Chapter 7

The Lessons of Dr. John Snow: A Call for Translational Health Geography

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7.1 The Lessons of Dr. John Snow about Geographic Scale and Translation of Findings

Dr. John Snow hypothesized that cholera was a water-borne disease, and so, he plotted deaths from cholera in Soho district of London, UK, on a dot map, and identified the Broad Street pump as the likely source of the epidemic. In a triumphant action that makes him a central figure in the fields of epidemiology, geography and others, he persuaded authorities to remove the pump handle, and the epidemic was put to an end [1] [2]. Regardless of whether this story is legend and independent of the chronology of events [1], Snow's investigation reminds us about the salience of (1) geographic scale in examining spatial patterns of disease and relationships between health and the environment; and (2) the translation of research findings about these patterns and relationships into interventions to improve health.

Each and every disease or health outcome creates a spatial pattern [3], and so, questions of scale are paramount if the investigation of a phenomenon at a particular geographic scale can distort statistical results and alter observed patterns [4]. In reality, the detection of a spatial pattern requires the alignment of the scale imposed by the analyst with the scale at which the phenomenon varies spatially [5]. If Snow had examined the outbreak at a different geographical scale, he may not have identified the observable spatial distribution of cholera cases [6].

Health researchers' focus on the local scale has caused an increase in research into community, neighborhood, and built environment factors influencing health, and the mechanisms for these influences [7]-[11]. A sole focus on individual-level risk factors may exclude community and other socio-structural conditions that also affect risk [12].

Furthermore, interventions for structural changes can have a larger impact on population health than those just for individual-level changes [13]. For example, neighborhoods are shaped by social and economic processes, and are thus amenable to modification, presenting a promising avenue for effective public health intervention [9] [14] [15]. At the same time as the focus has turned to the local scale rather than just the individual level, there has been a growing realization about the roles of global processes and factors. These include global climate change in altering spatial distributions of environmental hazards and disease burdens, as well as having implications for social justice and health disparities [16] [17].

Perhaps as important as Snow's focus on local geographic scale was his action after the discovery of the contamination caused by the Broad Street water pump. The growing urgency for this type of reaction of 'removing the pump handle' is revealed by the growing popularity of what is termed translational research. Translational research "transforms scientific discoveries arising from laboratory, clinical, or population studies into clinical applications to reduce [disease] incidence, morbidity, and mortality" [18]-[20].

In particular, evidence of the existence of health disparities among different population groups has mounted [21]-[23]. Action to mitigate disparities has been suggested repeatedly in the literature, often in conjunction with a suggestion of partnerships with affected communities [12] [24] [25]. These community-engaged research approaches seek to re-center power in research by involving subjects of research in all phases of the research process, such as, from formulation of questions to dissemination and use of results. Empowerment of communities for their own destinies is therefore a driving force necessary for mobilizing action [12] [25].

7.2 Challenges to Translational Health Geography

Nevertheless, community-engaged health research approaches may have special challenges for geographers if geographic information system (GIS) technology is utilized. A primary challenge is the tension between geographical scale and data confidentiality. Access to relevant spatial data has been described as "the single hardest part of the GIS adoption equation" [26].

The release of health data for research purposes is subject to regulations for protecting privacy and confidentiality, and these may limit both the geographic scale of available data and authorized users. The Privacy rule issued pursuant to the Health Insurance Portability and Accountability Act (HIPAA) of 1996, sets forth certain requirements for de-identification of protected health information in the United States, including the removal of detailed geography. Researchers can obtain data through data sharing agreements with data holding agencies, but the latter may stipulate data handling, data release, presentation, and storage practices.

Moreover, while agreements can be written to allow analyses of detailed geographic data, they often limit the depth of those analyses [10]. Some researchers have reported difficulties in achieving Institutional Review Board (IRB) approval for research projects incorporating community participation, as the status of community members confuses the definition of research subjects [27]. As Malone et al. [27] note, "we may need to consider how the current ethics culture of academia may have the effect of protecting institutional power at the expense of community empowerment". GIS functionality may thus be limited to basic choropleth maps of administrative units in public participation geographic information systems (PPGIS) projects where community members are incorporated as hands-on GIS users.

Even so, basic mapping with bounded units may produce spurious statistics, confused relationships, and mis-interpretation, due to the so-called small numbers problem and the aforementioned modifiable areal unit problem [28]-[31]. Merrick [32] has especially argued for participants' having a basic understanding of spatial concepts (distance, proximity, scale), cartographic principles (projection, symbolization, classification, hierarchy, color), and the GIS requirements for different types of analyses as well as an ability to operate the computer software. An expectation for community members' achieving these levels of expertise and understanding, often within a brief period, may be unrealistic.

7.3 Gerard Rushton's Contributions

Notwithstanding the foregoing, spatially filtered maps may contribute to overcoming technical and social challenges to a translational health geography, and Rushton and colleagues have now published extensively about spatial filtering methods [33]-[39]. Adaptive spatial filtering uses a pre-specified grid of estimation points and overlapping spatial filters that iteratively aggregate data from nearby areas, expanding variably across the study area to stabilize the population included in rates' calculations. The result is a map that displays disease rates as a continuous surface. This spatial filtering approach using adaptive bandwidth filters achieves at least three essential properties for disease maps: (1) Controlling the population basis of support used to calculate a rate; (2) displaying rates continuously over space; and (3) providing maximum geographic detail across the map [34].

Spatially-filtered maps may therefore enhance public access to spatially-detailed information on disease risk, thereby including community partners and public audiences who may not be sanctioned analysts of confidential disaggregate health data. But what must be done to leverage these maps as agents of information and change to improve population health? Four community-engaged research projects from the field of cancer prevention and control will illustrate future potential directions for a translational health geography.

7.4 Translational Health Geography: Progress in Cancer Prevention and Control

Cancer research has benefited from a significant amount of attention from health geographers and others using geographic methodologies in recent years [10] [40]-[43]. Some of the more significant earlier efforts focused on breast cancer, after several breast cancer advocacy organizations in the early 1990's pioneered research into environmental pollutants and breast cancer risk. New evidence from animal models had suggested a possible link between breast cancer risk and mammary carcinogens and endocrine-disrupting compounds [44]. For example, the Long Island Breast Cancer Study Project (LIBCSP) was initiated in 1993 after breast cancer activist organizations were successful in winning Congressional legislation (Public Law 103-43) mandating the project [44]. Despite its origins in activism, however, grants to fund the study were awarded to academic scientists, and so, some "activists sometimes felt shut out of the process" [44].

A second project emerged from a legislative mandate in Massachusetts for a breast cancer and environmental study after publication of data by the Massachusetts Department of Public Health about elevated breast cancer incidence on Cape Cod [44]. In order to bid for the research funds, Massachusetts activists founded the Silent Spring Institute. The Cape Cod Breast Cancer and Environment Study placed activists in governance roles. As described by Brody et al. [44], the first phase of the project involved GIS in the integration of cancer and environmental data and a search for patterns. The second phase of the project was a case-control study. Community members were updated and consulted throughout the project.

A third project is the Huntington Breast Cancer Action Coalition (HBCAC) breast cancer mapping project on Long Island. While this project was unique in its efforts to utilize mapping and community participation to investigate cancer, cancer information was not collected by a cancer registry on a continuous basis, but rather in a survey with a response rate of 37%. Finally, in my own work, the presentation of filtered maps of colorectal cancer in the tradition of Rushton's adaptive spatial filtering, supplemented by information on risk and preventive factors for colorectal cancer, enabled a community to organize and prioritize related experiences, thereby creating a future plan [45]-[47].

7.5 Conclusion: A Call for Translational Health Geography

In conclusion, translational health geography should investigate questions of health with emphases on the careful consideration of geographic scale and the translation of research findings into interventions to improve health. GIS can facilitate investigation of scale, whereas community-engaged research approaches can facilitate the translation of research into intervention.

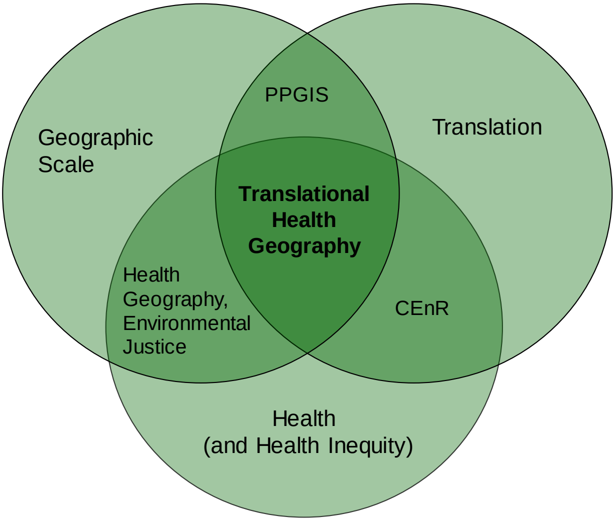

Figure 7.1 Schematic Translational Health Geography. (Color copy online.)

So far, however, the field of public participation geographic information systems (PPGIS) has had translation and scale at the forefront of investigations, but has largely neglected direct investigations of health. In contrast, the movement towards the use of community-engaged research approaches (CEnR) and related approaches for health disparities research has elevated questions of health and justice as well as the goal of translation at the forefront. These three literatures intersect in my opinion as in Figure 7.1, and so, the intersecting themes of (1) health, (2) scale as addressed by GIS, and (3) translation as addressed by participation should be the future foundation for translational health geography.

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