Biological Surveillance Techniques Developed with JMP

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Abstract

The Department of Homeland Security asked the question, "**how can we detect acts of biological terrorism?**" After discussion and consideration, our answer was "**If we can effectively detect an outbreak of a naturally occurring event such as influenza, then we can find an attack in which anthrax was used** because both present with similar symptoms."

The tools that were developed became much more relevant to the detection of naturally occurring outbreaks, and JMP was used as the primary communication tool for almost five years of interactions with all levels of the U.S. Government.

In this presentation, we will demonstrate how **the tools that were developed could have been used to defer the affects of the Coronavirus COVID-19**. The data that will be used for demonstration will be from Emergency Management Systems, Emergency Departments and the Poison Centers of America.

The Question

The Department of Homeland Security challenged us with the question:

"how will we detect acts of biological terrorism?"

The Results

- Developed the TAP Method which quantified the words of medical professionals and alerted prior to the rise in numbers of cases

- Developed the Disposition Method which assessed the severity of cases within groups of preliminary diagnosis

- Developed the Vector Method which provided an extremely fast method of detecting changes in symptom sets

- Developed Seasonal Accumulation Techniques which allowed the detection of influenza outbreaks months in advance of current methods.

- Developed the sympDB which provided the platform to study the profile of illnesses

The **TAP Method** quantifies and creates a metric from the words of medical professionals typically stored in unstructured (text) fields of data.

The graphic depicts a TAP Alert on December 6th preceding an outbreak of the Norovirus by several weeks. The best standard technique surfaced an alert on January 21st, and the media reported on the outbreak on February 11th.
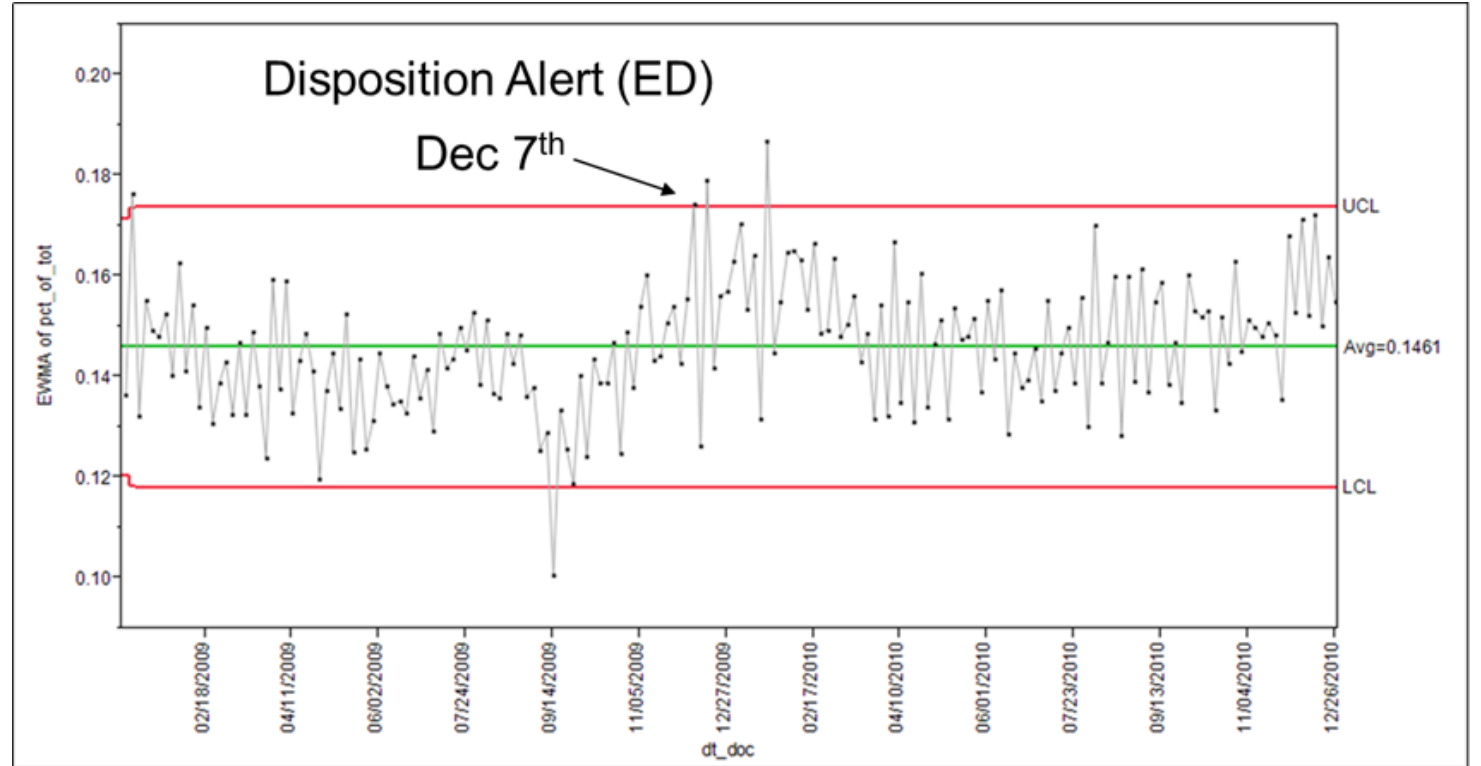
Data source: EMS
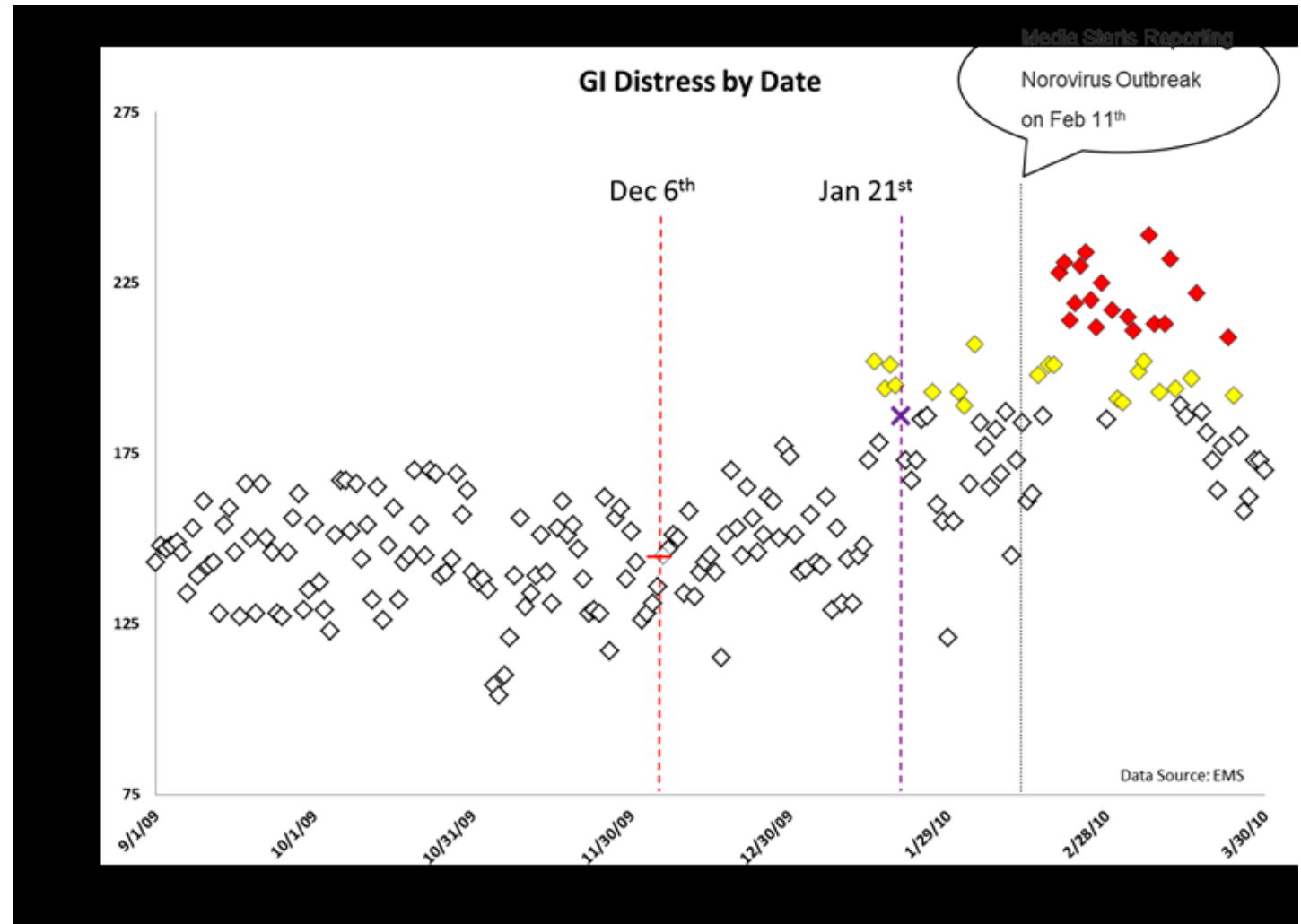
The **Disposition Method** evaluates the severity of cases, and considers the abnormality of the severity of observed cases.

The graphic depicts a Disposition Alert on December 7th in support of the TAP Alert depicted on the previous page.

Data source: ED

The **Vector Method** considers the correlation between data components. This is the fastest acting method (measure in minutes versus days).

The graphic depicts an alert in an exercise using simulated data to detect the spread of weaponized anthrax in a public place. The system picked up abnormalities and the primary location in only 10 calls.

Data source: Poison Center

Multivariate Control Chart
(considering Pulic Areas and Location)
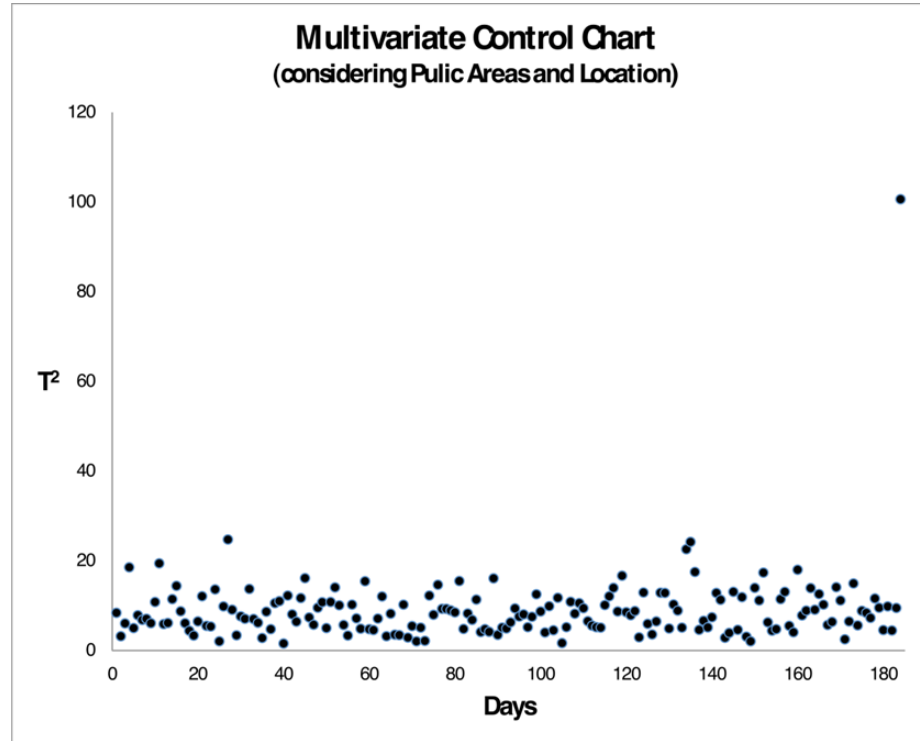
This alert was generated after 10 calls.

While not unusual to receive 10 calls, the combination of 10 calls to a specific area is considered to be abnormal.


Region
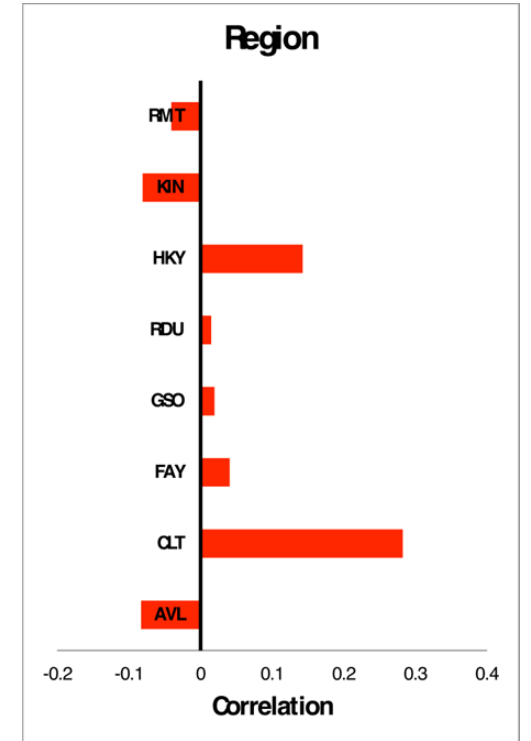
The system has indicated that Charlotte (CLT) has been the focus of caller activity

The **Seasonal Accumulation Technique** evaluates Google Search Engine data (this is not "Google Flu"), and essentially quantifies how many Google Searches are being made regarding any influenza-like-illness.

The graphic was taken from a presentation in which the prediction was made in "real-time" concerning the pending flu-season. The prediction for a "bad year" was made on September 1, 2012, and was supported by multiple TAP alerts within 2 weeks

Data source: Google Search Engine Data
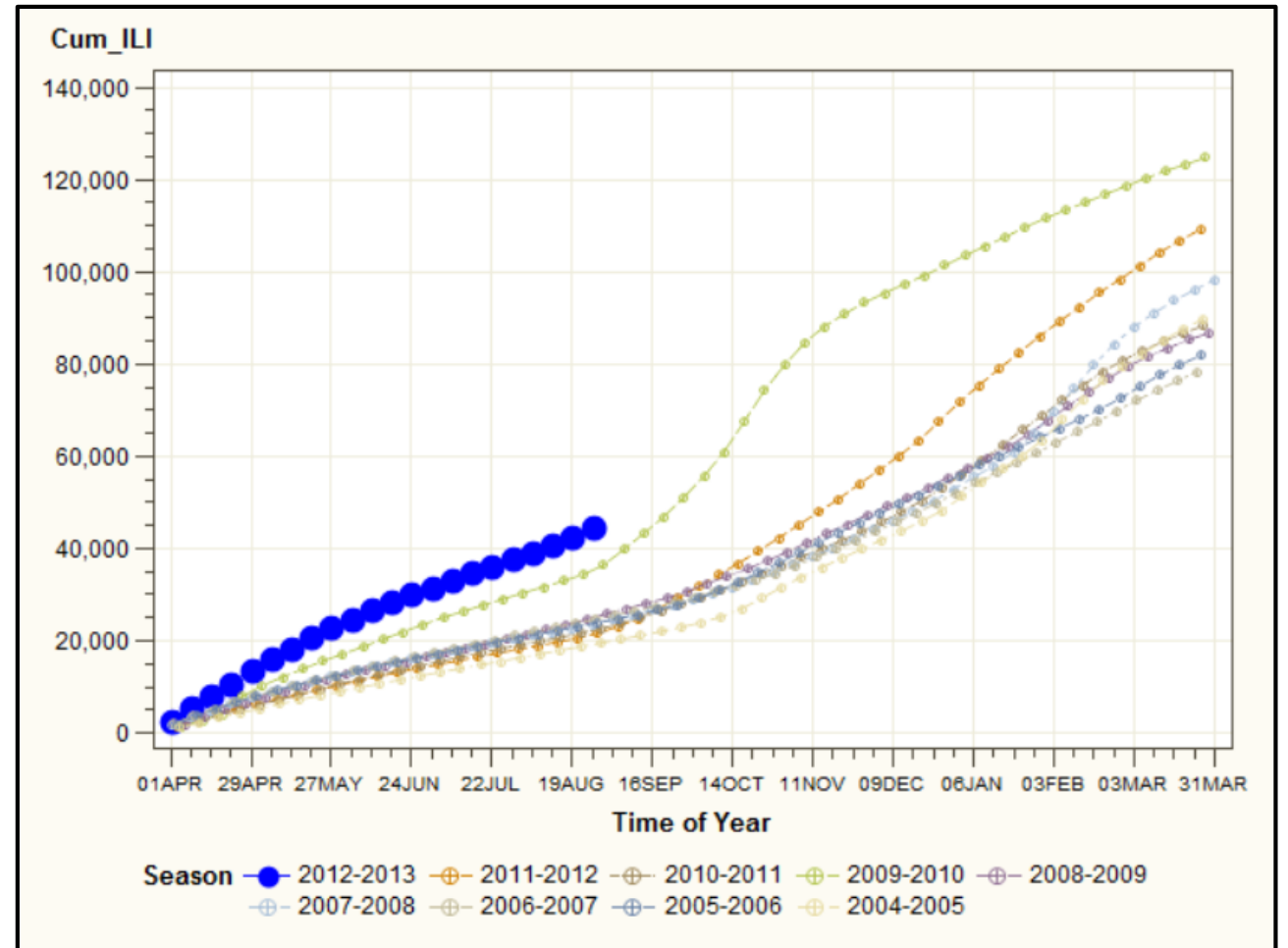
The **Symptoms Database (sympDB)** allowed us to profile outbreaks as they were occurring

The table depicts a profile of an actual outbreak in its early stages.

Data source: EMS

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	10.341883	0.092368	111.96	<.0001*
Age Group[<= 16]	4.5216881	0.090828	49.78	<.0001*
Sum(FEVER)	1.4602025	0.013936	104.78	<.0001*
Sum(COUGH)	0.7650448	0.02916	26.24	<.0001*
Sum(RESPIRATORY)	0.1380234	0.007222	19.11	<.0001*
Sum(PAIN)	-0.032763	0.001951	-16.79	<.0001*
Sum(DIARRHEA)	0.2461184	0.015891	15.49	<.0001*
Sum(ANIMAL)	-0.129955	0.008496	-15.30	<.0001*
Sum(GASTRO)	-0.272051	0.018588	-14.64	<.0001*
Sum(DYSPNEA)	0.0975738	0.006679	14.61	<.0001*
Sum(STRANGEODOR)	0.8075466	0.067794	11.91	<.0001*
Sum(ABDOMEN)	0.0590001	0.004983	11.84	<.0001*
Age Group[<=16]*(Sum(FEVER)-7.47896)	0.2329609	0.019709	11.82	<.0001*

Thank You!

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