

Environmental Public Health Tracking Network: Colorado's GIS Approach



Colorado Environmental Public Health Tracking

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of Public Health
and Environment



Environmental Public Health Tracking Network: Centers for Disease Control and Prevention

- 7 out of 10 deaths among Americans each year are from chronic diseases¹
- Chronic diseases place an economic burden on the U.S. economy in excess of \$1 trillion annually²
- Growing scientific evidence links environmental factors to many chronic diseases such as asthma, birth defects, and cancers
- Researchers have linked exposures to some environmental hazards with specific diseases
 - Exposure to asbestos and lung cancer
 - Exposure to lead and decreased mental function in children
- Other links remain unproven



1. CDC - National Center for Health Statistics

2. Ross DeVol, Armen Bedroussian, et al., "An Unhealthy America: The Economic Burden of Chronic Diseases, Milken Institute." October 2007

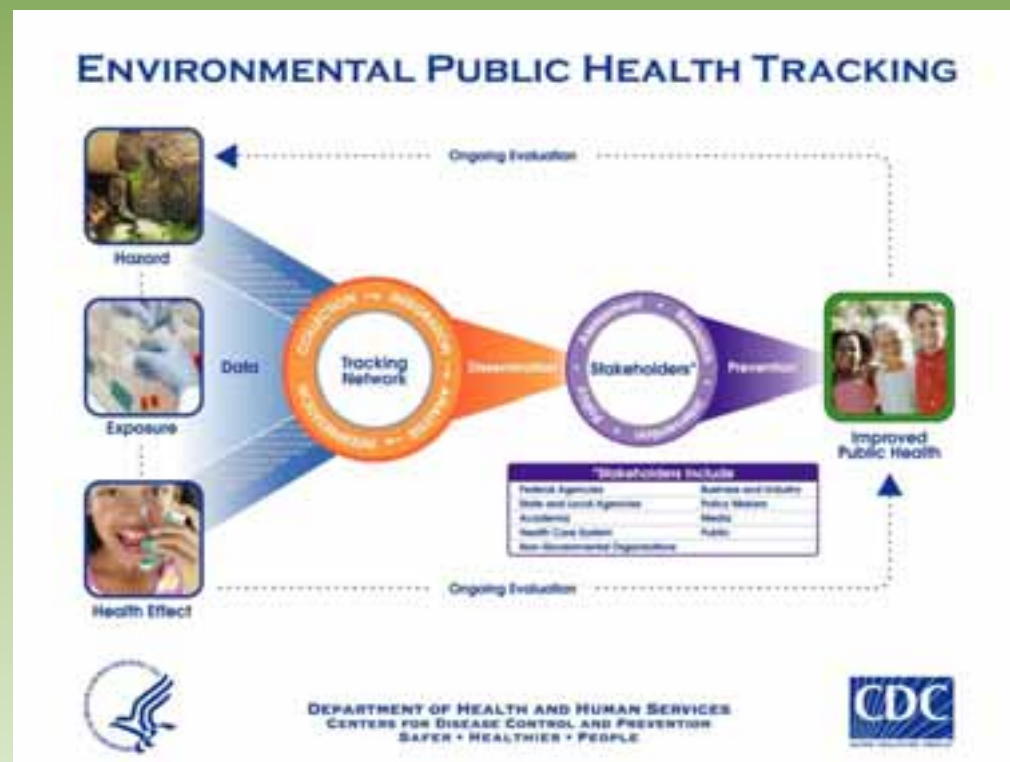
National Environmental Public Health Tracking Network

- Most environmental and health information is collected separately
- The information is scattered in a number of places and formats
- Difficult to study and monitor relationships

National Environmental Public Health Tracking Network (CDC)

The ongoing collection, integration, analysis, and interpretation of data about:

- Environmental hazards
- Exposure to environmental hazards
- Health effects potentially related to exposure to environmental hazards



National Environmental Public Health Tracking Network

- Health and environmental experts from states, cities, and other agencies helped CDC develop indicators.

- Based on many factors including priority for state and local health departments, priority for CDC, and whether or not data were available for a particular topic

- Nationally consistent data & measures

- Graph View, Table View, Map View

- Crude Data, Adjusted Rates, County and State Level Information

National Environmental Public Health Tracking Network

Home | Lead Tracking Program | State & Local Tracking Portals | Indicators & Data | Secure Portal

Tracking & Data

Home » Health Effects » Asthma

Indicators: Hospitalizations for Asthma

Current Area: Asthma

Select Current Area: Air Quality, Asthma, Birth Defects, Cancer, Child Welfare Reporting, Childhood Lead Poisoning, Community Water, Food Safety, Health Effects, Home, Radiation Characteristics, Reproductive and Birth Outcomes, Lead Data

Rate Indicator: Age-adjusted rate of hospitalization for asthma per 10,000 population

Derivation of Measure: Description: Recodes hospitalizations for asthma, ICD-9-CM 493.0X, by gender and race by state and by county

Adjustment: Description: Out-year resident population, by gender, for state and by county

Adjustment: Description: Age-adjustment by the direct method to year 2000 U.S. standard population

Unit: Hospital admission (categorized by discharge diagnosis)

Geographic Scope: State and National

Geographic Scale: Regions of jurisdiction—state, county

Time Period: Annual admission from January 1 through December 31 for each year, 2000–

Time Scale: Daily, monthly, and annual (as appropriate for the measure)

In 2004, 25.5 million people in the United States reported having asthma. In 2004, there were more than 574,000 hospitalizations for asthma. In 2002, there were more than 4,200 deaths in which asthma was the underlying cause. Asthma is the leading chronic health condition among children. There are ethnic, racial, income, and geographic disparities in poor asthma outcomes. Asthma causes lower quality of life, preventable unnecessary health outcomes, and large direct and indirect economic costs. Environment attributable fractions of the 1999–1998 economic costs for asthma were 25.2% for children aged <10 years and 44.4% for 10/19/09 aged 10–24 year, costing more than \$400 million for each age group.

A number of epidemiologic studies have reported associations between air pollution exposures and asthma. The association between ambient air particulate matter (PM) concentrations and asthma includes increased hospital admissions, a

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Contact Us

CDC (Phone): 800-CDC-INFO
800-232-4636
800-232-6348 (TTY)

Tracking Program:
tracking@nenn12.dhs.gov
1-877-425-7643

State and Local EPHT Portals

- CDC funds health departments in states and 1 city to build and implement local tracking networks.
- These state and local data systems also feed data into the national Tracking Network.
- Public and Internal Portals
- County vs. Community-level spatial data

California

Connecticut

Florida

Maine

Maryland

Massachusetts

Missouri

New Hampshire

New Jersey

New Mexico

New York

New York City

Oregon

Pennsylvania

Utah

Wisconsin

Find a profile of each state on our Communication Features page.

Communication Features

New States Join the Tracking Network
Summer 2009: Colorado, Kansas, Louisiana, Minnesota, South Carolina, and Vermont.
Summer 2010: Iowa
CDC continues to advance its goal to one day include all 50 states in the Tracking Network.

Colorado's Environmental Public Health Tracking Network

August 2009

- 8/1/09 – Colorado funded to join CDC's national network
- Provide environmental and public health data through web-based portals
- Join other states in providing a national picture of selected environmental and health indicator data
- Expand environmental public health capacity at the state and local level
- Develop additional health and environmental indicators important to Colorado
- Working towards first public portal release > January 2011

Using GIS to examine health outcomes with corresponding environmental quality data

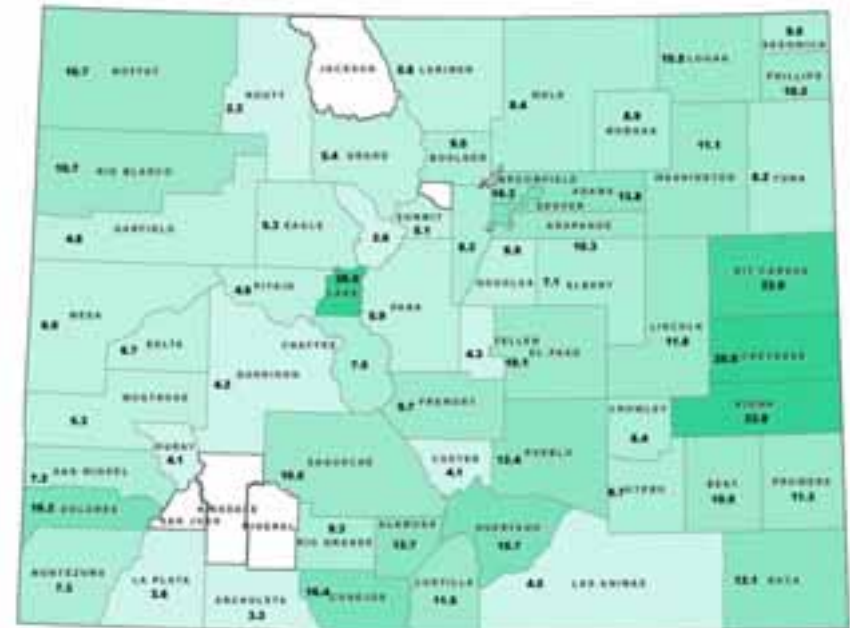
- ▶ Disease mapping: Long history (Snow).
- ▶ A survey in 1991 identified 49 international, national, and regional disease atlases (Walter and Birnie 1991).
- ▶ Environmental mapping: 1962 Canada Land Inventory (CLI) – an effort to determine the land capability for rural Canada by mapping information about soils, agriculture, recreation, wildlife, waterfowl, forestry, and land use at a scale of 1:50,000

Time, measurement technique, and resolution of each theme is probably different

- ▶ What we are trying to do with EPHT is to integrate data from very different data sources: environmental samples, land use, demographics, human health data (individual and aggregated).
- ▶ All have common link of geography (albeit at different scales).

Can the relationship between health outcome and our surrounding environment be described accurately by a geographical depiction?

2001, Number of Days of Maximum 8-hour Average Ozone Concentration with Number of Person-Days, By County, State of Colorado



When we put these together, geographically, the onto same map, the amount of exposure to the environmental theme is often assumed to be causal...

How do we account for variability to exposures on map?

Current approaches

- ▶ Environmental health risk inventories
- ▶ Community health profiles
- ▶ In order to determine if a link exists between an environmental source and a pattern of health outcomes, users must collect more detailed information on the population and on specific environmental conditions.
- ▶ Trace locations of individual people (patients, cases, or controls) back through time, to discover spatial clusters in the past or to determine past environmental exposures
- ▶ GIS serves as an initial tool for problem identification and hypothesis building in this link.
- ▶ Data on health outcomes must be obtained from national, state, or local sources. As a rule, public health agencies may limit access and distribution of data.

Environmental Health Screening with GIS: Creating a Community Environmental Health Profile, Journal of Environmental Health, April, 2000 by John C. Pine, James H. Diaz

Mapping activities at CDPHE before EPHT

Focus on individual programs and priorities

- Previous mapping for these programs done on a project by project basis at different time intervals – with different objectives
- Need to bring together the best methods for creating, managing, and visualizing data based on requirements.

Questions we need to stop and ask:

- What are the sources and quality of our data?
- What are the national EPHT guidelines/recommendations for viewing data? Are other methods applicable to Colorado data?
- What are the cartographic standards that have been applied at CDPHE? How well is the data suited for interpretation on map?
- How does this all come together into a desirable and consistent product? Users – Technical Advisory Committee, local PH, interested citizens

EPHT Geospatial Workgroups



- Community Mapping Team
 - Visualization Guidance Team
 - Subgroups of the Standards and Network Development (SND) Workgroup
 - Content Workgroups
-
- Objectives of Community Mapping Team:
 - Identify methods and tools to maintain confidentiality and reduce unstable rates due to small numbers when mapping health data at the community level.
 - Help build capacity in the state and national EPHT programs in the use of the tools.

Visualization Guidance Team (VGT)

- Review and describe how EPHT programs are mapping the nationally consistent data measures
- Recommend best practices for displaying and classifying non-suppressed and suppressed/unstable data, including guidance in cartography. (Nationally consistent data measures)
- Take into consideration the multiple mapping technologies that are being applied and will allow for the consistent and standardized display of data (where applicable and appropriate) across multiple portals in order to create visual consistency across portals.
- Get input and collaborate with Content Workgroups
- Empower users as well as data/GIS analysts and developers.

Our approach

- Develop, evaluate, and document our best practices for using our geospatial health and environmental data to support EPHT goals (National and State)
- Build on relationships and attend meetings with our EPHT data stewards and program staff
- Actively participate in discussions and decisions concerning portal development
- Implement the use of cartographic standards and map templates for developing EPHT products.
- Construction of our portal GIS services (development) environment (ArcGIS Server, SQL Server, SDE, Map Services, ArcGIS Viewer for Flex, etc.)
- Get input and collaborate with other portals through Geospatial Team
- Create first draft of static map images and get feedback (develop communication protocol)

Determining best practices

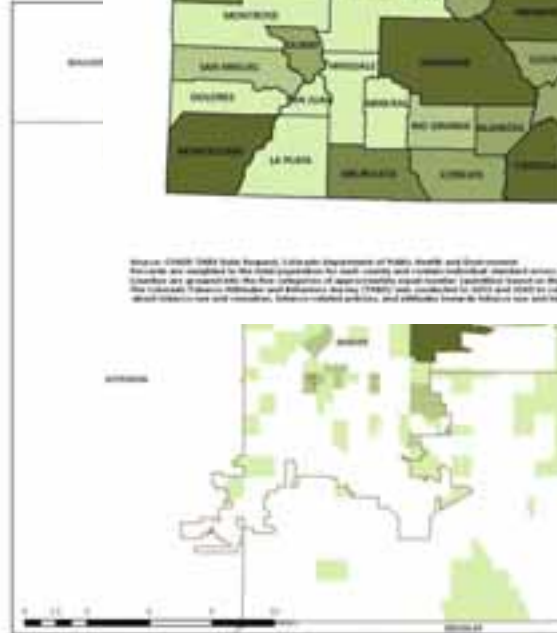
2005 Tobacco Attitudes and Behaviors Survey Results, Colorado
Percent responding yes to "Are you a current smoker?"



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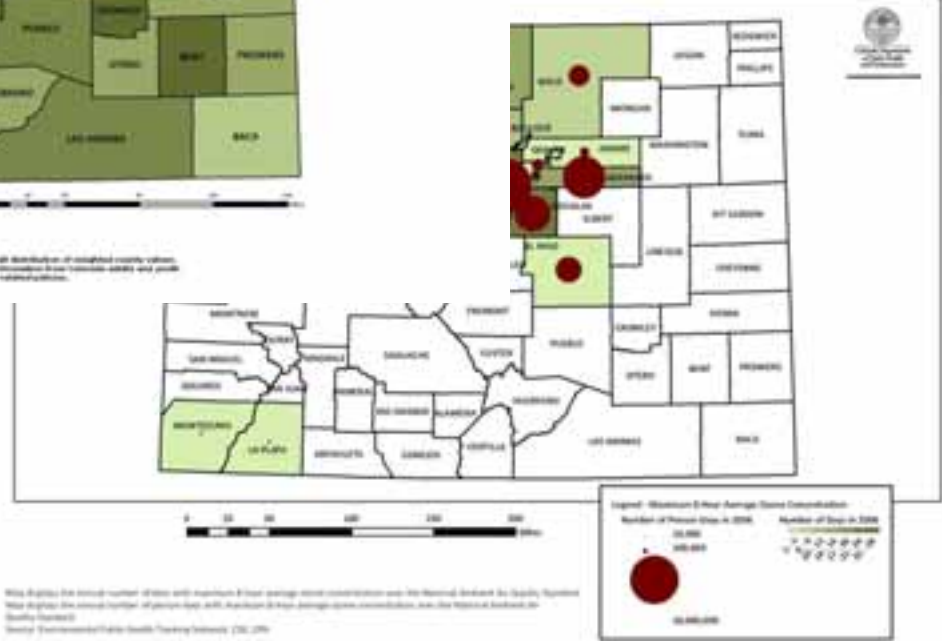


Year 2008



Source: 2005 Tobacco Attitudes and Behaviors Survey, Colorado Department of Public Health and Environment.
Percentages are weighted to the state population for each county and county individual standard errors.
County size is proportional to the raw population of each county (equal-area). Percentages based on the overall distribution of weighted county values.
The Colorado Tobacco Attitudes and Behaviors Survey (TABAS) was conducted in 2005 and 2007 to collect information from Colorado adults who smoke, who do not smoke and intend to smoke, tobacco-related activities, and attitudes toward tobacco use and tobacco consumption.

um 8-hour Average Ozone
ays, By County, State of Colorado



This figure is the total number of sites with maximum 8-hour average ozone concentration over the National Ambient Air Quality Standard. The size of the red circle is proportional to the number of sites with maximum 8-hour average ozone concentration over the National Ambient Air Quality Standard.
Source: Environmental Public Health Training Institute, 2008.

Standards Matrix for Map Products

	A	B	C	D	E	F
1	Standards Matrix CDPHE Map Products-October 2009					
2	Below is a listing of the Cartographic Standards developed by the Colorado Dept. of Public Health and Environment. This document should be considered a work in progress, and we will continue to refine all requirements and guidelines. Still pending new input.					
3	Developed directly from King County, Washington, Cartographic Standards Group.					
4						
5		ID Subject/Element	Requirement or Guideline	Date Revised	Description	Exception Examples
6		000 General	Requirement	July-09	All maps will have a north arrow, CDPHE logo, source information, status, title, legend, scale bar, northline, date, symbol and their definition.	Specialized communications projects such as publications, brochures, displays, PowerPoint presentations, other mixed-media presentations, and draft documents make it impossible to include many of these elements.
7		002 North Arrow	Requirement	July-09	The direction of north on the map and the orientation of the north arrow will be to the top of the page.	
8		003 Map Text	Requirement	July-09	The font color for all text on the map other than text that is part of the map view itself (e.g., feature labels) should be black. This includes the lettering for the logo and scale bar.	Red fonts may be used to clarify important items on the map.
9		004 Scale Bar	Requirement	July-09	Scale bars will be in units of feet or miles.	Maps used for survey of specific areas may require different units as needed.
10		005 Northline	Requirement	July-09	All maps should use a northline to highlight the map, scale, north arrow, and legend on the map.	
11		006 Status	Requirement	July-09	The phrase "DRAFT" should appear on the map when it is not final or in progress. The phrase "FOR INTERNAL STAFF USE ONLY" should appear on the	

- Standards matrix is a document for CDPHE map authors to use (and update) when developing products. Catalog of all mapping techniques used at CDPHE. Not just EPHT.
- Move from “basic inventory” to defining smoothing/data suppression techniques.

Map Template



- Use of the template forces the look and feel of the maps to be consistent and increases the ability of map users to understand information throughout a series of maps.
- These templates are also used to introduce discussions among environmental and public health program specialists and data stewards concerning best methods to classify and visualize data.

Colorblind-safe schemes

The same five designs show color assignments when on a neutral background for five classes of sequential and diverging data. (The stacked color is an equivalent substitute for three colors, right?)



Figure 1 shows five sequential colors, neutral background, 100% color composition.

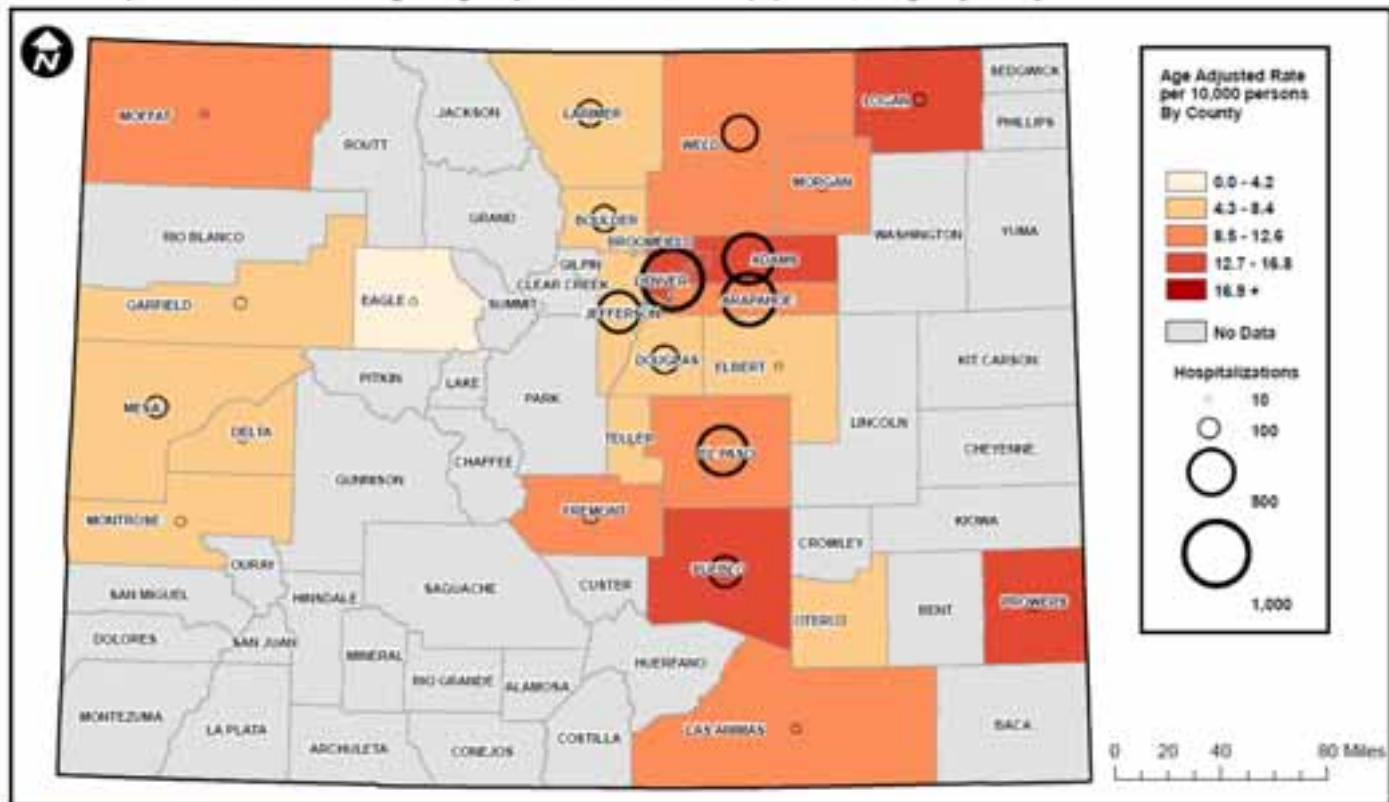
Sequential Class	No. of Color Classes	Color Scheme	Count of Color Classes	Red	Green	Blue	Color Pair Counts
Sequential 1	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 2	5	Sequential Bufo	100, 200, 300, 400, 500	219	210	140	✓
Sequential 3	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 4	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 5	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 6	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 7	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 8	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 9	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 10	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 11	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 12	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 13	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 14	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 15	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 16	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 17	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 18	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 19	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓
Sequential 20	5	Sequential Bufo	100, 200, 300, 400, 500	219	140	140	✓

Different methods for classifying Asthma Hospitalization Rates



Colorado Environmental Public Health Tracking

Asthma Hospitalizations in 2009 showing the Age-Adjusted Rate for the Total population, All Ages by County



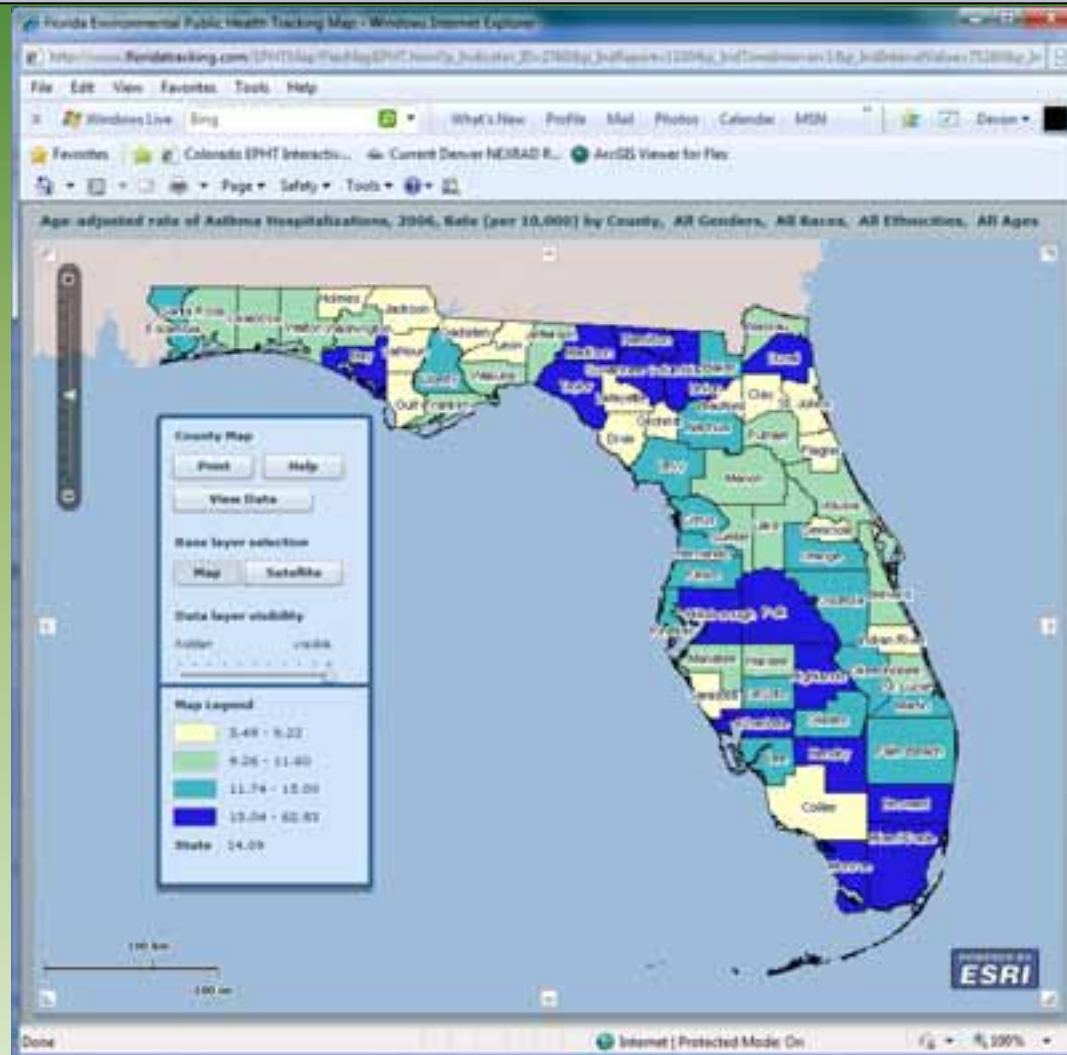
NOTES ABOUT THE DATA IN THIS MAP:

- Colorado statewide age ad. rate per 10,000 of hospitalizations due to asthma is 9.25 with a 95% confidence interval of 8.98 - 9.51
- If the county area is filled with a hatch pattern, the data has been suppressed from the map due to the number of events being less than 12.

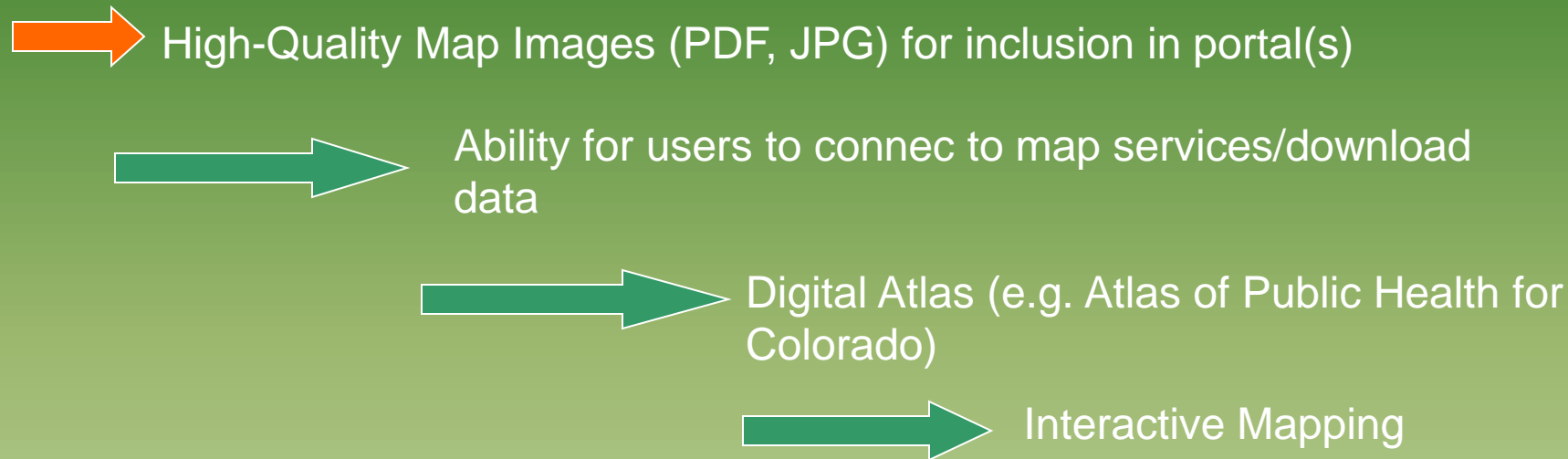


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Classifying Asthma Hospitalization Rates



Looking ahead..



- ▶ 4 Components
- ▶ Clear, consistent mapping, querying, overlay, and analysis products that utilize recent and historical data.
- ▶ Ability to educate users (and consumers) of these products on the limitations (and benefits) of using geospatial data in analyses.

Issues to tackle next

- ▶ Asthma hospitalizations, Heart Attacks (MI), Carbon Monoxide Poisoning, Air Quality, Water Quality
- ▶ Map products should maintain consistency with portal design
- ▶ Develop model for storing and distributing geospatial data
- ▶ Support geospatial workgroup efforts to document best practices and guidance for visualizing each data measure
- ▶ Continue to develop and document standards and templates
- ▶ Internal portal

Beneficial Work

The use of GIS technologies within the National Environmental Public Health Tracking Program has provided the GIS staff at CDPHE an opportunity to develop, document, and evaluate our internal methodologies used to visualize spatial data.

Acknowledgements and Contact Information

- **Eric Brown, Environmental Data Coordinator, CDPHE**
- **Mark Egbert, GIS Coordinator**

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