

**Data Sharing to Improve Community Health** 

Oct. 3 - 4 | Plymouth, MI

# Navigating HIPAA in a Geospatial World

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CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

FOR IMMEDIATE RELEASE May 6, 2013

PH13-017

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#### California Birth Records Found in Unsecure Location

SACRAMENTO - A California Department of Public Health (CDPH) investigation has found that a reel containing images of 2,000 State of California Birth Records for 1974 was found in an unsecure location. These birth certificates contain names, addresses, Social Security numbers and some medical information.

CDPH has no evidence that this incident has resulted in any unauthorized use of this information. CDPH continues to collaborate with the California Highway Patrol in this investigation.

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Inn at St. John's



# We responded with...

- Increased training for staff
- No more data 'check outs'
- Enhanced physical security for reels
- Sped up digitization plans
- Notifications to those impacted
- And more...

### Dr. Nirav Shah Health Commissioner New York

CALIFORNIA HEALTHCARE FOUNDATION



## 3 major concerns:

- 1) Guard against data breaches
- 2) Avoid misinterpretations of data
- 3) Don't embarrass the administration



## 3 major concerns:

- 1) Don't embarrass the administration
- 2) Don't embarrass the administration
- 3) Don't embarrass the administration





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#### HEALTH AND HUMAN SERVICES

### California HHS Open Data Portal Paves Way for State Health Data

California officially releases a health portal to display high value data sets for residents and developers.

BY JASON SHUEH / AUGUST 10, 2014



Estella Geraghty, deputy director at the California Department of Public Health announces the formal release of California's first Health and Human Services open data portal. JASON SHUEH

Geraghty says the birth of California's first Health and Human Services (HHS) open data portal is much like the birth of a child: It took about nine months to create and is the object of great affection.

AD



# Overview

- We can overcome perceived barriers
- Digital transformation creates challenges as well as opportunities
- GIS is a valuable part of digital transformation

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- HIPAA is a perceived barrier to using GIS
- We can make progress and reap the rewards

#### Digital Transformation Is Just Beginning .

We Are Living in an Era of Exponential Technological Advancement

#### Artificial Intelligence

Design Thinking

**Smart Devices** 

Autonomous Vehicles

Automation

Sensed Data Persistent Surveillance Immersive Experiences

Efficiency and Collaboration

Data-Driven Analytics

Predictive Analytics

IoT

Advanced Modeling

**Real-Time Monitoring** 

Pervasive Mapping

Bioinformatics

ping

Cloud Computing

Geospatial Solutions

Open Data Access and Transparency

Technology is playing a fundamental role . . . . . . Integrated Into everything we do

Pervasive Understanding of Our World

Data Linkages

Synthetic Biology

Location Intelligence

#### How Do We Take the Next Step?

Embrace Digital Transformation . . . . . . and Leverage Technology Thoughtfully



... Create Enabling Technologies Foundation for Our Future

## We're still human

- Everybody loves to innovate, but nobody likes to change
- Status quo is the enemy of innovation
- What can we unlearn today?



## A Conundrum:

#### "Data can either be useful or perfectly anonymous but never both" (Ohm, 2009)



2019

#### Why We Care

High quality data is needed to:

- Inform policy creation
- Plan & prioritize initiatives
- Target interventions
- Evaluate outcomes



#### For centuries we've focused on the microscopic



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## The world of the small could be tricky!





Joseph Lister, the Father of Antiseptic Surgery

De Public health law SUMMIT

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## Our faith in the small flourishes

Watson & Crick discover the structure of DNA in 1953







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## The power of genetics is undeniable





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## We are unique



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## **Shifting Focus**







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## **Drivers of Health Outcomes**





### **Place Matters for Health!**



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### Make the healthy choice the easy choice



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## Our perception is based on our context



Our

environments

shape how we

see our world



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### Which is more important?



#### YOUR ZIP CODE > GENETIC CODE



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#### The first step for a diabetic patient to be able to take their medications...



#### ... is having the transportation to go and get them



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### Access to Care

30

#### Maybe its not the will to eat better that's scarce...



#### ...but rather its access to grocery stores that's out of reach



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#### Wholesome food or food dessert?

#### Not every community will have a fancy gym...



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...but we know that the population can flourish when simple sidewalks are available.



 Dependence
 Public health law

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Safe places for physical activity



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## Place Matters for Health!

## **Place Matters for Health**

WHERE people live and the environments around them, has a significant impact on their personal health and outcomes





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Hippocrates, 460 BC


#### The Science of Where

Helps us to answer the 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



What is where? Why is it there? Why do I care? How can I prepare?

#### A Framework & Process Applied to the complete health workflow



# Many elements for success





# Homelessness

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# Veterans get help in real time



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#### Census tracts with homeless Veterans



#### Homeless Shelters in LA, per HUD



#### Shelters with beds set aside for Veterans



## Veteran beds within a 15 minute walk time





# **Vector Control**

# No more children with microcephaly







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 Improve
 Pymouth, MI

#### Suitable Aedes habitats



Seasonal locations where Aedes may be present

## **Biosurveillance through Social Media**



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# Preparedness

#### California plans for medical surge &



# connects citizens to healthcare services

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#### CDC's Social Vulnerability Index



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#### Socioeconomic Theme



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#### **Demographic Theme**



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### Housing & Transportation Theme



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#### The world is aware





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#### https://www.nsc.org/home-safety/get-involved/memorial/

#### 🚳 esri Celebrating Lost Loved Ones to the Opioid Epidemic- see new link at https://losttoopioids.nsc.org

#### + Add Lost Loved One 🕴 🖉 🧷













# Better Decisions – Better Health

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### Counties combat heart disease by improving the built environment



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#### Klamath County, Oregon

#### Kids can be placed in better foster homes



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#### **Tapestry Segmentation Data**





#### **Complications of Diabetes**

Cancer



#### Early Death



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#### **Navigating HIPAA in a Geospatial World**



HIPAA REQUIREMENTS

#### Protected Health Information (PHI)

- Any individually identifiable health information including demographic information, that is created, used, disclosed, or received by a health care provider, health plan, or health care clearinghouse. PHI includes data about past, present, and future health conditions, health care provision, and health care payments.
- Examples of PHI include name, address, telephone number, birth date, and Social Security Number



(HHS, 2015)

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(HHS, 2015)

#### Who is affected by the Privacy Rule?

- Covered entities (note: not all health data is PHI)
- The Privacy Rule does not directly apply to research but may affect researchers because it may affect their access to information, but it does not regulate them or research, *per se*.
- To gain access for research purposes to PHI created or maintained by covered entities, the researcher may have to provide supporting documentation on which the covered entity may rely in meeting the requirements, conditions, and limitations of the Privacy Rule.

Covered Entities	Health Plans	Health Care Providers	Health Care Clearinghouses
	Institutions, Organizations, Persons who transmit health data electronically		
	Billing, payments, insurance, claims		

#### Geocoding, a first step to using geography

- Take care when geocoding PHI
- Beware of unintentionally obfuscating your results
  - Be sure you have high quality reference data
  - Adjust your matching rules to suit the situation


## Geocoding - DONTs

- You may NOT give your data to someone else to geocode for you if they are not listed on your IRB protocol or given permission to handle your PHI (such as a BAA)
- You may not geocode PHI in ArcGIS Online unless deployed in a private cloud
  - What about just submitting the addresses?



- You can geocode using your ArcGIS desktop software if you have reference data (like the Esri World Geocoder or StreetMap Premium) available on that machine
- You can geocode in your enterprise implementation of your ArcGIS Platform if you have 'portal' installed / turned on AND you have reference data also within your portal environment (i.e. on premise)
- You can geocode in a HIPAA compliant cloud (e.g. Spatialitics Health)



# Geo-Enabling the Healthcare Enterprise

An Overview







Spatialitics<sup>™</sup> Health is built on a foundation of HIPAA-Compliant data management policies and rules and is supported by HIPAA-Compliant cloud infrastructure.





### Encode



### **GEOCODING PROCESS FLOW**







### SPATIALITICS - HIPAA-COMPLIANCE OPERATIONAL LAYERS



### **GEOCODING HIPAA-COMPLIANT FEATURES**





#### **Data Security**

Partitioned storage to keep each customer's data separated with all PII out of the Geocoding or other Spatial Analysis processes



#### **Secure Infrastructure**

Hosted on Azure's secure HIPAA-compliant cloud infrastructure



#### **Complete Encryption**

TLS 256-bit AES data encryption at server and in-transit with access only to authorized users



#### **Trained Team & SOPs**

Trained team and HIPAA-compliant helpdesk incident and change management, following protected data SOPs and policies



#### **Regular Audit**

Consistent auditing and testing for internal and external vulnerability assessment



#### **Third-Party Certification**

Yearly third–party certification to guarantee adherence with HIPAA compliance



Spatialitio	s" Geocoder Features Plans Help Contact	👗 Log In
	First Name Password	
	Submit	0



Spatialitics" Geocoder			🛓 Username
My Organization Users	Dashboard Geocode	Map API Keys	
Organization Nam	ገ <b>e</b> Settings Entitlements		Customer ID: xxxx
Users	Geocodes	Storage	Subscription
Total users: 3 API users: 0	Total remaining: 2000	Total remaining: 600 MB	Created: Jul 21, 2018 Expires: Jul 21, 2019



Espatialitics" Geoco	der			🛓 Username			
My Organization	Jsers Dashboard Ge	eocode Map	API Keys				
Organizatio Overview Us	n Name age Settings Entitlem	nents		Customer ID: xxxx			
Quick Select:	Quick Select:       Last 30 days       ↓       From:       02/06/2018       ▼       To:       02/06/2018       ▼       Go						
User	Role	Geocodes	Usage Type	Date			
Steve	User	1002	File upload	Jun 05, 2018			
Caroline	Administrator	12452	ΑΡΙ	Jun 04, 2018			
Bruce	User	800	File upload	Jun 03, 2018			
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(Spatialiti	<b>cs</b> " Geocoder atth				🛔 fabricadmin
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	Street select column 🗢	City select column 🗢	State select column	Zip select column 🗢	
	Address information in single	:olumn ?		Cancel Back Next	



spatialitics" Geocoder						🛓 fabrica	admin		
Organizations	s Users Dashboard	Geocode Map	API Keys						
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	Step 3 of 3: Upload file to	geocode							
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Spatialitics Health Website https://spatialitics.com/health/



Spatialitics Health: Product Introduction

https://youtu.be/B0LbyU0hFtM

#### Videos



Spatialitics HIPAA-Compliant Geocoder

https://youtu.be/KYrM67TzAUc



Spatialitics Health: Clinical and Business Apps

https://youtu.be/2yyoUCm7xSA



## Data De-Identification Under HIPAA

Many organizations select Safe Harbor due to its simplicity

## Safe Harbor identifiers



#### 1. Names

- 2. Dates (except year)
- 3. Telephone numbers
- 4. Vehicle identifiers
- 5. FAX numbers
- 6. Device identifiers & serial numbers
- 7. Email addresses
- 8. URL's
- 9. Social Security Numbers

- 10. IP addresses
- 11. Medical record numbers
- 12. Biometric identifiers (incl finger and voice prints)
- 13. Health plan beneficiary numbers
- 14. Full-face photographs & comparable images
- 15. Account numbers
- 16. Certificate/license numbers
- 17. Any other unique identifying number or characteristic
- 18. Geography

## Geographies as defined by Safe Harbor

Eliminate all geographic subdivisions smaller than a state, including street address, city, county, precinct, ZIP code, and their equivalent geocodes, except for the initial three digits of the ZIP code if, according to the current publicly available data from the Bureau of the Census that geography has < 20,000 people.



# Mapping county-level data may violate HIPAA

- 10% of all U.S. counties have more than 200,000 residents
- More than 40% of counties have fewer than 20,000 residents
  - E.g. 8/58 California counties have < 20,000 people

Plumas	
Inyo	
Mariposa	
Mono	

Trinity Modoc Sierra Alpine



## Data De-Identification Under HIPAA



3 ← numerator 5 ← denominator

- CDC WONDER databases suppresses cells with numerators <10</li>
- National Environmental Public Health Tracking Network suppresses cells that are greater than 0 but less than 6
- CMS suppresses values of <11</li>
- Range is 3 to 40
- Most fall into the range of 10-15

## Small cell suppression

- Geographic masking to suppress cell counts ≤10 on a map
- It is often necessary to suppress complementary cells as well to avoid the calculation of actual cell values by subtraction or other mathematical operations





With Masking

3 ← numerator 5 ← denominator

- National Center for Health Statistics 250,000
- National Environmental Health Tracking Network 100,000
- Maine Integrated Youth Health Survey 5,000

Risk varies based on the level of ZIP code and how the ZIP code is combined with other variables.

Date of Birth + Sex + 5-Digit ZIP code is unique for over 50% of US residents, meaning that with these 3 pieces of information more than half of US residents could be identified

Year of Birth + Sex + 3-Digit Zip code is unique for 0.04% of US residents

## Aggregation

You can aggregate on any of your cells: age, racial/ethnic categories, time periods (months, years), geography



## Perturbation

Randomly offsetting point data in a way that obscures actual address locations (in blue), while preserving the overall spatial pattern. Also known as geomasking. Focus on the 'k' statistic.



# Numerator OR Denominator rule is okay.



### Institute for Families in Society, (South Carolina), Decision Tree

## CA Dept of Healthcare Services, Decision Tree

### Must meet numerator AND denominator condition

#### OR

Apply scoring criteria

IF Score ≤12 (go to risk assessment)

IF Score >12 (Suppress small and complimentary cells first)

#### THEN

 Assess legal, policy and programmatic risk



and who meet the HIPAA Privacy Rule implementation specifications: A person with appropriate knowledge or and experience with generally accepted statistical and scientific principles and methods for rendering information not individually identifiable." [45 CFR Section 164.514(b)(1)]

## **Publication Scoring Criteria**

(\*originally from Illinois Dept of Public Health)

- Focuses on most commonly used variables in health
- Two identification criteria assessed:
  - Variable specificity (generally numerator)
  - Size of potential population (generally denominator – like geography)

Variable	Characteristics	Score
Sex	Male or Female	+1
Age Range	>10-year age range	+2
	6-10 year age range	+3
	3-5 year age range	+5
	1-2 year age range	+7
Race Group	White, Asian, Black	+3
	Detailed Race	+5
Hispanic Ethnicity	yes or no	+2
	Detailed ethnicity	+3
Language Spoken	English, Spanish, Other Language	+2
Events	1000+ events in a specified population	+2
	100-999 events	+3
	11-99 events	+5
	<11 events	+8
Geography	State or geography with population >2,000,000	-5
	Population 560,001 - 2,000,000	-3
	Population 20,001 - 560,000	0
	Population ≤ 20,000	+5
Data Year	5 years aggregated	-5
	2-4 years aggregated	0
	1 year (e.g., 2001)	+3
	Bi-Annual	+4
	Quarterly	+5
	Monthly	+7

## References

- "Guidelines and Methods for De-Identifying Protected Health Information." Institute for Families in Society, University of South Carolina, October 2017.
- "Department of Health Care Services Policies Regarding Public Records Act Requests and Public Aggregate Data Reporting." California Department of Health Care Services, May 14, 2015.
- Zandbergen, Paul A. "Ensuring Confidentiality of Geocoding Health Data: Assessing Geographic Masking Strategies for Individual-Level Data." *Advances in Medicine*, 29 April 2014.
- "To Whom Does the Privacy Rule Apply and Whom Will It Affect?" NIH. <u>https://privacyruleandresearch.nih.gov/pr\_06.asp</u>
- El Emam, Khaled and Arbuckle, Luk. "Anonymizing Health Data: Case Studies and Methods to Get You Started." O'Reilly Media Inc, 2013.





# What Does MapMasq<sup>™</sup> Do?



- Take discrete data points and mask the spatial location.
- Randomly distort data while attempting to preserve spatial patterns.
- Support for variable aggregation into "bins"
- Aggregation based on census populations
- MapMasq is the calculator, not an "easy button" to HIPAA compliance – depending on the dataset, locations, and sensitivity other methods may need to be applied. – "Expert Determination"
- Links to published studies at mapmasq.com in the resource section

# **Two Areas of Masking**

- Retains Point Data
  - K-Mean Neighbor
    - "Jiggering"
  - Rounding/Truncating
  - Random Obfuscation

- Aggregation
  - Standard Bins
    - Triangles, Squares, Hexegons
  - Census Driven
    - Numerator Rule
    - Denominator Rule
      - Age, Sex, Combination

# Triangle, Square, Hexagon Bins



Σ	✓ ×⁄y			
	Bin Ar	nalys	is Tool	
Point	Features AUSA	ATIN_F	PT_ALL 🔹	-
Shape	Туре	Hex	agon	•
Size:	2		Square Miles	
+				1.1
Slider	scale:	1		•
Kee	p empty bins	V F	Remove Previous	
	Run			

Hint: To adjust the slider value with better precision, enter the value in the 'Size' text box.



## **Census Numerator Rule**



Σ 👄 🌠	
Numerator/De	nominator Tool
Input Data	_
AUSATIN_PT_ALL	
Select All Points	Draw Masking Area
Select All Points Masking Algorithm	Draw Masking Area
Select All Points Masking Algorithm Numerator	Draw Masking Area Numerator Rule 15



# **Census Denominator Rule**



Fie	Field: 🃰 Add 👮 Delete 편 Calculate 🛛 Selection: 🕀 Zoom To 📲 Switch 📄 Clear 💭 Delete 📑 Copy							
	OBJECTID	Shape	Shape_Length	Shape_Area	demographic_population	input_data_count	meets_rule	
	1	Polygon	142792.986585	490044482.852497	17521	13	True	
	2	Polygon	30927.082721	31060910.036244	16627	19	True	
	3	Polygon	21048.232926	11781136.291775	18316	152	True	
	4	Polygon	33948.001807	31188337.009537	16802	99	True	
	5	Polygon	24945 529938	22662347 272674	16860	120	True	
### **Rounding/Truncating Coordinates (lat/long)**

- Stacks the points
- Ability to "aggregate" without loss of individual points!



### **Coordinate Rounding & Truncation**



- Two simple displacement algorithms: rounding and truncation
- Allows you to enter the number of spaces past the decimal point on your latitude and longitude to round or truncate to
- Tendency to aggregate data points to a single location depending on the number of spaces past the decimal you are working with
- A report back to the user will indicate how the truncation coarsens the accuracy
- Maintains attribute features its still a point dataset (stacked)

### **Donut Masking**



- Extent of the masking can be set
  by drawing a box or
  assuming your extent is the
  data frame in view
- The blue dots are the original record location
- A circle is generated for the minimum displacement distance (blue) – that record cannot be placed within that circle
- The outer circle (orange) is the farthest displacement distance – the record should not be placed outside of that circle

### **K Mean Neighbors**



- Primary donut masking algorithm
- K is the number of neighbors around the feature to consider
- Creates the inner and outer circles of the donut based on the value of K and the density / distance of its neighbors
- Each point shifts within the donut in a random compass direction
- Includes a K-Anonymity score

### K Mean Angular Neighbors



- The direction a feature is moved is based on the location of its neighbors
- Builds a range in the centroid of the direction of the nearest neighbors
- Considers the angular displacement of its neighbors relative to North
- Increases the number of circles that overlap
- Includes a K-Anonymity score

### K-Mean Neighbor, "jiggering", "Donut"



### **Assessing Risk**

#### Conservative Parameters <1% with Score of 0



### **Deployment Information**

- Works as an extension to ArcGIS Pro
- Can be use separately for your data
- Incorporate into an enterprise platform



### The Future

- Always exploring new techniques, such as differential privacy and principal components analysis
- Your ideas / needs are welcome





Cybersecurity GovTech Biz Emerging Tech Cloud Gov Experience More

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## What Happened Next?

- The other 12 HHS Departments began contributing data
- The state gov ops group launched their open data portal
- The open data handbook is online and used as a guide for many organizations wanting to share data
- 4 new laws before the legislature

Oct. 3-4, 2019

Plymouth, MI





### **Increased sharing**

- Intra-departmental
- Inter-departmental
- Fewer FOIA requests



### Innovation

- Inter-departmental Open Data Working Group
- Hackathons
- Innovation Fellow
- Innovation Program







Undersecretary Secretary Governor appointee for Innovation & **Digital Services** 

# Summary

- We can overcome perceived barriers
- Digital transformation creates challenges as well as opportunities
- GIS is a valuable part of digital transformation

Data Sharing to Improve Community Health

- HIPAA is a perceived barrier to using GIS
- We can make progress and reap the rewards



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