Cancer Clusters
“What are we afraid of?”

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Outline

- Introduction and background
- Public health role
- Major clusters in recent times
- Modest Successes
- Future directions

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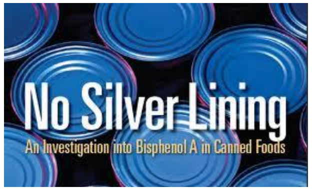
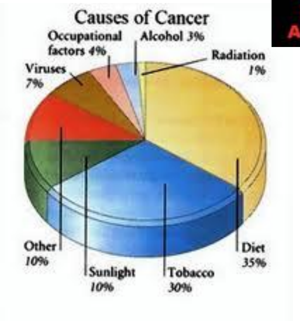
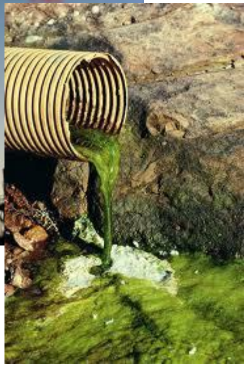
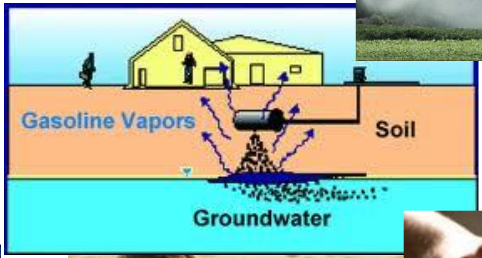
Let's start with what's on everyone's mind…

- **Since the beginning of the industrial age consequential exposure to by products of modernization have been associated with ill effects to human health**
- **Recent studies suggest that evidence in the fossil records and early humans support the theory of "modern carcinogens"**
  - David, Nature Rev Cancer 2010









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Current Events – Hungarian Toxic Mud spill

"Residents have reported burns and eye irritation…The National Disaster Management Directorate announced the sludge (a waste product in aluminum production) contains heavy metals, including lead, and that its dust can cause lung damage, including cancer…
It is toxic if ingested."

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NPR October 6th 2010

Historical Examples

- **Work-related cancer clusters are well documented in the medical literature.**
  - scrotal cancer among chimney sweeps in 18th century London
  - osteosarcoma among female watch dial painters in the 20th century
  - skin cancer in farmers
  - bladder cancer in dye workers exposed to aniline compounds
  - leukemia and lymphoma in chemical workers exposed to benzene
- **In 2007, Delaware health officials confirmed the presence of a cluster of cancer near the Indian River Power Plant.**
  - The News Journal reported that the rate of cancer cases in the area is 7 percent higher than the national average
    - The state study was released to Lt. Gov. John Carney, who requested the report
  - The same article noted that "the Division of Public Health is unlikely to study the matter further. The Department cited a lack of resources" as well as the difficulty of "pinning down” a precise environmental cause.

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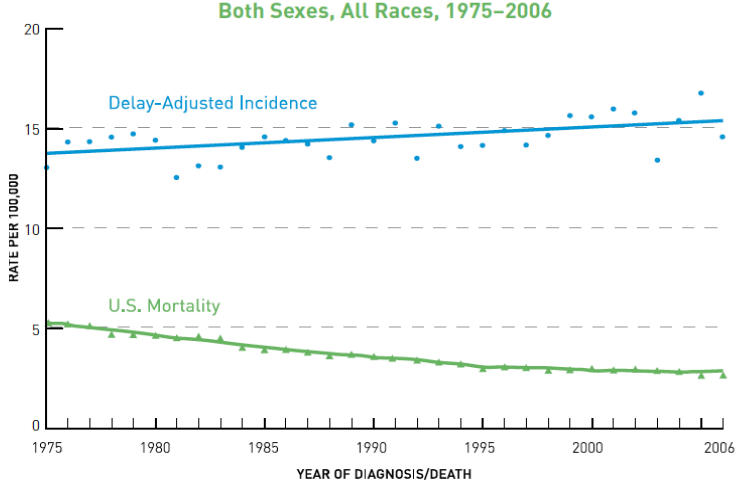
Cancer facts; National Cancer Institute. U.S. National Institutes of Health
Associated, Press (August 6, 2007), "Cancer cluster found near power plant”

Childhood Cancer Incidence in the USA

- **12,500 newly diagnosed case of childhood cancer annually**
- **Childhood cancer remains leading cause of disease related mortality in children**
- **Confirmed risk factors for childhood cancer are few**
  - Growing body of evidence suggests environmental exposures play a role

SEER Delay-Adjusted Incidence and U.S. Mortality
All Childhood Cancers, Under 20 Years of Age
Both Sexes, All Races, 1975–2006



Source: SEER 9 areas and U.S. Mortality Files, National Center for Health Statistics, Centers for Disease Control and Prevention. Rates are age-adjusted to the 2000 U.S. Std Population (19 age groups—Census P25-1103).

Regression lines are calculated using the Joinpoint Regression Program Version 3.3.1, April 2008, National Cancer Institute.

Delay-adjusted incidence is an algorithm used to estimate incidence if it were unaffected by reporting delays.

Bunin, Toxicol Appl Pharmacol 2004

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Presidential Cancer Panel - May 2010

"The true burden of environmentally induced cancers has been grossly underestimated."

- **Recommendations to conduct new or updated assessments of current occupational and environmental exposures**
  - Specifically focused assessment of childhood exposures

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Environmental links and cancer clusters

- **Little is known about specific environmental triggers or thresholds between safe and unsafe exposures in children**
- **Prior statistical methods have not proven any links between the environment and cancer**
  - Studies have not been able to refute the link as well
  - Prior methodologies may have had issues separating possible causes from confounding factors

Kulldorff, Am J Prev Med 2006
Gregario, Urology 2004

Cancer Clusters a Definition

- ***Unusually high rates of a certain type of cancer in a geographic area***
  - *generally imply an environmental cause for cancer because specific local conditions that could cause local concentrations of cancer*

CDC, http://www.cdc.gov/nceh/clusters
Thun, CA Cancer J Clin 2004

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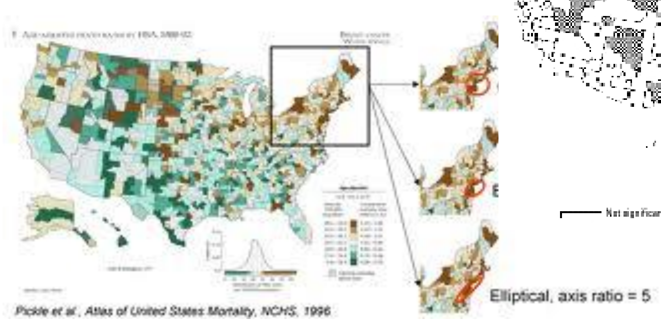
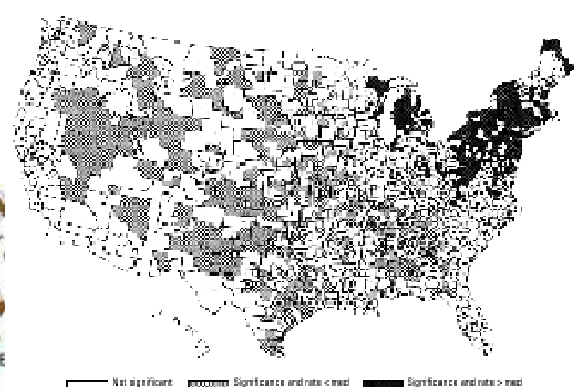
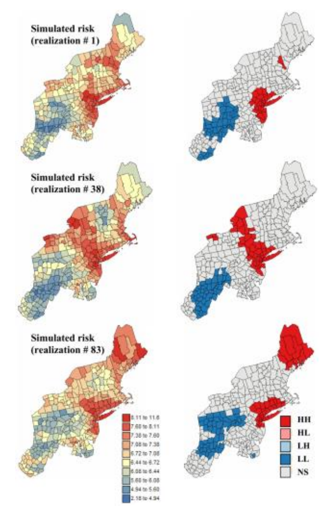
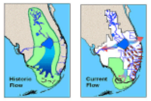
Cancer Clusters

- ***Hundreds of studies from the 1960s through the 1990s showed hardly any statistically significant environmental cause for any cluster in the US***









Caldwell, Am J Epidem 1990

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Cancer Clusters

- ***One conclusion is that clusters are simply a coincidence***
  - *"In a country as large as the US such coincidences would be expected to happen numerous times over a ten-year period"*
- ***A closer look at clusters and the statistical methods used to test them, however, suggests that there may be value in studying cancer through clusters***

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Thun and Sinks, Cancer 2004

The Issue Now

- "Over 1,000 citizens ask public health agencies to investigate suspected disease clusters across the U.S. each year, but state agencies are usually unable to offer a substantive response to such requests"

epiNewswire 2006

Current Public Health Procedures for investigating Possible Cancer Clusters

- **In 1990, the CDC turned cancer cluster studies over to the states**
  - emphasize treating citizens reporting cancer clusters with respect
  - recommend that the health agency must develop an approach that maintains community relations and that manages clusters without excessively depleting resources
- **Tone and language place limitations on the value of cluster investigations**
  - “the unofficial consensus among workers in public health is that most reports of clusters do not lead to meaningful outcome…Despite these impediments, reports of clusters cannot be ignored. The health agency must develop an approach that maintains community relations and that manages clusters without excessively depleting resources”

Response to Cancer Clusters with Suspected Environmental Etiology: State and Federal Capacity Building Workshops (March 11-12, 2003). http://www.cdc.gov/nceh/clusters/response.htm

National Center for Environmental Health (NCEH)

- **Subsection of the CDC sponsored two workshops in 2003**
  - For representatives from state health agencies
- **Participant questionnaires revealed:**
  - The majority of states apply a systematic approach in responding to reports
  - Upon receiving an inquiry from a concerned citizen about a possible cancer cluster states try to educate the caller about the issues and complexities involved in the study of cancer clusters
  - Participants noted that very few inquiries proceed past this initial telephone contact.

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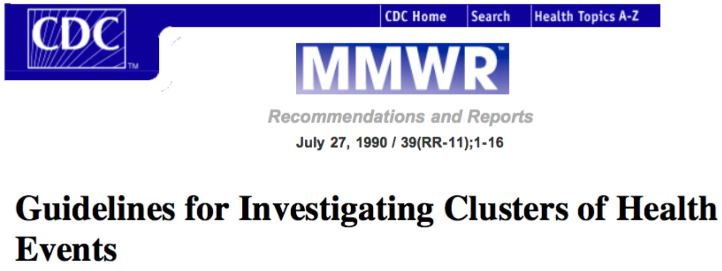
Response to Cancer Clusters with Suspected Environmental Etiology: State and Federal Capacity Building Workshops (March 11-12, 2003). http://www.cdc.gov/nceh/clusters/response.htm

Current Public Health Procedures for investigating Possible Cancer Clusters

- **Most state representatives report that their states generally follow the procedures specified in CDC's "Guidelines for Investigating Clusters of Health Events"**
- **These guidelines were published in 1990 and generally reflect methodologies developed earlier**
  - http://www.cdc.gov/mmwr/preview/mmwrhtml/00001797.htm



CDC Home | Search | Health Topics A-Z

MMWR

Recommendations and Reports

July 27, 1990 / 39(RR-11);1-16

Guidelines for Investigating Clusters of Health Events

Response to Cancer Clusters with Suspected Environmental Etiology: State and Federal Capacity Building Workshops (March 11-12, 2003). http://www.cdc.gov/nceh/clusters/response.htm

Current Public Health Procedures for investigating Possible Cancer Clusters

- **Statistical methodologies used are also noted to be developed prior to 1970**
  - (Appendix) http://www.cdc.gov/mmwr/preview/mmwrhtml/00001798.htm

CDC | CDC Home | Search | Health Topics A-Z

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Recommendations and Reports

July 27, 1990 / 39(RR-11);17-23

Guidelines for Investigating Clusters of Health Events - APPENDIX. Summary of Methods for Statistically Assessing Clusters of Health Events

Response to Cancer Clusters with Suspected Environmental Etiology: State and Federal Capacity Building Workshops (March 11-12, 2003). http://www.cdc.gov/nceh/clusters/response.htm

Current Public Health Procedures for investigating Possible Cancer Clusters

- **Outside pressures appear to also have influenced development of cluster investigations.**
  - Minnesota was noted to have performed many small-scale cluster studies from 1980-1990.
    - Since then a public education campaign has been promoted stressing the futility of cancer cluster investigations

Fagin, Newsday 2002

Current Approach

- **Part of initial triage approach**
  - Weed out 80% of reports at first contact
- **Telephone investigation for “Suspected Clusters”**
- **Halted from further investigation IF**
  - Only 2-3 cases in a town are included in the cluster (numbers)
  - Different cancers are included in the cluster (heterogeneity)
  - Cluster includes relatives or friends living in other parts of the state (genetic confounding)

Connecticut Dept of Public Health, Fact Sheet what you need to know about cancer clusters, 1999

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Current Approach

- **Statistical Clusters**
  - Subsequent verifications checked against the state cancer registry
  - Most verified clusters “filed” and assumed to be simply random concentrations
- **Meaningful Clusters**
  - Fully investigated
  - Both statistically significant and likely to have an obvious cause
  - CDC and Agency for Toxic Substances and Disease Registry (ATSDR) involvement

Connecticut Dept of Public Health, Fact Sheet what you need to know about cancer clusters, 1999

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Cancer Registries Amendment Act

- **1992 – mandated each state to establish a cancer registry with common variables and a common data structure**
- **For each cancer**
  - Demographic data on each case
  - Industrial or occupational background of each person with cancer
  - Date of diagnosis and source, type, site, stage and treatment
- **Projected to be used to find patterns in cancer occurrence**
- **Despite these mandates, subsequent cancer cluster reports have remained primarily in the public domain rather than the DOH**

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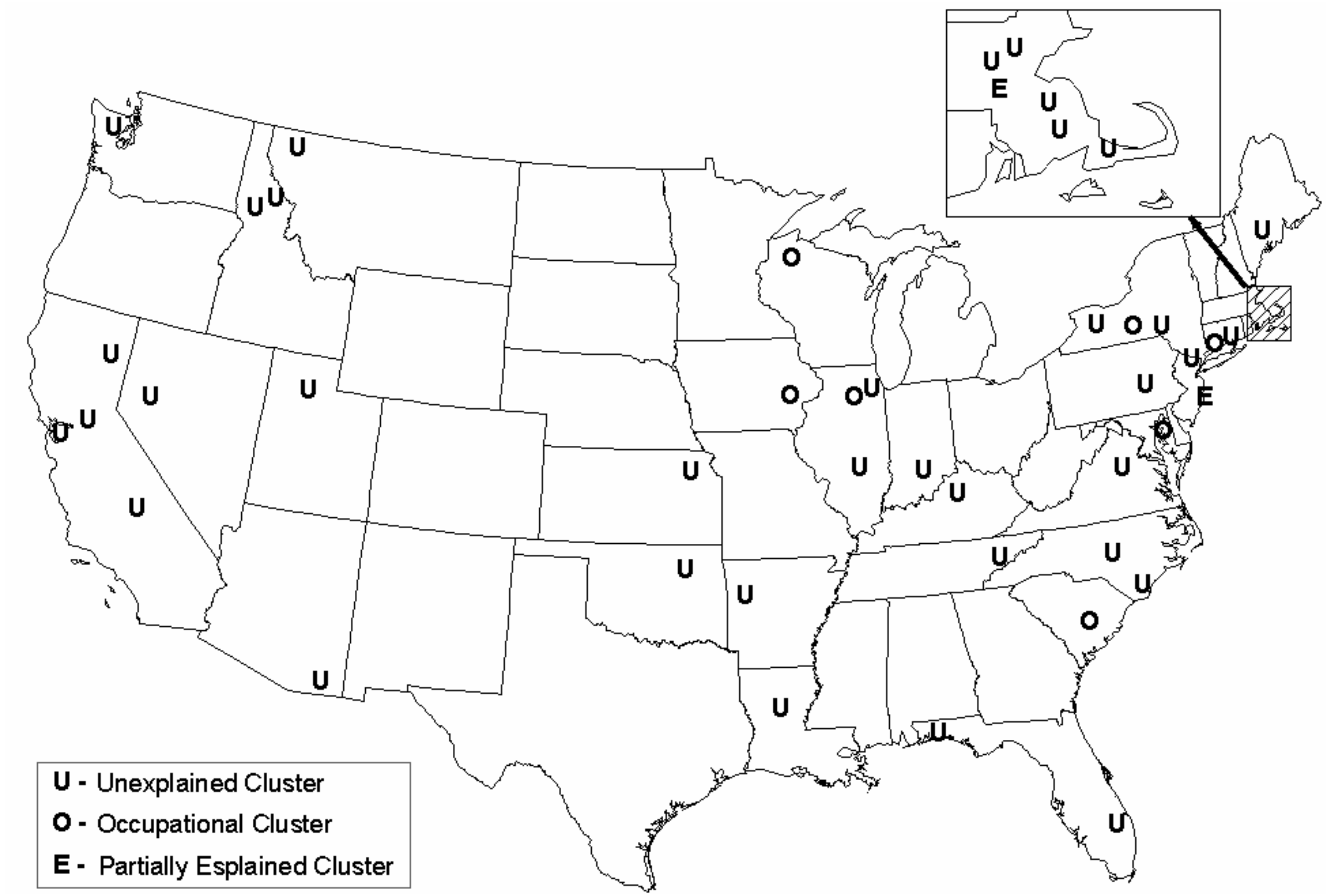
www.cdc.gov/cancer/npcr/npcrpdfs/publaw.pdf

Meaningful Cancer Clusters in the United States since 1995



McGlinn, Middle States Geographer, 2006

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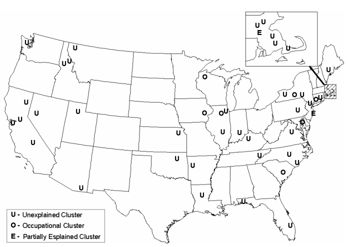
Meaningful Cancer Clusters in the United States since 1995

- **Of the 49 clusters identified 10 accepted as occupational exposures**
  - No statistically significant link to causality identified
  - Highly publicized and “legally proven” clusters were never found by there DOH to have a statistically significant environmental cause
    - Woburn, MA - “A Civil Action”
    - Hinkley, CA - “Erin Brockovich”



McGlinn, Middle States Geographer, 2006

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Clusters and the Environment

- **Fallon, NV – 17 cases of childhood leukemia from 1997 to 2003 (pop 24,000)**
  - Nevada state health division turned to CDC and ATSDR for further investigation
  - Elevated levels of arsenic, uranium, tungsten found in soil and well water
  - No environmental link was identified
- **University of Arizona researchers also found cluster in area (Sierra Vista, AZ) with elevated levels of similar contaminants**

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CDC, Churchill County final Report 2003
ATSDR, www.atsdr.cdc.gov/NEWS/fallonei.html

Clusters and the Environment – Successes and Lessons

- **Tom's River, NJ and Ashland, MD are cancer clusters in the United States reporting a statistically significant relationship to a likely environmental trigger.**
  - The result of the Tom's river study (NJDHSS, 2003) was that two environmental factors appear to have contributed to leukemia in female children under 5 years old:
    - Prenatal exposure to drinking water from a contaminated well field,
    - Prenatal exposure to air emissions from the Ciba-Geigy chemical/dye plant
  - The two extra steps were the keys to finding meaningful links between the environment and disease in this study
    - including data on prenatal exposure
    - breaking the population into those younger than 5yrs
      - In the population up to age 20, leukemia occurred at a significantly elevated rate, but no significant correlation to environmental exposure was found.
- **carefully thought-out investigations have a greater chance of finding significant results than simply following a formula assuming that everyone is equally at risk, a method that has consistently failed.**

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NJDHSS, Final Technical Report 2003

Clusters and the Environment- Successes and Lessons

- **In 1998, the Ashland MD (MDPH) report described increased risk for local populations to develop any type of cancer, as well as rarer, soft-tissue cancers due to the combination of:**
  - substantial contact with water on or around the Nyanza site
    - children 10-18 years old in the years 1965-1985
  - family history of cancer
- **This illustrates the importance of a clearly defined at-risk population**
- **cancer cluster studies (if done correctly) are difficult, time-consuming and expensive but, they may help to explain the relationship between environment and disease.**

MDPH, Ashland Health Study Final Report, 2006

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In the News - Locally

- **"Bladder Cancer Clusters in Florida." Nieder et al. J Urology, July 2009**
- **Populations in "The Acreage" are concerned over increased accounts of brain tumors in children.**
  - Aug 2009 level I report noted possibility of elevated rates though contention that changes in population may have artificially elevated rates
    - sampling of water supply did not yield abnormal results.
  - Jan 2010 CDC issues clarification letter stating on further review methodology appears sound and elevation in brain cancer rates appear to be present.
  - Jan 2010 Level II report confirms "cluster" of brain tumors in The Acreage
  - Feb 2010 Gov Crist seeks Federal assistance in investigating The Acreage Brain Tumor Cluster

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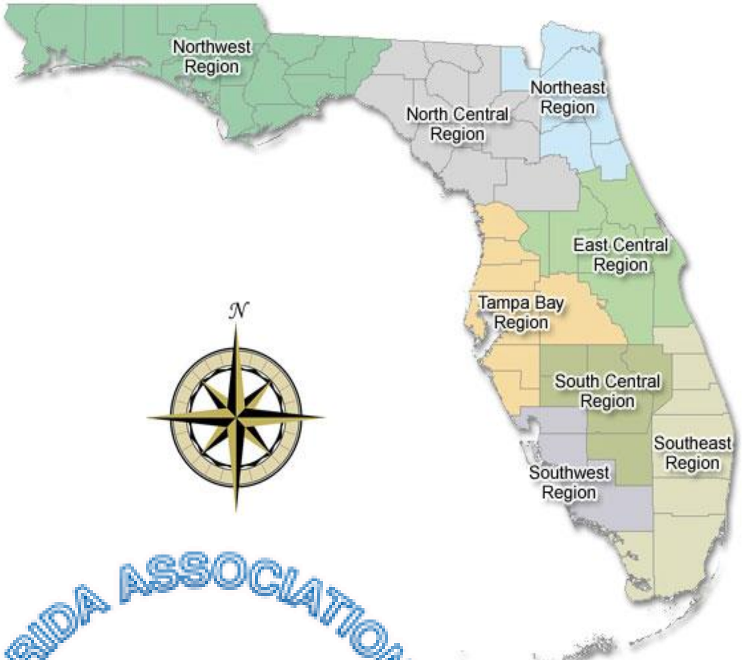
Florida Survey

- **Florida cancer statistics**
  - Existing public de-identified dataset
  - High level of data ascertainment
  - Geographically comprehensive
  - Limited variation (one dataset)
  - Diagnostically accurate



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FAPTP Pediatric Cancer Registry

- **Under state mandate, FAPTP's pediatric cancer registry has been in operation since 1980.**
  - SPIRS (Statewide Patient Information Reporting System) is used to:
    - identify trends in the incidence and prevalence of childhood cancer
    - evaluate childhood cancer-care patterns to promote the availability of state-of-the-art care
    - monitor treatment facilities for quality control for the state of Florida, Children's Medical Services (CMS) Program
    - provide information for program planning and development
- **Patients are registered in SPIRS from 16 of the pediatric hematology/oncology centers statewide**
  - include patients < 21 years of age who have been diagnosed with cancer.
  - Data quality is very high for research purposes
  - Data reconciled annually between FAPTP centers and other state registries
- **Diagnosis codes**
  - designated by the International Classification for Childhood Cancer (ICCC)
- **Demographic information**
  - date of birth, age at cancer diagnosis, sex, and zip code of residence

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FAPTP vs. FCDS Cancer Registries

- **FCDS (Florida Cancer Data Systems)**
  - Statewide hospital based reporting system
    - Tendency for duplicates and over reporting
  - Records of all age and tumor types (unrestricted dataset)
    - Limited detail and expertise regarding pediatric tumors
- **FAPTP**
  - Restricted dataset
  - Provider based reporting system
    - Possible limitations in identifying older age groups which may be treated outside the pediatric oncology FAPTP practices
      - Tendency for under reporting
- **FAPTP and FCDS reconciled annually**

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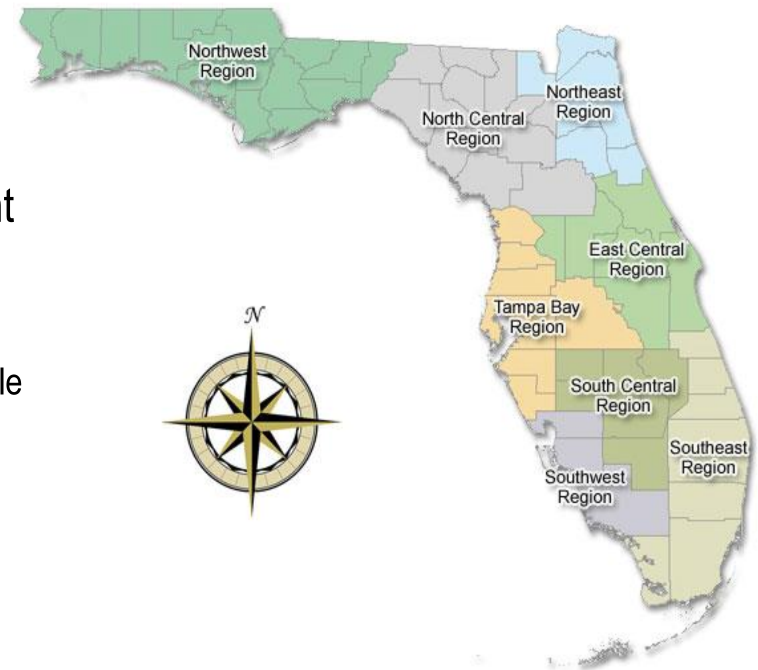
Statewide Florida Survey

- **FAPTP cancer dataset**
  - Existing public de-identified dataset
  - High level of data ascertainment
    - Staff CRAs trained specifically for registry entry and maintenance of local data
    - CRAs also generally serve duel role as highly trained COG CRA
    - Limited selection/information bias (provider specific)
  - Geographically comprehensive
  - Limited variation (one dataset)
  - Diagnostically accurate
    - Based on pathology/provider confirmation
    - Reconciled continually



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Cluster Analysis

- **Wide range of methods and techniques for detecting clusters in spatial data.**
- **Examples:**
  - Ipop (Oden, 1995)
  - Spatial scan statistic (Kulldorff, 1997)
  - Maximized excess events test, MEET (Tango, 2000)
  - Flexible spatial scan statistic (Tango and Takahashi, 2005)

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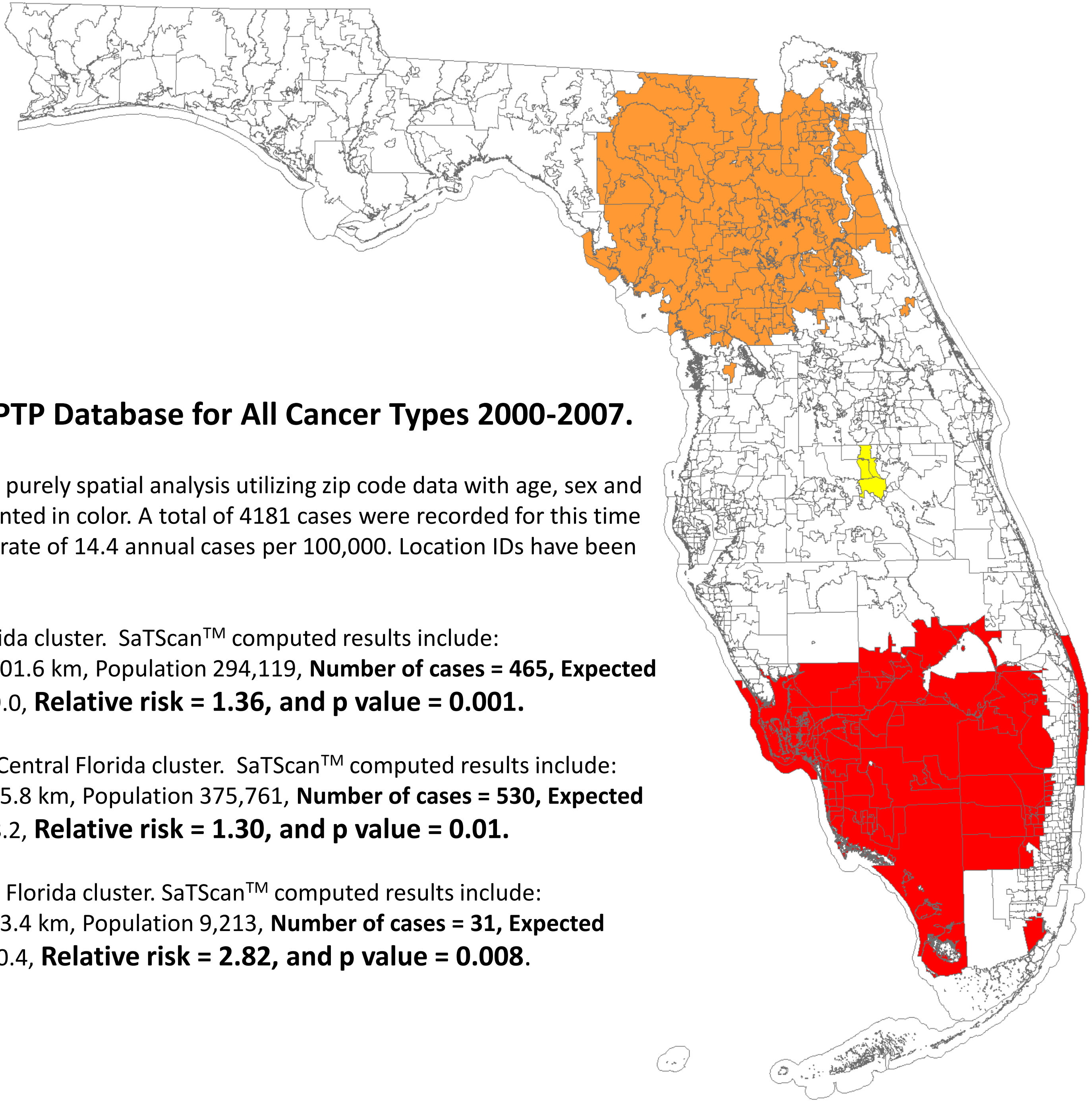
SaTScan^{TM}

- **Procedure uses a window (circle) on the map and allows it to move over an area.**
- **At each position the window contains an amount of nearby smaller areas**
- **For each window, a null hypothesis against the alternative hypothesis is being tested:**
  - H0 : No elevated risk of cancer cases within the scanning window compared to its outside counterpart.
  - Ha : Elevated risk of cancer cases within the scanning window compared to its outside counterpart.

Purely Spatial Analysis

Space Time Analysis



Purely Spatial Analysis of FAPTP Database for All Cancer Types 2000-2007.

Clustering representation of SaTScan™ purely spatial analysis utilizing zip code data with age, sex and race as covariates. Clusters are represented in color. A total of 4181 cases were recorded for this time period with a corresponding incidence rate of 14.4 annual cases per 100,000. Location IDs have been removed for privacy protection.

The **red** area represents the South Florida cluster. SaTScan™ computed results include: Coordinates/radius = (26.3N, 81.3W)/101.6 km, Population 294,119, **Number of cases = 465, Expected cases = 352**, Annual cases/100000 = 19.0, **Relative risk = 1.36, and p value = 0.001.**

The **orange** area represents the North Central Florida cluster. SaTScan™ computed results include: Coordinates/radius = (29.9N, 82.4W)/95.8 km, Population 375,761, **Number of cases = 530, Expected cases = 420**, Annual cases/100000 = 18.2, **Relative risk = 1.30, and p value = 0.01.**

The yellow area represents the Central Florida cluster. SaTScan™ computed results include: Coordinates/radius = (28.2N, 81.5W)/13.4 km, Population 9,213, **Number of cases = 31, Expected cases = 11.3**, Annual cases/100000 = 40.4, **Relative risk = 2.82, and p value = 0.008**.

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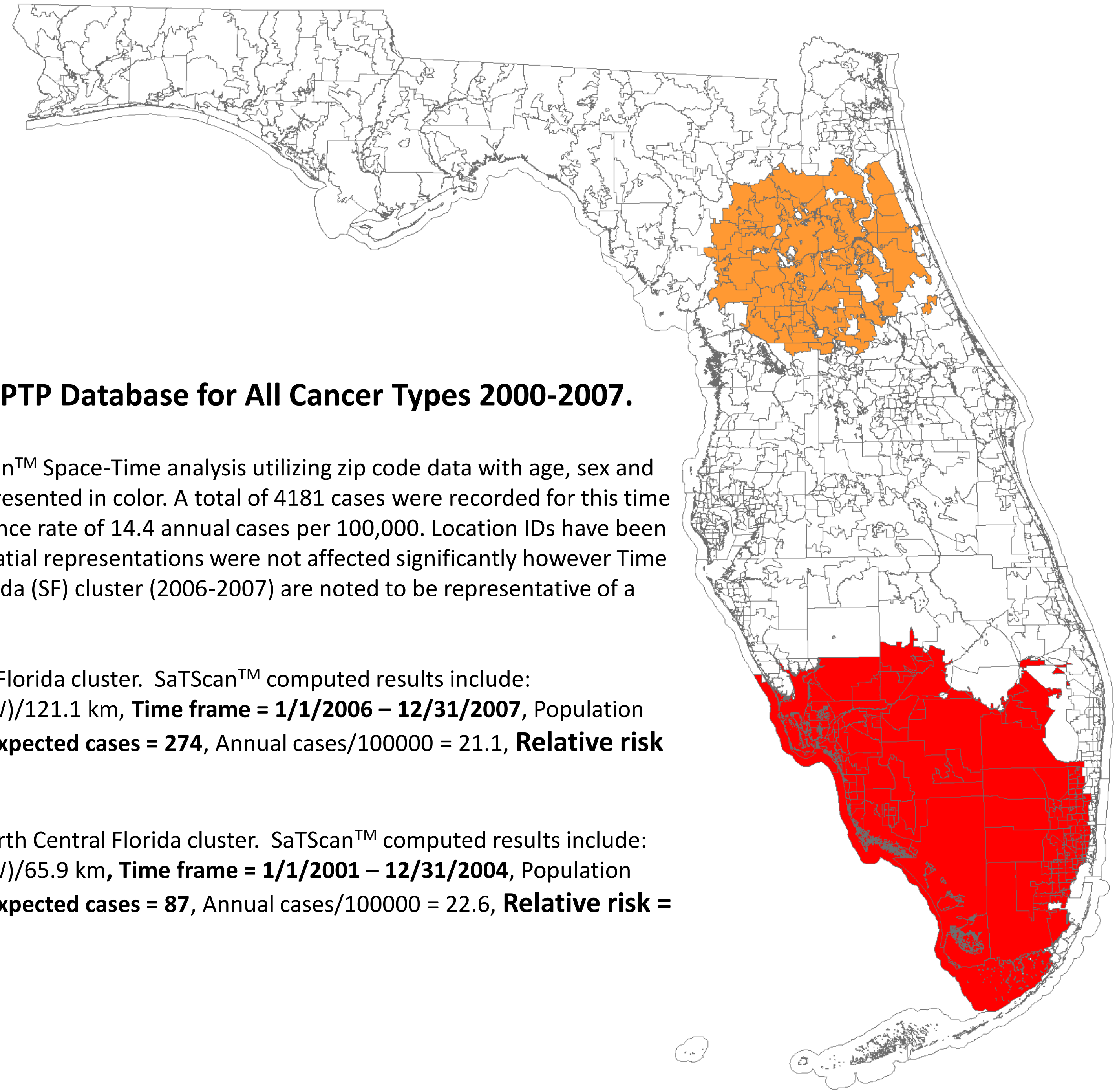

Space-Time Analysis of FAPTP Database for All Cancer Types 2000-2007.

Clustering representation of SaTScan™ Space-Time analysis utilizing zip code data with age, sex and race as covariates. Clusters are represented in color. A total of 4181 cases were recorded for this time period with a corresponding incidence rate of 14.4 annual cases per 100,000. Location IDs have been removed for privacy protection. Spatial representations were not affected significantly however Time frame results for the Southern Florida (SF) cluster (2006-2007) are noted to be representative of a recent surge in incidence rates.

The **red** area represents the South Florida cluster. SaTScan™ computed results include: Coordinates/radius = (26.0N, 81.4W)/121.1 km, **Time frame = 1/1/2006 – 12/31/2007**, Population 963,643, **Number of cases = 403, Expected cases = 274**, Annual cases/100000 = 21.1, **Relative risk = 1.52, and p value = 0.001.**

The **orange** area represents the North Central Florida cluster. SaTScan™ computed results include: Coordinates/radius = (29.5N, 82.0W)/65.9 km**, Time frame = 1/1/2001 – 12/31/2004**, Population 155,681, **Number of cases = 136, Expected cases = 87**, Annual cases/100000 = 22.6, **Relative risk = 1.59, and p value = 0.058**.

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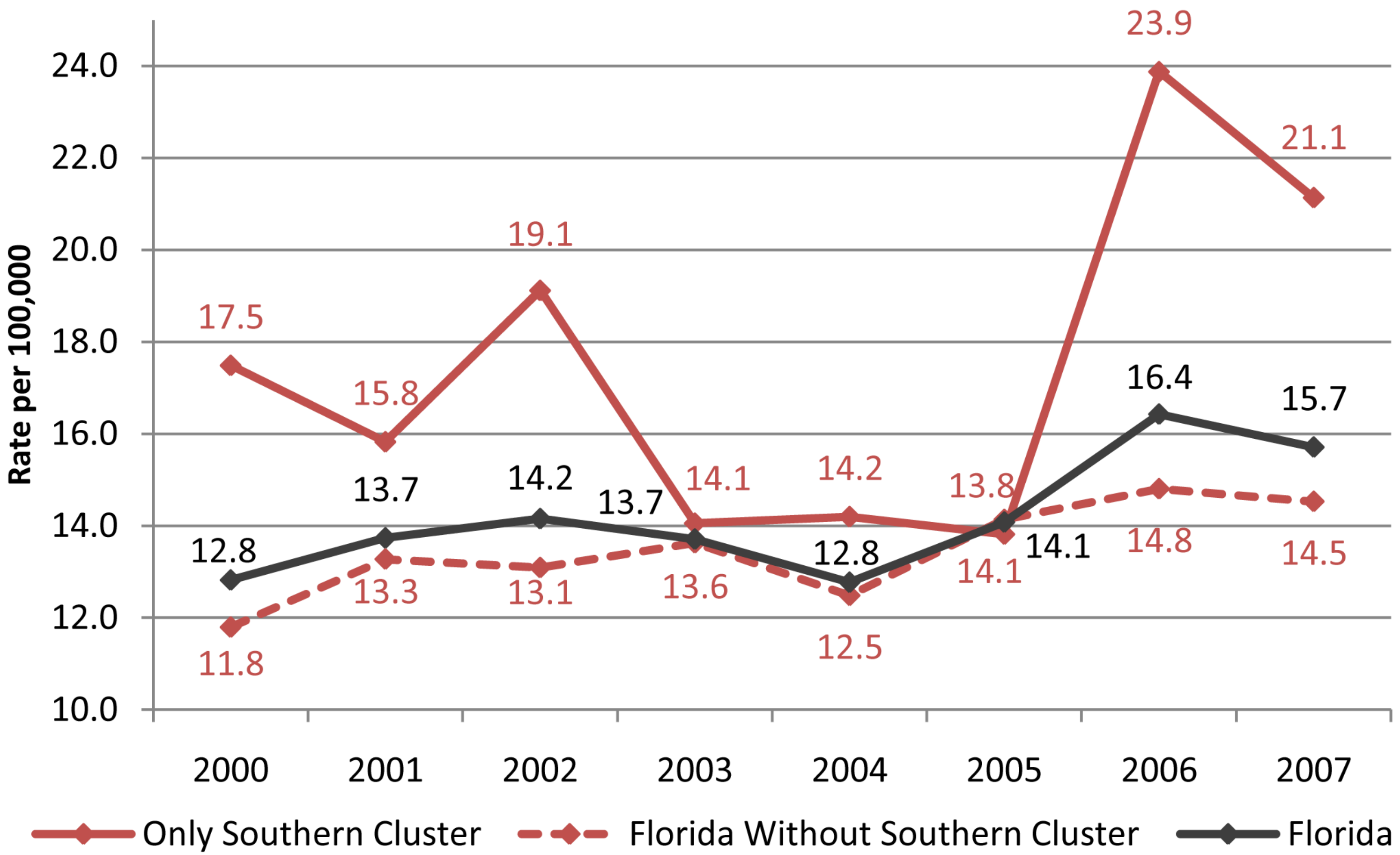
Age-adjusted Pediatric Cancer Incidence Rates 2000-2007.



Incidence counts were utilized directly to compute incidence rates using FAPTP Dataset for 2000-2007 and Florida population statistics for 2000. Southern Florida cluster (SF) is shown in comparison to rates for the entire state of Florida and to rates for the state of Florida excluding the influence of the SF. Differences between these rates during 2006-2007 suggest that the rise in Florida rates during this period were heavily influenced by the surge in incidence rates in the SF cluster.

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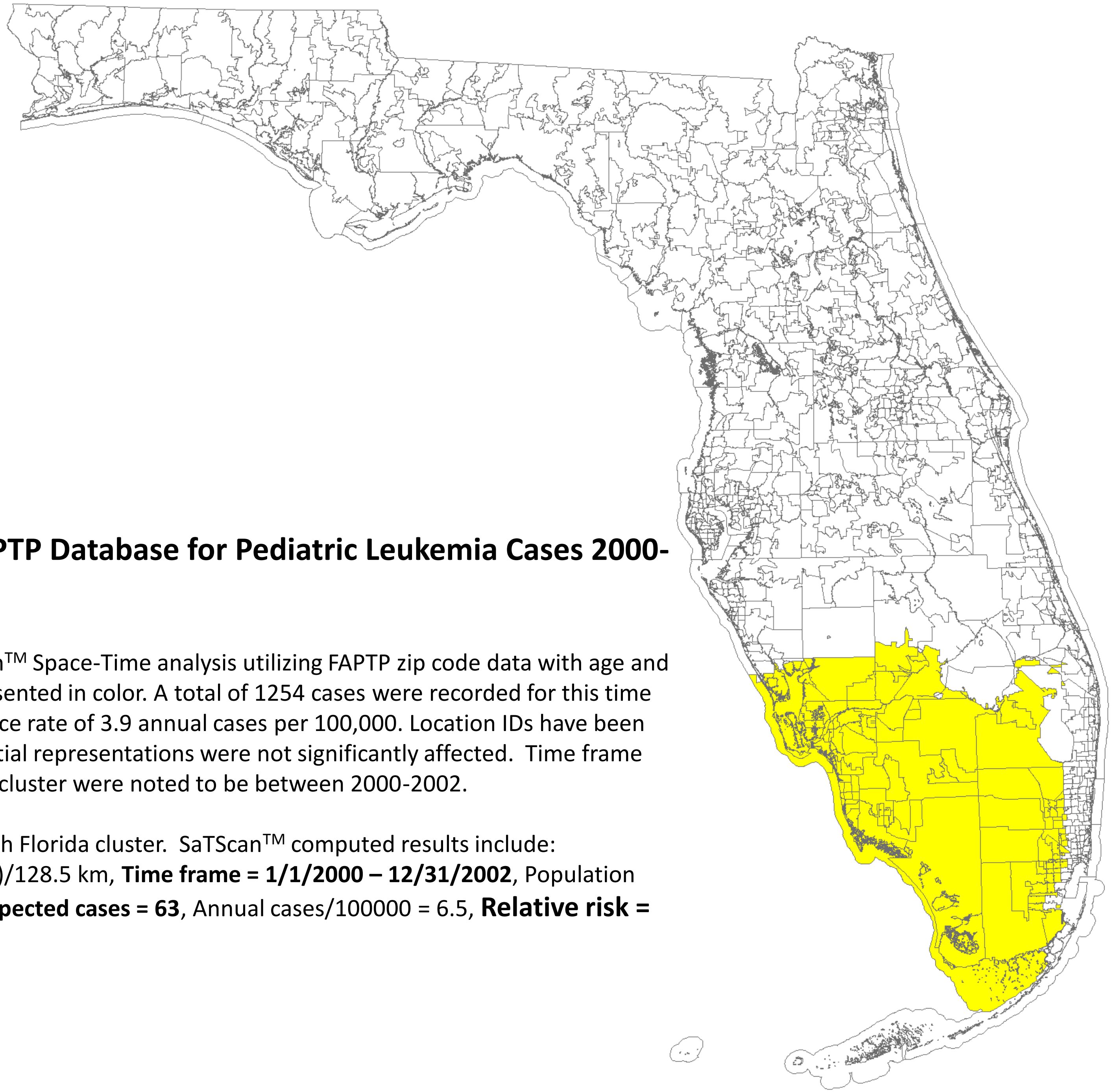
Space-Time Analysis of FAPTP Database for Pediatric Leukemia Cases 2000-2007.



Clustering representation of SaTScan™ Space-Time analysis utilizing FAPTP zip code data with age and sex as covariates. Clusters are represented in color. A total of 1254 cases were recorded for this time period with a corresponding incidence rate of 3.9 annual cases per 100,000. Location IDs have been removed for privacy protection. Spatial representations were not significantly affected. Time frame results for the Southern Florida (SF) cluster were noted to be between 2000-2002.

The yellow area represents the South Florida cluster. SaTScan™ computed results include: Coordinates/radius = (26.0N, 81.6W)/128.5 km, **Time frame = 1/1/2000 – 12/31/2002**, Population 553,592, **Number of cases = 105, Expected cases = 63**, Annual cases/100000 = 6.5, **Relative risk = 1.74, and p value = 0.047.**

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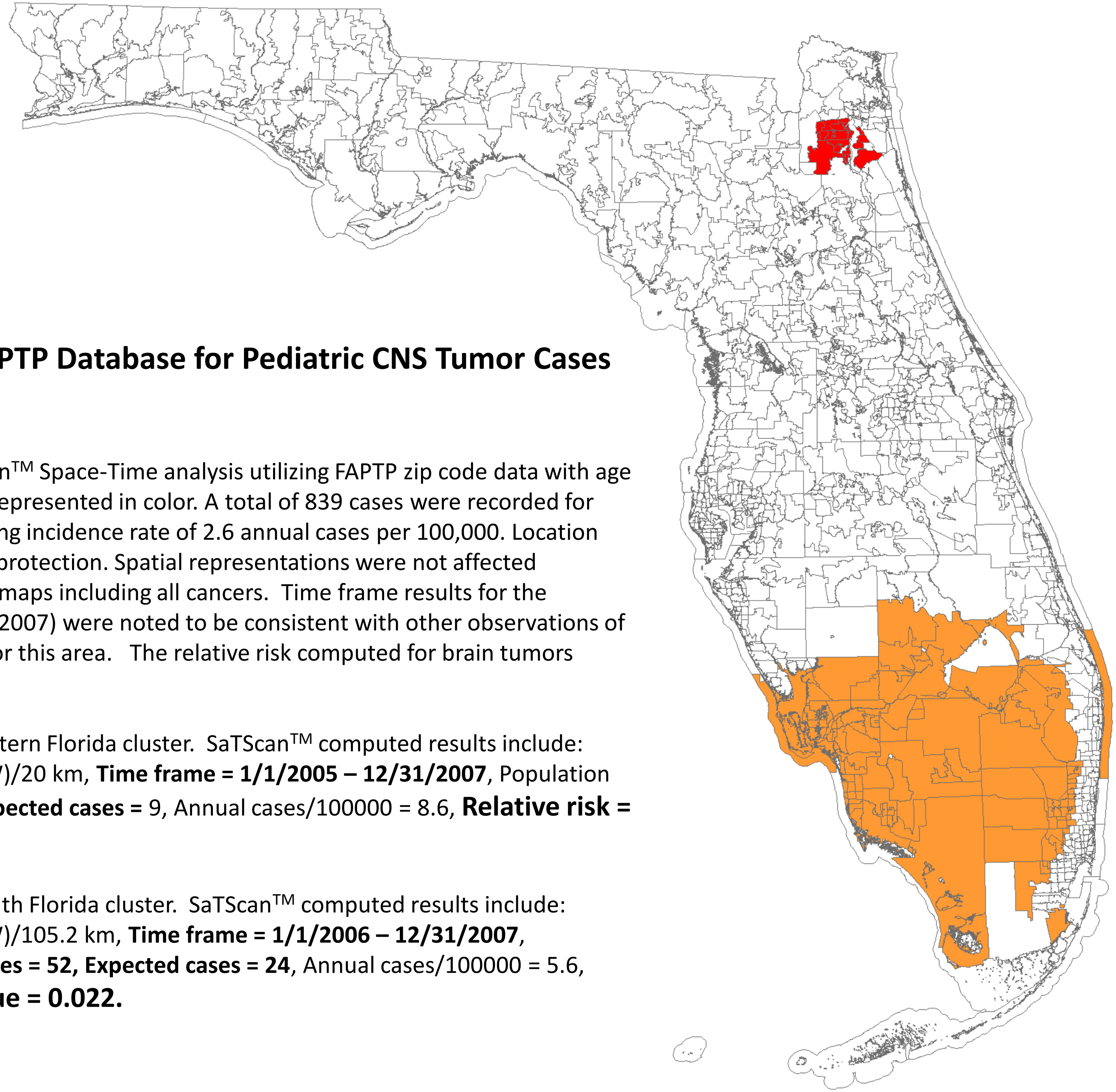
Space-Time Analysis of FAPTP Database for Pediatric CNS Tumor Cases 2000-2007.

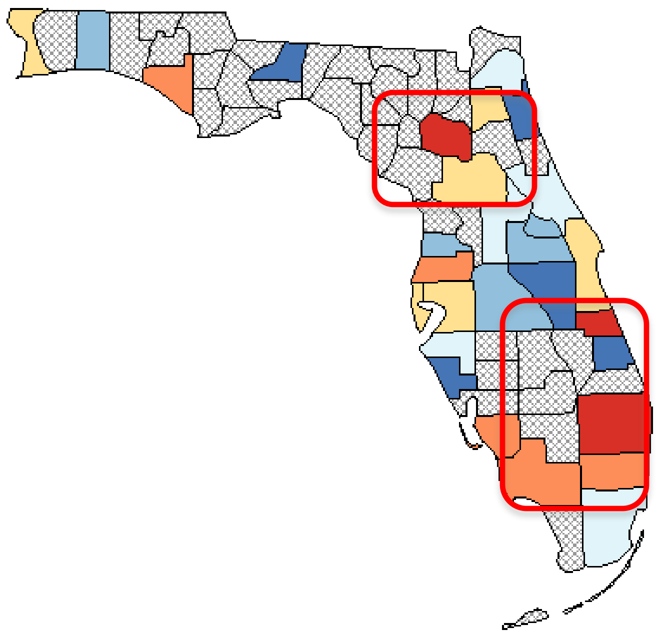
Clustering representation of SaTScan™ Space-Time analysis utilizing FAPTP zip code data with age and sex as covariates. Clusters are represented in color. A total of 839 cases were recorded for this time period with a corresponding incidence rate of 2.6 annual cases per 100,000. Location IDs have been removed for privacy protection. Spatial representations were not affected significantly compared with cluster maps including all cancers. Time frame results for the Southern Florida (SF) cluster (2006-2007) were noted to be consistent with other observations of recent increase in incidence rates for this area. The relative risk computed for brain tumors during this time frame was 2.253.

The **red** area represents a Northeastern Florida cluster. SaTScan™ computed results include: Coordinates/radius = (30.1N, 81.8W)/20 km, **Time frame = 1/1/2005 – 12/31/2007**, Population 111,133, **Number of cases = 29, Expected cases =** 9, Annual cases/100000 = 8.6, **Relative risk = 3.42, and p value = 0.002.**

The **orange** area represents the South Florida cluster. SaTScan™ computed results include: Coordinates/radius = (26.3N, 81.3W)/105.2 km, **Time frame = 1/1/2006 – 12/31/2007**, Population 455,519, **Number of cases = 52, Expected cases = 24**, Annual cases/100000 = 5.6, **Relative risk = 2.25, and p value = 0.022.**



Incidence Rates† for Florida, 2002 - 2006
Childhood (Ages <15, All Sites)
All Races (includes Hispanic), Both Sexes



Age-Adjusted

Annual Incidence Rate

(Cases per 100,000)

Quantile Interval

- 17.5 to 17.9
- 16.4 to 17.4
- 15.6 to 16.3
- 14.8 to 15.5
- 13.9 to 14.7
- 10.7 to 13.8
- Suppressed */**

US (SEER + NPCR)
Rate (95% C.I.)
15.2 (15.0 - 15.3)

Florida
Rate (95% C.I.)
15.6 (15.0 - 16.2)

Created by statecancerprofiles.cancer.gov on 03/09/2010 12:06 am.
State Cancer Registries may provide more current or more local data.
Data presented on the State Cancer Profiles Web Site may differ from statistics reported by the State Cancer Registries (for more information).

† Incidence rates (cases per 100,000 population per year) are age-adjusted to the 2000 US standard population (19 age groups: <1, 1-4, 5-9, ... , 80-84, 85+). Rates are for invasive cancer only (except for bladder which is invasive and in situ) or unless otherwise specified. Rates calculated using SEER*Stat. Population counts for denominators are based on Census populations as modified by NCI. The US populations included with the data release have been adjusted for the population shifts due to hurricanes Katrina and Rita for 62 counties and parishes in Alabama, Mississippi, Louisiana, and Texas (See US Population Data - 1969-2006 for more information.)

* Data have been suppressed to ensure confidentiality and stability of rate estimates. Counts are suppressed if fewer than 16 cases were reported in a specific area-sex-race category.

** Data have been suppressed for states with a population below 50,000 per sex for American Indian/Alaska Native or Asian/Pacific Islanders because of concerns regarding the relatively small size of these populations in some states.

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http://statecancerprofiles.cancer.gov/index.html

Epidemiologic Mapping of AYA Males with Colorectal Cancers in Florida

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INTRODUCTION

Over the past decade, the survival rate of patients diagnosed with cancer has improved dramatically; however, little to no improvement in cancer survival rate has occurred in patients aged 15 to 39. This 15 to 39 age group is referred to as adolescent and young adult (AYA). Recent epidemiologic surveys have shown that the top five cancer incidences comprised 39% of cases for males and included brain, testicular, non-Hodgkin's lymphoma, melanoma, and colorectal cancers.

OBJECTIVE

To identify geographic and temporal clusters of elevated cancer rates in colorectal cancers among adolescent and young adult males in Florida**.**

METHODS

The incidence rates per 100,000 from 2000-2007 were obtained from the Florida Cancer Data System (FDCS) database for each county and cancer type year by year. These rates were then used in conjunction with the population estimates from the U.S. Census Bureau to determine a count of incidences in Florida by county by year. Spatial and space-time analysis using SaTScan™ was used to identify clusters of counties in Florida with higher cancer rates than expected.

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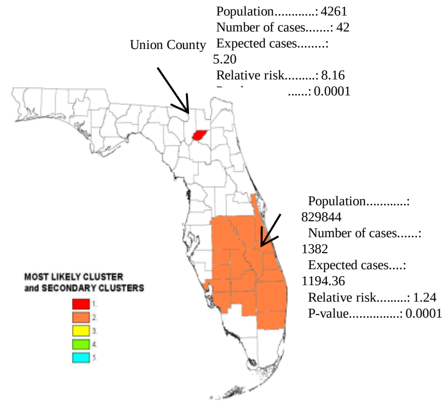
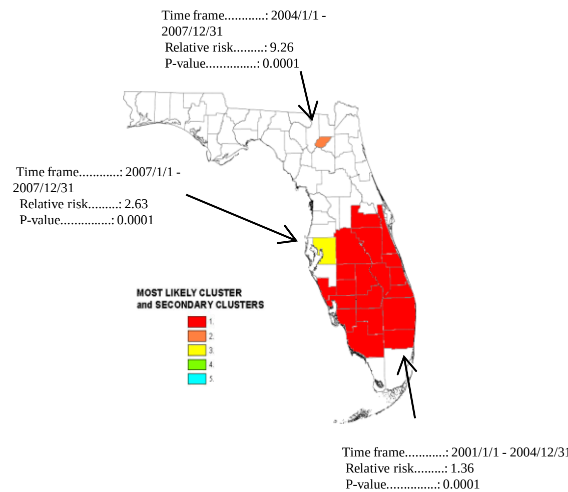


Purely Spatial Analysis



Space Time Analysis

RESULTS

Two significant cancer clusters were identified using spatial analysis. The most likely cluster was identified in North Central Florida (RR=8.16, p=0.0001) and the second included areas of the East Central, South Central and Southeast regions (RR=1.24, p=0.0001). Three significant clusters were identified using space-time analysis. The most likely cluster comprised areas of East Central, South Central, Southwest and Southeast Regions of Florida (RR=1.36, p=0.0001, time frame 2001-2004). A secondary cluster was identified in the North Central Region (RR=9.26, p=0.0001, time frame 2004-2007). Another secondary cluster was located in the Tampa Bay Region (RR=2.63, p=0.0001, time frame 2007).

CONCLUSIONS

There is evidence of spatial and space-time cancer clustering in south and northeastern Florida. This evidence is suggestive of the presence of possible predisposing factors in these cluster regions. A factor identified in one small cluster included the Florida Department of Corrections Reception and Medical Center, which artificially increases the concentration of at risk AYA males in this analysis. Other identified clusters, however, comprise larger geographic regions. Therefore, further study is needed to investigate these and other potential risk factors.

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1. Raid Amin, Alexander Bohnert, Laurens Holmes, Ayyappan Rajasekaran, and Chatchawin Assanasen (2010). "Epidemiologic Mapping of Florida Childhood Cancer Clusters". Pediatric Blood and Cancer, pp.1-8.
2. Kulldorff M, Nagarwalla N. Spatial disease clusters: Detection and Inference. Statistics in Medicine, 14:799-810, 1995
3. Huang, Youjie . Cancer Incidence and Mortality Among Adolescence and Young Adults Age 15-39 in Florida.. 2009 Meetings Proceedings of the North American Association of Central Cancer Registries, Inc. (NAACCR, Inc.)

Epidemiologic Mapping of AYA Males with Non-Hodgkins Lymphoma in Florida

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INTRODUCTION

Over the past decade, the survival rate of patients diagnosed with cancer has improved dramatically; however, little to no improvement in cancer survival rate has occurred in patients aged 15 to 39. This 15 to 39 age group is referred to as adolescent and young adult (AYA). Recent epidemiologic surveys have shown that the top five cancer incidences comprised 39% of cases for males and included brain, testicular, non-Hodgkin's lymphoma, melanoma, and colorectal cancers.

OBJECTIVE

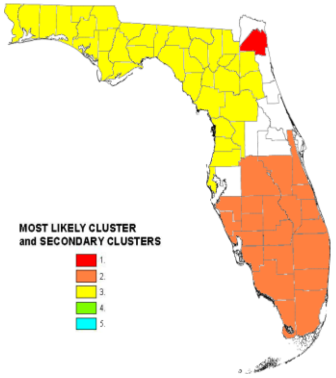
To identify geographic and temporal clusters of elevated cancer rates in Non-Hodgkins lymphomas among adolescent and young adult males in Florida.

METHODS

The incidence rates per 100,000 from 2000-2007 were obtained from the Florida Cancer Data System (FDCS) database for each county and cancer type year by year. These rates were then used in conjunction with the population estimates from the U.S. Census Bureau to determine a count of incidences in Florida by county by year. Spatial and space-time analysis using SaTScan™ was used to identify clusters of counties in Florida with higher cancer rates than expected.

RESULTS

In purely spatial analysis, we identified two significant cancer clusters. The most likely cluster was located in the North Central region (RR=11.49, p=0.0001). A secondary cluster was located within the East Central, South Central and Southeast regions of Florida (RR=1.38, p=0.0003). In space-time analysis three significant clusters were identified. The most likely cluster was located in the Northeast Region of Florida (RR=7.24, p=0.0001, time frame 2003). A secondary cluster again included the East Central, South Central and Southeast Regions of Florida (RR=2.18, p=0.0001, time frame 2000). Another secondary cluster was identified in the regions comprising the Northwest Region, North Central Region and the Tampa Bay Region (RR=1.56, p=0.0255, time frame 2000-2002).



Space-Time Analysis Map

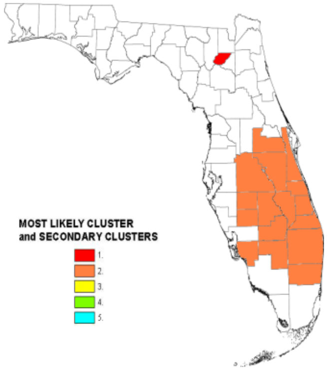
Summary of Space-Time Analysis Data

Study Period…………………: 2000/1/1-2007/12/31
Number of locations………….: 67
Total population……………...: 2720693
Total number of cases………..: 1024
Annual cases/100 000………..: 4.7
Most likely cluster: Duval County (red area)
Duval case number…………...: 45
Duval expected case number…: 6.46
Duval relative risk……………: 7.24
P-value………………………..: 0.0001

Secondary Clusters

Orange Coordinates…: 26.191595 N 81.708212 W
Population…..: 1237401
No. of cases…: 115
Expected cases: 56.22
Relative Risk..: 2.18
P-Value……...: 0.0001

Yellow Coordinates…:29.79331 N 84.814358 W
Population…..: 640 642
No. of cases…: 129
Expected cases: 86.86
Relative Risk..: 1.56
P-Value……...: 0.0255



Purely Spatial Analysis Map

Summary of Spatial Analysis Data

Study Period……………..: 2000/1/1-2007/12/31
Number of locations…….: 67
Total population………...: 2720693
Total number of cases…..: 1024
Annual cases/100 000…..: 4.7
Most likely cluster: Union County (Red area)
Union Co. case number....: 18
Union Co. expected cases.: 1.59
Annual cases/100 000…...: 53.2
Union Co. relative risk…..: 11.49
P-value…………………..: 0.0001

Secondary Clusters

Orange area displayed as only statistically significant secondary cluster.
Coordinates…: 27.359153N 80.343490 W
Population…..: 995 735
No. of cases…: 454
Expected cases: 374.42
Relative Risk..: 1.38
P-Value……...: 0.0003

CONCLUSIONS

There is evidence of spatial and space-time cancer clustering in south and northeastern Florida. A factor identified in one small cluster included the Florida Department of Corrections Reception and Medical Center, which artificially increases the concentration of at risk AYA males in this analysis. This evidence is suggestive of the presence of possible predisposing factors in these cluster regions. Therefore, further study is needed to investigate these and other potential risk factors.

REFERENCES AND ACKNOWLEDGEMENTS

1. Huang, Y. & Hylton T. (2009) Cancer Incidence and Mortality among Adolescence and Young Adults Age 15-39 in Florida. The North American Association of Central Cancer Registries
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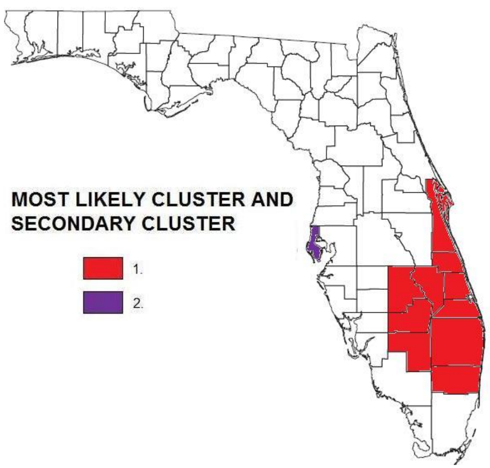
3. Cancer Epidemiology in Older Adolescents and Young Adults 15-29 Years of Age, 1975-2000; National Cancer Institute.

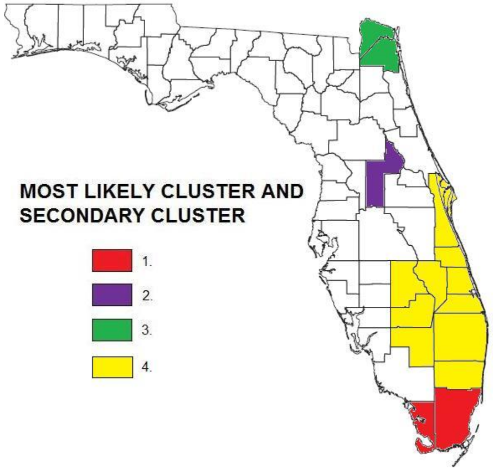
Preliminary Evaluation of Breast Cancer Cluster Mapping

Spatial

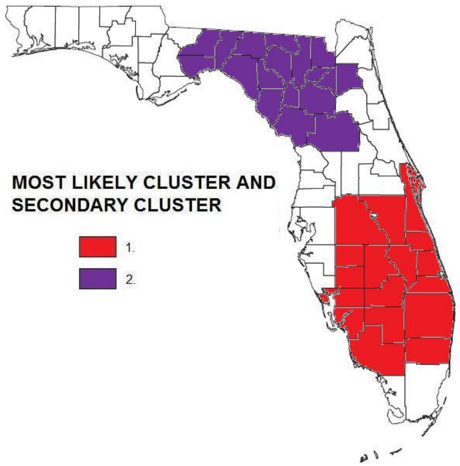
Space-time

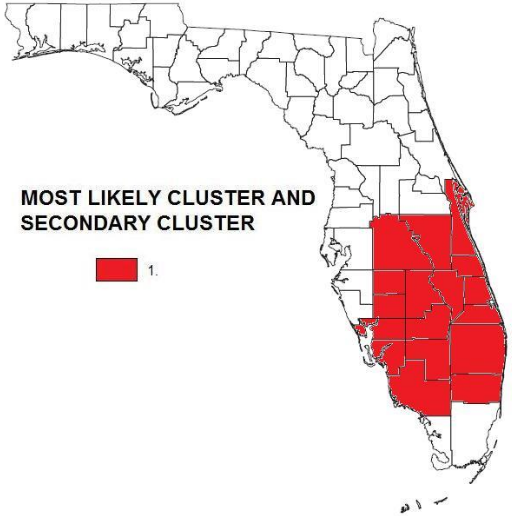
"White"





"Other"





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A brief history of Lung Cancer

- **Worldwide, lung cancer kills over 1 million people a year.**
  - Extensive prospective epidemiologic data clearly establish cigarette smoking as the major cause of lung cancer.
- **In 1878, it represented only 1% of all cancers seen at autopsy.**
- **What caused such a dramatic increase in an obscure disease?**
- **Academic discussions included possible etiologic factors:**
  - increased air pollution by gases and dusts, caused by industry; the asphalting of roads; the increase in automobile traffic; exposure to gas in World War I; the influenza pandemic of 1918; and working with benzene or gasoline.
  - smoking was briefly mentioned as another possibility
- **Many investigations failed to show an association between smoking and lung cancer until the 1930's**
  - Smokers, including many physicians, could not imagine that the habit was detrimental to their health.
- **In the 1950s Doll and Hill in England and Cuyler Hammond and Ernest Wynder in the U.S. provided evidence for a causal association between smoking and lung cancer.**

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Summary

- While cancer clusters studies remain challenging, we must successively (through our methodology) narrow the potentials for erroneous conclusion.
- Causal elements remain elusive given the complex nature of tumors, their long induction period, and our restricted knowledge of childhood malignancy carcinogenesis
- The search for evidence for and against a causal association remain challenging, but worth the effort.

Future Prospects

- **Childhood Cancer Research Network (CCRN)**
  - North American pediatric cancer registry
- **Currently COG registration collects some demographic data**
  - CCRN involves the patient and family at the beginning of the registration process giving them opportunity to authorize the collection of personal identifiers and possibly future contact for research purposes (ACCRN07)
  - Seek to identify the causes and consequences of childhood cancer

Steele, Cancer Epidemiol Biomarkers Prev 2006

Future Prospects

- **Proposed legislation introduced by U.S. Senator Barbara Boxer (D-CA)**
  - create a nationwide database of suspected clusters and deploy federal agency resources to investigations into environmental correlates of local disease clusters
  - strengthen federal inter-agency coordination of cluster investigations and authorize federal partnerships with states and universities to investigate disease clusters.
  - Federal labs would support biomonitoring and analysis of environmental contaminants.
- **“Health officials are currently working with their hands tied … and don’t have the resources or time to address the concerns,” explains National disease Cluster Alliance (NDCA) Executive Director Terry Nordbrock, MPH.**
  - “I keep being contacted by people whose state cancer registry officials have confirmed an unexpectedly high rate of disease, but their only suggestion for intervention is to invite the concerned residents to speak at smoking cessation workshops. This bill will … be able to directly address the environmental concerns that community members are asking.”

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EpiNewswire Oct 5 2010

THANK YOU

FLORIDA ASSOCIATION OF PEDIATRIC TUMOR PROGRAMS, INC.

FLORIDA DEPARTMENT OF HEALTH

Nemours Center for Childhood Cancer Research

University of West Florida