# Title

# Transforming Data into Actionable Information: Design and Development of the ESSENCE-FL Public Health Surveillance System

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#### 1. Abstract

This Davies Report concerns the organization, Florida Department of Health (FDOH), who implemented the Electronic Surveillance System for the Early Notification of Community-based Epidemics, Florida (ESSENCE-FL) System. This organization functions in the "world" of public health surveillance, with the specific imperative of early outbreak detection, and goal of improving population health. This report focuses on the role of epidemiologists, whose primary goals are to detect and investigate disease outbreaks. I focus on the primary functions of disease monitoring and outbreak response and describe its success. I describe its Workflow, and provide an example of the user's interaction with the system, including the cognitive processes involved ("least effort"). I describe the information system put into place, and how it works to support that Workflow and the Functions. I also describe the modules comprising the system (ED, reportable diseases, poison control, and vital statistics), and how they, themselves, are "systems" in their own right. I describe the data, information, knowledge employed by the modules and the system to support those functions. Finally, I describe the technology underlying the information system.

I consider the standards in the system from each level of the Stack, in the context of interoperability. I also describe the privacy, confidentiality, and security concerns addressed and any ethical issues either explicit or implicit in their report.

I close with an assessment of the completeness of this report itself, an assessment of the Stack for describing the project, and with my thoughts on what I gained from the exercise.

## 2. World

- This project lives in the world of public health surveillance and epidemiology.
- The imperatives were to improve early outbreak detection, enhance situational awareness during public health emergencies, close surveillance loops, and provide actionable data to guide public health practice and decision making.
- The project aligns with the NAM initiative goal of improving population health outcomes through use of data analytics and information systems.
- The public health world affected the system requirements and design in the following ways:
  - The need for intuitive tools usable by epidemiologists with varying technical skills.
  - Flexible and adaptive design to incorporate new data streams.
  - Role-based access controls to protect confidential data.
  - Analytics focused on statistical anomaly detection and data visualization.
  - Capability to quickly update definitions, syndromes, and analytic methods.

## 3. Organization

- The organization is the Florida Department of Health (FDOH).
- It is a state-level public health agency.
- The mission statement is: "To protect, promote & improve the health of all people in Florida through integrated state, county, & community efforts."
- The organization-level goal was maximizing early detection of disease outbreaks to improve population health outcomes.
- No new policies or models were mentioned.
- Evidence includes examples of using the system for enhanced situational awareness and early outbreak detection during disasters and disease outbreaks.
- They demonstrate timeliness and effectiveness of public health response and interventions enabled by the system.
- The nature of a large, geographically dispersed public health agency affected the design by requiring:
  - o Centralized data collection and analytics with distributed access

#### 4. Role

- The role is Epidemiologist.
- Yes, Epidemiologist is a primary, mission-critical role for this public health disease surveillance and outbreak detection project. Epidemiologists are the main users of the system and rely on it to perform their core function of monitoring health data to identify and investigate disease outbreaks. The system was designed specifically to fit the workflow and analytical needs of epidemiologists. Having real-time access to integrated data sources and automated detection algorithms allows epidemiologists to perform their role more efficiently and effectively. Without the system, epidemiologists would lack a centralized and systematic mechanism to carry out disease surveillance across multiple health data streams.

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## **5.** Functions

- The primary functions are disease monitoring and outbreak investigation.
- The goal is maximizing timely detection and characterization of disease outbreaks.
- Evidence includes examples of detecting outbreaks through statistical anomalies and visualizations not apparent through routine methods.
- If the system did not accomplish this goal, I would use a summative evaluation
  framework to systematically assess where and why it is falling short.
  Summative evaluation can help identify if certain system components like the
  data sources, analytics, or user interface design are deficient in supporting the
  core disease surveillance functions. It can reveal if the algorithms are not
  detecting outbreaks that epidemiologists identify through other means.
  Comparing performance to established criteria and benchmarks will quantify
  the gaps. This evaluation approach is comprehensive and provides actionable
  data to guide system improvements.

#### 6. Workflow

- The report describes the epidemiologist workflow as using the system to monitor health data streams, run statistical anomaly detection algorithms to identify outliers, visualize data in various ways, drill down to investigate alerts, and characterize trends.
- The description does not provide details on confirming or validating signals, steps to investigate potential outbreaks, or how analyses are translated into public health action.
- Here is a sample screenshot ESSENCE-FL Implementation:



• The theory of information behavior that best applies is least effort. The system summarizes volumes of data into a concise tabular view highlighting statistical alerts, allowing users to quickly identify anomalies without having to manually

- Custom reporting features
- The report indicates the system was developed iteratively through enhancements and phased implementation. This aligns closest with the agile software development method.
- The architecture fits closest to the distributed architecture model, with centralized data storage and analytics but distributed access for geographically dispersed users.
- The solution builds on existing departmental systems for reportable disease data (Merlin) and vital statistics. It also incorporates and replaces some regional ED syndromic surveillance systems.

#### 8. Module

- The modules most relevant to the disease monitoring function are:
  - Emergency department chief complaint data
  - Reportable disease case data
  - o Vital statistics mortality data
  - Poison control call data
- The emergency department (ED) chief complaint module could be considered an information system on its own. It collects data from multiple EDs, processes and categorizes the chief complaints using natural language processing, analyzes the data for statistical anomalies, and generates visualizations and alerts. This module encapsulates capabilities for data ingestion, management, analysis, and presentation focused specifically on ED syndromic surveillance. It provides all the key functions of an information system tailored to this data source. The report states that existing regional ED syndromic surveillance systems were incorporated into or replaced by this statewide module, further demonstrating its status as an independent system that was integrated into the larger ESSENCE-FL platform.

## **10. Technology**

#### Technologies supporting the project include:

- Web-based system architecture
- Use of HL7 messaging
- Statistical analysis and modeling software
- Geospatial mapping software
- Natural language processing
- Cloud hosting and storage

The most important technology is the natural language processing used to categorize free text chief complaints. This appears to be on the "Plateau of Productivity" in the Hype Cycle, as it is a mature technology with widespread adoption.

#### Interoperability:

• The system exchanges data with external sources following industry standards like HL7. It participates in national data sharing initiatives.

#### Standards:

- Data: HL7, PCD, NEDSS, ICD-10
- System: HTTPS, FTP, XML, OAuth
- Knowledge: Epidemiology methodology standards
- Guidance: Meaningful Use requirements

## **11. Policies**

- Inter-organizational agreements: Agreements with hospitals for provision of ED data, Office of Vital Statistics for mortality data, poison control centers for call data.
- Use cases: Disease surveillance, outbreak detection, public health reporting.
- Functional standards: Meaningful Use requirements for syndromic surveillance.
- Identifiers/privacy: De-identified data, role-based access controls.
- Information exchange: Data transmission protocols (FTP, HTTPS), standard messaging formats (HL7).
- Data content: Standard codes and classifications used where applicable (ICD-10, NDC, SNOMED).
- Transport: Secure protocols like SSL/TLS and SSH for data transmission.

# **12. Privacy, Confidentiality, Security**

- Privacy concerns are addressed through use of de-identified data with no direct patient identifiers.
- Confidentiality is addressed through role-based access controls, allowing only authorized users to access data required for their public health duties.
- Security concerns are addressed through:
- Secure data transmission protocols like SFTP
- Encrypted database storage
- Access controls and password requirements
- SSL/TLS encrypted connections
- VPN for remote access
- Public key authentication
- Traffic filtering and activity logging
- Use of a demilitarized zone and firewall protections

This multilayer security approach protects data privacy and ensures the system meets security best practices for a public health setting.

## Conclusion

In conclusion, analysis of the Florida Department of Health's Davies Award application provides valuable insights into the development and implementation of the ESSENCE-FL public health surveillance system. We see how the imperative for improved outbreak detection drove the design of a flexible, intuitive system centered around the epidemiologist user. The report details the data, modules, workflow, and technology comprising ESSENCE-FL to support enhanced disease monitoring for better population health. Consideration of standards, policies, ethics, and success factors reveals the complexity behind effectively translating raw health data into actionable public health information. This exercise demonstrates the value of the informatics perspective in thoroughly understanding the components and strategy behind creating an impactful public health surveillance information system. Thoughtful system design leveraging data, analytics, technology, and a user-centric approach can transform the practice of epidemiology to achieve its life-saving mission more efficiently.

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