

ESSENCE 101

3:30PM EST | December 6th, 2022 | 2022 SyS Symposium

Trainer:

- Travis Lim, MS, MPH, DrPH – Johns Hopkins University Applied Physics Laboratory (JHUAPL)



Council of State and Territorial Epidemiologists



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Laboratory (JHUAPL)



ESSENCE 101

2022 Syndromic Surveillance Symposium

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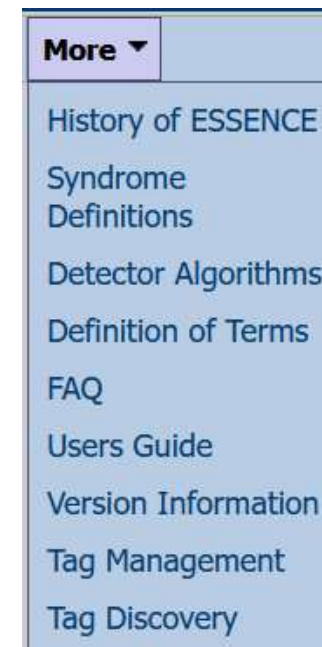
Content was developed for and funded by the Centers for Disease Control and Prevention (CDC) for training purposes. The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of CDC.

Preamble and Housekeeping

- Intended for those relatively new to ESSENCE and/or to syndromic surveillance [0-2y]
- Tie-in some concepts from “Syndromic State of Mind”
- ESSENCE is embarking on a UI/UX redesign process
 - Less emphasis on specific workflows, which may be streamlined in the future
- Use breakout groups to discuss questions or exercises
- Do you have specific topic(s) you would like to focus on?

Resources

- Knowledge repository: <https://knowledgerepository.syndromicsurveillance.org/>
- YouTube channel videos: <https://www.youtube.com/@essence7241/videos>
- ESSENCE User Group, 4th Thursday of every month 3-4pm
(<https://nsspcommunityofpractice.org/callcalendar/>)
- ESSENCE Users Guide, FAQ, Syndrome Definitions (under “More” menu)



Overview

- NSSP overview
- The data
 - Sources
 - Structure and fields with focus on ED data
 - Quality
 - Access controls
- The tools – follow a single simple workflow
 - Querying
 - Time series and stratified time series
 - MyESSENCE dashboard
 - Table builder (Pivot table)
- The analytics
 - Overview of alerting algorithms

Review of Syndromic Surveillance Questions

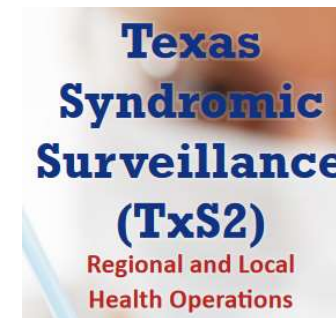
- What are some key analytic questions that epidemiologists may wish to answer with syndromic surveillance data?

Review of Syndromic Surveillance Questions

- What key words or terms can be used to search for a particular disease or syndrome?
- Are visits for a syndrome or disease of interest higher than expected?
- Are those elevated visits associated with particular patient demographic(s), geographic location(s), or other factors such as climate?

Multiple Instances of ESSENCE System

- NSSP is available to all jurisdictions (have full access to their own data)
- NSSP users have access to limited details from all jurisdictions
- Some jurisdictions have customized instances (installations) of ESSENCE



Tarrant County, TX
Houston, TX

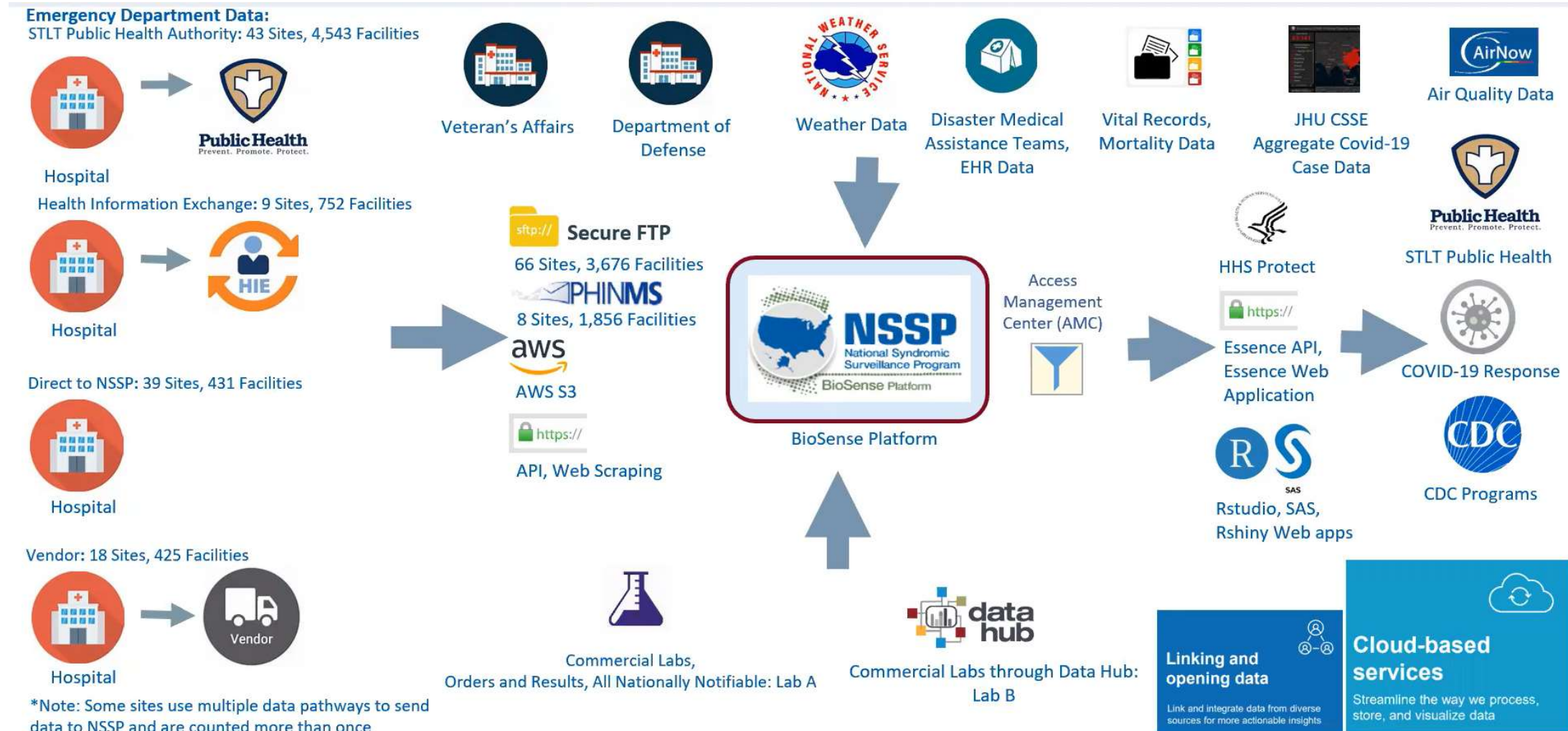


Scope and Coverage - NSSP

- About 72% of Emergency Departments in the U.S.* as of July 2022, or ~ 73.5% of population in a participating health service area
 - (*not including Federally operated, such as the VA)
- Data from 50 states, D.C., and Guam
- Four commercial laboratories (national chains) report laboratory data, only one for all conditions
- Six states report mortality data
- About ~3500 facility sites reported some data to ESSENCE in the past 12 months

*Source: CDC Division of Health Informatics and Surveillance
<https://knowledgerepository.syndromicsurveillance.org/community-practice-monthly-calls>*

NSSP Data Flow



Source: CDC Division of Health Informatics and Surveillance / Karl Soetebier (fhd1@cdc.gov)
<https://knowledgerepository.syndromicsurveillance.org/community-practice-monthly-calls>

ESSENCE Data



13Jul2006	02:56 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_1429	18	Female	none	FEVER HEARTBURN NAUSEA
13Jul2006	11:34 PM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_1532	2	Male	none	FEVER
13Jul2006	07:46 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_4945	27	Female	none	FEVER
13Jul2006	06:33 PM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_7036	4	Female	none	HIGH TEMPERATURE/FEB SEIZURE
13Jul2006	12:32 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_798	20	Female	none	FEVER
13Jul2006	10:43 AM	MD_PRINCE GEORGES - 20772	Prince Georges, MD	AAMCERCC_NULL_VAER_4048	18	Female	none	FEVER
13Jul2006	07:21 PM	MD_PRINCE GEORGES - 20774	Prince Georges, MD	AAMCERCC_NULL_VAER_5733	33	Female	none	CHILLS
13Jul2006	09:20 PM	MD_PRINCE GEORGES - 20774	Prince Georges, MD	AAMCERCC_NULL_VAER_645	4	Female	none	FEVER

NSSP Data Overview

- Data agnostic – could add any data source
 - Minimum requirement: time x something to count
- Other NSSP Data sources
 - Emergency Department patient visit records
 - Urgent care, inpatient and outpatient records*
 - Commercial laboratory test orders and results
 - Mortality records from vital statistics
 - Weather data
 - Air Quality data
 - Disaster medical assistance teams EHR data
 - COVID-19 electronic lab reporting (CELR)
 - Additional future sources:, National Notifiable Disease Surveillance System (NNDSS)
- Free text syndromic data for maximum potential
 - Sets ESSENCE apart from other public health data surveillance
 - Richest and least constrained in ED and patient encounters

Combined data table (“ED” data)

ED Data Overview – Free Text

- Most robust text fields:
 - Chief complaint (used as basis for syndromes and sometimes CCDD)
 - Discharge diagnosis (often ICD-10 codes, SNOMED)
- Other possible text field examples
 - Triage notes (lower completeness, depends on jurisdiction)
 - Admit reason
 - Discharge disposition
 - Clinical impression
 - Travel history
- Can opt to search full “history” of text fields if updated
- Text data exploration
 - Free text in various ED fields, especially chief complaint
 - Can be quantified by summing records that match a custom free text query

ED Data Structure

- Derived from various hospital messaging formats and standardized; not all fields are used

Date/ time	Geographic location	Patient demographics	Disease / condition information	Much more! →
Date + Time	Zipcode Region	MedRecNo Age Sex PatientCl...	ChiefComplaintParsed ChiefComplaintUpdates Category_flat SubCategory_flat Discharge Diagno... DischargeDiagnosisUpda... Hospital	
13Jul2006 02:56 AM	OT_OTHER_REGION - OTHER Other_Region	AAMCERCC_NULL_MDER_1429 18 Female none	FEVER HEARTBURN NAUSEA none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; none none	Hospital 01
13Jul2006 11:34 PM	OT_OTHER_REGION - OTHER Other_Region	AAMCERCC_NULL_MDER_1532 2 Male none	FEVER none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; none none	Hospital 01
13Jul2006 07:46 AM	OT_OTHER_REGION - OTHER Other_Region	AAMCERCC_NULL_MDER_4845 27 Female none	FEVER none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; none none	Hospital 01
13Jul2006 06:33 PM	OT_OTHER_REGION - OTHER Other_Region	AAMCERCC_NULL_MDER_7036 4 Female none	HIGH TEMPERATURE FEB SEIZURE none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus;Seizure; none none	Hospital 01
13Jul2006 12:32 AM	OT_OTHER_REGION - OTHER Other_Region	AAMCERCC_NULL_MDER_798 20 Female none	FEVER none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; none none	Hospital 01
13Jul2006 10:43 AM	MD_PRINCE GEORGES - 20772 Prince Georges, MD	AAMCERCC_NULL_VAER_4048 18 Female none	FEVER none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; R19.8 none	Hospital 01
13Jul2006 07:21 PM	MD_PRINCE GEORGES - 20774 Prince Georges, MD	AAMCERCC_NULL_VAER_5733 33 Female none	CHILLS none ;Fever; ;Chills;FeverOrChills; D63.8 none	Hospital 01
13Jul2006 09:20 PM	MD_PRINCE GEORGES - 20774 Prince Georges, MD	AAMCERCC_NULL_VAER_645 4 Female none	FEVER none ;Fever; ;FeverOnly;FeverOrChills;FeverPlus; N76.1 none	Hospital 01

Data Dictionary



National Syndromic Surveillance Program (NSSP)

NSSP > NSSP Technical Resource Center > Technical Publications and Standards



Technical Publications and Standards

Data Dictionaries

- [Commercial Lab Data Dictionary](#) – This dictionary includes data elements and processing rules for six commercial (anonymized) laboratories.
- [Laboratory User Tables](#) – This file includes three tables: an analytic data dictionary and lookup tables for the laboratory test categorizations and laboratory result categorizations.
- [NSSP Data Dictionary](#) **UPDATED** – This dictionary provides details on data elements stored in NSSP data tables. The Archive Processed table worksheet—1 of 14 worksheets in this document—links to the Public Health Information Network Vocabulary Access and Distribution System (PHIN VADS) website for specific data elements associated with a standard. PHIN VADS is a web-based enterprise vocabulary system for accessing, searching, and distributing vocabularies used in public health and clinical care practice. It promotes the use of standards-based vocabulary to support the exchange of consistent information among public health partners. (No password is required to access document.)

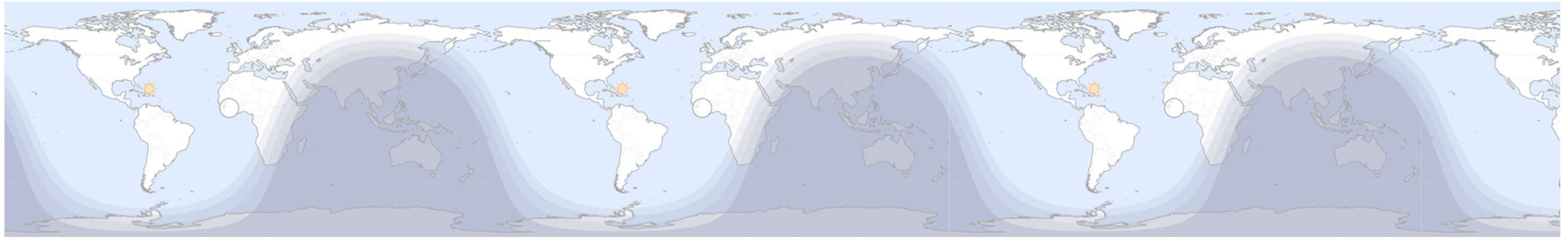
<https://www.cdc.gov/nssp/technical-pubs-and-standards.html#Dictionaries>

ED Data Structure

- Quiz: What does one row of data represent in the ED dataset?
 - A patient
 - A patient-facility-day
 - A patient-syndrome
 - It depends on the query
 - I don't know

Date ▾	Time	Zipcode ▾	Region ▾	MedRecNo ▾	Age ▾	Sex ▾	PatientCl... ▾	ChiefComplaintParsed ▾	ChiefComplaintUpdates ▾	Category_flat ▾	SubCategory_flat ▾	Discharge Diagno... ▾	DischargeDiagnosisUpda... ▾	Hospital ▾
13Jul2006	02:56 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_1429	18	Female	none	FEVER HEARTBURN NAUSEA	none	;Fever;	;FeverOnly;FeverOrChills;FeverPlus;	none	none	Hospital 01
13Jul2006	11:34 PM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_1532	2	Male	none	FEVER	none	;Fever;	;FeverOnly;FeverOrChills;FeverPlus;	none	none	Hospital 01
13Jul2006	07:46 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_4945	27	Female	none	FEVER	none	;Fever;	;FeverOnly;FeverOrChills;FeverPlus;	none	none	Hospital 01
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13Jul2006	12:32 AM	OT_OTHER_REGION - OTHER	Other_Region	AAMCERCC_NULL_MDER_798	20	Female	none	FEVER	none	;Fever;	;FeverOnly;FeverOrChills;FeverPlus;	none	none	Hospital 01
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Typical data reporting and update frequency



Health facilities
can send
messages (new
records or
updates) at any
time/frequency

Messages
queued and
batched for
processing and
ingestion

ED database
continuously
receives
ingested records

Time resolution
in the ED
dataset is exact
to the minute

Data analysis
default is daily
time resolution

Known Data Caveats

- Participation and reporting compliance among sites (hospitals, labs, counties, states)
 - Fluctuates over time
- Difficult to calculate accurate rates; catchment and denominator not always clear
- “sampling bias”
- Facility updates can unintentionally overwrite informative data with blank
 - Some key fields preserve “last (or first) non-NULL value” from history of values
- Data quality, especially free text fields
 - Abbreviations, shorthand, misspellings, jargon, hospital-specific conventions
- SyS Community of Practice – Data Quality Subcommittee

Data Quality Analyses from the SyS Community

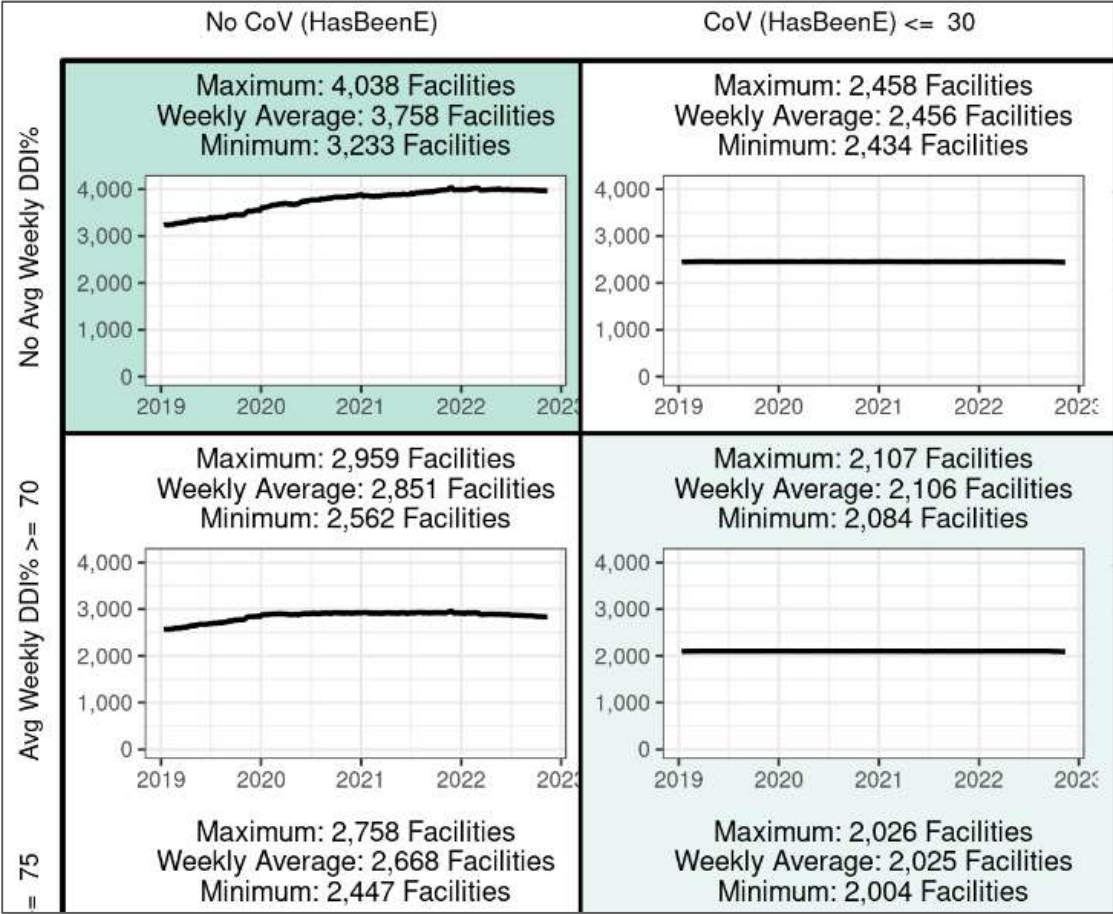
Average Weekly Discharge Diagnosis Informative

DQ Year	Minimum	25th Percentile	Median	Mean	75th Percentile
	All	All	All	All	All
Current Year	0	80.42	92.04	79.63	96.6
One Year Back	0	76.34	90.7	78.3	96.05
Two Year Back	0	69.86	89.02	76.42	95.37
Three Year Back	0	59.96	85.32	73.17	94.76
Four Year Back	0	51.22	80.1	69.29	93.2

CDC Division of Health Informatics and Surveillance (DHIS), Kelly Carey (qlv5@cdc.gov); <https://github.com/CDCgov/Rnssp>

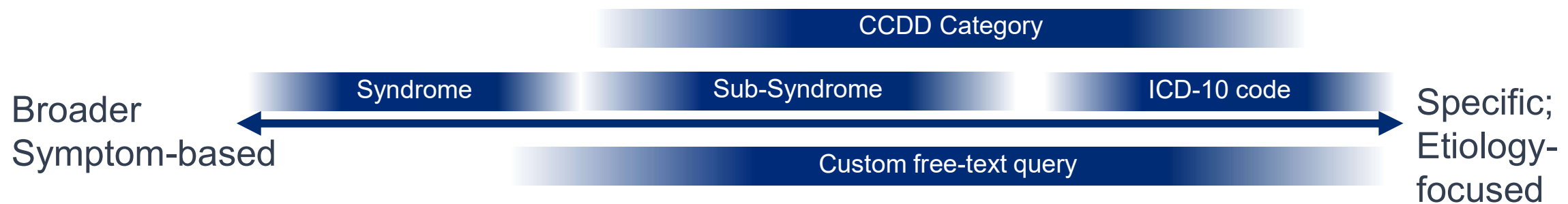
Comparing the Number of Facilities Included in a Query by Data Quality Filter Combinations

Three Year Back Filters: January 01, 2019 to November 11, 2022

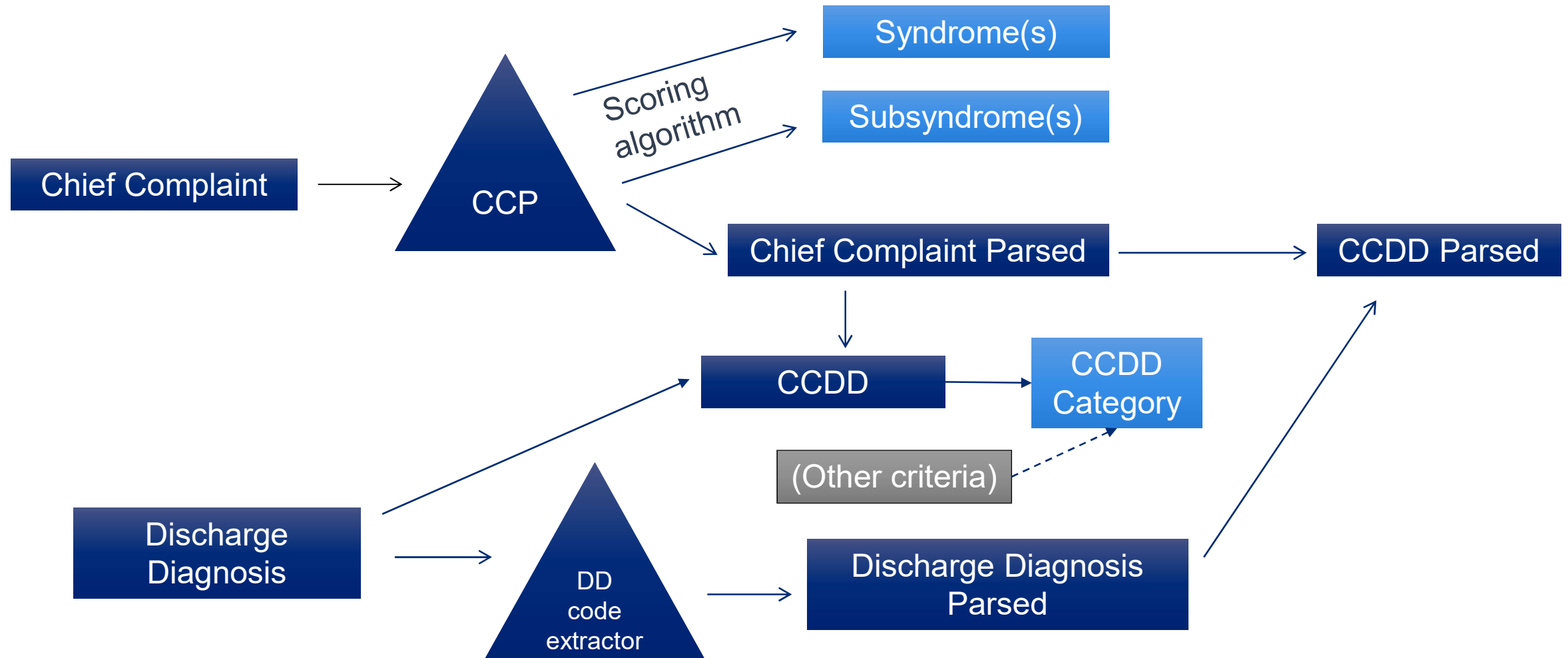


Classifying records by syndrome or condition

- Original SyS by syndrome or sub-syndrome
 - Syndrome categories were defined by the SyS community with emergency medicine and surveillance SMEs
 - Clinically oriented, many are symptoms
- Chief complaint / discharge diagnosis category (CCDD)
 - More recent classifications of interest for public (population) health; SyS evolves over time
 - More focused on etiologies or diseases than symptoms
 - Can construct from multiple fields (including syndrome)
- International Classification of Diseases (ICD-10) code from discharge diagnosis
 - Most specific – diagnosis given
 - Other codes: ICD-9, SNOMED
- Custom free-text query combining one or more of the above



Chief Complaint (pre-)Processor



CCDD Example

myESSENCEEvent List ▼Overview PortalQuery PortalStat TableMap PortalBookmarksQuery ManagerData Quality ▼Report ManagerMore ▼

History of ESSENCE

Syndrome Definitions

Detector Algorithms

CC and DD Categories ▼

CDC Unintentional Drowning v1

Category: CDC Unintentional Drowning v1

Definition:
Search Chief Complaint History and Discharge Diagnosis History Fields: (, (^DROWN^, andnot, (^FEEL^DROWN^, or, ^FELT^DROWN^, or, ^drowning feel^, or, ^drown^own^fluid^, or, ^drown out^, or, ^blood drown^, or, ^drowniness^, or, ^syndrown^, or, ^indrown^, or, ^withdrawn^, or, ^drownsy^, or, ^breakdrown^, or, ^plan^drown^, or, ^drown^self^, or, ^herself^, or, ^drown himself^, or, ^attempting to drown^, or, ^attempt to drown^, or, ^drowning attempt^, or, ^drown it^, or, ^sounds like drowning^, or, ^sounds like he is drowning^, or, ^sounds like she is drowning^, or, (^want^drown^, andnot, (^check^, or, ^evaluat^, or, ^tried to drown^,),),), or, (^FOUND^, and, ^BOTTOM^, and, ^POOL^,), or, (, (, (^UNDER^WATER^, andnot, (^ear^, or, ^eye^,),), or, (^WATER^, and, (^INHAL^, or, ^aspirat^, or, ^lung^, or, ^turning blue^, or, (^swallow^, AND, (^cough^, or, ^chest^, or, ^breath^, or, ^choking^, or, ^/[R05^, or, ^/[R06^, or, ^gasping for air^,),),), andnot, (^substance^inhal^, or, ^inhalation of substance^, or, ^drink^water^, or, ^ask^water^,),), and, (^TUB ^, or, ^POOL^, or, (^BATH^, ANDNOT, ^bathroom^,), or, ^SWIM^, or, ^LAKE^, or, ^RIVER^, or, ^CREEK^, or, ^POND^, or, ^OCEAN^, or, ^WAVE^, or, ^SPRING^,),), or, (^submer^, ANDNOT, (^burn^, or, ^cast^, or, ^splint^, or, ^not submer^, or, ^ampu^, or, ^sickle^, or, ^not fully submer^, or, ^partially submer^, or, ^ear^, or, ^submerged object^, or, ^eye^, or, ^submerged up^, or, ^deny submer^, or, ^denies submer^, or, ^no submer^, or, ^not submer^, or, ^sting^ray^,),), or, (^f[ae]ll^, and, ^pool^, and, (^cough^, or, ^wheeze^, or, ^resucit^,),), or, (^swim^, and, (^unresponsive^, or, ^strugg^,),), or, (^/[T75.1 ____ [A;/]^, or, ^/[T751[0-9X][0-9X][A;/]^, or, ^/[V9[02]. ____ [0-9X][A;/]^, or, ^/[V9[02][0-9X][0-9X][0-9X][A;/]^, or, ^/[W16. ____ 1[A;/]^, or, ^/[W16[0-9X][0-9X]1[A;/]^, or, ^/[W16.[49]1X[A;/]^, or, ^/[W16[49]1X[A;/]^, or, ^/[W22.041[A;/]^, or, ^/[W22041[A;/]^, or, ^/[W6[579]. ____ [A;/]^, or, ^/[W6[579][0-9X][0-9X][A;/]^, or, ^/[W7[34]. ____ [A;/]^, or, ^/[W7[34][0-9X][0-9X][0-9X][A;/]^,),), ANDNOT, (^suicid^, or, ^assault^, or, (, (^/[X71^, or, ^/[X92^,), ANDNOT, (^/[V9[02]. ____ [A;/]^, or, ^/[V9[02][0-9X][0-9X][0-9X][A;/]^, or, ^/[W16. ____ 1[A;/]^, or, ^/[W16[0-9X][0-9X]1[A;/]^, or, ^/[W16.[49]1X[A;/]^, or, ^/[W16[49]1X[A;/]^, or, ^/[W22.041[A;/]^, or, ^/[W22041[A;/]^, or, ^/[W6[579]. ____ [A;/]^, or, ^/[W6[579][0-9X][0-9X][0-9X][A;/]^, or, ^/[W7[34]. ____ [A;/]^, or, ^/[W7[34][0-9X][0-9X][0-9X][A;/]^,),),

Description:
The purpose of this query is to identify initial visits for unintentional drownings in emergency departments and ambulatory healthcare settings.

Data Access Control and Permissions

- Full details vs. HHS region limited details
 - Data details will still be line level and preserve the number of rows but columns are removed
 - Access controls may restrict to limited details only
- Custom access controls can be applied at the query level
 - Example: Fulton county health officer's queries will always have a "WHERE region = Fulton_GA" appended, or syndrome for disease-specific investigation
 - Customized by the jurisdictional administrator

Data Access Control Differences

Access	[Sub] / Syndrome	Geography	Chief complaint	Discharge diagnosis info	CCDD category	Age format	Sex	Race / Ethnicity	Patient ID	Data quality
Px location limited	• / •	Patient's HHS region		ICD chapter/section		Group	•	•		•
Px location full	• / •	Patient's zip x county*	•	•	•	DOB	•	•	•	•
Facility location limited	• / •	Facility's HHS region		ICD chapter/section		Group	•	•		•
Facility location full	• / •	Facility x zip x county*	•	•	•	DOB	•	•	•	•

* ESSENCE region = collection of zip codes mapped to county

Using the ESSENCE System

What is ESSENCE

- Web-based information system to query the data, explore the queried data, and create some visualizations and analytics (especially alerting)
- “Electronic Surveillance System for the Early Notification of Community-based Epidemics”
 - Less emphasis on early notification aspect recently
 - Track and describe trends or patterns in disease and any unexpected deviations from those trends
 - Detect any instance of rare or emerging diseases or conditions
 - Use expanded to many disease and conditions, examples: firearms, suicide, boating accidents, homelessness
- Specialized interface for syndromic surveillance
 - Can handle the large volume of data better than other generic analytic platforms
 - Features developed in consultation with user community over many years

Introduction

- A demonstration will guide the user through select ESSENCE features and functions. However, there is more than one pathway to access ESSENCE data visualization and analysis features.
- No single “correct” method for using ESSENCE - after walking through suggested paths within this demo, the user is encouraged to further explore additional functions embedded within ESSENCE features.
- With frequent use and familiarity, over time, individuals often establish their preferred path(s) for viewing ESSENCE visualizations and analysis outputs of interest.

Exploring Data

Two primary ways to evaluate data for exploratory or summary analysis

1. Quantitative Enumeration

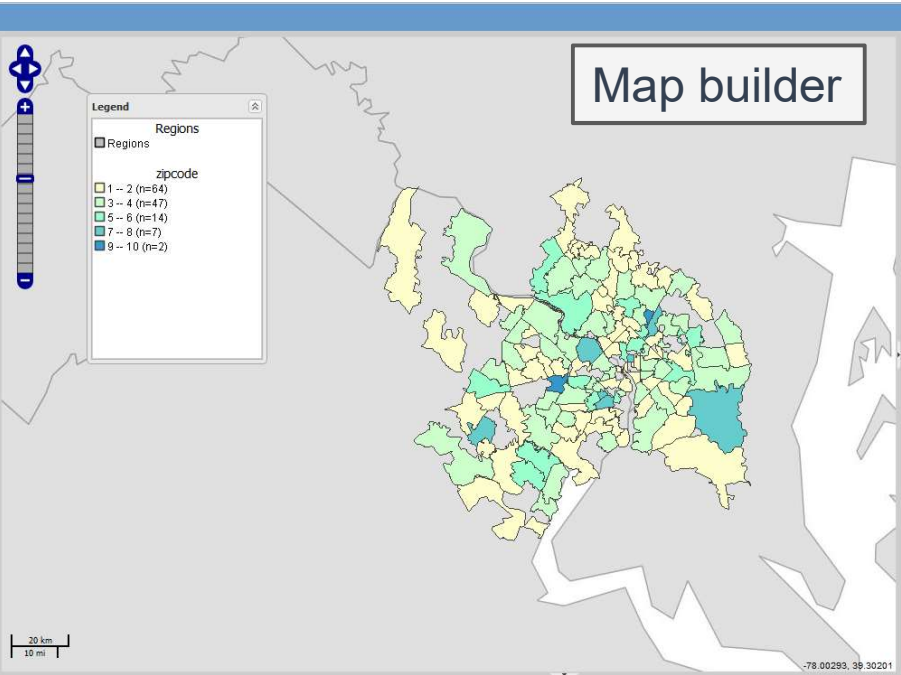
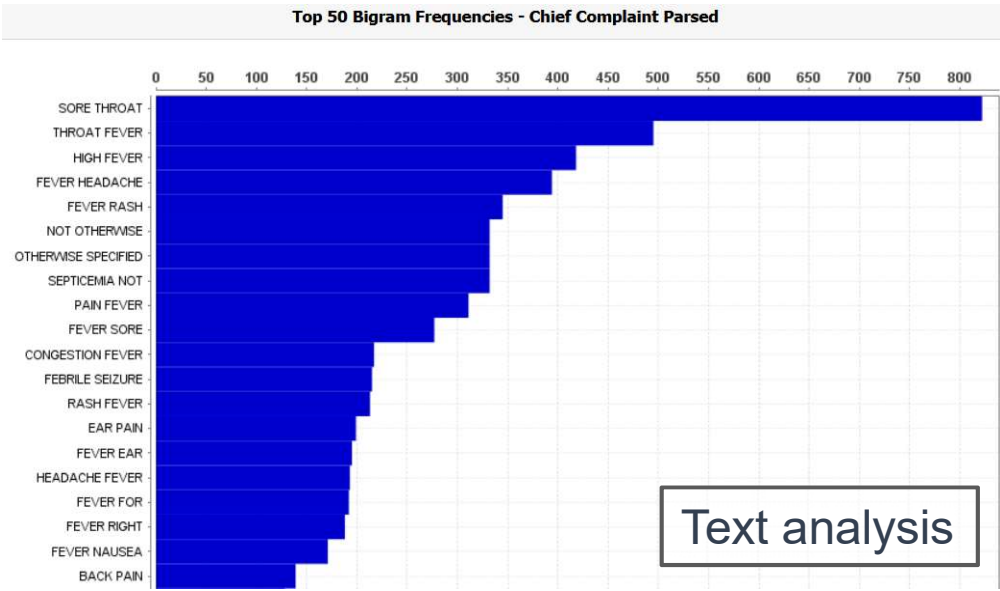
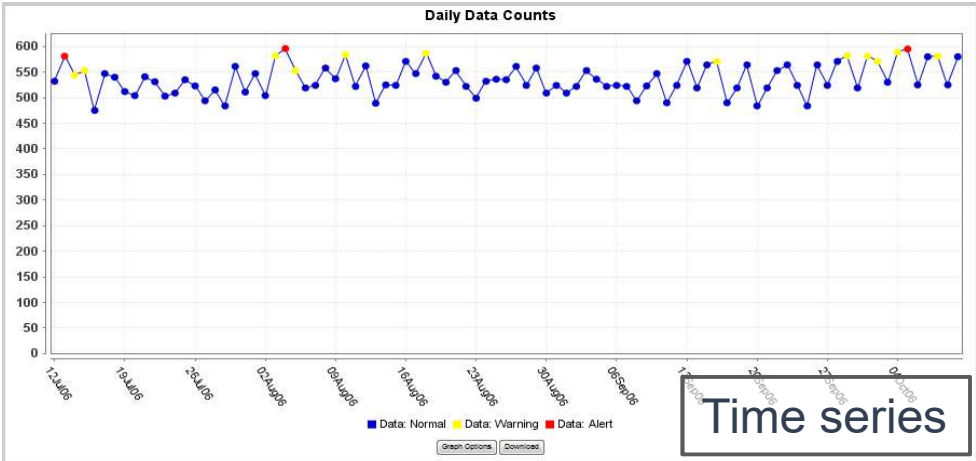
- Number of records matching query parameters
- Percentage of records matching query parameters (Number of matching records / denominator of broader record count)
 - Example: percent of pediatric ILI visits out of total ILI visits

2. Text data exploration

- Characterize free text in various ED fields, especially chief complaint
- Can be quantified by summing records that match a custom free text query

Basic ESSENCE system components

Core ESSENCE Tools



Syndrome	Facility Type	
	data (22 cells)	

Data Table		
Show All Totals Hide Zero Count Rows		
Syndrome	Facility Type	
Show Totals	Show Totals	
	Emergency Room	Urgent Care
Bot_Like	186	56
Fever	23206	10563
GI	54916	24242
Hem_Ill	60	45
Loc_Les	2862	1318
Lymph	870	457
Neuro	1827	825
Other	355099	157044
Rash	2814	18120
Resp	1611	680
SI_Death		

Table Builder (Pivot table)

Date	Time	Zipcode	Region	PatientCI...	ChiefComplaintParsed	ChiefComplaintUpdates	Category_flat
13/jul/2006	02:56 AM	OT_OTHER_REGION - OTHER	Other_Region	male	none		FEVER HEARTBURN NAUSEA
13/jul/2006	11:34 PM	OT_OTHER_REGION - OTHER	Other_Region	male	none		FEVER
13/jul/2006	07:46 AM	OT_OTHER_REGION - OTHER	Other_Region	male	none		FEVER
13/jul/2006	06:33 PM	OT_OTHER_REGION - OTHER	Other_Region	male	none		HIGH TEMPERATURE FEB SEIZURE
13/jul/2006	12:32 AM	OT_OTHER_REGION - OTHER	Other_Region	male	none		FEVER
13/jul/2006	10:43 AM	MD_PRINCE GEORGES - 20772	Prince Georges, MD	18	Female	none	FEVER
13/jul/2006	07:21 PM	MD_PRINCE GEORGES - 20774	Prince Georges, MD	33	Female	none	CHILLS
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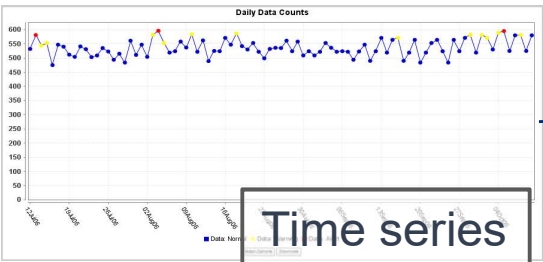
Data details (line level data export)

Core ESSENCE Tools: Workflow

A query (via query portal)

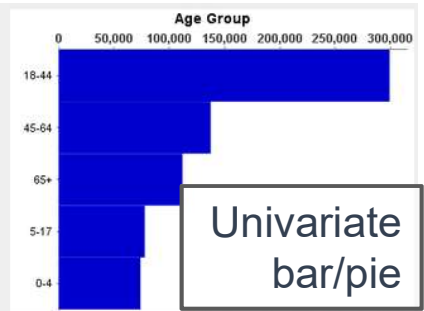
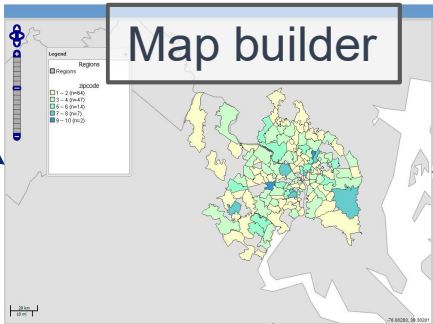
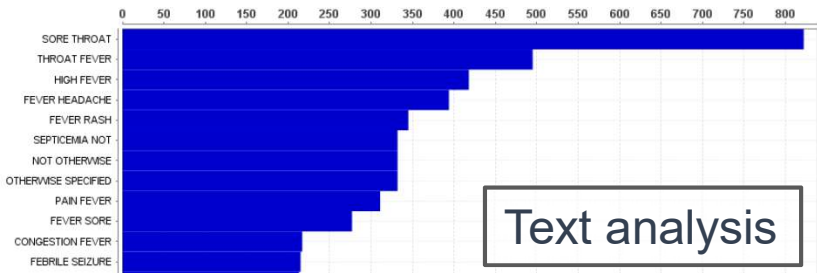
Syndrome	Facility Type
data	(22 cells)
Data Table	
Show All TotalsHide Zero Count Rows	
Syndrome	Facility Type
Show Totals	Show Totals
	Emergency Room Urgent Care
Bot_Like	186 56
Fever	23206 10563
GI	54916 24242
Hem_Ill	60 45
Loc_Les	2882 1318
Lymph	970 457

Table Builder (Pivot table)



Sex	PatientCl...	ChiefComplaintsParsed
Female	none	FEVER HEARTBURN NAUSEA
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER
Female	none	FEVER

Data details (line level data export)



Dashboard (myESSENCE)

Logging In

- Note: *Mozilla Firefox is the recommended web browser for use with ESSENCE. Compatibility is not guaranteed with other browsers.*
 - Enter your user ID and password and click the Log In button

The image shows a login interface for the ESSENCE system. On the left is a circular logo with the word "ESSENCE" in blue, a globe, and a caduceus. To the right of the logo are two text input fields: the top one is labeled "User ID" and the bottom one is labeled "Password". Below these fields is a "Log In" button.

- This will take you to the NSSP ESSENCE home page

Accessing the Query Portal

ESSENCE - NSSP - Training
Home

Manage Users | Analyze Logs | Reference Manager | Logout ESSENCE Test User

Bookmark Name: Bookmark Page:
No Comments Available | Add to Comment

Home | Alert List | myAlerts | myESSENCE | Event List | Overview Portal | **Query Portal** | Stat Table | Map Portal | Bookmarks | Query Manager | Data Quality | Report Manager | More

Version 1.20



System Information	
Date	Description
14Jul20	Staging system maintenance occurs the second Thursday of every 1 month from 2:00 PM to 4:00 PM

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NOT FOR PUBLIC DISCLOSURE

- The Home Page provides access to the System Information section. This section can contain announcements and information posted by the administrators.

What is the purpose of a query?

- I don't know exactly what I'm looking for yet (case definition): craft the most accurate search parameters to identify “real” cases with maximum sensitivity* and specificity
 - Syndrome definition process – an entire community of practice dedicated to this
 - Usually disease-specific experts
- I know what I'm looking for (query to filter): Filter through all records to create a salient analytic subset

Quiz: Elements of a Query

- According to epidemiologic case definition principles, what are the key elements that a query might need to include?
- Is there such thing as a “right” or “wrong” query for syndromic surveillance? [bonus: how would we know?]

The Core of an ED Query

- Date range and time resolution
 - Default 90 days
 - Longer or historical date ranges can significantly slow down the speed of a query
 - System needs to pull baseline window period to set up alert detection baseline (daily, weekly)
- Geographic resolution / granularity (geography “system”)
- Disease categorization method (medical grouping “system”)
- The query’s result metric
 - Count of records
 - Percentage of records, out of some denominator

Epidemiologic Criteria: Who, what, when, where

When

The screenshot shows the 'Query Wizard' interface with several annotations:

- When:** A blue box labeled 'When' points to the 'Start Date' and 'End Date' fields, which are circled in blue. The 'Start Date' is '12Jul06' and the 'End Date' is '10Oct06'.
- Where:** A green box labeled 'Where' points to the 'Selected Query Fields' list on the right, which is circled in green. It contains 'Geography System' (Region), 'Region' (Arlington, VA), 'Medical Grouping System' (ChiefComplaintSubSyndromes), 'ChiefComplaintSubSyndromes' (Influenza, ILI, RespiratorySyncytialVirus), and 'Age Group' (0-4, 5-17).
- What:** An orange box labeled 'What' points to the 'ChiefComplaintSubSyndromes' list in the center, which is circled in orange. It shows 'Available' items (AbdominalCramps, AbdominalPain, AbdominalPainGroup, AbdominalTenderness, Abscess, AcuteBloodAbnormalities, AcuteBloodAbnormalitiesGroup, AlcoholUse) and 'Selected' items (Influenza, ILI, RespiratorySyncytialVirus).
- Who:** A red box labeled 'Who' points to the 'Available Query Fields' list on the left, which is circled in red. It includes 'Region', 'Zipcode Free Text', 'Facility', 'Special Regions', 'Facility Location', 'Zipcode', 'Medical Grouping System', 'ChiefComplaintSubSyndromes', 'Syndrome', 'ChiefComplaints', 'Age Group Filters', 'Sex', 'Race', 'Ethnicity', and 'Patient Class'.

At the bottom, a blue box contains the text: '4. Execute query to one of these outputs:'

Below the blue box are several buttons: Table Builder, Time Series, Data Details, Text Analysis, Graph Builder, Overview, Edit Overlay, Adv Qry, Explain Qry, and Reset.

1. Select a query field

2. Define the search parameters for that field (keep all; AND)

3. Apply selection

Query defaults: Any vs. All

Query Wizard

Datasource: ER Data by Patient Location | Time Resolution: Daily | Detector: Regression/EWMA 1.2 | As Percent Query: No Percentage Query | Start Date: 12Jul06 | End Date: 10Oct06

Available Query Fields: Region, Zipcode Free Text, Facility, Special Regions, Facility Location, Zipcode, Medical Grouping System, ChiefComplaintSubSyndromes, Syndrome, ChiefComplaints, Age Group Filters

ChiefComplaintSubSyndromes

Search String: [] Apply Clear Tip

ChiefComplaintSubSyndromes List:

Available	Selected
AbdominalCramps	Influenza
AbdominalPain	ILI
AbdominalPainGroup	RespiratorySyncytialVirus
AbdominalTenderness	
Abscess	
AcuteBloodAbnormalities	
AcuteBloodAbnormalitiesGroup	
AlcoholUse	

Query

Region: Arlington, VA AND Age Group: 00-04, 05-17 AND ChiefComplaintSubSyndromes: ILI, Influenza, RespiratorySyncytial...

The query is all visits with the specified region, age group, and chiefcomplaintsubsyndromes.

At this geographic granularity

Match any of these things

and

Match any of these things

and

Match any of these things

Pop-up will explain expected result

Explain Qry

Advanced Query

ESSENCE - NSSP - Training
Advanced Query

Manage Users | Analyze Logs | Reference Manager | Logout Essence Test User

Bookmark Name: [] Bookmark Page: []
No Comments Available | Add to Comment

Home | Alert List | myAlerts | myESSENCE | Event List | Overview Portal | Query Portal | Stat Table | Map Portal | Bookmarks | Query Manager | Data Quality | Report Manager | More

Data Source: Patient Location (Full Details) | Start Date: 12Jul2006 | End Date: 10Oct2006 | Detector: Regression/EWMA 1.2

Message Area

Query

[AGEGROUP="00-04"] AND [SYNDROME="GI"] OR [AGEGROUP="05-17"] AND [SYNDROME="Fever"]

Example: [AGEGROUP = "00-04"] OR ([SUBSYNDROME = "ACUTE BLOOD ABNORMALITIES"] AND [ZIPCODE = "21043"]) [More...](#)

Query Builder

AND OR () Add Expression Undo Last Change

Variable Tip

- QUARTER
- RACE
- REGION
- SEX
- SITE
- STATE
- SYNDROME
- TENYEARAGEGROUP
- TRIAGENOTESORIG
- TRIGGEREVENTHISTORY

Operator

- =
- <>
- Contains
- Starts With
- Ends With
- Does Not Contain
- Does Not Start With
- Does Not End With

Values

- Bot_Like
- Exposure
- Fever
- GI
- Hemm_Ill
- ILI
- Injury
- Neuro
- Other
- Rash

Group multiple selections with : ☒ OR ☐ AND

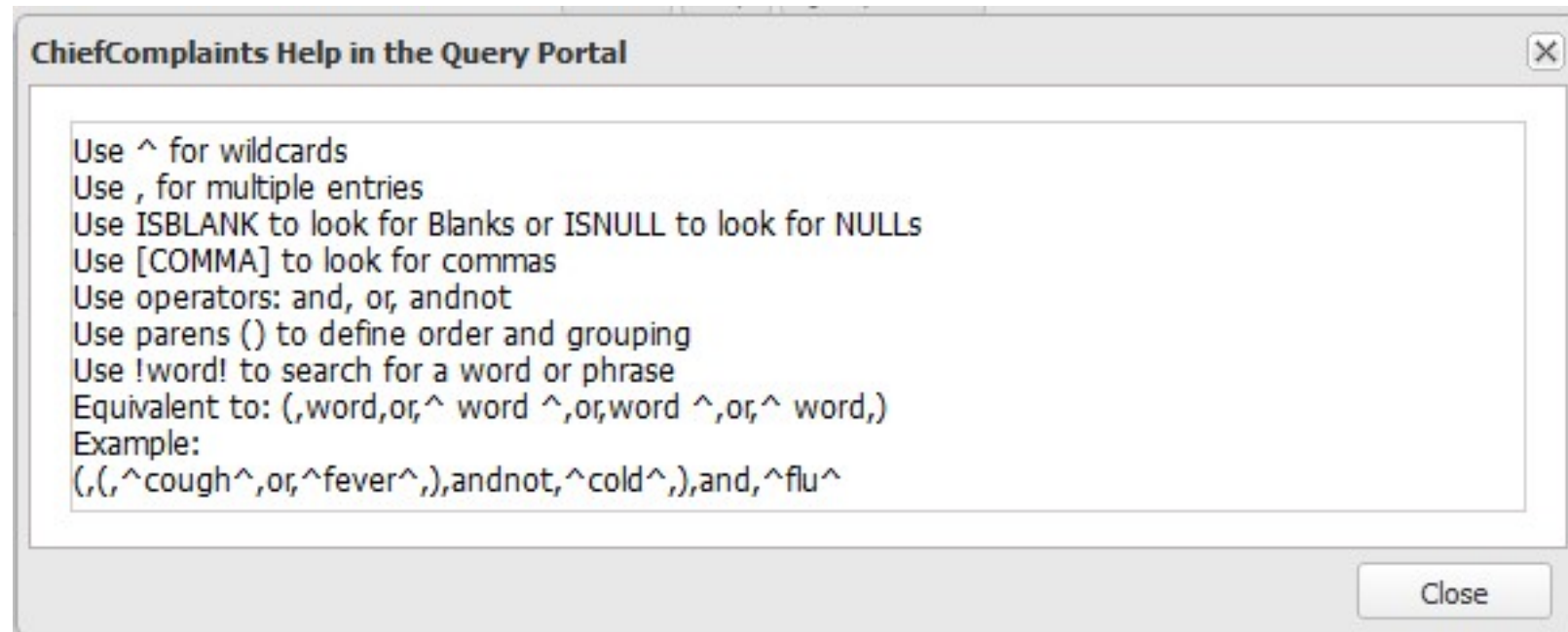
Validate Query | Save Private Expression | Save Public Expression | Save Administrator Expression | Clear Query

Execute

- For the purpose of this walkthrough, please choose the Adv Qry button
- The AQT screen allows you to create complex queries, such as overriding default “and” behavior for query fields
- You can use the forms at the bottom to choose Variables, Operators, and Values.
- Once chosen, you can click “Add Expression” to put the expression into the Query window.
- You can also type your query directly into the Query Window.
- Continue on next slide...

Free-text querying syntax basics

- All text is case insensitive
- Typically use wildcard caret ^ character before and after ^ search term, otherwise implies search term comprises the whole text field
- Be aware of possible negations
- The chief complaint processor will expand common abbreviations into CC parsed field

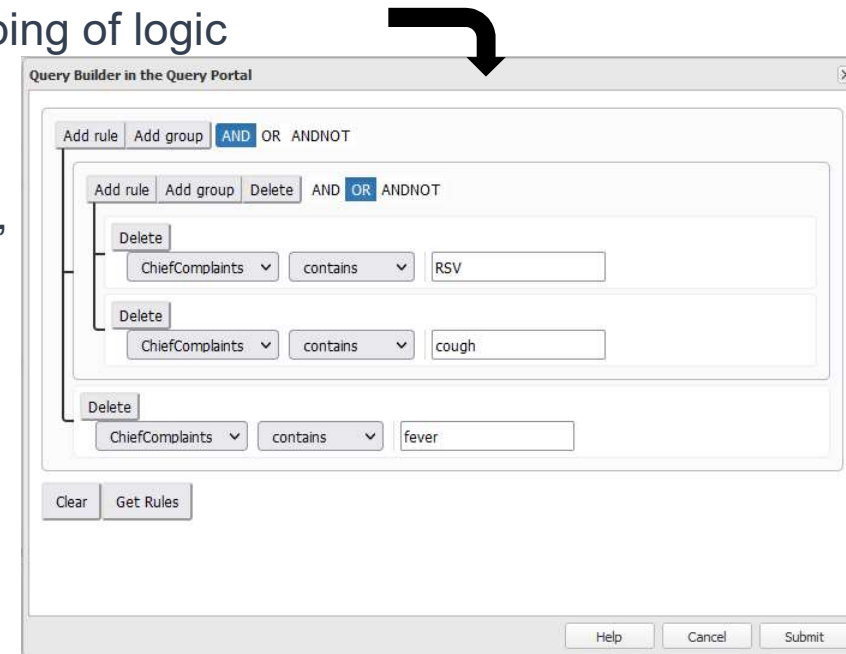


Breakout Room Quiz: Natural Language Complications

- Search for string ^COVID^, which of the following results could be excluded in a COVID case definition? (how would you exclude?)
 - “Suspected COVID”
 - “ILI not COVID”
 - “Fatigue / side effects associated with COVID vaccine”
 - “patient had no COVID vax[ccine]”
 - “wanted to make sure its not COVID”
 - “had a recent COVID infection”
- YouTube tutorial on free-text querying: <https://www.youtube.com/watch?v=wwZBsYS1Kt4>

Free-text querying syntax: AND, OR, ANDNOT

- Order of operations:
 - Parentheses
 - AND/ANDNOT (left to right)
 - OR (left to right)
- TIP: click “Query Builder” to visualize operational grouping of logic
 - ^RSV^,OR,^cough^,AND,^fever^
- TIP: query should not contain extra spaces, linebreaks, or special characters from (e.g. from Word document)
 - ^RSV^,OR,
(^cough^,AND,^fever^)
- TIP: query may still work without commas, but may not behave as expected
- Practice: search for records that have both fever and cough, or the term “COVID” by itself, except exclude all records that mention vaccine.

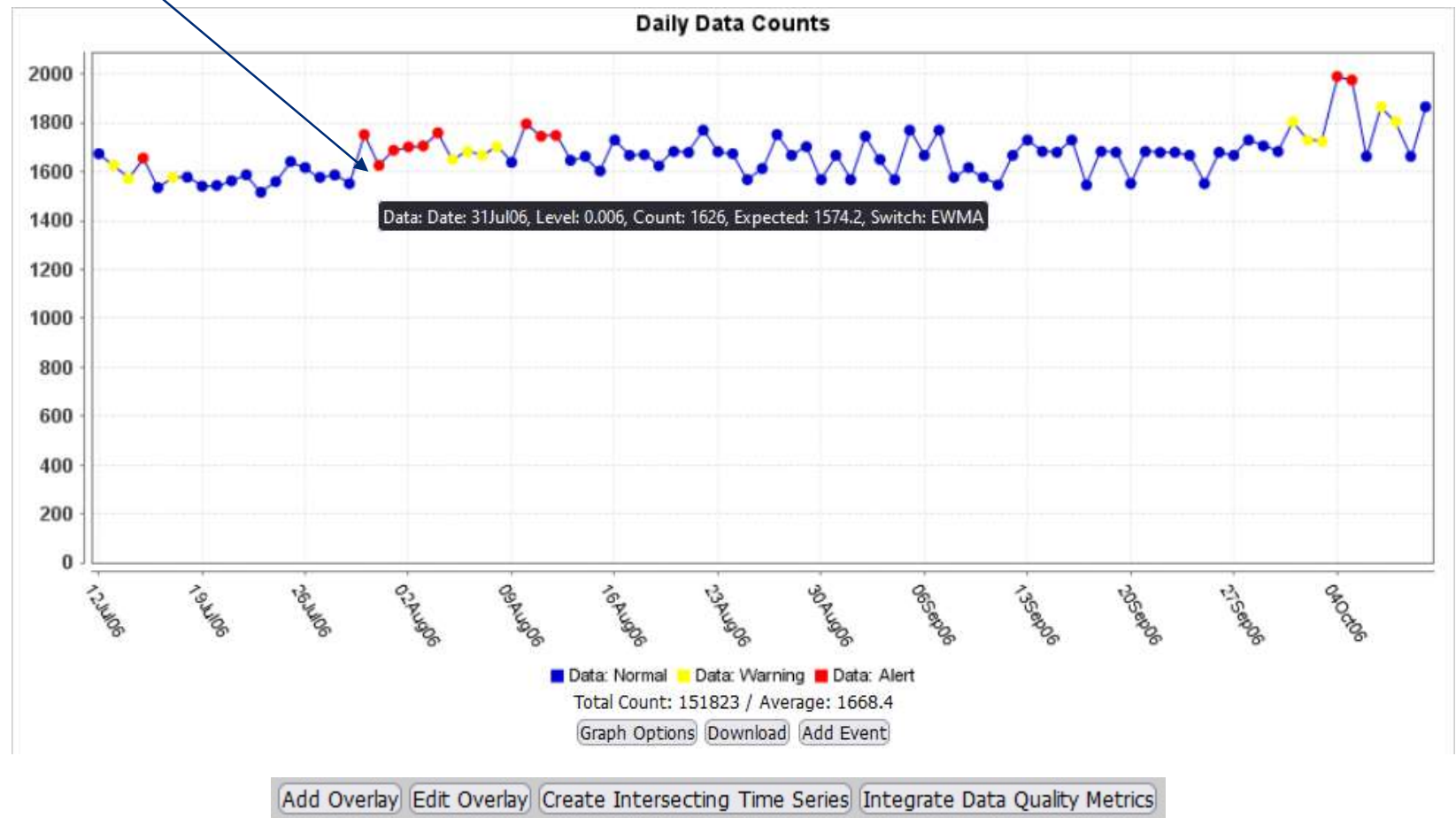


Time Series

Time Series Page

- Time series is a core descriptive tool for syndromic surveillance
- It is one of the primary ways to visualize the result of a query.
- The primary data analysis tool in ESSENCE, **alerting** [for higher-than-expected number of records], is based on time series data.
- You can further investigate time series by stratifying by demographic or geographic sub-groups.
- A query with no filters will return all records by default

Mouseover point for information



Stratified time series

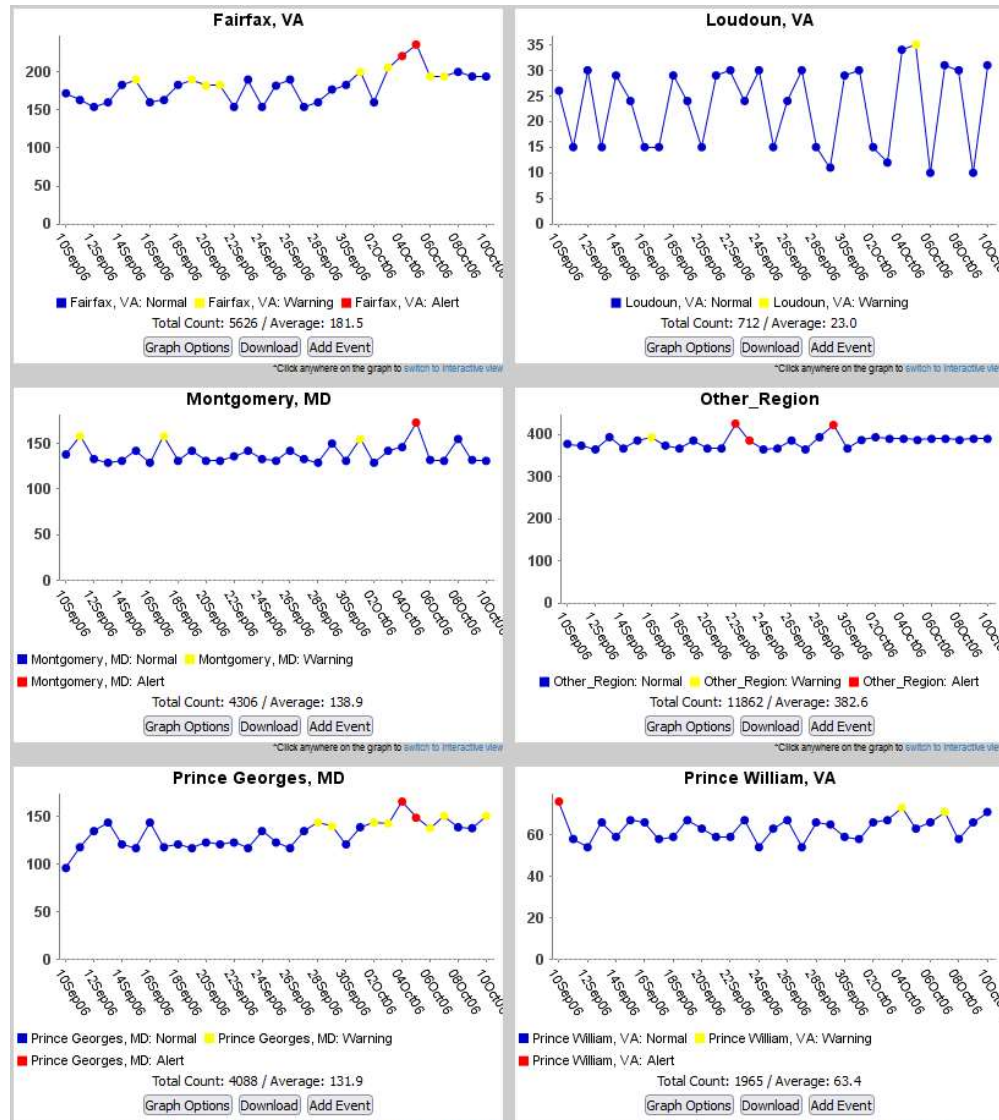
- Stratify (disaggregate) time series data by sub-group
 - All overlaid on the same plot (within-graph stratification)
 - Create separate sub-plots for each stratum (between-graph stratification)
- Allows comparison and/or isolation of group(s)

The screenshot shows a web-based configuration interface for data series. It includes sections for 'Query Options' and 'Data Series Options'. The 'Data Series Options' section is expanded, showing settings for stratification and graph display. The 'Within Graph Stratification' dropdown is empty. The 'Across Graphs Stratification' dropdown is set to 'Region'. Under 'Graph Options', 'Multiple Graphs (Small)' is selected. The 'Composite with Zero Series Removed' checkbox is unchecked, and the 'Remove Zero Series' checkbox is checked. An 'Update' button is at the bottom right of the configuration area.

Data Series Options	
Within Graph Stratification:	
Across Graphs Stratification:	Region
Graph Options:	☐ Single Graph ☒ Multiple Graphs (Small) ☐ Multiple Graphs (Large) ☐ Micro Graphs
Composite with Zero Series Removed: Help	☐
Remove Zero Series: Help	☒
Update	

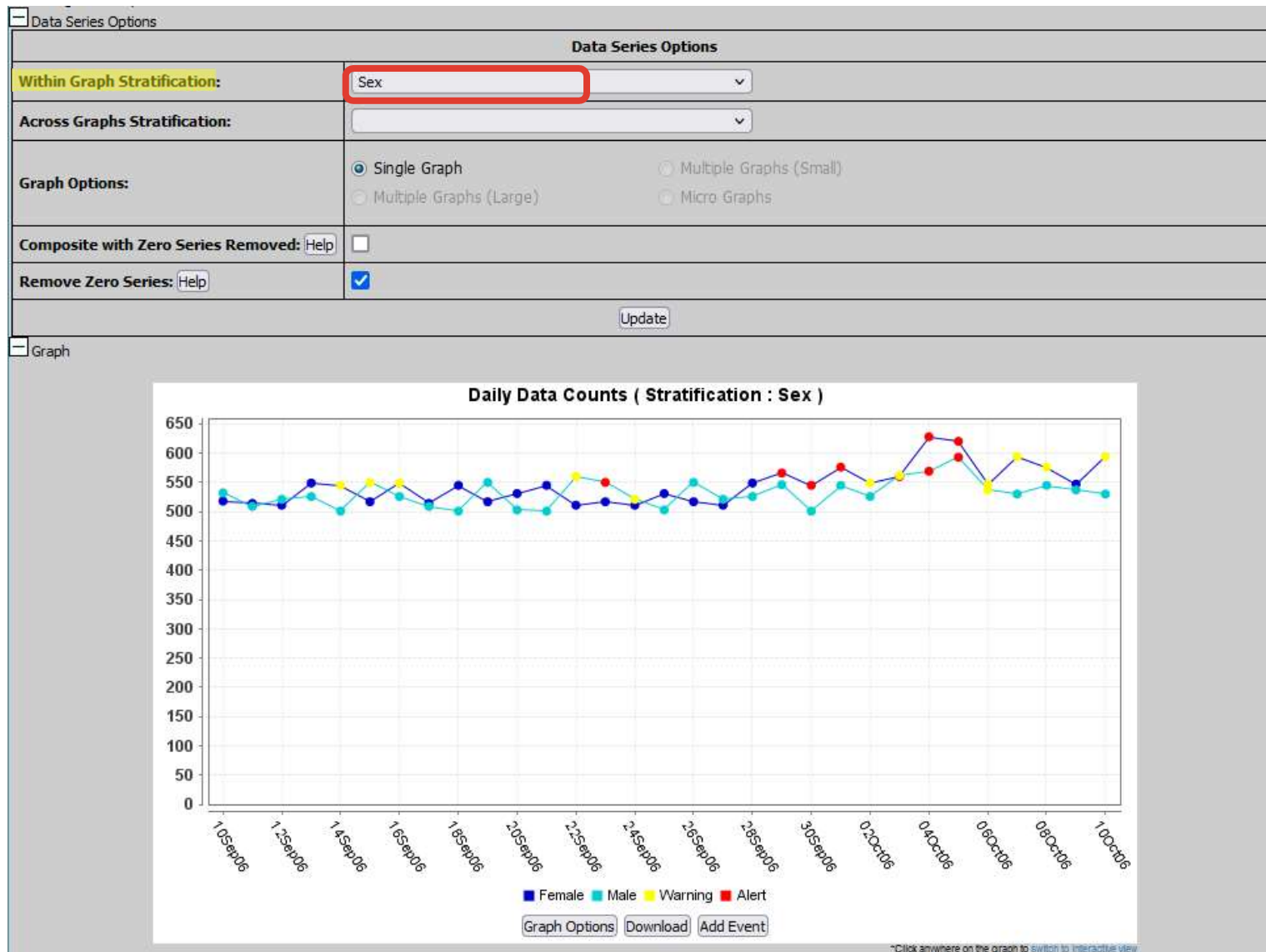
- There are also options for Removing Zero Series, and putting each year as its own series.
- For the purpose of this walkthrough, please select “Across Graphs Stratification -> Region”, and Update.

Time Series Page: Across-Graph Stratification



- Each ESSENCE region (mapped county) is now in its own time series graph.
- Alerts are calculated separately for each region stratum.

Time Series Page: Within-Graph Stratification



- Select within-graph stratification to draw each strata on the same graph.
- The Y-axis will be shared in common. If on separate graphs, Y-axis will auto-scale separately. User can choose free Y as micrographs
- Next expand the “configuration options” [+] icon to revisit the query parameters

Time Series Page: Configuration Options

Configuration Options

Query Wizard

Datasource: ER Data by Patient Location Time Resolution: Daily Detector: Regression/EWMA 1.2 As Percent Query: No Percentage Query Start Date: 10Sep06 End Date: 10Oct06

Available Query Fields

- ER Data by Patient Location
 - MyFilters
 - Geography System
 - Region
 - Zipcode Free Text
 - Facility
 - Special Regions
 - Facility Location

Sorts/Filters/Processing (Beta)

- ER Data by Patient Location
 - Within Graph Stratification
 - Across Graph Stratification**
 - Graph Display Style
 - Labels and Display
 - Filtering and Sorting
 - Multigraph Options
 - Micrograph Options
 - Other Options

Across Graph Stratification

Geography

Selected Query Fields

- Geography System
 - Region
- Medical Grouping System
 - ESSENCE Syndromes
- Across Graph Stratification**
 - Geography
- Graph Display Style
 - Multiple Graphs (Small)
- Remove Zero Series
 - True
- Composite with Zero Series Removed
 - False
- Year Stratification Graph Start Week or Month
 - January

Expanding query “Configuration Options” revisits the query parameters. Note updates automatically made for stratification

Stratification and other graph options can be pre-defined before running a query

Table Builder Time Series Data Details Text Analysis Graph Builder Overview Edit Overlay Adv Qry Explain Qry Reset

MyFilter: Create

myESSENCE Dashboard

myESSENCE Dashboard

- MyESSENCE is a customizable dashboard comprising visualizations or outputs from one or more queries, and save the configuration for future reference and/or sharing to other users.
- Dashboards are organized by tab. To open a dashboard, you can click on the corresponding tab; alternatively, the list of tabs is displayed under myESSENCE overview, and you can select one or more and click the “open” button.



myESSENCE Dashboard, continued

- Each “widget” (time series graph, map, pivot table, alert list, or data details table) will draw on an underlying query which can be defined by a saved query, or can be directly sent to myESSENCE tabs using the “Add to myESSENCE” button in time series options
- When the dashboard tab is loaded, queries will re-run, updating the dashboards. (Widgets that rely on more complex queries could take some time to appear.)
- Start with the “add new widget” menu:

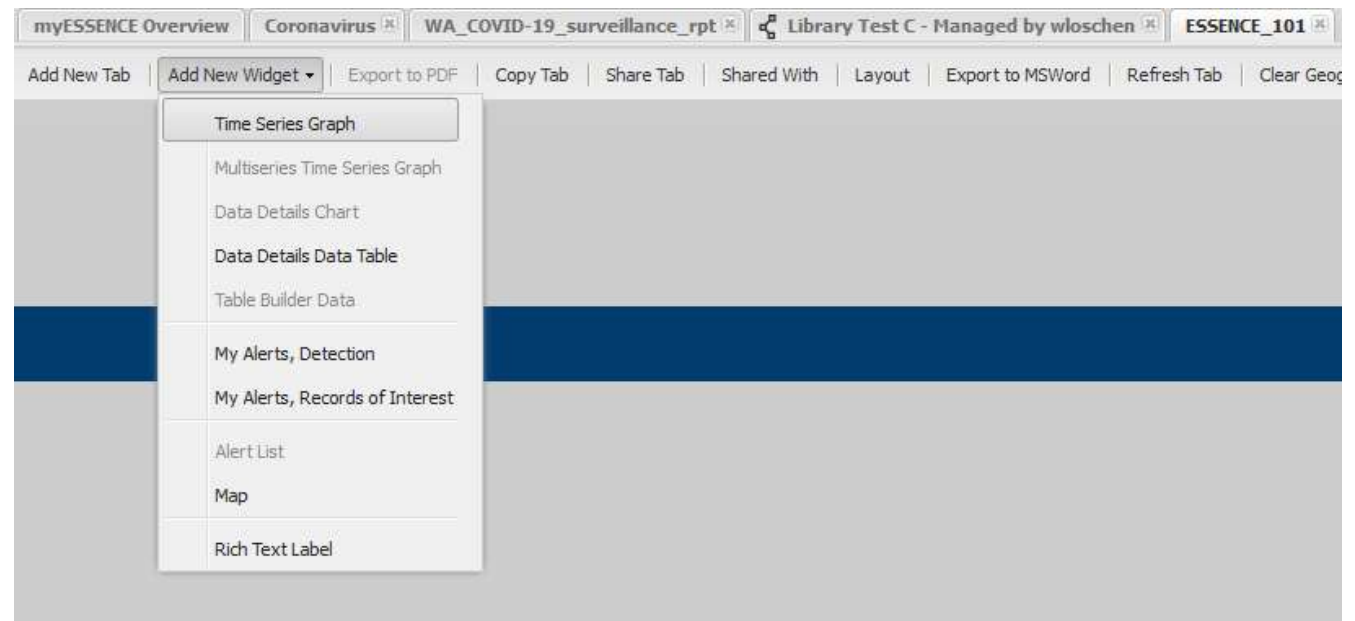
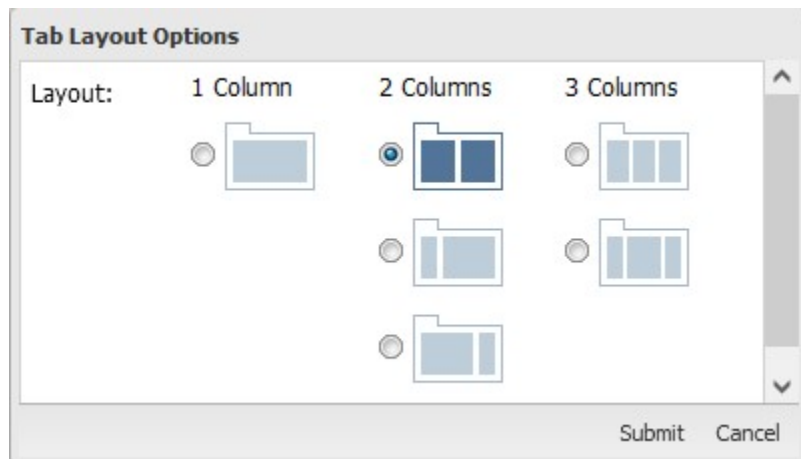


Table Builder (Pivot Table, crosstabs)

- Must define a categorical row variable and categorical column variable
- Table contents are the cross-tabulation of record counts for those categorical combinations
- Show all totals (similar to Excel pivot table grand totals)

Sex	Region																	Total
	Alexandria, VA	Anne Arundel, MD	Arlington, VA	Baltimore City, MD	Baltimore, MD	Carroll, MD	Charles, MD	Fairfax, VA	Frederick, MD	Harford, MD	Howard, MD	Loudoun, VA	Montgomery, MD	Other_Region	Prince Georges, MD	Prince William, VA	Washington, DC	
Female	404	0	548	0	0	0	0	2798	0	0	0	374	2195	6023	2061	967	1534	16904
Male	411	0	501	0	0	0	0	2828	0	0	0	338	2111	5839	2027	998	1428	16481
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	815	0	1049	0	0	0	0	5626	0	0	0	712	4306	11862	4088	1965	2962	33385

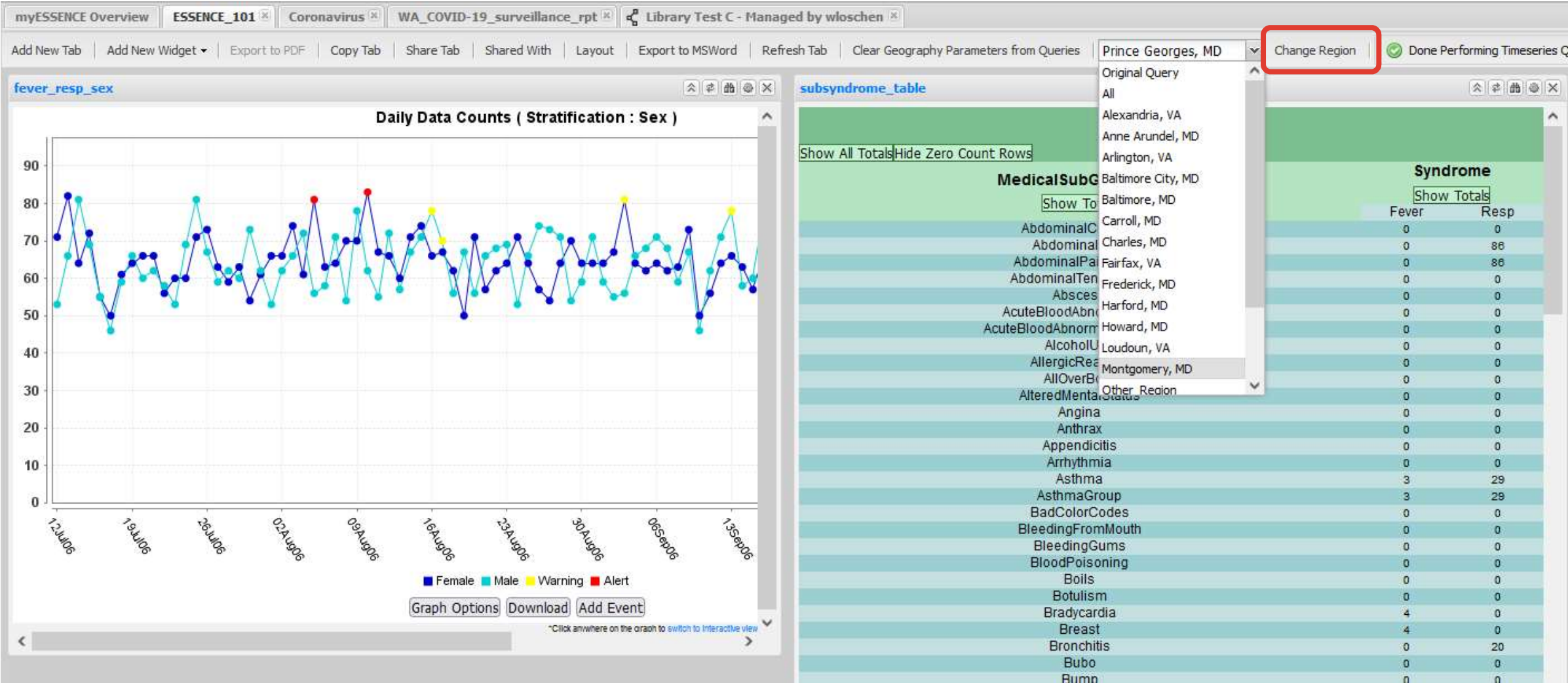
- Time series and data tables that are stratified by syndrome, sub-syndrome, CCDD category, or ICD-10 code will cause apparent duplication – why?
 - Check data structure in line level data (data details)

Sending Visualizations to myESSENCE Dashboard

- Add pivot table directly to myESSENCE dashboard tab under Query Options

The image shows a screenshot of a web application interface. On the left, there is a sidebar with several expandable sections: 'Description' (expanded), 'Query Options' (collapsed), 'Configuration Options' (expanded), and 'Table Configuration Options' (collapsed). Below 'Query Options', there are three buttons: 'Add to myESSENCE', 'Save Report Query', and 'API URLs'. The 'Add to myESSENCE' button is highlighted. Overlaid on the right is a dialog box titled 'Save Table Builder to Portal'. The dialog has a close button (X) in the top right corner. It contains two rows of input fields. The first row is 'Tab Name:' followed by a dropdown menu showing 'ESSENCE_101'. The second row is 'New Portlet Name:' followed by a text input field containing 'cross_tab', followed by the text 'or Replace Portlet:' and another dropdown menu. At the bottom right of the dialog are two buttons: 'Submit' and 'Cancel'.

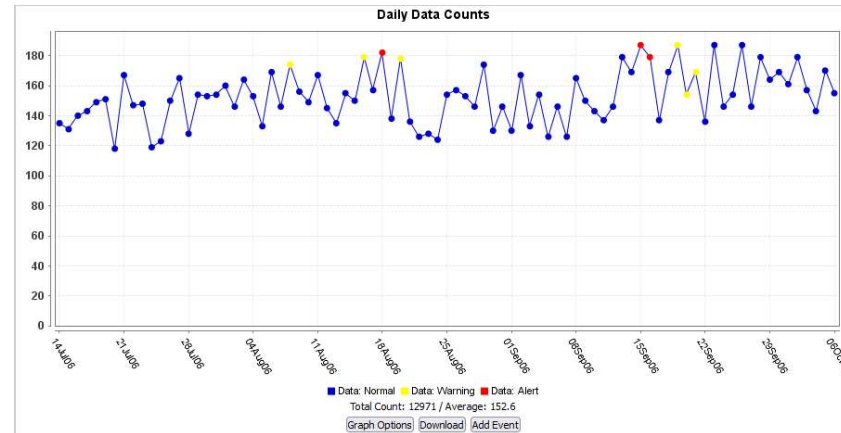
myESSENCE dashboard Region Slicer (filter)



ESSENCE Alerting algorithms

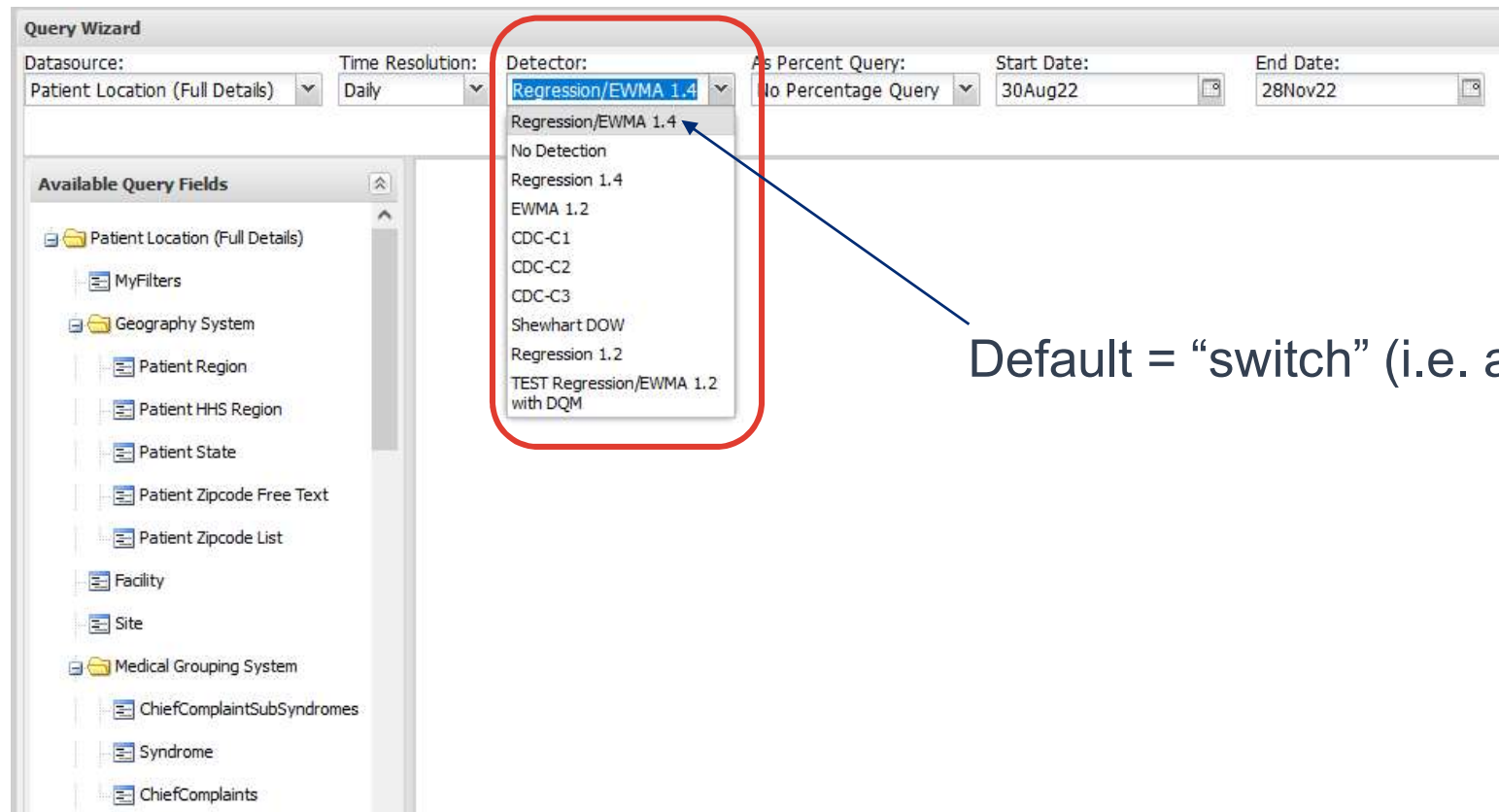
Alerting Algorithms Overview

- Alerting algorithm conducts an analysis of a time series query result



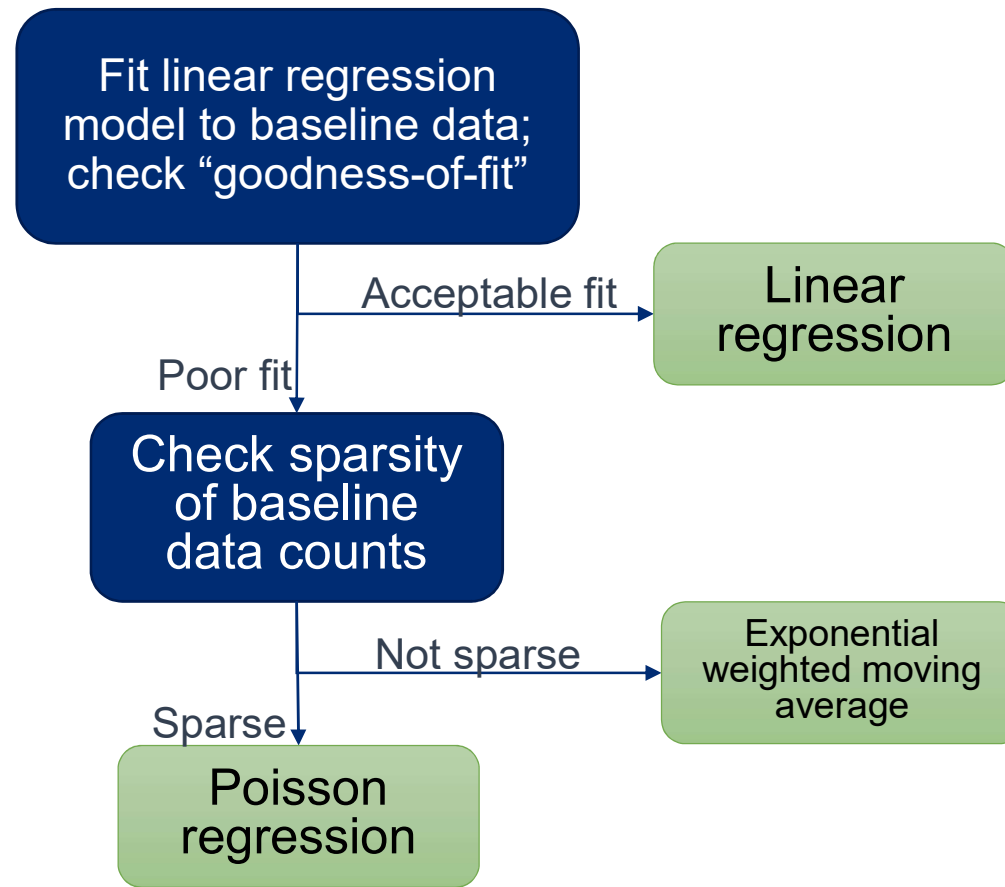
- Purpose: to direct the attention of the users to data features that merit further investigation
- Monitor for unusually high counts, not low counts (one-sided tests).
 - Not optimized for proportions (Y-axis = % of visits)
- Each day's alerting status is calculated independently (does not consider alert status from previous day(s))

Select Algorithm for on-the-fly Query

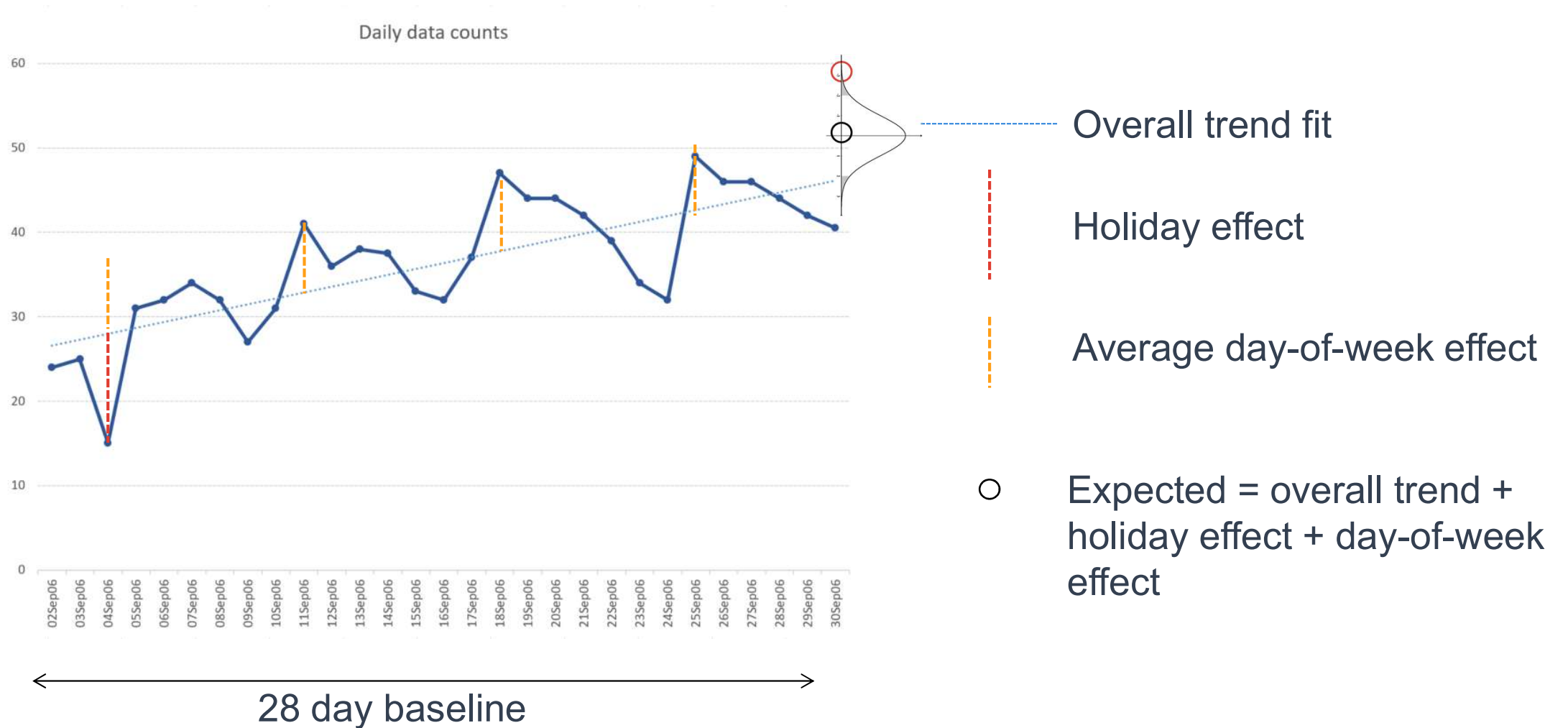


Default = "switch" (i.e. automatically select best)

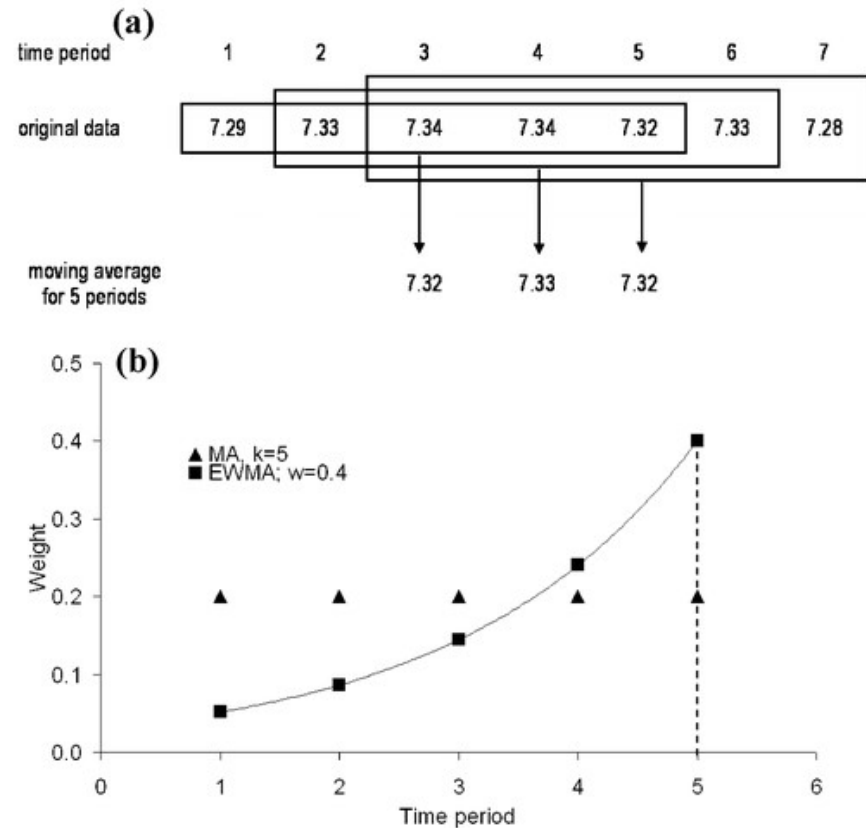
Switch Algorithm



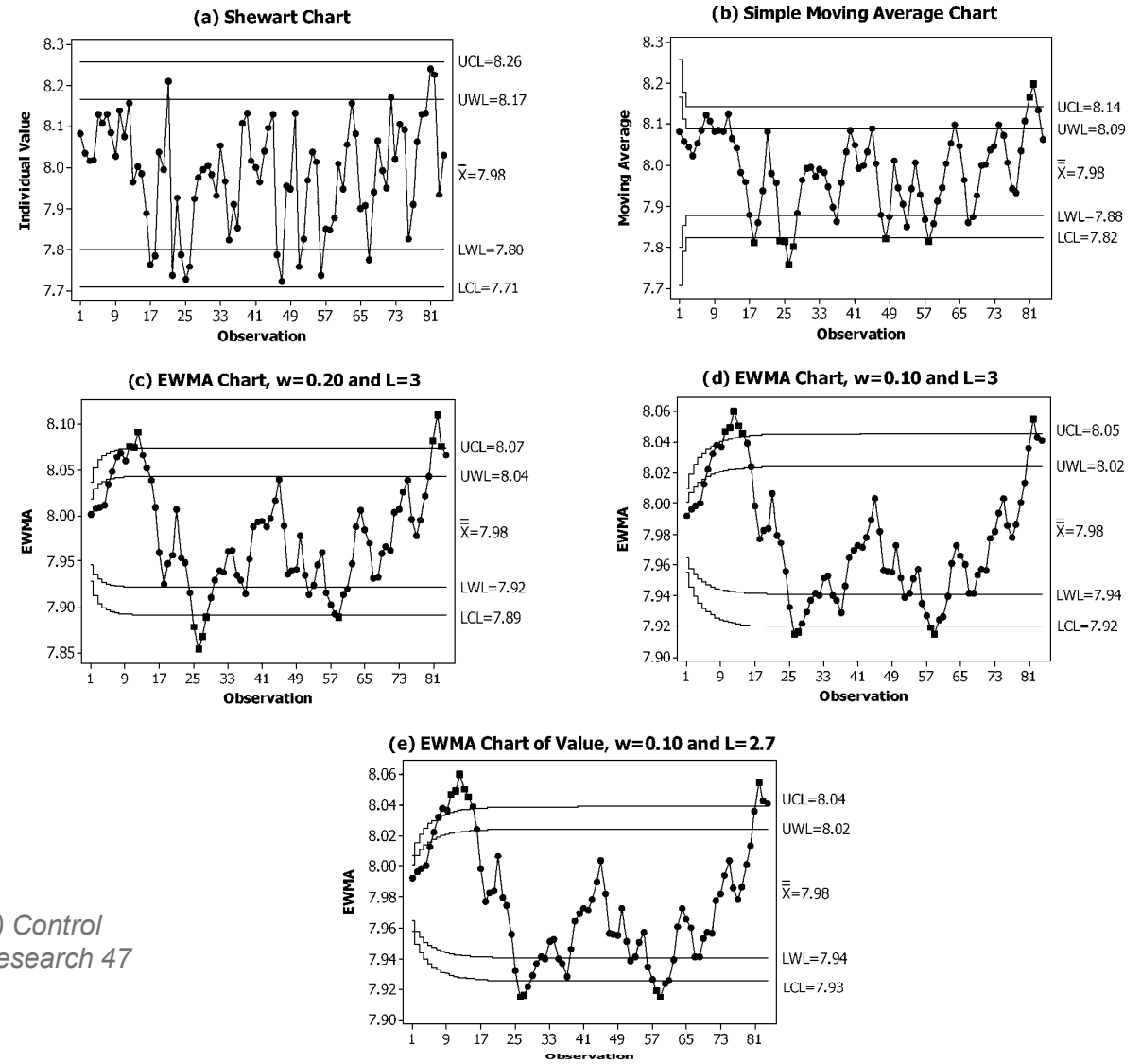
Linear Regression Algorithm



Exponentially Weighted Moving Average



Carson PK and Yeh AB. (2008). Exponentially Weighted Moving Average (EWMA) Control Charts for Monitoring an Analytical Process. *Industrial & Engineering Chemistry Research* 47 (2), 405-411



Compare Detector Algorithms for your Query

Popup options
(underneath time series
result)

Select detectors to compare:

Regression/EWMA 1.2

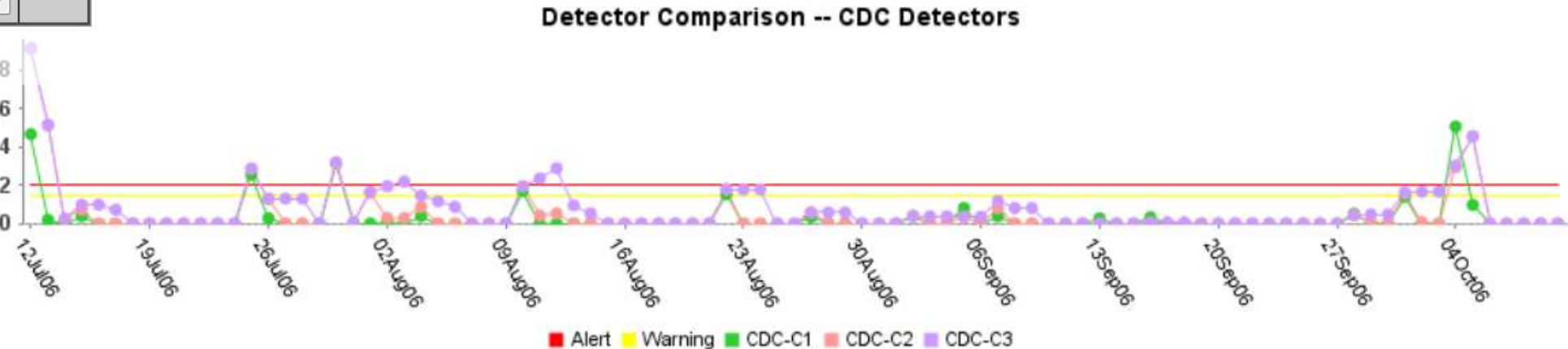
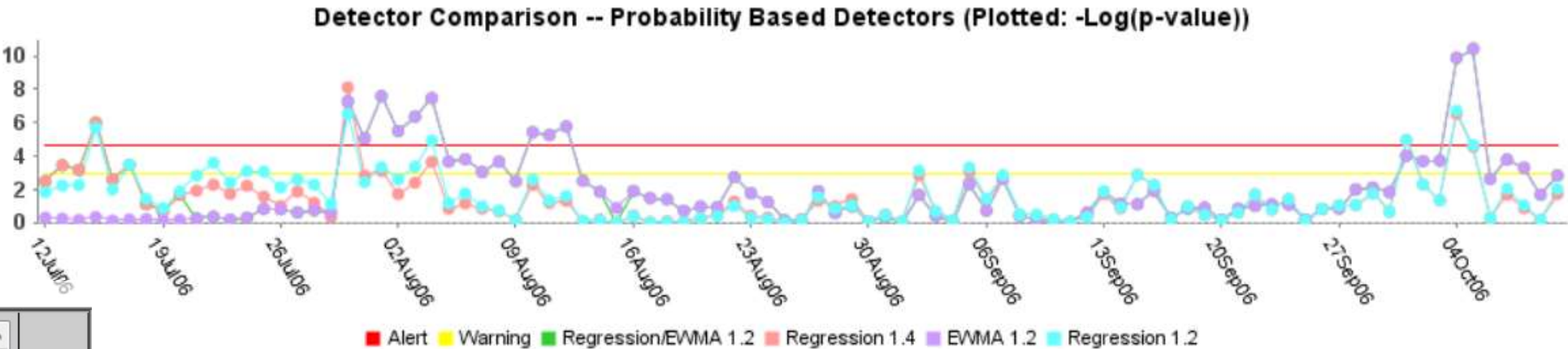
Regression 1.4

EWMA 1.2

CDC-C1

CDC-C2

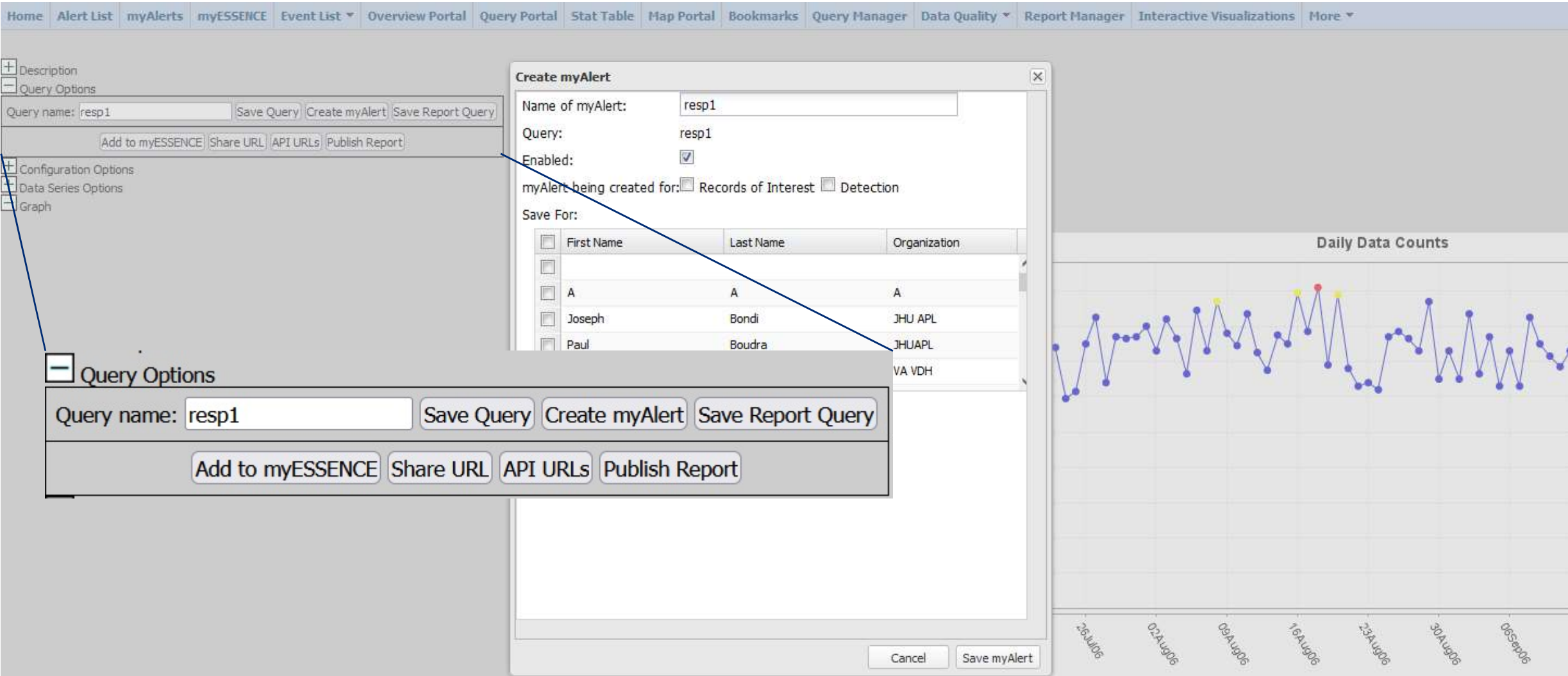
Submit



Other Types of ESSENCE Alerting Algorithms

- Temporal
 - Detect anomalous increases in cases over time (daily, weekly)
- Spatial
 - Detect geographic case clusters anomalous relative to a sliding baseline spatial distribution
- Time of Arrival
 - Detect temporal clusters of syndromic visits with similar arrival times (hourly)
- Summary
 - Provide alerts across numerous data streams adjusted for multiple testing
- Word Alerts
 - Find individual and unexpected terms in recent chief complaints that are anomalous relative to a baseline set

Creating Alert Notifications – Statistical Increase



Creating an Alert Notification – Record of Interest

- Sends notification for a single record matching criteria
- Useful for conditions that are rare, dangerous, unknown etiology
 - Ebola; rabies; Havana syndrome

myAlerts

Double click on a row to edit that myAlert definition						
Name	Query	Enabled	Show Records of I	Show Detection	Shared By	
Daily Fever	Daily Fever	true	false	true		Share
Weekly Fever	Weekly Fever	true	false	true		Share
Daily Fever and Blood	Daily Fever an...	true	true	false		Share
Daily Hosp Fever w Fairfax Patie...	Daily Hosp Fev...	true	false	true		Share
Daily AQT Fever and Blood	Daily AQT Fev...	false	true	false		Share
Daily All SubSyndromes (Long ...	Daily All SubSy...	false	false	true		Share
Daily AQT ChiefComplaint (Long)	Daily AQT Chie...	false	false	true		Share
Multi Medical Grouping AQT Qu...	Multi Medical G...	true	false	true		Share
Daily AQT Fever	Daily AQT Fever	true	false	true		Share
AQT Fever and FeverChills	AQT Fever an...	true	false	true		Share
RKim_FL_Long_CC_Query	RKim_FL_Long...	true	true	true		Share
RKim_SessionURL_Query	RKim_SessionU...	true	true	true		Share
Daily Merlin	Daily Merlin	true	false	true		Share
Ears C2 on Daily Resp Rash and ...	Daily Resp Ras...	true	false	true		Share
Min 20 Count - Daily Resp Rash ...	Daily Resp Ras...	true	false	true		Share
Weekly GI+Fever No Cube	Weekly GI+Fe...	true	false	true		Share
Derp Derp Bad Alert	Derp Derp Bad...	true	false	true		Share
SI_Death Query	SI_Death Query	true	false	true		Share
SI_Death Query Test	SI_Death Que...	true	false	true		Share
SI_Death Query Test (2)	SI_Death Que...	true	false	true		Share

[illegible]

- The Manage Alert Definitions option pops up the window shown here.
- You can double click on a definition to edit it.
- The Subscribe option allows you to setup email subscriptions for myAlerts.
- For the purpose of this walkthrough, please click on the Query Manager option from the main ESSENCE menu bar.

Back-End vs. On-The-Fly

- In ESSENCE, the Alert List and myAlert pages are computed by algorithms running on a set schedule on back-end compute servers.
- Time series graphs are color-coded red and yellow based on on-the-fly runs of the temporal detection algorithm chosen by the user.
- This means that the alert list results can get out of sync with the time series results if newer data has been processed since the last time the back-end detection process has ran.



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Resources

- Knowledge repository: <https://knowledgerepository.syndromicsurveillance.org/>
- YouTube channel videos: <https://www.youtube.com/@essence7241/videos>
- ESSENCE User Group, 4th Thursday of every month 3-4pm
(<https://nsspcommunityofpractice.org/callcalendar/>)
- ESSENCE Users Guide, FAQ, Syndrome Definitions (under “More” menu)



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Thank you

National Syndromic Surveillance Program

Community of Practice

Resources that Advance the Science and
Practice of Syndromic Surveillance



2022

Syndromic Surveillance Symposium

December 6–8, 2022



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CONSULTING