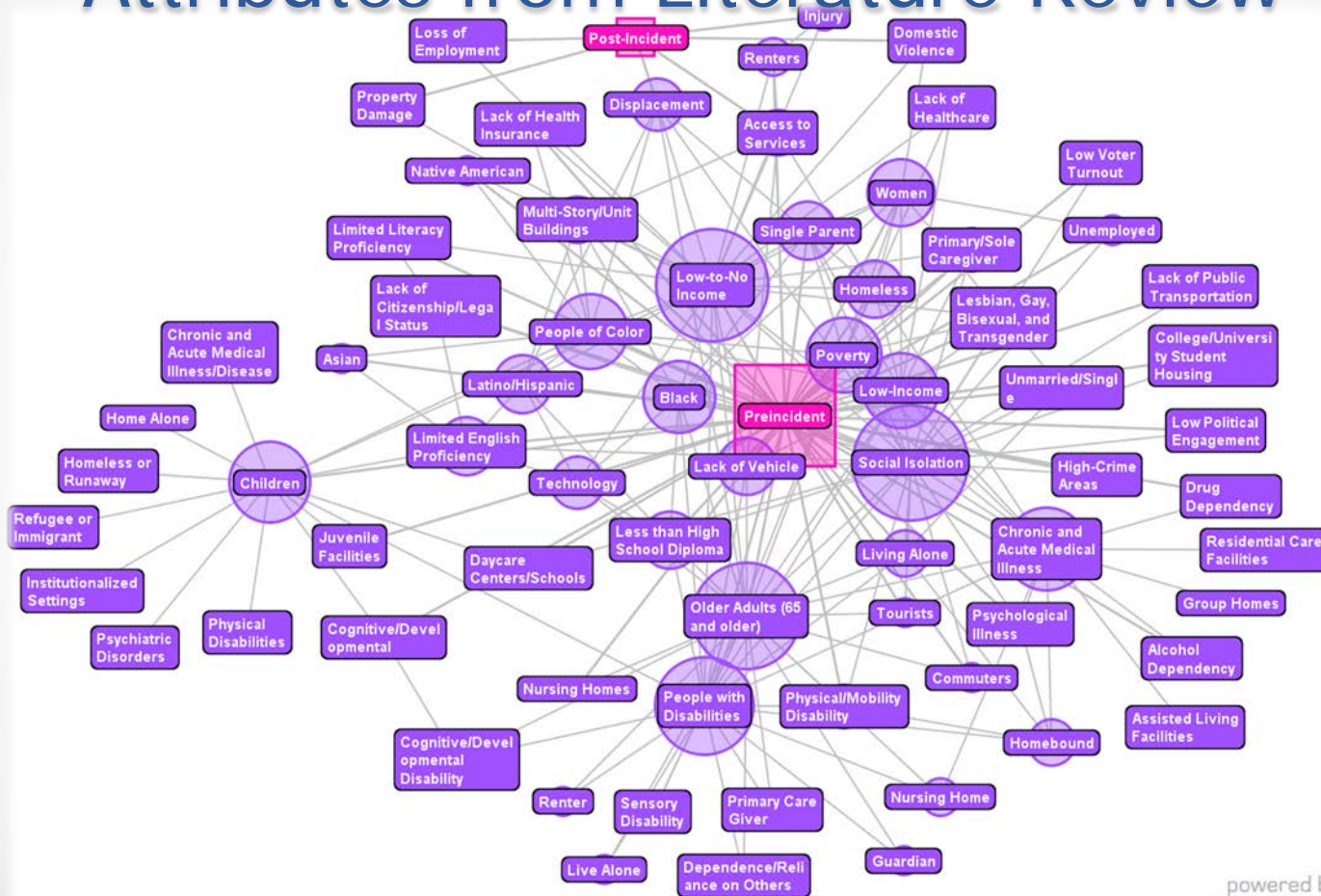
Interpersonal  
Community  
Institutional



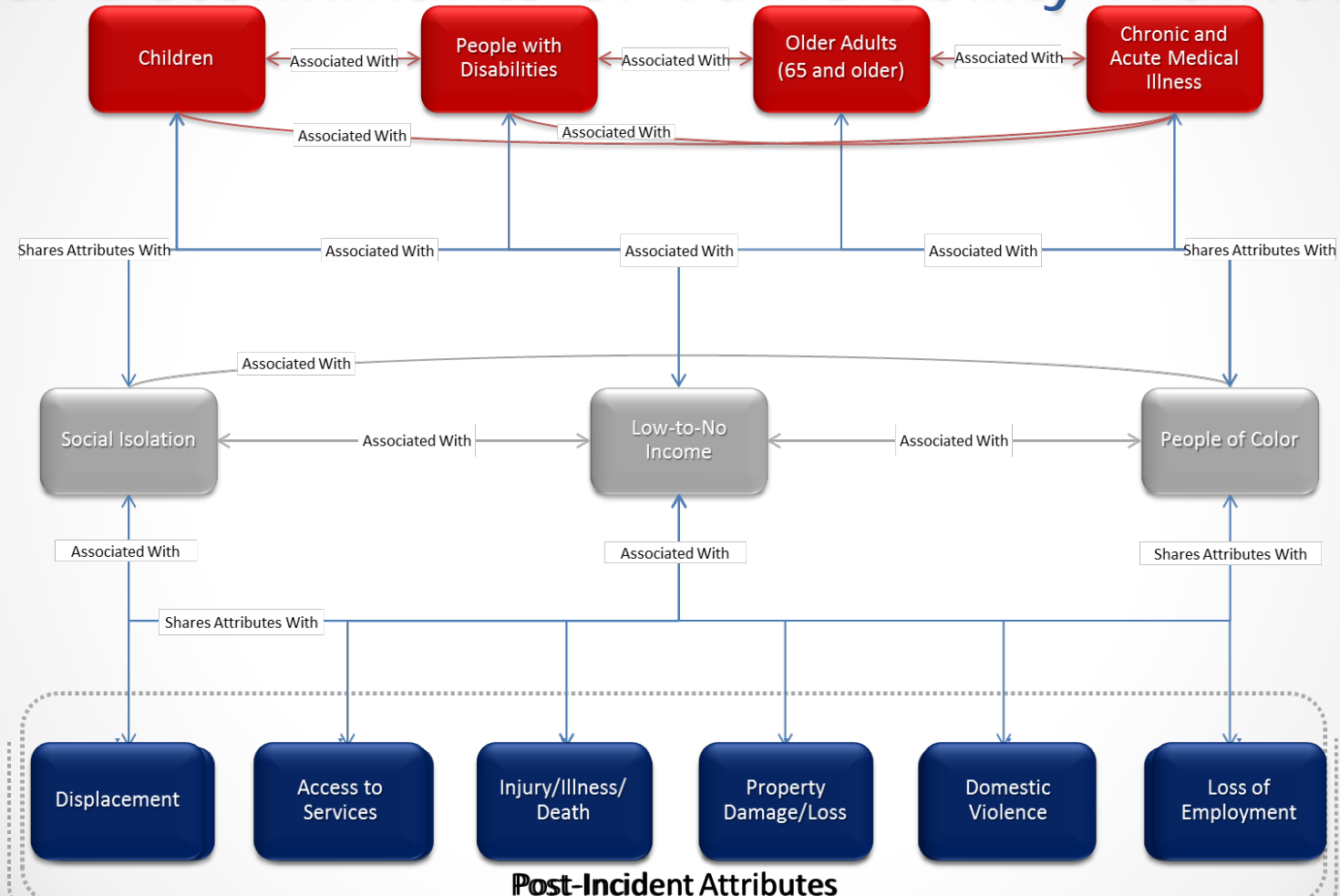
# Socially Vulnerable Populations



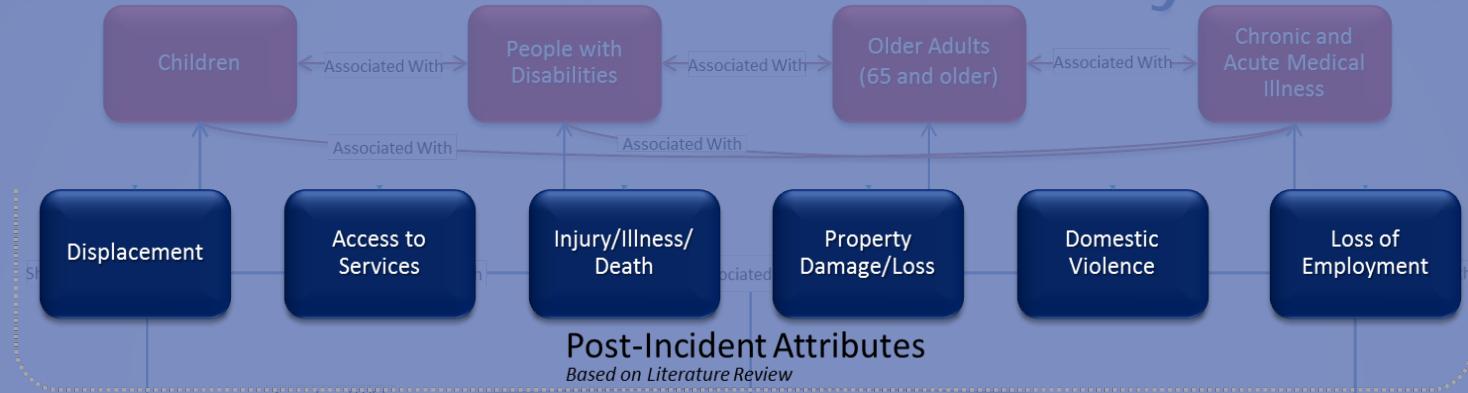
# Link Analysis of Pre-Incident & Post-Incident Attributes from Literature Review



# Social Determinants of Vulnerability Framework



# Social Determinants of Vulnerability Framework



- Types of consequences resulting from an emergency
- People who are socially vulnerably are more likely to experience at disproportionate levels.



Post-Incident Attributes



# Model of Social Isolation in Boston

**Table 4: Model of Social Isolation in the Boston, MA**  
Model Summary

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .975 <sup>a</sup> | .951     | .949              | 59.837                     |

a. Predictors: (Constant), OCC\_RENTER, TotChild, OlderAdult, LessThanHS, Women, Low\_to\_No, POC2, NoVehicle, TotDis, MedIllnes

Coefficients<sup>a</sup>

| Model      |            | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|------------|------------|-----------------------------|------------|---------------------------|--------|------|
|            |            | B                           | Std. Error | Beta                      |        |      |
| 1          | (Constant) | 16.534                      | 10.937     |                           | 1.512  | .132 |
|            | TotDis     | .164                        | .042       | .167                      | 3.872  | .000 |
|            | TotChild   | .247                        | .021       | .428                      | 11.560 | .000 |
|            | OlderAdult | .271                        | .036       | .249                      | 7.608  | .000 |
|            | Low_to_No  | -.050                       | .015       | -.132                     | -3.379 | .001 |
|            | LessThanHS | -.084                       | .027       | -.100                     | -3.127 | .002 |
|            | POC2       | .040                        | .008       | .215                      | 5.217  | .000 |
|            | Women      | -.065                       | .031       | -.181                     | -2.089 | .038 |
|            | MedIllnes  | .055                        | .044       | .127                      | 1.251  | .213 |
|            | NoVehicle  | -.028                       | .029       | -.041                     | -.965  | .336 |
| OCC_RENTER | .241       | .028                        | .484       | 8.483                     | .000   |      |

a. Dependent Variable: SocIsol

# Model of Social Isolation in Boston

Over 95% Variability Explained

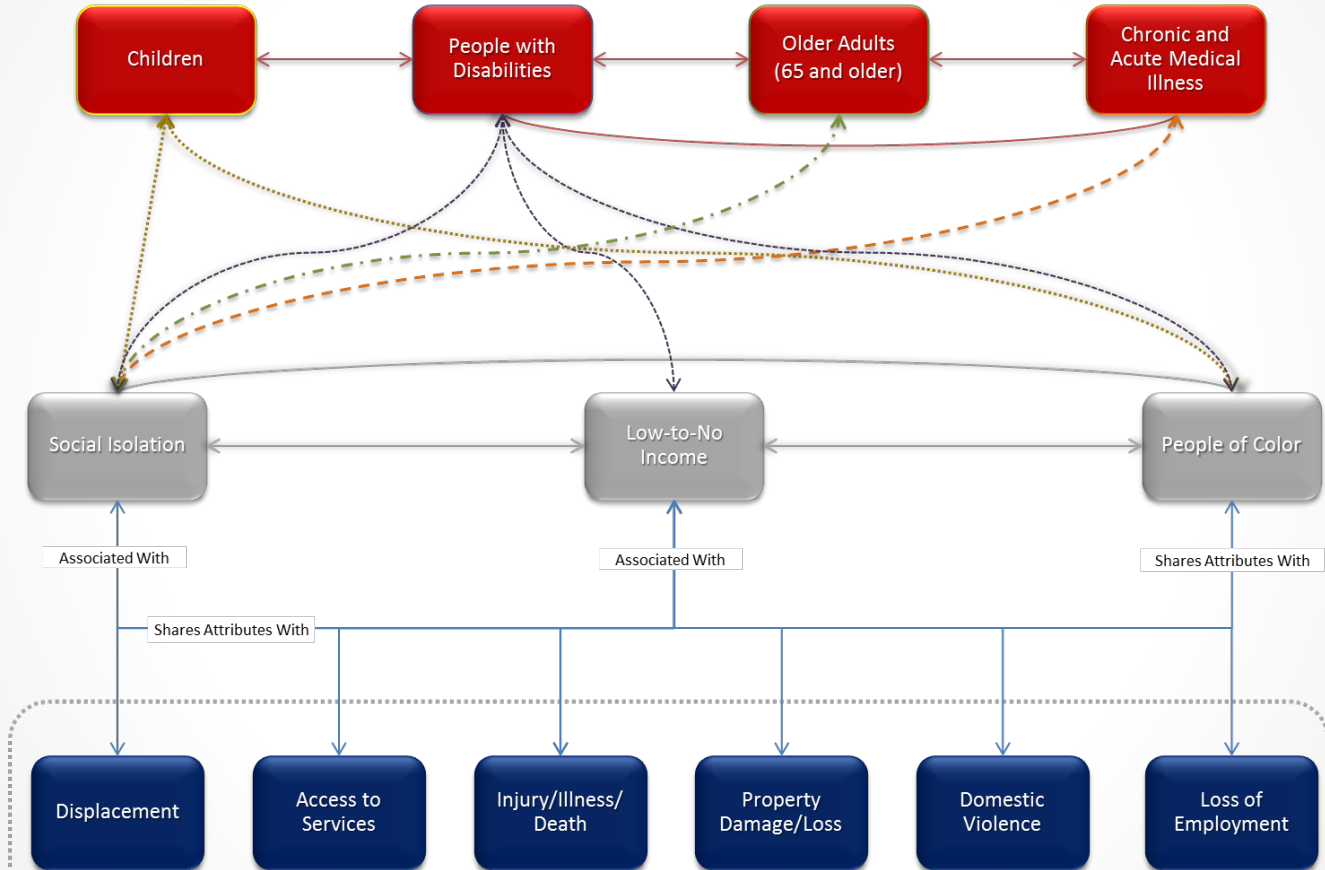
- People with Disabilities
- Children
- Older Adults
- Low-to-No Income
- Less than High School Education
- People of Color
- Women
- Renters

| Model |                          | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|--------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                          | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)               | 16.534                      | 10.937     |                           | 1.512  | .132 |
|       | Low to No Income         | -.164                       | .042       | .167                      | 3.872  | .000 |
|       | LessThanHS               | -.247                       | .021       | -.428                     | 11.560 | .000 |
|       | OlderAdult               | .271                        | .036       | .249                      | 7.608  | .000 |
|       | Women                    | -.050                       | .015       | -.132                     | -3.379 | .001 |
|       | People of Color          | -.084                       | .027       | -.100                     | -3.127 | .002 |
|       | Children                 | -.065                       | .031       | -.181                     | -2.089 | .038 |
|       | People with Disabilities | .055                        | .044       | .127                      | 1.251  | .213 |
|       | Renters                  | -.028                       | .029       | -.041                     | -.965  | .336 |
|       | Other                    | -.241                       | .028       | -.484                     | 8.483  | .000 |

a. Dependent Variable: SocIsol

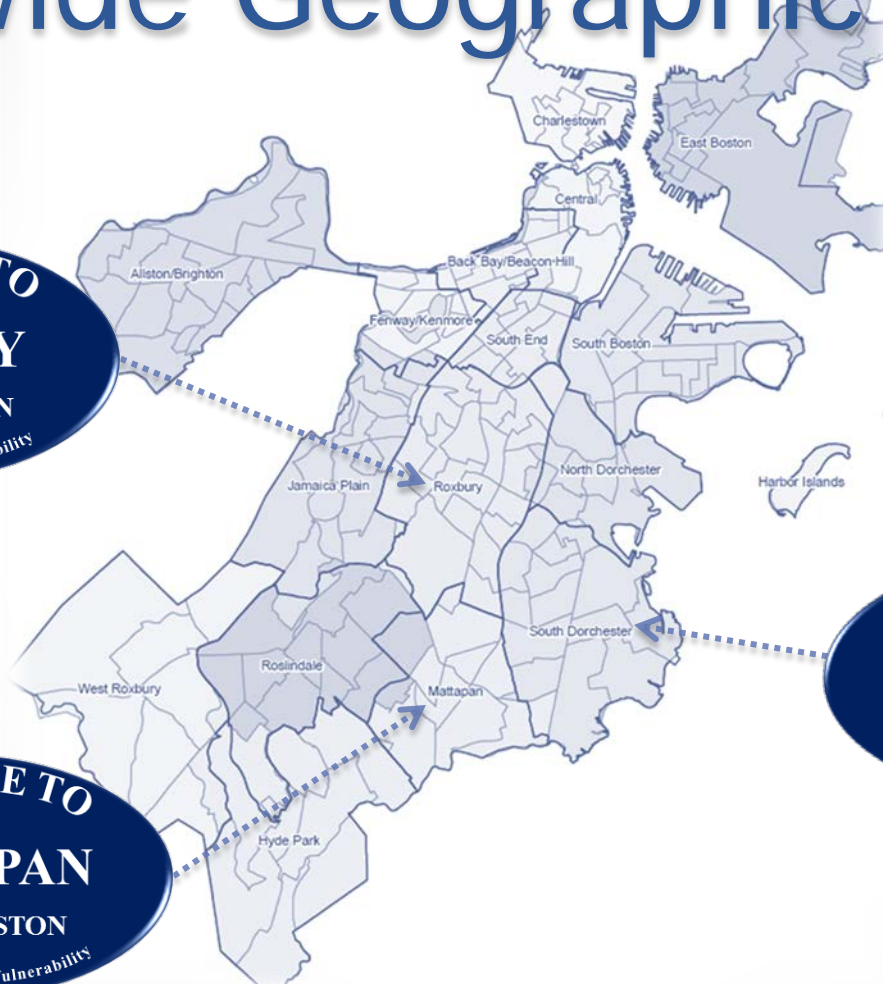


# Social Determinants of Vulnerability for Boston



Post-Incident Attributes  
*Based on Literature Review*

# Citywide Geographic Analysis



Social Isolation

Low-to-No Income

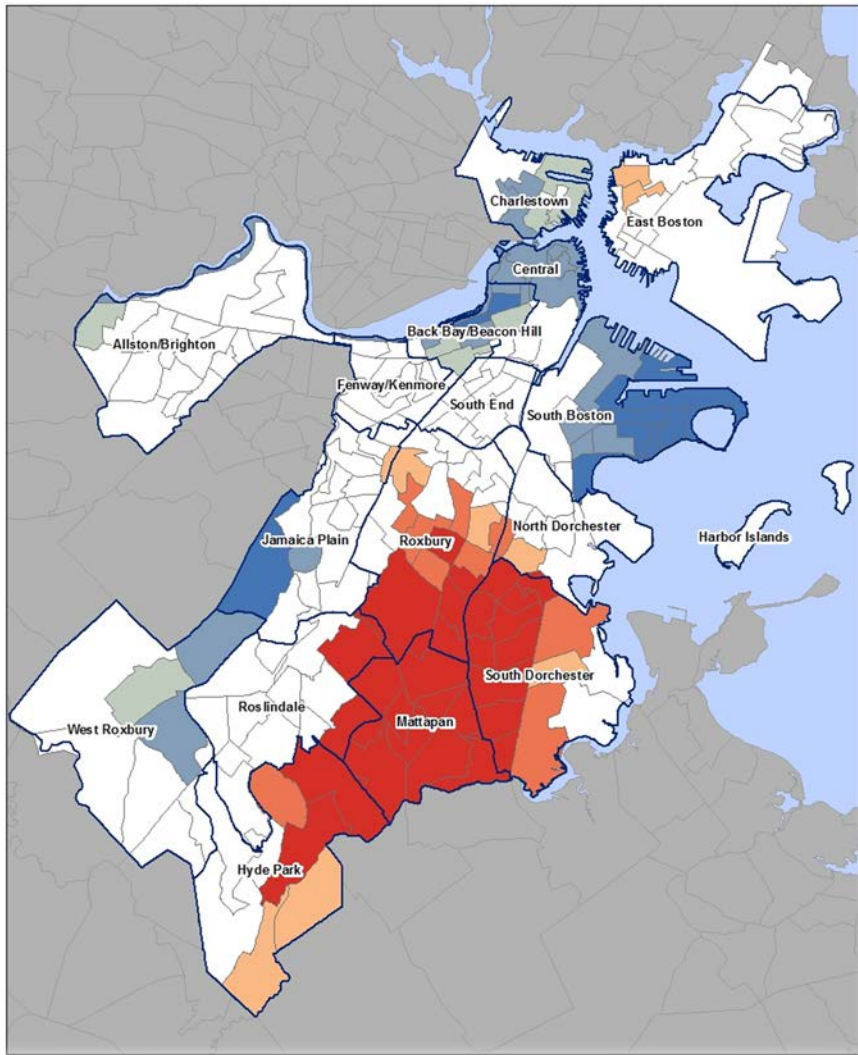
People of Color

**WELCOME TO  
ROXBURY**  
CITY OF BOSTON  
*Social Determinants of Vulnerability*

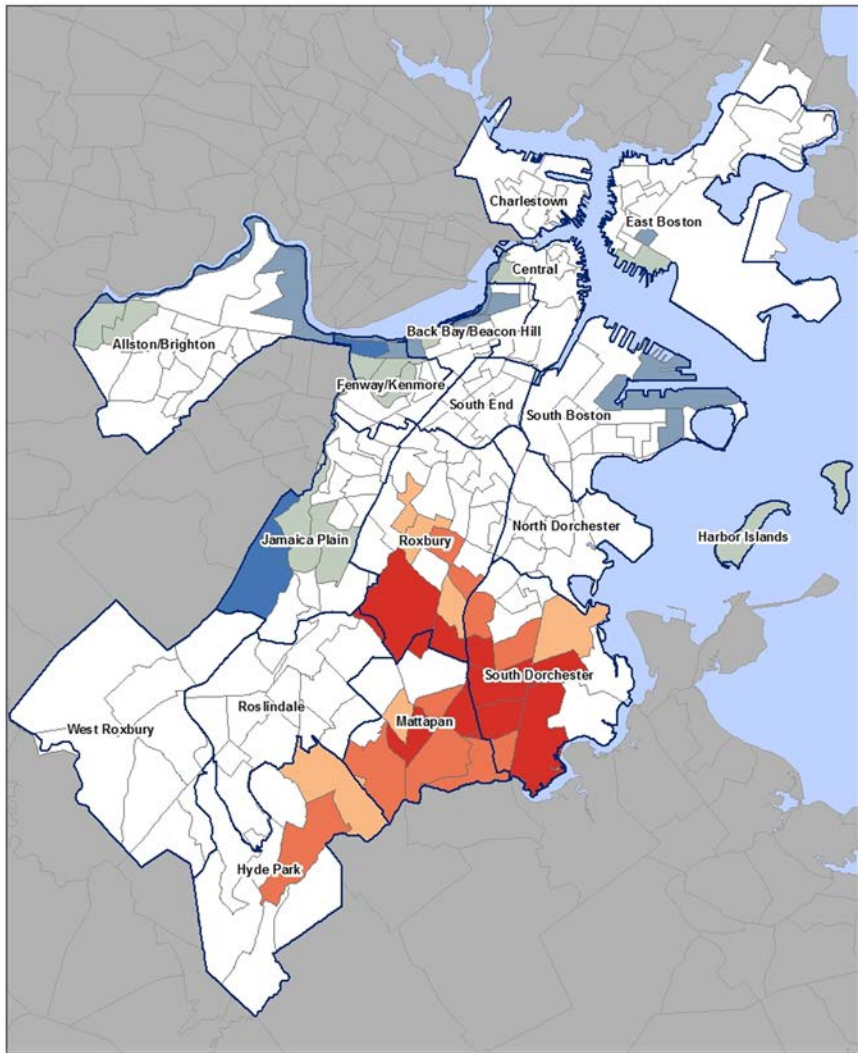
**WELCOME TO  
SOUTH  
DORCHESTER**  
CITY OF BOSTON  
*Social Determinants of Vulnerability*

**WELCOME TO  
MATTAPAN**  
CITY OF BOSTON  
*Social Determinants of Vulnerability*

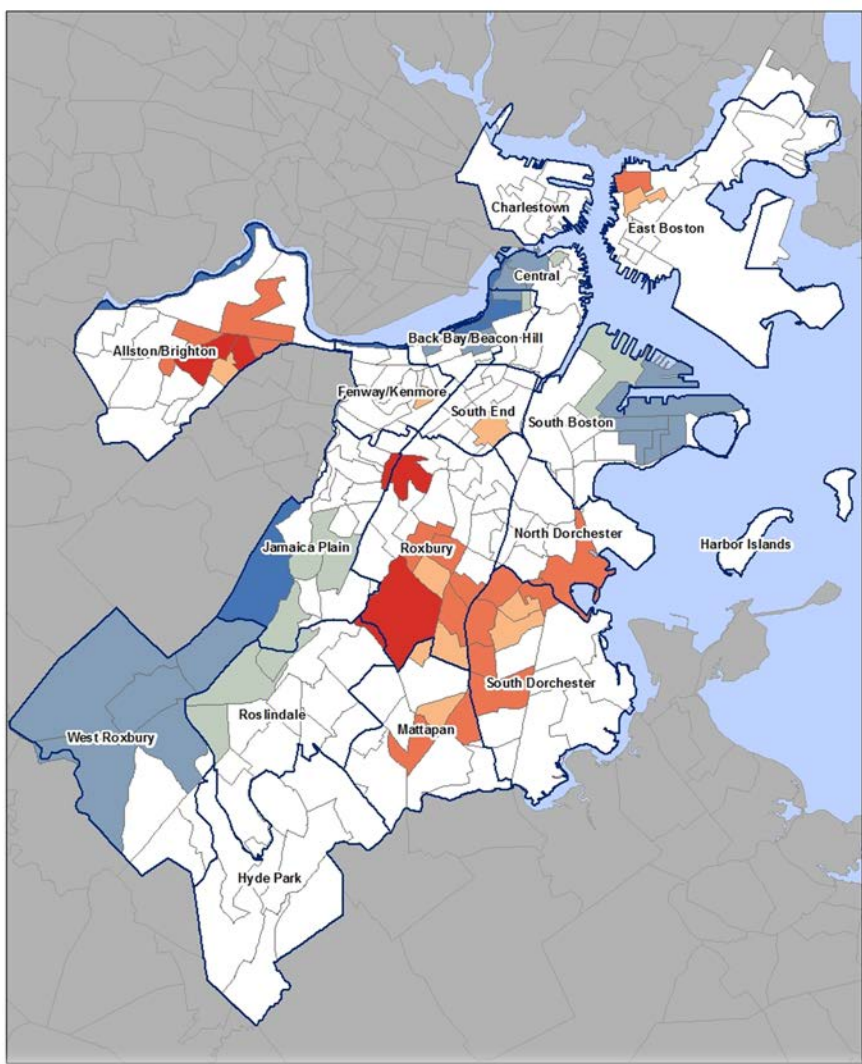
# PEOPLE OF COLOR



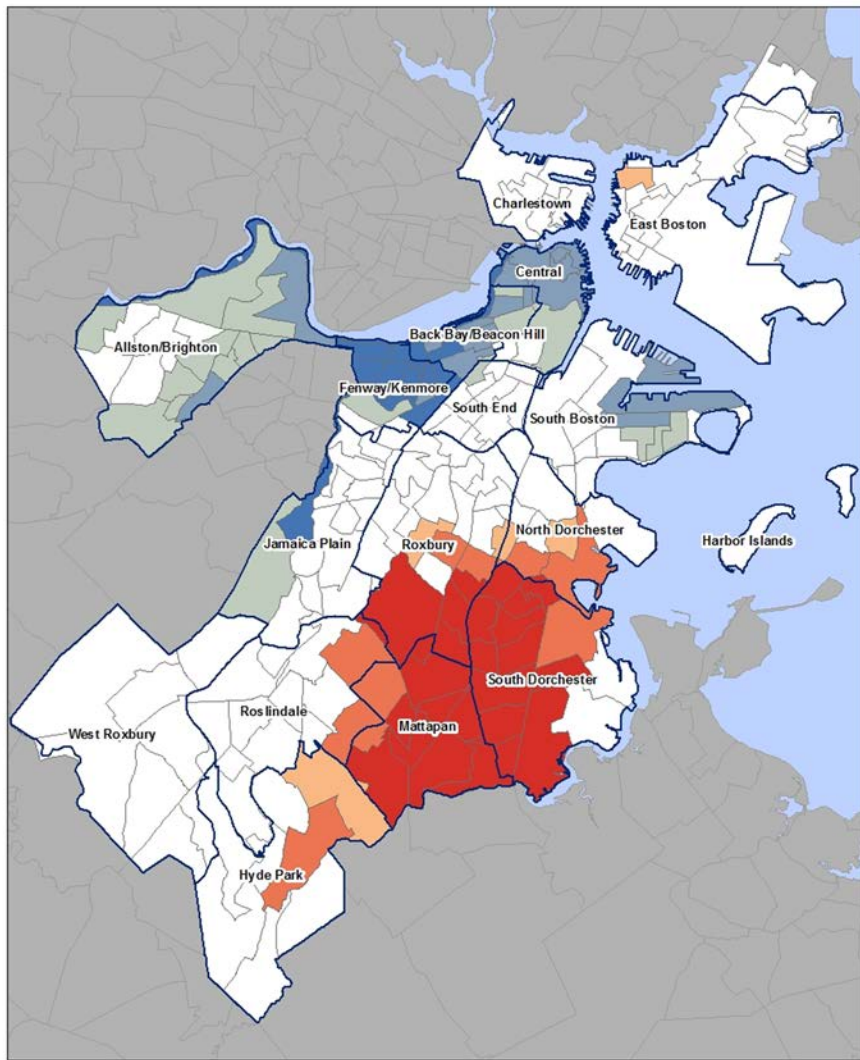
# SOCIAL ISOLATION



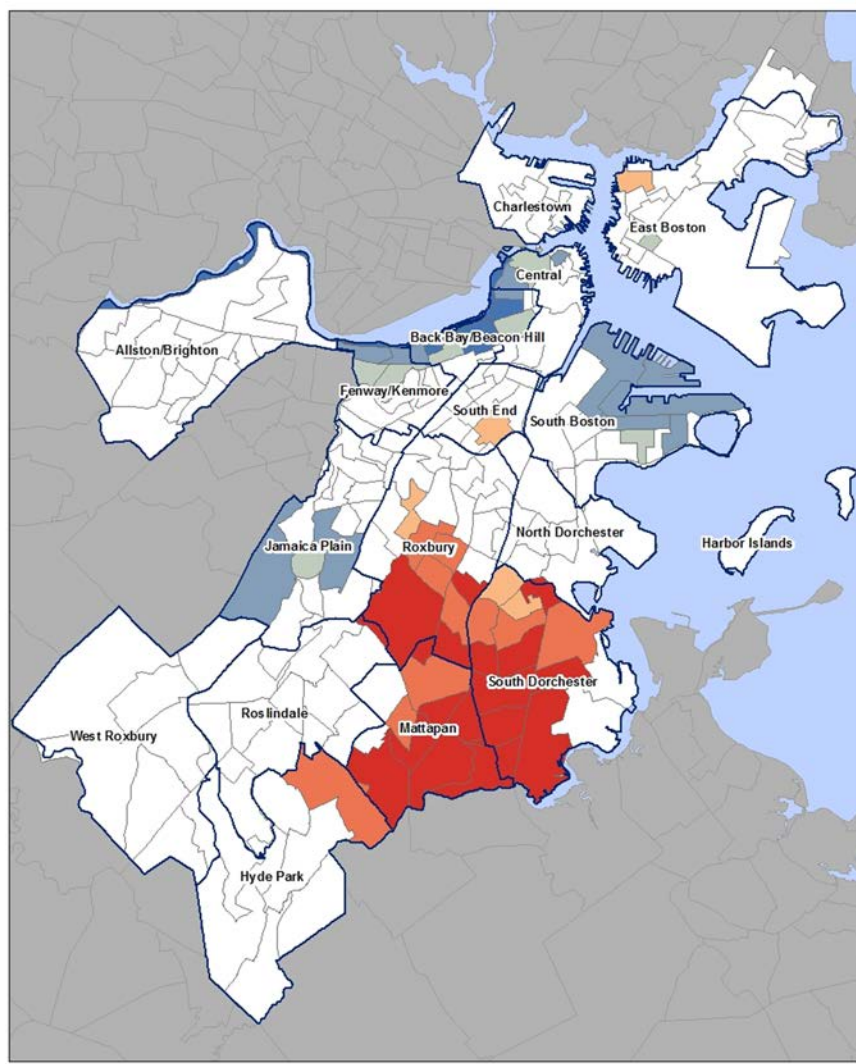
# LOW-TO-NO INCOME



# CHILDREN



# PEOPLE WITH DISABILITIES



# Emergency Management Mission Areas



Mitigation

Response

Recovery

- Risk & Disaster Resilience Assessment
- Community Resilience
- Long Term Vulnerability Reduction



# Emergency Management Mission Areas



Mitigation

Response

Recovery

- Public Information & Warning
- Mass Care Services
- Critical Transportation

# Emergency Management Mission Areas



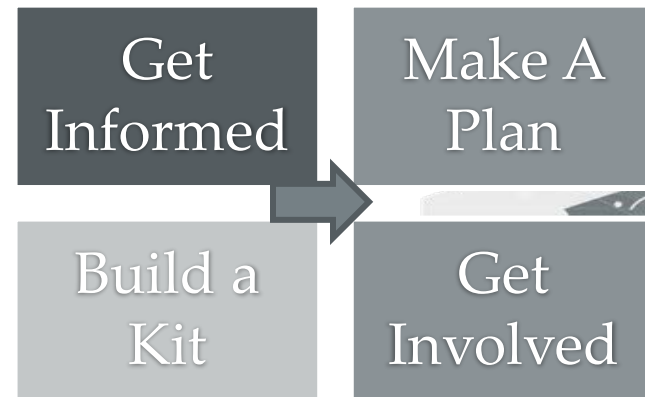
Mitigation

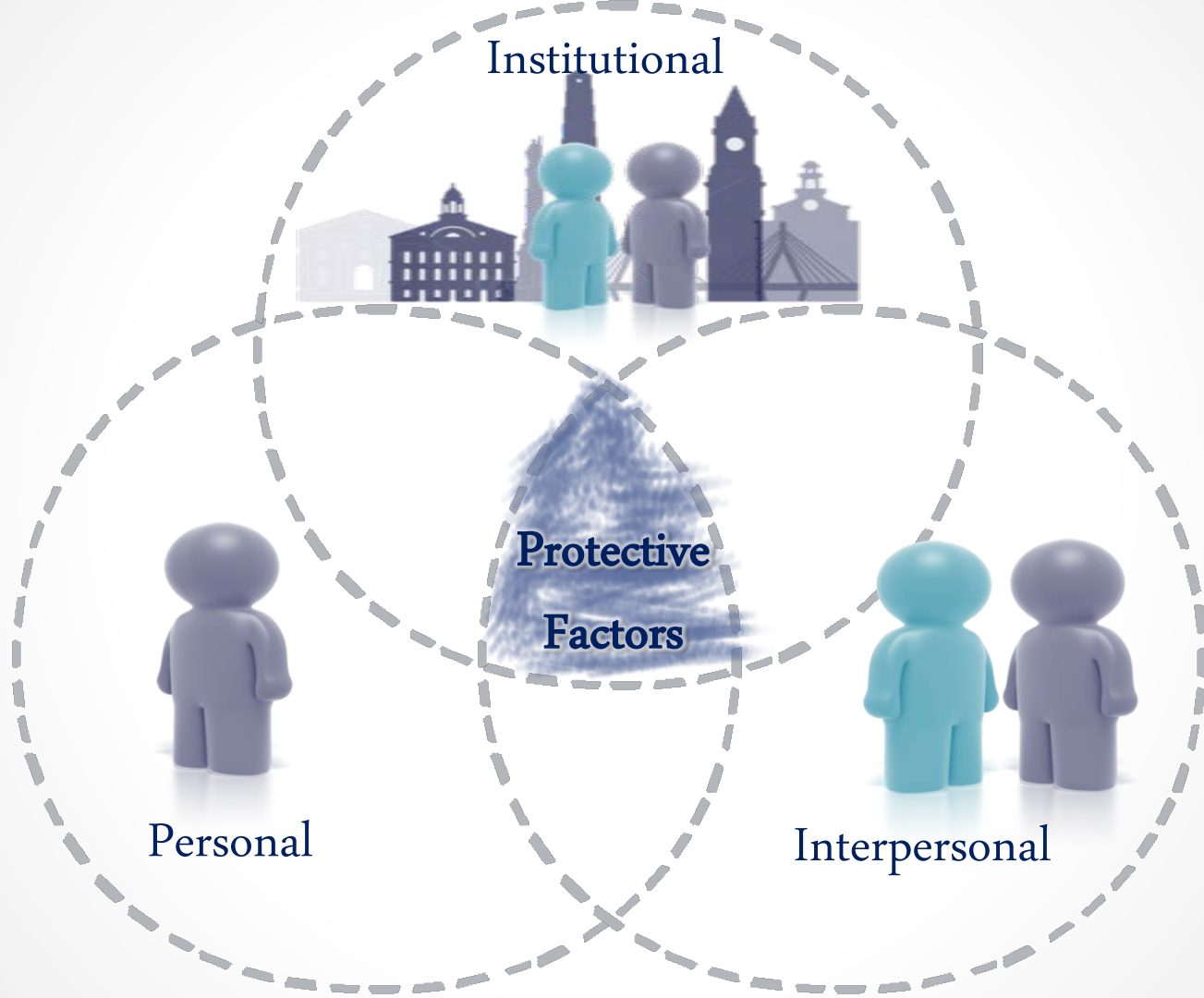
Response

Recovery

- Health & Social Services
- Housing
- Economic Recovery

# From Individual Preparedness to Communities Resilience





Institutional

Protective  
Factors

Personal

Interpersonal

# Public Health & Medical Intelligence



# Balanced Approach to Building Resilience



*Disasters fracture us  
along fault lines that  
already exist.*

--- Jim Siemianowski,  
LICSW  
April 28, 2014  
Footprints of Disaster Conference



# Geographic Information Systems (GIS) in Public Health: Supporting the Needs of People in Preparedness, Response, and Recovery

2015 Esri National Security Summit | July 19, 2015

Dr. S. Atyia Martin, CEM | [www.AtyiaMartin.com](http://www.AtyiaMartin.com) | [atyia@live.com](mailto:atyia@live.com)