

# Using GIS to Display and Analyze ESSENCE Medical Surveillance Data

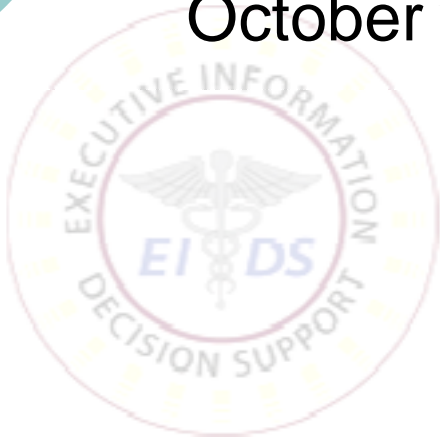
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# Presenters

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Teaming Partner with the prime Apptis, Inc., responsible for the development of the GIS component of the upcoming re-release of the EI/DS ESSENCE application

- **Andrew Murdoch**, GIS Programmer / Analyst with ARCBridge Consulting



# Presentation Outline

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- Overview of the EIDS-ESSENCE application
- Medical surveillance basics
- Description of GIS mapping components
- Two use-case scenarios
- Summary

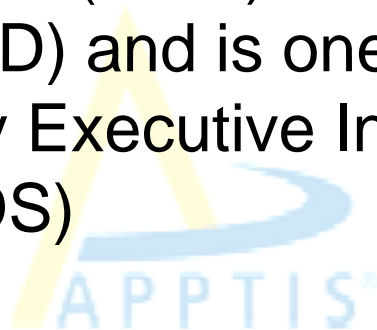
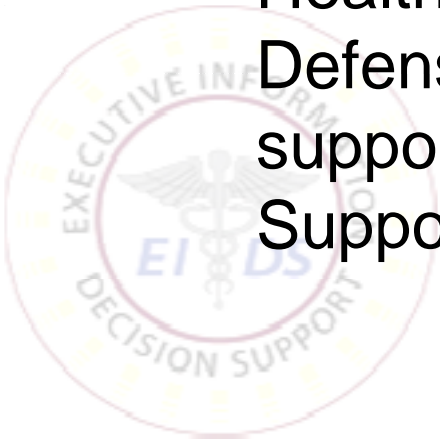




# EIDS-ESSENCE Overview

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- **ESSENCE** (Electronic Surveillance System for the Early Notification of Community-based Epidemics) is a web-based disease outbreak detection and alert application used by the military medical community
- **ESSENCE** is administered by the Medical Health Service (MHS) of the Department of Defense (DoD) and is one of many products supported by Executive Information / Decision Support (EIDS)





# ESSENCE Overview, Continued

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- ESSENCE end users include medical surveillance personnel, epidemiologists, and Public Health Officers
- Provides medical surveillance and alert notification on possible disease outbreaks within the military community, including military dependents
- Uses DoD world-wide healthcare data, processed nightly
- Uses sophisticated statistical detection algorithms developed by Johns Hopkins University – Applied Physics Laboratory (JHU-APL)

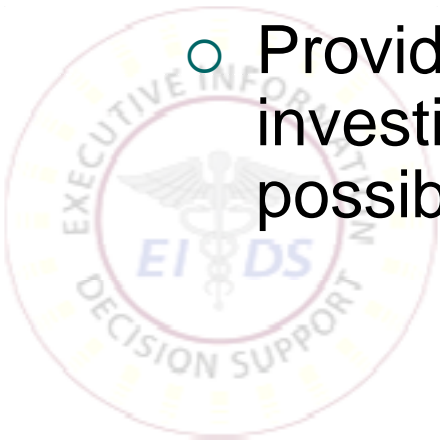




# Purpose of ESSENCE Medical Syndromic Surveillance

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- Detect rapid or unusual increases in the occurrence of certain illness syndromes
- Provide Alerts that may indicate outbreaks of infectious diseases or possible use of biological warfare
- Electronically distribute Alerts via email or text-enabled devices
- Provide ad hoc query capability to provide investigative drill down into data supporting possible outbreaks

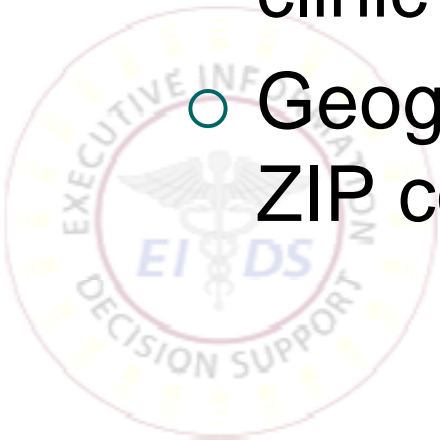




# ESSENCE GIS Mapping Component

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- Visualizes medical surveillance data
- Geographically displays patient home ZIP codes
- Geographically displays Military Treatment Facility (MTF) hospitals' and clinic locations
- Geographically displays **Spatial Alert** ZIP code clusters





# EIDS & Apptis Objectives for ESSENCE GIS Next Release (Block 2)

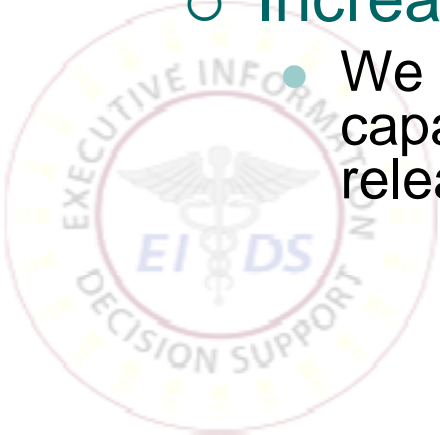
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## ○ Increase performance speed!

- Prior versions of the ESSENCE application GIS component took up to 60 seconds to load a map view. The version we've developed has a load time of under 30 seconds.
- Previous version created a new ArcIMS map service for each user request to the database. The new version creates “dynamic layers” in a single map service, dramatically speeding load time.

## ○ Increase end user adoption of GIS module!

- We anticipate more users will take advantage of the capabilities of the GIS component once this next release is deployed.





# ESSENCE GIS Map Portal Query Screen

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ESSENCE2 - Windows Internet Explorer

Google

ESSENCE2

**EXECUTIVE INFORMATION AND DECISION SUPPORT** 05/Sep/2007

**ESSENCE**

Home Site Selection Alert List Query Map Portal Matrix Portal Preferences Privacy Policy Reference Logout

**Map Portal**

Site	TRICARE-NORTH	Datasource	SADR
Map Type	Full Data Map	Syndrome	All Syndromes
Start Date	07/Jun/2007	End Date	05/Sep/2007
Submit			

**Map Configuration Help**

<b>Full Data Map Type Description</b>	The Full Data Map shows the raw data associated with the datasource. Each data layer is accompanied by a corresponding detector layer which will show any alerts for that datasource.
<b>Detector Alerts Map Description</b>	The Detector Alerts Map shows a map with Temporal and Spatial Detector Alerts for the chosen time period.
<b>Syndrome</b>	Choose a Syndrome to filter the data that will be displayed on the map.
<b>Start Date</b>	Choose a Start Date to filter the data that will be displayed on the map.
<b>End Date</b>	Choose a End Date to filter the data that will be displayed on the map.
<b>Submit Button</b>	Submits the configuration and opens the map.

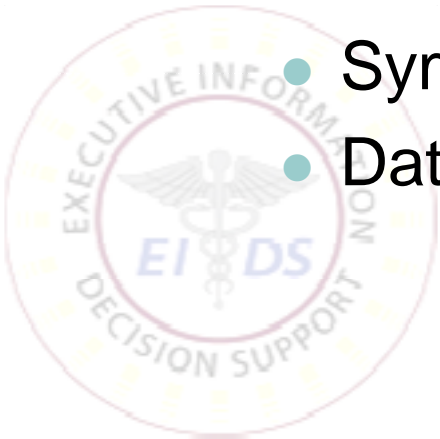
ESSENCE2 Local intranet 100%



# ESSENCE Patient Count Map Display

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- Displays total patient counts per ZIP code
- Query criteria include:
  - Data source (outpatient data, pharmacy data, laboratory and radiology data)
  - Military administrative region
  - Symptom categories
  - Date ranges

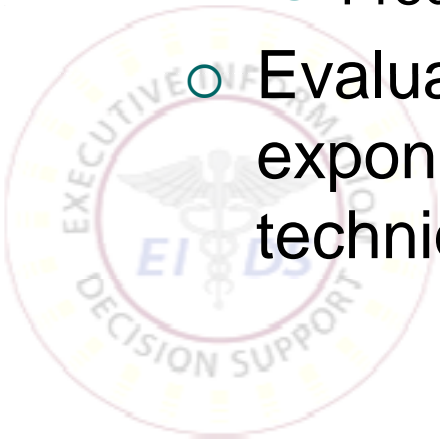




# ESSENCE MTF Temporal Alert Map Display

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- Displays MTFs that raise “temporal alert” during specified time range
- Based on statistically significant combination of factors including:
  - Number of patients reporting a symptom
  - Type of symptom reported
  - Frequency of patient incidents
- Evaluated using linear regression models and exponential weighted moving average statistical techniques

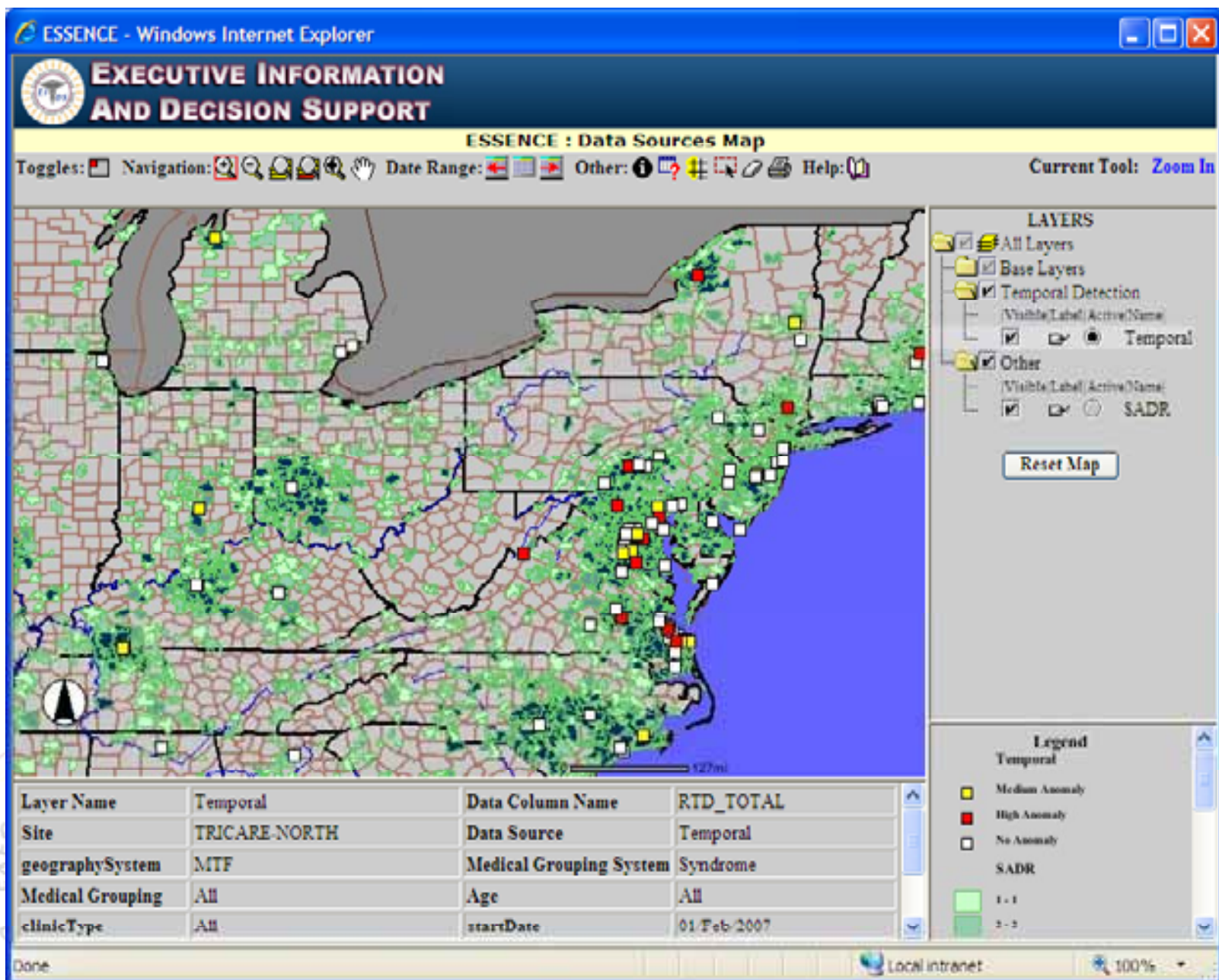




# ESSENCE GIS Data Source Map Display

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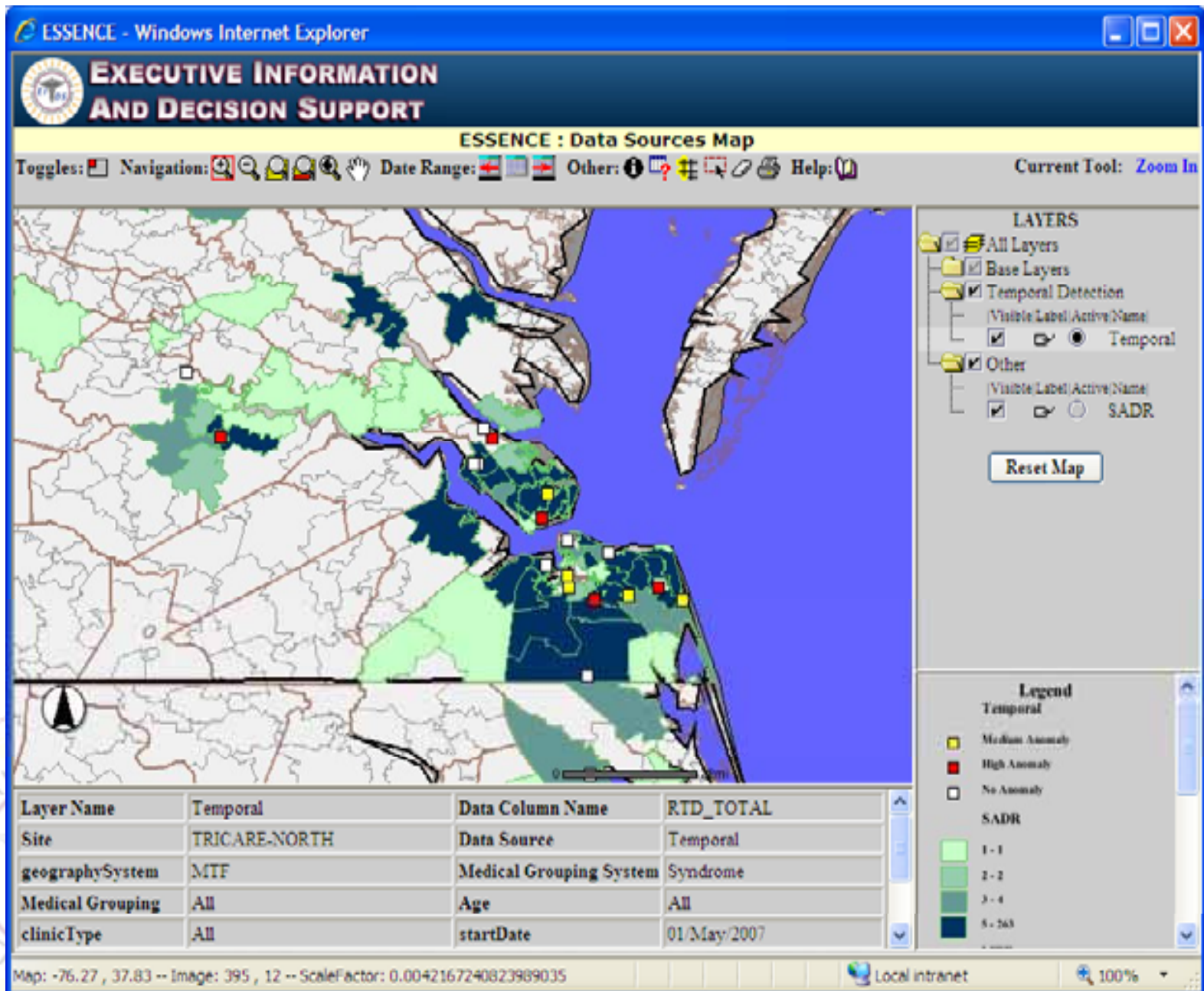


# ESSENCE GIS Data Source Close-up

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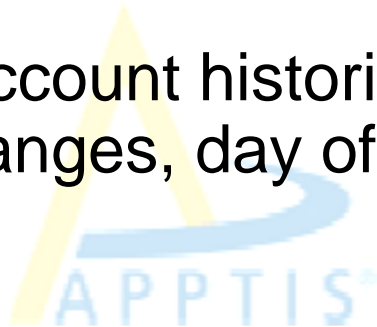
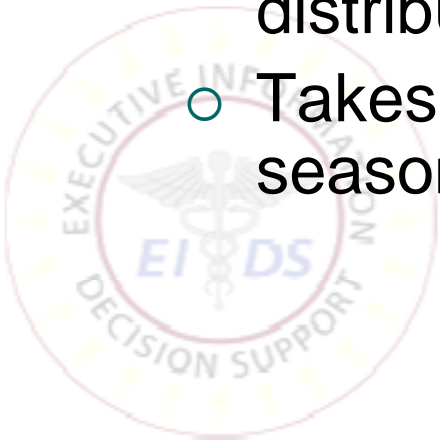




# ESSENCE Spatial Alerts Map Display

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- Displays geo-statistically significant clusters of patient ZIP codes
- Determined using SaTScan spatial scan statistics algorithms (Martin Kulldorff and JHU-APL)
- Alerts when actual patient spatial distribution differs significantly from expected baseline distribution
- Takes into account historical averages, seasonal changes, day of week variations, etc.

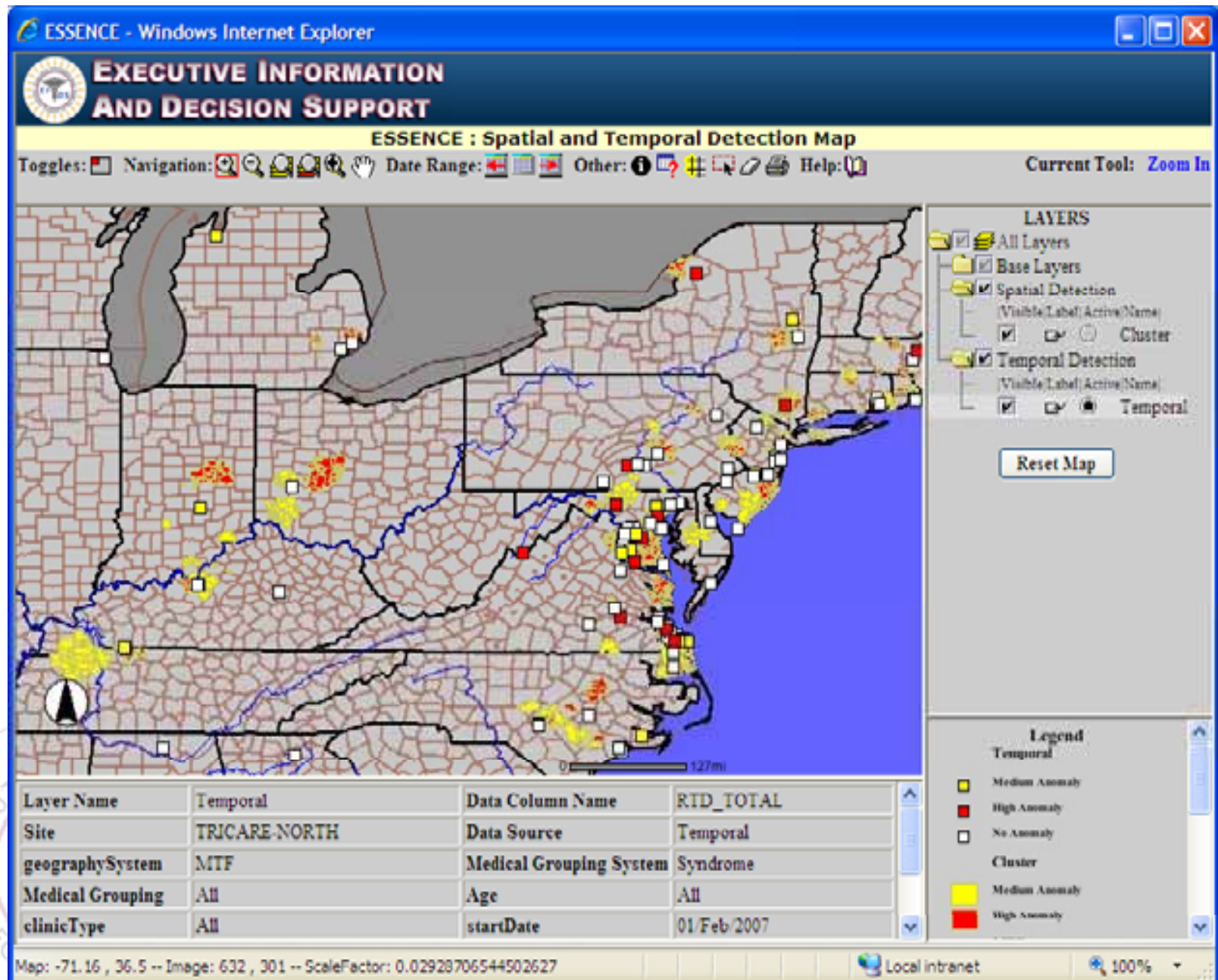




# ESSENCE GIS Spatial Detection Map Display

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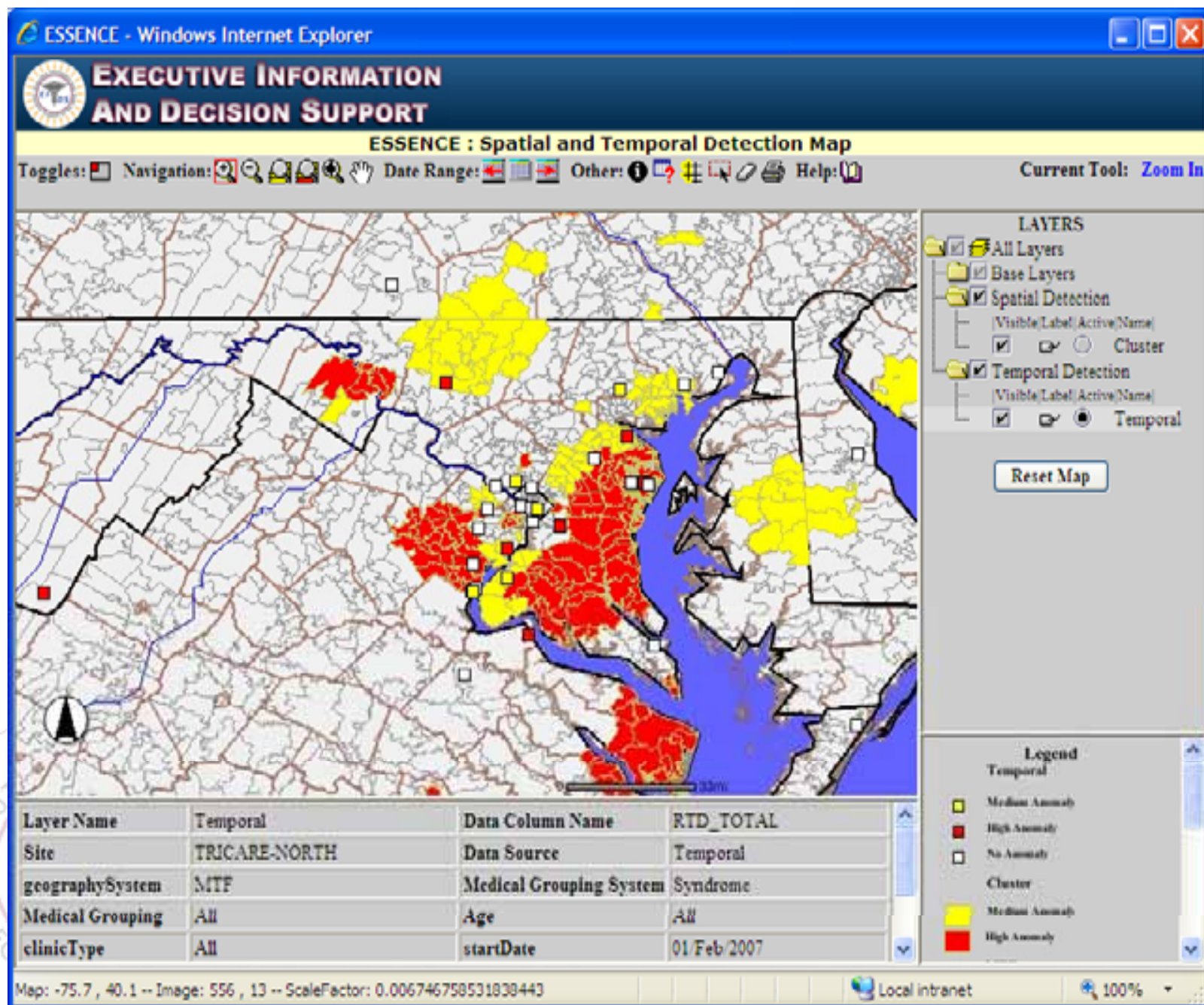


# ESSENCE GIS Spatial Detection Close-up

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# Scenario 1 – Text Based Drilldown

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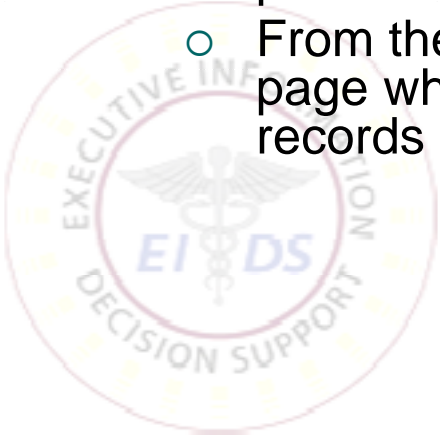
- An ESSENCE user (subscribed to an alert list) gets several red or yellow alerts on their text-enabled device (or via email).
- When the user is next able to, they log in to the ESSENCE website.
- The user views the text-based alert list for temporal (hospital or clinic based) alerts or for spatial (ZIP code cluster based) alerts.
- For temporal alerts the user can investigate the recent history of a facility with an alert using the “time series” tool. This displays a graph of patient visits over time for a particular pathology syndrome.
  - From the time series page, the user can link to the GIS to view the highlighted ZIP codes with patient counts for that data source, syndrome, medical facility and date range.
- For spatial alerts the user can view a text list of spatial clusters showing their associated ZIP codes and alert status. Spatial alerts are only available for SADR ambulatory data record data sources.
  - From the detail view of the spatial alerts, the user can link to the GIS to view the highlighted ZIP codes with patient counts for that particular spatial alert (based on syndrome, medical facility and date range)
- A user can also view a data details page that can be used to drill further down to individual patient encounter data including PHI data.



## Scenario 2 – GIS Based Drilldown

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- An ESSENCE user (subscribed to the alert list) gets several red or yellow alerts on their text-enabled device (or via email).
- When the user is next able to, they log in to the ESSENCE website.
- The user opens the detector alerts map from the GIS using the “map portal” page by selecting an administrative region, medical data source, syndrome and date range.
- In the GIS the user identifies a particular spatial cluster of interest, identifies a ZIP code in the cluster and links to the text-based spatial alerts page to view the text alert for that particular spatial alert.
- From the spatial alerts page the user can open a data details page which allows them to view individual patient encounter records including PHI data.

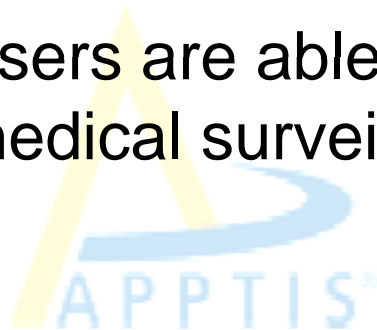




# Summary

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- Without GIS components, ESSENCE users would have no ability to visualize the spatial distribution of patient incident records of interest other than reading ZIP code values from a tabular report
- Display of Spatial Alerts adds new opportunities for analysis of potential disease outbreaks
- ESSENCE users are able to see spatial patterns in medical surveillance data







# Future Plans for ESSENCE GIS

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- Upgrade from ArcIMS 9.2
- Enhance user interface
- Investigate feasibility of “timeline” viewer in animated map display

