Enabling Geographic Research for Health Professionals at Harvard University

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Presentation Outline

• Geographic information support at Harvard: the CGA, HMC, HGL.

• Public health research at Harvard and the application of geographic analysis

• The CGA project workflow and available datasets

• Case study: The Nurses Health Study
• Case study: Surgical Safety Web Map
• Case study: Maps for The Lancet publication

• Conclusion
The Center for Geographic Analysis (CGA), Harvard University
INDIA: DISTRICT BOUNDARIES, 1951

Abstract: This datalayer shows district boundaries of India for 1951. Includes district socio-demographic Census attribute data such as total population, population by sex, and rural/urban populations. This layer is part of the India HistoricMap dataset showing decadal change in district boundaries of India since 1951. Socio-demographic data is included for the Census years i.e. 1951, 1961, 1971, 1981, 1991 and 2001. This data layer is sourced from secondary government sources, chiefly Survey of India, Census of India, Election Commission, etc. Scale 1:1,000,000.

Purpose: These data are intended for researchers, students, and policy makers for reference and mapping purposes, and may be used for basic applications such as viewing, querying, and map output production.

Time Period of Content: 1951

Created By: 
Public Health Research at Harvard

Not to be left out, back on the main Harvard campus in Cambridge:
Harvard Humanitarian Initiative
Harvard Initiative for Global Health
Faculty of Arts and Sciences

Many affiliated Boston hospitals
Public Health Research at Harvard

Geographic component

• Health surveillance and infectious disease control
  proximity to pathogens, transmission patterns
• Child obesity / physical activity in the built environment
  where is physical activity occurring? Parks, school, street, etc.
• Crisis mapping, response to natural disasters
  damage assessment, affected population locations, updated mapping
• Air pollution monitoring
  tying geographic coordinates to air quality levels
• Incubator implementation in Indonesia
  mapping original installations and tracking dissemination
• Cardiac (heart attack) studies in multiple cities
  proximity to fast food restaurants, health clubs, etc.
The CGA project workflow and available datasets

Center for Geographic Analysis
Project Specification

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<th>Technical Overview</th>
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<th>Budget</th>
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<td>(see CGA Financial Model Overview below)</td>
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<th>Risk</th>
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<td>Risks and concerns</td>
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<th>Data Confidentiality</th>
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<td>Data for this project is (place an x next to all that apply): ___ HRCI ___ HCI ___ Non-confidential</td>
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<th>Project Manager</th>
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<td>Month/Day/Year</td>
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Available data sets – ESRI Data and Maps
Census block centroids, ~8.2 million blocks in the whole U.S. all with a population count.
Existing geographic data, USA – Census variables

Thousands of additional census variables are available for download in tabular format at the block group, tract, and county level:

- income
- educational attainment
- means of transportation
- marital / family status
- gender
- employment
- ancestry
- military service

These are all mappable by downloading the tables, and doing a Table Join to the associated blockgroup, tract, county, zip code, state, etc. GIS layer.
The CGA project workflow and available datasets

Gridded population of the world dataset (CIESN, U. of Columbia)
399,781 population counts and densities
The CGA project workflow and available datasets

Demographic and Health surveys [http://measuredhs.com](http://measuredhs.com)

- Aggregated survey data with latitude, longitude coordinates for 90 countries.
- Includes information on HIV, Malaria, nutrition, vaccinations, education, family planning, wealth, mortality, domestic violence...
Case study: The Nurses Health Study

• Established at HSPH in 1976 – epidemiologic study of women’s health
• 238,000 registered nurses followed to examine risk factors for major non-communicable diseases

GIS techniques applied:

• Address geocoding
• Spatial join
• Cartographic production
• Spatial smoothing to generate air particulate predictive model

Case study: The Nurses Health Study

Environmental risk factors and health outcomes sub-study
Particulate matter model used in conjunction with surveys from 66,000 nurses.
Variables included:

- Hypertension
- family history of heart attacks
- hypercholesterolemia
- body mass index
- physical activity levels
- smoking status
- diabetes
- median house value
- household income

Multivariate regression analysis performed

Findings demonstrated that chronic particulate matter exposure was associated with risk of all-cause and cardiovascular mortality.

Case study: The Surgical Safety Web Map

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<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Not applicable</th>
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<tr>
<td>Has the patient confirmed his/her identity, site, procedure, and consent?</td>
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<tr>
<td>Is the site marked?</td>
<td>Yes</td>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td>Is the anaesthesia machine and medication check complete?</td>
<td>Yes</td>
<td></td>
<td></td>
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<td>Is the pulse oximeter on the patient and functioning?</td>
<td>Yes</td>
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<tr>
<td>Does the patient have a:</td>
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<td>Known allergy?</td>
<td>No</td>
<td></td>
<td>Yes</td>
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<td>Difficult airway or aspiration risk?</td>
<td>No</td>
<td></td>
<td>Yes, and equipment/assistance available</td>
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<td>Risk of &gt;500ml blood loss (7ml/kg in children)?</td>
<td>No</td>
<td></td>
<td>Yes, and two IVs/central access and fluids planned</td>
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**Anticipated Critical Events**

- To Surgeon:
  - What are the critical or non-routine steps?
  - How long will the procedure take?
  - What is the anticipated post-operative outcome?

- To Anaesthetist:
  - Are there any anaesthetic concerns?

- To Nursing Team:
  - Has sterility (including patient name) been confirmed?
  - Are there any equipment issues?

- Is essential imaging available?
  - Yes
  - No
  - Not applicable

**Nurse Verbally Confirms:**

- The name of the procedure
- Completion of instrument, sponge and needle counts
- Specimen labelling (read specimen labels aloud, including patient name)
- Whether there are any equipment problems to be addressed

**To Surgeon, Anaesthetist and Nurse:**

- What are the key concerns for recovery and management of this patient?
The advancement of safe surgery
The advancement of safe surgery

Jun. - 2010
Participating Hospitals: 3,790
Case study: The Lancet Publication
Conclusion

- LOTS of public health research is being conducted at Harvard.

- Much of this research can benefit from geographic techniques and analysis.

- The existing GIS infrastructure at Harvard (data, software, hardware, and people) enables extensive use of GIS for public health research.
Acknowledgments to my co-authors

Wendy Guan, Center for Geographic Analysis

Julia Finkelstein, Harvard School of Public Health

Bonnie Burns, Harvard Map Collection

Thank You! Questions?