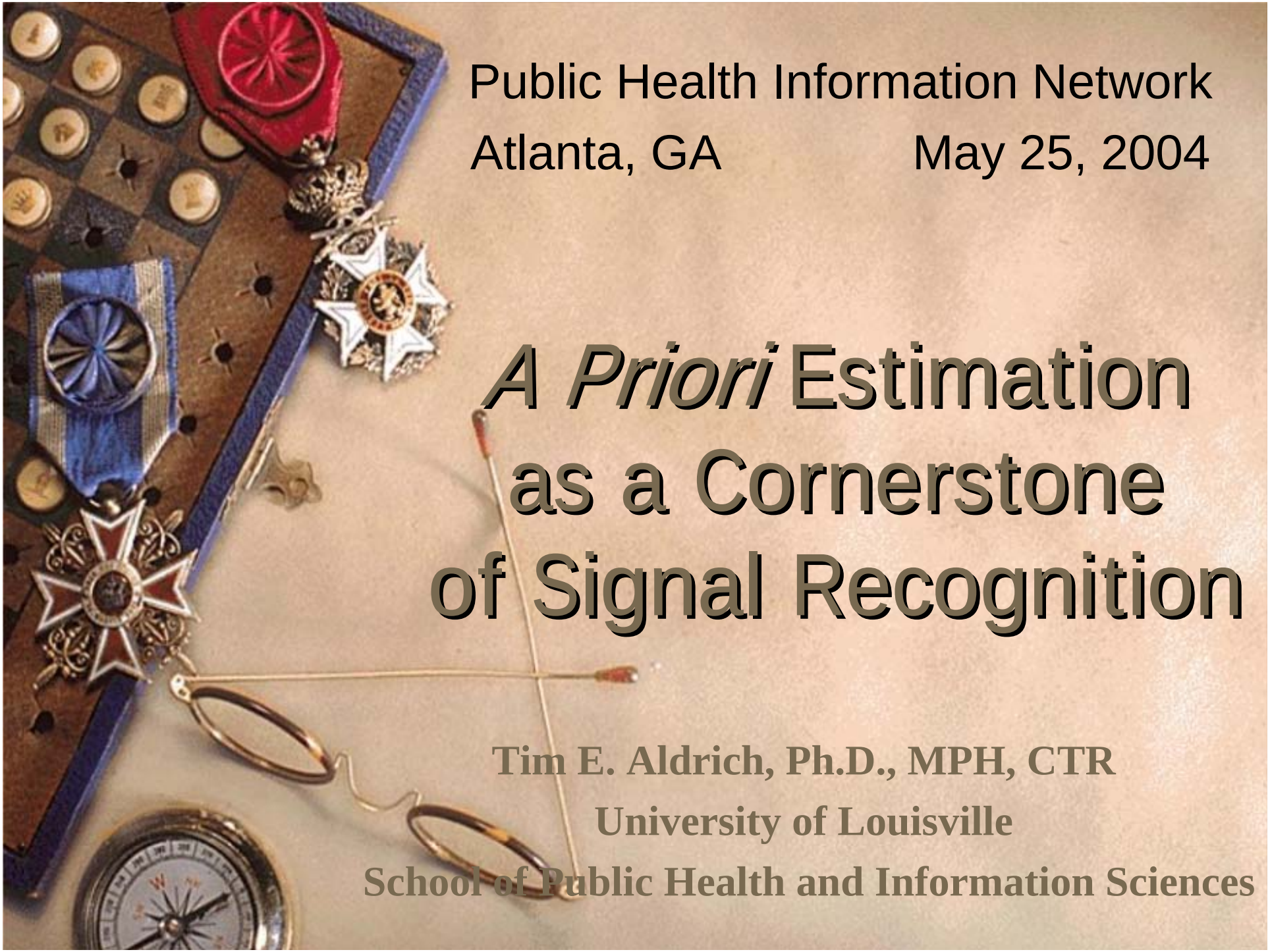


Public Health Information Network

Atlanta, GA May 25, 2004

A Priori Estimation as a Cornerstone of Signal Recognition

Tim E. Aldrich, Ph.D., MPH, CTR

University of Louisville

School of Public Health and Information Sciences

"Good surveillance does not necessarily ensure the making of right decision, but it reduces the chances of the wrong ones."

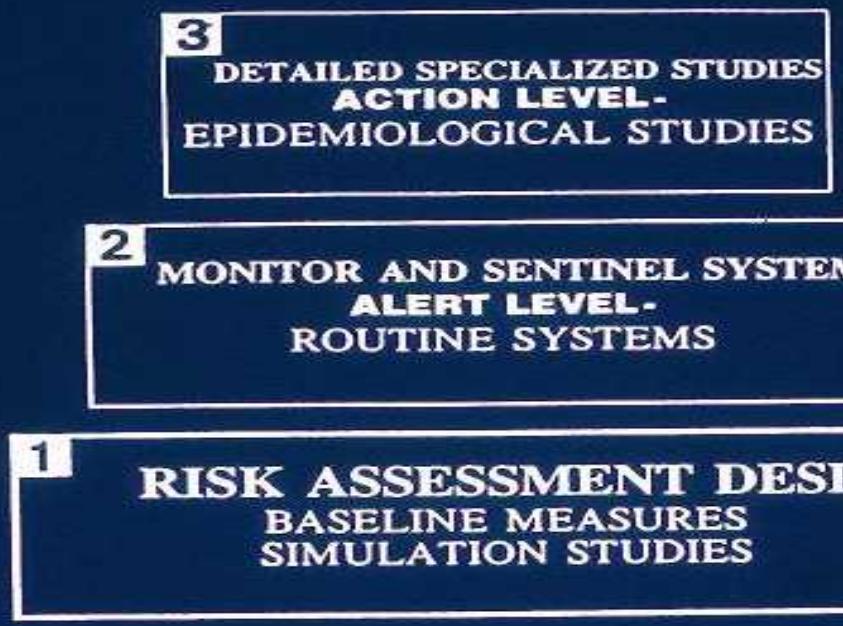
Alexander Langmuir, MD, MPH; Director of Epidemiology for CDC from 1949-1969

Surveillance: A state of continuing watchfulness: the systematic collection, analysis, and dissemination of data on adverse health outcomes occurring in a defined population.

Lowell Sever, Ph.D.

CDC, 1986

Figure 4. Three Tiered Information Capability.



Source: Glasser, J. H. Health Statistics Surveillance Systems for Hazardous Substance Disposal, *Proceedings of the 1985 Public Health Conference on Records and Statistics*, National Center for Health Statistics; DHHS Publ No. (PHS) 86-1214.

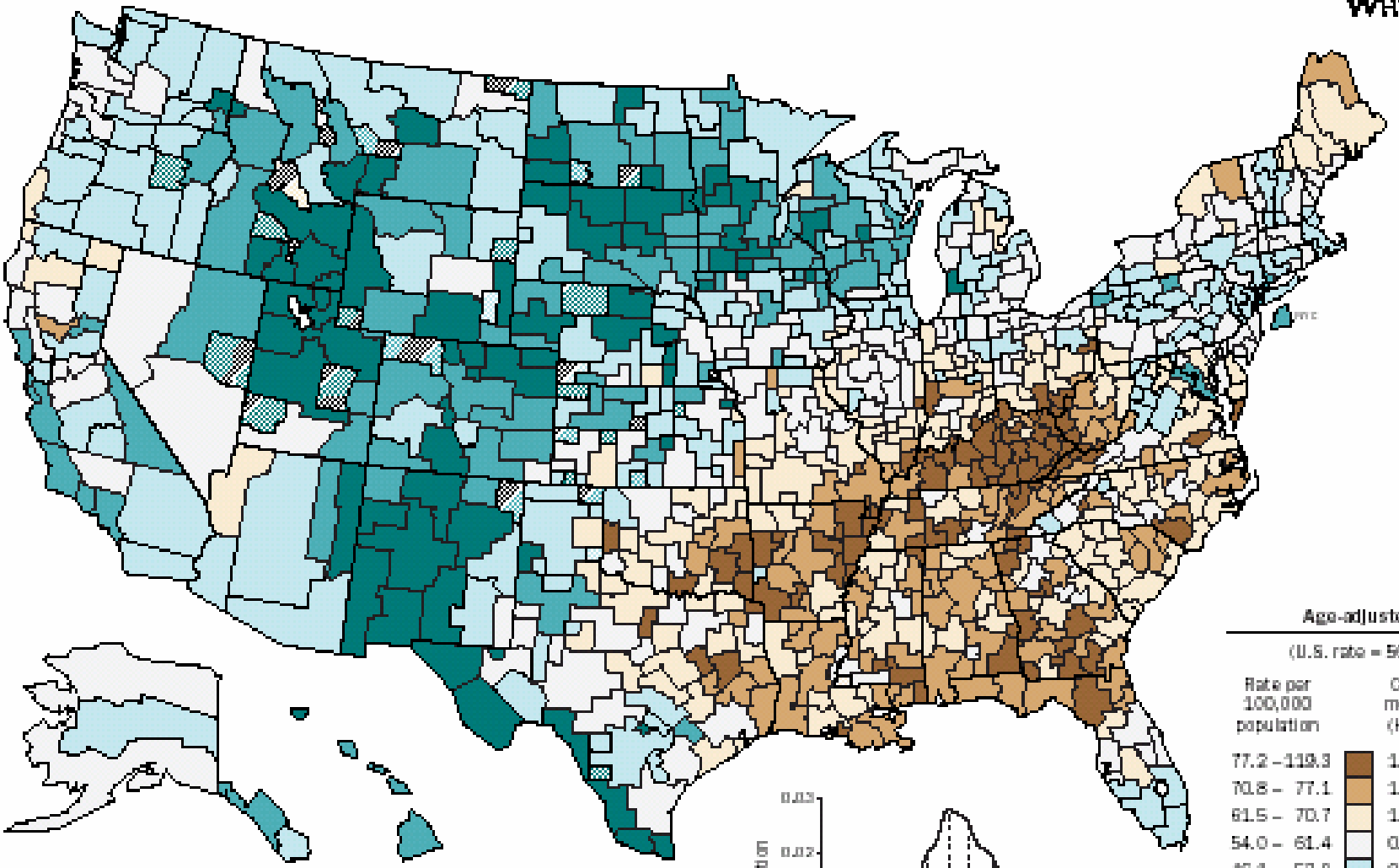
"The closer the [geographic] approach, the more rates should increase, if the data are sensitive to the underlying causal process."

Dr. Tom Mason, USC SPH

Tampa, FL. February 14, 1995

Age-adjusted death rates by HSA, 1988–92

Lung cancer
White male

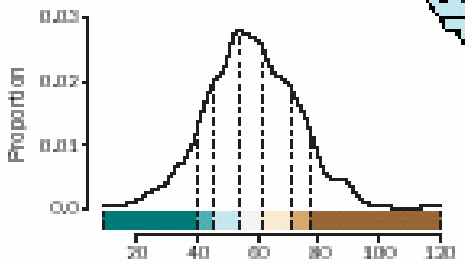


Age-adjusted

(U.S. rate = 56.1)

Rate per 100,000 population	Comparative mortality ratio (HSA to U.S.)
77.2 – 119.3	1.38 – 2.13
70.8 – 77.1	1.26 – 1.38
61.5 – 70.7	1.10 – 1.26
54.0 – 61.4	0.96 – 1.10
46.1 – 53.9	0.82 – 0.96
40.0 – 46.0	0.71 – 0.82
9.4 – 39.9	0.17 – 0.71

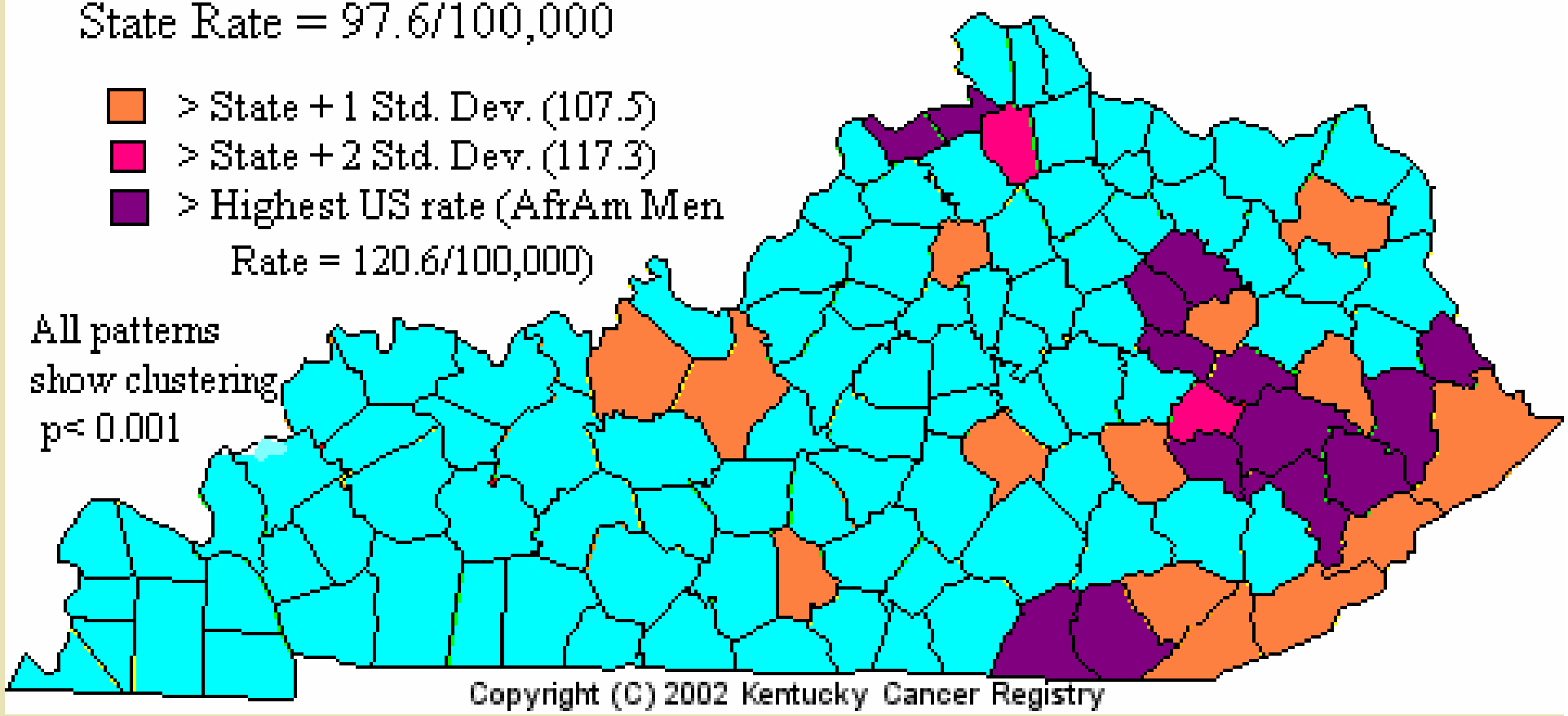
Hatching indicates sparse data

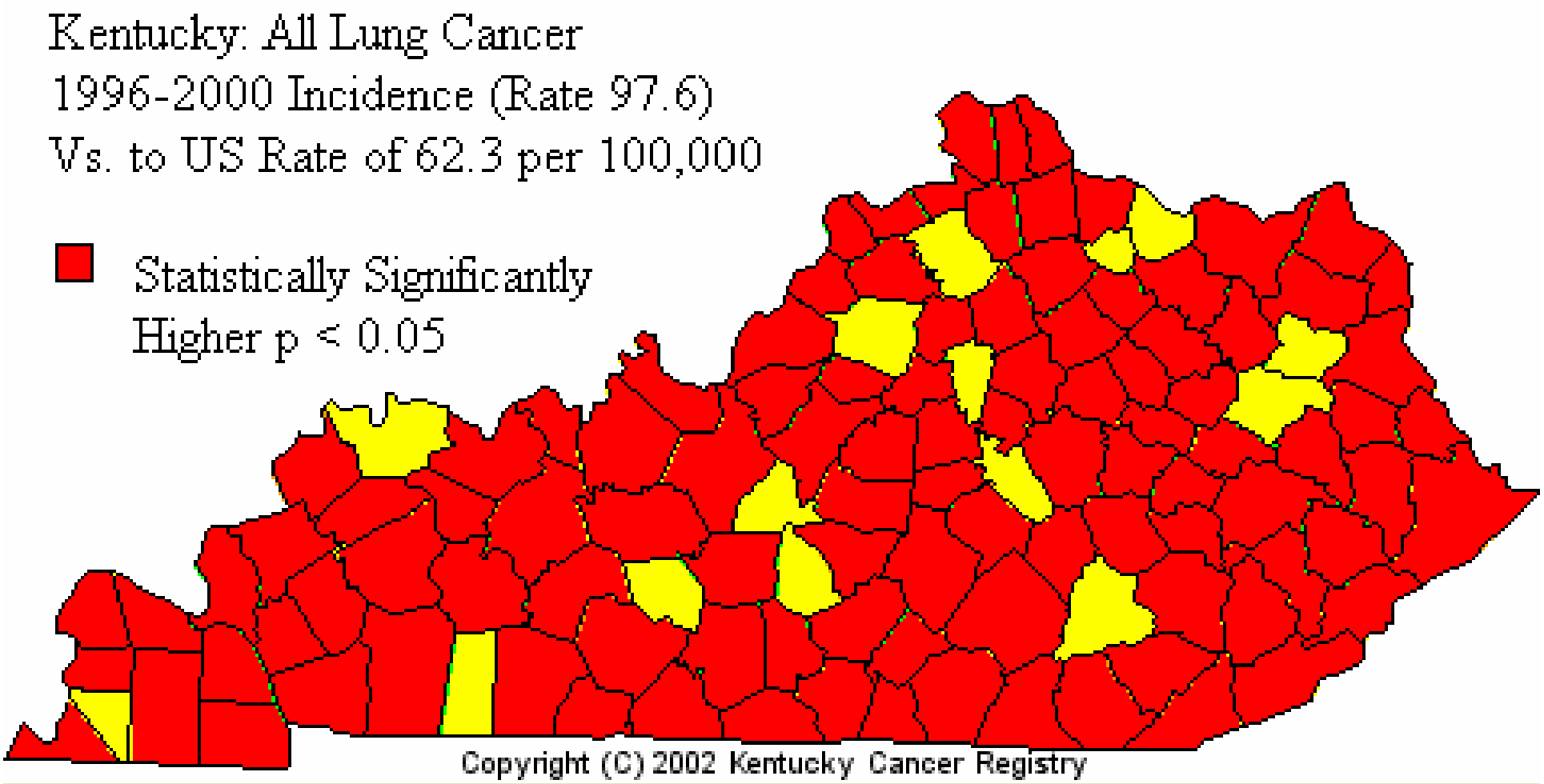


ICD-9 Category 162

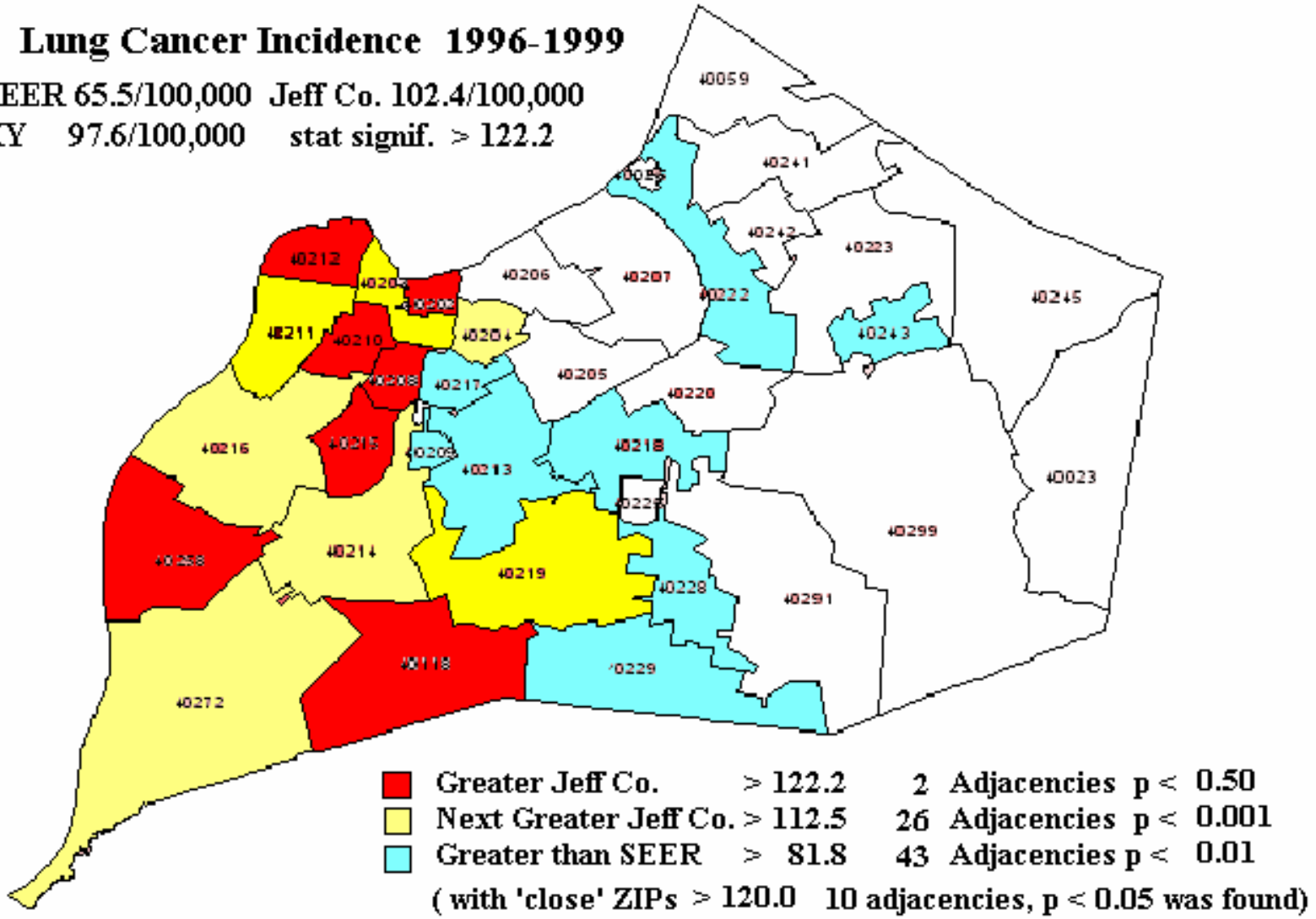
SOURCE: CDC/NCHS

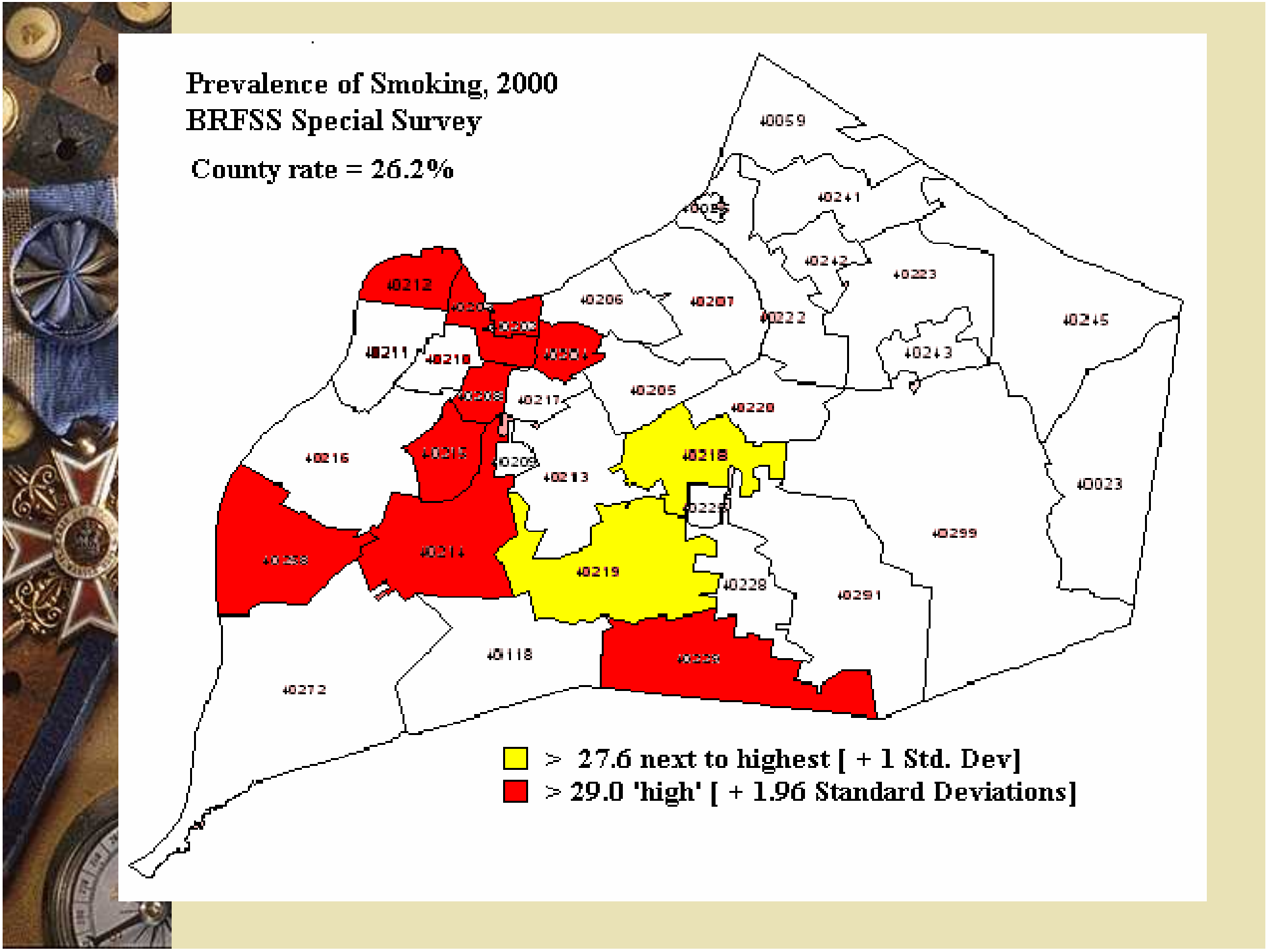
Kentucky Lung Cancer Incidence 1996-2000



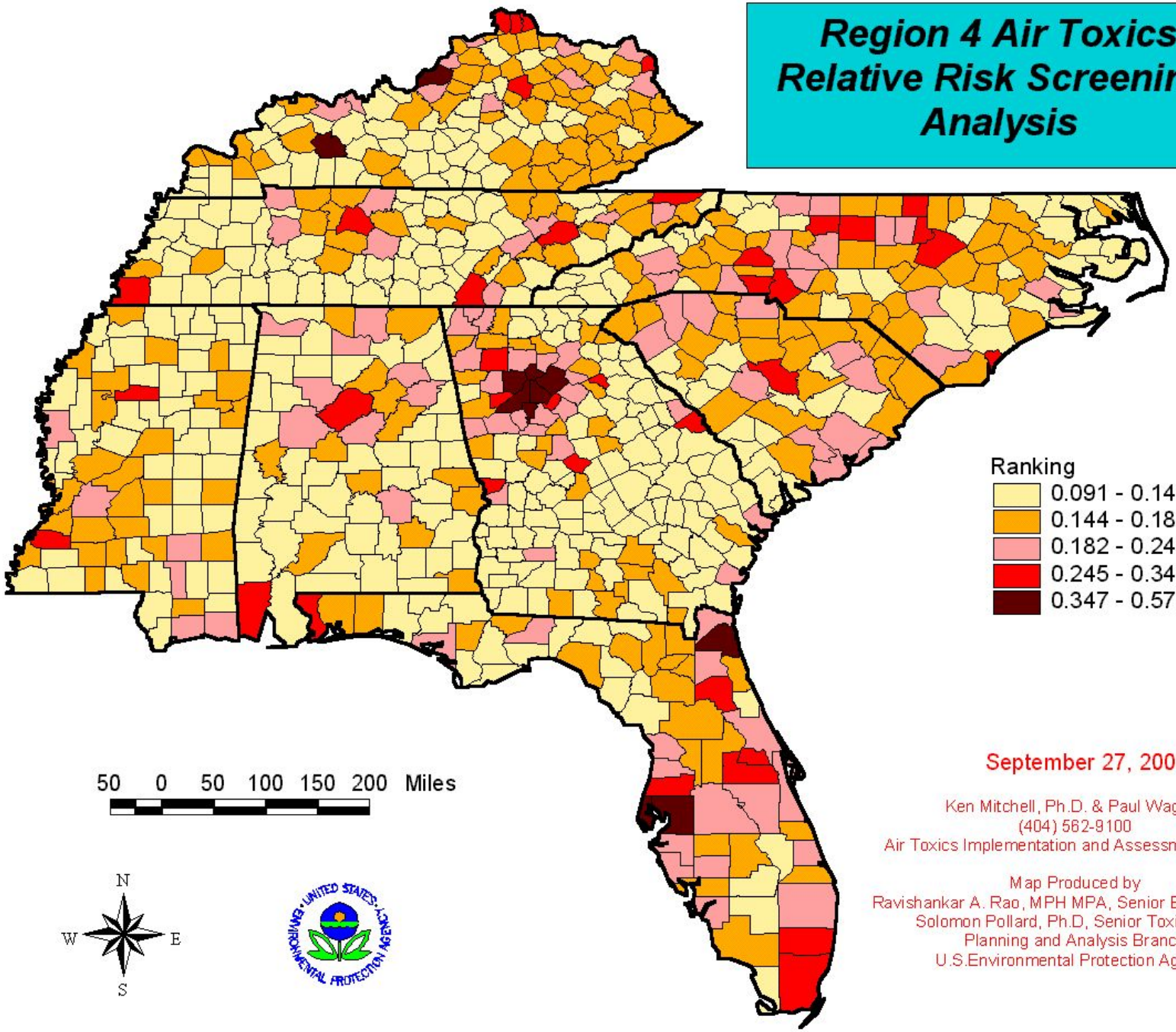


105 of the 155 nation's highest lung cancer rates by county are in KENTUCKY


Lung Cancer Incidence 1996-1999
SEER 65.5/100,000 Jeff Co. 102.4/100,000
KY 97.6/100,000 stat signif. > 122.2
40059
40241
40242
40223
40245
40206
40207
40222
40243
40204
40205
40220
40023
40216
40213
40218
40299
40214
40219
40228
40291
40272
40229
Greater Jeff Co. > 122.2 2 Adjacencies p < 0.50
Next Greater Jeff Co. > 112.5 26 Adjacencies p < 0.001
Greater than SEER > 81.8 43 Adjacencies p < 0.01
(with 'close' ZIPs > 120.0 10 adjacencies, p < 0.05 was found)


Prevalence of Smoking, 2000
BRFSS Special Survey
County rate = 26.2%
40059
40241
40242
40223
40245
40207
40222
40243
40206
40212
40211
40218
40205
40217
40220
40216
40215
40213
40218
40023
40299
40214
40219
40228
40291
40118
40272
> 27.6 next to highest [+ 1 Std. Dev]
> 29.0 'high' [+ 1.96 Standard Deviations]

Region 4 Air Toxics Relative Risk Screening Analysis

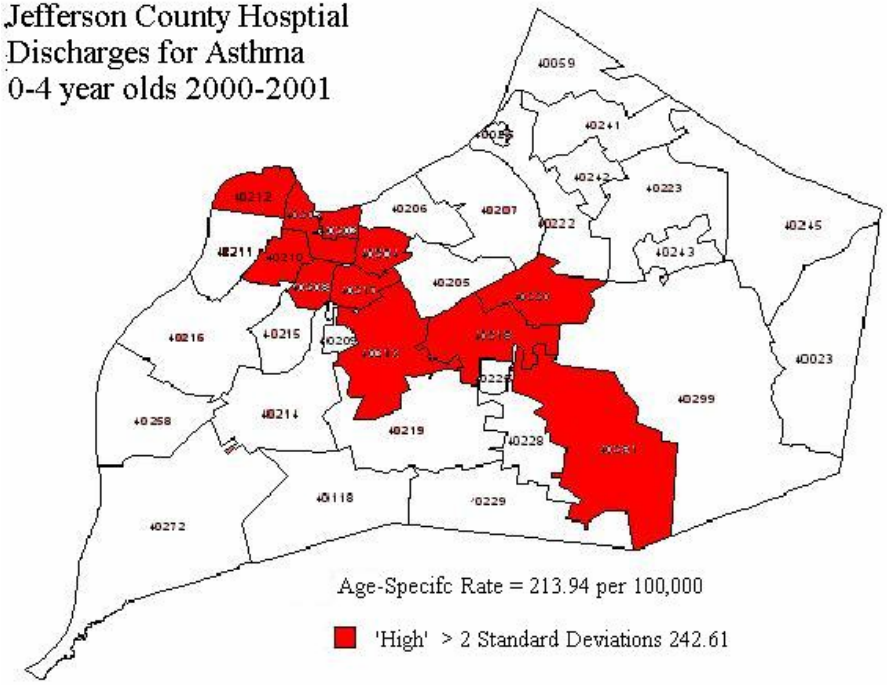


September 27, 2002

Ken Mitchell, Ph.D. & Paul Wagner
(404) 562-9100
Air Toxics Implementation and Assessment Section

Map Produced by
Ravishankar A. Rao, MPH MPA, Senior Epidemiologist
Solomon Pollard, Ph.D, Senior Toxicologist
Planning and Analysis Branch
U.S.Environmental Protection Agency

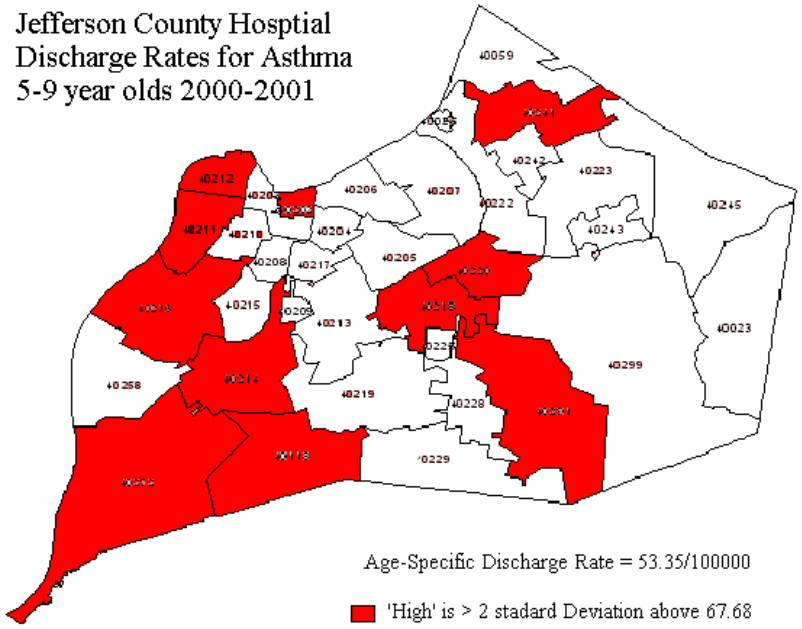
Jefferson County Hosptial
Discharges for Asthma
0-4 year olds 2000-2001



Age-Specifc Rate = 213.94 per 100,000

'High' > 2 Standard Deviations 242.61

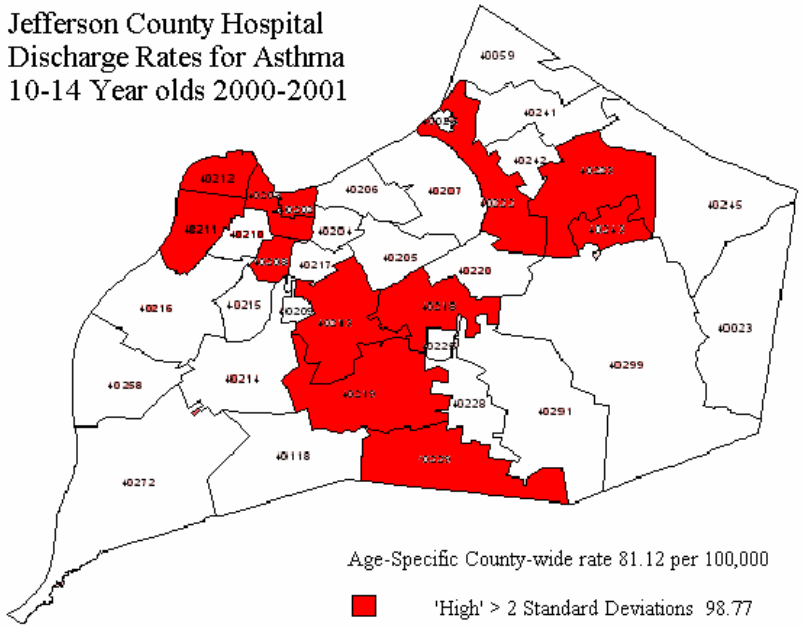
Jefferson County Hosptial
Discharge Rates for Asthma
5-9 year olds 2000-2001



Age-Specific Discharge Rate = 53.35/100000

'High' is > 2 stadard Deviation above 67.68

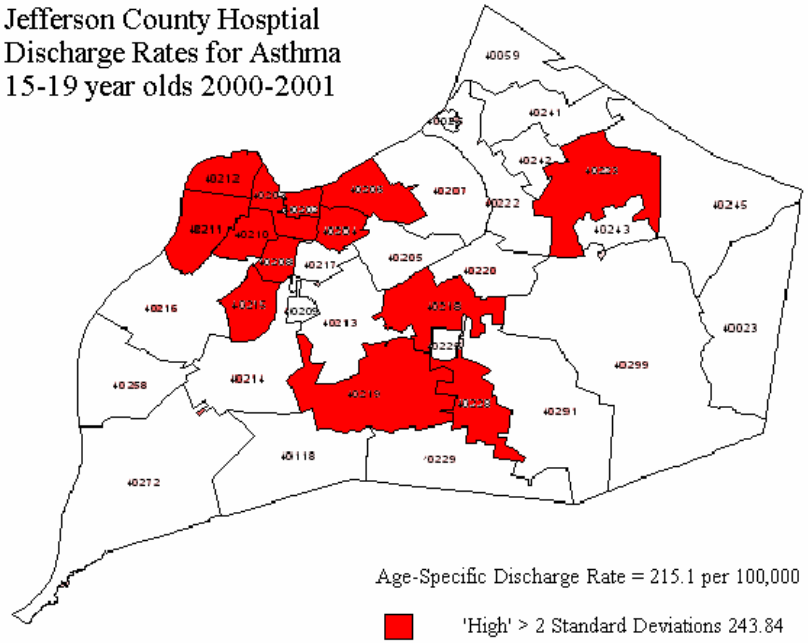
Jefferson County Hospital
Discharge Rates for Asthma
10-14 Year olds 2000-2001



Age-Specific County-wide rate 81.12 per 100,000

'High' > 2 Standard Deviations 98.77

Jefferson County Hosptial
Discharge Rates for Asthma
15-19 year olds 2000-2001

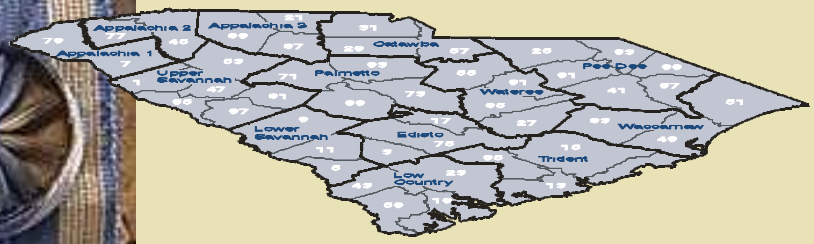


Age-Specific Discharge Rate = 215.1 per 100,000

'High' > 2 Standard Deviations 243.84

Deaths	Tier II Analyses	State Level Data
Hospitalizations	Drill Down	District Level
Emergency Dept		County Level
Un-Scheduled Visits	Feed Back	ZIP Code
Scheduled Visits	Tier I Analyses	Community Level
Diminished HRQoL		Case-specific

Sequential Spatial Stochastic Curtailment



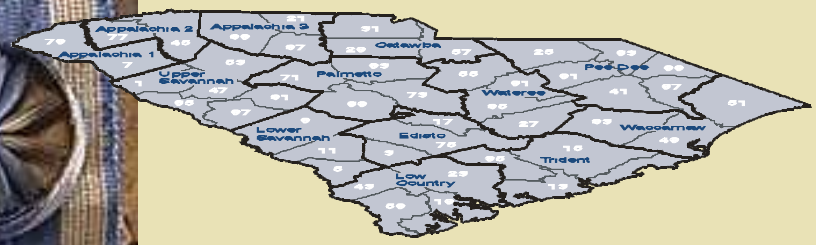
Established Risk Factor:
Smoking for Lung Ca
SMR = 2.1 p = 0.12

Regional Risk for AA
SMR = 4.6 p < 0.10

County AA Males 45-64 yo
SMR = 6.5 p < 0.01

Cluster in Specific Community

Sequential Spatial Stochastic Curtailment



This same progressive logic over a probability surface may be connected to disease cluster analyses for cell occupancy using a negative binomial solution

$$\Pr = \frac{\left[\begin{matrix} n \\ m \end{matrix}\right]}{m^n} [m-1]^{n-k}$$

The sequential search for a recurring rare [or aberrant] event in a small area, over time.

Sequential Spatial Stochastic Curtailment

Conceive eventual multi-variate regression perspective [individual or community units]

$$X_1 + X_2 + X_3 = \beta_1 Y_1 + \beta_2 Y_2 + \beta_3 Y_3 + \beta_4 Y_4 .... + e$$

HRQoL Mortality Morbidity Race Smoking Access Education
(Disability) (Community Indicator)

"To understands God's thoughts, we must study statistics, for they are the metric of his design."

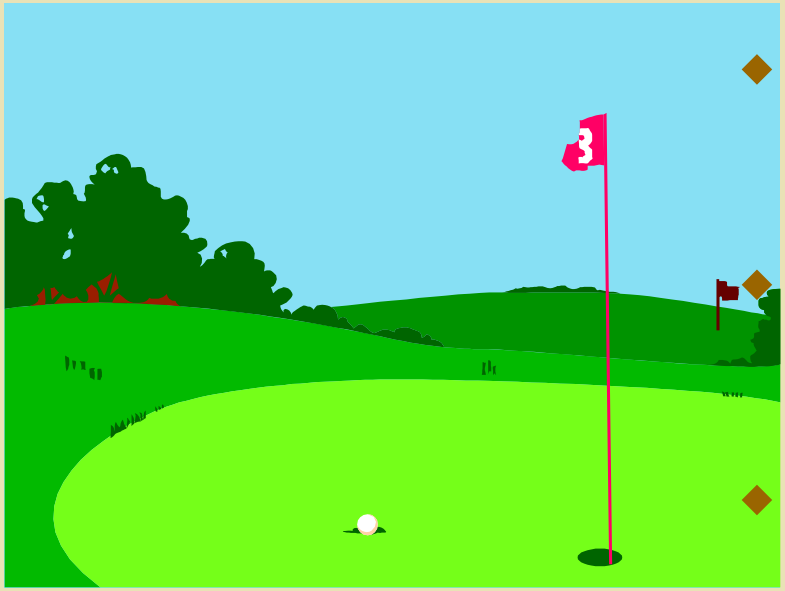
Florence Nightingale, 1820-1910. "the Lady with the Lamp."
Served in the Crimean War 1854-56. Fellow of the Royal Statistical Society (1858) and the American Statistical Association (1874).

Spatial & Probabilistic Progression

- Utilizes expanding GIS capabilities
- Applies ‘prior’ distributions from over-lapping, or larger geographic areas
- Linking logical continuums of the disease/ exposure/outcomes spectrum
  - access issues , e.g., behavior, attitudes, detection, treatment, survival,
  - environmental exposure patterns,
  - and using strategic population sub-groups, e.g., age, race, gender

Sorta Like the Logic of Golf

- Progressive targeting



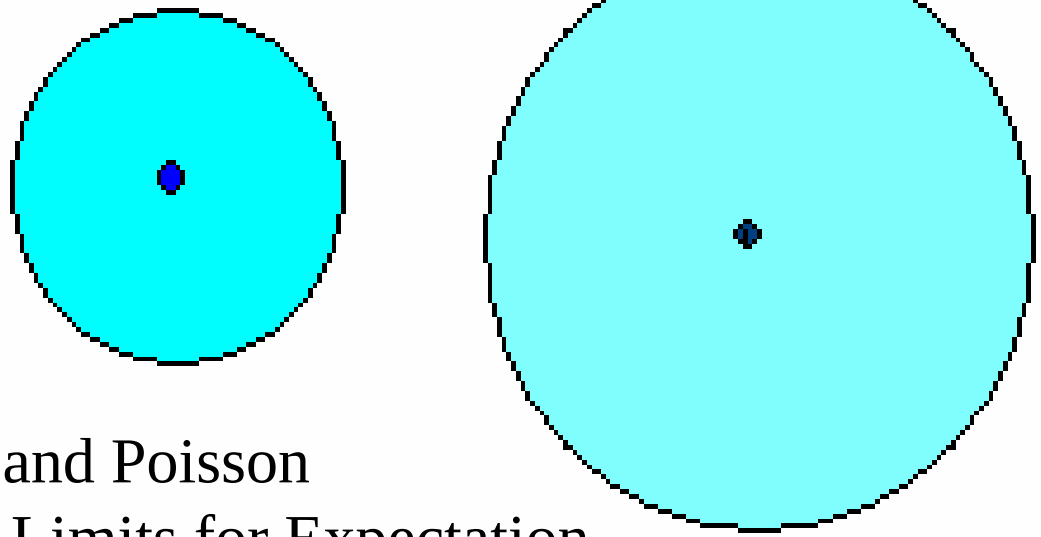
- Changing clubs
- Narrowing Objective
- Eventual Success

Hence our acronym…**Fore**: Finding of Regional Effect

t to Z

Use [semi] Bayesian Reasoning to derive a MLE

Reason with variance of MLE to determine signal



Community-level observed

State Rates and Poisson Confidence Limits for Expectation

Can not get more cases, but can get more data.

Ideas from: Clinical Trails and GIS

- Sequential [play the winner] techniques
  - Armitage, P. Sequential Clinical Trails. 1975
- Stochastic Curtailment
  - Davis BR Hardy RJ *JClinEpid.47(9):1033-42,1994*
- Recursive Partitioning
  - www.recursive-partitioning.com
- Geographic Methods for Adjacency
  - Grimson R. *Math.Biosc.*46:257-78.1979.; and Lawson, AB. Stat Methods in Spatial Epid. 2001
- Geographic Methods for Classification
  - Brewer CA and Pickle L. Annals Assoc. Am. Geographers. 92(4):662-81. 2002

Forms of Dissemination

Marketing

MESSAGE ⟷ Communication

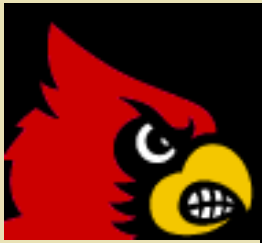
Advocacy

"The reason for collecting, analyzing, and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow."

Foege, Hagan, Newton: International Journal of Epidemiology, 5: 29-37. 1976.

Contact: Tim E. Aldrich, Ph.D., M.P.H.
School of Public Health and Information Sciences
University of Louisville 555 So. Floyd Street
Louisville, KY 40292
Voice: 502-852-3006 Fax: 502-852-3294
E-mail: tealdr01@gwise.louisville.edu

UK UNIVERSITY of KENTUCKY



UNIVERSITY of LOUISVILLE
dare to be great

UNIVERSITY OF SOUTH CAROLINA

'Its amazing what you can see when you look..." Yogi Berra

Sentinel Health Event:

A preventable disease case, disability, or untimely death whose occurrence serves as a warning signal.

Information Accumulation

Number of cases	Appreciated Observations	Your Reaction	Population at Risk	
One	Rareness Implications	"Ah Ha!"	City? County? ADD? State?	100,000; 250,000; 500,000; 4,000,000
Two	Sequence Timing	"Well Damn…"	Reduce the population at risk to shared traits	County, gender, age, school
Three	Statistical Significance [Hardy et al, AJE,1990]	"Here we go!"		

Indicators are designed for circumstances where one case will not convince you to action, but patterns may be compelling.

Figure 8. Summary Table Of The Number Of Deaths Required (Or The Magnitude Of SMR Required) For An Alert* Or Action To Be Taken For Various Values Of The Expected Number Of Deaths

Expected Number of Deaths	Number of Deaths For an Alert	For Action
0.050	1 (20)**	3 (60)
0.100	2 (20)	3 (30)
0.200	2 (10)	4 (20)
0.400	2 (5)	4 (10)
0.500	2 (4)	5 (10)
1	3 (3)	6 (6)
2	5 (2.5)	9 (4.5)
4	8 (2)	12 (3)
5	9 (1.8)	14 (2.8)
10	15 (1.5)	22 (2.2)
15	21 (1.4)	29 (1.93)
20	26 (1.3)	36 (1.8)
25	33 (1.32)	43 (1.72)
30	38 (1.27)	49 (1.63)

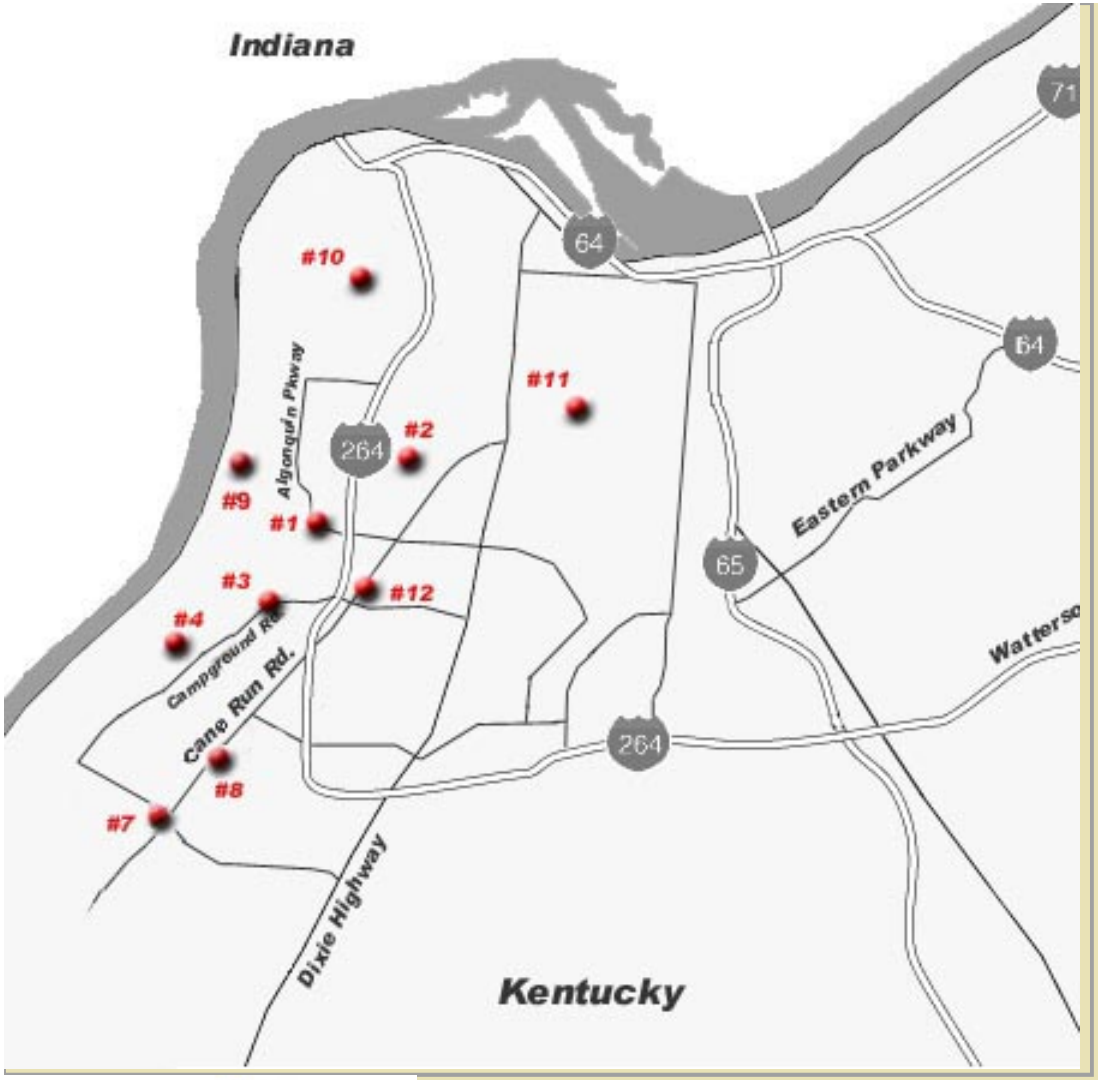
*Action and alert levels correspond to $p_2 = 0.001$ and $p_1 + p_2 = 0.09$ for a two-year error level of 0.01.

**( ) corresponding SMR associated with the specified expected number of deaths and observed number of deaths.

Source: Hardy, RJ., *Monitoring for Health Effects of Low-Level Radioactive Waste Disposal: A Feasibility Study*, 1983.

Geographically referenced Environmental and Health Datasets

- ED Admissions
- Environmental Data
  - Weather
  - Air pollutants
- Census data



There are a variety of community and agency responses to this concern for air quality. The report from these local monitoring locations (2001-2002) is expected shortly.

Kentucky Pollution Prevention Center

http://www.kppc.org/ejp2/air_quality/sites/index.cfm

f09902