**HEALTH**
MONITORING

**EpiCenter User Manual**
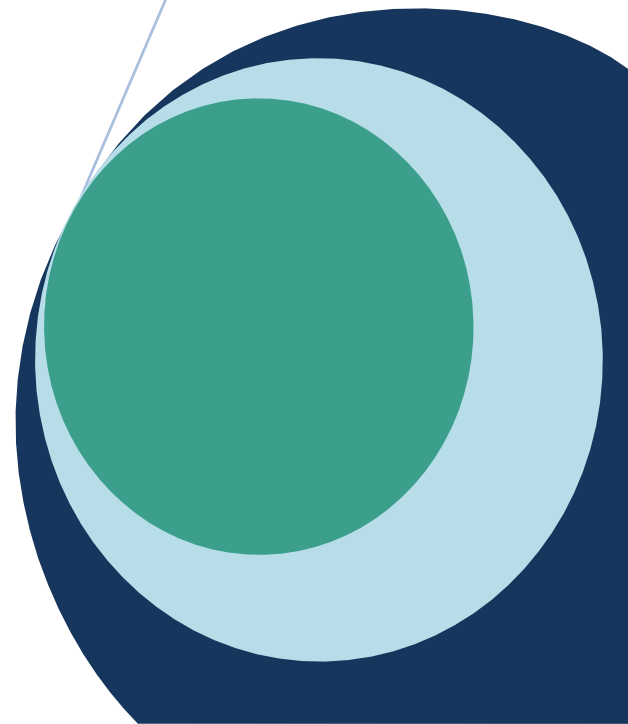
**Version 3.5.18**

# Table of Contents

# 1 Introduction

The EpiCenter system analyzes healthcare data for the purpose of detecting anomalies suggestive of public health threats, such as disease outbreaks and bioterrorism. When anomalies are detected, EpiCenter provides automatic notification to appropriate health department personnel.

This user manual defines components and describes functionality for EpiCenter Version 3.5.18 (released December 2019).

EpiCenter 3.5.18 is accessible by both public health users and users at individual healthcare facilities.

All public health users are able to view the Summary, Anomalies, Investigations, Charts, Maps, and Options pages. Access may be available to the Dashboard, Reports, Label, and Custom Classifiers pages.

The functionality for healthcare facility users is limited to the Charts and Options pages. Some facility users are also able to view the Reports and Dashboard pages.

# 2 Data Analysis Components

This section describes how EpiCenter models healthcare data and presents available analysis methods. The terminology introduced here is used throughout the user manual and the EpiCenter product.

## 2.1 Data Types

### 2.1.1 Acute Care Interactions

Acute Care Interactions records typically include the following:

- Patient Data, or information specific to a patient. Examples include gender, race, and ethnicity.
- Facility Data, or information specific to a facility. Examples included the facility identifier.
- Interaction Data, or a fundamental interaction between a patient and a healthcare provider that results in information useful to public health. Examples include registration, admission, and discharge.
- Data Element, or a patient-, provider-, or interaction-specific detail that is relevant in the context of the data type. Examples include age at registration and date of discharge.

In most cases, this data is collected in real time, meaning that a record is received at Health Monitoring Systems within minutes of a patient being registered at the facility.

EpiCenter is also capable of processing update messages. Update messages can include updates to the original message, or elements such as patient temperature, discharge disposition, or preliminary diagnosis data. For a complete breakdown of Health Monitoring System's technical guidelines, a separate document is available upon request.

### 2.1.2 Poison Control Center Call Data

Poison control center call data is available in the EpiCenter system, at either the aggregate or line-level, in select areas. This data is obtained remotely from either the National Poison Data System (NPDS) or state poison control centers. It provides information about calls to poison control centers within a specific geographic area. If users access line-level data, the following pop-up message will state "Case-level poison center data is not to be redistributed. Any report or publication utilizing Poison Center data must obtain written approval from the applicable Poison Center(s) prior to distribution." The user then must accept these terms to view the data.

### 2.1.3 Reportable Disease Cases

Reportable disease case data includes the occurrence of diseases that are mandated for reporting by a public health entity. These disease cases have various status designations, including suspected, probable, and confirmed. Note: Analysis tools associated with this data type are only available for regions where this data type is collected.

## 2.2 Classifiers

All incoming data is automatically classified by the EpiCenter system. The Infectious Disease Symptoms, Syndromes, Animal Related Injury, Influenza Related Illness, Traumatic Injuries, Immediate Notification, Alcohol Related (beta), Dental (beta), and Heat Related Illness (beta) classifiers are used to classify the free-text chief complaints from acute care interactions. The Bioterrorism/Agents, Body Systems, and Special Clinical Effects classifiers are used to group poison control center call data based on the clinical

effects already assigned by the NPDS.

## 2.2.1 Classifiers for Acute Care Interactions

### 2.2.1.1 Infectious Disease Symptom Classifier

The Infectious Disease Symptom Classifier classifies free-text chief complaints based on a specific symptom (as opposed to the grouping of symptoms used by the Syndrome Classifier). This method of classification alleviates many of the inconsistencies seen with the Syndrome Classifier. For example, one group of system developers could associate a chief complaint of fever with a constitutional category while another group of developers might place this complaint in an influenza-like illness category. The Infectious Disease Symptom Classifier provides a solution for this issue by approaching the classification process with the symptoms of disease in mind rather than by attempting to group symptoms into syndromic classifications.

### 2.2.1.2 Syndrome Classifier

The Syndrome Classifier classifies free-text chief complaints based on classifications that group together symptoms associated with the presentation of common diseases. The Syndrome Classifier contains seven syndromic classifications, each composed of one or more classifications from the Infectious Disease Symptom Classifier. As a result, the Syndrome Classifier can categorize a chief complaint into one or more classifications.

### 2.2.1.3 Animal Related Injury Classifier

The Animal Related Injury Classifier classifies free-text chief complaints into classifications related to animal-inflicted injuries. Rabies is included among these classifications. This classifier can assign a chief complaint to one or more classifications.

### 2.2.1.4 Influenza Related Illness Classifier

The Influenza Related Illness Classifier contains several classifications that are used to identify free-text chief complaints indicative of influenza. A chief complaint can be assigned to one or more classifications by this classifier.

### 2.2.1.5 Traumatic Injury Classifier

The Traumatic Injury Classifier classifies each free-text chief complaint into one or more classifications related to traumatic injuries. Note: this classifier includes a Drugs classification.

### 2.2.1.6 Immediate Notification Classifier

The Immediate Notification Classifier classifies free-text chief complaints based on a list of certain keywords that are considered rare enough and serious enough to warrant immediate attention (e.g., "anthrax"). Because these keywords are exceedingly rare, time series of these classifications are typically analyzed differently for surveillance using the immediate qualification method (See Section 3.2). These classifications can also be analyzed using the standard (simple) method if preferred.

### 2.2.1.7 Alcohol Related Classifier (Beta)

The Alcohol Related Classifier tracks alcohol-related Acute Care Interaction visits as identified in free-

text chief complaints. At present it contains only one classification. The Alcohol Related Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

### 2.2.1.8 Dental Classifier (Beta)

The Dental Classifier tracks dental-related Acute Care Interaction visits as identified in free-text chief complaints. Each chief complaint can be classified into one or more classifications by this classifier. The Dental Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

### 2.2.1.9 Diagnosis Classifier

The Diagnosis Classifier is used to classify a patient's preliminary diagnosis that arrives in the form of an ICD-9 and ICD-10 codes. This classifier has multiple classifications, each composed of a grouping of ICD-9 and ICD-10 codes. The Diagnosis Classifier is only available in areas where healthcare facilities are submitting this data type.

### 2.2.1.10 Heat Related Illness Classifier (Beta)

The Heat Related Illness Classifier classifies free-text chief complaints that are related to heat illness. It can classify each chief complaint into one or more classifications. The Heat Related Illness Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

## 2.2.2 Classifiers for Poison Control Center Call Data

### 2.2.2.1 Bioterrorism/Agents Classifier

The Bioterrorism/Agents Classifier identifies poison control center calls that could be suggestive of a bioterrorist threat. This classifier uses groupings of clinical effects previously assigned by the NPDS.

### 2.2.2.2 Body Systems Classifier

The Body Systems Classifier groups poison control center calls on the basis of the affected body system. This classifier uses groupings of clinical effects previously assigned by the NPDS.

### 2.2.2.3 Specific Clinical Effects Classifier

The Specific Clinical Effects Classifier contains specific NPDS clinical effects that could be suggestive of public health threats and that correlate with other data types available in the EpiCenter system. This classifier is based on the clinical effects previously assigned by the NPDS.

### 2.2.2.4 – Poison Control Illegal Drug Classifier (Beta)

The Poison Control Illegal Drug Classifier identifies poison control calls that could be suggestive of Illegal Drug use. This classifier uses groupings of clinical effects previously assigned by the NPDS. The Poison Control Illegal Drug Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

### 2.2.2.5 – Poison Control Medication Classifier (Beta)

The Poison Control Medication Classifier classifies poison control calls that are indicative of medication

use. This classifier is based on the clinical effects previously assigned by the NPDS. The Poison Control Medication Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

### 2.2.2.6 – Poison Control Occupational Classifier (Beta)

The Poison Control Occupational Classifier groups poison control calls that are suggestive of a workplace exposure. This classifier uses groupings of clinical effects previously assigned by the NPDS. The Poison Control Occupational Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

### 2.2.2.7 – Poison Control Opioid-Related Evidence Classifier (Beta)

The Poison Control Opioid-Related Classifier identifies poison control calls that are indicative of Opioid use. This classifier is based on the clinical effects previously assigned by the NPDS. The Poison Control Opioid-Related Evidence Classifier is currently in a beta state as it undergoes additional refinement to improve its accuracy.

## 2.2.3 Classifiers for Reportable Disease Cases

### 2.2.3.1 Reportable Disease Classifier (Beta)

The Reportable Disease Classifier categorizes data on the basis of disease identifier, which can be either text or alphanumeric code. Reportable diseases are significant diseases that can pose a threat to public health (e.g., West Nile, botulism, cholera, Lyme disease).

## *2.3 Analysis Methods*

EpiCenter provides multiple statistical analysis methods used for identifying data anomalies and trends. Analysis methods are available on both the Charts and Maps pages. The analysis methods on the Charts page generate a threshold line that is viewable on a chart. Additionally, automated surveillance tasks can be created using these analysis methods. On the Maps page, the analysis methods are used to create a geographic projection of the probability of data anomalies. The parameters for each analysis method can be adjusted by selecting the settings icon ( ⚙ ) on both the Charts and Maps Pages.

Each analysis method available on the Charts and Maps Pages is described below. A guide for adjusting the parameters for each analysis method is provided in Appendix 1: Analysis Method Parameters.

## 2.3.1 Constant Threshold (Charts Page)

The Constant Threshold, as its name implies, is used to set a fixed threshold. The default threshold for this analysis method is 0. The Constant Threshold can be configured to detect a single instance of a condition and so is most commonly used to detect immediately reportable conditions.

## 2.3.2 CuSum EMA (Charts Page)

The Cumulative Sum with Exponential Moving Average (CuSum EMA) algorithm uses the same procedure as the EMA algorithm to compute predicted counts. However, with the CuSum, the threshold is the current predicted count plus a certain number of standard deviations of the prediction

errors from the past. The exact number of standard deviations is determined by a set threshold multiplier (default value is 4), a cumulative sum of prediction errors, and a weighting parameter k (default value is 0.5). The threshold calculation requires an additional training period, which is set to 14 days by default.

### 2.3.3 Exponential Moving Average [EMA](Charts Page)

The Exponential Moving Average (EMA) algorithm computes the predicted count for the current day as a weighted average of the actual counts for a certain number of days in the past. The weight for the most recent day is set by the weighting exponential parameter (default value is 0.2). The weight for days in the past is calculated from that parameter and the weights decay exponentially as they recede further into the past. The length of the training window is computed from the weighting exponential and a significance level parameter (default value is 0.9). The default values yield a training window of 17 days.

To determine the threshold for the current day, the algorithm calculates the standard deviation of a certain number of past prediction errors (i.e., the difference between the predicted count and the actual count). The standard deviation is weighted to place greater weight on recent errors, in a manner very similar to how the predicted value is computed. The exact number of past prediction errors used depends on two user-specified parameters: the weighting exponential (default value is 0.2) and the level of significance (default value of 0.9). Just as with the predicted value, these defaults lead to a window of 17 days. The threshold is then the predicted count plus N standard deviations; N defaults to 4 but can be adjusted.

### 2.3.4 Moving Average (Charts Page)

The Moving Average algorithm, also called Simple Moving Average, computes the predicted count for the current day as the average of the actual counts for the past N days. The user can specify the number of past days to use; the default value is 14.

To determine the threshold for the current day, the algorithm calculates the standard deviation of a certain number of past prediction errors (i.e. the difference between the predicted count and the actual count). The standard deviation is weighted to place greater weight on recent errors. The exact number of past errors used depends on two user-specified parameters: the weighting exponential (default value is 0.2) and the level of statistical significance (default value is 0.9). Using these defaults yields a window of 17 days. The threshold is then the predicted count plus N standard deviations; N defaults to 4 but can be adjusted.

### 2.3.5 Recursive Least Squares (Charts Page)

The Recursive Least Squares algorithm computes a predicted count for the current day from a weighted sum of the actual counts of the current day and the past $p - 1$ days, where p is the average period parameter set by the user (default value is 7 days). The weights for the weighted sum are calculated in such a way as to minimize the sum of the absolute value of the errors. This sum of errors is computed to give more weight to more recent errors. The exact weighting is controlled by the lambda parameter, which defaults to 0.99. RLS also has a training period which can be adjusted by the user; the default is 60 days.

The threshold for the current day is simply the predicted count for the current day plus a constant

number of standard deviations of the prediction errors; this number defaults to 4 standard deviations.

## 2.3.6 Poisson Threshold (Charts Page)

The Poisson algorithm computes the predicted count for the current day as the average of the actual counts for the past $N$ days. The user can specify the number of past days to use; the default value is 14. The threshold for the current day is then calculated from a Poisson distribution with a mean equal to the predicted value for that day. The user specifies a threshold multiplier (number of standard deviations), as with the other methods. However, since the variance of a Poisson distribution is equal to the mean, the threshold cannot be just that number of standard deviations from the mean. Rather, to be consistent with other thresholds, the cumulative probability for that number of standard deviations above the mean is calculated for a standard normal distribution. The value from the Poisson distribution that corresponds to the same cumulative probability is then used as the threshold.

## 2.3.7 Exponential Moving Average Probability (Maps Page)

The Exponential Moving Average algorithm computes the predicted count for the current day as a weighted average of the actual counts for a certain number of days in the past. The weight for the most recent day is set by the weighting exponential parameter (default value is 0.2). The weights for days in the past are calculated from that parameter; they decay exponentially as the days recede further into the past. The length of the training window is computed from the weighting exponential and a significance level parameter (default value is 0.9). The default values yield a training window of 17 days.

The percentile calculated by this algorithm is for the difference between the actual count and the predicted count. It is based on the distribution of differences seen over the past $D$ days, where $D$ defaults to 60 days. These differences are assumed to follow a normal distribution with the observed mean and standard deviation. The percentile for the current difference is then the probability of observing a difference as close or closer to the mean as the current difference is, under that normal distribution. When these differences do not follow a normal distribution, hatching is added to the map shading to indicate that the calculated probability may be slightly skewed.

## 2.3.8 Poisson Visit Frequency (Maps Page)

The Poisson algorithm computes the predicted count for the current day as the average of the actual counts for the past $N$ days. The user can specify the number of past days to use; the default value is 14.

The threshold for the current day is then simply the probability of observing a count smaller than or equal to the current count given a Poisson distribution with a mean equal to the predicted count.

## 2.3.9 Recursive Least Squares Probability (Maps Page)

The Recursive Least Squares algorithm computes a predicted count for the current day from a weighted sum of the actual counts of the current day and the past $p-1$ days, where $p$ is the average period parameter set by the user (default value is 7 days). The weights for the weighted sum are calculated in a way that they will minimize the sum of the absolute value of the errors. This sum of errors is computed to give more weight to more recent errors. The exact weighting is controlled by the lambda parameter, which defaults to 0.99. Recursive Least Squares also has a training period that can be adjusted by the user; the default is 60 days.

The percentile calculated by this algorithm is for the difference between the actual count and the

predicted count. It is based on the distribution of differences seen over the past $D$ days, where $D$ defaults to 60 days. These differences are assumed to follow a normal distribution with the observed mean and standard deviation. The percentile for the current difference is then the probability of observing a difference as close or closer to the mean as the current difference is, under that normal distribution. When these differences do not follow a normal distribution, hatching is added to the map shading to indicate that the calculated probability may be slightly skewed.

### 2.3.10 Simple Moving Average Probability (Maps Page)

The Simple Moving Average algorithm computes the predicted count for the current day as the average of the actual counts for the past $N$ days. The user can specify the number of past days to use; 14 is the default.

The percentile calculated by this algorithm is for the difference between the actual and predicted counts. It is based on the distribution of differences seen over the past $D$ days, where $D$ defaults to 60 days. The differences are assumed to follow a normal distribution with the observed mean and standard deviation. The percentile for the current difference is then the probability of observing a difference as close or closer to the mean as the current difference is, under that normal distribution. When these differences do not follow a normal distribution, hatching is added to the map shading to indicate that the calculated probability may be slightly skewed.

## 2.4 Data Conditioning

By default, EpiCenter displays the actual counts received from data sources. However, EpiCenter also provides the ability to condition data for day-of-week effect, such as the weekly increase in emergency department visits on Mondays. This data conditioning technique uses a wavelet analysis method to minimize the effect of this recurring pattern when calculating the threshold value.

Wavelet analysis can be used to filter out undesirable signals in data. In this instance, the "signal" that needs to be filtered out is the human behavioral tendency to seek healthcare at convenient times during the weekly cycle rather than at the first onset of symptoms. Thus the wavelet analysis looks for patterns in the data that repeat every seven days. Those patterns are then removed from the data. What remains should more closely resemble how the counts would appear if patients sought healthcare uniformly throughout the week.

Data conditioning can be applied via the Options dropdown menu on the Charts and Maps pages. When applied to charts, the conditioned counts will appear as a solid blue line while the actual values will be displayed as a dotted blue line (see Figures 1 and 2)

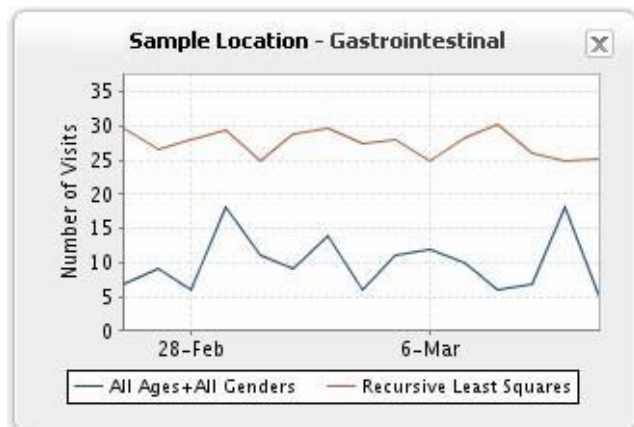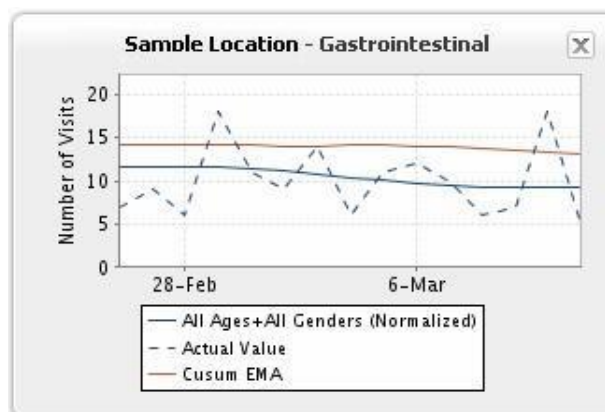**Figure 1: Data not conditioned for day-of-week effect**



**Figure 2: Data conditioned for day-of-week effect**



## .5 Data Representation

Three methods of data representation are available in EpiCenter. These include:

- The number of records, which displays counts as raw data;
- The percentage of all records, which displays counts as a percentage of all records;
- The rate per 100,000 population, which displays counts as a rate based on the Census Bureau's 5-year ACS estimates for 2013-2017

## 2.6 Totaled By

The Totaled By selector is available near the bottom of the left control panel on the Charts and Maps pages. It is used when generating counts by geography and when configuring surveillance tasks.

When data is totaled by home location, the patient's home zip code is used to define a geography. For example, if the location is set to Pennsylvania and the data is totaled by home location, results will return for all patients with a home zip code in the state of Pennsylvania.

When data is totaled by facility, the zip code of the facility is used to define a geography. For example, if the location is set to Pennsylvania and the data is totaled by facility, results will return for all visits that took place at a facility with a zip code in the state of Pennsylvania.

For viewing data from a specific facility, as opposed to a geography, the default setting is "totaled by facility."

## 2.7 Predicted Value

The predicted value is enabled and disabled on the Charts page menu under Advanced Options. When enabled, the predicted value appears as a green line on the chart. On the Anomalies page, the predicted value automatically appears on all charts shown in the bottom right quadrant.

The predicted value is the expected number of records for a particular time period given what was observed in the recent past. The prediction depends on the analysis method that was applied; refer to Section 2.3 for more details on how each method calculates predictions.

# 3 Surveillance

The EpiCenter system conducts automated surveillance on incoming data for the purpose of detecting data anomalies. In the event that a data anomaly is detected, the system will send a notification by email.

In order for an anomaly to be recognized by the system, a series of conditions must be met. The conditions depend on the method of qualification that is selected when the surveillance task is scheduled.

## 3.1 Simple

The simple qualification method uses a trailing 24-hour window and requires that the following conditions be met before EpiCenter generates an anomaly:

1. The observed count is greater than or equal to the set number.
2. The observed count is greater than the threshold.
3. Any other threshold(s) that have been applied (i.e. normalized or day-of-week) is exceeded.
4. No anomaly with identical parameters has been created in the past 24 hours.

If any latent visits are received that fall within the parameters and the 24-hour trailing window used to detect a specific anomaly, these additional visits will be noted on the anomaly detail page, but additional notifications will not be generated. Any patient visits that fall within the parameters of a specific anomaly but are received after the anomaly was generated will potentially be included in a future anomaly. This will happen if requirements 1-3 above are met 24 hours after the initial anomaly was generated.

The simple qualification method can be used to detect anomalies for all classifications.

## 3.2 Immediate

The immediate qualification method uses a set 24-hour window based on a calendar day (midnight to midnight). It requires that the following conditions be met before EpiCenter generates a new anomaly:

- The observed count is greater than the threshold.
- No anomalies using the same parameters have been generated for the same calendar day.

In the event that one or more visits matching the parameters of a specific anomaly are received after the anomaly is generated, and that occur either on the same calendar date as the anomaly or on the date prior (latent data), the case(s) will be added to the existing anomaly; an updated email notification will then be generated following the hourly running of surveillance. This additional instance will also be noted on the anomaly detail page. If applicable visits are received on the calendar date following the initial anomaly, another new anomaly will be created.

# 4 User Interface

## 4.1 Logging In

The EpiCenter user interface is accessible at https://epicenter.hmsinc.com. EpiCenter is supported for use with the most recent versions of Internet Explorer (IE11), Google Chrome, and Microsoft Edge.

### 4.1.1 Username and Password

Each EpiCenter user is assigned a unique username. This username is the same as your email address. Users are also given a password, which can be changed. (Instructions for changing passwords are in the Change Password box on the Options page.) Enter your assigned username and password combination into the corresponding boxes on the login page to gain access to EpiCenter. If an entry is incorrect, the login page will signify that by outlining the problematic field in red and displaying an exclamation-point icon (see Figure 3).

Selecting the Remember Me checkbox will keep the user logged in until he/she logs out via the logout button located in the top right corner of the interface. Do not use the Remember Me checkbox if multiple people are accessing EpiCenter on a shared computer.

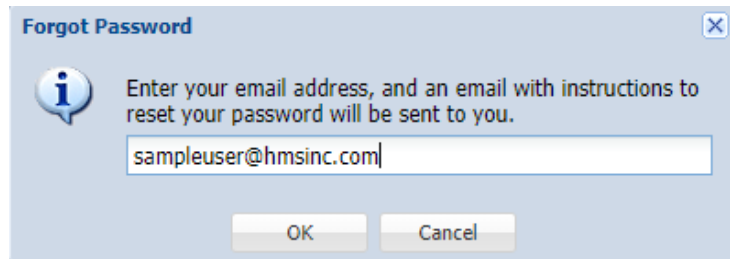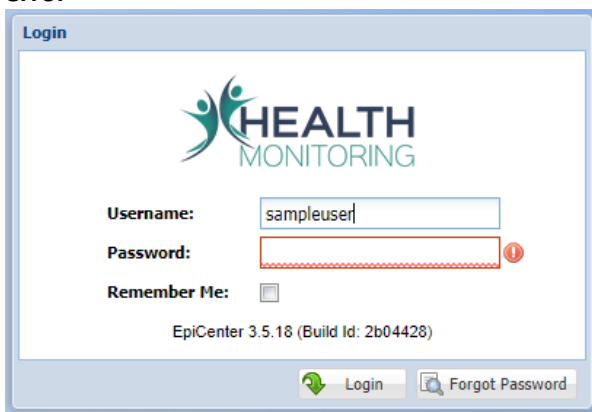**Figure 3: EpiCenter Login page indicating password error**





**Figure 4: Forgot Password email input**

## 4.1.2 Forgotten Password

To request a new password, click the Forgot Password button at the lower right corner of the login box. A popup will ask you to enter your email address (see Figure 4). Users should enter the email address that corresponds to their username.

You will then receive an email with a direct link to the password reset box (see Figure 5).

After entering and confirming a new password, you will be routed back to the login page. You can now enter your username and new password.
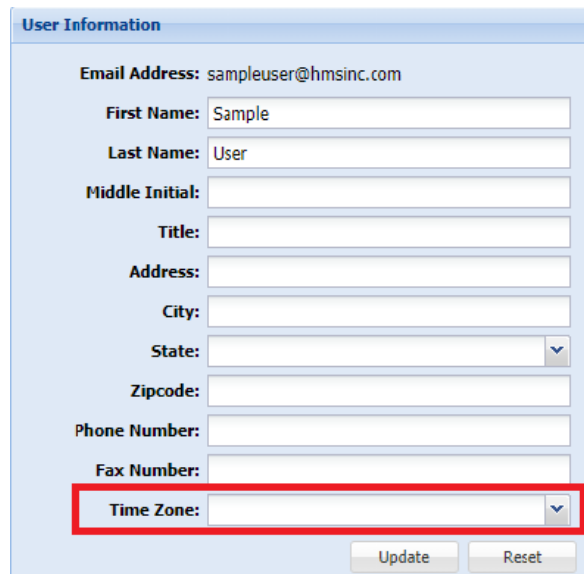


**Figure 5: Reset Password box**

Please note: If you contact Health Monitoring Systems directly to request that your password be reset, you will be given a temporary password and you will be prompted to reset your password following login.

## 4.1.3 Time Zone Settings

EpiCenter requires the time zone setting on a user's PC to match the time zone assigned to their EpiCenter user account. These settings dictate the time zone that is used for data display for each individual user. If there is an inconsistency between the PC and EpiCenter time zone settings, the user will receive an error message upon login (see Figure 7). Before proceeding with EpiCenter use, the time zone setting for either the PC or EpiCenter must be updated so that they match. Users can update their EpiCenter time zone settings on the Options page.


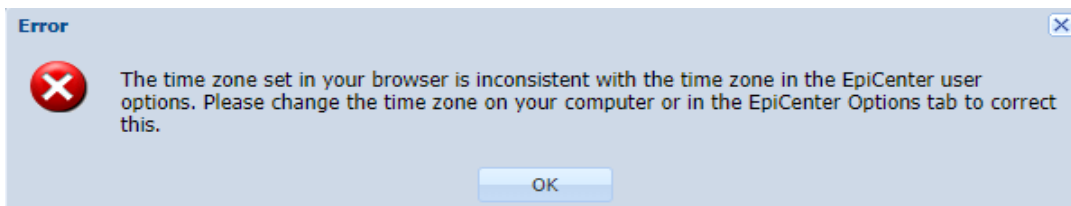
**Figure 6: Time Zone Settings**



**Figure 7:  Time zone error**

## 4.2 Navigating the User Interface

### 4.2.1 Tabs

The EpiCenter user interface contains multiple pages, which are accessed by selecting the corresponding tab along the top margin of the interface. These page tabs include Summary, Dashboard, Anomalies, Investigations, Charts, Maps, Reports, Labels, Custom Classifier, Options, and Administration. The availability of tabs may vary based on a user's permission level.

### 4.2.2 Control Panel

A standard Control Panel is available on each page in EpiCenter except for the Options page. The Control Panel is located in the leftmost section of the user interface. The functionality included on the control panel are enabled on certain pages throughout the application and disabled on others. Figure 8 identifies each specific functionality.

### 4.2.3 Location Selector

The Location selector is a free-text box that specifies the location for which data is viewed. To use this feature, select the text box and begin typing the name of a location. A location can be a geography (e.g., state, county, zip code, or custom region) or the name of a healthcare facility (on the Charts page only). The system will auto-complete your entry and list all matches in a dropdown box. You can then make a selection by highlighting your desired location.

When searching for a geography, if only one match is available, the dropdown box will also contain geographies within that larger geography. This includes a county listing if a state name is entered in the location text box or a zip code listing if a county name is provided (see Figure 9).

If no matches are available, a red border will appear around the location text box. Further, if a valid location is entered but it is outside of a user's authorized region, a red asterisk will appear next to the location name.

The location selector is enabled on the Summary, Anomalies, Investigations, and Charts pages.

**Figure 8: Control Panel**



**Figure 9: Location selector**

## 4.2.4 End Date Selector



Figure 10: Calendar popup tool

The End Date selector is used to specify the end date of a date range for viewing data. If the Hour selector is enabled, the End Date selector then defines the 24-hour sliding window applied to the data. The end date can be entered as free text or by using the Calendar popup tool. To activate the Calendar popup tool, click on the calendar image to the right of the date (see Figure 10).

Use the arrows located to the left and right of the month and year label to display the previous and next months, respectively. Select a date by clicking directly on the calendar. The down arrow to the immediate right of the month and year label provides an additional popup allowing for the selection of a specific month and year. After selecting the month and year, click OK to return to the calendar. The Today button located at the bottom of the Calendar popup sets the end date to today's date.

The End Date selector is enabled on the Anomalies, Investigations, Charts, and Maps pages. The selector is shown on the Summary page, but disabled, as the system uses an automatic default of seven days ending on the current date.

The end date can be replaced with an MMWR week on the Charts page to produce a chart using the MMWR week instead of the calendar date. To do this, enter the following text into the date selector: "MMWR [week #] [year]" (see Figure 11). There is no need to specify the year if you are using the current year. The Time Period indicator can then be set to indicate how far back in time the data should extend from the



MMWR week entered. Please note: The analysis methods currently available in EpiCenter on the Charts page are intended for use on daily counts and thus are incompatible with the aggregated weekly data accessed by the MMWR week feature.

Figure 11: Charting on the basis of MMWR week

## 4.2.5 Time Period Indicator

The time period indicator is a free-text box used to indicate the time span (preceding the end date) for which data will be shown. The time period can be entered as a number of days, weeks, months, or years. The numerical portion of the time period must be entered in figures, not as text (i.e., "2" instead of "two"). For example, to view data for the one month prior to May 1, 2008, users would set the end date to 5/1/2008 and enter "1 month" in the time period indicator.

The time period indicator is enabled on the Anomalies, Investigations, Charts, and Maps pages. The time period indicator is disabled on the Summary page; as that page automatically uses a default setting of seven days preceding the current date. The time period indicator is also disabled on the Maps page; that page displays data for only one day, the date indicated by the End Date selector.

## 4.2.6 Submit Button

The Submit button is used to generate results once all settings have been specified. Clicking the Submit button will show results in the user interface. This button is enabled on the Summary, Anomalies, Investigations, Charts, and Maps pages.

## 4.2.7 Options Menu

To access the Options dropdown menu, click on the underlined blue text below the Time Period indicator. The contents of this menu will vary by page throughout EpiCenter.

On the Charts and Maps pages, the top portion of the dropdown menu lists analysis methods. Users can select an analysis method by clicking directly on its name in the dropdown menu. A bullet will appear to the left of the selected method and the blue underlined text below the Time Period indicator will display the name of the selected method (see Figure 12).
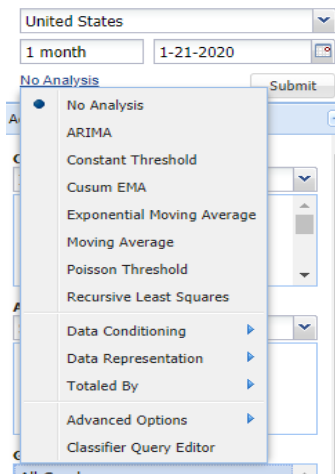


**Figure 12: Analysis method selection, Charts page**

Below the analysis methods on the Options dropdown menu is Data Conditioning. This option is enabled on the Charts and Maps pages. By highlighting Data Conditioning, you can apply the conditioning that accounts for day-of-week effect. To select this, click on the corresponding text in the secondary dropdown men, where a bullet will appear to the left of the selected conditioning method (see Figure 13).
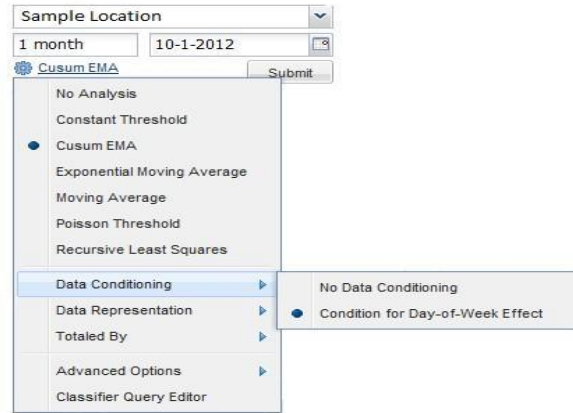
**Figure 13: Data Conditioning selection**
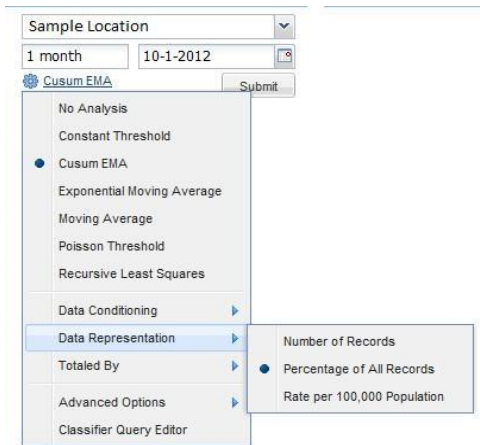
The next feature on the Options menu is Data Representation. This functionality is enabled on the Charts and Maps pages. After highlighting Data Representation on the dropdown menu, you can choose to represent data as the number of records, the percentage of all records, or the rate per 100,000 population. Select a data representation method by clicking directly on the corresponding text; a bullet will appear next to the selected method (see Figure 14).

**Figure 14: Data Representation selection**

The next feature on the Options menu is Totaled By. This functionality, which is enabled on the Charts and Maps pages, allows users to specify how they wish to total counts: by hour, day, week, or month (see Figure 15).

On the Charts page, the Advanced Options submenu allows you to select various checkboxes in order to combine results, enable the hour selector, and/or plot predicted values (see Figure 16).

If Combined Results is active and the user has chosen more than one classification from the Classification selector, the system will display one
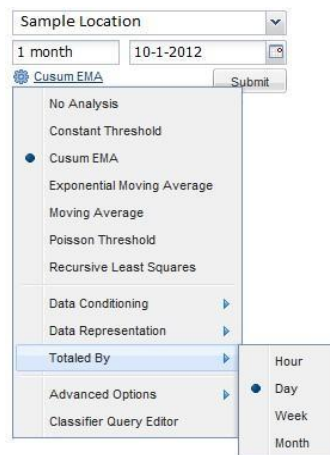
**Figure 15: Totaled By options: hour, day, week, month**

chart showing the number of records that have been classified into one or more of the applicable classifications. Please note: Each record is only counted once. If Combined Results is deselected, the system will return a chart for each of the classifications; each chart shows the counts for only that classification.

If the Enable Hours selector box is checked, an hour will appear next to the date in the End Date selector. This hour can be changed by the user. Its value sets the end point of the 24-hour sliding window that defines one "day" in data queries (see Figure 17). When the Enable Hours option is first activated, the hour that appears in the End Date selector field defaults to the most recent full hour. If the user selects the current date as the end date, the selected hour (which ends the 24-hour sliding window) can be no later than the full hour immediately following the current time.

If the Enable Hours selector is deactivated, the End Date selector contains only a date; by default, the 24-hour sliding window defines one "day" as the period between 12:00 am and 11:59 pm. The Enable Hours selector uses whatever time zone has been specified on the Options page.

If Plot Predicted Values is enabled, a green predicted value line displays on all charts when plotted.
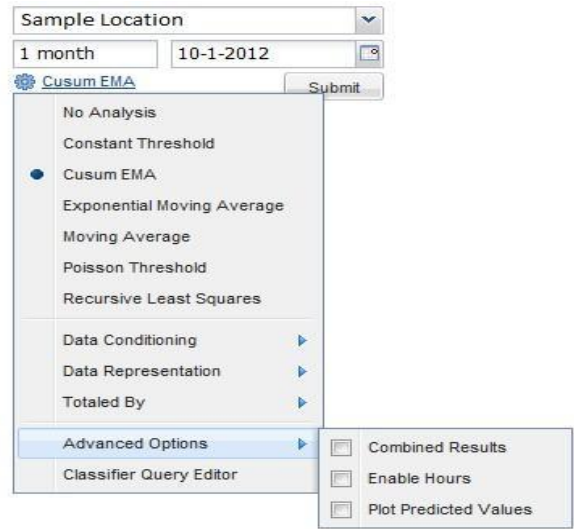


**Figure 16: Advanced Options as shown on Charts page**
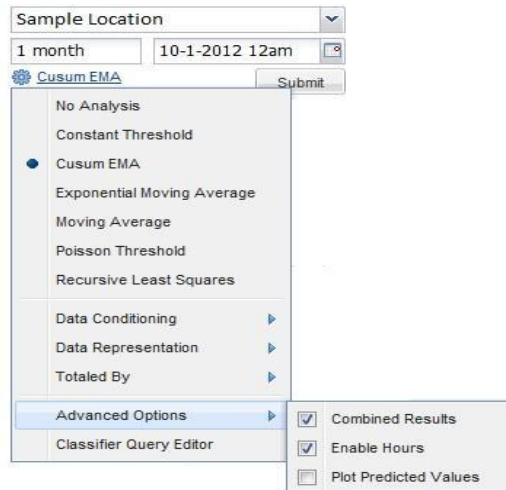


**Figure 17: Enable Hours selector**

The final feature on the Options dropdown is the Classifier Query Editor. It is enabled on the Charts and Maps pages. The Classifier Query Editor allows users to create a query using one or more classifiers via a popup window (see Figure 18). To select a classifier, click on the desired option. Clicking the Add Classifier button will show another classifier and its classification selector. To remove a classifier from the query, click the trash can icon next to its classification selector.

After selecting the desired classifiers, click Apply. The chart that appears will depict an "and" relationship between the chosen classifiers (i.e., each case will have to meet *all* conditions, not just one.) To remove this query, disable the Classifier Query Editor, and display the default Classifier selector tool in the Control Panel, click the underlined text reading Remove Query.
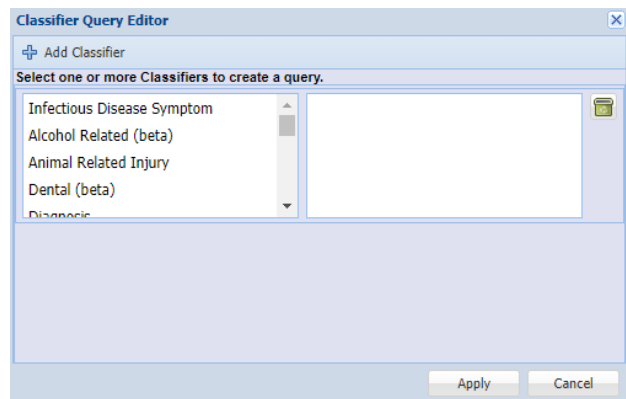


**Figure 18: Classifier Query Editor**

## 4.2.8 Analyzer Configuration

On the Charts and Maps pages, use the ⚙ at left of the Options dropdown to configure parameters for the selected analysis method. Clicking on the icon produces the Analyzer Configuration popup window; the fields in the window show all applicable parameters. If one or more adjustments are made to an analysis method, the word "(custom)" will appear after the analysis method's name. To restore default parameters, open the Analyzer Configuration window and click the Reset button.

## 4.2.9 Data Type Indicator

The Data Type indicator is enabled on the Charts and Maps pages. It is a header that specifies the type of data being used for analysis. Available data types will vary by area and may include:

- Acute care interactions data
- Poison control center call data
- Reportable disease data

## 4.2.10 Data Type Selector

The Data Type selector is used to open or close the list of attributes for a specific data type. The selector appears as a minus (-) sign for an open data type and a plus (+) sign for a closed data type. To open a data type panel, click on the plus sign. Any data type panel that had been open will automatically close.

- The Data Type selector is enabled on the Charts and Maps pages.

## 4.2.11 Classifier Selector

The Classifier selector allows the user to view all data associated with the defined attributes or apply filtering by a specific classifier. Click the down arrow on the right side of the Classifier dropdown box to produce a list of the classifiers (see Figure 19). To view all data, select Total Counts. To use a classifier, click directly on its name. Once a classifier is selected, the Classification selector (directly below it) will populate accordingly.

The Classifier selector is enabled on the Charts and Maps pages.



**Classifier:**

Infectious Disease Symptom

- Total Counts
- Infectious Disease Symptom
- Additional Chief Complaint
- Opioid-Related Evidence Classifier
- Additional Diagnosis Opioid-Related Evidence Classifier
- Alcohol Related (beta)
- Animal Related Injury
- BioSensePA
- Chief Complaint Opioid-Related Evidence Classifier
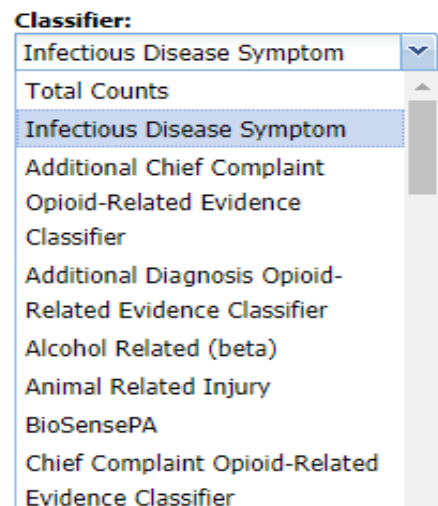
**Figure 19: Dropdown menu for Classifier selector**

## 4.2.11.1 Age Group Selector

The Age Group selector defines the ages by which patient data can be grouped. Epicenter's default age groups are listed in Figure 20.

Selecting All Age Groups returns data for all patients, regardless of age. The Unknown age group contains records in which the patient's age is not provided. These patient records are included in the All Age Groups category. To select multiple age groups, press and hold the CTRL key on your keyboard while clicking
on the desired groups. To select multiple age groups listed consecutively, click on the first and last in the set of chosen age groups while holding down the SHIFT key. This will highlight the first and last age groups in the list plus all of the age groups
in between. Custom age groups notions are now available for some users. If more than one notion is available, the desired notion can be selected using the drop-down window.

| Age Group | Age Range |
|-----------|-----------|
| Unknown | n/a |
| Infant | 0-2 |
| Preschool | 3-5 |
| Child | 6-12 |
| Adolescent | 13-17 |
| Adult | 18-64 |
| Geriatric | 65-150 |

**Figure 20: Age groups listed in Age Group selector**

The age group selector is enabled on the Charts, Maps, and Dashboard pages

## 4.2.11.2 Gender Selector

The Gender selector allows users to view data for all genders, for a specific gender, or for a set of genders. The Unknown category contains records for patients whose gender is unknown or was not provided. These patient records are included when All Genders is selected.

To select more than one gender, press and hold the CTRL key on your keyboard. To select multiple categories listed consecutively, click on the first and last desired gender categories while holding down the SHIFT key. This will highlight the first and last categories as well as those in between.

The Gender selector is enabled on the Charts, Maps, and Dashboard pages.

### 4.2.11.3 Provider Type Selector

Enabled on the Charts and Maps pages, the Provider Type selector allows users to view data for all provider types, for a specific provider type, or for a set of providers. By default, the system uses data from hospitals and urgent care facilities. The complete list of provider type options is: All Provider Types, Hospital, Urgent Care, FQHC, Health Department, Health Information Exchange, Health System, Medical Group, Nurse Call Center, OTC, Physician, Physician Office, Physician Practice, and Poison Control.

To select more than one provider type, press and hold the CTRL key as you highlight more than one list item. To select multiple provider types listed consecutively, click on the first and last desired type while holding down the SHIFT key. This will highlight the first and last provider types as well as all of those in between.

### 4.2.11.4 Totaled By Selector

The Totaled By selector allows the user to see patient data grouped by either the patients' home zip code or by the zip code of the facility visited by patients. Use the down arrow on the right side of the Totaled By dropdown box to select a preference or switch between the two options.

The Totaled By selector is enabled on the Charts, Maps, and Dashboard pages.

### 4.2.11.5 Race Selector

The Race selector allows the user to see patient data for all races, for a specific race, or for a set of races. The n/a category contains records for patients whose race is unknown or was not provided. These records are included when All Races is selected.

To select more than one race type, press and hold the CTRL key as you highlight more than one list item. To select multiple provider types listed consecutively, click on the first and last desired type while holding down the SHIFT key. This will highlight the first and last race types as well as all of those in between.

The Race selector is enabled on the Charts, Maps, and Dashboard pages.

### 4.2.11.6 Ethnicity Selector

Enabled on the Charts, Maps and Dashboard pages, the Ethnicity selector allows the user to see patient data for all ethnicities, for a specific ethnicity, or for a set. The n/a category contains records for patients whose ethnicity is unknown or was not provided. These records are included when All Ethnicities is selected.

To select more than one ethnicity, press and hold the CTRL key as you highlight more than one list item. To select multiple provider types listed consecutively, click on the first and last desired type while holding down the SHIFT key. This will highlight the first and last ethnicity as well as all of those in between.

### 4.2.11.7 Discharge Disposition Selector

The Discharge Disposition selector allows the user to see patient data for all discharge dispositions, for a specific discharge disposition, or for a set of discharge dispositions. The n/a category contains records for patients whose disposition is unknown or was not provided. These records are included when All Discharge Disposition is selected.

To select more than one discharge disposition, press and hold the CTRL key as you highlight more than one list item. To select multiple provider types listed consecutively, click on the first and last desired type while holding down the SHIFT key. This will highlight the first and last discharge disposition as well as all of those in between.

The discharge disposition selector is enabled on the Charts, Maps, and Dashboard pages.

### 4.2.11.8 Advanced Selector

The Advanced selector allows the user to create custom selectors within EpiCenter. A special project would be needed to develop a group of selectors for use within the Charts, Maps, and Dashboard pages.

# 5 Summary

The Summary page is displayed when a user first logs into EpiCenter. It provides a snapshot of data from the past seven days. The Summary page can be set to display the default Classifier Summary View or a predefined custom surveillance view. To select your preferred view, use the Options dropdown menu; click on the desired view where listed in the dropdown menu. When a view is selected, a bullet will appear next to its name. The blue underlined text just below the Time Period indicator shows the name of the selected view (see Figure 21).
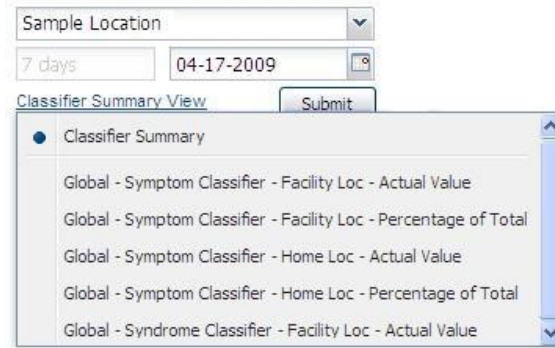
**Figure 21: Options dropdown menu, Summary page**

The Classifier Summary View contains a chart displaying all acute care interactions, which is located in the upper left section of the viewing window. It also displays one chart for each classifier and one for each data type; in each case, the data is broken down by classification. Each classifier-based chart depicts data for the seven classifications that had the highest counts for the past seven days (see Figure 22). When a classifier contains fewer than seven classifications, all classifications are shown. Each chart contains a legend below the X axis. The data displayed on the charts is automatically totaled by home location for geographies and by facility location if a specific facility name is chosen from the Location selector.



**Figure 22: Classifier Summary View, Summary page**

The Location selector on the Summary page defaults to the logged-in user's accessible region. The location can be focused on any area within that accessible region. After entering or selecting a new location, click the Submit button to update the charts.

To show a custom surveillance view on the Summary page, select its title from the Options dropdown menu; its charts will then be displayed on the screen (see Figure 23). To remove a chart from a surveillance view, click the X in the chart's upper right corner. If all charts are removed from a surveillance view, the view will be deleted. Charts can be added to a surveillance view from the Charts page (see section 9.2, Surveillance Views).
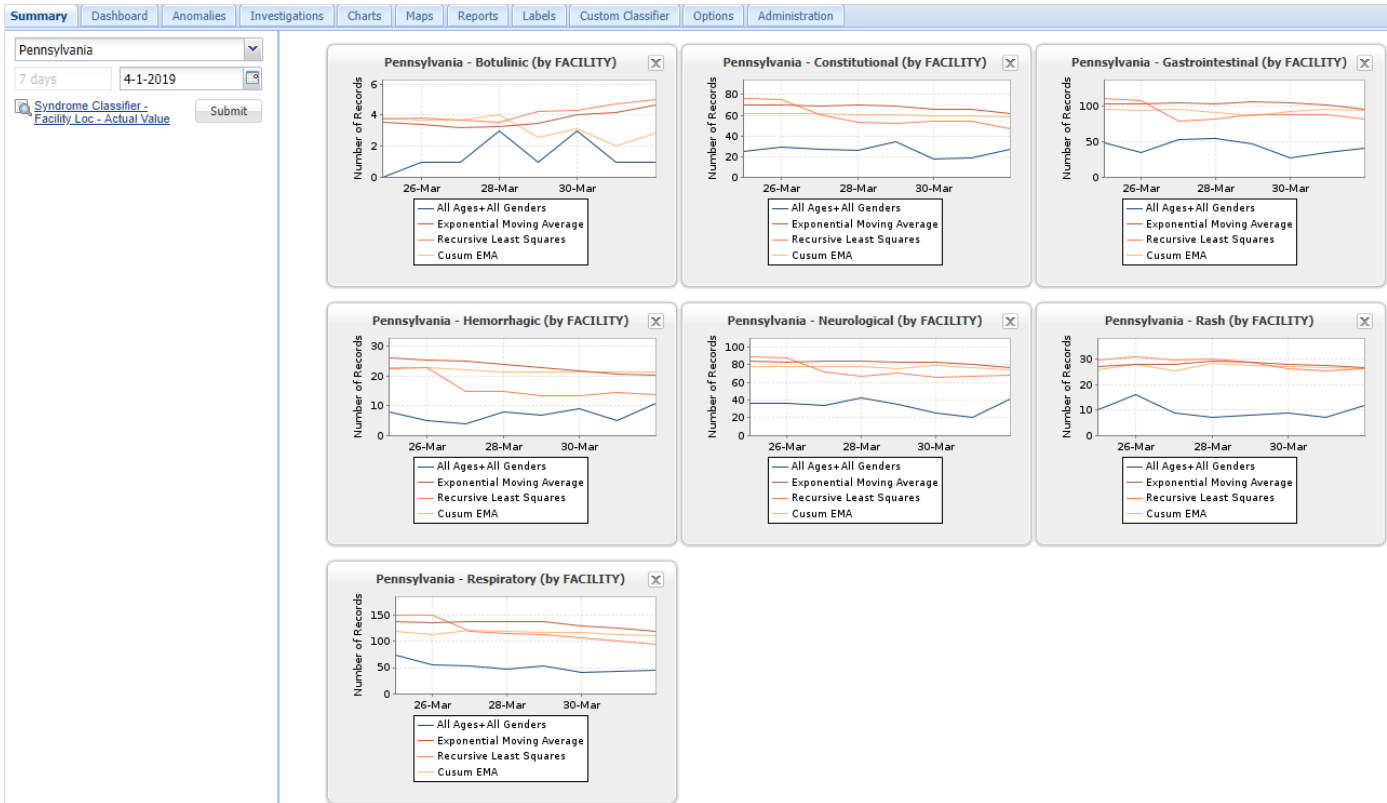


**Figure 23: Custom surveillance view, Summary page**

## 5.1 Creating and Editing Surveillance Tasks

Some organizational administrator-level users are able to create a surveillance task for a particular surveillance view on the Summary page. To do so, select the Settings icon (  ) next to the Options dropdown menu. This produces a popup window in which the user can set surveillance task parameters (see Figure 24).

To add a new surveillance task, click the Add Surveillance Task button near the upper left corner of the Edit Surveillance Tasks box. A new entry will be added to the surveillance task listings in the main section of the popup box. Please note: An organization can create a maximum of 30 surveillance tasks. Please contact Health Monitoring Systems if you require additional tasks beyond this limit.

To edit an existing surveillance task, change the parameters as desired and click the Save button.

To set parameters, use the Edit Surveillance Tasks box. Figure 25 lists the surveillance parameters and options.



**Figure 24: Edit Surveillance Tasks window**

**Figure 25: Surveillance parameters and available options**

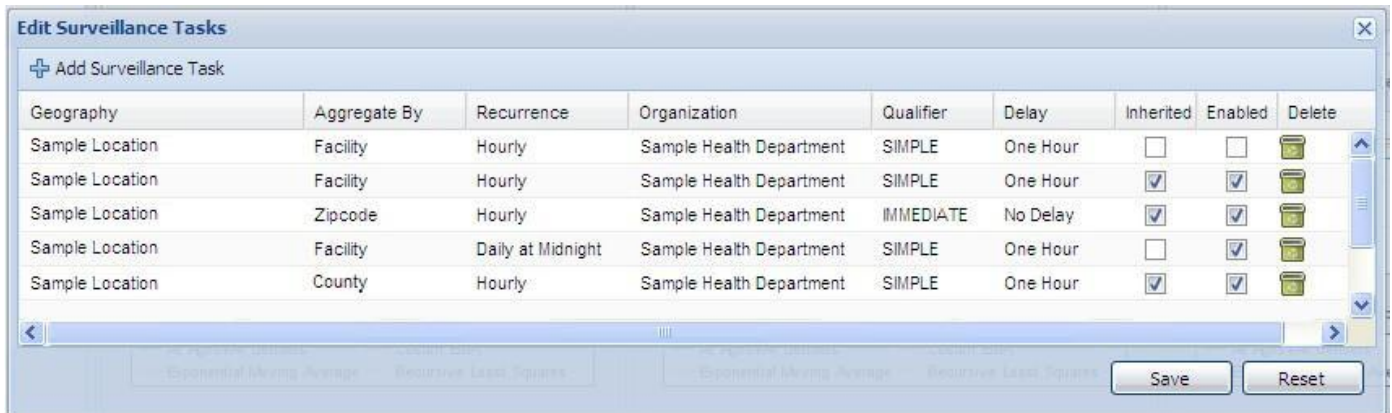| Parameter | Available Options | Description |
|---|---|---|
| Geography | A user's accessible region or a portion of that region | A surveillance task can be set for a user's entire accessible region or for a smaller area within that region. For example, a user who is permitted to access data for Florida could create a task for the entire state, a specific county, a zip code, or a custom region within Florida. |
| Aggregate By | State County Zip code Region Facility | This setting specifies the level at which data aggregation is applied to the geography. For example, if the geography for a surveillance task is Florida and the user elects to aggregate by county, surveillance will be run separately for each county in Florida. Aggregating by facility runs surveillance for each data-submitting facility in the indicated geography. |
| Recurrence | Every 10 minutes Hourly Daily at noon Daily at midnight | This setting controls the intervals at which a surveillance task is run. |
| Organization | The user's organization | The Organization field will default to the user's organization. If a user's organization is a sponsoring organization, its sponsored organizations will be available for selection within this field. |
| Qualifier | Simple Immediate | The qualifier dictates the set of conditions that must be met for the system to recognize an anomaly. |
| Delay | 0:00 One-hour increments from 1:00 to 23:00 | The Delay setting indicates a discretionary timespan between the end of the 24-hour reporting window and the time of day when the surveillance task is run. A delay period allows for reporting latencies. For example, if a surveillance task recurs daily at noon with a one-hour delay, the surveillance task will run at noon over records for the 24 hours ending at 11:00 am on that day. |

| Parameter | Available Options | Description |
|---|---|---|
| Expiration Date | Any future date | Each surveillance task must be assigned an expiration date, after which the task will be discontinued. |
| Inherited (only for sponsoring organizations) | Checkbox is checked or unchecked | This checkbox is unchecked by default, which indicates that the surveillance view cannot be viewed by other organizations that are sponsored by the user's organization. Checking this box makes the surveillance task viewable to the sponsored organizations. |
| Enabled | Checkbox is checked or unchecked | This checkbox is checked by default, indicating that the surveillance task is enabled. Unchecking the box disables the task. Disabled surveillance tasks will remain on the list of tasks associated with a surveillance view, and can be re-enabled at a later time. |
| Trigger on File Receipt | Checkbox is checked or unchecked | This checkbox is unchecked by default. It is checked only in cases where surveillance tasks require immediate notification. |
| Active Monitoring | Checkbox is checked or unchecked | This checkbox is unchecked by default. When checked, it enables active monitoring tasks, causing surveillance to run every 10 minutes, with the possibility of generating an anomaly every hour. |
| Delete | Click on icon to delete task | Clicking on the trash can icon disables the associated surveillance task and permanently removes it from the task list. |

After all parameters are set, click Save. Clicking the Reset button will return fields to their default values.

The surveillance task will reflect the values set in the Edit Surveillance Tasks popup box; it will also exhibit the attributes that were selected for the charts in the surveillance view. These may include analysis method, data conditioning, data representation, classifier and classification, age group, gender, and totaled-by location. Note: For all surveillance tasks, data are represented as actual values. If a data representation format other than number of records (actual values) is selected as a part of the surveillance view, it will be applied in addition to the actual values. In such cases, the system will not detect an anomaly unless the selected thresholds for both types of data representation are exceeded.

Surveillance tasks that use the same analysis method and data set will trigger alerts only once every 24 hours. Exception: Immediate notification anomalies will trigger alerts upon detection. For surveillance tasks set to run every 10 minutes, only one anomaly will be generated per hour.

# 6 Dashboard

The Dashboard page is available to all subscribing users from public health agencies. This page utilizes the report functionality and operates in the same manner as the reports page. The page provides users access to a trend dashboard that includes interactive charts. A special project would be needed to develop the custom dashboard page.

On the Dashboard page, the Control Panel allows users to apply various filtering options to either the whole dashboard or each individual chart. If a single chart control panel is chosen, the corresponding chart will be outlined in yellow.
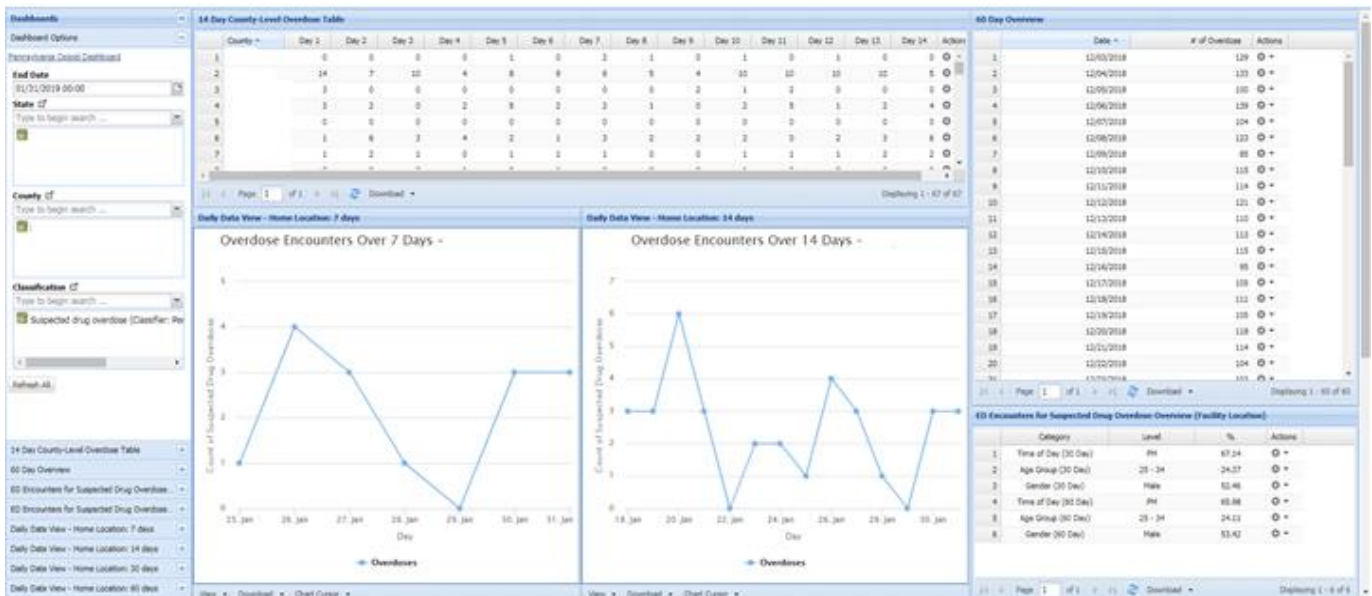


**Figure 26: Dashboard Prototype**

# 7 Anomalies

Anomalies are detected by surveillance tasks. Each anomaly that is detected within the collected data will appear on the Anomalies page of the EpiCenter interface. Also, a notification is sent to public health users when an anomaly is detected.

On the Anomalies page, the Control Panel allows users to apply various filtering options and to download the matching anomalies list.

Filtering options can be found in the Control Panel. To include inactive anomalies, check the top box (see Figure 27). Below that, the anomaly filter option allows users to select or deselect entries on the basis of data type, classifier, and totaled-by location. Selecting Total Counts from the Classifier selector displays all data, regardless of classification.



**Figure 27: Filter Anomalies, Anomalies page**

The list of matching anomalies can be downloaded via the Advanced Options dropdown. To retrieve the data as a CSV file, choose "Download list as CSV"; to get a spreadsheet file, select "Download list as Excel." Selecting an option will initiate the download process. Open the file by following the prompts from your computer's default application.

## 7.1 Surveillance Tasks

A surveillance task involves defining a set of parameters so as to identify data anomalies. To configure a surveillance task, create a surveillance view on the Charts page, then access that surveillance view on the Summary page. From there, more surveillance tasks can be added. Health Monitoring Systems recommends that users follow our Default Notification Configuration when creating surveillance tasks (see Appendix 2).

## 7.2 Notifications

### 7.2.1 Standard Notifications

In the event that an anomaly is detected, an automatic notification (see Figure 28 is emailed to all users who have notification subscriptions matching the geography and classifier/classification of the anomaly. To create or update notification subscriptions for your area, please contact Health Monitoring Systems directly.

**IMMEDIATE NOTIFICATION UPDATE - Anthrax Anomaly in Sample Location**

Monitoring of Acute Care Interactions for residents of Sample Location identified 1 additional interaction. Anthrax includes the following classifications: anthrax (immediate notification). All interactions occurred between April 29, 2009 11:59 PM and April 30, 2009 11:59 PM.

Using Constant Threshold analysis, these 4 interactions (current total) exceed the threshold of 0.00.

The time of the anomaly was 11:59 PM.

Please note, the purpose of this notification is to inform you that one or more emergency department registration was classified into the classification indicated above. This does not signify a confirmed diagnosis or actual case.

**Summary**

| | |
|---|---|
| Time Detected | April 30, 2009 10:08:04 AM EDT |
| Last Occurrence | April 30, 2009 4:17:39 PM EDT |
| Indication | Acute Care Interactions |
| Classification(s) | anthrax (immediate notification) |
| Location | Sample Location |
| Analysis Method | Constant Threshold |
| Data Conditioning Method | No Data Conditioning |
| Results of Analysis | 4 (Number of Visits) (current total) |
| Records Totaled By | Home Location |

Click here to view this anomaly in EpiCenter.

**Figure 28: Notification email sample**

### 7.2.2 Update Notifications

If an immediate notification has been issued for a particular location, the system will issue an update notification if it detects additional relevant visits within the window of the initial anomaly. The subject line and body of an update notification will contain the term "update" and provide the current count versus the count seen at the time of the initial anomaly is provided (see Figure 29).

**Fever Anomaly at Sample Location**

Monitoring of acute care interactions at Sample Location identified 22 interactions. Fever includes the following classifications: fever (infectious disease symptom). All interactions occurred between April 30, 2009 3:12 AM and May 01, 2009 3:12 AM.

Using Exponential Moving Average analysis, these 22 interactions exceed the predicted value of 10.60 and the threshold of 20.58.

The time of the anomaly was 3:12 AM.

**Summary**

| | |
|---|---|
| Time of Anomaly | May 1, 2009 3:12:07 AM EDT |
| Time Detected | May 1, 2009 3:12:09 AM EDT |
| Indication | Acute Care Interactions |
| Classification(s) | fever (infectious disease symptom) |
| Location | Sample Location |
| Analysis Method | Exponential Moving Average |
| Data Conditioning Method | No Data Conditioning |
| Results of Analysis | 22 (Number of Visits) |
| Records Totaled By | Facility Location |

Click here to view this anomaly in EpiCenter.

Download cases in Excel or mobile web

**Figure 29: Text of update notification email**

## 7.3 Matching Anomalies

The Matching Anomalies view lists all anomalies that fit the search terms shown at the top of the Control Panel. Active anomalies for a given location are listed in reverse chronological order (i.e., newest entries first).

Each anomaly on the list is shown on the map with an orange marker at its location. The lettered map markers correspond to the lettered anomalies in the list. Multiple anomalies for the same location are grouped under one marker. To move between multiple pages of matching anomalies, use the left and right arrows at the bottom of the Control Panel, next to the page number indicator

Each entry on the Matching Anomalies list provides the date of the anomaly, the classification used, the analysis method used, the location, the actual count, the predicted count, and the anomaly threshold. Clicking directly on the text on the Matching Anomalies list will return the detail view for that particular anomaly. Clicking on a map marker will produce a popup caption containing that anomaly's specific information ( See Section 7.4).

**Figure 30: Overview map, Anomalies page**

Use the Advanced Options dropdown under the Time Period selector to download a list of matching anomalies in either CSV or Excel format. The downloaded file reflects the parameters as defined in the Control Panel.

# 7.4 Anomaly Detail View

The anomaly detail view of the Anomalies page provides additional information for any entry in the Matching Anomalies list. Selecting an item in that list will generate this view. Also, the anomaly detail view is automatically displayed when EpiCenter is launched from a link in a notification email.

The anomaly detail view contains four sections, each with tools for evaluating the anomaly. These sections are described below, beginning with the upper left section and proceeding in clockwise order.

## 7.4.1 Narrative (Upper Left)

The top left quadrant of the anomaly detail view includes a narrative that describes the anomaly and presents options for investigating the anomaly. Figure 31 shows a sample narrative. Descriptive text components are indicated in red and available actions are blue:

1. Data Type
2. Location
3. Time period
4. Totaled by
5. Analysis method

6. Number of interactions
7. Predicted value
8. Threshold
9. Percentage of total
10. Threshold as percentage of total

11. Detection date and time
12. Anomaly disposition
13. Update disposition
14. Create new investigation
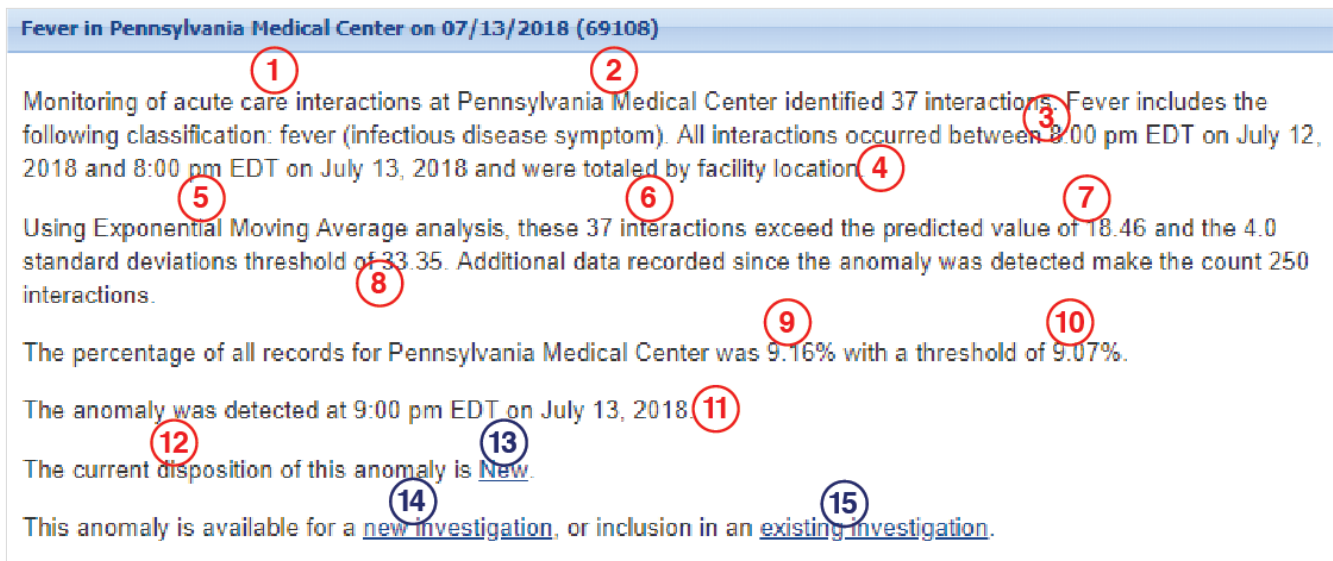15. Add to existing investigation

Figure 3: Anomaly detail narrative

All investigations with which the anomaly has been associated are listed in the narrative quadrant. Clicking on an investigation's name will return details about that particular investigation.

A user can also select or change a disposition for the anomaly or assign it to an investigation. To create a new investigation, click "new investigation" in the final sentence of the narrative. This will produce a popup window with a free-text box where the user can enter the investigation's name. To link the anomaly to an existing investigation, click "existing investigation." A dropdown list will appear that contains all active investigations within the user's accessible region, with which the anomaly has been associated. After the user names the new investigation or selects one from the list, EpiCenter will open the Investigations page.

If an anomaly is qualified for immediate notification, the narrative quadrant will indicate the number of times the anomaly has been triggered. Surveillance for an immediate notification occurs hourly. For each additional case detected within the window of the anomaly, the trigger count will increase by one. The page also indicates the current total number of patients associated with the anomaly.

## 7.4.2 Map (Upper Right)

In the top right quadrant, a map shows the anomaly's location and the surrounding area. Clicking on the orange map marker will produce a popup with the date of the anomaly, the classification used, the location, the analysis method used, the actual count, and the anomaly count threshold.

This map functions similarly to the one on the Maps page. The label at the bottom of the map indicates the analysis method used.

## 7.4.3 Chart (Lower Right)

The bottom right quadrant of the anomaly detail view contains a chart. The blue line on the chart represents data that matches the anomaly's classification(s) and location. The red line shows the anomaly threshold, which reflects the analysis method used to detect the anomaly. The data on this chart can be presented as a number of records, as a percentage of all records, or as a population rate per 100,000 people. To change the representation, click on the underlined portion of the chart header. A small dropdown list of data presentation formats will appear; a blue bullet signifies that a particular option has been selected.

The chart on the anomaly detail view displays data for the 30 days prior to the anomaly detection date. Five days' worth of post-detection data are also displayed. The post-detection data appears as a blue dotted line at the far-right edge of the chart. That dotted line depicts data trends following the time of the anomaly while also accounting for latent messages (see Figure 32). To reproduce a chart from the anomaly detail view on the Charts page, apply the same attributes and 24-hour sliding window using the Enable Hours selector.

Clicking directly on the chart will produce a larger popup chart that is identical to the quadrant version. The larger chart functions similarly to the Charts page's popup charts (see Charts, page 46). One notable difference is that in the Patients tab, rows highlighted in yellow will indicate data that came in after the anomaly was initially detected.
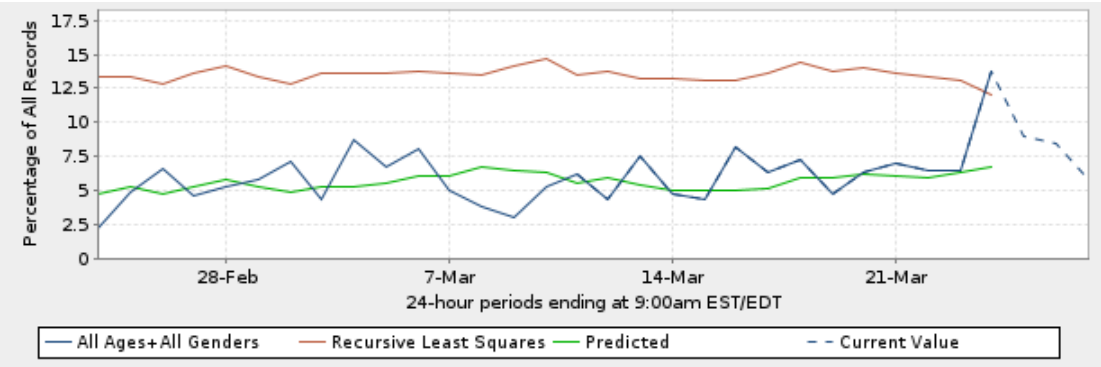


**Figure 32: Anomaly detail chart**

## 7.4.4 Descriptive Analysis (Lower Left)

In the lower left quadrant of the anomaly detail view, a descriptive analysis bar chart displays the distribution of data by a specified attribute; options include age group, facility name, gender, and zip code. These distributions can be viewed as a percentage of all records, as a number of records, or as a population rate per 100,000 people. To select attributes and data representations, click on the underlined portion of the chart title and choose from the
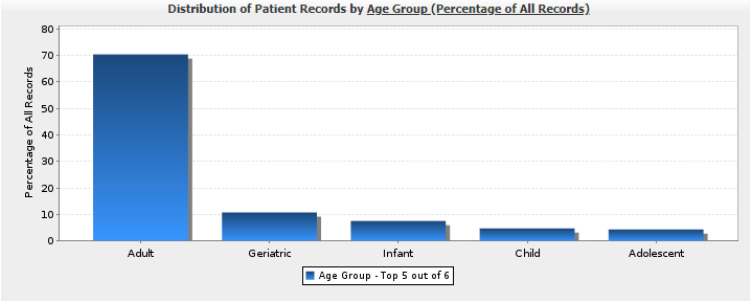


**Figure 33: Descriptive analysis, Anomalies page**

list shown in the popup menu. Blue bullets next to an attribute and a data representation format indicate the user's selections (see Figure 33).

The descriptive analysis chart also provides a comparison feature, which is accessed from the chart title's dropdown menu. Near the bottom of the menu, select Comparison. The comparison will appear as a second set of bars on the chart (see Figure 34). The second set of bars represents the distribution of patient records from the specified time period for the selected attribute.

The comparison time period is defined in the Comparison Details popup box (see Figure 35). The comparison chart also displays a $\chi^2$ statistic and a $p$ value that indicate whether the difference between the anomaly distribution and the historical distribution is statistically significant. To remove the comparison from the chart, click on the chart title to produce the popup menu and select Turn Off Comparison.
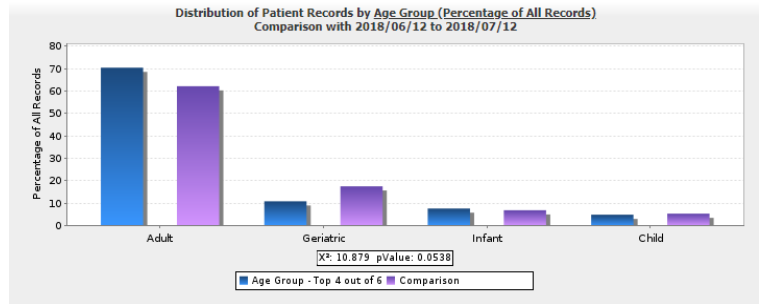


**Figure 34: Descriptive analysis with comparison, Anomalies page**



**Figure 35: Comparison Details popup box for setting comparison time frame**

# 8 Investigations

The Investigations page is a tool to help users manage the overall workflow and common processes for investigating anomalies and potential public health events.

## 8.1 Overview Map
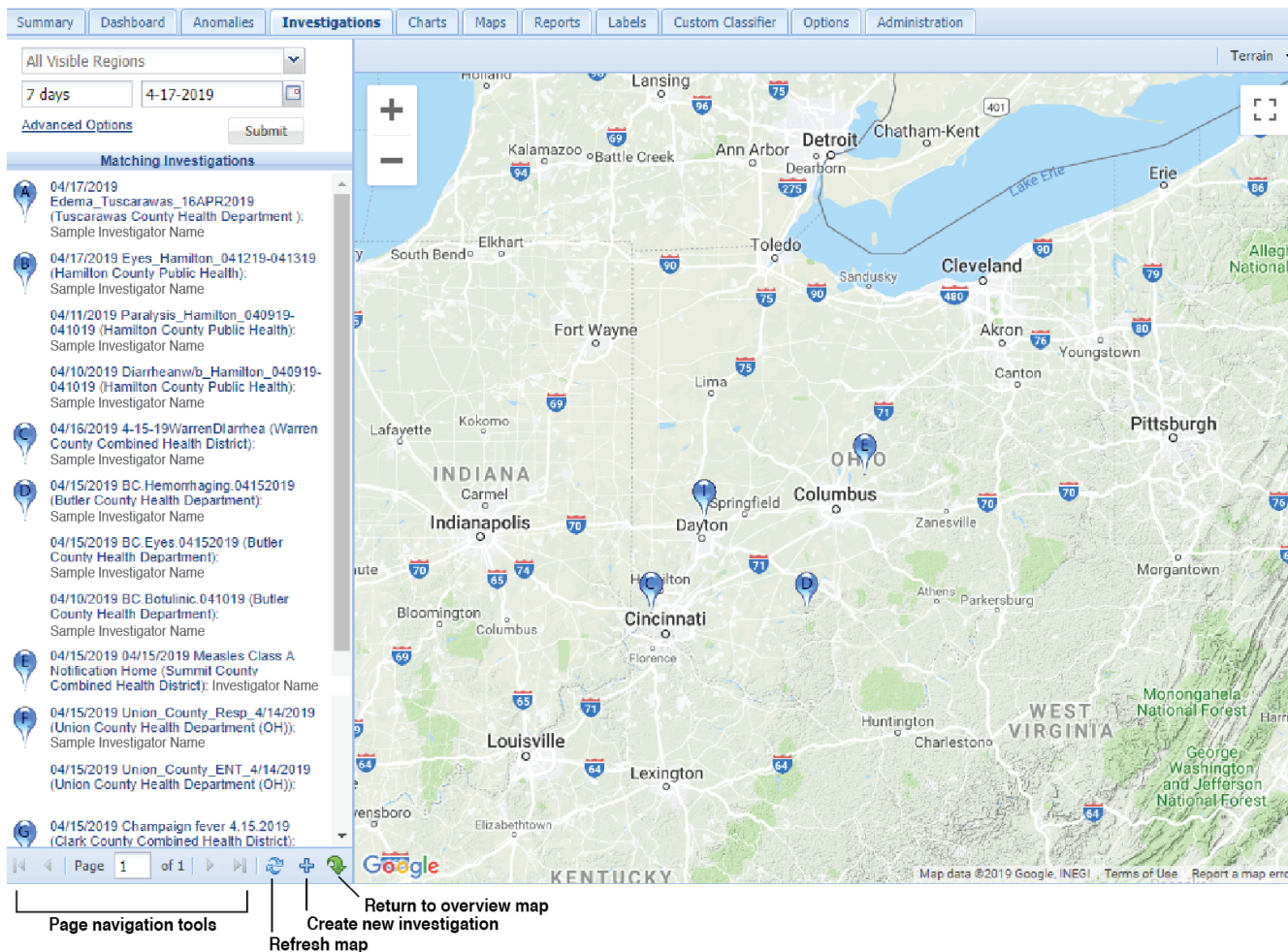


**Figure 36: Overview map, Investigations page**

A map of the user's region is shown next to a Matching Investigations list (see Figure 36). Entries on the list accord with the location, time period, and end date in the upper section of the Control Panel. Active investigations for a given location are listed with the newest item first.

Each investigation on the list is represented on the map by a blue marker at the location of the investigator's organization. The letter next to an investigation on the list corresponds to the map marker with the same letter. If an organization has launched multiple investigations, they will all be grouped under one marker.

Each entry on the Matching Investigations list includes the investigation's start date, its title, the investigating

organization, and the investigator's name. Clicking on a map marker will produce that investigation's Summary popupwhich contains the same information. If more than one investigation is associated with a marker, only the most recent investigation will be described in the Summary. Clicking directly on an item on the Matching Investigations list will immediately return the detail view (See Section 8.2) for that investigation.

With checkboxes on the Advanced Options dropdown menu, located under the Time Period selector, a user can choose to show inactive investigations or to view only investigations assigned to that user (see Figure 37)..

The Control Panel's bottom margin contains left and right arrows that are used to navigate among multiple pages of matching investigations (see Figure 36). Nearby are two clickable icons.

Clicking the refresh icon (  ) reloads the Matching Investigations list; clicking the plus-sign icon (  )enables the user to create an investigation directly, without associating an anomaly.
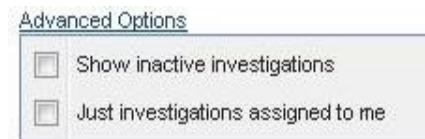


**Figure 367: Advanced Options,**

**Investigations page**

# 8.2 Investigation Detail

The investigation detail view of the Investigations page provides additional information about a specific investigation. This page is automatically displayed when a user creates a new investigation directly from an anomaly or adds an anomaly to an existing investigation.

The functionality that is available on the investigation detail view may vary by organization. Both the standard and enhanced views are described below.

## 8.2.1 Standard Investigation Detail View

The standard investigation detail view contains four quadrants. They are described below, beginning with the upper left quadrant and proceeding clockwise.

### 8.2.1.1 Narrative (Upper Left)

In the narrative section of the investigation detail view, the header provides the investigation's creation date, name, and identification number. Under the header are a description of the investigation and various possible actions for conducting the investigation (see Figure 38. Descriptive text components are indicated in red and available actions are in blue.

**Change the investigator:** Clicking here will produce a popup list of all available investigators. The list includes all EpiCenter users within your organization. Depending on the user's preference settings for assignment emails, the system may automatically send a notification email to a newly assigned investigator. Settings for assignment emails can be adjusted on the Options page (See Section 14).

**Change the investigation name:** Clicking here brings up a small window with a free-text box for typing in the investigation's new name. After entering the information, click Save.

**Associate anomalies:** Click here to see a popup box with a list of all active anomalies in the accessible region. Selecting new will automatically associate it with the investigation.

1. Start time of investigation
2. Person who started investigation
3. Person's organization
4. Current investigator
5. Number of anomalies associated with investigation
6. Current state of investigation

7. Change the investigator
8. Change the investigation name
9. Associate anomalies
10. Add comments
11. Edit permissions
12. Update the state of the investigation



**Figure 38: Add Comment box**
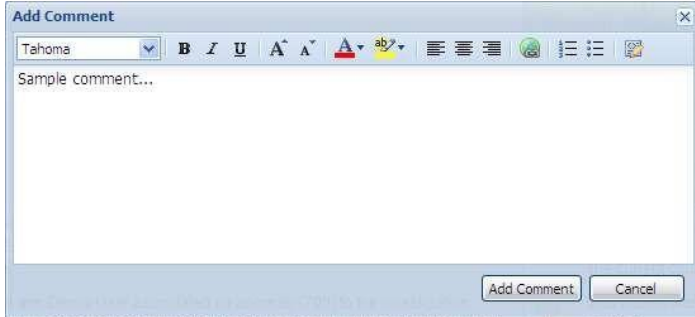
**Add comments:** In this popup window, users can add free-text comments to the comments section in the lower left quadrant of the investigation detail view (see Figure 39). After entering the information, the user must click the Add Comment button.
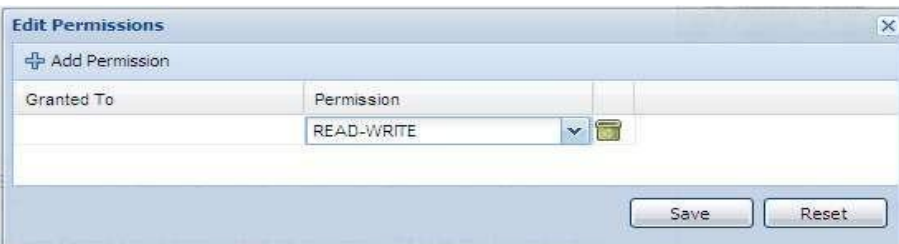


**Figure 40: Edit Permissions box**

**Edit permissions:** Users at the organizational administrator level can share investigations with EpiCenter users outside of their organization by editing permissions. Click on that phrase to produce a popup window

**Follow these steps to share an investigation:**

1. Within the Edit Permissions popup, click on the Add Permission button in the upper left corner to create a new entry.
2. Choose an organization from the Granted To dropdown list, which shows all the organizations that your organization is authorized to share investigations with. If you wish to share an investigation with an organization that is not listed, please contact Health Monitoring directly.
3. Assign the organization a permission level: None, Read-Only, Read-Write, or Admin.
4. Repeat steps 1-3 for each additional organization.
5. To confirm, click the Save button at the bottom of the popup window.

To delete an entry, click on the green garbage bin in the Delete column. Clicking the Reset button will cause the list of entries to revert back to the settings that were last saved.

**Update the state of the investigation:** Clicking on the phrase "update the state" produces a popup list of resolution categories. Select one and click the OK button to finalize. The list items may vary by region. Figure 41 outlines the default investigation workflow.
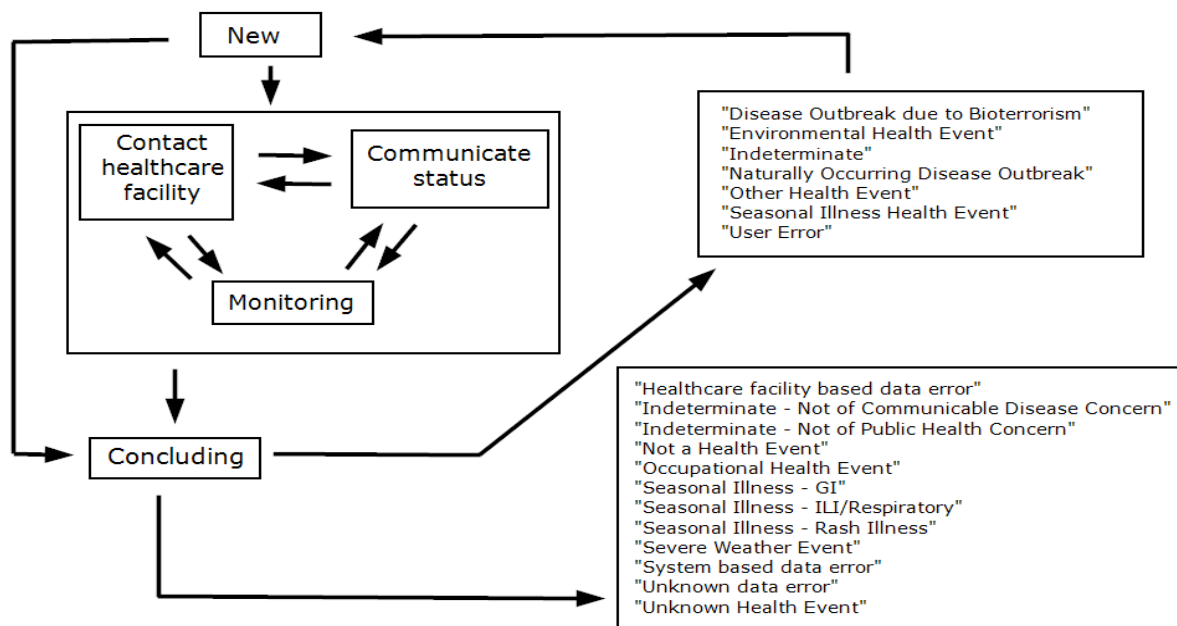


**Figure 41: Investigation Workflow**

## 8.2.1.2 Map (Upper Right)

This section contains a map with two types of markers. The blue marker shows the location of the initial investigator's organization. When the user clicks a blue marker, a popup appears with investigation details, including its name, the name of the current investigator, and the investigator's organization.

Other markers, which will be either orange or red, indicate the locations of all associated anomalies. Clicking on an orange or red marker displays a Summary box with the anomaly count, the place name, and details about the most recent anomaly: its creation date, the classification and analysis method used, the actual and predicted counts, and the count that represents the anomaly threshold.

## 8.2.1.3 Anomaly Status (Lower Right)

This quadrant lists all anomalies associated with the investigation (see Figure 42. Each entry has the date of the anomaly, plus the classification, location, and analysis method used to detect the anomaly. It also provides the current count for that classification and location and indicates whether that value exceeds the detection threshold in place when the anomaly occurred. The threshold count is shown in parentheses.

08/31/2015 3:03 pm: System Administrator modified permissions for this investigation.

05/12/2015 12:49 pm: System Administrator: Reaching out to ED staff for more information.

05/12/2015 12:48 pm: System Administrator associated an anomaly (69078) to the investigation: "Abdominal by Exponential Moving Average in St. Medard Medical Center found 63.0 with a maximum of 48.49".

05/12/2015 11:19 am: System Administrator associated an anomaly (69090) to the investigation: "Nausea by Exponential Moving Average in Pennsylvania Medical Center".

05/12/2015 11:19 am: System Administrator began the investigation "Nausea by EMA (5.12.15)". System is the investigator.

**Figure 42: List of associated anomalies**

The marker next to each anomaly indicates by its color whether the current count still exceeds the detection threshold. It may change color. If the marker is…

- ●Red: The current counts exceed the detection threshold.
- ●Orange: The current counts do not exceed the detection threshold.

Clicking on one of the listed anomalies takes the user to that event's anomaly detail view (See Section 7.4). In the narrative portion of the anomaly detail view, the investigation's name is provided; clicking on that name will return the user to the investigation detail view. To remove an anomaly from an investigation, click on the entry in the associated anomaly list and select Remove from the small popup box.

## 8.2.1.4 Comments (Lower Left)

The comments section contains all activities and logged comments related to an investigation (see Figure 43). Whenever someone takes an action on the investigation, an entry automatically appears in this area. Eligible actions include beginning the investigation, changing the investigator or the name of the investigation, associating or removing an anomaly, adding comments, editing permissions, or updating the state of the investigation. To add free-text comments, click the underlined phrase "add comments" where it appears in the narrative quadrant. All comments will update in real time.



10/16/2014: **Abdominal** in **St. Medard Medical Center** by Exponential Moving Average.
The current count of 385 visits exceeds the detection threshold (48.49).

12/11/2014: **Nausea** in **Pennsylvania Medical Center** by Exponential Moving Average.
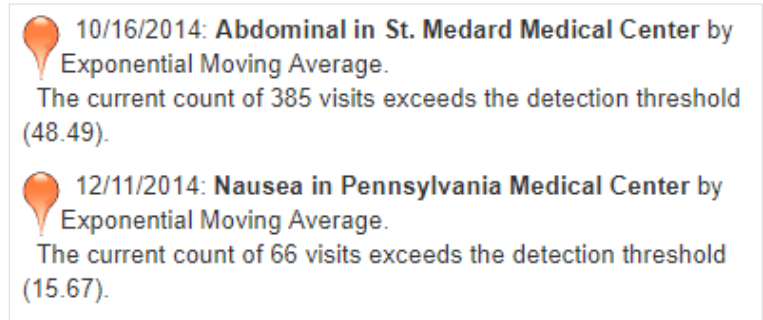The current count of 66 visits exceeds the detection threshold (15.67).

**Figure 43: Comments section, Investigations page**

# 9 Charts

The Charts page is available to users from public health agencies and healthcare facilities. However, healthcare facility users may view data only for their facility (or, when affiliated with a health system, the system's multiple facilities). Users can plot and compare charts by specifying the desired parameters in the Control Panel. The visit records associated with the selected parameters may be viewed in the Chart Detail popup. Charts created on this page can be added to a new or existing surveillance view for display on the Summary page (See Section 9.2).

The data analysis underlying EpiCenter's charts involves two steps. First, the system generates a predicted count of occurrences for the current day. The prediction is based on actual counts from some number of days in the past. The exact number of days used for the prediction is unique to each algorithm; it can be specified by the user or calculated from other user-specified parameters, depending on the algorithm.

Second, the system calculates a threshold for the current day. If the number of occurrences exceeds the threshold, EpiCenter will issue an alert. Predicted counts are rarely perfect; some degree of error is always present. Therefore there will always be some deviation between the predicted count and the actual count. Given information about how prediction errors are distributed under normal conditions, it is possible to calculate an anomaly threshold. The anomaly threshold represents a level of deviation from the predicted count that would be unexpected under normal conditions. This threshold can also be adjusted by the user. A lower threshold will generally result in greater sensitivity (that is, the system will detect more anomalies) but reduced specificity (causing a greater number of false positive alerts). A higher threshold will have the opposite effect.

Computing predicted counts and thresholds are related but separable processes. The methods for one can be combined in various ways with the methods for the other. The analysis methods built into EpiCenter represent some of the most common combinations.

## 9.1 Plotting Charts (With Examples)

The user must specify attributes in order to plot a chart; it will then appear in the main window, to the right of the Control Panel. To plot a chart, follow these steps (optional actions are marked with an asterisk):

1. On the Control Panel, enter a location in the free-text Location selector.
2. Specify an end date using the End Date selector.
3. If the Enable Hours box on the Advanced Options submenu has been checked, define the 24-hour sliding window. *
4. Enter a historic time period in the Time Period indicator.
5. Click on the Options dropdown menu to choose an analysis method. Adjust parameters for the analysis method if desired. *  Note: If parameters are adjusted, "(custom)" will appear by the method's name.
6. Apply data conditioning. *
7. Specify a data representation format. *
8. On the Advanced Options submenu, opt to combine results. *
9. On that same menu, opt to plot the predicted values. *
10. Expand the appropriate data type panel using the Data Type selector.
11. Select a classifier from the Classifier selector.
12. Choose one or more classifications from the Classification selector. Note: To view all visits, regardless of classification, select Total Counts.
13. Choose one or more age groups from the Age Group selector. *

14. Choose one or more genders from the Gender selector. *
15. Identify the desired provider type from the Provider Type selector. * By default, the system will use data from hospitals and urgent care centers.
16. Select a totaled-by location with the Totaled By selector.
17. Choose one or more races from the Race selector. *
18. Choose one or more ethnicities from the Ethnicity selector. *
19. Click the Submit button.

*if desired*

## Example 1: State-Level Views of Vomiting and Diarrhea with CuSum EMA Analysis and Day-of-Week Data Conditioning

Plot charts for Sample Location showing acute care interactions that the infectious disease symptom classifier categorized as vomiting or a type of diarrhea, between April 1, 2018 and May 1, 2018. Use a standard 24-hour sliding window. Display data for all age groups, genders, provider types, races, all ethnicities, and all discharge dispositions; have it totaled by the patient's home location. Use the CuSum EMA analysis method with default parameters to generate a threshold. Condition the data to account for the day-of-week effect. Represent the data as the number of records. View each classification on a separate chart.

You would take the following actions to create this chart (see Figure 43):

1. Type the state's name into the Location selector. Once the dropdown menu provides a matching name, select it.
2. Using the popup calendar tool on the End Date selector, display May 2018 and select the date (May 1). Alternatively, type in the date, using the format MM-DD-YYYY.
3. Make sure the Enable Hours selector is deselected; this causes the system to use the standard 24-hour sliding window.
4. Type "1 month" into the Time Period indicator.
5. From the Options dropdown menu, select CuSum EMA. A bullet appearing next to CuSum EMA will indicate that it has been selected.
6. From the Options dropdown menu, select Data Conditioning and click on Condition for Day-of-Week Effect. A bullet appearing next to Condition for Day-of-Week Effect will indicate that it has been selected.
7. From the Options dropdown menu, select Data Representation and click on Number of Records. A bullet appearing next to Number of Records will indicate that it has been selected.
8. From the Options dropdown menu, select Advanced Options and then deselect the checkbox next to Combined Results. The empty checkbox for Combined Results will indicate that it has been deselected.
9. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
10. Click on the Classifier selector's dropdown arrow and select Infectious Disease Symptom from the menu.
11. In the Classification selector list, choose the three items Vomiting, Diarrhea – Not Watery/Bloody, and Diarrhea – Watery/Bloody. To select multiple classifications, click on each item while continuing to hold down the CTRL key on your keyboard.
12. Choose Standard Age Group from the dropdown from the Age Group selector list.
13. Choose All Genders from the Gender selector list.
14. Choose All Provider Types from the Provider Type selector list.
15. Click on the Totaled By selector arrow and choose Totaled by Home Location.
16. Choose All Races from the Race selector list.
17. Choose All Ethnicities from the Ethnicity selector list.
18. Choose All Discharge Dispositions from the Discharge Disposition selector list.
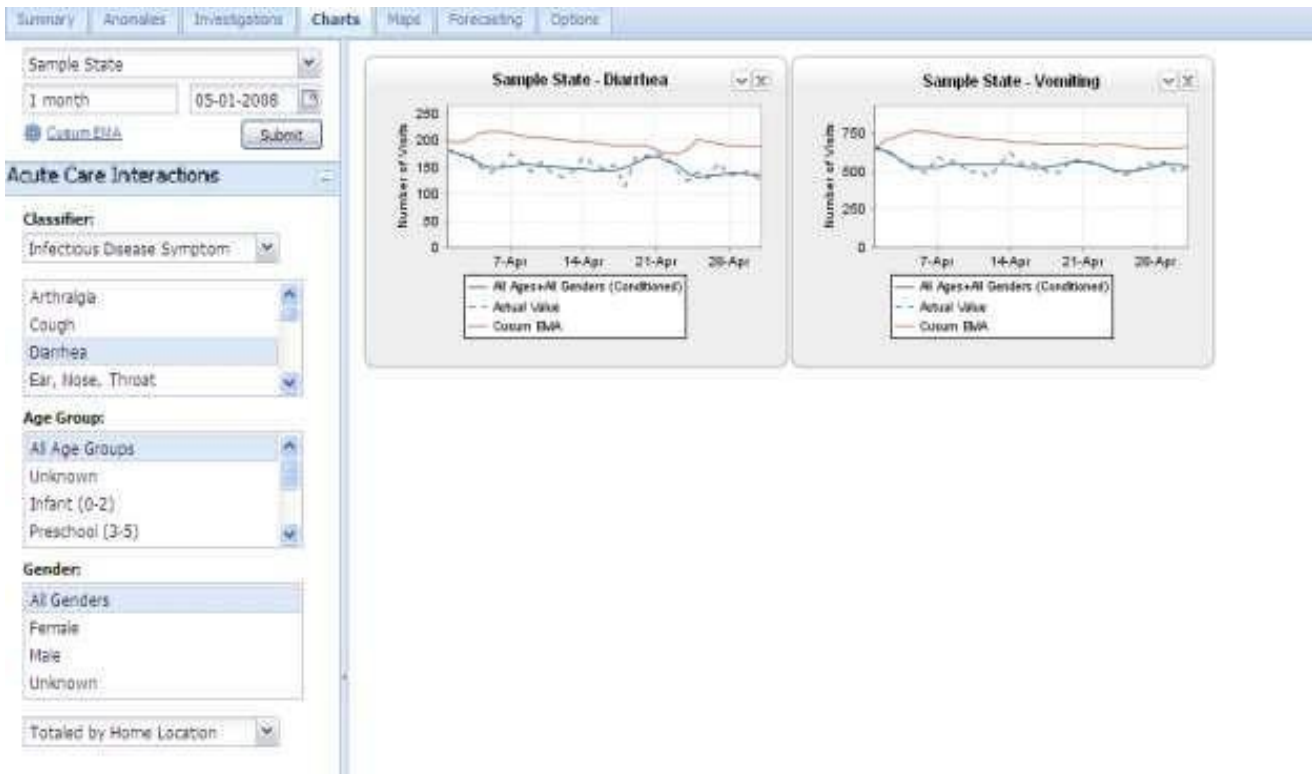19. Click the Submit button to generate the chart.

**Figure 44: State-level view of vomiting and diarrhea counts with CuSum EMA analysis and day-of-week data conditioning applied**

## Example 2: County-Level View of Cough with Exponential Moving Average Analysis Based on an Anomaly

Produce an actual value chart to mirror an anomaly detail chart for the purpose of applying adjusted analysis method parameters. The anomaly was detected for patients with a home zip code in Sample County at 11am on June 26, 2018 for acute care interactions classified as cough (an infectious disease symptom) that occurred between 10am on June 25, 2018 and 10am on June 26, 2018. The Exponential Moving Average analysis method was used. No data conditioning was applied.

You would take the following actions to create this chart (see Figure 44):

1. Type the county's name into the Location selector. Once the dropdown menu provides a matching month name, select it.
2. Using the popup calendar tool on the End Date selector, display June 2018 and select the date (June 26). Alternatively, type in the date, using the format MM-DD-YYYY.
3. On the Options dropdown menu, highlight Advanced Options and then select the checkbox next to Enable Hours. An hour will now appear to the right of the end date. Select 10am as the cutoff point for the 24-hour sliding window.
4. Type "1 month" into the Time Period indicator.
5. From the Options dropdown menu, select Exponential Moving Average. A bullet will appear next to Exponential Moving Average to indicate that it has been selected. Click on the gear icon to produce the Analyzer Configuration popup window. Adjust parameters as desired. Click the Apply button.
6. On the Options dropdown menu, highlight Data Conditioning; from the submenu, select No Data Conditioning. A bullet next to that entry will indicate that it was selected.
7. From the Options dropdown menu, select Data Representation; from the submenu, choose Number of Records. A bullet appearing next to Number of Records will indicate that it was selected.
8. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
9. From the Classifier selector menu, select Infectious Disease Symptom.
10. Choose Cough from the Classification selector list.
11. Choose Standard Age Group from the dropdown from the Age Group selector list.
12. Choose All Genders in the Gender selector list.
13. Choose All Provider Types from the Provider Type selector list.
14. Choose All Races from the Race selector list.
15. Choose All Ethnicities from the Ethnicity selector list.
16. Choose All Discharge Dispositions from the Discharge Disposition selector list.
17. Use the Totaled By selector to choose Totaled by Home Location.
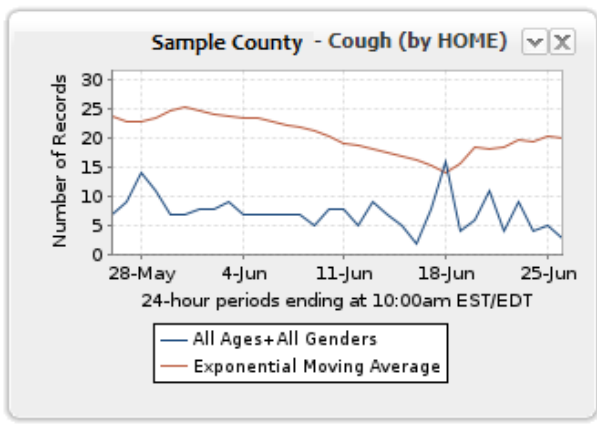18. Click the Submit button to produce the chart.

**Figure 45: County-level view of cough with Exponential Moving Average analysis based on an anomaly**

## Example 3: Facility-Specific View of Animal Attacks, Bites, and Scratches with Moving Average Analysis

Plot one chart for Sample Hospital showing the facility's acute care interactions that were classified by the animal-related injury classifier as animal attack, animal bite, or animal scratch. The time period is September 21, 2018. Use a standard 24-hour sliding window. Display data for all age groups, genders, provider types, all races, ethnicities, and all discharge dispositions. Use the Moving Average analysis method with default parameters to generate a threshold. Do not apply data conditioning. Represent the data as number of records. View all the data on one combined chart.

You would take the following actions to create this chart (see Figure 45):

1. Type "Sample Hospital" into the Location selector. Once the dropdown menu provides a matching name, select it.
2. Using the popup calendar tool on the End Date selector, display September 2018 and select the date (September 21). Alternatively, type in the date, using the format MM-DD-YYYY.
3. Type "3 weeks" into the Time Period indicator.
4. Make sure the Enable Hours selector is deselected; this causes the system to use the standard 24-hour sliding window.
5. From the Options dropdown menu, select Moving Average. A bullet will appear next to Moving Average to indicate that it has been selected.
6. On the Options dropdown menu, highlight Data Conditioning; from the submenu, select No Data Conditioning. A bullet appearing next to No Data Conditioning will indicate that it has been selected.
7. On the Options dropdown menu, highlight Data Representation; from the submenu, select Number of Records. A bullet will appear next to Number of Records to indicate that it has been selected.
8. On the Options dropdown menu, highlight Advanced Options; from the submenu, select Combined Results by clicking its checkbox. A check in the box next to Combined Results will indicate its selection.
9. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
10. From the Classifier selector, choose Animal Related Injury.
Click on the three classifications Animal Attack, Animal Bite, and Animal Scratch in the Classification selector list while holding down the CTRL key on your keyboard. All three should be highlighted.
11. Choose Standard Age Group from the dropdown from the Age Group selector list.
12. Choose All Genders in the Gender selector list.
13. Choose Hospital from the Provider Type selector list.
14. Choose All Races from the Race selector list.
15. Choose All Ethnicities from the Ethnicity selector list.
16. Choose All Discharge Dispositions from the Discharge Disposition selector list.
17. Use the Totaled By selector to specify that the data should be totaled by facility location. The system will validate this: If a hospital is identified but the user has specified Totaled by Home Location, the mismatch will be indicated by a red border around the selector window.
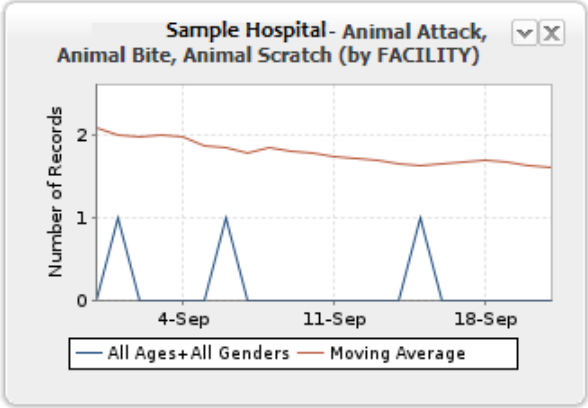18. Click the Submit button to produce the chart.

**Figure 46: Facility-specific view of animal attacks, animal bites, and animal scratches with Moving Average**

**analysis**

## Example 4: All Acute Care Interactions for a Single Hospital

Plot one chart for Sample Hospital showing all acute care interactions for that facility on August 31, 2018 and the three days prior. Use a standard 24-hour sliding window. Display data for all age groups and genders. Do not apply data conditioning or an analysis method. Represent data as number of records.

You would take the following actions to create this chart (see Figure 46):

1. Type "Sample Hospital" into the Location selector. Once the dropdown menu provides a matching name, select it.
2. Using the popup calendar tool on the End Date selector, display August 2018 and select the date (August 31). Alternatively, type in the date, using the format MM-DD-YYYY.
3. Type "3 days" into the Time Period indicator.
4. Make sure the Enable Hours selector in the Advanced Options submenu is deselected; this causes the system to use the standard 24-hour sliding window.
5. From the Options dropdown menu, select No Analysis. A bullet will appear next to No Analysis to indicate that it has been selected.
6. On the Options dropdown menu, highlight Data Conditioning; from the submenu, choose No Data Conditioning. A bullet will appear next to No Data Conditioning to indicate that it has been selected.
7. On the Options dropdown menu, highlight Data Representation; from the submenu, choose Number of Records. A bullet appearing next to Number of Records will indicate that it has been selected.
8. Disregard the issue of whether to combine results, as this functionality does not apply to Total Counts.
9. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
10. From the Classifier selector, choose Total Counts. Note: The Classification selector is not applicable to Total Counts.
11. Choose Standard Age Group from the dropdown from the Age Group selector list.
12. Choose All Genders in the Gender selector list.
13. Choose Hospital from the Provider Type selector list.
14. Choose All Races from the Race selector list.
15. Choose All Ethnicities from the Ethnicity selector list.
16. Choose All Discharge Dispositions from the Discharge Disposition selector list.
17. Use the Totaled By selector to specify that the data should be totaled by facility location. The system will validate this: If a hospital is identified but the user has specified Totaled by Home Location, the mismatch will be indicated by a red border around the selector window.
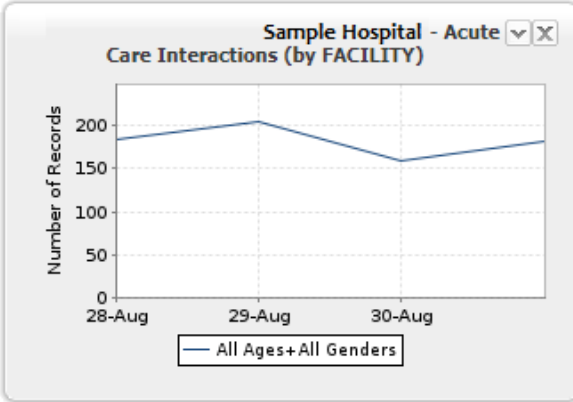18. Click the Submit button to produce the chart.

**Figure 47: Total counts of acute care interactions for four days at a specified hospital**

## Example 5: State-Level View of ILI Symptoms and Admissions with Exponential Moving Average Analysis

Plot charts for Sample Location showing acute care interactions that were classified as ILI symptoms by the infection disease symptom classifier and discharge dispositions that were classified as Admitted between September 1, 2018 and October 1, 2018. Use a standard 24-hour sliding window. Display data for all age groups, genders, and provider types; have the data totaled by patients' home location. Use the Exponential Moving Average analysis method with default parameters to generate a threshold. Condition the data to account for day-of-week effect. Represent the data as the number of records.

You would take the following actions to create this chart (see Figure 47).

1. Type "Sample Location" into the Location selector. Once the dropdown menu provides a matching name, select it.
2. Using the popup calendar tool on the End Date selector, display October 2018 and select the date (October 1). Alternatively, type in the date, using the format MM-DD-YYYY.
3. Type "1 month" into the Time Period selector.
4. Make sure the Enable Hours selector is deselected so that the system will use the standard 24-hour sliding window.
5. From the Options dropdown menu, select Exponential Moving Average. A bullet will appear next to Exponential Moving Average to indicate that it has been selected.
6. On the Options dropdown menu, highlight Data Conditioning; from the submenu, choose Condition for Day-of-Week Effect. A bullet next to that item will indicate that it has been selected.
7. On the Options dropdown menu, highlight Data Representation; from the submenu, select Number of Records. A bullet will appear next to Number of Records to indicate that it has been selected.
8. From the Options dropdown menu, select Classifier Query Editor. This will display the Classifier Query Editor popup. Within the popup, select Influenza Related Illness on the Classifier menu and ILI Symptoms on the Classification menu. Both terms (Influenza Related Illness and ILI Symptoms) will be highlighted in blue to indicate that they have been selected.
9. In the Classifier Query Editor popup, click the Add Classifier button in the upper left of the window, directly above the first Classifier selector. This will add a second pair of Classifier and Classification selectors below the first pair. Select Diagnosis ILI Classifier from the second Classifier selector and Influenza (Identified Virus) from the adjacent Classification selector.
10. Click the Apply button to save the settings and close the popup window. You will see on the Control Panel that the Classifier selector has been replaced by the parameters of the chosen classifier query.
11. Choose Standard Age Group from the dropdown from the Age Group selector list.
12. Choose All Genders in the Gender selector list.
13. Choose All Provider Types from the Provider Type selector list.
14. Choose All Races from the Race selector list.
15. Choose All Ethnicities from the Ethnicity selector list.
16. Choose Discharged to Home from the Discharge Disposition selector list.
17. Set the Totaled By selector to the Totaled by Home Location option.
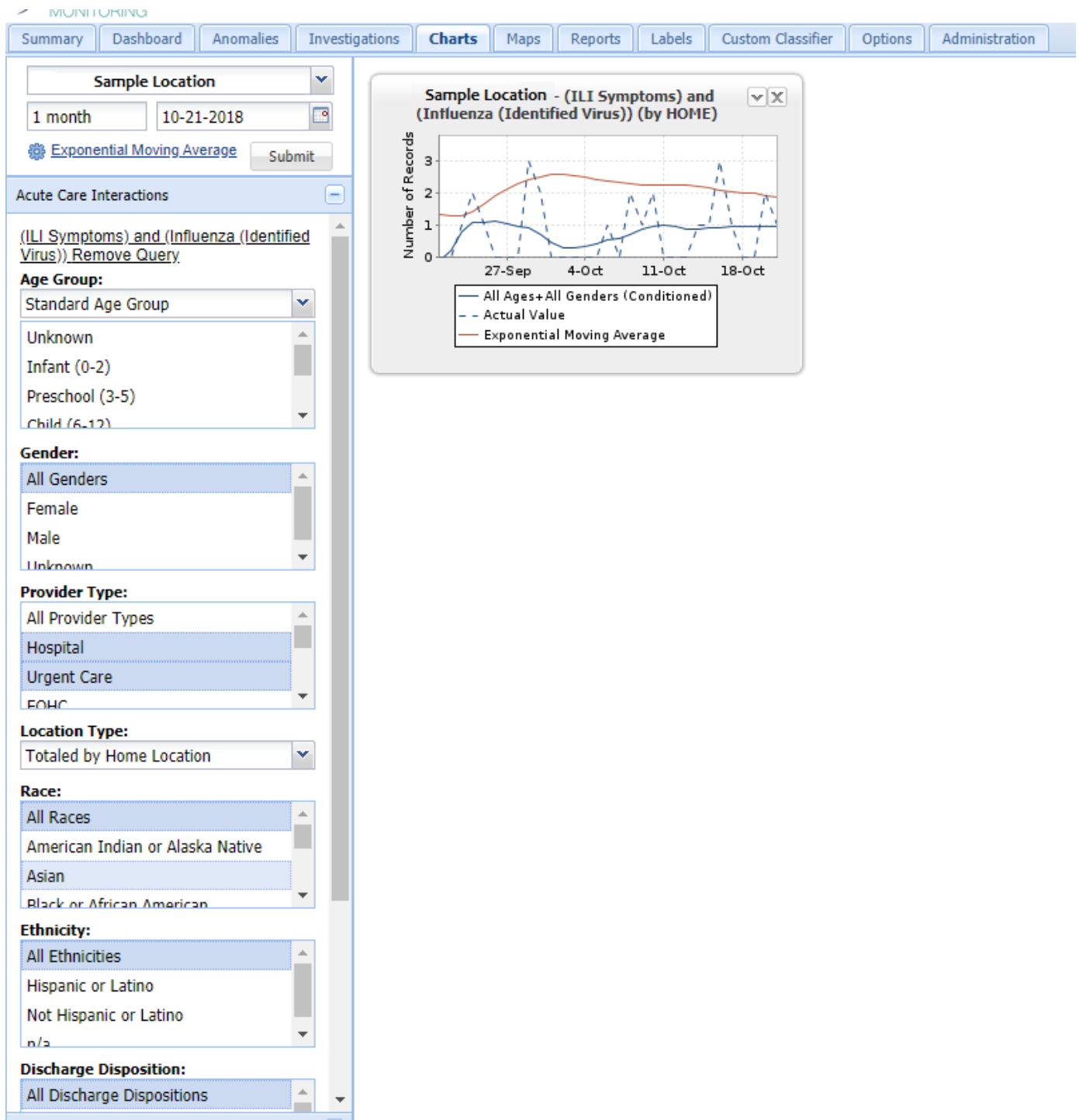18. Click on the Submit button to produce the chart.

**Figure 48 State-level view of ILI symptoms and admissions with Exponential Moving Average analysis**

## 9.2 Surveillance Views

Each chart plotted on the Charts page can be added to a new or existing surveillance view. To do so, begin by locating the surveillance view dropdown menu, which appears when a user clicks on the down arrow symbol in the upper right corner of a chart (see Figure 49).

To add the chart to an existing view, highlight Add to Existing View on the dropdown menu. A submenu that lists all existing views will appear to the right. Select the desired view. To add the chart to a new surveillance view, select Create New View. A popup box will prompt you to give the new surveillance view a unique name. Enter the name into the free text box in the popup and click the Save button. To terminate the process of creating the new view, close the popup or click the Reset button.

After the Save button has been clicked, the system will confirm that the view has been created and the chart has been added to it. In the confirmation box, there is also a free-text field for renaming the chart if desired.

To add charts to the newly created view, repeat the steps above. A maximum of 30 charts and 30 unique classifications can be added to a single surveillance view. Authorized users can examine or edit surveillance views on the Summary page.



**Figure 49:
Popup menu
for assigning charts
to surveillance views,
Charts page**

## 9.3 Labels

Users can create labels directly from charts on the Charts page. To do so, click on the down arrow symbol located in the upper right corner of a chart. This produces a dropdown menu with the labeling options Apply Existing Label and Apply New Label. Selecting Apply New Label opens a popup window with free-text fields where the user can input a name and an item description. Click the Save button to create the new label.

In addition, labels can be created on the Labels page by clicking on the plus-sign icon in the lower left corner of the Control Panel. Users can edit existing labels on that page as well.

## 9.4 Chart Details Popup Window

Clicking directly on a chart on the Charts page produces a popup window with two tabs. The Chart tab is the default view; it shows a larger version of the selected chart. The Patients tab provides line listings for the associated patients (see Figure 49).

### 9.4.1 Chart Tab

As noted above, the Chart tab shows a larger version of the selected chart. To download the daily counts displayed on the popup chart, click the Download Counts button in the popup window's lower left corner. The system can output the file in CSV or Excel format. Selecting an option initiates the download. To open the downloaded file, follow the prompts from your computer's default application.
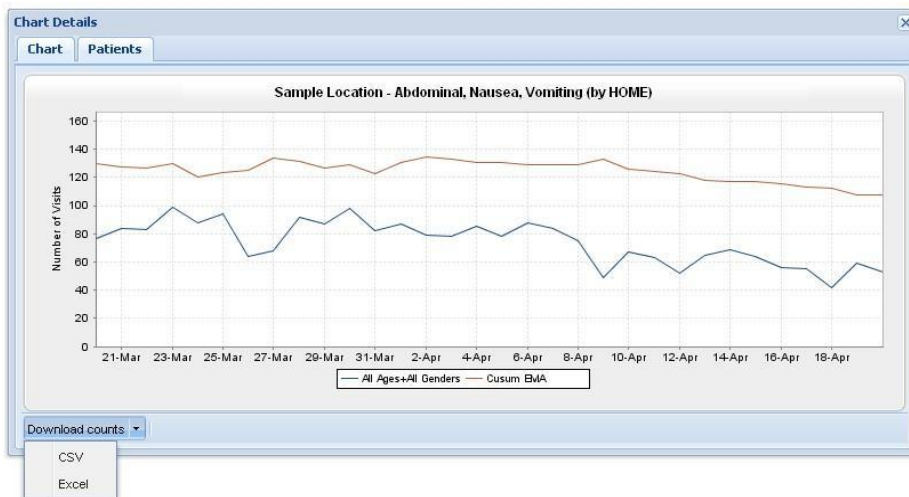


**Figure 50:**
**Chart Details popup window**

## 9.4.2 Patients Tab

Individual listings of all patients associated with the chart are shown on the Patients tab in the popup window. By default, each record contains the date and time of the visit; the patient's age, gender, and home zip code; the facility name; the visit number; relevant phrases from the free-text chief complaint; and visit classification(s). If a patient's age is unknown, it is displayed as "-1."

The patient's date of birth, race, ethnicity, and country of origin are also available for display, but must be turned on manually from the column display control menu. Columns that have been selected (as indicated by a marked checkbox) will appear on the Patients tab listing (see Figure 50). Note: A downloaded file in CSV or Excel format will include all available columns, not only those shown in the Patients tab.
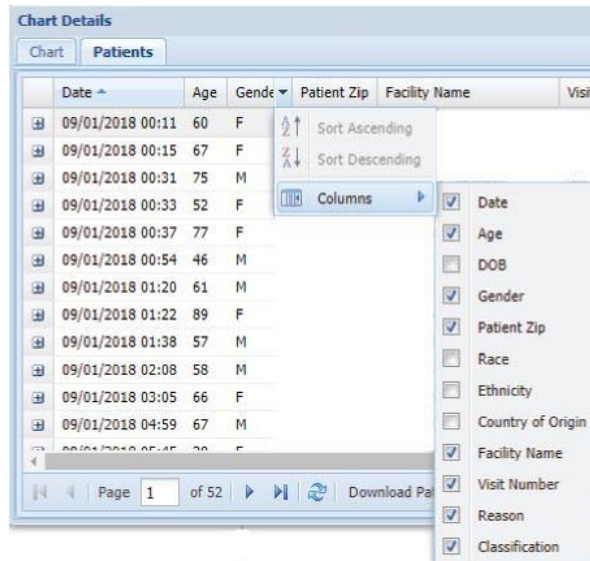


**Figure 51: Column display control menu, Charts page**

If more than 100 records are associated with the chart, use the page controls at the bottom left of the Chart Details popup window to navigate among multiple pages of line listings.

**Figure 52: Patients tab, Charts page**

To automatically download the line listings provided in the popup window, click the Download Patients button at the bottom center of the popup window. Files can be downloaded in CSV or Excel format. Selecting an option initiates the download. To open the downloaded file, follow the prompts from your computer's default application.
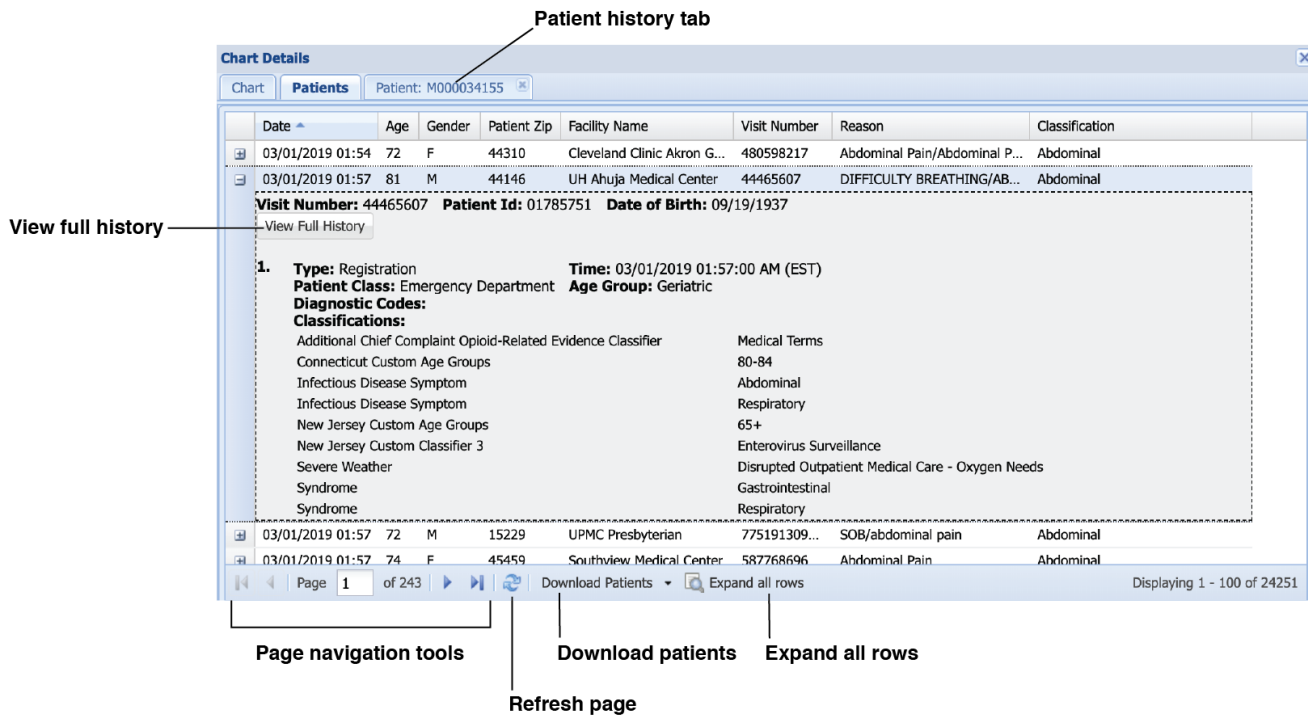
If a line listing contains both a patient ID and visit number, users with access permission can view additional information by expanding that record's line listing. To do so, click the plus sign at the left edge of the entry in the Patients tab (see Figure 49). An expanded listing includes information about the record type, date and time of visit, patient class and age group, diagnostic codes (when applicable), and classifications.

To expand all line listings, click the Expand All Rows button at the bottom of the window. To collapse an expanded listing, click the minus sign at the left edge of the expanded entry.

If a patient ID and/or visit number are not available for a patient, the patient history will not be displayed.

To see a patient's full history from the facility indicated in the line listing, click the View Full History button under the visit number. Clicking this button opens an additional tab in the popup window. The additional tab contains all available line listings for the patient's current visit as well as listings for any past visits to this facility. (Note: Patient history is available only for visits that occurred after the facility began submitting data to EpiCenter.) Full history can be opened for multiple patients by expanding each patient's listing on the Patients tab and then selecting View Full History on that listing. Full history tabs can be closed by selecting the X to the right of the tab name. The Chart Details popup window can be closed by clicking the X in the window's upper right corner.

# 10 Maps

The Maps page provides a geographic representation of data anomalies. Quick Charts that show trends can be derived from the map data. Users can also apply spatial scans (See Section 10.5) to ascertain the probability of a disease outbreak.

## 10.1 Navigating Maps

Data may be mapped for the regions and subregions associated with the user's access level. For example, users with statewide access can map state data, county data, and/or zip code-level data; users with countywide access can map data for the zip codes in that county. To specify the desired region, go to the Control Panel's View subtab and choose State, County, or Zipcode from the Region Type dropdown, then click Submit. To see more place names, tick the Label Features checkbox. For data from zip codes representing very small areas, select the Show Point Zips checkbox. To map hospitals, go to the Control Panel's Markers subtab and select Facilities.

Additionally, various formats are available for the map layer; options include Hybrid, Roadmap, Satellite, and Terrain. Choose one with the Map View selector in the upper right corner of the map frame (see Figure 53).

Users can adjust the map viewing window by clicking directly on the map and dragging it into place. To zoom in on a specific area, double-click on the location on the map or click the plus sign in the map's upper left corner; to zoom out, click the minus sign there.
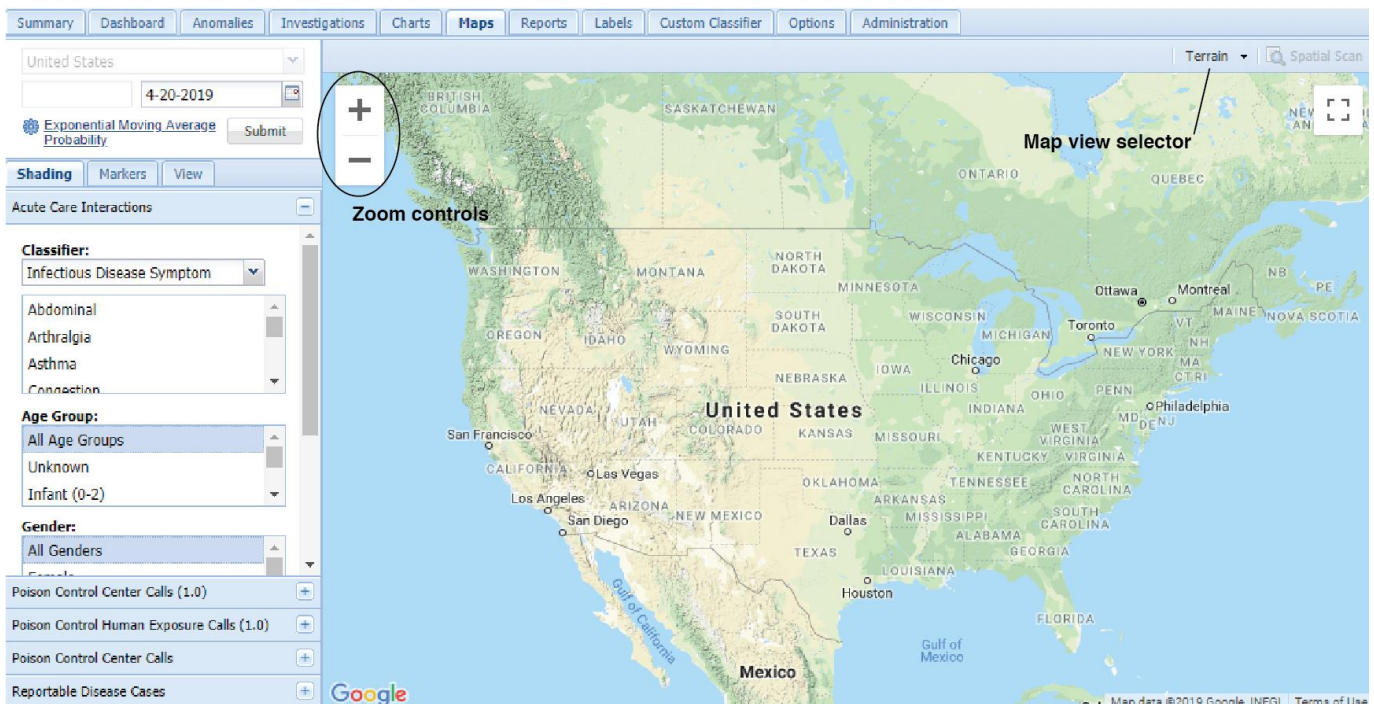


**Figure 53: Map controls**

## 10.2 Plotting Data on Maps (With Examples)

The Location selector box on the Maps page reflects the user's level of access. Input to this text box is disabled; users navigate the map using the mouse. The Time Period indicator is also inactive, as maps represent only one day's worth of data at a time. With the End Date selector, the user specifies the date for the desired data. The user selects an analysis method and, on subtabs, specifies parameters (see Figures 53 and 54).

To plot data on the map page, follow these steps:

1. Specify a date using the End Date selector.
2. From the Options dropdown menu, select an analysis method. Adjust the parameters if desired.
3. Activate data conditioning from the Options menu if desired.
4. Specify a data representation using the Options menu.
5. Use the Data Type selector to access the desired data type.
6. On the Shading subtab in the Control Panel, select a classifier from the Classifier selector.
7. From the Classification selector, pick at least one classification. Note: To view all visits, select Total Counts from the Classification selector.
8. Choose at least one age group from the Age Group selector.
9. Choose at least one gender from the Gender selector.
10. Choose a provider type from the Provider Type selector.
11. Select a totaled-by method from the Totaled By selector.
12. Choose at least one race from the Race selector.
13. Choose at least one Ethnicity from the Ethnicity selector.
14. Choose at least one Discharge Disposition from the Discharge Disposition selector.
15. Click the Submit button to view the specified data on the map
16. Shading will appear on the map to indicate the data's variance from expected levels.
17. Map markers can be activated to show healthcare facility locations as well as data on air quality and reportable diseases (as available by region).
18. Adjust the level of detail, apply label features, or display point zip codes by making one or more selections on the Control Panel's View subtab.
19. To focus on a viewing area, click and drag your mouse to show the desired location. Double-click to zoom in. Alternatively, zoom in or out by clicking the plus or minus sign in the map's upper left corner.
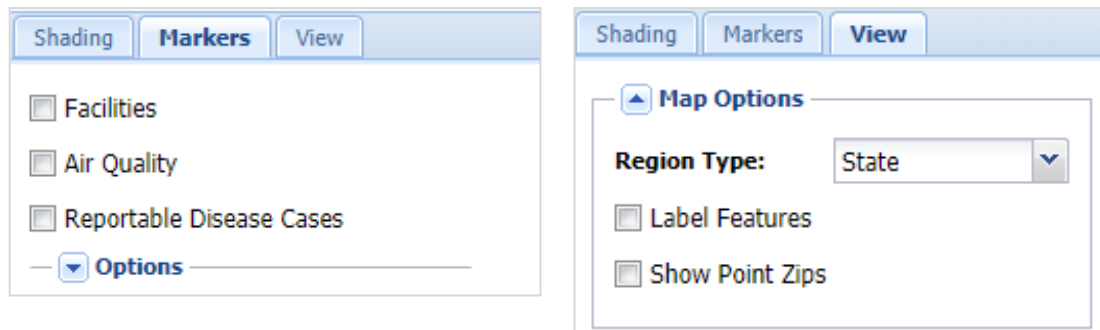


**Figure 54: Patient selection**

**Figure 55: Control Panel subtabs, Maps page**

# Example 1: County-Level View of Diarrhea, Fever, and Vomiting for Patients Under the Age of 18 with Poisson Visit Frequency Analysis and Data Represented as Percentage of All Records

For a county in your state, view mapped data showing acute care interactions classified as diarrhea (both types), fever, and vomiting. Use the date June 30, 2018. Display data for patients of all genders who are under the age of 18; total data by the patients' home location, all races, all ethnicities, and all discharge dispositions. Use the Poisson Visit Frequency analysis method with default parameters. Do not apply data conditioning. Represent data as a percentage of all records. (For result, see Figure 55.)

1. Using the popup calendar tool on the End Date selector, display June 2018 and select the date (June 30). Alternatively, type in the data, using the format MM-DD-YYYY.
2. From the Options dropdown menu, select Poisson Visit Frequency. From the dropdown list. A bullet will appear next to Poisson Visit Frequency to indicate the selection.
3. On the Options dropdown menu, highlight Data Conditioning; from the submenu, choose No Data Conditioning. A bullet will appear next to No Data Conditioning to indicate the selection.
4. On the Options dropdown menu, highlight Data Representation and click on Percentage of All Records. A bullet will appear next to Percentage of All Records to indicate the selection.
5. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
6. From the Classifier selector, choose Infectious Disease Symptom.
7. In the Classification selector list, click on Diarrhea – Not Watery/Bloody, Diarrhea – Watery/Bloody, Fever, and Vomiting while holding down the CTRL key on your keyboard.
8. Choose Standard Age Group from the dropdown in the Age Group selector list and select Infant, Preschool, Child, and Adolescent.
9. Choose All Genders in the Gender selector list.
10. Choose All Provider Types from the Provider Type selector.
11. The Totaled By selector is set by default to Totaled by Home Location.
12. Choose All Races in the Race selector list
13. Choose All Ethnicities in the Ethnicity selector list.
14. Choose all Discharge Dispositions from the Discharge Disposition selector list.
15. Click the Submit button to produce the map. It will be shaded based on your specifications.
16. On the View subtab, set the Region Type dropdown to County.

17. Click and drag the map to center the desired county for viewing. Zoom in on it using the map controls.



**Figure 56: County-level view of diarrhea (both types), fever, and vomiting for patients under age 18, with Poisson Visit Frequency analysis applied and matching data represented as a percentage of all records**

## Example 2: Zip Code-Level View of All Acute Care Interactions with Exponential Moving Average Probability

For a zip code within your county, view mapped data showing all acute care interactions for the date August 15, 2018. Display data for all age groups and all genders, from all provider types, totaled by the patients' home location, all races, all ethnicities, and all discharge dispositions. Use the Exponential Moving Average Probability analysis method with default parameters. Do not apply data conditioning. Represent data as number of records. (For result, see Figure 56.)

1. Using the popup calendar tool on the End Date selector, display August 2018 and select the date (MONTH 15). Alternatively, type in the date, using the format MM-DD-YYYY.
2. From the Options dropdown menu, select Exponential Moving Average Probability. A bullet will appear next to Exponential Moving Average Probability to indicate the selection.
3. On the Options dropdown menu, highlight Data Conditioning; from the submenu, choose No Data Conditioning. A bullet will appear next to No Data Conditioning to indicate that it has been selected.
4. On the Options dropdown menu, highlight Data Representation; from the submenu, choose Number of Records. A bullet appearing next to Number of Records will indicate that it has been selected.
5. Ensure that Acute Care Interactions selectors are visible in the Data Type selector.
6. From the Classifier selector, choose Total Counts. Note: The Classification selector is not applicable to Total Counts.
7. Choose All Age Groups from the Age Group selector list.
8. Choose All Genders from the Gender selector list.

9.  Make sure that the Provider Type selector indicates data will come from All Provider Types.
10. The Totaled By selector is set by default to Totaled by Home Location.
11. Choose All Races from the Race selector list.
12. Choose All Ethnicities from the Ethnicity selector list.
13. Choose All Discharge Dispositions from the Discharge Disposition selector list.
14. Click the Submit button to produce the map. It will be shaded based on your specifications.
15. On the View subtab, set the Region Type dropdown to Zipcode.
16. Click and drag the map to center the desired zip code for viewing. Zoom in on it using the map controls.
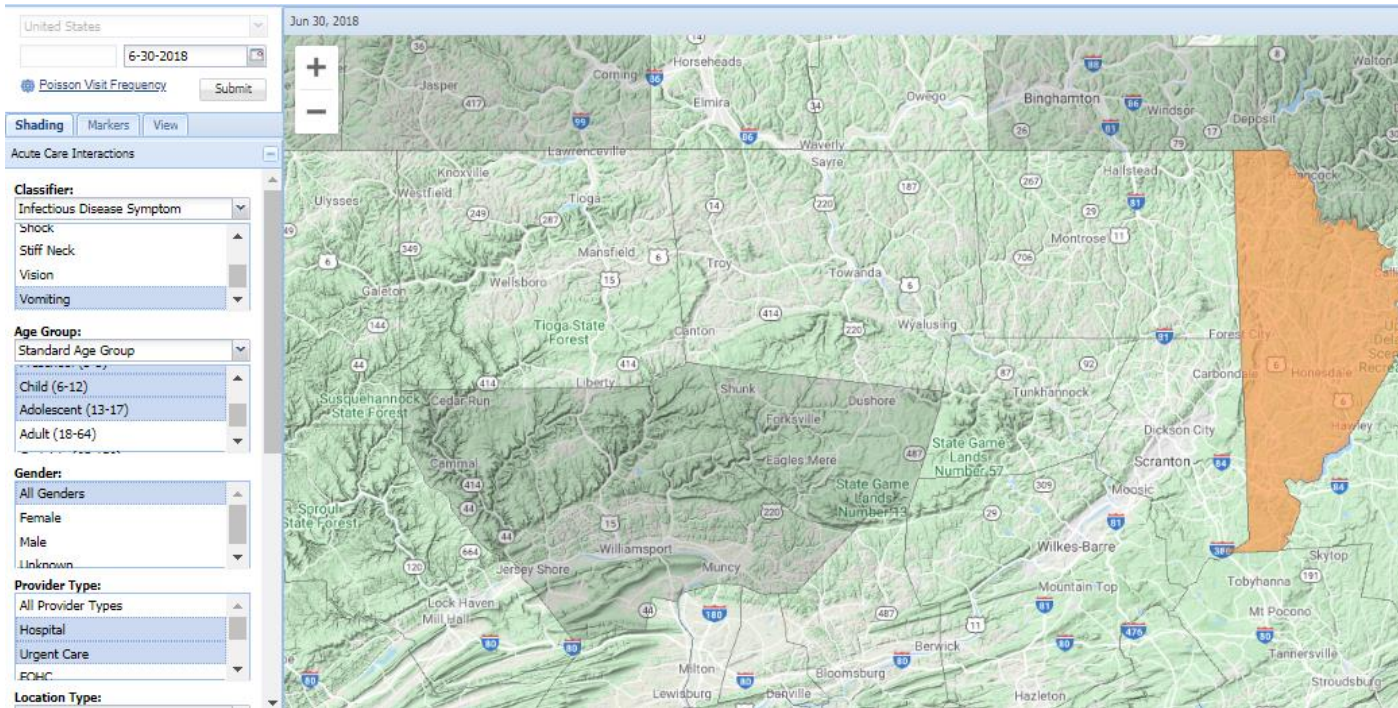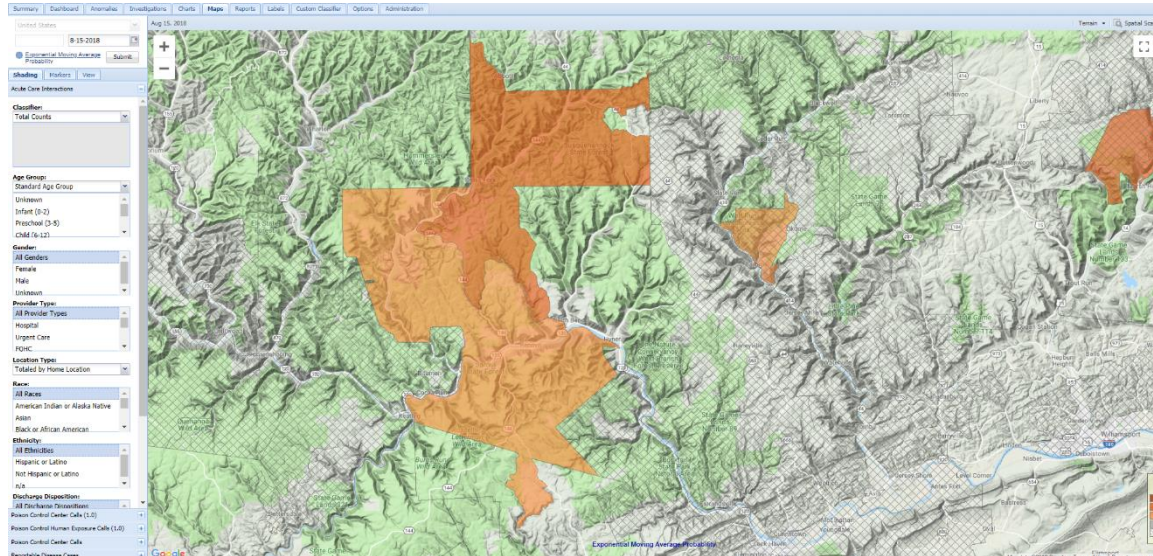


**Figure 57: Zip code-level view of all acute care interactions with Exponential Moving Average Probability analysis applied**

## 10.3 Interpreting the Map

The data analysis for maps comprises two steps. First, the system generates a predicted count of occurrences for the current day. The prediction is based on actual counts from some number of days in the past. The exact number of days used for the prediction is unique to each algorithm; it can be specified by the user or calculated from other user-specified parameters, depending on the algorithm.

The second step involves calculating the likelihood of the current actual count, based on past counts. The system calculates this figure as a percentile; the more typical (i.e., less extraordinary) the current value is, the lower the percentile. On the map, the shading represents the percentile, with darker shades indicating higher-percentile (that is, more extraordinary) values. The shading levels' cutoff values are expressed as two, three, or four standard deviations from the mean in a normal distribution. (Two standard deviations from the mean roughly equates to the 95th percentile.) These values are indicated on the map legend.

With the exception of the Poisson Visit Frequency method, all of the map analysis methods make the assumption that prediction errors are distributed normally. As the system calculates the percentile, the selected analysis method checks to see if the assumption of normality actually holds. When there is evidence that the assumption does not hold for a particular region, the map indicates this by adding cross-hatching to that region's shading. The cross-hatching therefore indicates that the calculated percentile for that region may be skewed. In many cases, the percentile may be slightly underestimated, though circumstances do exist in which it is overestimated.

A skew in prediction errors generally indicates that there is some structure in the data (e.g., seasonality) that is not fully captured by the predictive model. Choosing an alternative analysis method (for example, changing from moving average to recursive least squares) may improve the model fit.

The map legend is located in the map's lower right corner. Unless the legend is selected, only a small portion of it will appear. Select the legend by hovering your cursor over it; this will cause it to expand (see Figure 58.

## 10.4 Additional Map Features

Clicking once on a map location will produce a small popup menu. The top portion of the menu identifies the location and reports its population.

Selecting Quick Chart on the popup menu will generate a large popup chart for the target area. The chart displays 30-day counts for the specified parameters and chosen area, as well as an anomaly threshold line based on the analysis method shown on the Control Panel. This popup chart functions just like the one on the Charts page (see Chart Details Popup Window, page 70).

Selecting Charts or Local Anomalies on the popup menu will navigate you to that page. All settings from the Control Panel as well as the selected map location will be carried over during navigation.
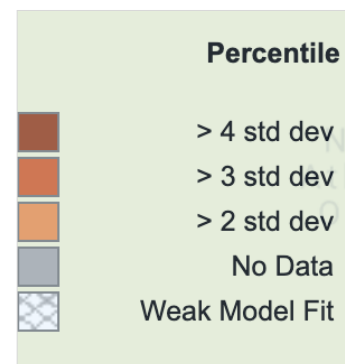


**Figure 58: Map legend**

## 10.5 Spatial Scan
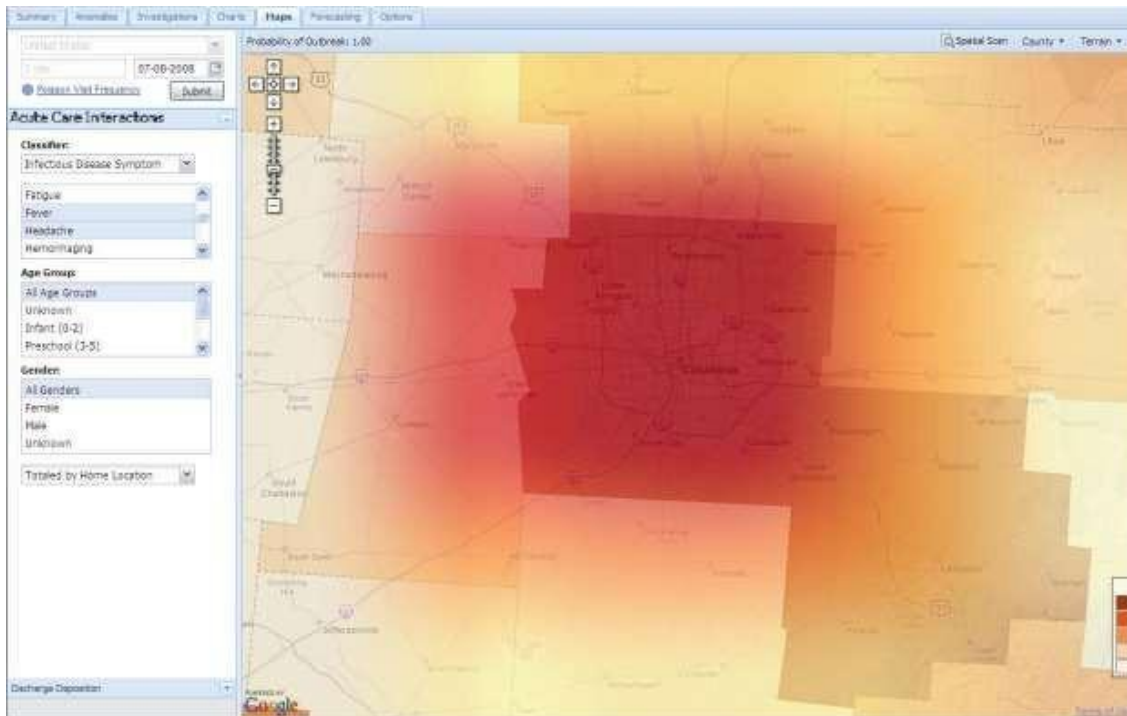


**Figure 59: Spatial Scan, Maps page**

Users can apply spatial scan to the geographic area shown in the map window by clicking the Spatial Scan button in the map's upper right corner. Map shading will appear, indicating the probability of an outbreak within the displayed area. The probability of an outbreak will also display in the map's upper left corner (see Figure 59).

Spatial scan, by its nature, is scale-dependent; its results will differ according to the regions that have been selected. In particular, the results may appear misleading when a zoomed-in map contains only a few regions. When the map view contains only a few regions with similar occurrences, the scan may report that none of the regions are especially different from the others. In such cases, better results can be achieved by zooming out on the map to include more regions in the spatial scan.

The Spatial Scan feature is based on research conducted at Carnegie Mellon University and the University of Pittsburgh. Please see http://www.cs.cmu.edu/~neill/papers/sss-nips05.pdf for more information.

## 10.6 Air Quality Data

AIRNow air quality data is available as an add-on to the Maps page in EpiCenter. If available for the user's area, this data can be accessed on the Control Panel's Markers subtab by ticking the checkbox next to Air Quality (see Figure 60).

Air quality data is displayed on the map in the form of cloud icons. A small cloud indicates a specific sampling site where measurements are taken. A larger cloud represents a reporting area, which corresponds to a broader metropolitan area and includes all applicable sampling sites for that area. Zooming in on a reporting area cloud will cause the map to display the individual sampling sites. Clicking directly on a cloud icon will produce a popup window (see Figure 60).



**Figure 60: Air Quality checkbox, Maps page**

Values for several data types are available on the popup window, including carbon monoxide (CO), sulfur dioxide (SO2), ozone, particulate matter 2.5 (PM2.5), particulate matter 10 (PM10), wind speed (measured in m/s), and wind direction (measured in degrees). Available data types will vary per sampling location. The peak air quality index (AQI) includes ozone levels (calculated using an 8-hour moving average) and PM2.5 (24 hour moving average). To view wind direction and wind speed data, click on the down arrow next to Peak AQI to display the dropdown menu, then select Wind. To download AQI and wind data, click the Download Data link to the right of the dropdown menu.

For sampling sites, ozone and PM2.5 AQIs are plotted on a chart for one week, ending on the date selected. The colored horizontal lines on the chart serve as reference guides to indicate significant changes in AQI.

A legend that explains the shading of the cloud icon can be found in the lower right corner of the map, above the standard map legend. Unless the legend is selected, only a small portion of its left side appears in the window. To expand the legend, position your cursor over it (see Figure 61). The color of each cloud icon on the map will reflect the highest pollutant level associated with that location.
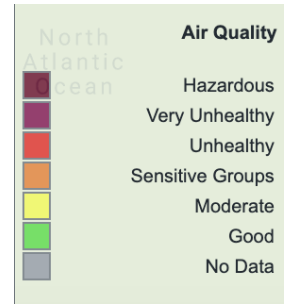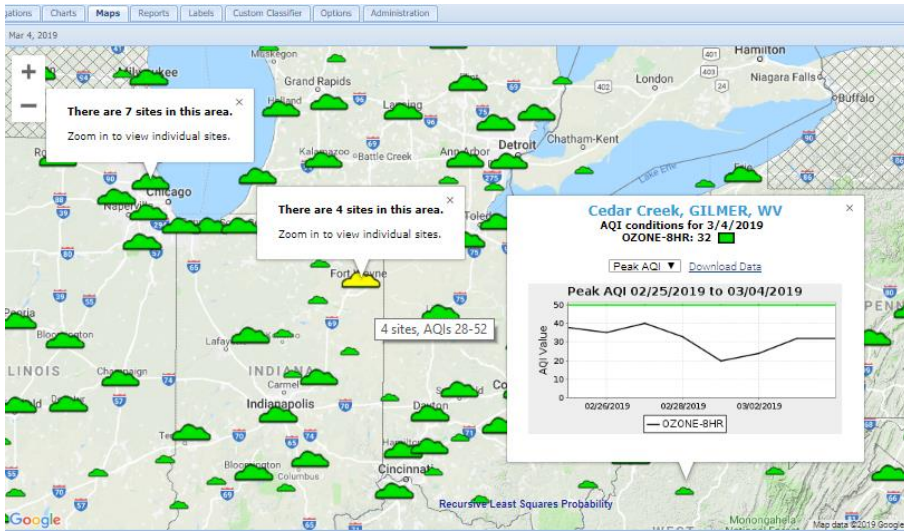
**Figure 61: Air Quality Index data, Maps page**



**Figure 62: Air Quality**

**data legend, Maps page**

## 10.7 Reportable Disease Cases Data

Data on reportable disease cases is available as an add-on to the Maps page in EpiCenter. Where available, data for reportable disease cases can be displayed as map shading as specified in the Control Panel's Shading subtab. To provide a basis for the map shading, the user must select an analysis method. Note: If the data is totaled by week, only Poisson Visit Frequency analysis can be used. If the data is totaled by day, all methods are available.

To view actual counts of reportable disease cases, select the Control Panel's Markers subtab and tick the checkbox for Reportable Disease Cases. Select the down arrow next to the Options label to expand options for defining and mapping reportable disease markers. Next, select parameters for counts, as on the Shading subtab. The Days Before and After selector box at the top of the Options section is used to indicate the period of time covered by the count. Specify the desired number of days surrounding the date in the End Date Selector. The maximum allowed value is 14 days before and after, for a total of 28 days (see Figure 63).

Markers indicating case counts appear on the map as triangles. To see counts for an area, hover the cursor over its marker. Triangles can be viewed on state-, county-, and zip code-level maps as selected on the View subtab. Clicking directly on the triangle will produce a popup chart showing past counts (see Figure 63).

To show the values that correspond to the triangles' shading, there is a legend in the lower right corner of the map. It is partially hidden, but users can reveal it by hovering the cursor over the legend's left



**Figure 63: Parameters for reportable disease case markers, Maps page**
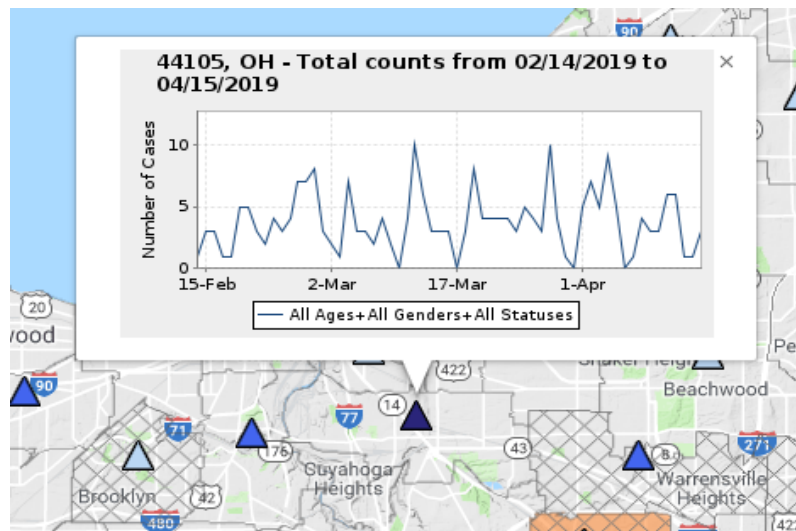
edge.

**Figure 64: Reportable disease case markers and popup chart**

# 11 Reports

The Reports page contains a collection of data reports that pertain to a user's region. Many of these were previously accessible through the Pulse monitoring system.

## 11.1 Accessing and Working with Reports

To view a report, select its title from the Report dropdown on the Control Panel. Some reports may require additional input before they can be generated. When all necessary details have been specified, click the Submit button on the Control Panel to run the report.

Results for each report appear in a tab in the page's main window. To open additional reports, click on the rightmost tab, which is smaller than the others and has a plus-sign icon. A new tab will be opened with an empty Report dropdown menu. To navigate from one report to another, click on the destination report's tab. To close a report, click on the X in the upper right corner of its tab.

A report can be sorted by column in either ascending or descending order. To do so, choose the column you wish to sort by, then click the down arrow just to the right of that column's heading. In the dropdown menu that appears, choose the preferred sorting order. The dropdown menu also includes a Columns option, which when selected opens a submenu for customizing the report display. Check or uncheck items in the Columns submenu to indicate which report columns are to be shown on screen. (Downloaded reports contain all available columns.) Multipage reports are paginated and can be navigated using the arrow keys near the window's lower left corner.

To view the expanded record for any line listing, double-click that row. A popup box will provide the expanded view; text in any field may be copied by highlighting it, then right-clicking the mouse or typing CTRL+C.

Some reports are linked via the Pivots functionality. To determine if your open report has this supplemental information, click on the gear icon in the Actions column at the far right of the report grid. If the word "Pivots" appears in the popup menu, hover your cursor over that word to see a list of the available pivot reports. Selecting one of those will open the pivot report in a new tab. It is sometimes possible to select multiple line listings within a report for pivoting; in such cases all the pivot results will be combined for display.

## 11.2 Report Charts

For some reports, users can display results in the form of an interactive chart. A report that can be charted is marked as such by a chart icon ( ) next to its title in the Control Panel dropdown menu. When the report is run, the main panel will automatically display the chart view instead of the regular grid view. Users can toggle between chart and grid views by clicking the down arrow next to View, at the lower left of the main panel, and making a selection from the popup menu. The chart's default cursor is a pointer; to choose one of the alternative indicators (a vertical line or crosshairs), click the down arrow next to Chart Cursor at the main panel's lower left corner and select the preferred option. Hovering the cursor (in any form) over one of the chart's data points will display a popup caption indicating that point's x and y values.

Charts can be downloaded in several file formats: PNG image, JPEG image, PDF document, or SVG vector image. To do so, click the Download button located at the lower left corner of the chart panel.

## 11.3 Types of Reports

The table below (Figure 64) provides information about the standard reports contained on the Reports page. The availability of reports may vary by user and/or region. Users should contact Health Monitoring Systems directly to request custom reports. Additional reports may be available depending on user access and jurisdiction.

**Figure 65: Standard reports on the Reports page**

| Report Name | Description | Input | Output |
|---|---|---|---|
| ILI Admissions Report | List of facilities, number of ED registrations, number of admissions from ED registrations, applicable ILI statistics | State, End Date, Number of Days Back | Facility Name<br>Registration Date<br>Total Registrations<br>Total Admissions<br>Admissions with Registration<br>Admission Percent<br>Fever + ILI Registrations<br>Fever + ILI Admissions<br>Fever + ILI Admissions Percent<br>ILI Specified Registrations<br>ILI Specified Admissions<br>ILI Specified Admissions Percent |
| In-Process Facilities | A list of facilities that are changing/ have changed an aspect of their EpiCenter connection; includes notes on current status | N/A | Facility [Name]<br>[Facility] Identifier<br>City<br>State<br>Latest Note<br>Entry Time [and Date of Note] |
| Late Reporting | Number of facilities sending latent data (i.e., sent more than 24 hours after the patient's admit date and time), listed by date | Date Range<br>End Date | Date<br>Late Facilities<br>[Number of Facilities] Reporting<br>Percent [Reporting] Late<br><br>Note: Each date's line listing pivots to a Late Reporting on Date report. |
| Late Reporting on Date | A list of facilities that sent latent data pertaining to a specific date | Date | [Facility] Identifier<br>Facility Name<br>Total [Number Sent]<br>[Number Sent] Late<br>Late Percent |
| Less Than 50% Daily | A list of facilities that, for the 24-hour period prior to the specified date/time, sent a number of records totaling less than 50% of their 20-day average | Date<br>Time | Facility Name<br>20-Day Average<br>Count on Date<br>Percentage |

| Live by State | A list of all facilities currently submitting data to the EpiCenter system | State<br><br>Note: Available only for the user's accessible region | Facility Identifier<br>Facility Name<br>State<br>Live Date<br>Facility Type |
|---|---|---|---|
| Not Reporting | A list of facilities that have not sent data within the previous period, as defined (i.e., the number of hours specified by the user) | [Number of] Hours Back | Facility Name<br>City<br>State<br>[Facility] Identifier<br>Last Reported<br>Last Note<br>Entered By<br>Last Note Time |
| Over 80% Not Classified | A list of facilities for which more than 80% of records did not receive a classification for the 24-hour period prior to the date specified | Date<br>Time | Facility Name<br>Total Received<br>Total Others<br>Percent Others |
| Triage Note Search | Free-text search triage notes and observations sent by facilities within the user's region | Search Key<br>Date Range<br>End Date | OBX ID<br>OBX Date<br>Triage Note<br>Context<br>Facility Name<br>Facility City<br>Facility State<br>Surveilled?<br>Facility Identifier<br>Facility County<br>Interaction Date<br>Zip Code<br>Age Group<br>Gender<br>Patient Class<br>Visit Number<br>Chief Complaint<br>Discharge Disposition<br>Interaction Type<br>Excerpt |

# 12 Labels

The Labels page is used by organizations that wish to distribute charts and descriptions to external systems via RSS feed. This functionality is available only in areas that subscribe to this service. Health Monitoring Systems must work directly with an organization to enable communication between EpiCenter and the external system.

For each new label, the user provides a free-text name and item description. The label automatically displays the sponsoring organization, the name of the label's creator, and the date and time of creation; updated labels will also have the updater's name and the date and time of the change. The RSS URL appears below the free-text Item Description box (see Figure 65).

When adding a chart generated on the Charts page to a label, use the dropdown menu in the chart's upper right corner ). Only one chart can be added per label. If a chart is added to an existing label, it will replace the chart that is already there.

All current labels are listed in the narrow left panel. To create a label without a chart, click on the plus-sign icon in the lower right corner of that panel.

To save edits to a label, click the Save button in the lower right corner of the Edit Label popup box. To delete the label, click the Delete button.
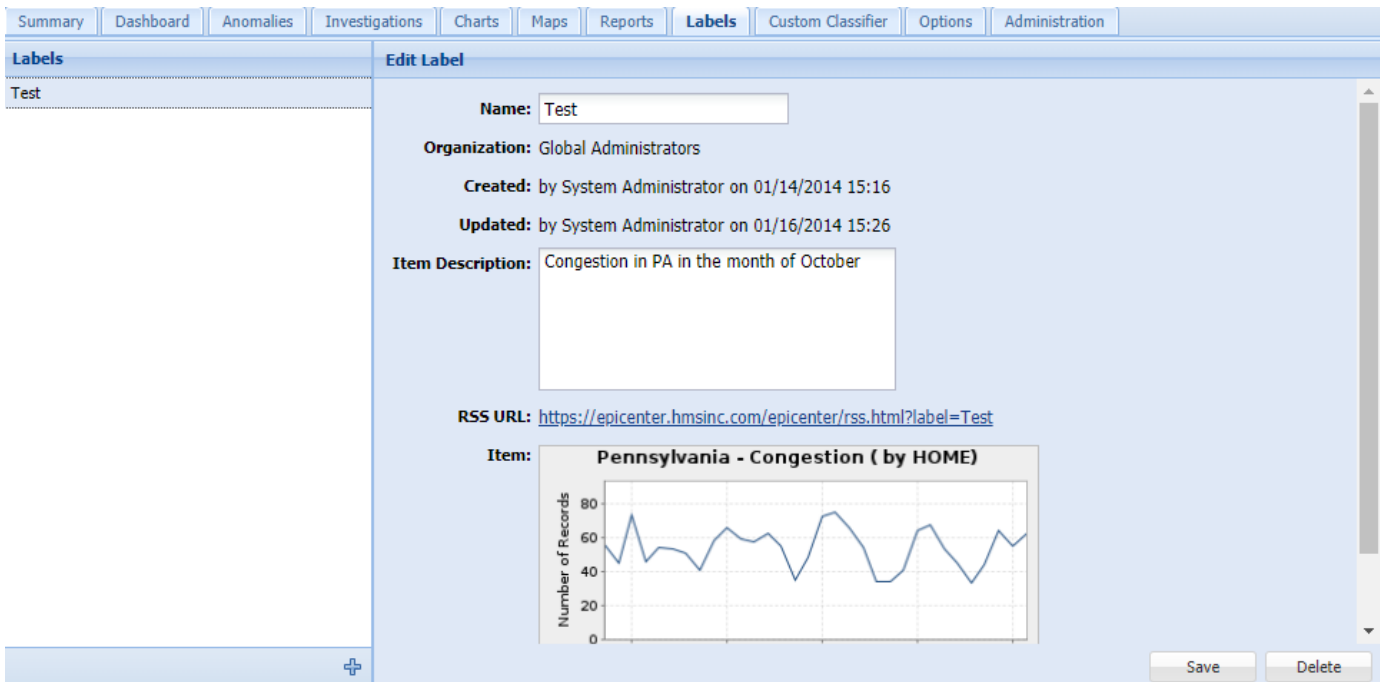


**Figure 66: Edit Label popup box, Labels page**

# 13. Custom Classifier

Subscribing organizations have access to custom classifiers in the EpiCenter system. These are created and updated on the Custom Classifier page. Each organization is automatically provided with one custom classifier that supports up to 10 classifications; to discuss options for additional custom classifications, organizations should contact Health Monitoring Systems for assistance. Access to the classifier editing tab is restricted to designated users within an organization (i.e., not every user in that organization), per Health Monitoring Systems policy.

Creating a custom classification on the Custom Classifier page involves naming the classification and then developing its keyword list. Begin by clicking the Create button at the bottom of the Control Panel. In the popup box that appears, name the classification with a free-text word or phrase of up to 80 characters in length. Once the classifier is named, the screen will show a blank chart at the center and a blank chief complaint list at the right edge of the browser window (see Figure 66). The classifier is now in an editing state, meaning that the classification is under construction and not yet published for use.



**Figure 66: Custom classification screen, Custom Classifier page**

To develop the keyword list associated with a custom classifier, click directly on the link that reads "Click to add keywords, negative indicators, and conditions." Doing so will produce the Edit Classification popup window, where keywords, negative indicators, and conditions are defined (see Figure 67).

The keyword list is the primary means of constructing a classification. As free-text chief complaints are received by the system, any complaint containing an expression on the keyword list will be classified accordingly. Complaints containing negative indicators will be excluded. Users can further refine the classification with the Add Condition option, in which they specify desired field, symbol, and value parameters. Regular expression is used to identify both keywords and negative indicators. (Additional information about regular expression is available here: \ https://en.wikipedia.org/wiki/Regular_expression

Also, sending the reader to Java documentation may tell the reader that our system is written in Java. This could present a minor security risk.

To add keywords, negative indicators, and/or conditions, click the appropriate buttons at the top of the Edit Classification window. To remove a keyword, negative indicator, or condition, find the unwanted entry and click the green wastebasket icon next to it in the Delete column.
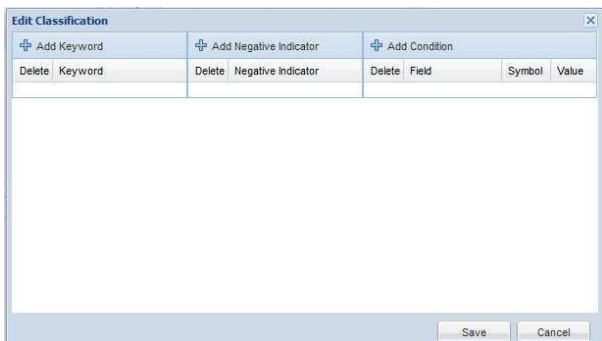


Figure 68: Edit Classification popup window

Once all keywords, negative indicators, and conditions are defined, save them by clicking the Save button near the lower right corner of the Edit Classification window. At that point, the previously blank chart will update with a time series based on the results of the custom classification. The text above the chart will indicate the expressions that have been specified in the classification. The right edge of the screen will show a chief complaint list populated by all the matching complaints and corresponding counts..

The data referenced in the time series chart and complaint list reflect only the past week's records from the user's visible region. (Data availability may be further restricted but not expanded.)

A user can continue to edit the classification by repeating the steps for defining the keywords/negative indicators/ conditions and reviewing each new version of the time series chart and complaints list.

Once the user is satisfied that the keyword list is ready for use -- based on satisfactory output from the custom classification – the classification can be published. This is done by clicking the Publish button near the Control Panel's lower left corner. Publishing the classification will cause the data in the system to be classified, after which the classification will be available to users throughout EpiCenter just like any other classification. After publishing, the classification can no longer be edited, as doing so would introduce inconsistency into the data over time.
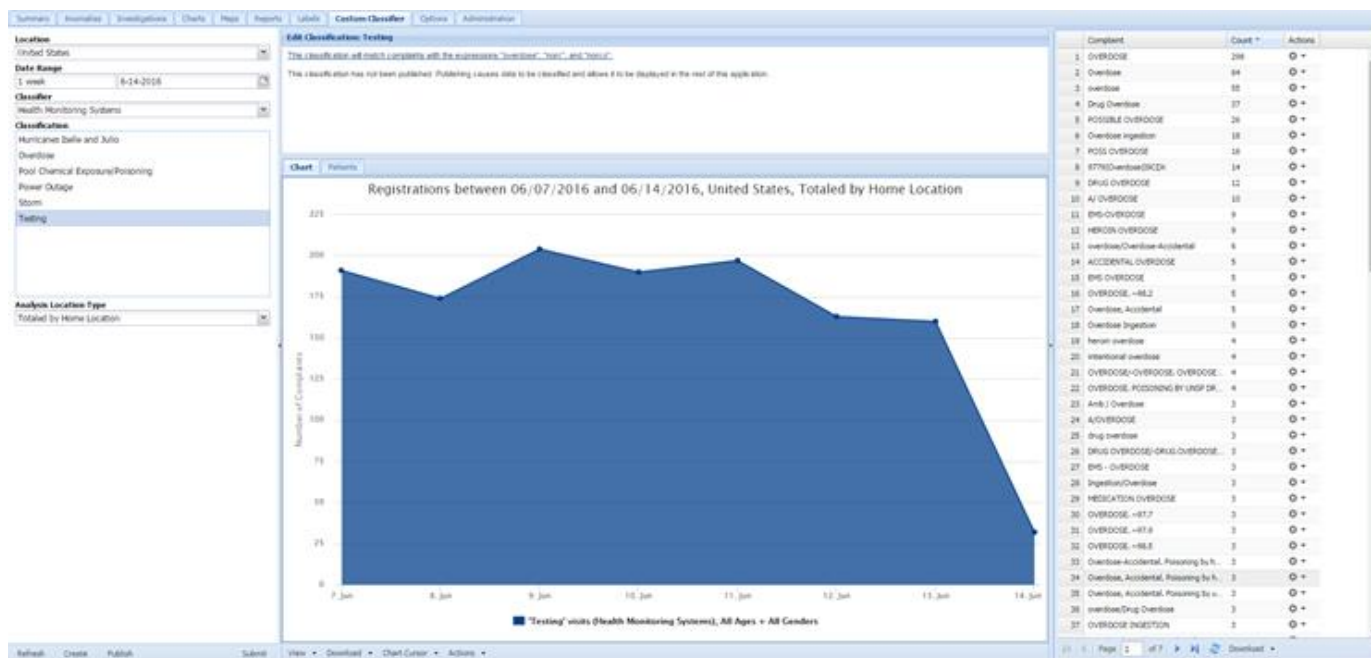


Figure 69: Custom classification chart and chief complaint list, in progress

Classifications are published individually, meaning that a custom classifier can contain both published and unpublished classifications. Note also that classifications within a classifier may or may not be logically connected.

To prevent multiple users from making simultaneous changes to the same classification, that classification will enter a locked state as soon as someone begins working on it. If another user attempts to gain access during this time, the system will refuse and indicate that the classification is locked. Unlocking occurs automatically when the user saves changes or leaves the classification interface idle for over ten minutes. If necessary, a custom classification in an edit state can be manually unlocked by clicking the Unlock button located at the bottom of the Control Panel.

# 14 Options

The Options page allows users to update their user information, change their passwords, set preferences for views and notifications, manage subscriptions, and download report files.



**Figure 70: User Options screen, Options tab**

## *14.1 User Information*

To update user information, enter the information directly into the appropriate fields' free-text boxes. Click the Update button to save the updates. Clicking the Reset button will cause each field to revert to its original value.

## *14.2 Changing a Password*

The first step in changing a password is to type the existing password into the first field in the Change Password box. Next, enter the new password in the middle field and retype it in the bottom field to confirm it. The new password's security assessment is indicated by a colored bar under the New Password field; red represents passwords likely to be least secure and green represents those expected to be most secure. To submit the change, click the Change button. The system will then confirm the acceptance of the new password.

A password change will be disallowed if an incorrect password is entered in the Old Password field or if the text entered in the New Password field does not match the text in the confirmation field. If the password change is denied, the problem field will be highlighted in red. Clicking the Clear button will remove all text from all fields in the Change Password box.

## 14.3 Setting Preferences

In the Preferences box, the Default Region field indicates the geographical region that will appear in the Location selector upon login. This field can be set to specify the user's entire accessible region or a subregion.

The Default View field states the surveillance view that will appear on the Summary page upon login. To view all available surveillance views, click the down arrow next to the Default View field; this will display a dropdown list.

The Assignment Emails field is used to adjust settings for investigator notification emails. Three assignment email options are available:

- ●Never notify me of investigation assignments
- ●Notify when others assign investigations to me
- ●Notify when anyone assigns investigations to me

Click the Update button to save the updated default region and/or default view. Clicking the Reset button will cause each field to revert to its previous value.

## 14.4 Subscription Management

Some users will see the Subscriptions box at the bottom of the Options page. Clicking the plus-sign icon labeled Add Subscription (in the upper left corner of this box) will produce the Edit Subscription popup window. Enter a meaningful name in the Subscription Name free-text field; in the field labeled "Destination (email)," enter the email address to which notification information should be sent. The Surveillance Task dropdown menu lists all available surveillance tasks. Click directly on the task for which you want to receive notifications.
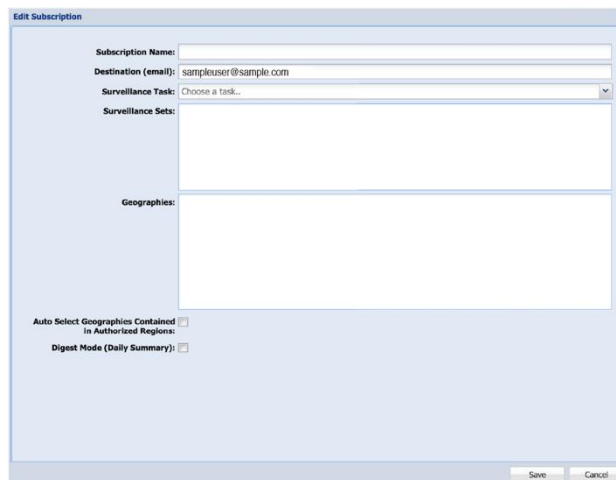


**Figure 71: Edit Subscriptions box, Options page**

To select more than one surveillance set, press and hold the CTRL key on your keyboard while clicking on the desired sets. To choose surveillance sets that are listed consecutively, click on the first and last desired surveillance sets while holding down the SHIFT key. This will select the first and last sets as well as those listed between them.

The Geographies text box contains all available geographies, based on the selections made when the surveillance task was created. Press and hold the CTRL key on the keyboard to select more than one geography. To select multiple geographies listed consecutively, click on the first and last desired list items while holding down the SHIFT key. This highlights those two geographies plus each one listed between them.

Tick the checkbox labeled Auto Select Geographies Contained in Authorized Regions to set the subscription to run on specific geographies. Check the Digest Mode (Daily Summary) box to receive only one email, sent at 8:00 am ET, that contains all anomaly notifications generated during the prior 24 hours.

All subscriptions are listed in the Subscriptions portion of the Options page. An existing subscription can be edited by clicking on the left icon in the Actions column. Click on the right icon to delete a subscription ( )

Users without access to subscription management should contact their project sponsor or Health Monitoring Systems for more guidance in creating or editing notification subscriptions.

## *14.5 Downloading Report Job Files*

Specific reports may be compiled to run on a regular basis. Users should work directly with HMS to set up and schedule these reports. Once the report parameters have been established, the report file is listed in the Files Available for Download section, and can be downloaded by authorized users (see Figure 69). The report list can be filtered by date of creation, file ID number, file name, and job name.

# Appendix 1: Analysis Method Parameters

## *Constant Threshold (Charts)*

|  | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Constant Threshold** | The constant threshold to use | 0 | 0 to ∞ | This indicates the value that must be exceeded to generate an anomaly notification. |

## *Cumulative Sum Exponential Moving Average (CuSum EMA) (Charts)*

|  | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Predicted Value (Exponential Moving Average)** | The weighting exponential, or smoothing factor, alpha | 0.2 | 0 to 1, exclusive | Smaller values decrease the weight placed on the current count when calculating the predicted count, and thus increase the weight of past counts; larger values have the opposite effect. Smaller values also increase the length of the weighting window, while larger values decrease it. |
|  | Desired statistical significance | 0.9 | 0 to 1, exclusive | Smaller values decrease the desired statistical significance and thus the length of the weighting window; larger values increase the length of the weighting window. |
| **CuSum Normalized Residual Threshold** | The training window | 14 days | 1 day to # days for which data is available | Smaller values will decrease the training window and thus will decrease the smoothness of the threshold calculations, while larger values will increase the window and the threshold smoothness. |
|  | Threshold multiplier | 4 standard deviations | 0 to ∞ | Smaller values will reduce the number of standard deviations from the predicted count used to define the threshold, leading to lower thresholds and more alerts. Larger values will lead to higher thresholds and fewer alerts. |
|  | The allowed deviation from the reference value before impacting the cumulative sum | 0.5 standard deviations | 0 to ∞ | Smaller values generally decrease the tolerance of the method for deviations between observed and predicted counts, leading to lower thresholds and a greater number of alerts. Larger values generally increase this tolerance, leading to higher thresholds and fewer alerts. |

## Exponential Moving Average (Charts)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Predicted Value (Exponential Moving Average)** | The weighting exponential, or smoothing factor, alpha | 0.2 | 0 to 1, exclusive | Smaller values decrease the weight placed on the current count when calculating the predicted count, and thus increase the weight of past counts; larger values have the opposite effect. Smaller values also lengthen the weighting window; larger values shorten it. |
| | Desired statistical significance | 0.9 | 0 to 1, exclusive | This parameter is used to calculate the weighting window. Smaller values decrease the desired statistical significance and thus shorten the weighting window; larger values lengthen the weighting window. |
| **EMA Residual Threshold** | The weighting exponential, or smoothing factor, alpha | 0.2 | 0 to 1, exclusive | Smaller values decrease the weight placed on the current error when calculating the standard deviation of the errors. They also increase the weight of past errors; larger values have the opposite effect. Smaller values also lengthen the weighting window, while larger values shorten it. |
| | Desired statistical significance | 0.9 | 0 to 1, exclusive | Smaller values decrease the desired statistical significance and thus the length of the weighting window; larger values increase the length of the weighting window. |
| | Threshold multiplier | 4 standard deviations | 0 to ∞ | Smaller values will reduce the number of standard deviations from the predicted count used to define the threshold, leading to lower thresholds and more alerts. Larger values will lead to higher thresholds and fewer alerts. |

## Moving Average (Charts)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Simple Moving Average (Predicted Value)** | Window to use for averaging results | 14 days | 1 day to # days for which data is available | Smaller numbers will decrease the amount of smoothing in the predicted counts and also decrease the lag between changes in the actual values and changes in the predicted values. Larger values will increase smoothing and increase this lag. |
| **EMA Residual Threshold** | The weighting exponential, or smoothing factor, alpha | 0.2 | 0 to 1, exclusive | Smaller values decrease the weight placed on the current error when calculating the standard deviation of the errors. They increase the weight of past errors; larger values have the opposite effect. Smaller values also lengthen the weighting window, while larger values shorten it. |
| | Desired statistical significance | 0.9 | 0 to 1, exclusive | Smaller values decrease the desired statistical significance and thus the length of the weighting window; larger values increase the length of the weighting window. |
| | Threshold multiplier | 4 standard deviations | 0 to ∞ | Smaller values will reduce the number of standard deviations from the predicted count used to define the threshold, leading to lower thresholds and more alerts. Larger values will lead to higher thresholds and fewer alerts. |

## Poisson Threshold (Charts)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Poisson** | Window to use for averaging results | 14 days | 1 day to # days for which data is available | Smaller numbers will decrease the amount of smoothing in the predicted counts and decrease the lag between changes in the actual values and changes in the predicted values. Larger values will increase smoothing and increase this lag. |

## Recursive Least Squares (Charts)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Recursive Least Squares** | Training period | 60 days | 1 day to # days for which data is available | Smaller values will decrease the training window and thus decrease the smoothing of the threshold calculations, while larger values will increase the window and the threshold smoothing. |
| | Average period | 7 days | 1 day to the length of the training period | Smaller values will tend to decrease the amount of smoothing in the predicted counts, while larger values will tend to increase the amount of smoothing. |
| | Threshold multiplier | 4 standard deviations | 0 to ∞ | Smaller values reduce the number of standard deviations from the predicted count used to define the threshold, leading to lower thresholds and more alerts. Larger values will increase the number of standard deviations, leading to higher thresholds and fewer alerts. |
| | The "forgetting factor," lambda | 0.99 | 0 (exclusive) to 1 (inclusive) | Smaller values decrease the influence of past counts on predicting the current count, while larger values increase it. A value of 1 means that all counts within the average period are treated equally. |

# Exponential Moving Average Probability (Maps)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Exponential Moving Average** | The weighting exponential, or smoothing factor, alpha | 0.2 | 0 to 1, exclusive | Smaller values decrease the weight placed on the current count when calculating the predicted count, and increase that of past counts; larger values do the opposite. Smaller values also lengthen the weighting window; larger values shorten it. |
| | Desired statistical significance | 0.9 | 0 to 1, exclusive | This parameter is used to calculate the weighting window. Smaller values decrease the desired statistical significance and thus the length of the weighting window; larger values lengthen the weighting window. |
| **Probability Analyzer** | Training window to use | 60 days | 1 day to # days for which data is available | Smaller values decrease the training window and thus tend to decrease the validity of the assumption that errors follow a normal distribution, which decreases the reliability of the probability estimate. The assumption of normality becomes invalid for values less than 5. Larger values increase the training window, which will tend to lower the probability calculated for the current count. |
| | Kurtosis of training distribution must be <= sekMultiplier * SEK | 2 standard deviations | 0 to ∞ | To confirm the assumption of normality, the algorithm checks to see if the kurtosis of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values will increase the strictness of this check, while larger values will make it less strict. |
| | Skew of training distribution must be <= sesMultiplier * SES | 2 standard deviations | 0 to ∞ | To confirm the assumption of normality, the algorithm checks to see if the skew of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values will increase the strictness of this check, while larger values will make it less strict. |

# Poisson Visit Frequency (Maps)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Poisson** | Window to use for averaging results | 14 days | 1 day to # days for which data is available | Smaller numbers will decrease the amount of smoothing in the predicted counts and also decrease the lag between changes in the actual values and changes in the predicted values. Larger values will increase smoothing and increase this lag. |

## Recursive Least Squares Probability (Maps)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Recursive Least Squares Prediction** | Training period | 60 days | 1 day to # days for which data is available | Smaller values decrease the training window and thus decrease the smoothing of the threshold calculations, while larger values increase the window and the threshold smoothing. |
| | Average period | 7 days | 1 day to the length of the training period | Smaller values will tend to decrease the amount of smoothing in the predicted counts, while larger values will tend to increase the amount of smoothing. |
| | Threshold multiplier | [not applicable] | | |
| | The "forgetting factor," lambda | 0.99 | 0 (exclusive) to 1 (inclusive) | This parameter controls the exponential decay of past value influence. Smaller values decrease the influence of past counts on predicting the current count; larger values increase it. A value of 1 means that all counts within the average period are treated equally. |
| **Probability Analyzer** | Training window to use | 60 days | 1 day to # days for which data is available | Smaller values decrease the training window and thus tend to decrease the validity of the assumption that errors follow a normal distribution, which decreases the reliability of the probability estimate. The assumption of normality becomes completely invalid for values less than 5. Larger values increase the training window, which will tend to lower the probability calculated for the current count. |
| | Kurtosis of training distribution must be <= sekMultiplier * SEK | 2 standard deviations | 0 to ∞ | In order to confirm the assumption of normality, the algorithm checks to see if the kurtosis of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values increase the strictness of this check, while larger values make it less strict. |
| | Skew of training distribution must be <= sesMultiplier * SES | 2 standard deviations | 0 to ∞ | In order to confirm the assumption of normality, the algorithm checks to see if the skew of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values increase the strictness of this check, while larger values make it less strict. |

## Simple Moving Average Probability (Maps)

| | Value | Default | Range | Implications |
|---|---|---|---|---|
| **Simple Moving Average (Predicted Value)** | Window to use for averaging results | 14 days | 1 day to the number of days for which data is available | Smaller numbers decrease the amount of smoothing in the predicted counts and decrease the lag between changes in the actual values and changes in the predicted values. Larger values increase smoothing and increase this lag. |
| **Probability Analyzer** | Training window to use | 60 days | 1 day to the number of days for which data is available | Smaller values decrease the training window and thus tend to decrease the validity of the assumption that errors follow a normal distribution, which decreases the reliability of the probability estimate. The assumption of normality becomes completely invalid for values less than 5. Larger values increase the training window, which will tend to lower the probability calculated for the current count. |
| | Kurtosis of training distribution must be <= sekMultiplier * SEK | 2 standard deviations | 0 to ∞ | To confirm the assumption of normality, the algorithm checks to see if the kurtosis of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values increase the strictness of this check, while larger values make it less strict |
| | Skew of training distribution must be <= sesMultiplier * SES | 2 standard deviations | 0 to ∞ | To confirm the assumption of normality, the algorithm checks to see if the skew of the observed distribution is within acceptable limits for a normal distribution. This parameter defines the width of those limits. Smaller values increase the strictness of this check, while larger values make it less strict. |

# Appendix 2: Default Notification Configuration

## *Approach to Notifications*

Syndromic surveillance is designed to monitor health-related events in populations and indicate local occurrences of epidemic clusters and/or widespread increases of endemic disease. EpiCenter permits the monitoring of symptom trends using a symptom-based analysis of emergency department patient chief complaints as a proxy for disease.

All categories of symptoms have the potential to indicate unexpected increases in health events in the population. However, Health Monitoring Systems recognizes that not all health events warrant immediate notification of public health authorities. Therefore EpiCenter uses a tiered approach to anomaly notification that is based on public health's tiered approach to notifiable/reportable diseases.

### A. Immediate Notifications

The diseases of greatest concern to public health are those that are infectious and that have the potential to result in serious illness or death in a significant portion of the population — generally those diseases that are subject to national quarantine as established by the World Health Organization. Reporting of these diseases to public health is deemed immediate. The diseases on the resulting list are commonly referred to as "immediately reportable" or "notifiable." Table 1 lists the immediately reportable diseases that are common in various states.

The default analysis and notification configuration in EpiCenter is designed to provide users more immediate awareness of health-related conditions that might be the result of such diseases. The system accomplishes this with frequent, regular, ZIP code-level analysis of (priority) symptom categories, each consisting of chief complaint keywords that are associated with the signs and symptoms of these immediately notifiable diseases. Additionally, the appearance of certain words and phrases as a chief complaint will result in an immediate notification regardless of the number of patients involved (i.e., threshold = 1 case). These keywords and key phrases are associated with diseases of generally zero prevalence that pose the risk of serious harm to people. These diseases are listed in Table 2.

When analysis reveals an anomaly in the trends of any of these priority symptoms, EpiCenter sends an immediate notification to the user(s) pre-designated by the organizational administrator. Notifications will be repeated no more than once every 12 hours (i.e., subsequent anomalies of the same category, even if generated by different algorithms, will result in another notification only if 12 hours have passed since the advisory about the initial anomaly). The subsequent anomalies will be recorded, however, and can be viewed by users within EpiCenter.

Analyses of trends in the priority symptom categories are executed hourly, using algorithms that are based on exponentially weighted moving averages (EWMA) and cumulative sums (CuSum). These methods are attractive not only because of their simplicity, but also because they are likely to outperform more complex methods in situations where counts may be routinely low. Default threshold values are four standard deviations from the mean, with averages taken over 34 days (EWMA) and 31 days (CuSum).

1. **Exponentially Weighted Moving Average (EWMA):** a simple, robust statistical process control method for surveillance of sparse data. Observed values are weighted, with increased value given to more recent counts. Where recent epidemics could seriously affect the accuracy of forecasts, it is possible to enhance the method's sensitivity by using a short guard band to avoid contamination of the baseline.

2. **Cumulative Sums (CuSum):** A CuSum chart is a type of control chart used to detect small changes. CuSum charts plot the cumulative sum of the deviations between each data point (actual count) and a reference value (expected count). Useful for monitoring high-prevalence conditions, this method detects smaller shifts in and from the mean. It is made more robust by employing a two-in-a-row rule.

**Table 1: Diseases, common among various states, which are immediately reportable to public health.**

| Disease | Primary Symptoms |
|---|---|
| Anthrax | Fever, malaise, cough |
| Botulism | Paralysis, weakness, dysphagia, dry mouth, diplopia |
| Brucellosis | Fever, headache, weakness, sweating, arthralgia |
| Cholera | Watery stools, nausea, vomiting |
| Diphtheria | Sore throat, swollen neck |
| *Escherichia coli* O157:H7 | Watery to bloody diarrhea |
| *Haemophilus influenzae* | Fever, vomiting, lethargy, stiff neck |
| Meningitis | Stiff neck, fever, intense headache |
| Measles | Fever, conjunctivitis, cough, red blotchy rash beginning on face |
| Pertussis | Cough with "whooping" inhalations |
| Plague | Eschar, fever, chills, malaise, myalgia, headache, sore throat |
| Rabies | Headache, fever, paralysis, convulsions |
| Q Fever | Fever, headache, weakness, sweats |
| Smallpox | Fever, malaise, headache, severe backache, deep-seated to maculopapular rash |
| Tularemia | Indolent ulcer at organism site, swollen regional lymph nodes, painful swollen throat, abdominal pain, diarrhea, vomiting |
| Typhoid (Salmonellosis) | Headache, diarrhea, abdominal pain |

Viral Hemorrhagic Fevers        Fever, prostration, flushed face and chest, hemorrhaging

## B. Daily Summary Notifications

Other diseases on the various reportable lists generate less urgency than the immediately reportable diseases do. Nevertheless, an epidemic of any of these diseases is of concern to public health, and earlier awareness may well be of benefit. Such diseases include mumps, cryptosporidiosis, and shigellosis.

When analyzing trends in the symptom categories associated with these diseases, EpiCenter uses the same methods discussed in section A (above). However, the geographic base is different. These symptom categories are analyzed at the county level rather than at the ZIP code level, in order to reduce the sensitivity of analysis and the risk of false positives. Anomalies in categories of non-priority symptoms are reported to designated users in a daily summary email.

Certain variations within symptom categories may be related to some diseases' seasonal variation of incidence (e.g., seasonal influenza, certain diarrheal diseases). Recognizing these seasonal trends requires the use of modeling techniques that are sometimes more advanced than the routinely used EWMA and CuSum methods. Often EWMA and CuSum analysis of such seasonal trends generates anomalies that may indicate changes in these trends, such as a more rapid onset than usual or a higher degree of severity, or may simply show the increases expected with the seasonal trend.

**Table 2: Words, roots, and phrases that will, as a chief complaint, generate an immediate**

**notification**

| Anthrax | Bioterror | Botulism | Eschar |
|---------|-----------|----------|--------|
| Plague | Ricin | Smallpox | |

# C. No Notifications

Public health users of EpiCenter also have the ability to track health-related conditions that are associated with non-notifiable diseases within populations. As important as this function is, it does not require users to be notified of trend deviations in these conditions' symptom categories. These deviations and the associated analyses remain available to EpiCenter users as an on-demand feature.

*Summary of Default Notification Configuration*

The EpiCenter default notification configuration has been developed under the premise that not everything detected by the system warrants immediate notification of public health users. Indeed, immediate notification of all anomalies in every EpiCenter category would most likely create much more email than desired by users, resulting in decreased satisfaction and less trust in the system. Therefore, only those categories associated with the most common types of serious infectious diseases will generate immediate notifications when analysis reveals counts that significantly exceed expectations. For other categories associated with less serious diseases, users are advised of above-threshold counts in a single daily summary email — or, for diseases that are not reportable, need not be advised at all. The frequency of analysis for each symptom category is derived from this same hierarchy of urgency and is shown in Table 3.

*Deviations from Default Notification Configuration*

Unique characteristics of certain areas (e.g., a chemical-manufacturing plant) or local interest in certain infectious diseases (e.g., the Sin Nombre virus in the southwestern US) may foster a desire for automated notifications of unexpected changes in other symptom trends. For example, a health department with a chemical-manufacturing facility in its jurisdiction may want EpiCenter to analyze respiratory, cough, and/or non-specific rash categories more frequently and to generate immediate notifications of anomalies in the counts of these symptom categories.

Built-in EpiCenter functionality empowers organizational administrators to deviate from the default analysis and notification configuration. This capability is intended to assist in users' preferred level of customization by enabling the system to focus on local and/or seasonal events of concern. Indeed, organizational administrators may wish to consider deviations in identifying appropriate categories due to place-related factors and the historical trends of certain threshold levels. In such cases, the staff at Health Monitoring Systems can provide assistance.

Those who decide to deviate from the default settings should also be aware that such an action may significantly increase the probability of false positive notifications (i.e., statistical anomalies that result from other than true disease events).

**Table 3. Frequency of category analysis and user notifications of significant deviations from expected values**

| Symptom Category | Analysis Frequency | Analysis Threshold | Geographic Level | Notification Frequency | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | | Immediate | Daily | None |
| Fever | Hourly | 4.0σ | ZIP code | X | | |
| Paralysis | Hourly | 4.0σ | ZIP code | X | | |
| Stiff neck | Hourly | 4.0σ | ZIP code | X | | |
| Hemorrhaging | Hourly | 4.0σ | ZIP code | X | | |
| Watery or Bloody Diarrhea | Hourly | 4.0σ | ZIP code | X | | |
| Non-specific Diarrhea | Daily | 4.0σ | County | | X | |
| Influenza-like Illness | Daily | 4.0σ | County | | X | |
| Myalgia | On demand | UD | UD* | | | X |
| Headache | On demand | UD | UD* | | | X |
| Rash | Daily | 4.0 | ZIP code | | X | |
| Malaise | On demand | UD | UD* | | | X |
| Lymphadenitis | Hourly | 4.0σ | ZIP code | X | | |
| Fatigue | On demand | UD | UD* | | | X |
| Neurologic | Hourly | 4.0σ | ZIP code | X | | X |
| Cough | Daily | 4.0σ | County | | | |
| Vomiting | Daily | 4.0σ | County | | X | |
| Vision | Hourly | 4.0σ | ZIP code | X | | |
| Miscarriage | Daily | 4.0σ | ZIP code | | X | |
| ENT | On demand | UD | UD* | | | X |
| Arthralgia | Daily | 4.0σ | County | | X | |
| Jaundice | Daily | 4.0σ | County | | X | |
| Abdominal | Daily | 4.0σ | ZIP code | | X | |

*UD = User Defined