Data Validation of Health Data in Environmental Health Surveillance

Piloted solutions and lessons learned by the Environmental Public Health Tracking Program

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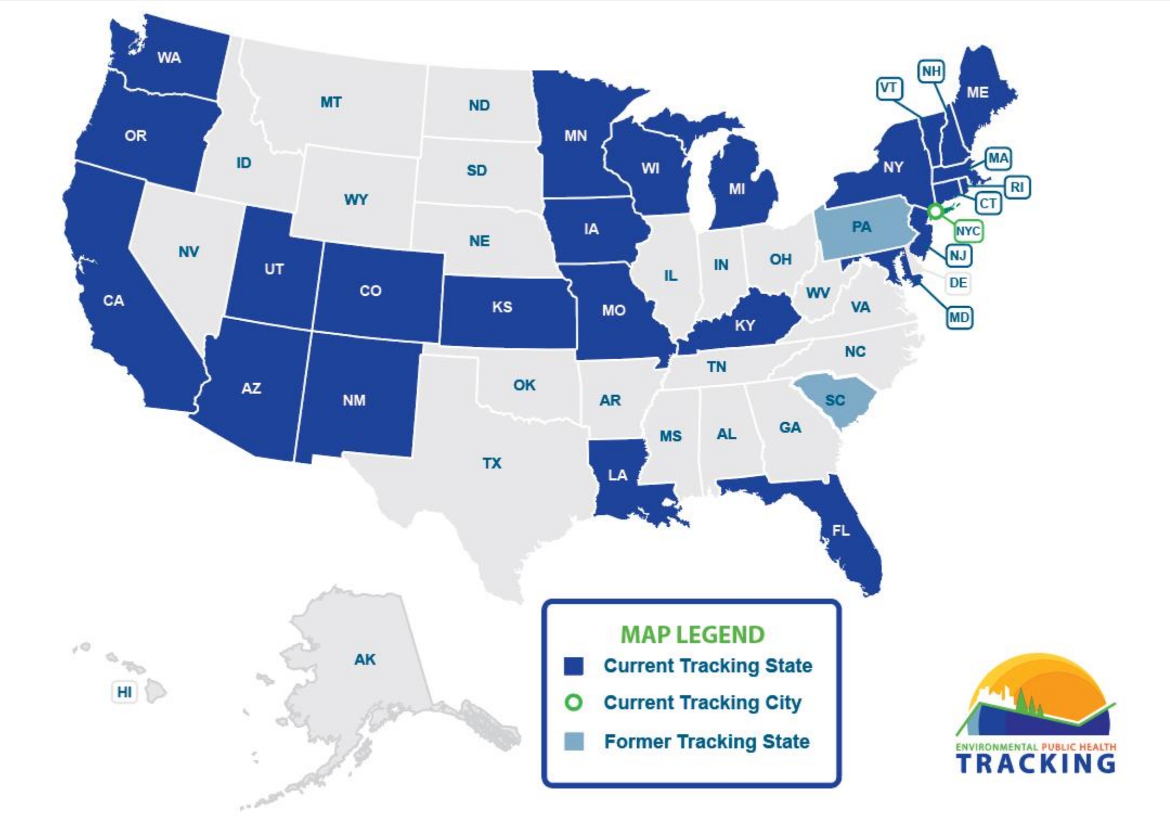
National Center for Environmental Health

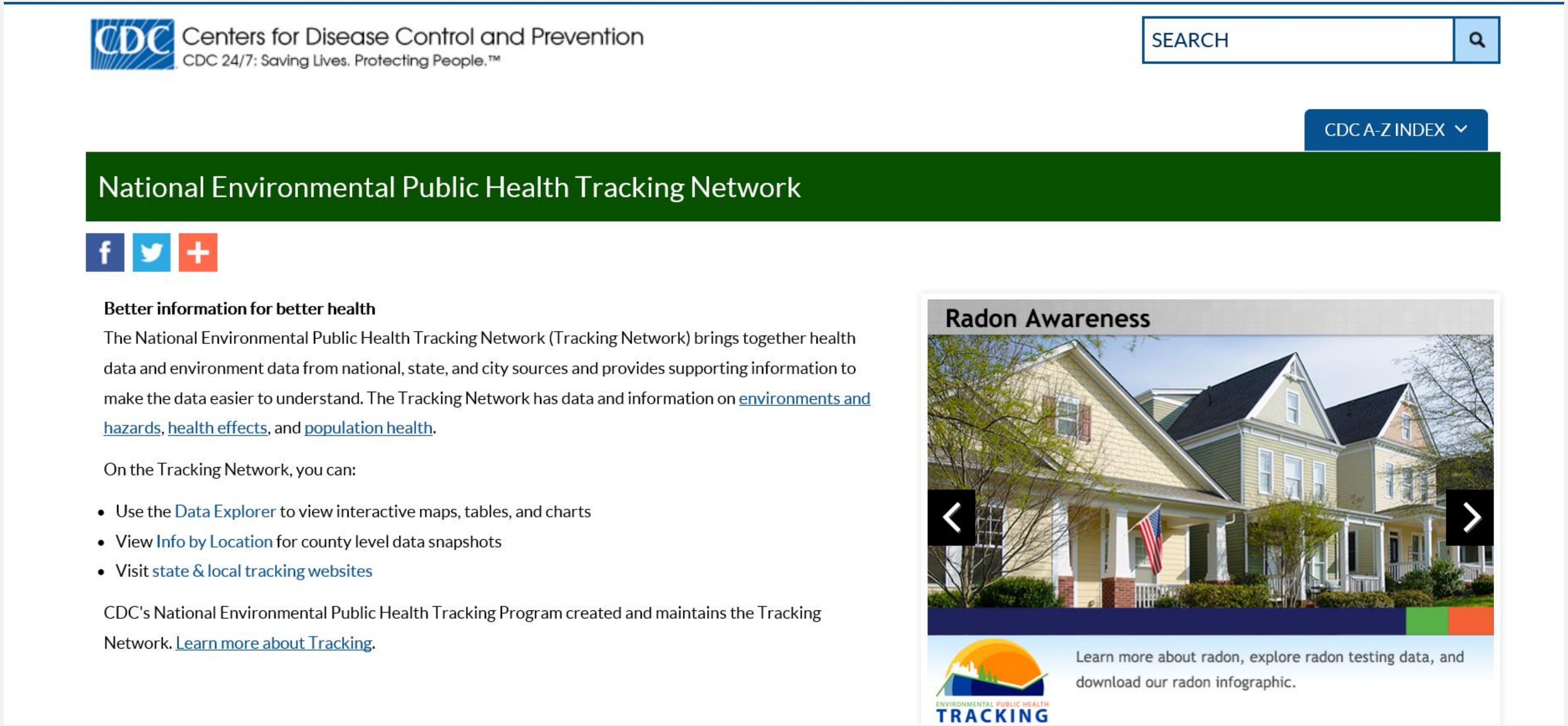
Outline

- **The Environmental Public Health Tracking Program**
- **Overview of Tracking Data Calls**
    - Hospitalizations and Emergency Department Visits Data
- **Tracking Validation Process**
- **What is “Meaningful Difference”?**
- **Piloted Solutions**
- **Summary and Lessons Learned**

The Environmental Public Health Tracking Program



National Environmental Tracking Network



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

National Environmental Public Health Tracking Network

Better information for better health

The National Environmental Public Health Tracking Network (Tracking Network) brings together health data and environment data from national, state, and city sources and provides supporting information to make the data easier to understand. The Tracking Network has data and information on environments and hazards, health effects, and population health.

On the Tracking Network, you can:

- Use the Data Explorer to view interactive maps, tables, and charts
- View Info by Location for county level data snapshots
- Visit state & local tracking websites

CDC's National Environmental Public Health Tracking Program created and maintains the Tracking Network. Learn more about Tracking.

Radon Awareness

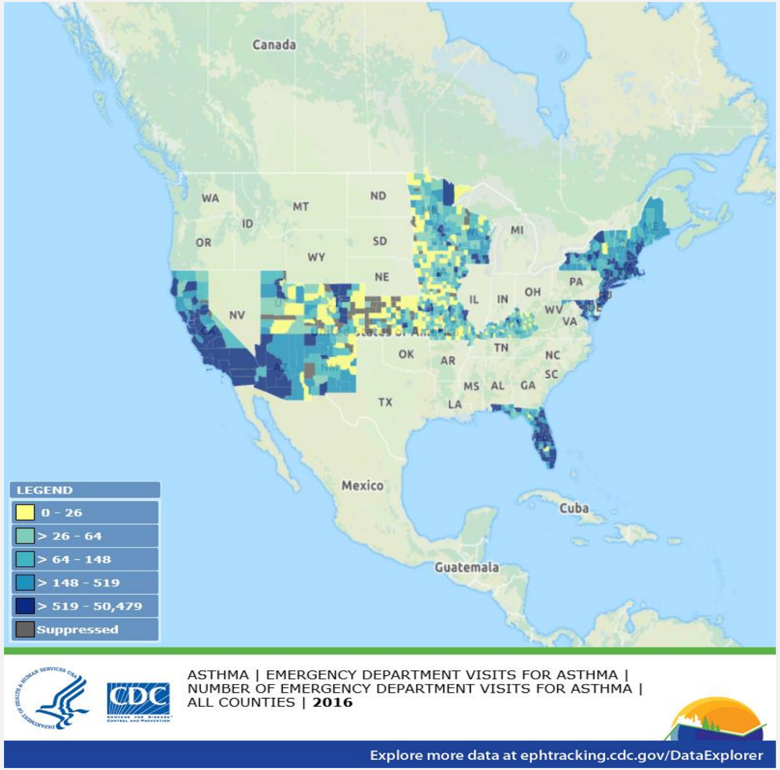
Learn more about radon, explore radon testing data, and download our radon infographic.

Overview of Tracking Data Calls

- **The Tracking Program receives data from recipient states through annual data calls**
  - Data is nationally consistent
  - Data dictionaries and How-to Guides
- **Data are submitted using a standardized XML schema through Tracking's secure data submission gateway**
- **Data thoroughly reviewed by CDC data management unit**

Hospitalization and Emergency Department Visits Data

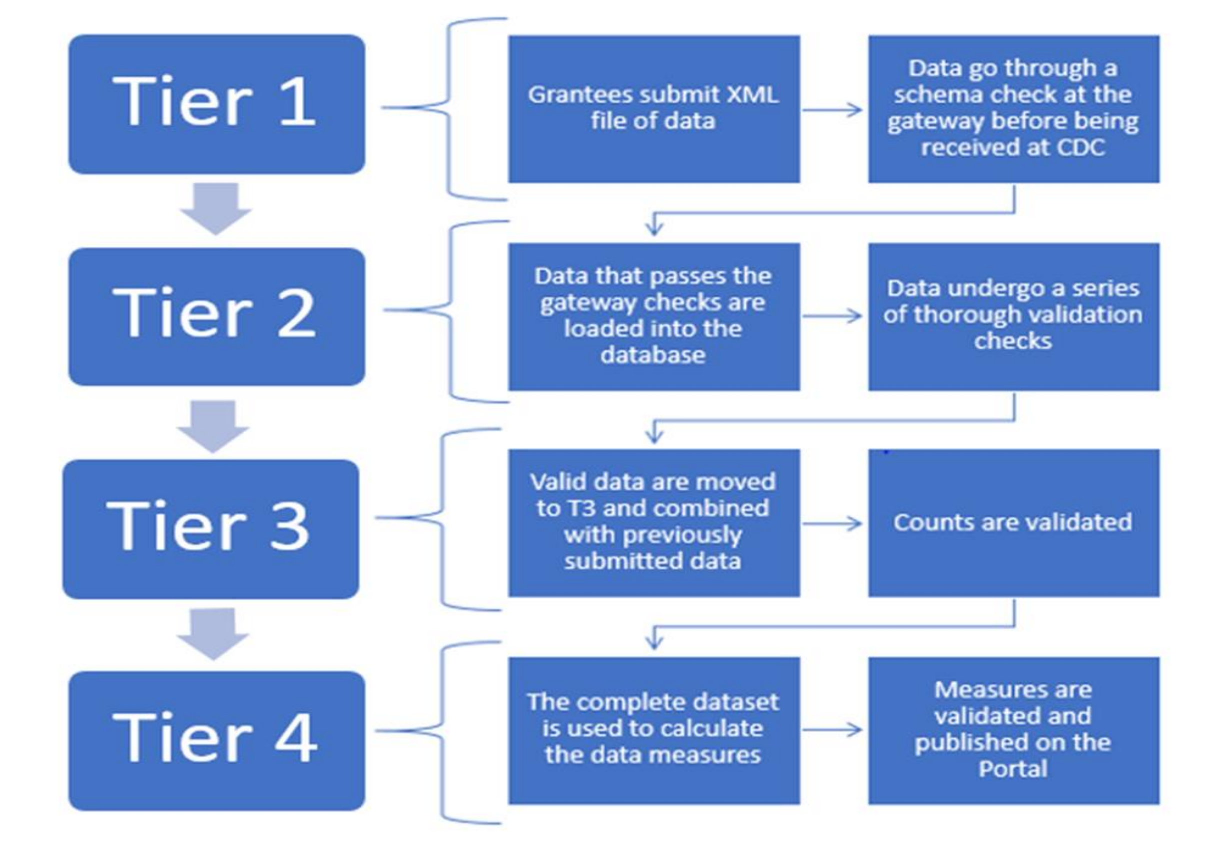
- **Hospitalization (Inpatient Discharge) data:**
  - Asthma
  - Chronic Obstructive Pulmonary Disease (COPD)
  - Carbon Monoxide Poisoning
  - Heat Stress Illness
  - Acute Myocardial Infarction
- **Emergency Department Visits Data:**
  - Asthma
  - COPD
  - Carbon Monoxide Poisoning
  - Heat Stress Illness



ASTHMA | EMERGENCY DEPARTMENT VISITS FOR ASTHMA |
NUMBER OF EMERGENCY DEPARTMENT VISITS FOR ASTHMA |
ALL COUNTIES | **2016**

Explore more data at ephtracking.cdc.gov/DataExplorer

High Level Overview of Validation Process



Tier 1

Grantees submit XML file of data

Data go through a schema check at the gateway before being received at CDC

Tier 2

Data that passes the gateway checks are loaded into the database

Data undergo a series of thorough validation checks

Tier 3

Valid data are moved to T3 and combined with previously submitted data

Counts are validated

Tier 4

The complete dataset is used to calculate the data measures

Measures are validated and published on the Portal

Tracking Data Validation

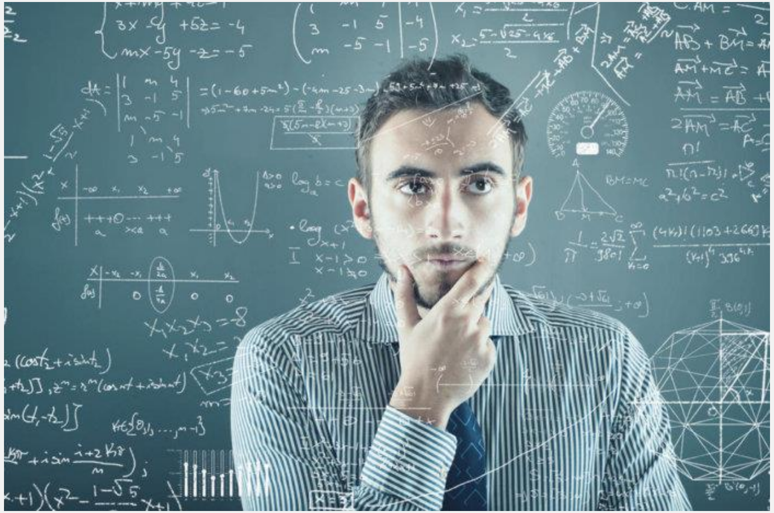
- Strange Patterns
- Lack or Excess of Data
- Outliers or Inconsistencies
- Unexpected Results

Unexpected Results – The Archive Comparison Check

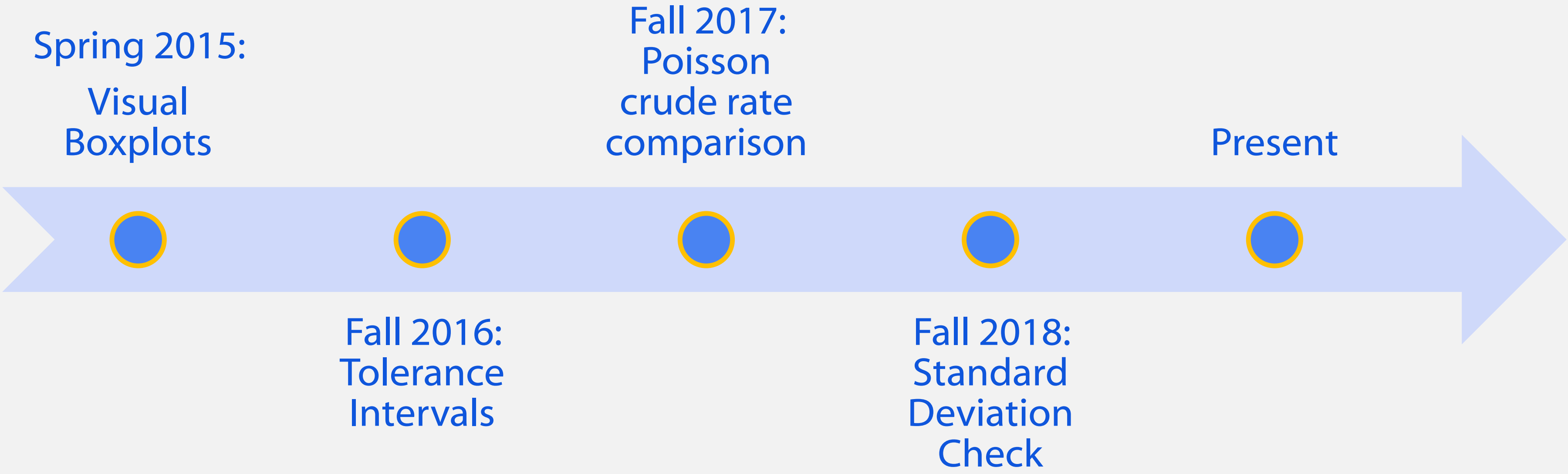
- **When data are determined to be “too different” from the previous data clarification is requested or the submission fails**
- **Previous Solution:**
  - Count and percent difference thresholds for archive data checks
  - Arbitrary thresholds
  - Most commonly flagged check
  - On average, clarification was needed for over 50% of the submitted files every year
- **How do we determine when change in data is due to chance alone or is a true error?**
  - The “Meaningful Difference” issue

The Meaningful Difference Problem

- **The "meaningful difference" problem:**
  - Surveillance data is expected to vary year to year
  - How do we explain what is just expected variation in our hospitalization and ED data and what is error?
- **Why this is important:**
  - To improve data quality
  - To have confidence in the observed trends
  - To know when public health interventions are needed



Piloted Solutions



Spring 2015:

Visual Boxplots

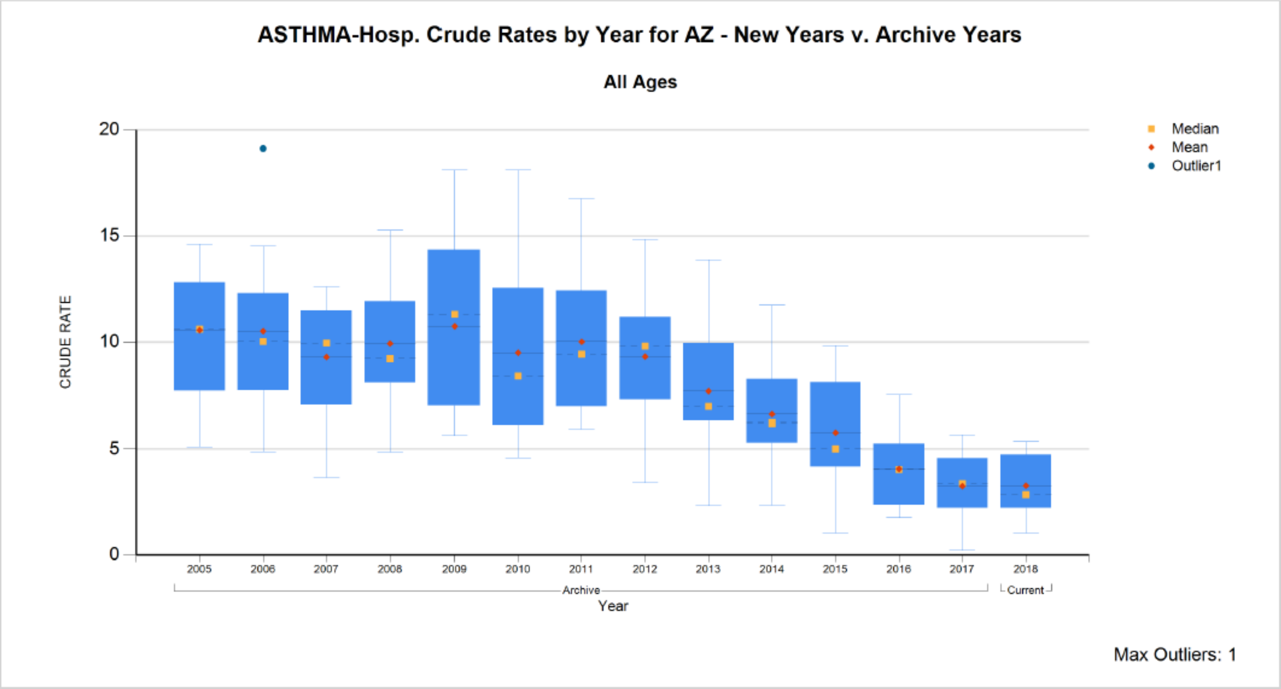
Fall 2016: Tolerance Intervals

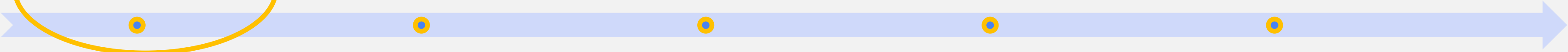
Fall 2017: Poisson crude rate comparison

Fall 2018: Standard Deviation Check

Present

Boxplot Visual Trend Check

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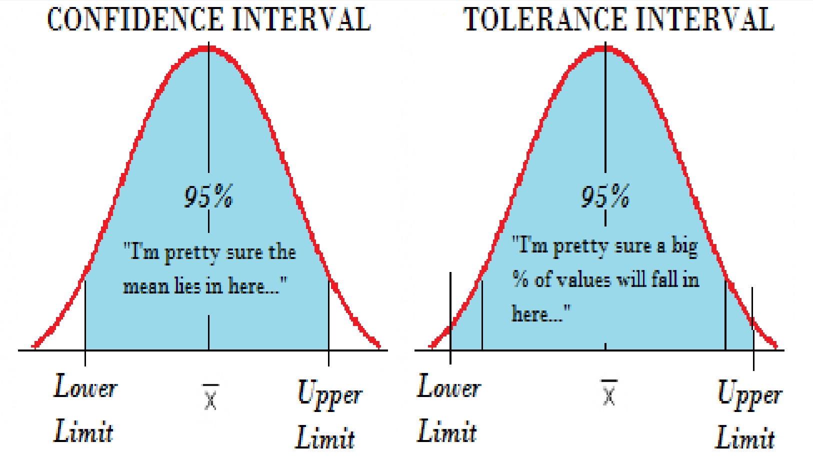
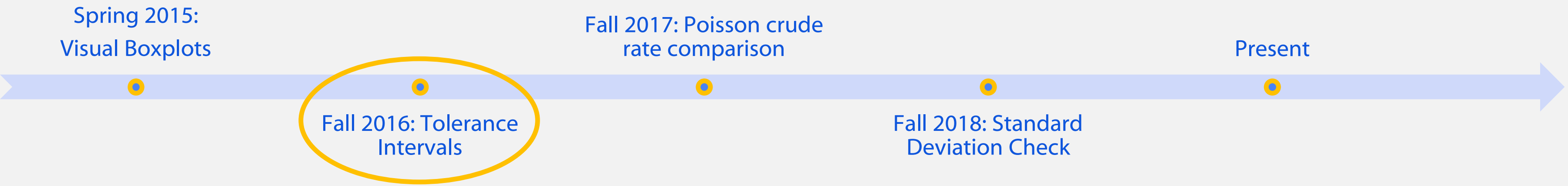
Box Plot - Results

- **Pros:**
  - Uses all years of data
  - Shows trend
  - Easy to spot outliers
  - Compares summary statistics
- **Cons:**
  - Review of boxplots is manual
  - Results are inferred
  - Not useful for ALL Tracking datasets
- **Has been used for all data calls since implementation and has been adapted for all recipient submitted datasets**

Tolerance Interval Check

- Show the expected range of individual observations
- Allows you to set the confidence (alpha) and percent of population (gamma)
- Set different alpha and gamma values to determine the appropriate threshold

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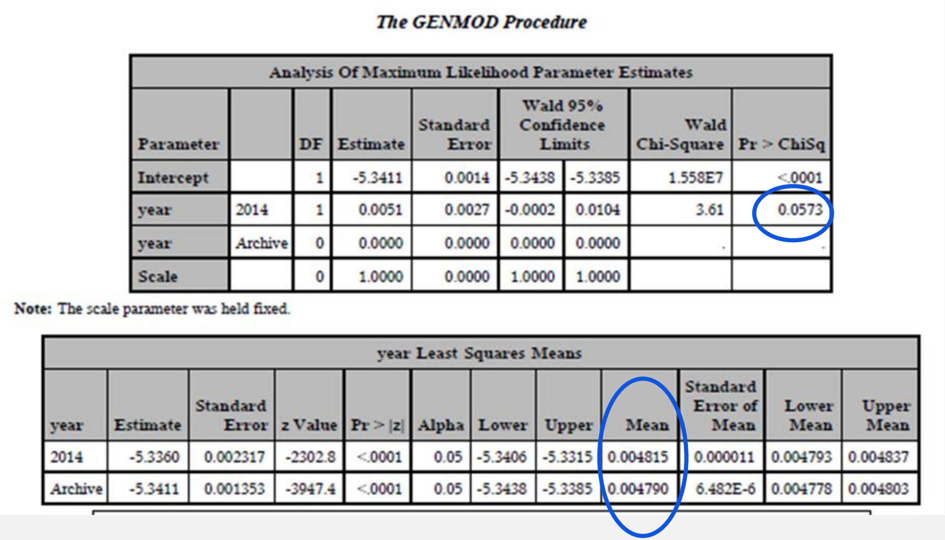
Tolerance Interval - Results

- **Pros:**
  - More statistically sound approach
- **Cons:**
  - Relied on determining arbitrary thresholds
  - Concern of missing records or flagging too many
  - Statistical assumptions
  - Not useful for all Tracking datasets
  - Most reports produced a large output
- **Check did not reduce the number of follow ups Tracking was performing throughout the data call**

Poisson Rate Comparison

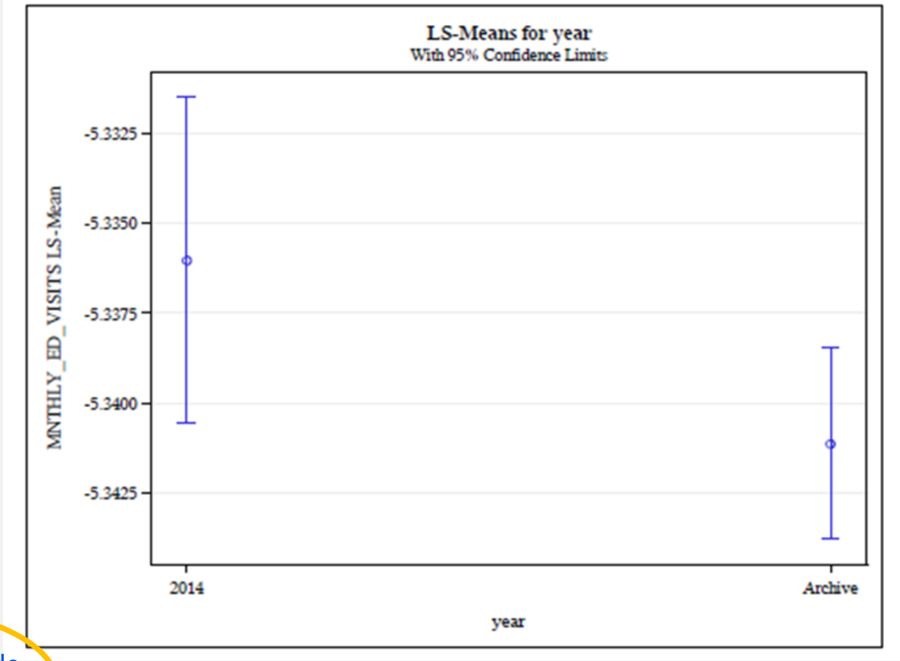


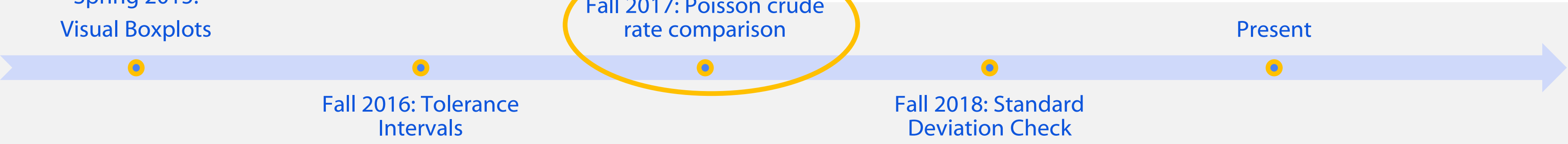
The GENMOD Procedure

Analysis Of Maximum Likelihood Parameter Estimates								
Parameter		DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept		1	-5.3411	0.0014	-5.3438	-5.3385	1.558E7	<.0001
year	2014	1	0.0051	0.0027	-0.0002	0.0104	3.61	0.0573
year	Archive	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale		0	1.0000	0.0000	1.0000	1.0000		

Note: The scale parameter was held fixed.

year Least Squares Means											
year	Estimate	Standard Error	z Value	Pr > |z|	Alpha	Lower	Upper	Mean	Standard Error of Mean	Lower Mean	Upper Mean
2014	-5.3360	0.002317	-2302.8	<.0001	0.05	-5.3406	-5.3315	0.004815	0.000011	0.004793	0.004837
Archive	-5.3411	0.001353	-3947.4	<.0001	0.05	-5.3438	-5.3385	0.004790	6.482E-6	0.004778	0.004803





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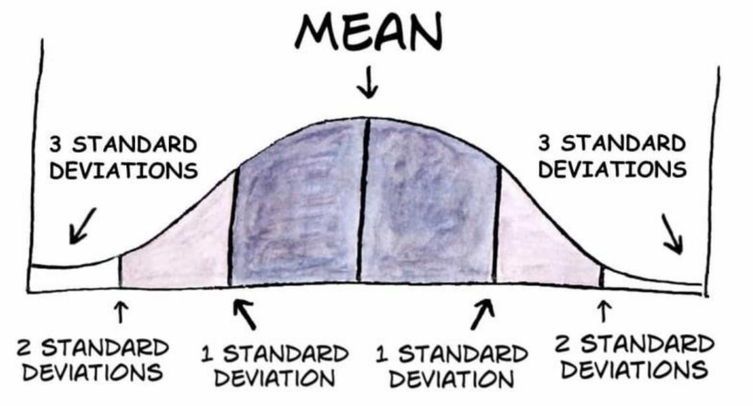
Present

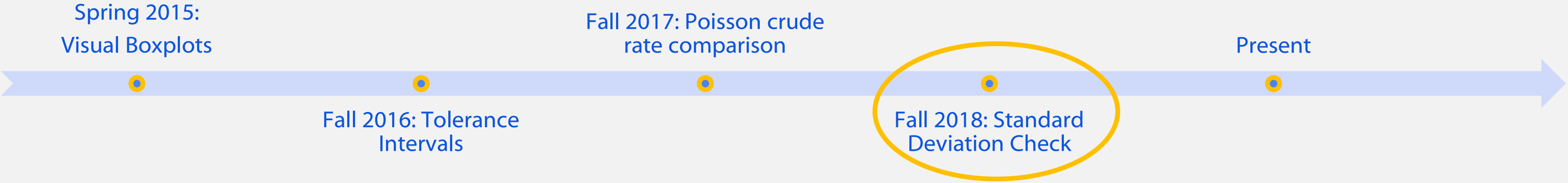
Rate Comparison - Results

- **Pros:**
  - Uses rates
  - Population denominator helps standardize small counts
  - More rooted in statistics
- **Cons:**
  - Number of counties/records can affect power
- **This check in combination with the box plots has been very helpful**
- **Still being used for validation and has been adapted for all applicable datasets**

Standard Deviation Check

- This check uses all previously submitted years of data for a single state and health outcome
- Compares summary statistics from previously submitted data to new years of submitted data





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Standard Deviation Check - Results

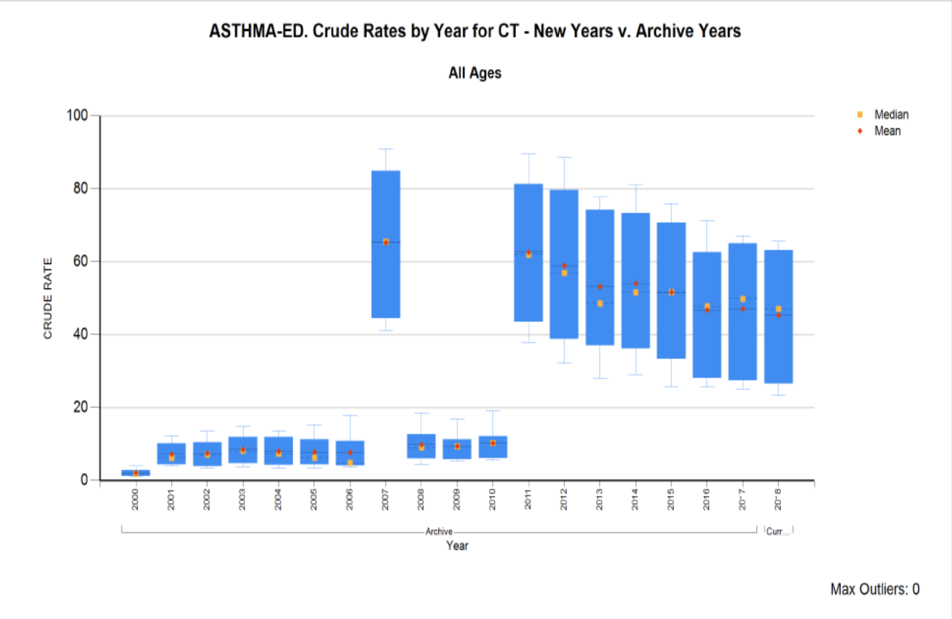
- **Pros:**
  - The calculated threshold is dynamic
  - Use of all previous years of data for comparison
  - Focuses on distribution of counts at state and county level
- **Cons:**
  - Inconsistent with catching errors
  - Less successful with data with small counts (CO Poisoning and Heat Stress Illness)
- **This check has been useful to supplement other archive checks**
- **Provides additional useful information about the distribution of the data**
- **Helps identify possibly problematic counties**

Summary-Improvements in Data Call

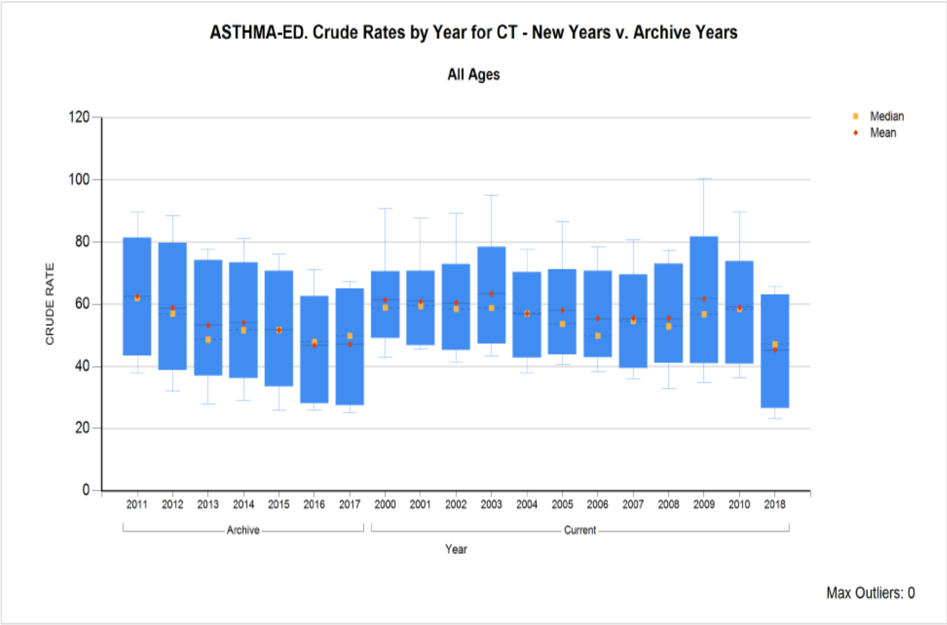
Metric	Fall 2015	Fall 2019
Number of Files Received	533	537
Percent of Submissions requiring follow up	71%	36%
Time to Public portal	~6 months	~4 months

Summary-Validation Success Story

Before resubmission



After resubmission



Lessons Learned

- **Hospitalization and emergency department visits data for surveillance poses unique challenges in spotting errors**
- **Exploring and piloting of more sophisticated checks have had mixed results**
    - Visual checks have shown effective in spotting errors
- **The introduction of advanced validation checks have shown to conserve program time and resources**
- **Tracking will continue to review and improve the validation process and pilot solutions to improve accuracy and timeliness of the hospitalization and emergency department visits data**

Thank you!

For more information, contact NCEH
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.