Threat Probability Action Tool (TPAT)

Quick Reference Card

SAND2014-2593P

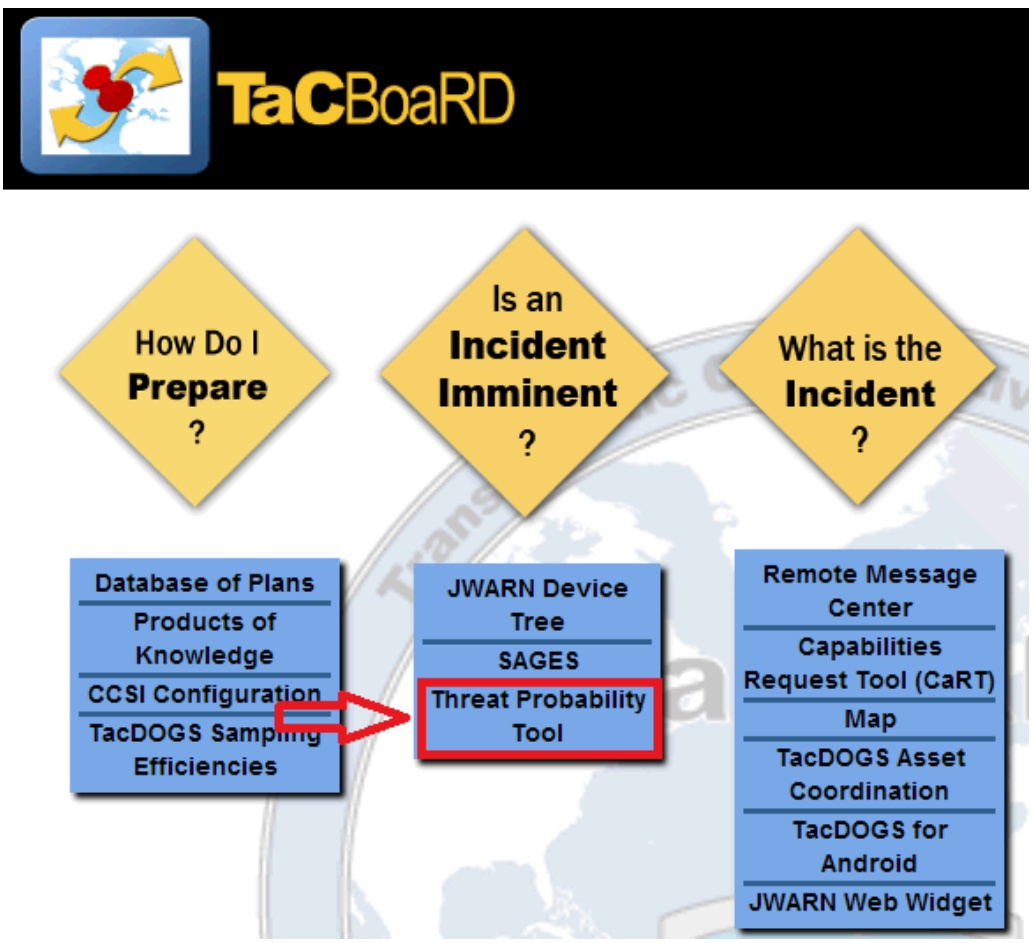
Threat Probability to Action Tool (TPAT) is a decision support tool that organizes and presents bioterrorism and public health knowledge to provide situational awareness, incident characterization, response options, and response guidance in order to help responders select the most appropriate public health and environmental response strategies for the unfolding bioterrorism incident.

TPAT consists of four tabs of information:

- **Data Streams**
- **Incident Characterization**
- **Response**
- **Analysis-Characterization**

TPAT also outputs layers on the TaCBoaRD Map

Launching TPAT

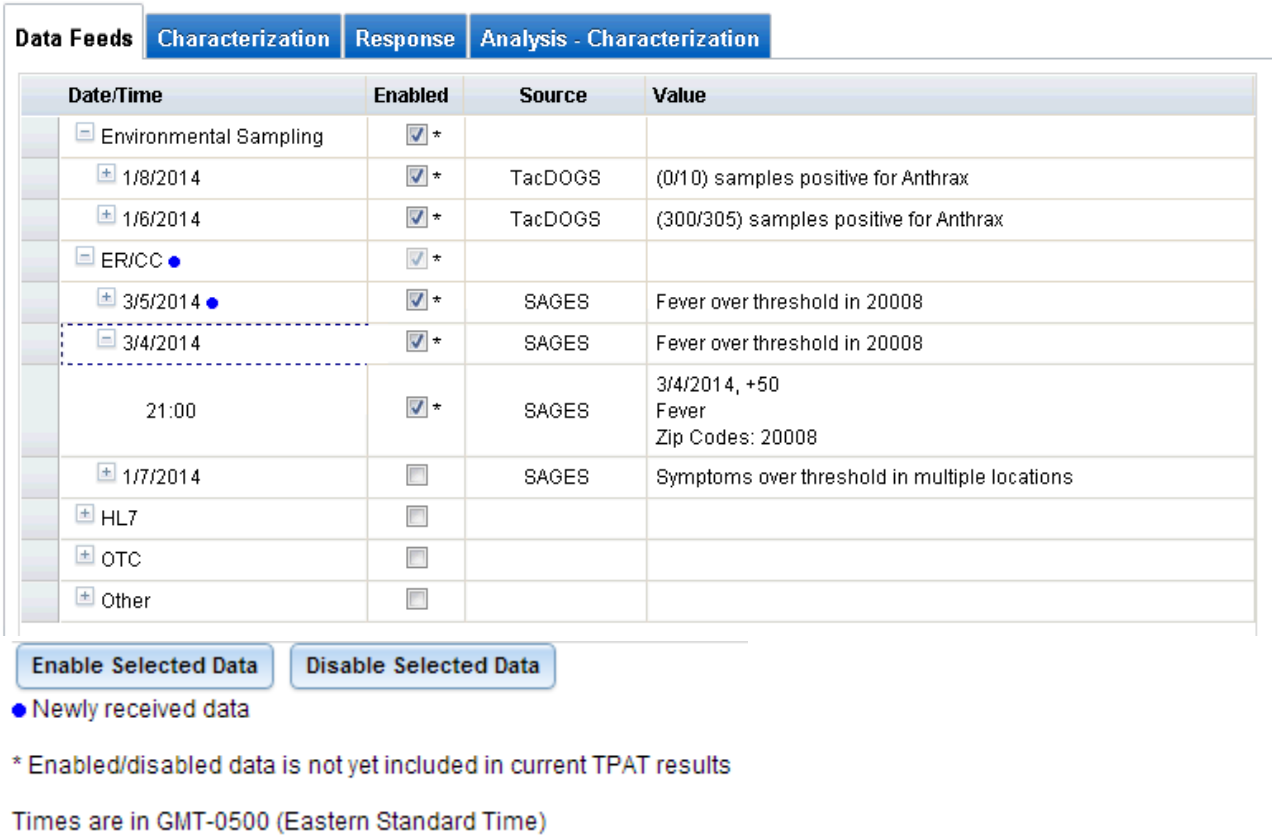


After logging into the TaCBoaRD, TPAT can be launched from the "Is an Incident Imminent?" section.

Threat Probability Action Tool (TPAT)

Quick Reference Card

Data Feeds Tab



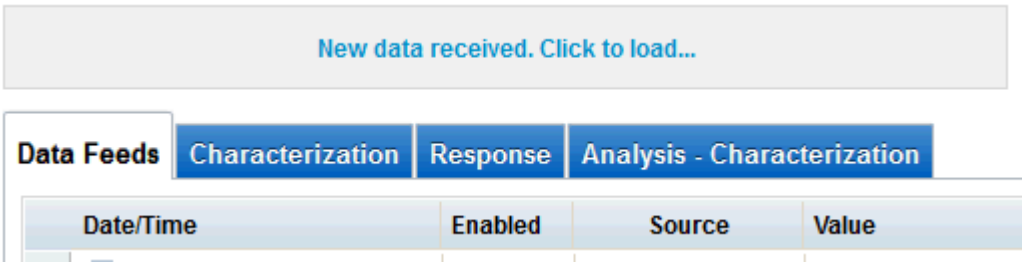
The Data Feeds tab shows every data feed that enters TPAT. The table displays the received data feeds in a tree. At the root of the tree are the data feed types:

- **Environmental Sampling**: environmental surface samples received from TacDOGS
- **ER/CC**: emergency room/chief complaint alerts received from SAGES
- **HL7**: HL7 positive diagnosed cases received from SAGES
- **OTC**: over-the-counter drug sale alerts received from SAGES
- **Twitter**: Twitter alerts received from SAGES
- **Other**: manual alerts received from SAGES

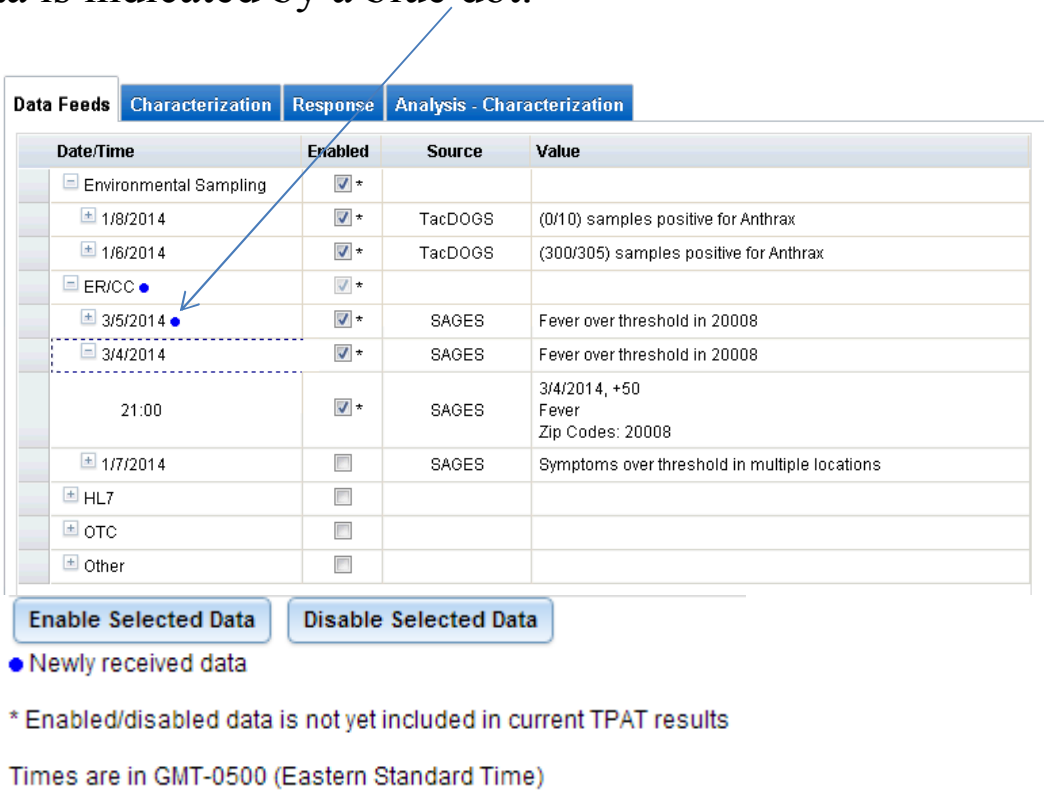
To view alerts of a certain type, expand the corresponding row by pressing the ⊞ button. Rows can be collapsed by pressing the ⊟ button. At the 2nd level, each data feed is rolled up by day. To see all data feeds from a certain day, expand the row for that day. The Value column provides a summary of the data.

Data Feeds Tab
Receiving New Data

When TPAT receives new data, the following status message will appear to the user:

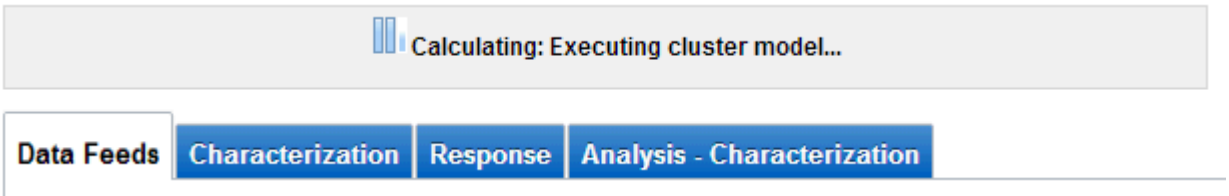


Clicking on the message will cause the Data Feeds tab to refresh, and the new latest data will appear in the table. Newly received data is indicated by a blue dot.



TPAT Calculations

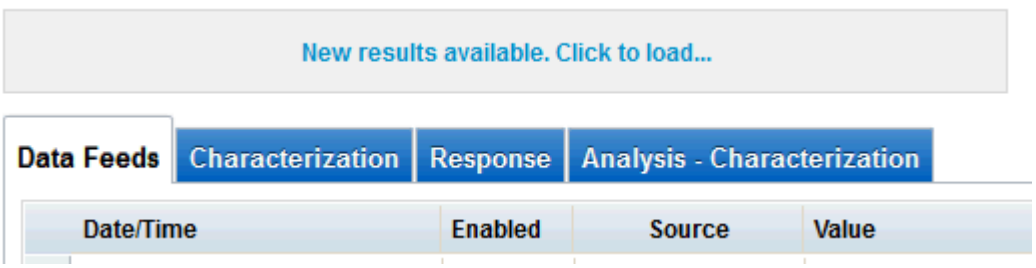
When TPAT is in the process of recalculating, a status message will appear indicating the current stage of calculation:



When TPAT receives new data, the user can trigger an immediate recalculation by clicking on the "recalculate" message that appears:

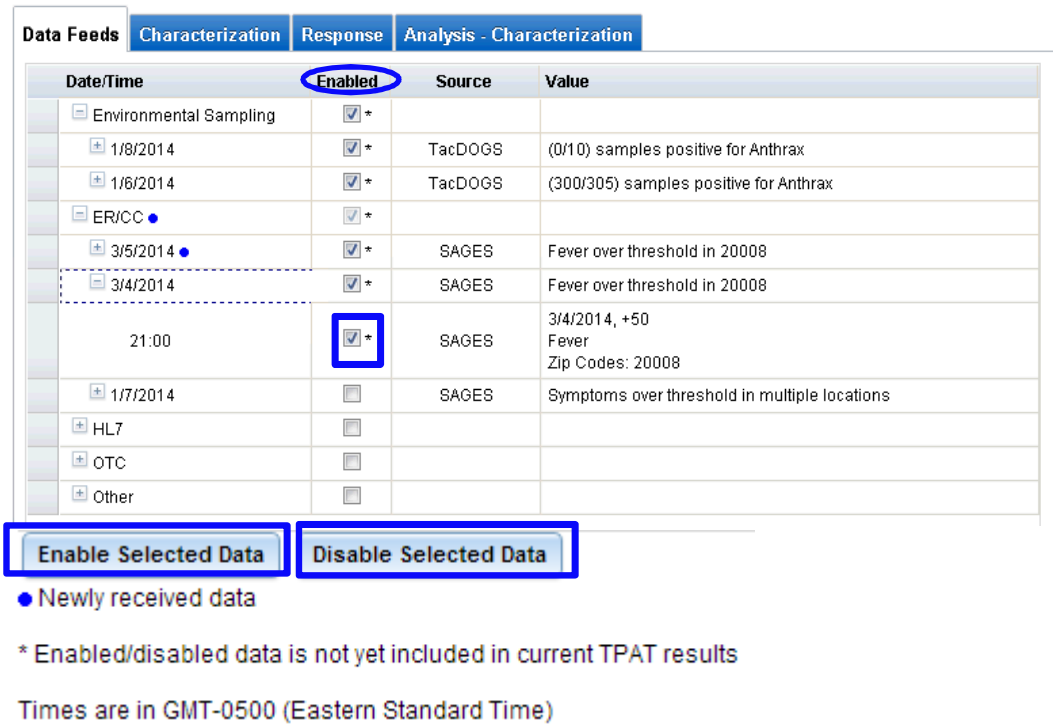
Otherwise TPAT will automatically recalculate results after the current calculation has finished.

When the calculations are complete, the following message will appear:



Clicking on the message will cause TPAT to refresh and latest results to be loaded which can be viewed in the Incident Characterization, Response, and Analysis-Characterization tabs.

Data Feeds Tab
Enabling/Disabling Data



The Enabled column contains a checkbox which tells the user whether or not the data feed should be included in the TPAT result calculations. The user can determine whether or not to include data by toggling the checkbox for a certain row, or selecting the desired data and pressing Enable Selected Data or Disable Selected Data. All child alerts will be enabled/disabled as well. After toggling the checkbox, a * will appear besides the checkbox which indicates that the change has not yet been included in the current TPAT calculations. The user will also see the below "recalculate" message:

Clicking on the message will cause TPAT to recalculate its results and include/exclude data depending on their enabled state.

Incident Characterization Tab

Incident Characteristic	Best Answer So Far	Notes
Disease	Anthrax	From laboratory-confirmed diagnoses.
Area of Interest	View area of interest based on: (•) Environmental Samples ( ) Biosurveillance data (patient home addresses) ( ) Composite (use with caution)	Calculated by finding the minimal geographic area that contains 90% of cases and includes the zone with the highest number of cases.
Day of Attack	5/10/2014 [5/9/2014 - 5/11/2014]	From fitting of observed ER/CC data with epidemic projection model. Number displayed is the most likely value, with 95% confidence that the value falls in the predicted range.
Exposed Population	34,850 people [25,740 - 45,220] (estimated range for lower bound)	Total number of people who received any level of exposure to the agent in the environment, including levels of exposure too small to be infectious. For contagious disease, does not include secondary infections. Number based on Glassman scaling of epidemic projection model results. Number displayed is the most likely lower bound value, with 95% confidence that the lower bound falls in the predicted range.
Projected # Symptomatic Cases	30,860 people [22,730 - 38,780] See graph	Total number of people who will become symptomatic over the course of the epidemic without intervention. From fitting of observed ER/CC data with epidemic projection model. Number displayed is the most likely value, with 95% confidence that the value falls in the predicted range.

Answer Quality

- Requires refinement with additional data or better model
- Depends on model result
- Answer is specific and certain enough to require little/no refinement

* Values may change from run to run due to the stochastic nature of the underlying models.

The Incident Characterization tab provides a comprehensive picture of the key incident characteristics, including:

Disease type – type of disease/agent suspected

Area of interest – the area that is most likely to have additional symptomatic people and contaminated areas.

Day of attack - estimated day when the attack occurred

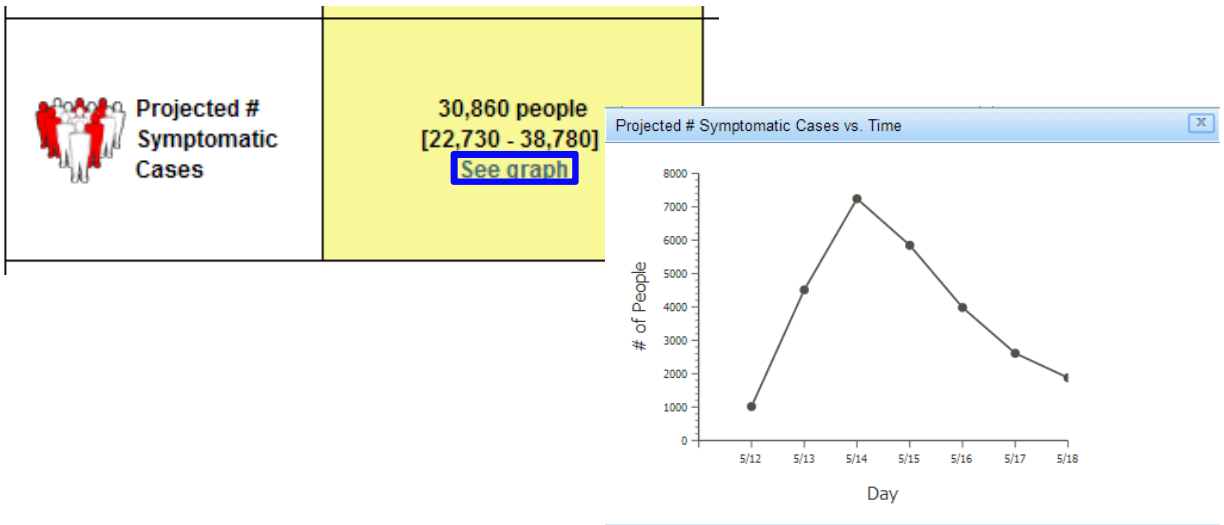
Exposed population - total number of people who received any level of exposure to the agent/disease. This includes levels of exposure too small to be infectious.

Projected # symptomatic cases - total number of people who will become symptomatic over the course of the epidemic without intervention.

The incident characteristics are calculated based on the incoming data feeds processed by the TPAT algorithms, as shown on the Analysis – Characterization tab. **When no diagnoses or positive environmental samples have been received, only the Disease and Area Of Interest characteristics are displayed.**

Incident Characterization Tab (cont.)

Clicking on See Graph in Projected # Symptomatic Cases displays a graph of the projected symptomatic cases over time, starting with the day of the first ER/CC alert from SAGES.



The Next Info To Seek Table displays further data gathering response options that are currently recommended by TPAT.

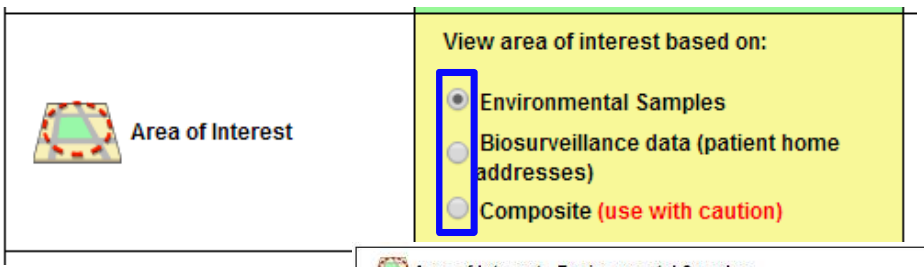
Next Info To Seek
• Initiate virologic testing and testing for bacterial infection • Environmental sampling • Epidemiological investigation • Syndromic/veterinary surveillance • Data combination

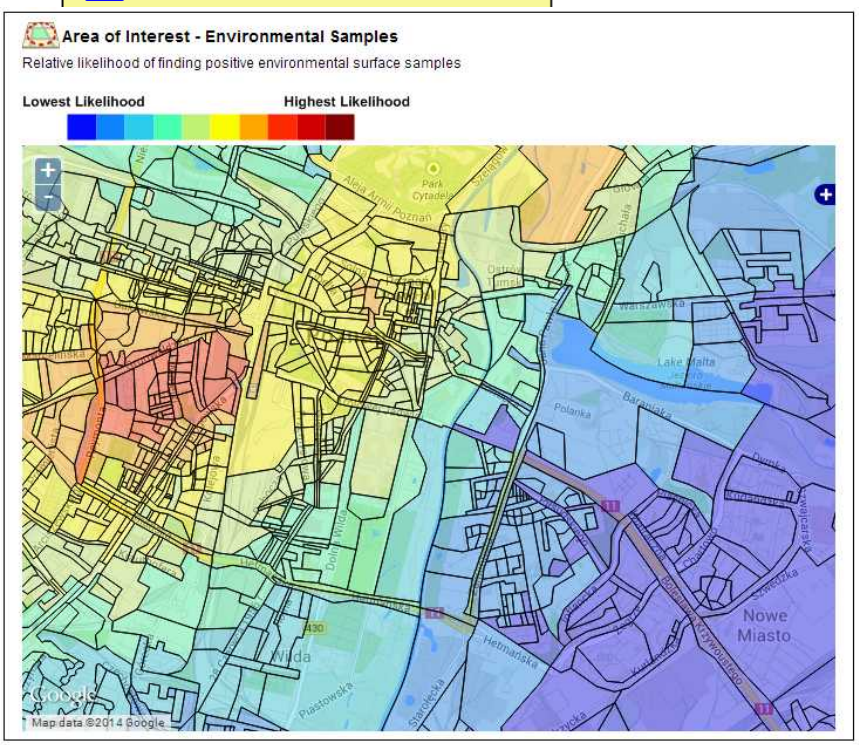
Incident Characterization Tab (cont.)
Area Of Interest

The Area of Interest map is displayed to the right of the Characterization table. The user can select which area of interest map to view by selecting the corresponding radio button in the Characterization table. TPAT generates area of interest maps based on the following:

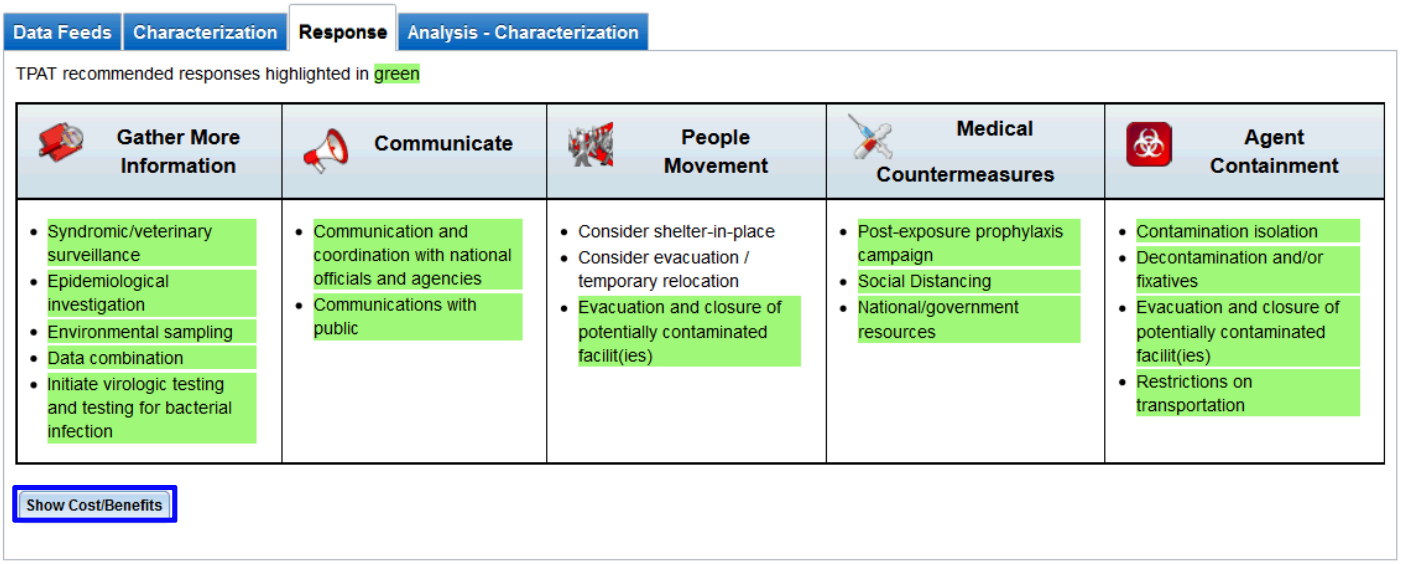
- Environmental samples - Relative likelihood of finding positive environmental surface samples
- Biosurveillance data - Relative likelihood of finding additional patients (including ER/CCs, severe cases, and diagnosed cases). **Biosurveillance data is based on patient home addresses. User must determine whether home locations are relevant to the incident.**
- Composite - Relative likelihood of finding additional patients and/or positive environmental surface samples. **Composite of maps based on biosurveillance data using patient home locations and environmental samples together. User must determine whether this composite is relevant to the incident.**

The area of interest map provides zoom ability by clicking the (+/-) buttons on the top-left, or panning by clicking and dragging in the map.





Response Tab



The Response tab shows possible responses in five categories: additional data gathering, communications, people movement, medical countermeasures, and agent containment. The situation-dependent responses recommended by TPAT are highlighted in green, with the recommendation being based on the current incident characterization.

User Actions

The user may push the Show Cost/Benefits button to opens cost/benefit information on each of the potential response options.

Response Tab
Cost/Benefits

Gather More Information | Communicate | People Movement | **Medical Countermeasures** | Agent Containment

Response Option	Benefits	Costs/Considerations
Post-exposure prophylaxis campaign	• One of the best approaches for reducing the impact of limited medical capacity, reducing public fears. (SMEs) • **Response Pathways Model**	• Difficult to target prophylaxis campaign (SMEs) • Monitoring required for adverse incidents, effectiveness of treatment and prophylaxis, and drug resistance. (HHS)
Social Distancing	• Reduces disease transmission	
National/government resources	• Provides necessary national assistance (e.g., prophylaxis, supplies, personnel, lab and hospital surge coordination); (attack could overwhelm capacity of even a well-prepared city). (SMEs)	

PEP Start	Estimated Casualties		
	Best[1]	Most Likely[2]	Worst[3]
No PEP	17,205*	20,992*	24,893*
5/5+	5,973	7,288	10,169
5/6	7,028	8,575	11,681
5/7	8,074	9,851	13,115
5/8	9,064	11,059	14,435
5/9	9,977	12,173	15,630
5/10	10,803	13,181	16,699
5/11	11,542	14,082	17,647
5/12	12,197	14,882	18,485
5/13	12,776	15,588	19,222
5/14	13,285	16,209	19,869
5/15	13,733	16,756	20,438
5/16	14,126	17,235	20,937
5/17	14,471	17,656	21,376
5/18	14,774	18,026	21,761

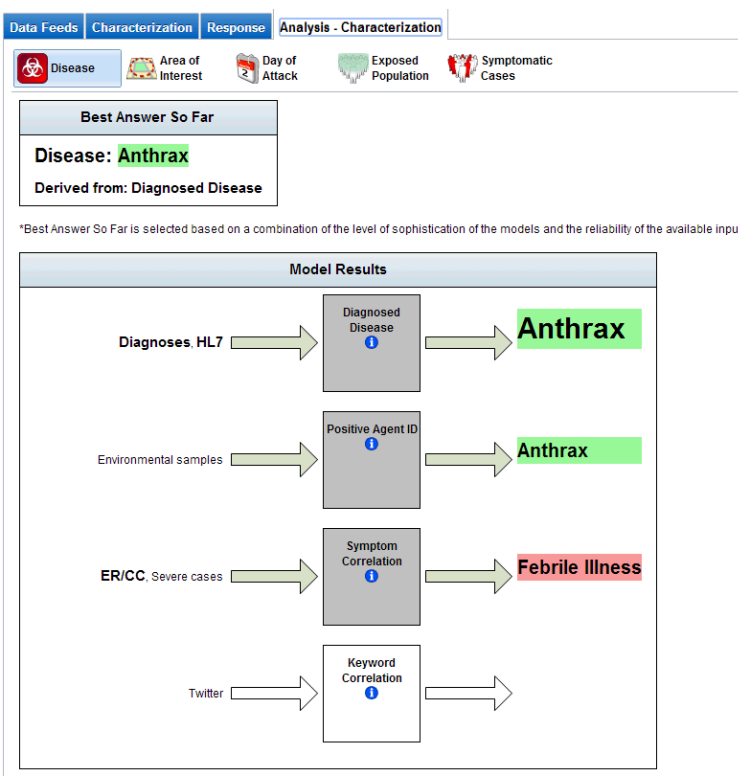
Assuming 2 days to prophylax exposed population
+ - Date of earliest diagnosis
* - Total symptomatic population calculated by Temporal Inverse Model
1 - 'Best' using latest attack date 5/1 calculated by Temporal Inverse Model
2 - 'Most Likely' using most likely attack date 5/1 calculated by Temporal Inverse Model
3 - 'Worst' using earliest attack date 4/30 calculated by Temporal Inverse Model

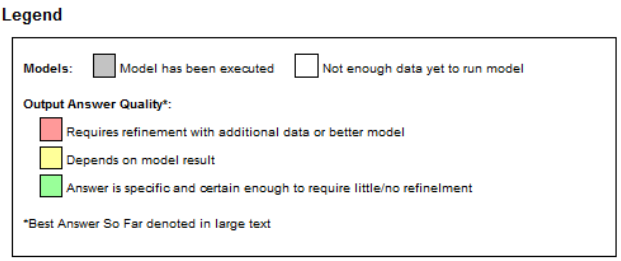
The Cost/Benefits button on the Response tab shows benefits and costs/considerations for each of the possible responses. The buttons at the top allow the user to switch between the response categories. The cost/benefits shown are generic cost/benefits information for all of the possible responses except for the post-exposure prophylaxis campaign; in that case, the table shows incident-specific calculations of the estimated number of casualties based on the start date of the prophylaxis campaign and the disease model projections consistent with the observed data.

User Actions

The user may select from among the sub-tabs which response option sub-tab to show.

Analysis-Characterization Tab





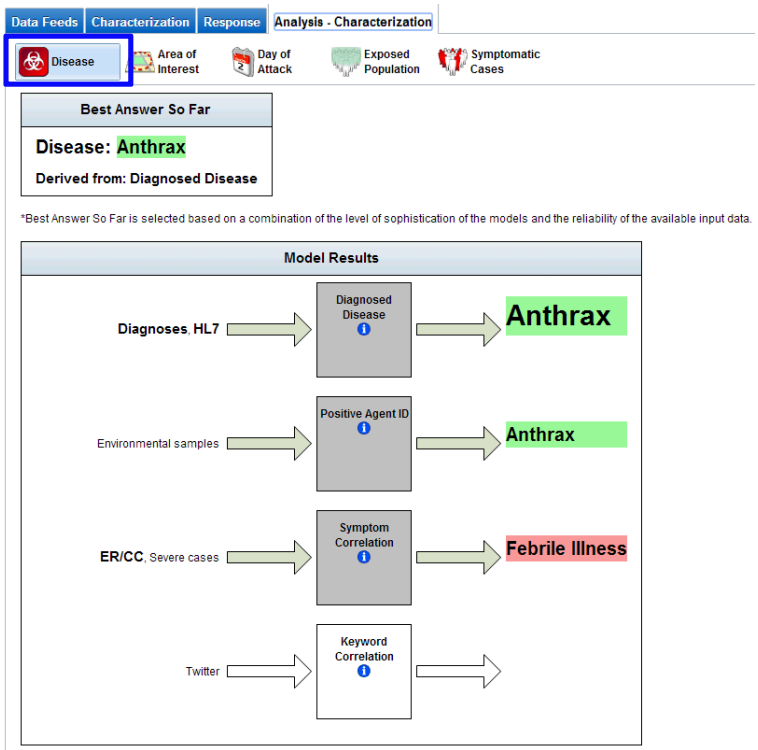
The Analysis – Characterization tab plus its sub-tabs, one for each incident characteristic, shows which models were used to produce each of the incident characteristics from the data streams. The model results box shows the different models that may be used to calculate the Best Answer So Far for the incident characteristic. The models are ordered from top to bottom by quality level, with the top-most model being the highest quality, and the bottom-most model being the lowest quality. The required inputs are shown on the left side of the box with input arrows to each model. The data inputs that were used to produce the model output are shown in bold text. The models that have been executed are colored grey, while the models that are missing required input data and have not been run remain white. The model outputs and the output answer quality are shown on the right side of the box with output arrows from each model. The output that is selected by TPAT as the Best Answer So Far is shown in the largest text. This answer is repeated in the Best Answer So Far box at the top.

User Actions

The user may select from among the sub-tabs which incident characteristic sub-tab to show. The user can click on the blue info button in the model box to read a description of the model.

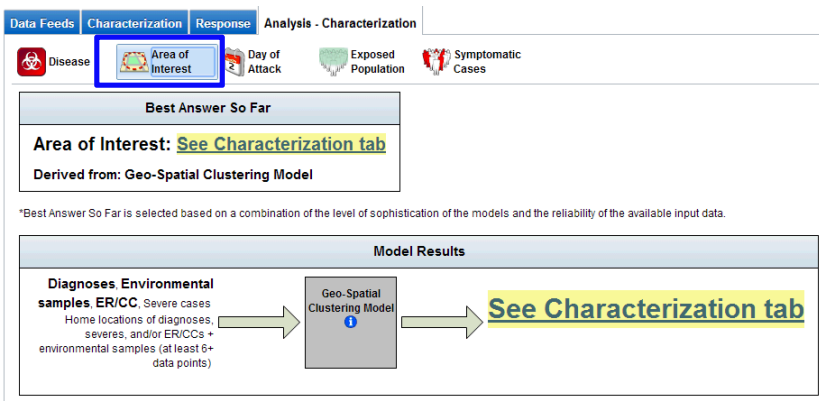
Analysis-Characterization Tab

Incident Characteristics Sub-tabs



The Disease tab shows the four models used to determine the disease:

- Diagnosed disease model – determines disease type based on received HL7 alerts
- Positive Agent ID – determines disease type based on received environmental samples
- Symptom Correlation – determines possible diseases based on symptoms of received ER/CC
- Keyword Correlation – determines possible disease type based on keywords contained in received Twitter data

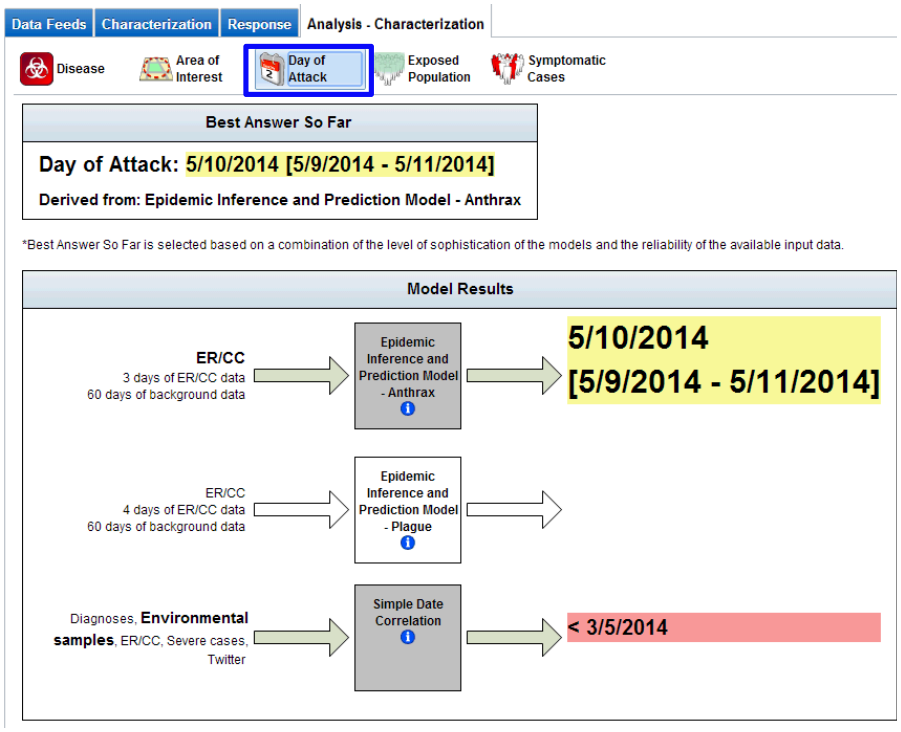


The Area of Interest tab shows the Geo-Spatial Clustering model, which calculates an area of interest by finding the minimal geographic area that contains 90% of cases and includes the zone with the highest number of cases. The clustering model generates 3 area of interest maps based on:

(1) Environmental samples
(2) Biosurveillance data (ER/CC, severe and diagnosed cases)
(3) Composite – weighted average of environmental and biosurveillance data

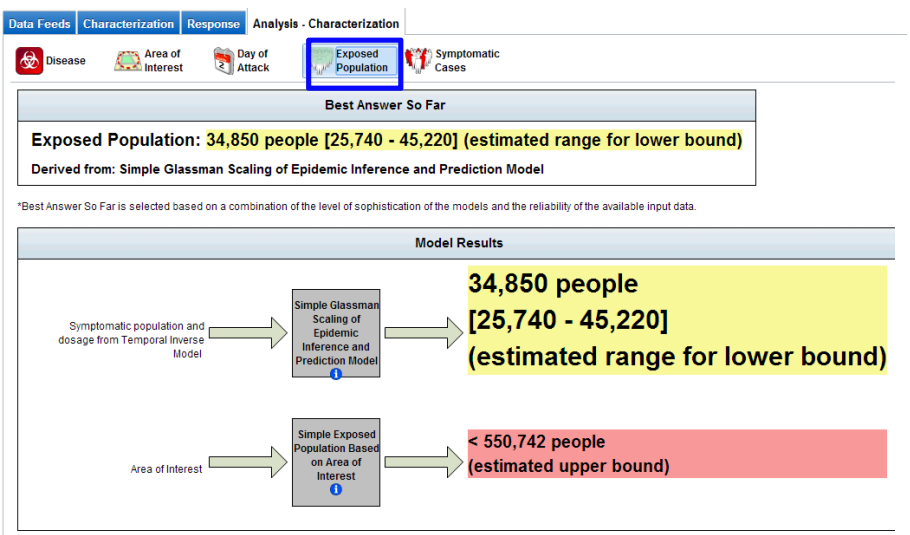
Analysis-Characterization Tab

Incident Characteristics Sub-tabs (continued)



The Day of Attack tab shows three models used for the estimate:

- Epidemic Inference and Prediction Model - Anthrax – after an anthrax diagnosis, estimates the anthrax epidemic curve (number of people who become symptomatic versus time) from the ER/CC data after
- Epidemic Inference and Prediction Model - Plague – after a plague diagnosis, estimates the plague epidemic curve (number of people who become symptomatic versus time) from the ER/CC data
- Simple Date Correlation – determines possible attack date based on dates of received ER/CC data together with disease incubation times.

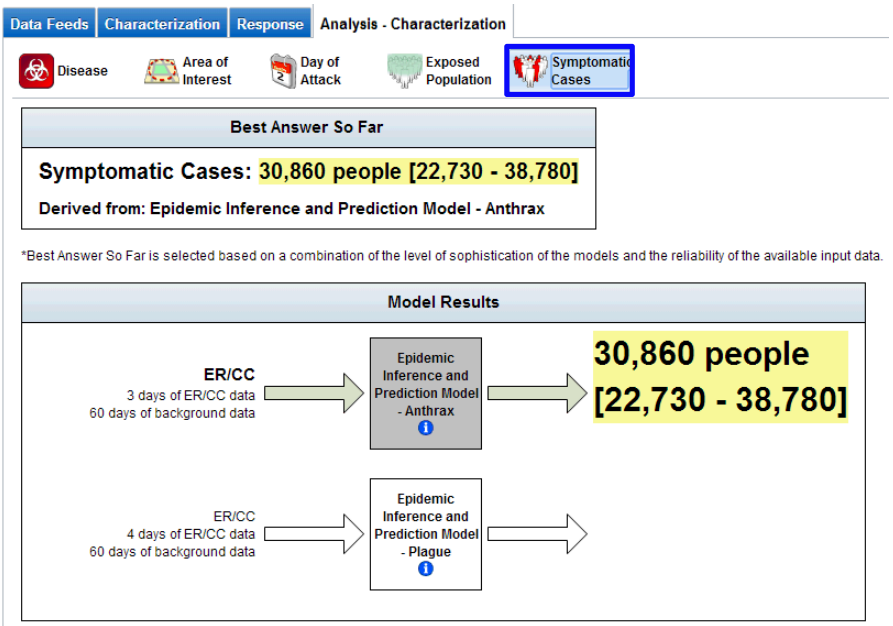


The Exposed Population tab shows two models used for the estimate:

- Simple Based on Area of Interest– before enough data for Epidemic Prediction model available to run, estimated from population in the area of interest from the cluster model
- Simple Glassman Scaling of Epidemic Inference and Prediction Model– After Epidemic Prediction model run, a scaling factor is applied to the projected number of symptomatic cases.

Analysis-Characterization Tab

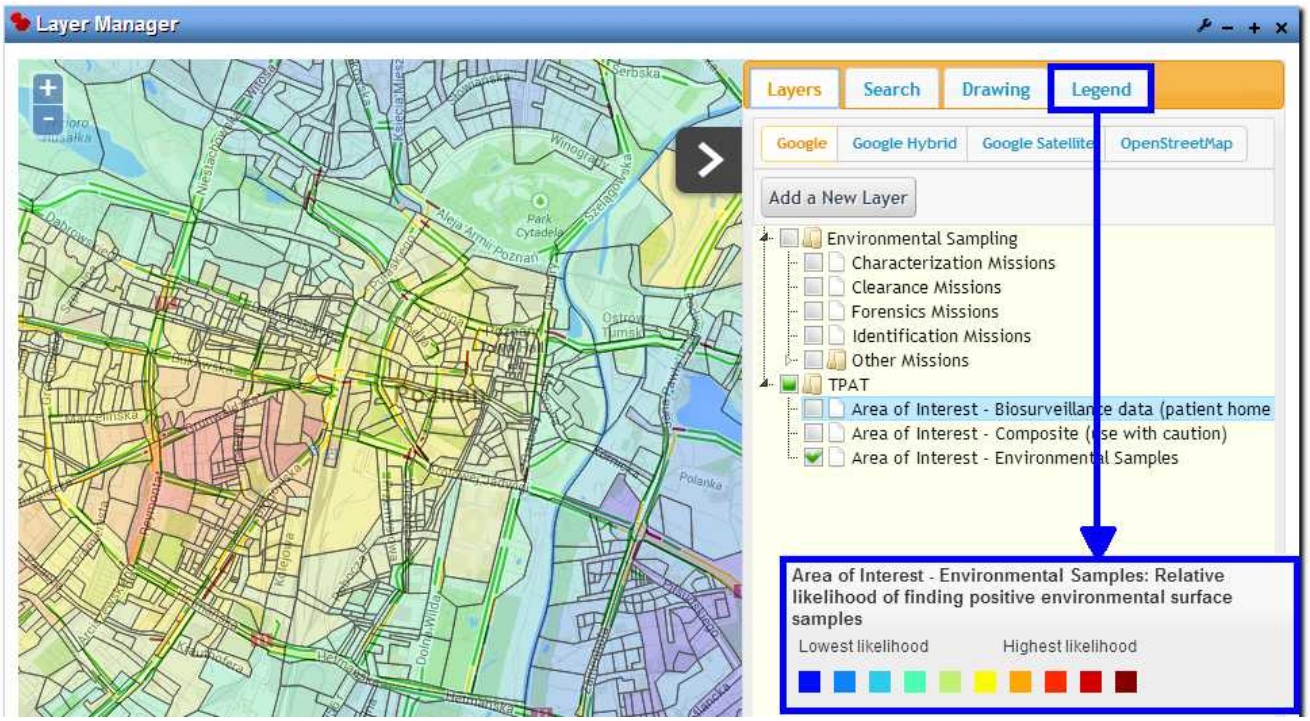
Incident Characteristics Sub-tabs (continued)



The Symptomatic Cases button shows two models used for the estimate:

- Epidemic Inference and Prediction Model - Anthrax – after an anthrax diagnosis, estimates the anthrax epidemic curve (number of people who become symptomatic versus time) from the ER/CC data
- Epidemic Inference and Prediction Model - Plague – after a plague diagnosis, estimates the plague epidemic curve (number of people who become symptomatic versus time) from the ER/CC data

TPAT Map Layers



The TaCBoaRD Map can be viewed by going to Incident->Map on the main TaCBoaRD menu bar. The TPAT Area of Interest map layers are located under the TPAT folder in the Layers tab. For a description of the area of interest layers generated by TPAT, see p. 8.

User Actions

The user uses the checkboxes on the right of the screen to select which map layers to display. Click on the Legend tab to view legends for the layers