2007 ESRI Health GIS Conference

Scottsdale, Arizona • October 7-10, 2007

# The Case for Place


***Raymond D. Aller, M.D., FCAP***

*Professor, USC School of Medicine*
*(Clinical Emeritus)*
*and*
*Director, Automated Disease Surveillance Section*
*Department of Public Health ACDCP*
*Los Angeles County*


*8 October 2007*

# Acknowledgments


- LA County Public Health
  - Doreen Keough, Librarian
  - Akbar Sharip, M.D., Epidemiologist
  - David Kwan, MPH, GIS Coordinator
  - Many others
- ESRI
  - Bill Davenhall
  - Jennifer Schneider-Camp
  - Ann Bossard
  - Chris Kinabrew, MPH, MSW
  - And others
- My colleagues in public health and epidemiology around the US, and the world

# Ray Aller, M.D., FCAP

- LA County Public Health Disease Surveillance
  - since 2003
- Prior to that, 20+ years practice of laboratory medicine in community, hospital, university and national labs
- Went to school for 25 years
  - BS, UCLA
  - MD, Harvard
  - AP/CP – UC San Francisco
- Active in several national laboratory, public health, and informatics organizations
- Thinking, writing, teaching and cheerleading about clinical informatics for three decades – over 200 publications

# The case for place ….

# Well, DUH ….

# Preaching to …..

- The choir:
  - Rather self-evident to most of us here
    - If we invested  the time and treasure to come to this meeting, we probably already understand/accept that place is an important determinant of health.
  - But we still must be able to persuade others …
    - For example, some of us had to use vacation or holiday time to be here

- The skeptics:
  - "Why would we need to know where?
    - A medical event happened
    - A patient lives
    - A patient has traveled
    - A patient has lived "
  - "We're too busy with more important issues in patient care"
  - Sometimes we have to engage in what – to us – is a painful elaboration of the obvious.

# Real estate and Medicine

- In real estate, the three most important factors in determining the value of a property are:
  - Location
  - Location
  - Location
- In both healthcare and public health, location has a major effect on all we do –
  - Location within the body
  - Location within a building
  - Location in the community
    - Proximity to the animal population
    - Toxic exposures
    - Proximity to infectious agents

# Location within the body

- Topography is the pivotal axis of the worldwide health/medical/veterinary nomenclature, SNOMED
- We take it for granted that location within the body governs function – and disease
- Yet, we get outside the body and all too frequently disregard interactions with our environment.

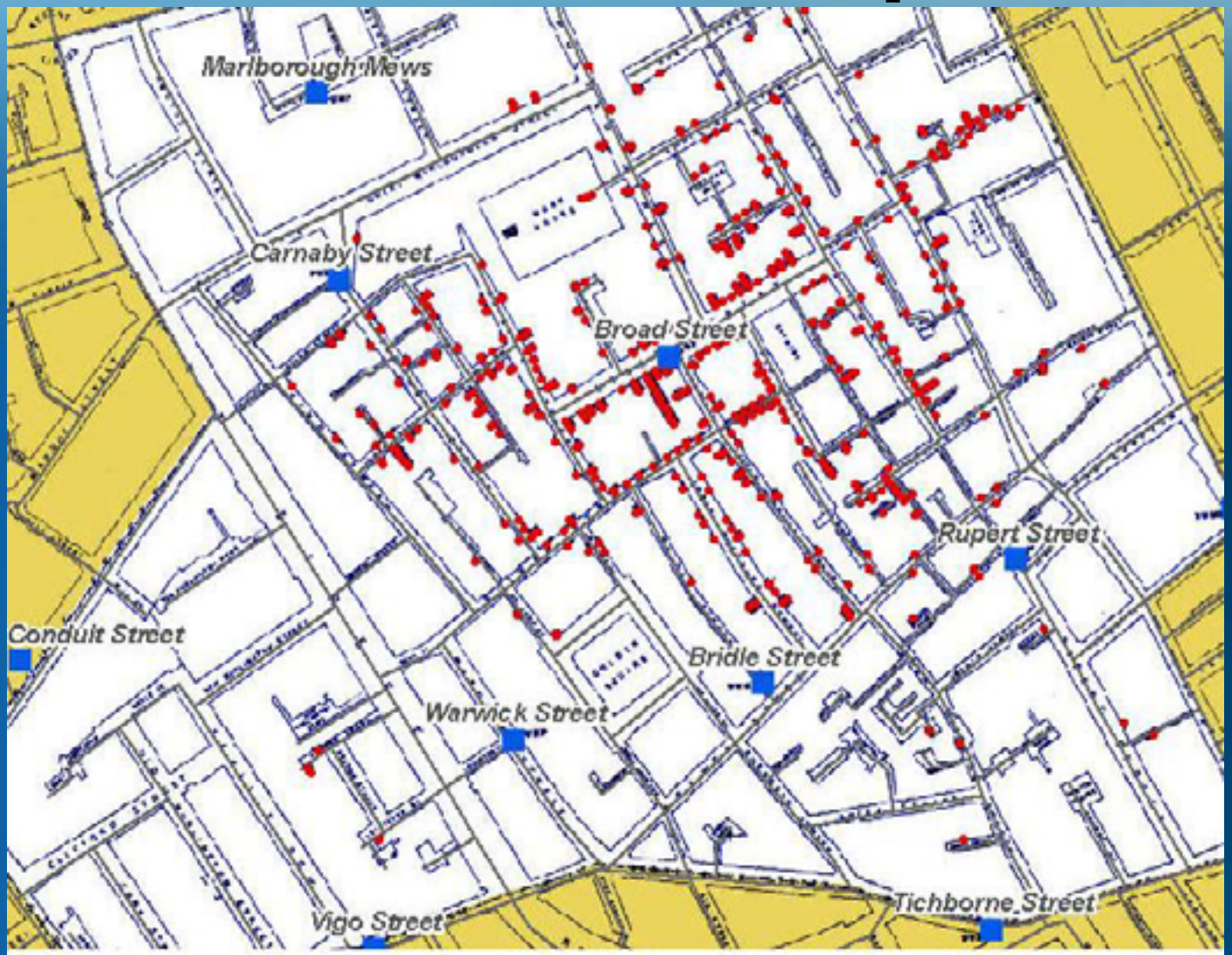
# We use GIS as …

- A way of thinking about data
- A means to understand relationships among events that may seem unrelated
- A mechanism to depict data and relationships that may facilitate understanding and action by the skeptics.

## A recent definition:

- Software technology for managing and applying information

# The foundations of epidemiology



# There's still nasty stuff out there

- Noxious agents are distributed non-uniformly
- Studying the geography of disease improves our chances of discerning, and eliminating, the causes.
- Controlling a disease outbreak depends on knowing where it is, and where/how it is spreading
- Numerous examples where place determines your sickness or health

# The air you breathe

- Exhaust from 4-lane highway/freeway, 200 meters – asthma, impaired lung function, cardiac disease, lung cancer, probably other effects
- 11% of US households live within 100 meters of major highways (definitional issues)

  – Brugge et al, Env. Health 2007;6:23

# Asthma and traffic/NO2

- Living near freeways more dangerous than living near other roads
  - Gauderman et al, Epi 2005;16:737-743

# Impaired lung development in highly polluted communities

- Deficiency in growth of FEV-1 from age 10 to 18
- Those with the highest exposure had a five times greater risk of low FEV-1 at age 18

- Gauderman et al, NEJM 2004;351:1057-67

# Cardiopulmonary mortality, air pollution near roads

- 2 x risk of cardiopulmonary death
  - Gehring et al, Epi 2006;17:545-551
- Range of particulate matter 3.4 – 28.3 ug/cub meter
  - For each 10 ug increase,
    - 24% increase in cardiovascular events
    - 76% increase in death from CV disease
    - 35% increase in cerebrovascular disease
  - Miller et al, NEJM 2007:356:447-58.

# It’s not just the air you breathe

- Risk of leukemia from petrochemical exposure
  - Complex exposure model
  - Yu et al, Am J Epi 2006:164:
- 25-36% increase in hospitalization for diabetes if you live in the same zip code as a toxic waste site (persistent organic pollutants)
  - Kouznetsova et al, Environ Health Perspect 2007;115:75-79

# Editorial reviewing this domain

- Ward et al, Am J Epi 2006;164:208-211

# And it isn't just "environmental"

- Living in the same neighborhood with sick people is hazardous to your health
  - "Core area" of gonorrhea infection
  - Becker et al, Am J Epi 1998;147:709-16

# Place determines …

- Access to care
- Disease risk
- Prevention
- Diagnosis
- Prognosis
- Therapeutic options
- Patient empowerment
- Marketing healthcare services
- Etc.

# “Geography is medical destiny”

- John Wennberg, Dartmouth
- It’s not just air, water, or infections – the density of medical practitioners of various types makes a major difference in …

- Access to health and social services
- The likelihood of a correct diagnosis
- Chances for successful medical outcomes
- Ability to receive affordable and timely care

- Rates for expensive medical procedures vary by a factor of two, or more between different regions of the US – without evident differences in benefit

# Five crucial questions in understanding

- Who ?
- What ?
- Where ?
- When ?
- Why ?

# In clinical medicine, we're pretty good about asking four of these

- However, in a typical 10-minute office visit, there isn't time to ask
  - Where have you lived?
  - Where have you worked?
  - Where have you traveled?
- How might we empower the patient to give us this information?
- How might we then correlate it with what's known about disease contributors in that geography?
  - Not many physicians can keep in mind all the recent headlines "cancer risk rises for those near rail yards", or "asthma higher in children living near freeways"

# Making it part of our medical evaluation

- Do we consider these factors in our differential diagnosis?
- Typically, no
  - We don't pay attention to where the patient lives
  - We don't know where they have lived
  - We don't know the "topography of exposures"
  - We don't know how exposure correlates with risk

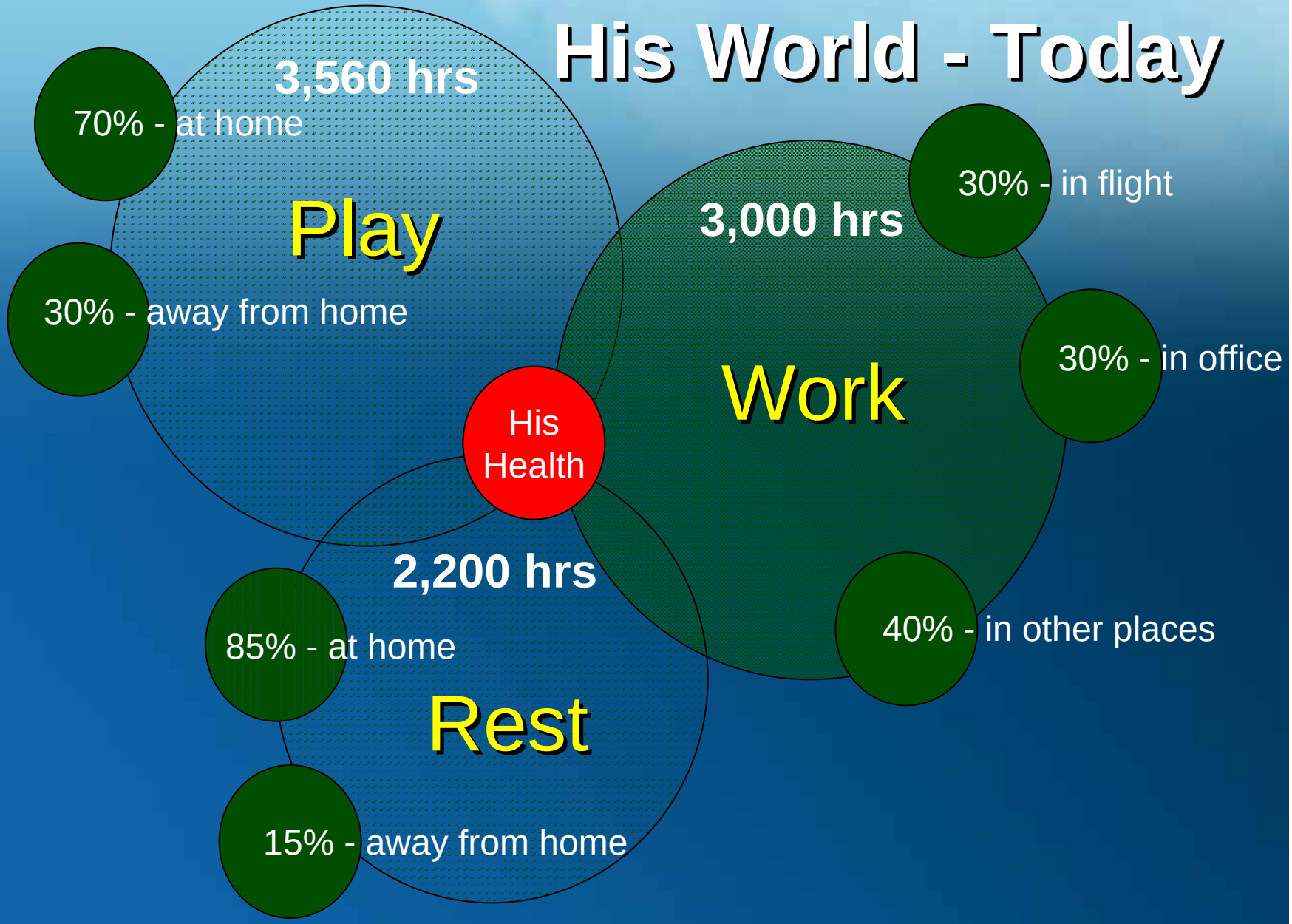
# But we can choose…

- “Ignorance is temporary, but stupidity is permanent”
  - An unnamed high-school guidance counselor
- Overcoming that ignorance:  How do we gain and correlate the knowledge, to make the link between place and risk/disease.

# Where they live

- Change from considering this a free-text field, to a computable, geo-coded entity.
- But hold on a moment – they might spend only 1/3 of their days where they “live”
- A friend’s “place log”

WFD1




**…the reality of linking human health with environment**

**WFD1** bill2172, 6/4/2007

# His Place History

| Place History | Years - Environmental Exposure | |
|---|---|---|
| • Scranton, Pa | 6 | (methane gas – air quality) |
| • Clarks Summit, Pa | 13 | |
| • Owensboro, Ky | 4 | |
| • Lexington. Ky | 2 | (nerve gas –air quality) |
| • Atlanta, Ga | 2 | (smog – air quality) |
| • Louisville, Ky | 23 | (smog & polyvinyl chloride – air/water quality) |
| • Redlands, Ca | 10 | (smog, perchloroate - air/water quality) |

**His "geographically relevant" or "place history" risks leads us to potential cardiovascular, pulmonary, and CNS health issues (Sources: ToxTown and ToxMap – NLM)**

***70% of his hours are in his community!***

***67% of his years have been spent in "compromised" environments!***

# Another place history

- Duration -- Location -- Risks
- 4 years – Ann Arbor - ??
- 7 years – rural Michigan -- ??
- 1 year – Mt Stromlo/Canberra -- ? Hydatid disease
- 1.5 year – Westwood/LA – funny tasting air
- 9 years – Malibu -- ?
- 4 years – Boston -- ?
- 4 years – San Francisco -- ??
- 11 years – Santa Barbara -- ??
- 4 years – Palos Verdes/Long Beach – oil refineries
- 3 years – Salt Lake City -- ??
- 4 years – SBA/LAX/ATL/BNA/FLL/MEM/NEW/YVR -- ???
- 5 years – Vista/Los Angeles - ??

# Where they have lived

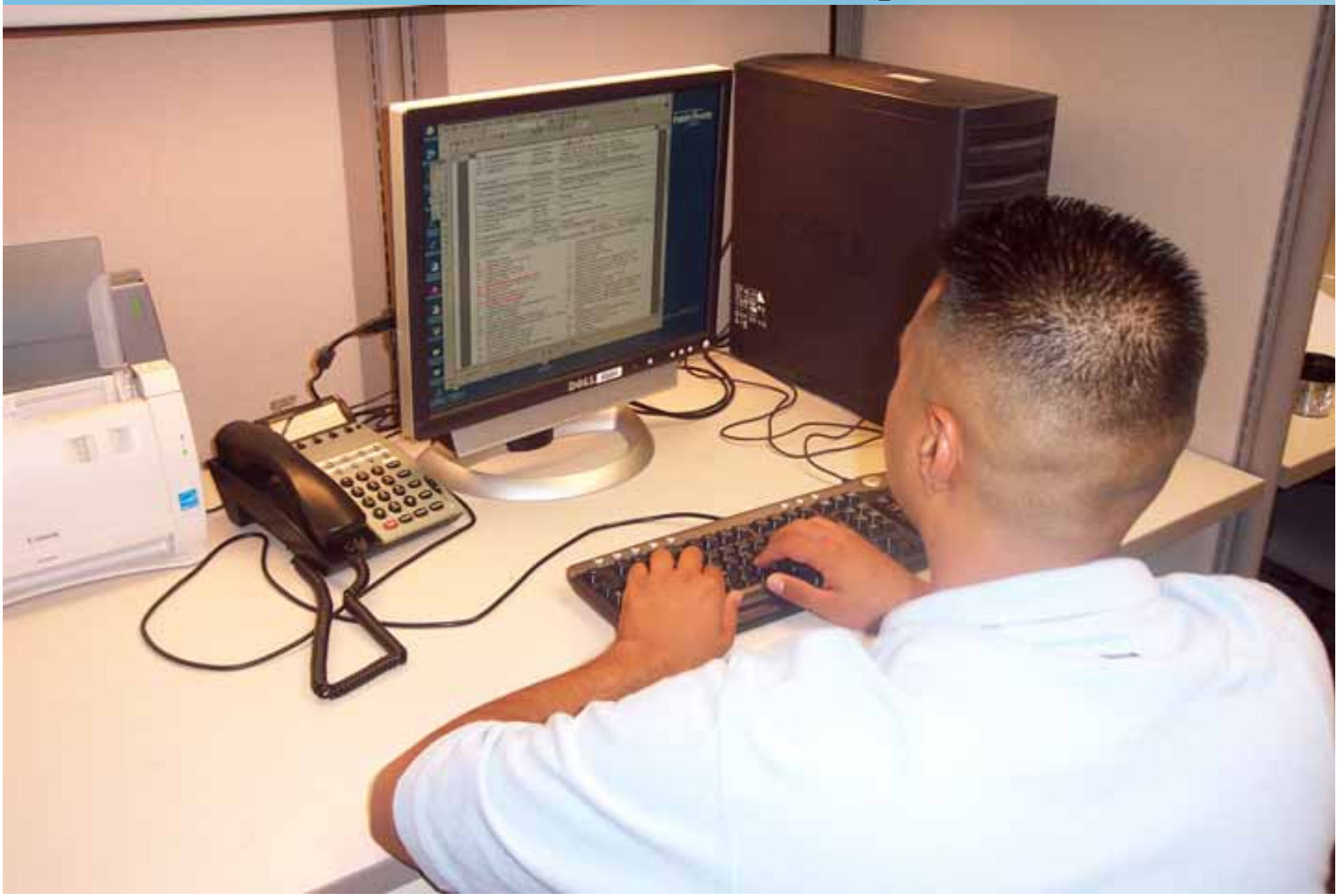
- The time has come to take a “place history”
- But where can we find the time in the exam room to take that history? …. We can’t!
- When is there time available?

# A place for place?

# Place history gathered in the waiting room

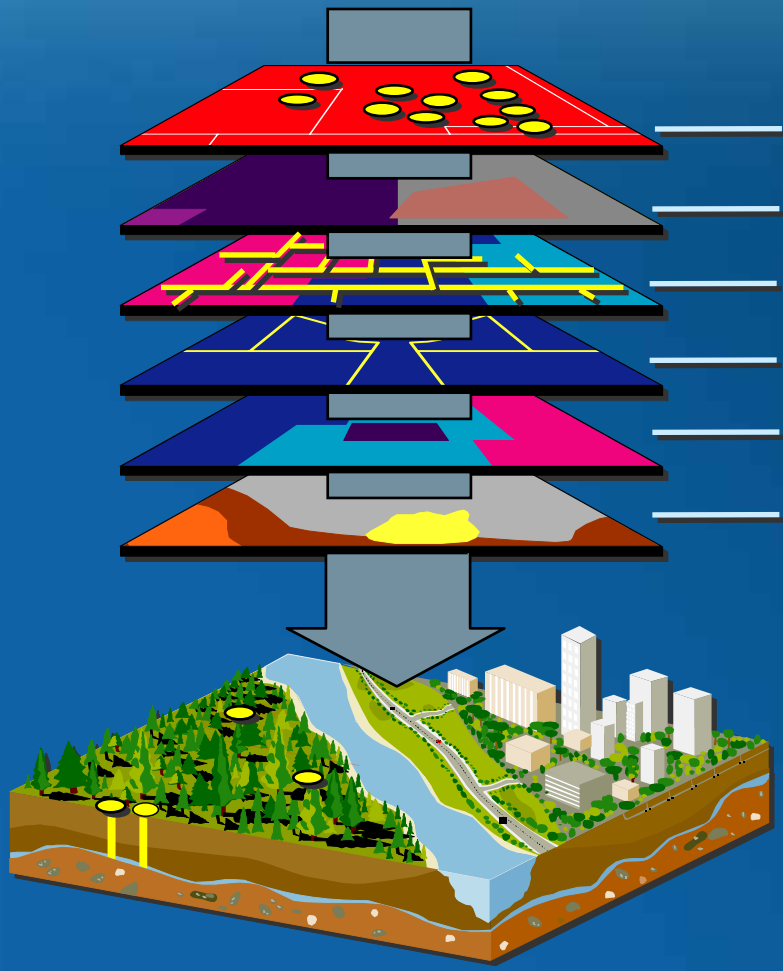
- The patient typically has several minutes per visit in the waiting room
- Ask them to sit at a workstation/kiosk that can gather their place history
- Codify/geo-code that place history

# A time and  tool for place



# GIS is a system for…

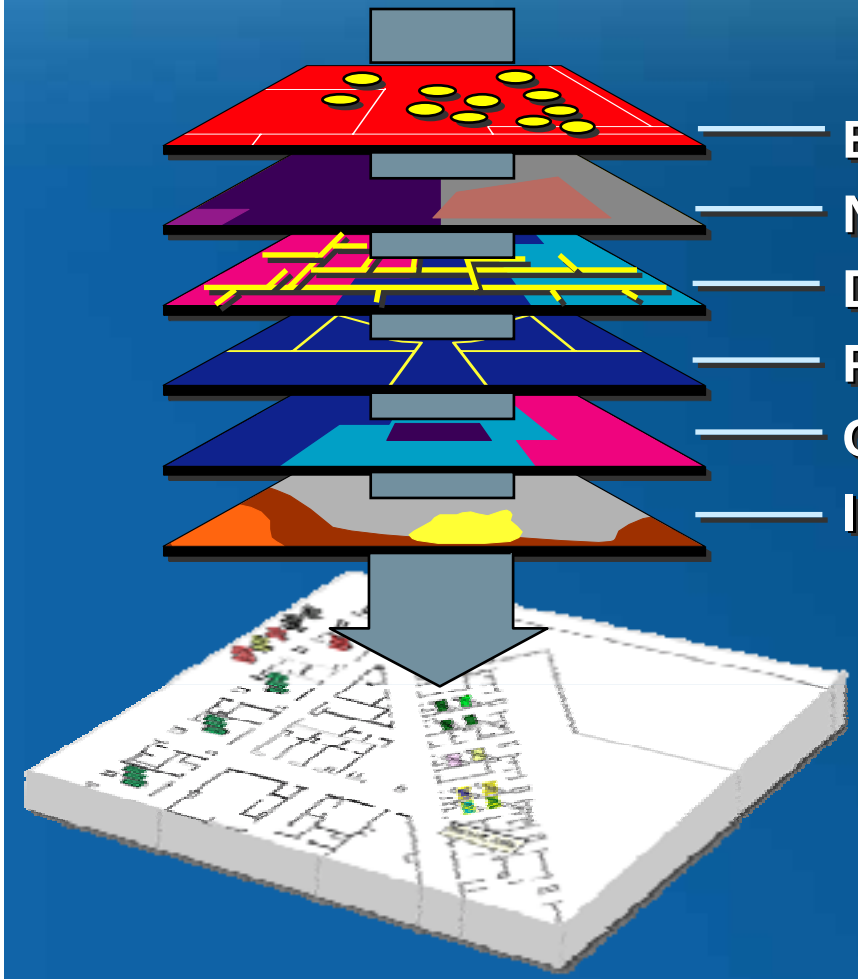
## integrating digital administrative health data



- Client and Patient Addresses
- Streets/Rivers/Land Features
- Hospital/Medical Center/ Clinics
- Postal Codes/Districts/County Councils
- Spatial Analysis – (i.e.travel times)
- Service Demand/Provider Density

**linking data to GEOGRAPHY**

# GIS is a system for...
## integrating digital health facility data

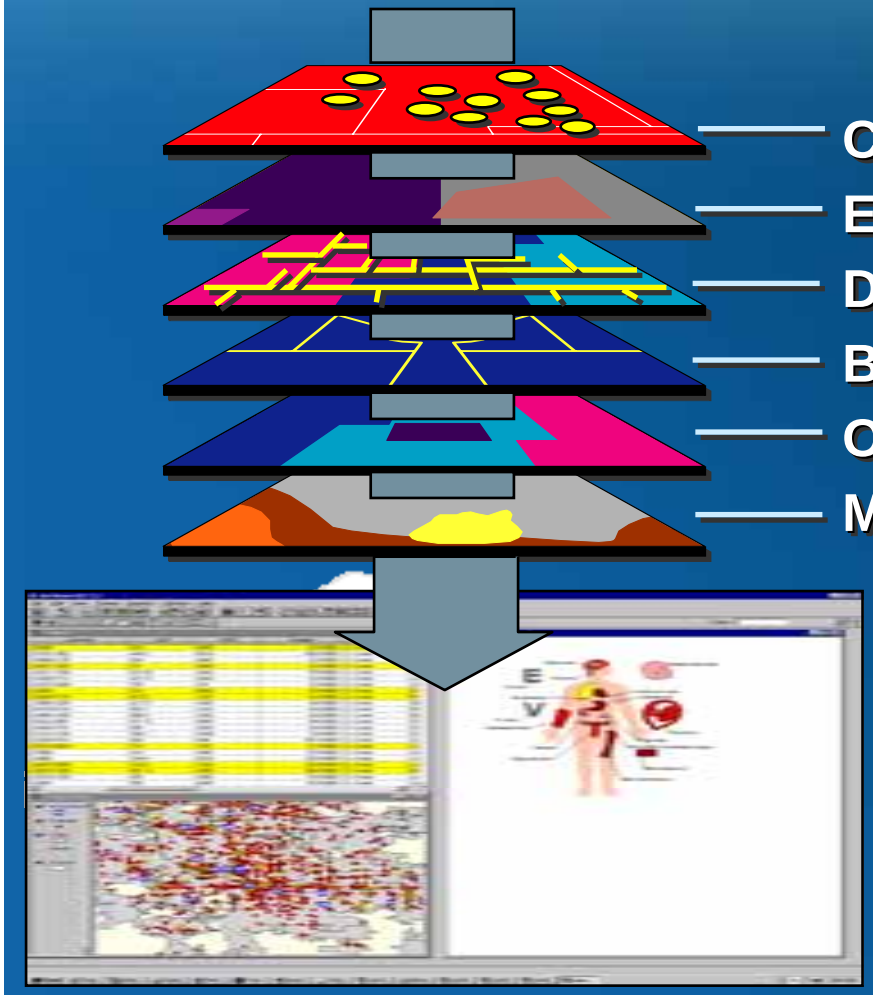


- Bed Location
- Nursing Units/Isolation Areas
- Dedicated Electric Circuits
- Fire and Smoke Sensors
- Occupancy Zones
- Infection Rates

**linking data to LOCATION**

# GIS is a system for…

## integrating digital personal health data to place

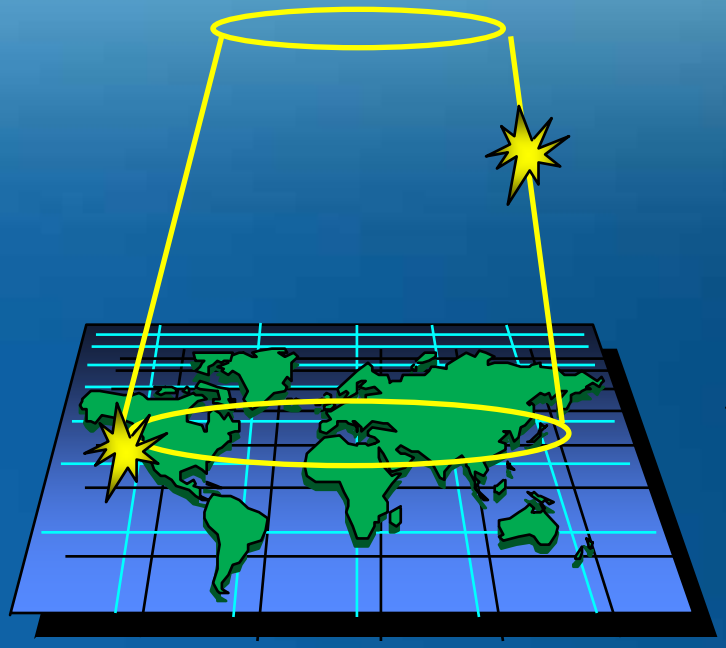


- Community Conditions
- Environmental Exposures
- Diagnostic “Place” History
- Behavioral Factors
- Outcome Measures
- Medical Threats and Risks

**linking data to PERSON**

# In the Real World we need to . . .

## See it all



Population Health

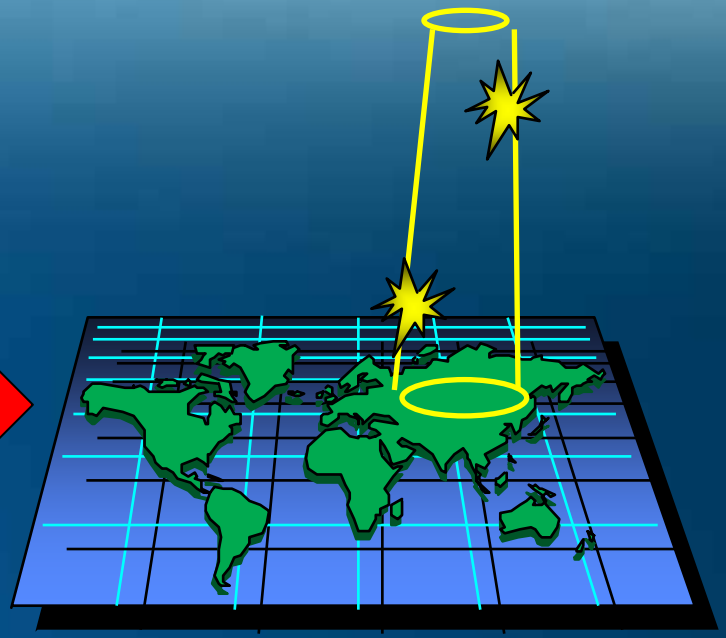
Health Demographics

Medical Networks

Global Resources

Global Problems

## See it in context



Individuals

Living Spaces

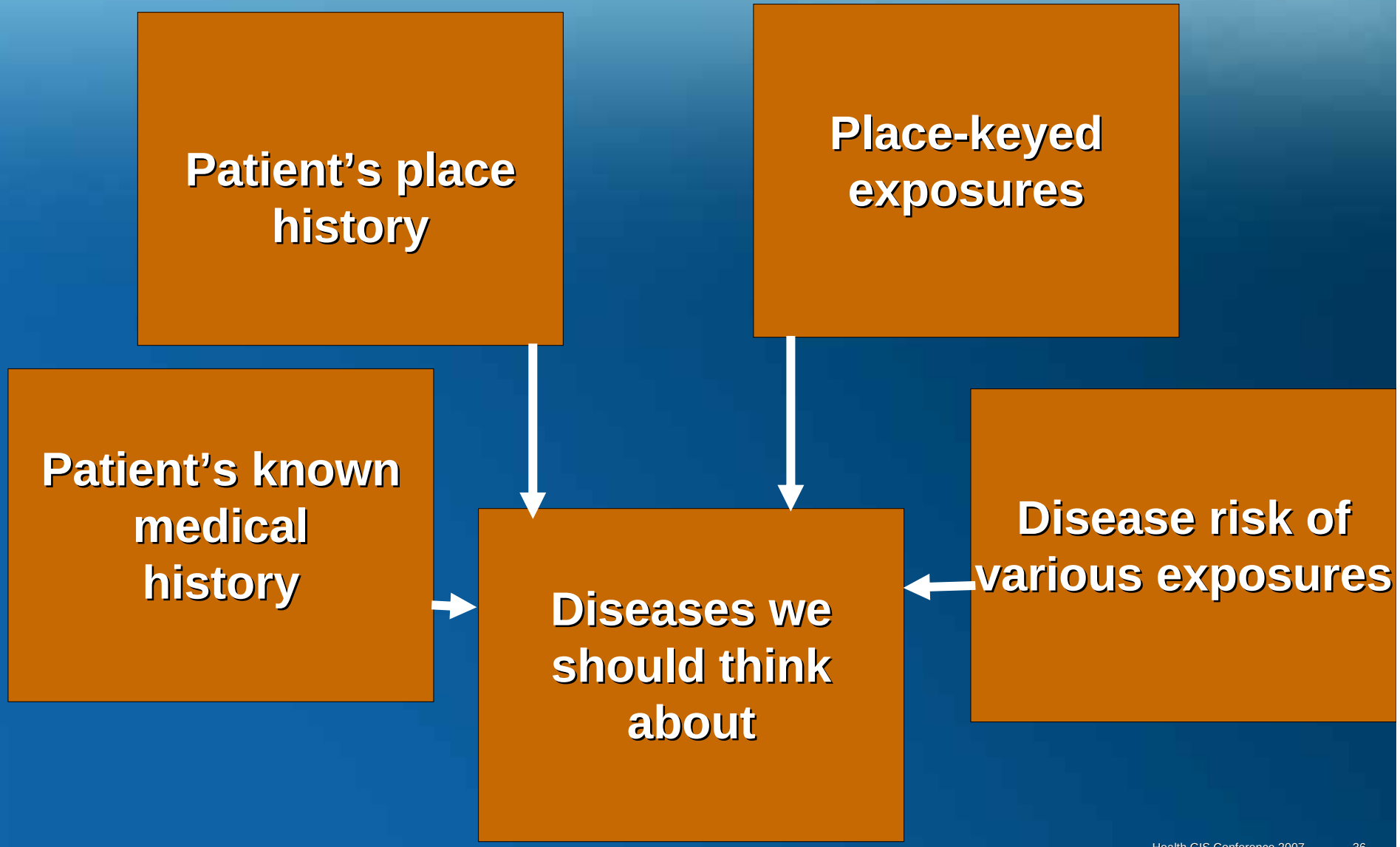
Local Facilities

Communities

Spot Exposures

..so the ability to scale within the context becomes essential!

# Bring together data from many sources



# Automated decision support

- We need tools to correlate our patient's place history with codified knowledge of established and emerging environmental factors.
- This knowledge can be applied in many settings
  - Primary care for 30 patients per day
  - Working to improve the health of 10 million people.

# Thank you !

**Ray Aller, MD**

**raller@ladhs.org**

**213-989-7208**