A virtual learning series for public health leaders.

Innovative Applications of Geographic Information Systems (GIS) for Population Health
ASTHO Building Environmental Health Informatics Capacity

Agency readiness for using GIS to map EHR and environmental health data

**Systematic Literature Review**
- 47+ sources from academia, research institutes, news, medical centers, and industry (GIS software and technology companies, EHR vendors)
- 12 sources covering GIS integration with EHRs
- 3 sources pilot testing or implementing GIS integration with EHRs

**Market Research**
- Interviews with health agencies and industry
- Participation in webinars, convenings, and events

**Survey Dissemination & Analysis**
- Developed survey questions on agency capacity for environmental health surveillance, GIS, and readiness for using GIS to map EHR data using systems development lifecycle (SDLC)
- 38 state and territorial health agency environmental health directors answered survey
- Conducted 2 polling questions during webinar

ASTHO explored current GIS capacity of state/territorial health agencies and assessed the landscape of innovative applications of GIS, to include integration with electronic health records (EHRs)

<table>
<thead>
<tr>
<th>Development</th>
<th>Integration &amp; Testing</th>
<th>Implementation</th>
<th>Planning</th>
<th>Operations &amp; Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**GIS used for environmental health surveillance**

- Desktop GIS: 57.9%
- Web GIS: 55.3%
- General purpose GIS: 18.4%
- Open source GIS: 15.8%
- Mobile GIS: 13.2%
- GIS complements: 5.3%
- CAD GIS: 5.3%
- Business mapping: 0.0%

**Majority of agencies are using Desktop & Web GIS**

Web GIS for a broad array of users
Desktop GIS for trained professionals

**Types of GIS that agencies use or plan to use for mapping EHR and environmental health data**

- ArcGIS: 86.8%
- Tableau: 23.7%
- Google Maps: 10.5%
- R/R Shiny: 10.5%
- MapViewer: 5.3%
- QGIS: 5.3%
- Maptitude: 2.6%
- TerraSync: 2.6%
- MapInfo Pro: 2.6%
- Other: 7.9%

**Majority of agencies are using ArcGIS for location-based mapping and analytics**

Project funded by Centers for Disease Control and Prevention (CDC)

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Poll Question #1
Poll Results

How comfortable are you using GIS for public health decision-making?

- NOT APPLICABLE (N/A): 2
- NOT AT ALL COMFORTABLE: 4
- SOMEWHAT COMFORTABLE: 23
- SOMEWHAT UNCOMFORTABLE: 14
- VERY COMFORTABLE: 13
Today’s Speakers

**Estella Geraghty**
Chief Medical Officer and Health Solutions Director
Health and Human Services Sector
Esri

**Erica Garcia-Lago**
Integrated Data Analyst
Office of Health Informatics
Wisconsin Division of Public Health
Wisconsin Department of Health Services

**Mark Werner**
Director
Bureau of Environmental and Occupational Health
Wisconsin Division of Public Health
Wisconsin Department of Health Services
ASTHOConnects:
Innovative Applications of Geographic Information Systems (GIS) for Population Health

Este Geraghty, MD, MS, MPH, CPH, GISP
Chief Medical Officer | Esri

July 19, 2019
The Science of Where | Answering fundamental questions of where…

• Where is it
• How do I get there
• What’s nearby
• Where are we going
• Where’s the problem
• Where is it changing
• Where is the issue
• Where is it suitable
• Where should we locate
Leveraging the Power of Geography . . . to Make Better Decisions

A Framework & Process | Applied to the complete health workflow

- Data Management & Integration
- Visualization & Mapping
- Analysis & Modeling
- Planning & Design
- Decision-Making
- Action & Outcomes

Geographic Knowledge

Measuring

Analyzing

Understanding

Collaborating

Leveraging the Power of Geography . . . to Make Better Decisions
Purview of Private vs Public Health | Things are Changing
The Cat is out of the bag! | Broader recognition of the value of population health
EHR vs CHR | Integrating data to create context

• Social determinants of health
• What people eat
• How much they sleep
• Are they obese
• Do they live in a food desert
• Are they lonely / socially isolated
• And more...
Convergence | Brings opportunity for greater collaboration and coordination
• Better Surveillance
• Better Resource Allocation
• Better Security
Tracking Flu | Visualizing spread in near real-time
Taking Action | Surge management

FLU EMERGENCY
Loma Linda

Cloudy with highs in the upper 40s to mid 50s

NHL: Penguins - 3, LA - 1
What else can be done? | Situational awareness for immunizations

- Map varying vaccination policies (religious, personal belief, medical exemptions)
- Calculate gaps in vaccination access
- Identify high risk and under-vaccinated populations
- Create mobile or web apps that guide people to resources
- Monitor population health goals using map-enabled dashboards (e.g. which communities are achieving the Healthy People 2020 goal of 95% MMR vaccination?)
- Equip healthcare providers in areas with low vaccination rates with educational materials specific to the anti-vaccination population to help those providers communicate as effectively as possible
Sickle Cell Disease | Readmission risk

- Increased for patients > 5 miles from hospital
  - Less access to appropriate subspecialty medical care
- Instituted EHR alert
Find resources by directly searching for them

Resources are shown based on distance from patient’s home

Patient’s appointments, Primary Care Provider, and preferred lab & pharmacy is automatically pulled from the EHR

There are 3 main categories of resources with customizable sub-categories that appear based on the patient’s EHR diagnoses

Map automatically centers on patient’s home address from EHR

Resources can quickly be added, updated & removed from database
Wellness Map | Detailed information to encourage utilization

Directions are automatically generated. Bus, walk, & other transportation modes available.

Business address, hours, phone, website, & list of services.
- Small cell suppression
- Aggregation
  - Tessellation
  - Lat / Long adjustments
  - Political boundaries
- Perturbation
  - Geomasking
  - Differential privacy
- HIPAA compliant geocoding
• **Walgreens Flu Index** (2018-2019 season)

• **The State of Vaccinations** story map

• **Kindergartners and Immunizations in California** story map

• [http://esri.com/health](http://esri.com/health) - several case studies, white papers and past webinars – including one about HIPAA

• **Esri Maps for Public Policy** [https://livingatlas.arcgis.com/policy/overview/](https://livingatlas.arcgis.com/policy/overview/)

• **Email**: egyraghty@esri.com
Geocoding Hospitalization Data in Wisconsin: Making the Environmental Public Health Case

Mark Werner
Director, Bureau of Environmental and Occupational Health

July 19, 2019
Describe the benefits and concerns associated with geocoded hospitalization data

Characterize the environmental public health benefits of geocoded hospitalization data
Hospitalization Data in Wisconsin

Hospitalization and ER discharge data

Compiled by hospital association

Made available to our agency

Collected at zip code level
<table>
<thead>
<tr>
<th>Population size</th>
<th>Zip code</th>
<th>Census tract</th>
<th>Census block group</th>
<th>Census block</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–115000</td>
<td>1–115000</td>
<td>2500–8000</td>
<td>600–3000</td>
<td>0–300</td>
</tr>
<tr>
<td>42000</td>
<td>42000</td>
<td>65000</td>
<td>210000</td>
<td>11000000</td>
</tr>
</tbody>
</table>

Population Measures
Zip Code Level Data
Zip Code Level Data
Example: Freeway Traffic and Asthma?
How Did We Get Better Data?
How Did We Get Better Data?
How Did We Get Better Data?
How Did We Get Better Data?
Questions?

Mark Werner
Division of Public Health
608-264-9880
mark.werner@wi.gov
How the Wisconsin Hospital Discharge Data is Geocoded

Erica Garcia-Lago
Integrated Analyst,
Office of Health Informatics

July 19, 2019
As of 2018 the WI Hospital Discharge Data contains block group.

Block group is the finest granularity allowed by the statute governing this process, Wis. Stat. ch.153 (Wis. Stat. §153.50 (6)(a) and (am):

[Link to Statute](https://docs.legis.wisconsin.gov/statutes/statutes/153/I/50/6/a).
Two Programs

- Geocoding is done using up to two programs.
- If the first program is unable to deliver acceptable accuracy, a second program is used.
• PostGIS is used for the first round of geocoding.

• PostGIS is open source software.

• PostGIS delivers block group based on street level.

• PostGIS uses an accuracy rating system:
  • if the score is <5, then accuracy is high enough to trust the block group delivered by PostGIS.
  • If score is >=5, then a second program is used.
• ArcGIS is used when PostGIS is unable to produce an accurate block group.

• ArcGIS delivers the latitude and longitude based on street level. That information is then fed back to PostGIS to get the block group.

• ArcGIS accuracy rating for getting the lat/long: a score of greater than 85 is a good score for ArcGIS.
Missing Values

- Using these methods, 97.3% of the records have an associated block group.

- Some addresses do not get geocoded:
  - Examples include a post office box, homeless, etc.
  - Only WI and border state addresses are geocoded.
Future Fields

We expect to have three new fields in the Hospital Discharge Data in the near future:

1. Accuracy scores from PostGIS
2. Accuracy scores from ArcGIS (if applicable)
3. Reason for missing block group (i.e., PO Box, missing address etc.)
Questions?

Erica Garcia-Lago
Division of Public Health
erica.garcialago@wi.gov
Poll Question #2
Poll Results

What are your organization's biggest barriers to using GIS?

<table>
<thead>
<tr>
<th>Reason</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>We don’t have time to learn and set up the system</td>
<td>7</td>
</tr>
<tr>
<td>We are using other tools for mapping and analytics</td>
<td>1</td>
</tr>
<tr>
<td>We do not have staff with GIS knowledge</td>
<td>14</td>
</tr>
<tr>
<td>We are concerned about data security</td>
<td>5</td>
</tr>
<tr>
<td>There is no budget for these tools</td>
<td>7</td>
</tr>
<tr>
<td>Our organization does not need GIS at this time</td>
<td>2</td>
</tr>
<tr>
<td>Internal policies that prevent purchase and use of GIS</td>
<td>3</td>
</tr>
<tr>
<td>None of the above</td>
<td>11</td>
</tr>
</tbody>
</table>
Additional Barriers Identified

QUALITATIVE RESULTS OF ‘NONE OF THE ABOVE’

Data driven decision-making
- Challenge to connect analytic projects with policy changes
- Need training on how analytic software tools can be used for decision-making

Resource limitations
- Not enough knowledgeable staff or software license / account holders
- Limited time for knowledgeable staff to provide assistance across the agency
- Inequitable resource allocation and varying levels of expertise between programs
- Knowledgeable staff and software are only available during a grant-funded project period
- Budget cuts to decrease number of license / account holders

Privacy concerns
- Don’t have authority to collect full address or concerns about providing address information
- Information is identifiable in rural areas with smaller population size numbers so can’t share analysis or maps with public
- Needing to aggregate the data to multi-year totals to have usable sample size
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Audience Q/A
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Shared Resources

These resources were shared during the live webinar by speakers and participants, including ASTHO’s State Environmental Health Directors and Informatics Directors Peer Networks. ASTHO has also included articles from our systematic literature review.
### Shared Sources

<table>
<thead>
<tr>
<th>Description</th>
<th>Source</th>
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<tr>
<td>Esri case studies, white papers, and past webinars</td>
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</tr>
<tr>
<td>The State of Vaccinations Story Map (a view of state policies)</td>
<td><a href="http://esrifederal.maps.arcgis.com/apps/MapJournal/index.html?appid=a885ae01899245a4ba80abf03d79adbe">http://esrifederal.maps.arcgis.com/apps/MapJournal/index.html?appid=a885ae01899245a4ba80abf03d79adbe</a></td>
</tr>
<tr>
<td>Kindergartners and Immunizations in California (a story map case study)</td>
<td><a href="https://urbanobservatory.maps.arcgis.com/apps/Cascade/index.html?appid=1de17557401a4ecb8d8c0766d3f453e0">https://urbanobservatory.maps.arcgis.com/apps/Cascade/index.html?appid=1de17557401a4ecb8d8c0766d3f453e0</a></td>
</tr>
<tr>
<td>Northern Kentucky YCAAM analysis</td>
<td><a href="https://nkhd.maps.arcgis.com/apps/Cascade/index.html?appid=809394d18a3a46de962d0d46df8cf258">https://nkhd.maps.arcgis.com/apps/Cascade/index.html?appid=809394d18a3a46de962d0d46df8cf258</a></td>
</tr>
<tr>
<td>Correlated death cause specific years of potential life lost (YPLL) with age-adjusted death data for those causes to look at subcounty level trends for top causes of death for residents</td>
<td></td>
</tr>
<tr>
<td>Contact Joshua Tootoo at Rice for details: <a href="mailto:jltootoo@rice.edu">jltootoo@rice.edu</a></td>
<td></td>
</tr>
<tr>
<td>Rice University, Geospatial Analysis Webpage</td>
<td><a href="https://cehi.rice.edu/spatial">https://cehi.rice.edu/spatial</a></td>
</tr>
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ArcGIS Is Open and Interoperable

**Open Standards and Formats**

- XLSForm
- GML
- SQL
- SLD
- SOAP
- WMTS
- KML
- LAS
- INSPIRE
- Shapefiles
- IMDf
- WCS
- IFC
- Web Scene (I3S)
- LERC
- CSW
- WPS
- REST
- OneGeology
- OPeNDAP
- JSON
- WaterML
- netCDF
- GeoPackage
- CityGML

**Direct Product Integration**

- MS Office
- SQL Server
- SharePoint
- Adobe Creative Cloud
- Jupyter Notebook
- Teradata
- Power BI
- Netezza
- Oracle
- Hadoop
- AutoCAD
- Revit
- R
- AWS
- Altibase
- Python
- PostgreSQL
- Dameng
- SQLite

**Open Software Architecture**

- Open Data Access
- Open APIs & SDKs
- Open-Source Integration
- Open-Source Contributions
- Extensible Architecture
- Embeddable

... Successfully Integrated Into Thousands of Systems...
<table>
<thead>
<tr>
<th>Source</th>
<th>Title</th>
<th>Authors</th>
<th>URL</th>
</tr>
</thead>
</table>
ASTHO Literature Review Sources


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Help ASTHO evaluate
Innovative Applications of GIS for Population Health
on your device now!