Learning through principled discovery framework of monitoring social
indicators: An exploratory spatial data analysis approach

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Key research question

The Central (State) planners problem:

Consider a centralized entity (e.g. State) with multiple localities (small areas).

How can the State planner benefit from a knowledge of patterns of key health indicators?

Can a methodological tool help the State planner help identify small with *exemplary or problematic patterns of health indicators? Integrating such ideas with program planning*

How should such knowledge be used in programme planning

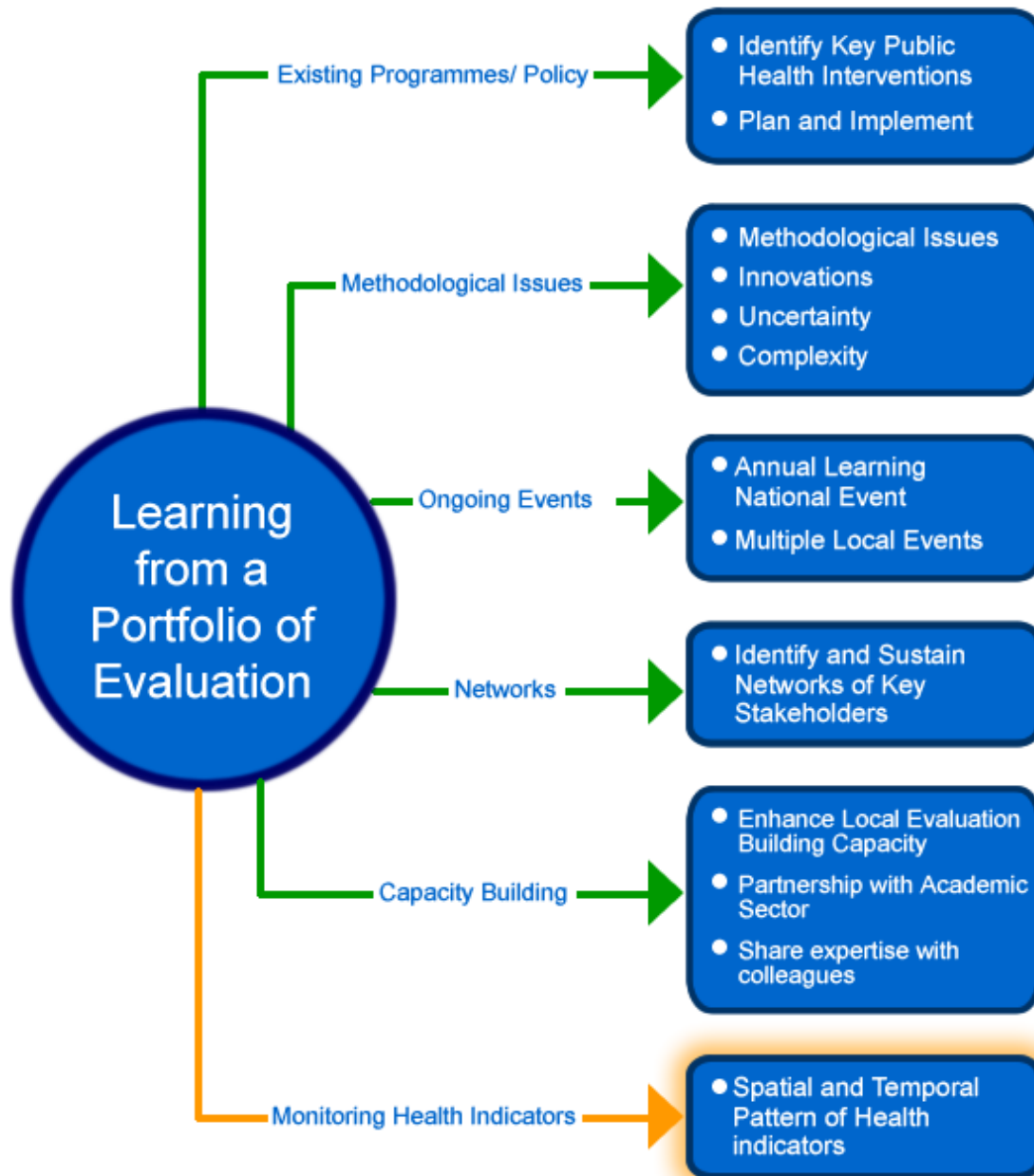*The notion of a "risk landscape"*

Risk Landscape

- Places might be part of regions that have similar levels and trajectories of social/health indicators

- Many such indicators might have similar patterns

- The focus of social/health programmes is to interrupt such trajectories

- One single social programme might not be enough to interrupt with trends in trajectories

The policy context of the problem

- Integrating Program Planning with Surveillance of Health Indicators

- NHS Health Scotland: Learning from a portfolio of evaluations

- Policy Evaluation and Appraisal (Evaluation) and the Public Health Observatory (Surveillance)

- The need for methodological tools
  - Can surveillance of health indicators inform future program planning?

- Reducing the Policy Analysts search space

- Local vs. Global patterns: How can policy makers benefit from an understanding of this tension?

Learning from a Portfolio of Evaluation

Existing Programmes/ Policy
- Identify Key Public Health Interventions
- Plan and Implement

Methodological Issues
- Methodological Issues
- Innovations
- Uncertainty
- Complexity

Ongoing Events
- Annual Learning National Event
- Multiple Local Events

Networks
- Identify and Sustain Networks of Key Stakeholders

Capacity Building
- Enhance Local Evaluation Building Capacity
- Partnership with Academic Sector
- Share expertise with colleagues

Monitoring Health Indicators
- Spatial and Temporal Pattern of Health indicators

The problem with evaluation: Lack of an understanding of ecology of interventions
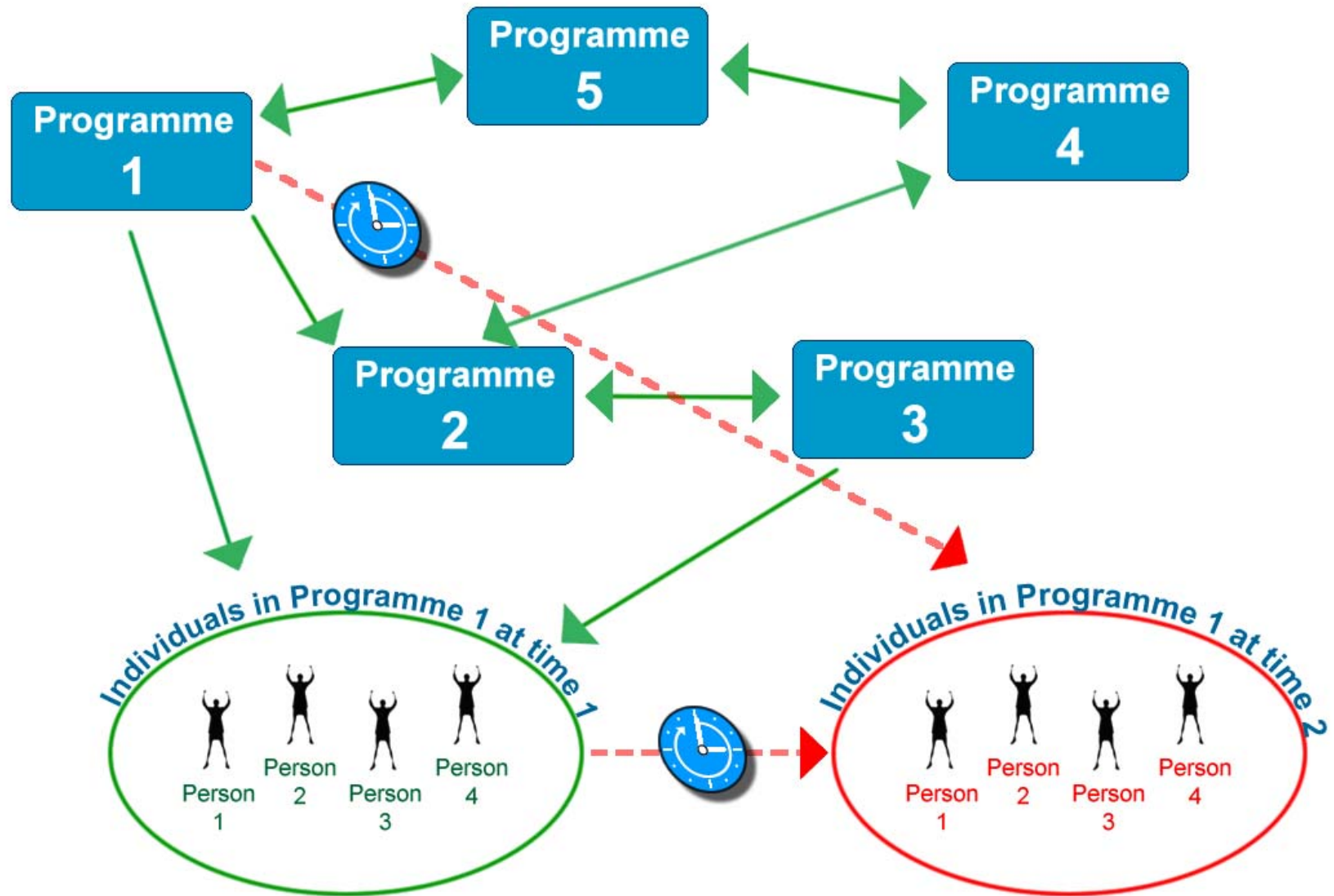
An example from Criminal Justice

- "If the primary causal mechanism underlying crime trajectories can be found in factors such as single family households, racial heterogeneity and economic deprivation, all linked to the social disorganization perspective, *then a much wider set of social interventions would be required to change the form of trajectories at crime hot spots…a complex combination of interventions might be required to have a meaningful and long term impact on crime as hot spots."* (Weisburd et al., 2004)

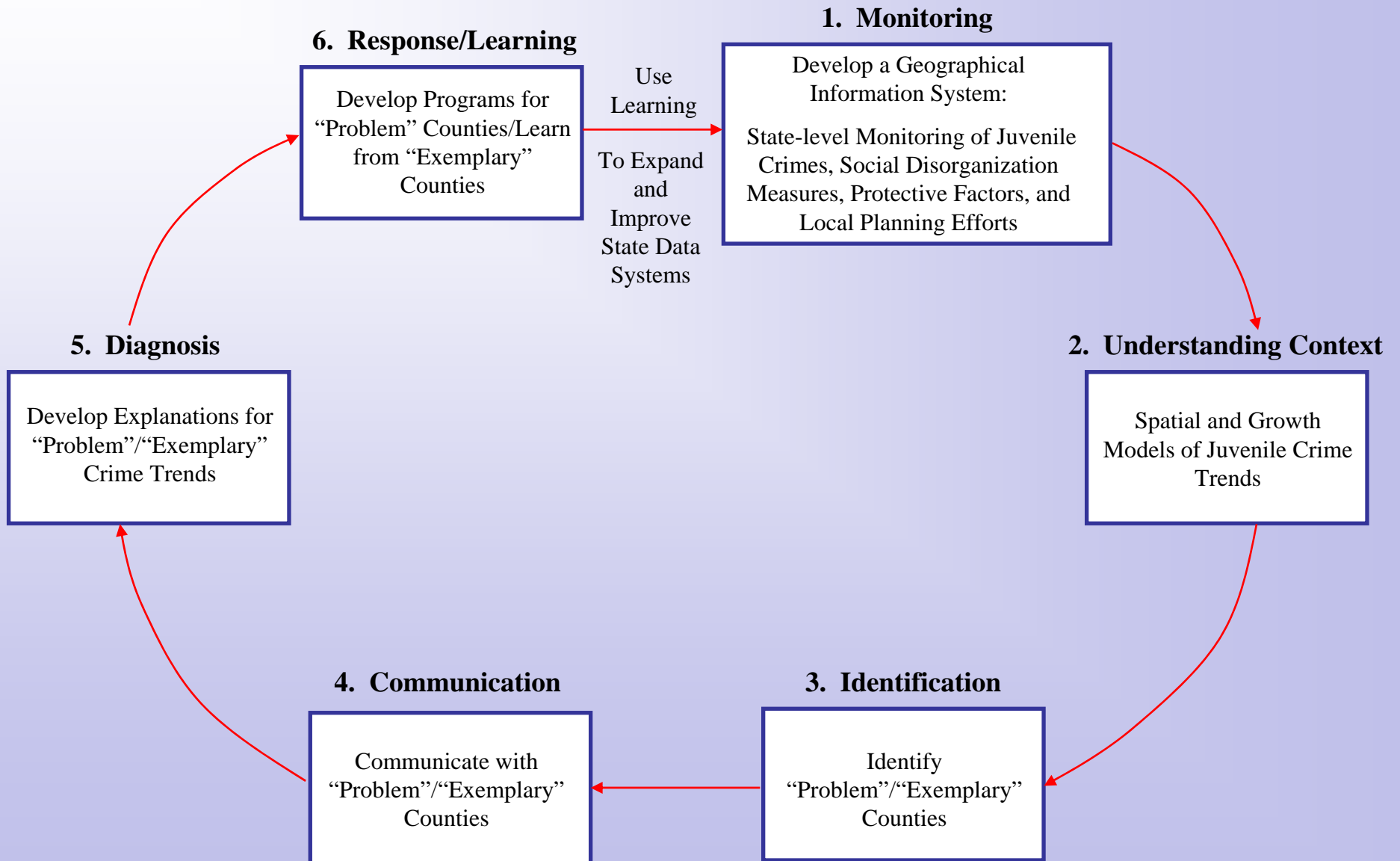# Possible explanations for focus on singular interventions

- Separate funding streams that do not encourage a focus on interactions between programmes and integrated outcomes;

- Evaluation funding periods tend to be tied to short-term implementation funding cycles;

- Methodological problems of capturing the dynamics of change across a number of areas within a wider system and possible unintended or detrimental effects.

Possible solutions

- Learn from places with interesting changes in trends/or levels of health indicators
- Focus on both spatial and temporal patterns
- "Patterns different from expectations" (in a cross-sectional and longitudinal sense)
- The focus today is primarily on levels of health indicators

The Proposal: Integrating Planning, Evaluation and Programmes

6. Response/Learning

Develop Programs for "Problem" Counties/Learn from "Exemplary" Counties

Use Learning

To Expand and Improve State Data Systems

1. Monitoring

Develop a Geographical Information System:

State-level Monitoring of Juvenile Crimes, Social Disorganization Measures, Protective Factors, and Local Planning Efforts

5. Diagnosis

Develop Explanations for "Problem"/"Exemplary" Crime Trends

2. Understanding Context

Spatial and Growth Models of Juvenile Crime Trends

4. Communication

Communicate with "Problem"/"Exemplary" Counties

3. Identification

Identify "Problem"/"Exemplary" Counties

Outline of Presentation

(1) Claims

(2) Introduce some basic ideas of exploratory spatial data analysis – focus especially on the tension between the global and the local patterns of health indicators

(3) Example

Key claims

- Spatial patterns can help identify "interesting" patterns that provide potential for learning

- Central program planners can "learn" from a spatial analysis of health indicators to inform future programs

Illustrative example

- Focus on deprivation as the primary cause

- Example of distribution of all-cause mortality

- Strong relationship between deprivation and mortality rates; identify areas that "buck" the spatial pattern; learn from such areas; examine if there are opportunities to "learn" from such places;

- Substantive issues: "Scottish Effect" and notions of resilience

Analysis of spatial patterns of mortality

- Global pattern: Is there overall spatial patterning in mortality?

- Local patterns: Where are the local patterns especially strong? Which of these localities are most "interesting" in a spatial sense? Can such patterns be explained due to structural factors (in this example: deprivation) or are innovative interventions implicated?

The Scottish Effect

- The term 'Scottish effect' has been used to describe unexplained 'excess' poor health in Scotland relative to England and Wales after 'controlling' for area levels of deprivation.

- The term implies that there is currently a 'missing factor' in our understanding of public health in Scotland. Limited clarity on the nature of the 'missing factor.'

Evidence for a spatial perspective

- It is notable that Scotland not only has higher average mortality rates than England and Wales but also the largest concentrations of the very poorest health areas.

- Seven of the ten highest mortality rate parliamentary constituencies in Britain during the 1990s located in Scotland, all in Glasgow
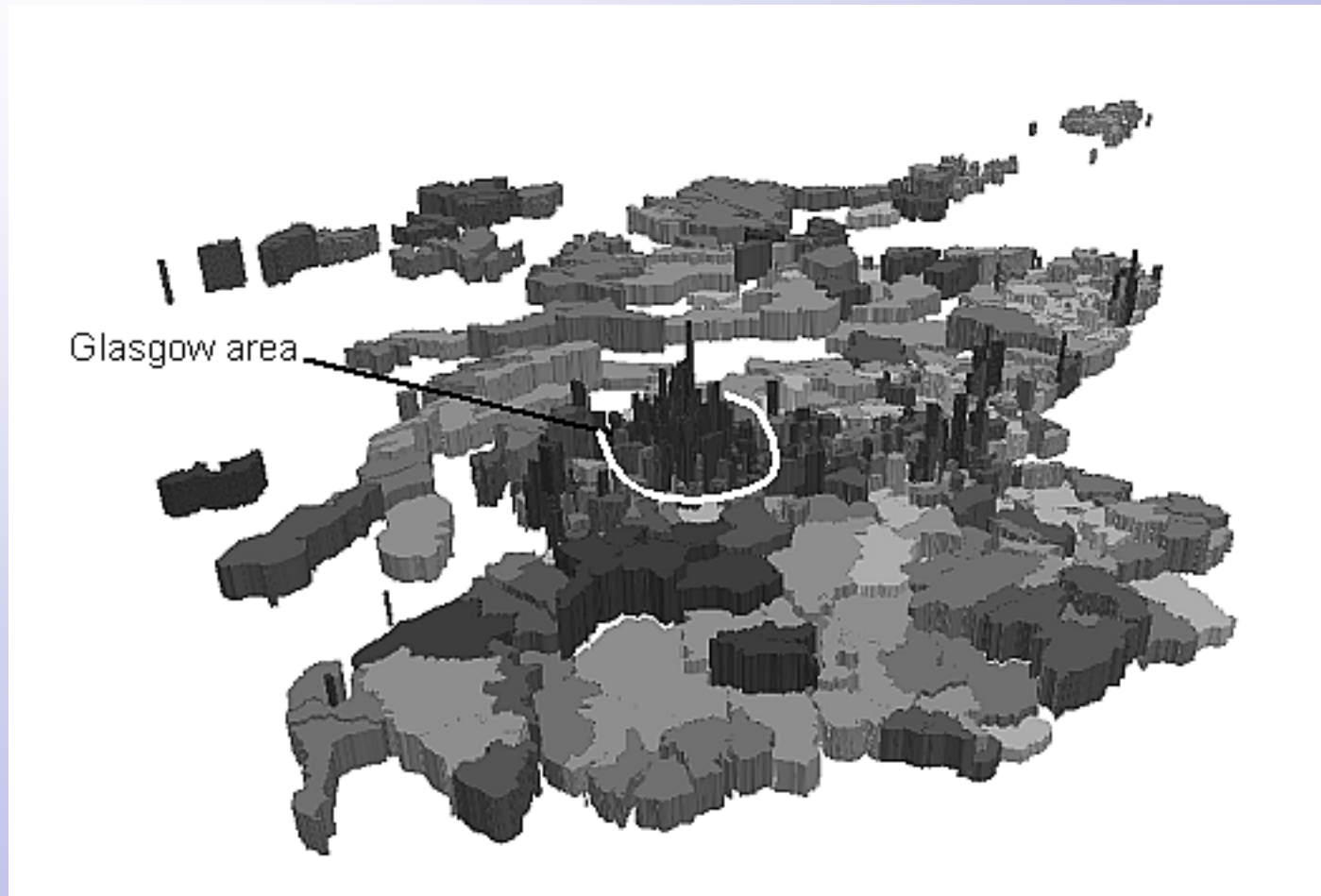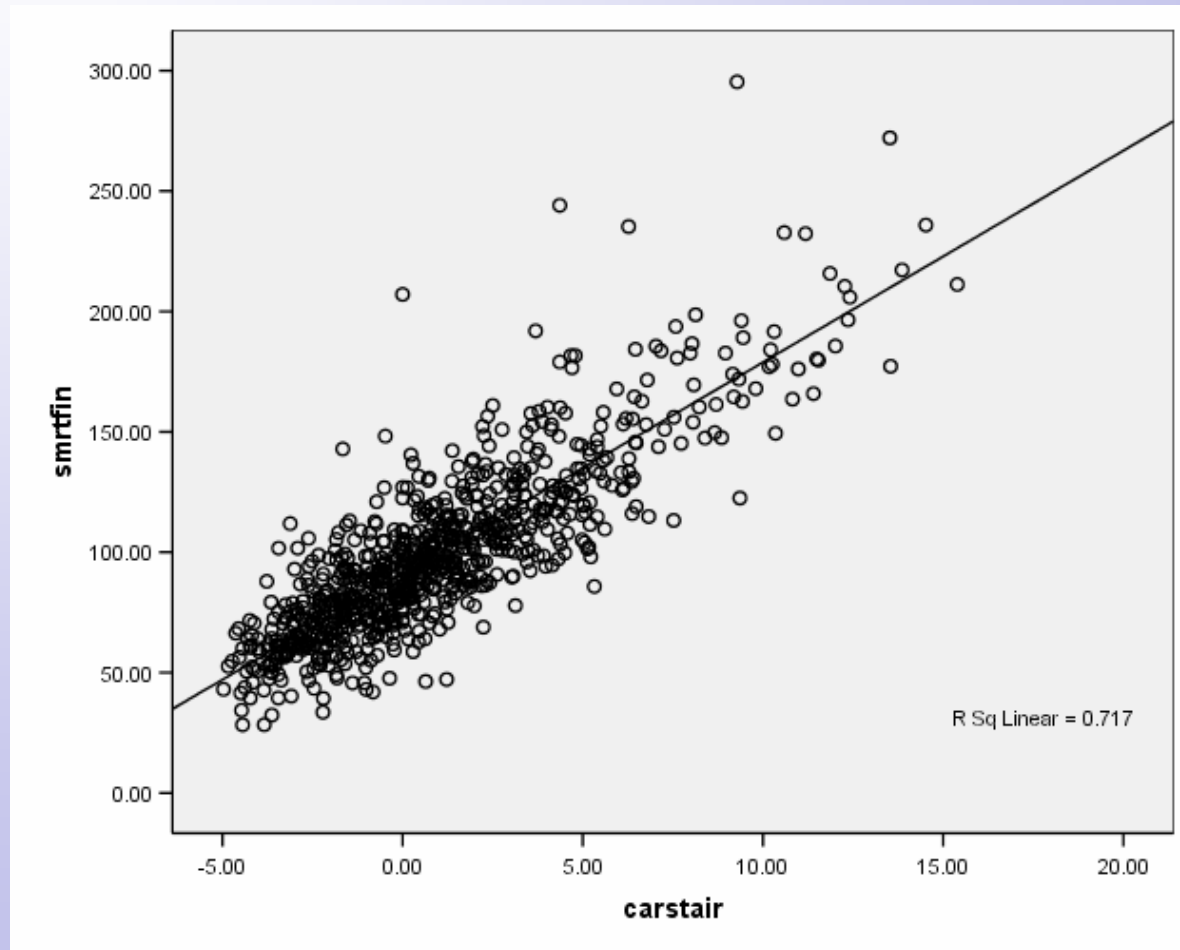
Distribution of Standardized Mortality Ratio

Scotfino.shp
0 - 28.35
28.35 - 66.77
66.77 - 91.17
91.17 - 121.06
121.06 - 164.56
164.56 - 244.07
244.07 - 670.06
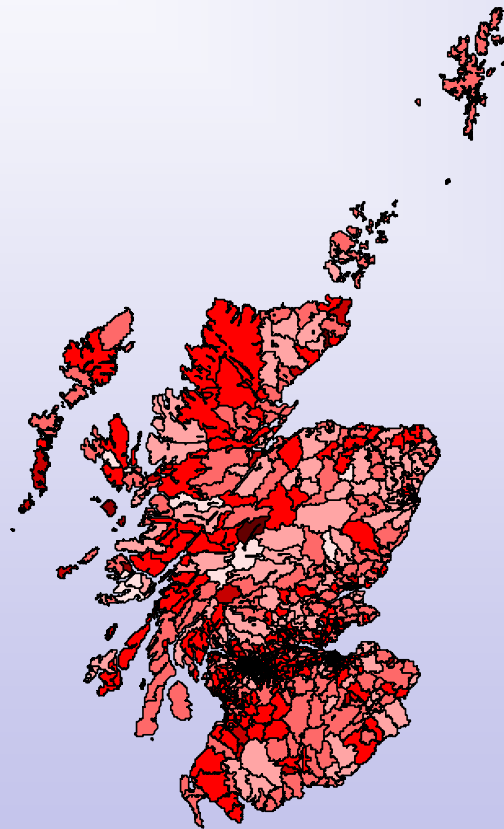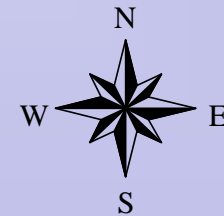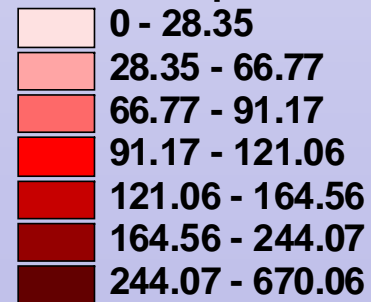
3-D rendering of SMR shaded by Carstairs score

Glasgow area

Relationship between deprivation and mortality

Methods: Exploratory Spatial Data Analysis

- Global spatial patterns examine the average spatial relationship across all of the units. Local spatial patterns examine the spatial patterning in specific areas

- *The challenge of defining "neighbors."*

- Spatial connectivity at the postcode sector level

The Challenge of operationalizing spatial contiguity: What are the neighbors of 5? (Anselin,1997)

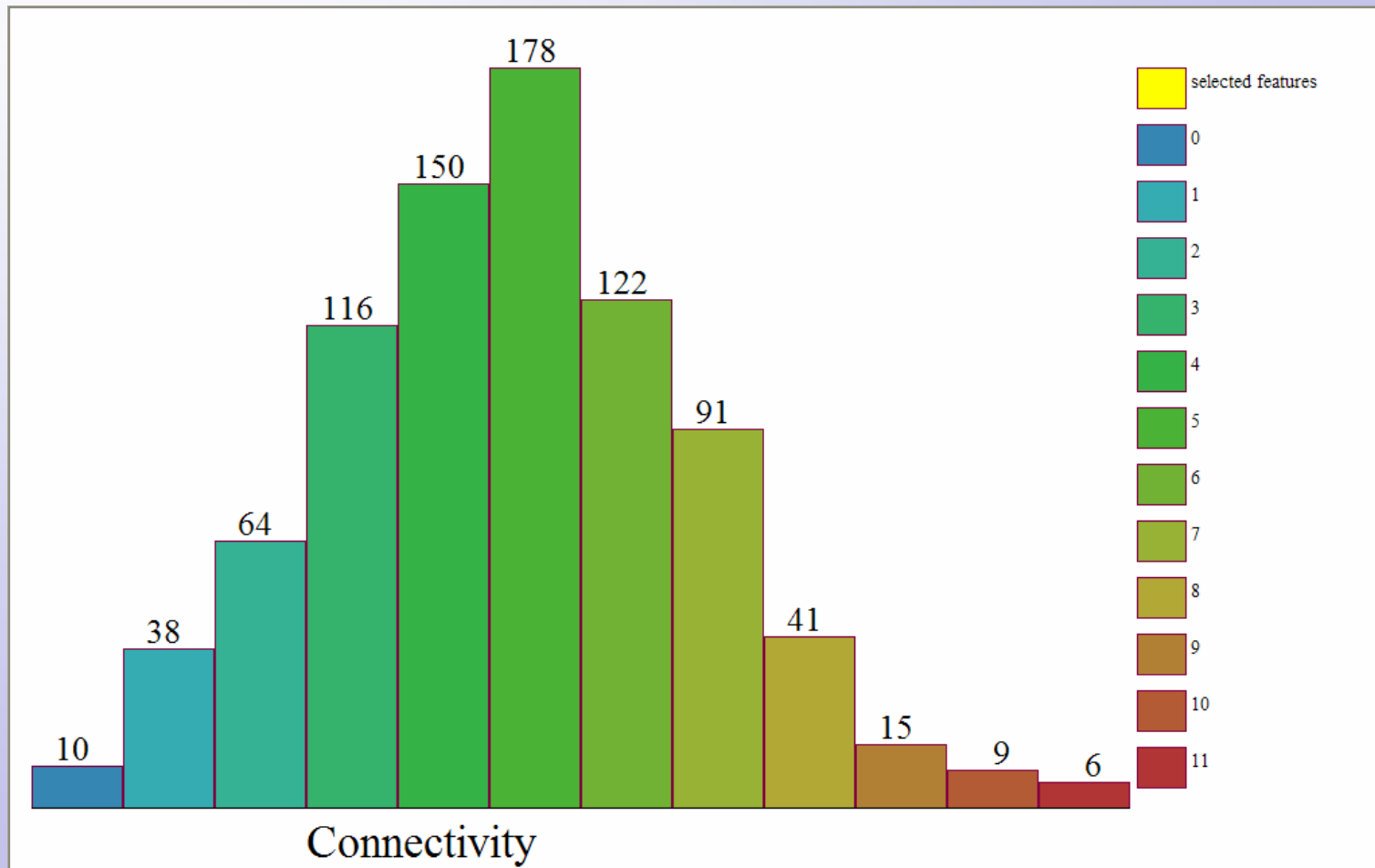|		
1	2	3
4	5	6
7	8	9

Rook Criteria: 2,4,6,8
Bishop Criteria: 1, 3, 7, 9
Queen Criteria: 1,2,3,4,6, 7, 8, 9

A typology of spatial patterns

- Analysis to help identify patterns: towards a typology of patterns
- A typology of five clusters:
  - Not significant
  - High-High
  - Low-Low
  - High-Low
  - Low-High
- Why is this relevant from a policy perspective?

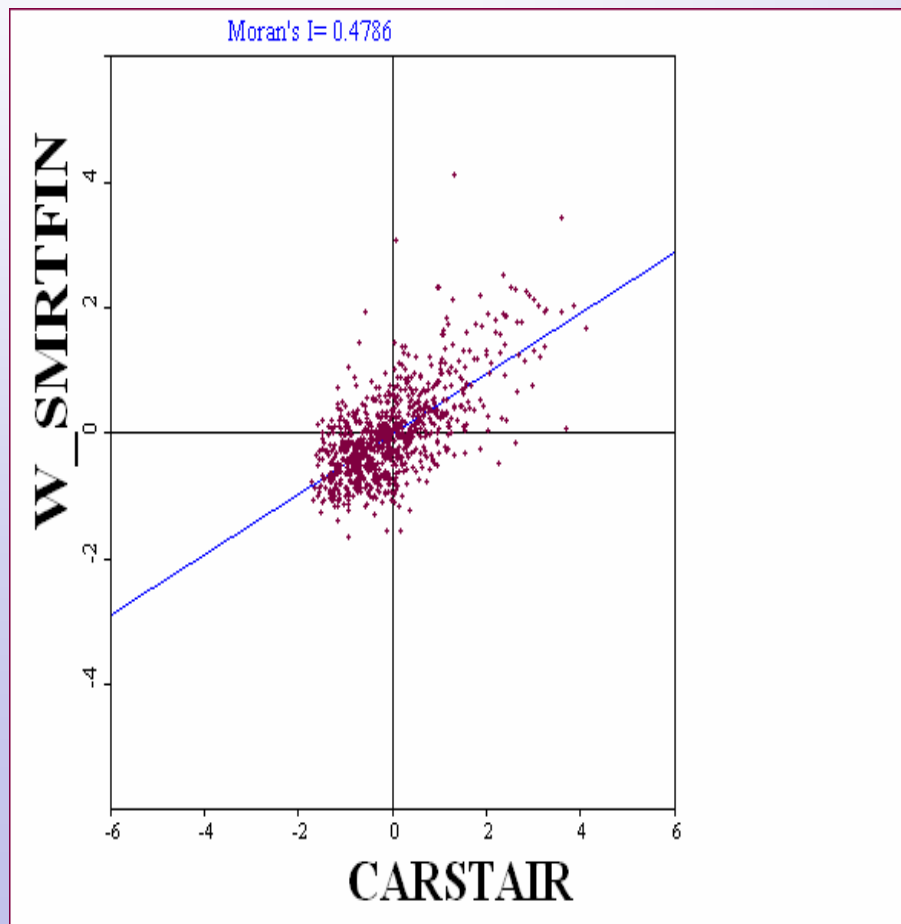# Results: Connectivity at the post-code sector level

Results: Global patterns in mortality rates

Moran's I= 0.4895
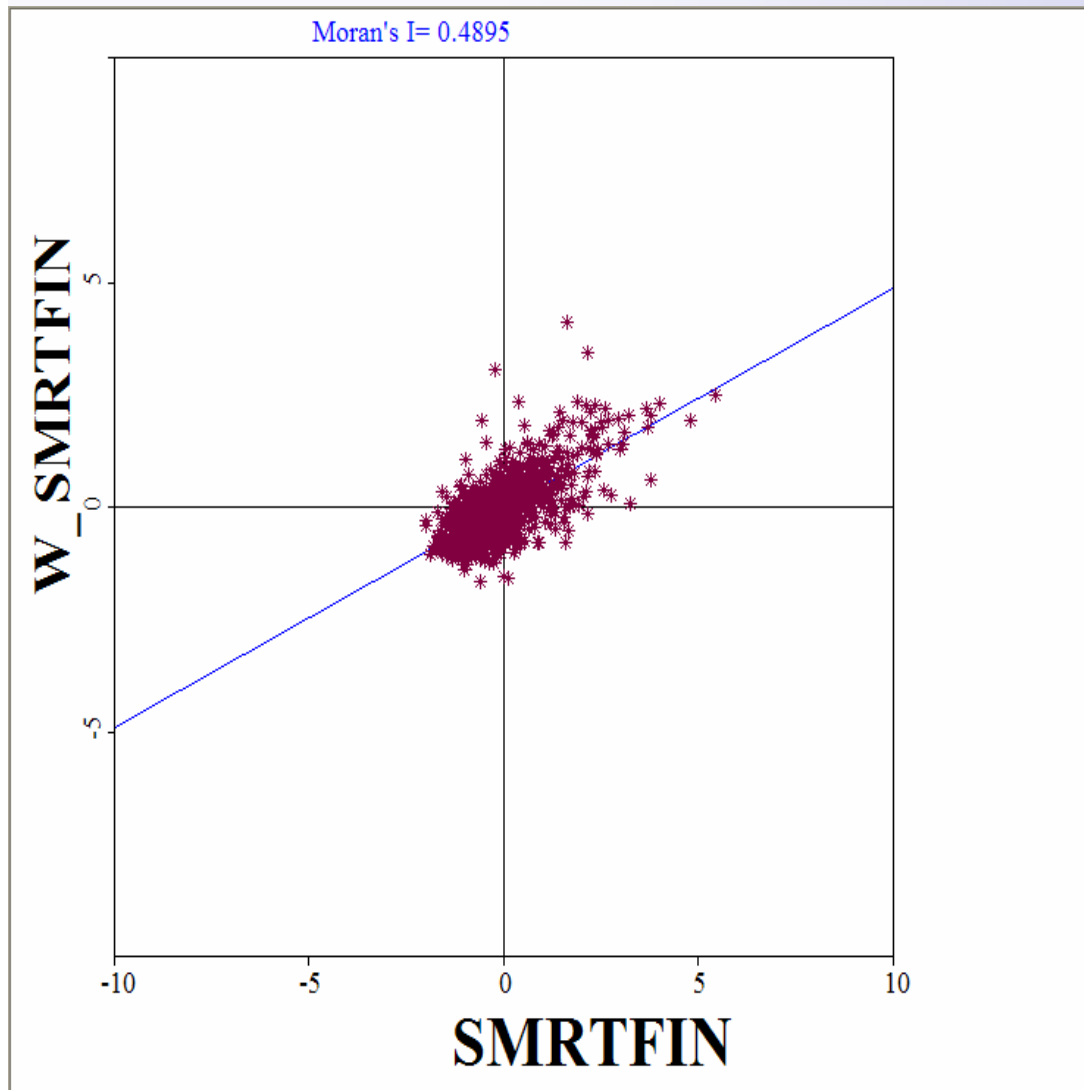
- Evidence of clustering in mortality rates
- This result is statistically significant (p < 0.001)

Global spatial relationship between deprivation and mortality

- Evidence of a spatial relationship between deprivation and mortality

- This relationship is statistically significant (p<0.001)

Cross-tabulations between the spatial typologies of postcode sector Carstairs scores and SMR

		Spatial typology for Carstairs score					
		Not Significant	High-High	Low-Low	Low-High	High-Low	Total
Spatial typology for SMR	Not Significant	536	13	28	5	2	584
	High-High	25	74	0	1	0	100
	Low-Low	40	0	79	0	4	123
	Low-High	2	2	0	13	0	17
	High-Low	6	0	7	0	3	16
	Total	609	89	114	19	9	840

Looking a little more deeply…

- Multiple possibilities:
  - Problems with data
  - Recent demographic shifts in the population
  - Innovative community interventions

'Anomalies'

- 14 'anomalous' postcode sectors in total

- High mortality
  despite low deprivation
  but high mortality & high deprivation neighbours (1 postcode sector)

- High mortality
  despite low deprivation
  plus low deprivation & low mortality neighbours (7 postcode sectors)

- Low mortality
  despite high deprivation
  plus high deprivation & high mortality neighbours (2 postcode sectors)

- Low mortality
  despite high deprivation
  but low mortality & low deprivation neighbours (4 postcode sectors)

Preliminary explanations?

- Tentative because of…

- small numbers of deaths in small areas

- & small numbers of anomalies

- random variation likely to have a large effect…

Some possible explanations for anomalies

- **Heterogeneous populations**
  - pockets of healthy populations within deprived, unhealthy areas
    - e.g. University populations in inner urban areas
  - pockets of unhealthy population within affluent, healthy areas
    - e.g. nursing home populations in suburban and rural areas

- **'Border' areas between high and low deprivation areas**
  - health of populations in areas with high deprivation bordering areas with lower deprivation may benefit from their neighbours status
    - e.g. deprived, suburban fringe areas

- **Artefact**
  - miscoding of place of residence on death certificate
    - e.g. hospital address not home address

Further investigation of anomalous areas

- **Further death data**
  - death rates by age & cause over longer time periods

- **Socio-economic structure of populations**
  - e.g. social class composition

- **Border zones between high and low deprivation and mortality areas**
  - where are these border zones located & what are their characteristics?

Examples…..

G1 1 – University campus centre of Glasgow

- Low mortality
  despite high deprivation
  plus high deprivation & high mortality neighbours

- G1 1 contains University of Strathclyde, John Anderson Campus

- Beneficial '**higher education effect**'? – university attracting healthy, young migrants to this postcode sector?

- 74% of population in this postcode sector is aged 15-35 years

G1 1 – centre of Glasgow
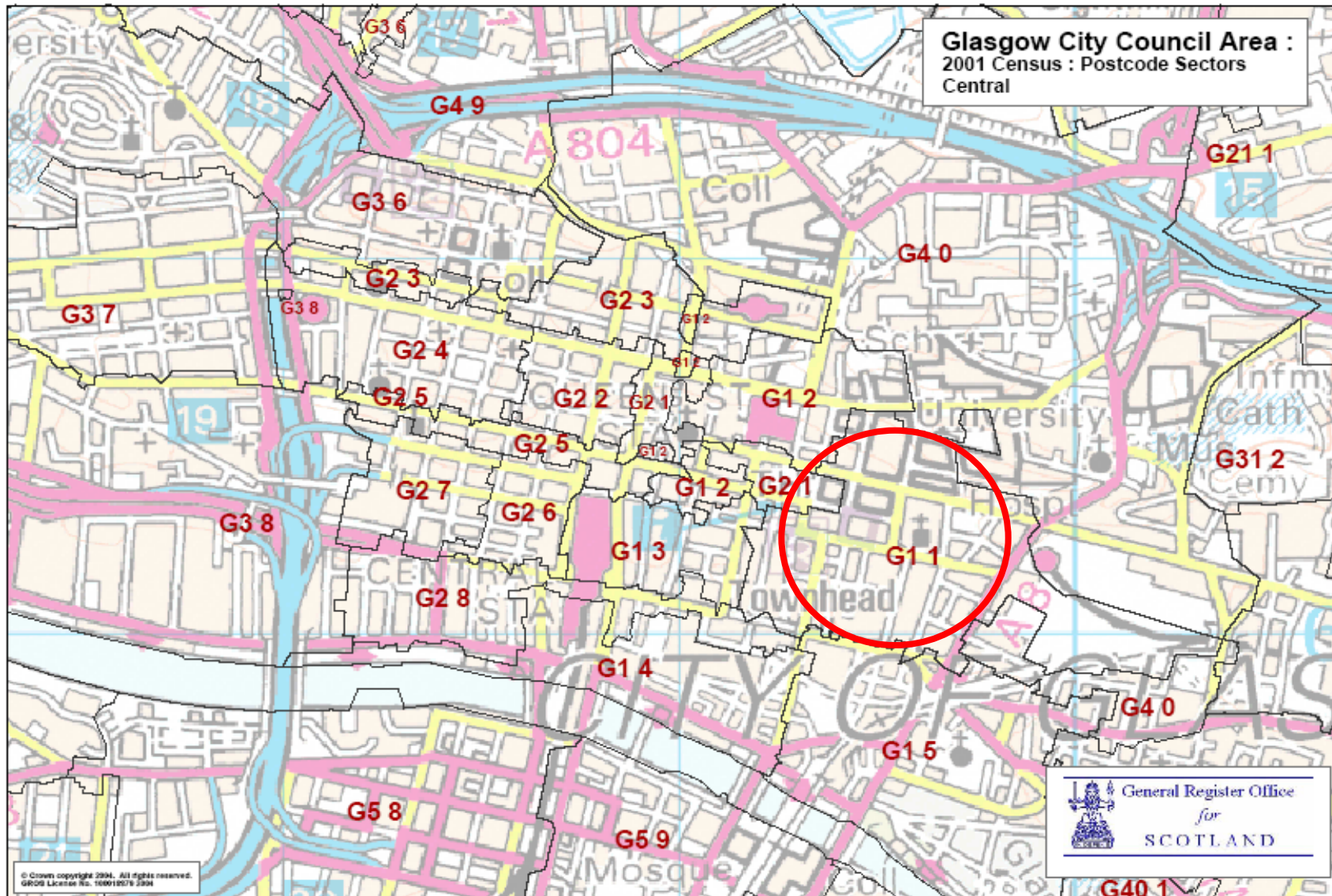
EH14 3, EH13 9 & EH4 7 – edge of Edinburgh

- Low mortality
  despite high deprivation
  but low mortality & low deprivation neighbours

- 3 of the 4 postcode sectors in this anomalous category are located on the outskirts of Edinburgh

- Is the health of populations in these postcode sectors benefiting from their location **bordering wealthy, suburbs & rural areas**?

EH14 3, EH13 9 & EH4 7 – suburbs of Edinburgh
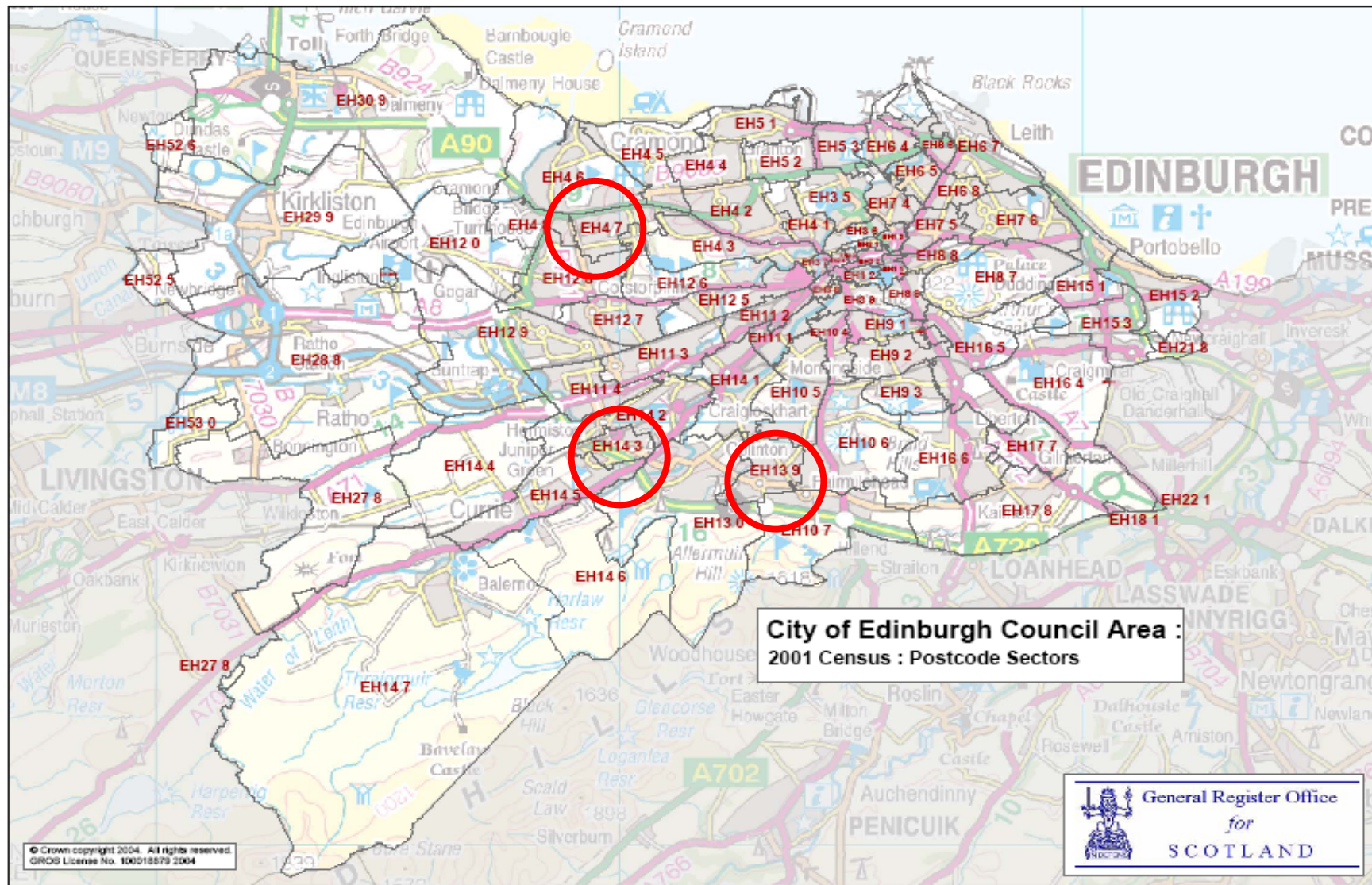
AB15 6 & DD9 7 – suburban & rural locations with hospitals and nursing homes

- **High mortality
  despite low deprivation
  <u>plus</u> low deprivation & low mortality neighbours**

- AB16 6 and DD9 7 postcode sectors both contain hospitals & nursing homes.

- Could the **hospital address** have been **coded in error** on death certificates of people who died in these hospitals?

- There has been considerable analysis of mis-coding of cause of death but less research on place of residence errors on death certificates.

- Rates of **deaths in nursing homes** have been found to be correlated with life expectancy at ward level in England yet uncorrelated with deprivation (Williams et al., 2004)

DD9 7- rural location with hospital & nursing home

DD9 7 - Brechin Infirmary
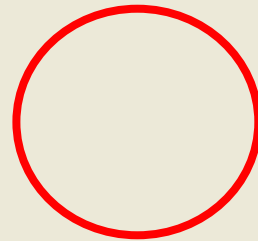
Conceptual Ideas (in need of development)

- Programmes as modifiers of risk landscapes

- The tensions between global and local patterns of risks

- The heterogeneity of program effectiveness, given variations in the landscape

Potential problems/promises

- The problems with social indicators
  - Don Campbell on the "corrupting effect of using social science indicators"

- Leveraging social indicator databases

- Learning through principled discovery

- Embedded processes of change

Role of Central Organization

- Diffusion of innovations
- Promoting cross-locality learning
- Moving beyond a fixation with performance towards learning
- A focus on patterns—not simply on levels of outcomes
- Localities as connected units

Conclusions

- *Spatial patterns* of deprivation in Scotland may be implicated in the *levels* of mortality. This is not the same as finding an association between mortality and deprivation across Scotland.

- Policy implications: Paying attention to specific places; "learning" from specific places

- Understanding complex combinations of interventions:
  - Understanding the "complex combinations of interventions" that might characterize the "exemplary" or "problem" small areas should be a focus of the intensive case studies.
  - The Public Health Observatory's Community Health Profiles: a more explicit spatial focus

- Organization issues involved in integrating surveillance, evaluation and program planning
  - Scotland as a great setting

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