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# Assessing the Usage of Dating Sites and Social Networking Sites in Newly Diagnosed HIV Positive Men Who Have Sex with Men (MSM) in Harris County, Texas, 2014

Najmus Abdullah\*, Sudipa Biswas, Weilin Zhou, Hafeez Rehman, Salma Khuwaja and Raouf R. Arafat

Houston Health Department, City of Houston, Houston, TX, USA

## Objective

To assess the usage of dating sites and social networking sites for finding sexual partners among newly diagnosed HIV positive MSMs in Harris County in 2014

## Introduction

Internet based technologies are becoming quite prominent among today's generation due to its easy accessibility through computer or phone devices [1]. Internet's relative anonymity leads high risk groups to find it easier to meet sexual partners with similar characteristics through dating sites like Grindr, Jack'D, Adams4Adams etc. and mainstream social networking sites like Facebook, Twitter, or Instagram. According to various studies, young MSMs prefer to use dating sites and social networking sites more as a source to meet sexual partners than older MSMs [2].

## Methods

Population-based surveillance data was generated from Houston Enhanced HIV/AIDS reporting system (ehars) for all newly diagnosed HIV positive MSM's in 2014. Data regarding usage of social networking sites as well as dating sites was gathered from the Disease Intervention Specialist (DIS) interviews from Sexually Transmitted Disease Management Information System (STDMIS). Descriptive analysis was performed to identify the distribution of dating and social networking sites usage across different age and race/ethnicity groups. Logistic regression analysis was used to examine the association of race with the usage of social networking sites and dating sites after adjusting for age. Data was analyzed using Stata Version 13 software.

## Results

The study findings indicate that 207 (32.2%) out of 643 MSMs used dating sites for finding sexual partners. On the other hand, only 22 (3.4%) out of 643 MSMs used social networking sites. Overall 20 (3%) out of 643 MSMs were not specific about their choice of internet sites for meeting their partners. Among different age groups, young MSMs (18-24 years old) are most likely to prefer dating sites (38%) compared to mainstream social networking sites (6%). White MSMs prefer dating sites (33%) over social networking sites (2%), same ratio holds true for the African American MSMs preference of dating sites (31%) vs. social networking sites (2%) and Hispanic MSMs preference of dating sites (32%) vs. social networking sites (4%). MSMs preferences of the dating sites are as follows: Grindr (15.5%), Adams4Adams (9.49%), Jack'D (8.71%), Phone apps like Mocospace/ Badoo (2.95%), Scruff (2.02%) and Craigslist (1.87%). Grindr was favorite choice of finding partners among Hispanic MSM (7.15%) followed by White MSM (4.04%) and African American MSM (3.27%). Facebook (2.8%) was the only preference among many social networking sites for finding partners. African American MSMs had a significantly lower likelihood of using social networking sites

in to White MSMs (OR: 0.61; 95% CI: 0.37-0.99). Similarly, African American MSM (OR: 0.54; 95% CI: 0.34-0.87) and Hispanic MSM (OR: 0.51; 95% CI: 0.32-0.82) had significantly lower likelihood of using dating sites compared to White MSM.

## Conclusions

Overall, a trend is seen among MSM who are more comfortable communicating and pursuing sexual partners through the dating sites than social networking sites. Our study shows the dating sites Grindr, Adams4Adams and Jack'D being more popular among Hispanic MSM, and African American MSM than White MSM. White MSM prefers social networking than Hispanics and African Americans may be because of the disparity in socio economic status and accessibility to networking sites. Popular dating sites like Grindr, Adams4Adams, and Jack'D, as well as mainstream social networking sites like Facebook could be used for culturally targeted HIV prevention programs among at risk populations by community based organizations.

## Keywords

MSM; INTERNET; HIV; DATING SITES; SOCIAL NETWORKING SITES

## Acknowledgments

Houston's HIV Surveillance Program

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## \*Najmus Abdullah

E-mail: Najmus.Abdullah@houstontx.gov





# The Epidemiologic Characteristics, Healthcare Associated and Household Transmission Dynamics of EVD Outbreak in a South-Southern City of Nigeria

Olawunmi O. Adeoye<sup>\*1</sup>, Endie Waziri<sup>1</sup>, Uchenna Anebonam<sup>1</sup>, Ifeoma Nwaduito<sup>2</sup>, Pauline Green<sup>2</sup>, William Komakech<sup>3</sup>, Nnanna Onyekwere<sup>2</sup>, Gabriele Poggensee<sup>1</sup> and Patrick M. Nguku<sup>1</sup>

<sup>1</sup>Nigeria Field Epidemiology and Laboratory Training Programme, Asokoro, Nigeria; <sup>2</sup>Rivers State Ministry of Health, PortHarcourt, Nigeria; <sup>3</sup>World Health Organisation, South South Zone, Nigeria

## Objective

This study describes the epidemiological characteristics and the transmission dynamics of the EVD outbreak in a South-Southern city of Nigeria

## Introduction

Ebola virus disease (EVD) is a severe illness that spread in the human population through human-to-human transmission. In the past, EVD outbreaks occurred in the rural communities of Africa, near tropical rainforests, but the most recent outbreak in West Africa has also involved major urban areas and big cities, with air travel playing an important role in its spread. On July 23, 2014, the EVD outbreak was declared in Nigeria following the confirmation of EVD in a traveller, who arrived acutely ill at the international airport in Lagos, South Western Nigeria from Liberia. The outbreak subsequently filtered to a South Southern Nigeria city, by a symptomatic contact who escaped surveillance in Lagos and flew to the South Southern city.

## Methods

A detailed case investigation was initiated on the 27<sup>th</sup>, August, 2014 to confirm the alert of a possible outbreak in the South Southern city of the death of a physician from illness with symptoms compatible of EVD. The possible source of exposure in the deceased physician was explored by tracing his contacts retrospectively. Stored sample of the physician's blood taken while he was ill was also sent for laboratory analysis. Standardised case and contact definitions were adopted. Contact identification, listing and follow up was done till the 21<sup>st</sup> after the last possible exposure with immediate isolation of cases. Analysis for confirmation of EVD was also done using RT-PCR.

## Results

The stored sample of the physician's blood was positive for EVD on RT-PCR. The retrospective tracing of the deceased physician's contact revealed he managed a patient, a contact of a confirmed case in another city of Nigeria, who escaped surveillance, and flew into the South-Southern city discreetly by plane while already very ill with symptoms of Ebola in the first week of August. This patient was said to have been managed in a hotel room by the physician for 5 days. Three secondary cases arose from this index case (the deceased physician). The deceased physician transmitted the virus to a patient he shared a hospital room with for 2 nights during the course of his illness. None of the health care workers that took care of him in the hospital was infected. He also generated 2 other cases within his household (his wife and sister) who were both involved in caring for him at home while he was ill, giving a total of 4 cases with 527 contacts listed in all (attack rate = 7.6/1000). There were two deaths (case fatality ratio = 50%). The mean incubation period was 13 days  $\pm$  4 days and average serial interval was 18 days  $\pm$  2 days

## Conclusions

Infection Prevention and Control measures in most health care facilities in Nigeria are focused on protecting health care workers from infected patients with little consideration on preventing cross infections among patients. Active surveillance and screening of passengers should not only be limited to international ports of entry but should be promptly and strictly enforced at domestic airports and inter-state borders as soon as an outbreak is declared to limit the spread of the outbreak locally.

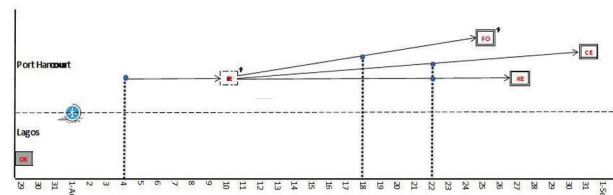


Figure: OK: Male, Protocol Officer, contact of UN001, travelled to Port Harcourt from Lagos on 1 August 2014 and returned to Lagos late 4 August 2014; E: Male, 47y, Medical doctor, attended to OK; IE: Female, 35y, wife of IE and medical doctor; F: Female, 50y, nosocomially acquired infection; O: Sister of E.



THE EVD TRANSMISSION CHAIN IN PORTHARCOURT, SOUTH SOUTHERN NIGERIA.

## Keywords

Epidemiologic characteristics; Transmission dynamics; EVD outbreak; Nigeria

**\*Olawunmi O. Adeoye**

E-mail: wunmiolat@yahoo.com

# Ebola Virus Disease Surveillance and Response Preparedness in Northern Ghana

Martin N. Adokiya\*<sup>1</sup> and John Koku Awoonor-Williams<sup>2, 3</sup>

<sup>1</sup>Department of Community Health, University for Development Studies, Tamale, Ghana; <sup>2</sup>Regional Health Directorate, Ghana Health Service, Upper East Region, Bolgatanga, Ghana; <sup>3</sup>Swiss Tropical and Public Health Institute, Switzerland, and University of Basel, Basel, Switzerland

## Objective

The objective of this study was to assess the EVD surveillance and response preparedness among frontline health workers in northern Ghana.

## Introduction

The recent Ebola outbreak has been described as unprecedented and its public health impact in terms of morbidity, mortality and coverage has been far greater than previously experienced [1-3]. This outbreak has revealed many weaknesses and inadequacies for disease surveillance and response systems in Africa due to underqualified staff, cultural beliefs and sometimes, lack of trust for formal health care sector performance [4-6]. Since 2014, Ghana had high risk of seeing EVD cases [2].

## Methods

Ghana is situated in West Africa and bordered by Ivory Coast to the west, Burkina Faso to the north, Togo to the east, and the Atlantic Ocean to the south. This was an observational study conducted among 47 frontline health workers in all the thirteen districts of the Upper East Region representing public, mission and private health services. A semi-structured questionnaire with focus on core and support functions (e.g. detection, confirmation etc.) was administered to the informants. In addition, 34 weekly IDSR reports (August 2014 to March 2015) were collated from each district.

## Results

Clinically diagnosed data revealed that 4 out of the 13 districts reported 9 EVD cases in 2014. Out of the 9 suspected cases, 8 of them died and the cause of death was unexplained. Bawku Municipal was the only district that reported a suspected case in 2015. All the ten suspected cases reported, none was confirmed (i.e. positive for the virus antigen).

The 47 key informants were (medical officers, district directors, disease control officers and laboratory officers). They had knowledge on EVD surveillance as well as the reporting of data. However, there were some challenges affecting surveillance and response preparedness such as delay in reporting, low quality personal protective equipment (e.g. gloves, aprons, infra-red thermometers etc.), inadequate staff and lack of laboratory capacity to test samples at the district or regional levels. Over 80% (38/47) of the informants were not satisfied with EVD surveillance. The reasons cited include lack of infra-red thermometers, ineffective screening, and lack of isolation centres.

## Conclusions

EVD surveillance is still insufficient, particularly the inadequate PPEs and lack of laboratory capacity to test suspected cases as well as local burial practices. The Ebola epidemic is a wake-up call for early case detection and response preparedness. This topic remains a neglected and deprived public health issue in SSA. Thus, disease surveillance and prevention activities are urgently needed in the health system.

**Key words:** Disease surveillance, core and support functions, health information system, Ghana

## Keywords

Disease surveillance; core and support functions; health information system; Ghana

## Acknowledgments

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\*Martin N. Adokiya

E-mail: nyaaba1979@yahoo.com





# Somebody's Poisoned the Waterhole: ASPCA Poison Control Center Data to Identify Animal Health Risks

Kristen Alldredge<sup>\*1,3</sup>, Leah Estberg<sup>1</sup>, Cynthia Johnson<sup>1</sup>, Howard Burkom<sup>2</sup> and Judy Akkina<sup>1</sup>

<sup>1</sup>USDA-APHIS-VS, Ft Collins, CO, USA; <sup>2</sup>Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA; <sup>3</sup>UC Davis, Davis, CA, USA

## Objective

To describe the value of the American Society for the Prevention of Cruelty to Animals (ASPCA) Poison Control Center (APCC) livestock animal calls as a passive data stream for biosurveillance of number of calls, species affected, toxicant exposures, and clinical syndromes.

## Introduction

The APCC hotline fields daily calls regarding potential animal intoxications from the US, its territories, and Canada. We explored the value of these data for identifying increased occurrences of intoxications related to livestock and poultry species, toxicant product categories, clinical syndromes, and illness severity. These data proved valuable for identifying risks of toxicant exposures by species, product category, and season. In addition to identifying intoxication risks to animal health, these data could be used to monitor for infectious outbreaks that may initially be confused for intoxications.

## Methods

The APCC hotline was contracted to provide ongoing de-identified call data from calls starting 01 October 2013 that were related to the following livestock taxa: equine, bovine, caprine, porcine, poultry, ovine, and camelid. The ingredient lists provided were categorized into mutually exclusive product categories (e.g. pesticide, prescription medication). Clinical signs were categorized into non-mutually exclusive syndromic categories (e.g. death, respiratory). Illness severity was categorized as none, mild/moderate, severe, and death. We used the Early Aberration Reporting System (EARS) C3 algorithm to identify counts (signals) for weekly toxicosis, species and syndromic events that occurred at a frequency more than three standard deviations above the expected occurrence.

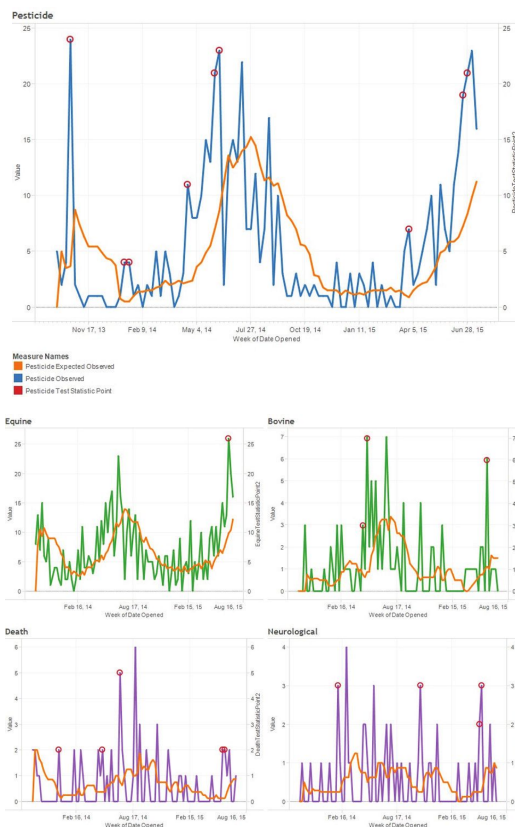
## Results

On average, the APCC hotline took 9 calls a week regarding our species of interest (range: 1-22). Calls came from all 50 states, Puerto Rico, and seven Canadian provinces. Pesticides were the most frequent intoxication product (36.2% of exposures) and were primarily involved in calls regarding horses or cattle. Calls regarding pigs were more likely to involve exposure to a human product (e.g. human medications, human food), likely reflecting that most pig-related calls were about companion animal breeds (e.g. pot-bellied pigs). Horses were the most common species discussed. Most animals involved in calls did not have clinical signs. Of those that did show specific clinical signs, most were gastrointestinal or dermatological. Death was most frequently associated with pesticide intoxication. Pesticide intoxication had a markedly seasonal trend, with peaks in pesticide calls seen May-August. Figures 1 and 2 show the C3 model for detecting increased incidence of calls about pesticides and select species/syndromes respectively.

## Conclusions

Analyzing APCC calls related to livestock and poultry species is useful for the purpose of risk identification and animal health

monitoring. Identification of seasonal trends – such as those with pesticides – can inform policymakers and livestock owners of the increased risk during specific times of year. Targeted education preceding summer months could help reduce the risk of pesticide exposure to animals. Identifying peaks in specific clinical signs could help identify unusual health trends. Use of these types of passive data streams provides a valuable information source for all health professionals interested in biosurveillance, animal health management, and risk identification.



## Keywords

Risk identification; Passive surveillance; Biosurveillance; Animal health monitoring; Toxicoses

## Acknowledgments

This work supported by USDA-APHIS-VS-CEAH and the Saul T. Wilson, Jr., Scholarship. Copyright©2015. The American Society for the Prevention of Cruelty to Animals (ASPCA). All Rights Reserved.

## \*Kristen Alldredge

E-mail: Kristen.L.Allredge@aphis.usda.gov



# Minnesota e-Health Data Repositories: Assessing the Status, Readiness & Opportunities to Support Population Health

Bree Allen\*<sup>1,2</sup>, Karen Soderberg<sup>1</sup> and Martin LaVenture<sup>1</sup>

<sup>1</sup>Office of Health Information Technology, Minnesota Department of Health, Saint Paul, MN, USA; <sup>2</sup>Council of State and Territorial Epidemiologists, Atlanta, GA, USA

## Objective

This project describes the informatics characteristics of clinical data repositories among Minnesota health systems and their opportunities and readiness to support public health practice. The focus of the study is the use of these data for public health prevention programs and surveillance, including the opportunities to address health disparities. We examine technical, organization, and process readiness of repositories in support of epidemiology and other key public health programs, and how these data can be used as a statewide public health resource.

## Introduction

Health care reform and the use of electronic health record systems is dramatically changing the health care landscape creating both challenges and opportunities for public health. High adoption of health information technology among Minnesota's health care providers has created an opportunity to advance e-health by collecting and using these data to improve population health. It has been demonstrated that interoperable clinical data repositories can serve surveillance needs to support both public health and clinical care.<sup>1</sup> Additionally, health reform is fostering the need for the collection of data to manage population health, compare and share data locally and across states for care coordination, and monitor cohorts and attributed populations. This project will provide a critical understanding of the status, challenges, and opportunities for leveraging the substantial investment in health care data systems to better support public health prevention programs, epidemiology, and surveillance to improve population health, address health disparities, and advance health equity.

## Methods

An initial scan of e-health data repositories was conducted using the 2014 Minnesota hospital survey. The survey found 96 of Minnesota's 133 non-federal acute care hospitals (72%) maintain a clinical data repository to support patient care management, population health, and/or research. A selection of these health systems are invited as key informants to participate in an individual or group interview to address each health system's e-health data repository, including the type and sources of data, levels of normalized and structured content, scope of data analytics capabilities, timeliness of data, capability for health information exchange, and readiness for use of HL7 and other standard messaging. Moreover, governance, policies, and functionality of the repository are assessed. We employ qualitative methods and examine interview notes in order to identify and code themes; narrative responses are reviewed to identify initial themes, and a second assessment identifies subthemes. Themes are used to determine readiness and opportunities for e-Health Data Repositories to support population health.

## Results

Results highlight first the Minnesota health data repositories and provide a profile of data elements and structure, indications of

data quality, and geographic distribution to support public health surveillance of chronic and infectious disease. Second, preliminary findings from key informant interviews reveal a wide range of models for developing and managing e-health data repositories. A minimal number of health systems use repositories for research, and data sharing agreements are not common across organizations. Barriers to sharing data tend to be associated with Minnesota's strict consent management laws and several systems noted challenges in harmonizing large and varied data sources in a timely manner.

## Conclusions

E-Health data repositories have the opportunity to play a critical role in supporting population health and key epidemiologic surveillance activities.<sup>1</sup> However, current Minnesota e-health data repositories are not used in public health practice beyond attributed populations. In order to take advantage of available data, more research is needed to help understand the types of available data, quantity, quality, and need for policy considerations to support statewide public health practice, as well as to develop a recommended framework for how these repositories can supplement existing registry programs at the Minnesota Department of Health.

## Keywords

Clinical data repository; Health disparities; Informatics; Population health; Electronic health record

## Acknowledgments

This study was supported in part by the Minnesota Department of Health and an appointment to the Health Systems Integration System Program Fellowship administered by CSTE and funded by the Centers for Disease Control and Prevention (CDC) Cooperative Agreement 3U38-OT000143-01S3.

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## \*Bree Allen

E-mail: bree.allen@state.mn.us



# Evaluation of the Measles Case-Based Surveillance System in Kaduna State (2010-2012)

Celestine A. Ameh\*<sup>2</sup>, Muawiyah B. Sufiyan<sup>1</sup>, Matthew Jacob<sup>3</sup>, Endie Waziri<sup>2</sup> and Adebola T. Olayinka<sup>1</sup>

<sup>1</sup>Ahmadu Bello University Zaria, Abuja, Nigeria; <sup>2</sup>Nigerian Field Epidemiology and Laboratory Training Program, Abuja, Nigeria;

<sup>3</sup>Kaduna State Primary Health Care Agency, Kaduna, Nigeria

## Objective

To evaluate the case-based Measles surveillance system in Kaduna State of Nigeria and identify gaps in its operations

## Introduction

In Africa, approximately 13 million cases of measles and 650,000 deaths occur annually, with sub-Saharan Africa having the highest morbidity and mortality (1). Measles infection is endemic in Nigeria and has been documented to occur all year round despite high measles routine and supplemental immunisation coverage (2,3). The frequent outbreaks of Measles in Kaduna State prompted the need for the re-evaluation of the Measles case-based surveillance system

## Methods

We adapted the updated CDC guidelines on surveillance evaluation to assess the systems usefulness, representativeness, simplicity, timeliness, stability and acceptability. A retrospective record review of the measles case-based surveillance data from 2010–2012 to assess data quality, and representativeness. We calculated the annualized detection rate of measles and non measles febrile rash, proportion of available results, proportion of LGAs that investigated at least one case with blood, proportion of cases that are IgM positive and the incidence of measles. We compared the results with WHO (2004) recommended performance indicators to determine the quality and effectiveness of measles surveillance system

## Results

According to the Stake holders, the case-based surveillance system is still useful and acceptable. The proportion of focal sites reporting declined from 96% in 2010 to 88% in 2012. Median interval between specimen collection and release of result improved from 31 days in 2011 to 16 days in 2012. However the best median turnaround time of 7 days was recorded in 2010. The annualized detection rate of measles and non-measles febrile rash fell below the recommended WHO standard in 2011 and 2012. Case definitions are simple and understood by all the operators. We found a progressive decline in the timeliness and data quality in the years under review.

## Conclusions

This evaluation showed that the surveillance system was still useful. Also, the efficiency and effectiveness of the laboratory component as captured by the “median interval between specimen collection and the release of results improved in 2012 compared to 2011 and 2010. However, there was a progressive decline in the timeliness and completeness of weekly reports in the years under review

## Keywords

Measles; Case-based; Surveillance; Evaluation; Nigeria

## Acknowledgments

We wish to thank the management of Kaduna State Primary Health Care Agency for providing the data needed for the evaluation and the NFELTP for providing the resources

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\*Celestine A. Ameh

E-mail: cameh1085@gmail.com



# Integrating R into ESSENCE to Enable Custom Data Analysis and Visualization

Jonathan Arbaugh and Wayne Loschen\*

Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA

## Objective

The objective of this project is to give users the ability to run custom R scripts from within the ESSENCE system. This capability would allow for custom analytics and visualizations to be baked into the system for daily use. It would also provide a sandbox area for new ideas and features to be tested before being developed more fully into the ESSENCE codebase for a more seamless use in the future. The project must do this while maintaining a secure environment for public health data to reside.

## Introduction

The use of R is increasing in the public health disease surveillance community. The ISDS pre-conference workshops and newly formed R Group for Surveillance have been well attended and continue to grow in popularity. The use of R in the National Syndromic Surveillance Program (NSSP) has also been of value to many users who wish to analyze and visualize public health data using custom R scripts. This interest in R, combined with a desire from many ESSENCE users to create custom analytics and visualizations, led to a summer internship project to look into the feasibility and ways R could be integrated into ESSENCE.

## Methods

The project aimed to perform three tasks: gather potential use cases and design potential user interfaces and interactions, determine the security requirements to accomplish the project, and prototype some portion of the project to determine feasibility. Initial use cases were gathered by speaking with existing ESSENCE super users with R familiarity. These included allowing users to use the ESSENCE system to perform queries and then applying R scripts to generate new graphs and text-based output. Initial user interface mock ups and R workflows were then created and reviewed. The vast majority of the project was spent determining the security requirements and ways to complete the task in a safe manner. Existing free and commercial R platforms were investigated and ways of embedding R into existing java-based web applications were discovered. Finally, one of the workflows was prototyped to show the feasibility of embedding R into ESSENCE.

## Results

Eight major use cases were discovered, including short and long running scripts using single and multiple query inputs of both time series and data details types. An “Apply R Script” button was added to the query portal to allow short running, single query input scripts to be ran as a prototype of one of these use cases. The query results will be then sent to an RServe process to run the script. Each script must be approved by a local administrator prior to use to alleviate many security concerns dealing with on-the-fly script deployment. The presentation will also discuss many other security aspects that were discovered dealing with potential sandboxing and jailing of R processes.

## Conclusions

Integrating R into ESSENCE is feasible and could provide users with the ability to perform custom data analysis and visualization.

This would allow the community to build and share visualizations and analytics within ESSENCE that have not been developed yet.

## Keywords

R; ESSENCE; Visualization; Analysis

## \*Wayne Loschen

E-mail: Wayne.Loschen@jhuapl.edu





# Refocusing Hepatitis C Prevention Through Geographic Viral Load Analyses

Ryan M. Arnold\*, Biru Yang, Qi Yu and Raouf R. Arafat

Houston Health Department, Houston, TX, USA

## Objective

To describe the use of Hepatitis C Virus (HCV) viral load (VL) results and geospatial analysis to guide prevention efforts.

## Introduction

Approximately 2.7 million Americans live with chronic HCV, with roughly 30,000 new cases in 2013<sup>1</sup>. Fortunately, recent clinical trials have shown great advances using interferon-free, oral direct-acting antivirals, with cure rates over 95%<sup>2</sup>. But only a few people have been treated<sup>3</sup>, and most are unaware of the infection<sup>4</sup>. This presents an opportunity for public health to address unmet needs, but most jurisdictions have limited surveillance and prevention efforts. Leveraging HCV surveillance, this analysis presents a cost-effective method to improve situational awareness and guide prevention efforts in Houston.

## Methods

The Houston Health Department (HHD) receives ELR and other reports for chronic and acute Hepatitis C, which include VL results. These are stored in Consilience Software's Maven 5.0. For this analysis, VL results were abstracted from Maven and managed in SAS v9.3. Geospatial analysis was performed using Esri's ArcGIS v10.1.

CDC HIV VL guidance<sup>5</sup> was used and modified for HCV. Average VL for each patient each year was calculated for trend and geospatial analyses. Finally, principal component analysis and bidirectional stepwise linear regression were performed on average VL by ZIP, US Census data, and American Community Survey data using SAS v9.3.

## Results

Since 2009, over 9,500 VL results were reported to HHD. This number increased annually, with over 2,700 reported from Jan-May 2015. The average HCV log value by ZIP code in 2015 ranged from 4.58 to 6.95 (Figure 1).

The final linear regression model is -

Average HCV log value (IU/mL) = 5.52577 + 0.00601\*(% of Families in Poverty) + 0.0029\*(% African American)

From several social and demographic variable risk factors, the model found that percent of families in poverty and percent African American were positively correlated with the average log value (Table 1).

## Conclusions

VL analyses are a viable method of identifying areas of decreased level of HCV suppression and increased potential for HCV transmission. This is crucial, as complications from unsuppressed HCV include cirrhosis and hepatocellular carcinoma<sup>6</sup>. Additionally, Medicaid programs have limited access to the most effective HCV therapies by various eligibility criteria, though most are not based on clinical evidence<sup>7</sup>. The utilization of these methods to significantly improve outcomes of prevention and intervention activities needs to be evaluated.

Table 1. Stepwise coefficient for the linear model.

	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	5.5258	0.0741	488.7386	5560.04	< 0.0001
% of Families in Poverty	0.0060	0.0036	0.2501	2.85	0.0963
% African American	0.0029	0.0017	0.2683	3.05	0.0852

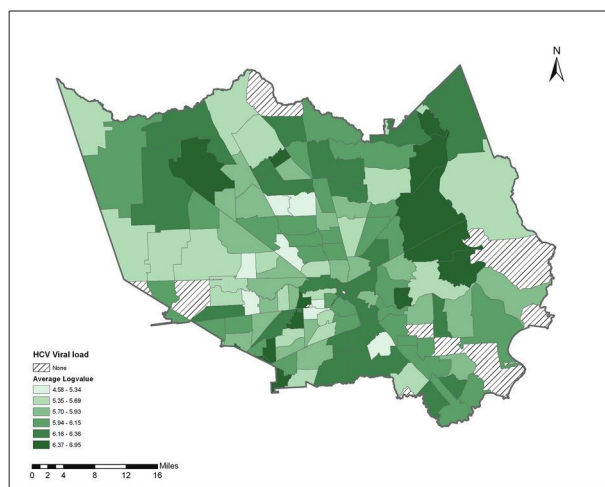


Figure 1. Average HCV viral load by ZIP, 2015.

## Keywords

Hepatitis C; Linear Regression; Geospatial Analysis

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\*Ryan M. Arnold

E-mail: [ryan.arnold@houstontx.gov](mailto:ryan.arnold@houstontx.gov)



# A Method for Detecting and Characterizing Multiple Outbreaks of Infectious Diseases

John M. Aronis\*, Nicholas E. Millett, Michael M. Wagner, Fuchiang Tsui, Ye Ye and Gregory F. Cooper

University of Pittsburgh, Pittsburgh, PA, USA

## Introduction

We describe an automated system that can detect multiple outbreaks of infectious diseases from emergency department reports. A case detection system<sup>1</sup> obtains data from electronic medical records, extracts features using natural language processing, then infers a probability distribution over the diseases each patient may have. Then, a multiple outbreak detection system (MODS) searches for models of multiple outbreaks to explain the data. MODS detects outbreaks of influenza and non-influenza influenza-like illnesses (NI-ILI).

## Methods

MODS searches over models of multiple outbreaks to maximize the probability of the data<sup>2</sup>. We start with Bayes' Theorem which states  $P(M|data) = (P(data|M)P(M))/P(data)$  where  $P(M)$  is the prior probability of an epidemiological model of zero, one, or more outbreaks,  $P(data|M)$  is the probability of the data given a model, and  $P(data)$  is the probability of the data. The method searches for the MAP (maximum a posteriori) model that maximizes the above numerator.

A model consists of baseline levels of non-outbreak influenza and NI-ILI, zero, one, or more influenza outbreaks, and zero, one, or more NI-ILI outbreaks. Searching for the MAP model requires MODS to search over the set of basic parameters for multiple influenza and NI-ILI outbreaks. We search over combinations of multiple influenza and NI-ILI outbreaks; our current implementation (running on a single 1.6GHz processor) takes about 24 hours to adequately search the space of models for a single dataset for one year.

## Results

We conducted a battery of experiments with simulated outbreaks consisting of zero, one or two influenza outbreaks and zero, one, or two NI-ILI outbreaks. We start with records of actual influenza, NI-ILI, and other patients, construct a model of multiple outbreaks, then instantiate the model by:

- Randomly sampling patients without influenza or NI-ILI according to a Poisson distribution.
- Randomly sampling influenza and NI-ILI patients according to the postulated outbreak model.

We then search over models consisting of zero, one, or two influenza outbreaks and zero, one, or two NI-ILI outbreaks and report the MAP model. In general, MODS can accurately predict starting dates and peaks for multiple influenza outbreaks, as well as the start, duration, and level of co-occurring NI-ILI outbreaks.

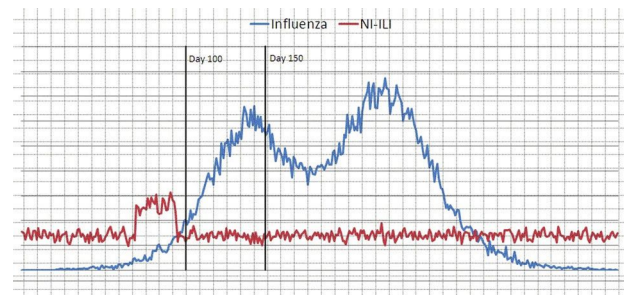
For instance, we constructed a model with two influenza outbreaks with start/peak days 20/138 and 80/222 and a NI-ILI outbreak with start/duration 70/25 (shown in diagram "Simulated Outbreaks").

On day 100, before either influenza peak, MODS predicted one influenza outbreak with start/peak days of 20/138 and one NI-ILI outbreak with start/duration days of 71/19. On day 150, after the first influenza peak but before the second, MODS predicted two influenza outbreaks with start/peak days of 20/138 and 76/215 and one NI-ILI outbreak with start/duration days of 71/19.

We also ran our system on data from Allegheny County for the 2009-2010 influenza season. Given data starting on June 1, 2009, by September 1 the system predicted a peak at about October 15 with a small NI-ILI outbreak in June. Previous analysis using thermometer sales as a measure indicate the actual peak was around October 19<sup>3</sup>.

## Conclusions

This work demonstrates that we can predict and characterize multiple, overlapping outbreaks from clinical data. In particular, it shows that the data have the required fidelity to detect and characterize multiple, overlapping outbreaks.



Simulated Outbreaks

## Keywords

outbreak detection; Bayesian modeling; influenza

## Acknowledgments

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\*John M. Aronis

E-mail: jma18@pitt.edu



# An Open Source Quality Assurance Tool for HL7 v2 Syndromic Surveillance Messages

Noam H. Arzt\* and Srinath Remala

HLN Consulting, LLC, Palm Desert, CA, USA

## Objective

To leverage an existing open source quality assurance software tool created for the immunization domain and modify it to serve as a quality assurance tool for syndromic surveillance messages.

## Introduction

The CMS EHR Incentive Programs include a measure for meaningful use of EHR systems for submitting syndromic surveillance messages to public health [1]. The Stage 2 measure defines the standard for transmission to be HL7 v2.5.1 Admit/Discharge/Transfer messages according to the PHIN Messaging Guide for Syndromic Surveillance and Conformance Clarification for EHR Certification of Electronic Syndromic Surveillance, Addendum to PHIN Messaging Guide for Syndrome Surveillance [2]. The National Institute of Standards and Technology (NIST) provides an online testing tool for validating messages [3]. While some jurisdictions use the Biosense platform for receiving, managing, and analyzing syndromic surveillance data, there is no consistent tool that is available to jurisdictions to assess the quality and conformance of data submissions both at the time of on-boarding a new reporting facility and on an ongoing basis during production operations [4].

The New York City Citywide Immunization Registry (CIR), the immunization information system for NYC that has been operational since 1997, has as part of its software suite an Open Source, web-based data quality assurance (QA) tool used by its research scientists to qualify new sites for reporting data electronically via HL7 v2 messages, and for monitoring the ongoing quality of data submissions over time [5]. A validation process evaluates incoming messages against the rules established by an implementation guide (IG) and stores the result of the evaluation in a CIR database table that is accessible by the QA Tool which displays the data to an administrative user. This project served as a proof-of-concept for implementing a similar process for syndromic surveillance.

## Methods

Building upon existing Open Source software, the project developed a self-contained, end-to-end prototype of the quality assurance system for syndromic surveillance. The resulting product has two main components:

1. A data validation process, using a local instance of NIST HL7 v2 Validation Tool and repackaged to accept a sample HL7 v2.5.1 ADT message via file upload, evaluate it against the PHIN Guide, and store both the raw message and any errors or warnings generated in a local CIR compliant database.
2. An enhanced version of the CIR QA Tool that reads the raw messages, errors and warnings from the previous step and allows users to query and display messages for a specific reporting facility and date range.

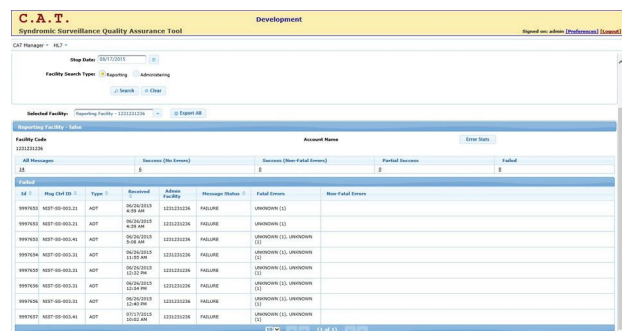
## Results

The system was created and deployed using open source software. Various test messages, based on NIST test data set, were sent through the system and the results were examined against known outcomes. The user interface required only minor modification (Figure) to accommodate the change in message type from VXU to ADT.

## Conclusions

This project demonstrated the successful leverage of public health developed, Open Source software from one domain to another. It also established new capacity for public health agencies to monitor the quality of data submissions for syndromic surveillance. Future enhancements to this product might include:

- Tighter integration with BioSense through export of “passing” messages into formats that can be imported into the BioSense platform.
- Enhancement of the summary statistics and reports available for message batches.
- More complete role-based security to recognize differing staff responsibility for different parts of the public health agency workflow that this product supports.
- User-configurable support for variations in the implementation guide specifications used to evaluate message and present errors and warnings.



ID	Msg ID	Type	Received	Address	Message Status	Fatal Errors	Non-Fatal Errors
9991932	9991932	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991933	9991933	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991934	9991934	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991935	9991935	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991936	9991936	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991937	9991937	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	
9991938	9991938	ADT	06/29/2015 11:29:59 AM	1231231234	FAILURE	UNKNOWN (1)	

## Keywords

HL7; ADT; syndromic surveillance

## Acknowledgments

The authors are thankful both the Centers for Disease Control and Prevention, Center for Surveillance, Epidemiology, and Laboratory Services (CDC/CSELS) for funding this work, and the Association of State and Territorial Health Officers (ASTHO) under whose auspices this project was conducted.

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- [2] <http://www.cdc.gov/phin/resources/PHINguides.html#ss>
- [3] <http://hl7v2-ss-testing.nist.gov/mu-syndromic/>
- [4] <http://www.cdc.gov/biosense/>
- [5] <http://www.nyc.gov/html/doh/html/hcp/cir.shtml>

\*Noam H. Arzt

E-mail: arzt@hln.com





# Role of Animal Identification and Registration in Anthrax Surveillance

Zviad Asanishvili, Tsira Napetvaridze, Otar Parkadze, Lasha Avaliani, Ioseb Menteshashvili and Jambul Maglakelidze

National Food Agency (NFA) of the Ministry of Agriculture, Tbilisi, Georgia

## Introduction

Anthrax is a globally distributed zoonotic disease caused by *Bacillus anthracis*, a soil-borne, Gram-positive, spore forming bacteria. *Bacillus anthracis* can infect people who slaughter or eat animals that are infected. Recent reports indicate the incidence of human anthrax has increased steadily over the last several years in Georgia (2007-2012). The Georgian National Animal Health Program has implemented an anthrax control program. The Ministry of Agriculture, the National Food Agency (NFA), and the Laboratory of the Ministry of Agriculture (LMA) are engaged in diagnosis and control of anthrax in animals. Epidemiological investigation and surveillance are used to determine the origin of anthrax affected animals and their route of migration, however, for successful implementation, proper animal traceability is required. Identification of cattle is one of the components of epidemiological investigation and has been ongoing in Georgia since 2012.

## Methods

During 2012-2014, 1,292,754 cattle were identified with ear tags. In 2014, four fatal cases in cattle (with ear tags) were investigated to determine the origin of the animals.

## Results

The cattle were found in seasonal pastures or on animal migration routes. All animals were from different regions relative to the seasonal pastures they were moved to and died.

## Conclusions

Implementation of this new approach to livestock monitoring within the anthrax control program is considered to be one of the main factors to improve epidemiological investigation and surveillance. In 2014, as a result of this program, Georgian legislation was updated to require the tagging and identification of cattle, enabling traceability of individual animals. The resulting traceability due to tagging of cattle is known to have reduced illegal movement. As a result, control of the cattle vaccination program was improved. This minimized the migration of unvaccinated animals in seasonal pastures, which is a major risk factor for the spread of the disease.

## Keywords

*Bacillus anthracis*; anthrax; cattle; tagging

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E-mail:



# Using Syndromic Surveillance to Rapidly Describe the Early Epidemiology of Flakka Use in Florida, June 2014 – August 2015

David Atrubin\*, Scott Bowden and Janet J. Hamilton

Florida Department of Health, Tampa, FL, USA

## Objective

Objective: To characterize flakka usage in Florida using multiple data sources within the Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE-FL)

## Introduction

Syndromic surveillance has historically been used to track infectious disease, but in recent years, many jurisdictions have utilized the systems to conduct all hazards surveillance and provide situational awareness with respect to previously identified issues. Flakka is a synthetic drug (class: cathinones) that recently has been featured in the media. Flakka is a stimulant that causes delusions, aggression, erratic behavior, a racing heart and sometimes death. Two specific counties (one in Florida and one in Kentucky) have been at the center of this emerging epidemic. In August 2015, Florida Department of Health (FDOH) partner agencies requested flakka-related health data in an effort to better understand the epidemiology and context of this problem. ESSENCE-FL is a large syndromic surveillance system, with four main data sources, that captures 87% of all emergency department (ED) visits statewide.

## Methods

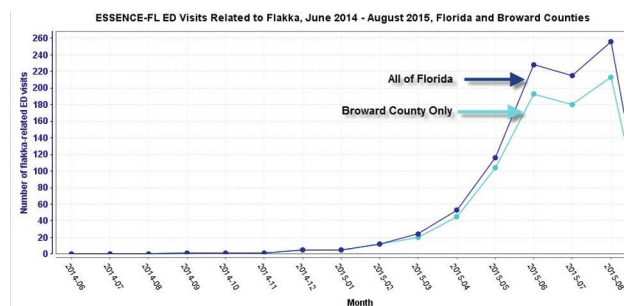
An iterative process was used to design a query to identify flakka-related visits in the ESSENCE-FL ED data. A concatenated chief complaint - discharge diagnosis field was queried using the following string: ^flakka^,or,^flaka^,or,^flacka^,or,^flaca^,or,^flacca^. An analysis of the data was conducted to describe flakka-related emergency department visits with respect to person, place, and time. Calls to the Florida Poison Information Center Network (FPICN), one of the four main data sources within ESSENCE-FL, were queried to provide additional situational awareness. Results of the analysis were shared with the Florida Fusion Center and subsequently with law enforcement partners.

## Results

From September 1, 2014 – August 31, 2015, a total of 917 flakka-related ED visits were identified using the specified query. Figure 1 demonstrates sharply increasing ED visits related to flakka in 2015. In Florida, Broward County was demonstrated to be at the epicenter of this emerging problem. A total of 85% of all flakka-related visits occurred at Broward County EDs, followed by 10% at Palm Beach County EDs. Additionally, the analysis showed that males presented to the ED for flakka-related visits nearly four times as frequently as females. Of the 917 flakka-related visits, 80% of them were in 20-50 year olds. Ninety-one flakka exposure calls were received by the FPICN between June 2015 (when flakka received its own Poison Index Code) and the end of August 2015. These calls demonstrated a nearly identical demographic (66% Broward County residents, 74% male, and 72% of the calls were from the 20-50 year old age category) as the ESSENCE-FL ED data.

## Conclusions

Having a comprehensive syndromic surveillance system in place that captures nearly all of the ED visits in Florida greatly facilitated this analysis and proved valuable to FDOH's partner agencies. Flakka is an emerging public health and safety issue, which while currently focused in one geographic area of the state, is likely to spread elsewhere. ESSENCE-FL proved useful in rapidly assessing the geographic spread, age, and gender impacted. While syndromic surveillance systems were not initially designed to conduct surveillance for emergent drug usage, having near real-time surveillance systems capable of providing timely, relevant data is critical in quickly characterizing emerging public health issues and helping to prioritize resource utilization. Implementing algorithms that search for previously unused words (e.g., flakka) or words or phrases that are being used in excess of their expected values would be beneficial in detecting these emerging threats more rapidly.



## Keywords

flakka; situational awareness; syndromic surveillance; drug use

\*David Atrubin

E-mail: david.atrubin@flhealth.gov

# Situational Awareness of Childhood Immunization in Kenya

Toluwani E. Awoyele<sup>\*2, 1</sup>, Meenal Pore<sup>1</sup> and Skyler Speakman<sup>1</sup>

<sup>1</sup>IBM, Langata, Kenya; <sup>2</sup>Carnegie Mellon University, Pittsburgh, PA, USA

## Objective

Large scale surveys has been used extensively to monitor childhood immunization rates. The purpose of this research is to find measurable features that informs the state of immunization in Kenya.

## Introduction

Despite the steady increase in immunization coverage in Kenya, the most recent Kenya Demographic and Health Survey (KDHS) shows that there is still immunization inequality across the country. Nationally, 2 out of every 3 (66.67%) children has been fully immunized but only 2 out of every 5 (40%) children in the North Eastern region were fully vaccinated<sup>1</sup>. There is a need to identify the characteristics of the households with children who are not fully immunized for effective intervention.

## Methods

Kenya Ministry of Health<sup>2</sup> provides information on required childhood immunization. BCG, DPT 1, 2 & 3, Polio 1, 2 & 3, Measles and Vitamin A are required to be given to children across the country at different ages. In this research, a child is considered fully vaccinated if he/she was up to the age of receiving a particular vaccination and had received the vaccination.

26 variables on wealth assets, media exposure and the demographic data of a mother were used as independent variables for building a generalized boosted regression model. The dependent variable was a child being fully vaccinated or not. The receiver operator characteristics (ROC) of the model was examined and the predictor importance of the variables were extracted.

Surveyed households were further clustered into groups using these most important measurable features.

## Results

Initially, 26 variables used was able to classify full immunization at an ROC measure of 64.24%. The predictor importance of these variables can be seen in Figure 1. The region a mother lives in, her highest educational level, the wall material of the house she lives and her frequency of listening to radio were four features with high predictor importance which can be measured without survey data. With these four variables, the model was able to classify at a rate of 63.56% which is not a significant drop from the initial classification rate.

The 6079 households analyzed were divided into three clusters using these four variables based on Akaike Information Criterion. Information on these clusters can be seen below:

- Low record of being fully up-to-date immunized: The 1325 households in this cluster do not listen to radio at all, have no education, live in houses with natural materials (grass/thatch) and can be found mostly in the North Eastern region of the country. 37.8% of these households have been fully immunized.
- Intermediate record of being fully up-to-date immunized: The 2817 households in this cluster listen to radio almost every day, have either primary or secondary school education, build their houses with natural wall materials and can be found in Nyanza, Rift Valley and Western part of the country. 52.2% of these households have been fully immunized.

- High record of being fully up-to-date immunized: The 1933 households in this cluster listen to radio almost every day, have higher, secondary or primary educational levels, build their houses with finished (Cement, Bricks) materials and can be found in Nairobi, Central and Eastern regions of the country. 55.8% of these households have been fully immunized.

## Conclusions

The region a mother lives, her level of education, her frequency of listening to the radio and house wall materials are informative in predicting whether her child is fully immunized or not. While this gives us some insight on the wealth and demographic characteristics of the mothers whose children are not immunized, we are missing some important information such as health seeking behavior and proximity to healthcare facilities which could influence a mother's decision to immunize her child.

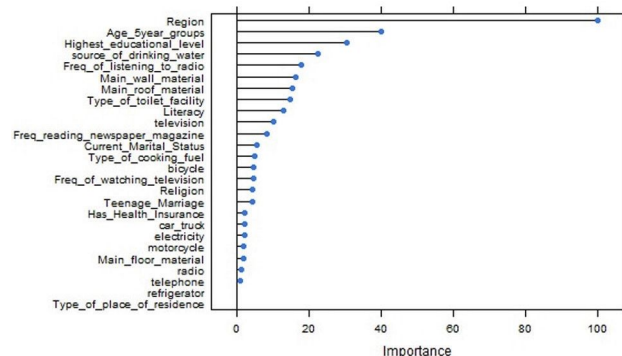


Figure 1

## Keywords

Kenya; Immunization; Clustering

## Acknowledgments

Thanks to United States Agency for International Development (USAID) for providing the dataset used for this analysis.

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\*Toluwani E. Awoyele

E-mail: [tawoyele@andrew.cmu.edu](mailto:tawoyele@andrew.cmu.edu)



# Surveillance for Mass Gatherings: Super Bowl XLIX in Maricopa County, Arizona, 2015

Aurimar Ayala\*, Vjollca Berisha and Kate Goodin

Public Health, Maricopa County, Phoenix, AZ, USA

## Objective

To describe the enhanced epidemiologic surveillance efforts in place during Super Bowl XLIX and related events, review epidemiologic surveillance results, discuss novel approaches for near real-time surveillance for situational awareness and early event detection and examine lessons learned for surveillance strategies during mass gatherings.

## Introduction

Super Bowl XLIX took place on February 1<sup>st</sup>, 2015 in Glendale, Arizona. In preparation for this large scale public event and related activities, the Maricopa County Department of Public Health (MCDPH) developed methods for enhanced surveillance, situational awareness and early detection of public health emergencies.

## Methods

From July 2014 to January 2015, an Epidemiology Work Group and a Public Health and Medical Resource Work Group met on a monthly basis to develop and coordinate epidemiologic surveillance strategies with local, state and federal partners. Surveillance strategies were developed and coordinated to monitor levels of disease activity and provide situational awareness during Pro Bowl (January 25<sup>th</sup>, 2015), NFL Experience and Super Bowl Central (January 24<sup>th</sup>, 2015 through February 1<sup>st</sup>, 2015) and Super Bowl. Fiesta Bowl (December 31<sup>st</sup>, 2015) was selected to pilot test surveillance strategies. Strategies included enhanced surveillance alerts, enhanced animal surveillance, field syndromic surveillance at first aid stations, syndromic surveillance for emergency room visits, hotel surveillance, urgent care surveillance, mortality surveillance, emergency medical services (EMS) surveillance, media surveillance and aberration detection algorithms for notifiable diseases.

## Results

Surveillance strategies were successfully tested during Fiesta Bowl. During Super Bowl and associated events, field surveillance collected information on 4 distinct syndromes (gastrointestinal, respiratory, dermatological and neurological) as well as injuries. Real-time mapping of field surveillance data was also in place and aided in the evaluation of syndromes reported. Aberration detection algorithms were run daily to detect illness reported to Arizona's notifiable disease surveillance system. Enhanced surveillance alerts were sent to healthcare providers asking them to report any increases in illness or unusual illness presentation. Alerts were implemented from January 22<sup>th</sup>, 2015 to February 6, 2015. Enhanced animal surveillance was in place during all events. The Arizona Prehospital Information and EMS Registry System was utilized to monitor for gastrointestinal and respiratory syndromes. Influenza-like illness surveillance for outpatient sentinel sites was also in place. Poison Control Center data and newly developed algorithms for mortality surveillance within an all hazards approach were analyzed daily. MCDPH monitored foodborne outbreaks and produced a daily outbreak report. Syndromic surveillance in hotels and urgent cares located within a 5 mile radius of the events was conducted. In addition, the NFL clinic provided daily reports to MCDPH. The MCDPH Public Health Incident Command Center was activated and the Intelligence

Section, responsible for epidemiologic surveillance, produced daily Intelligence Section Report summarizing results from all surveillance efforts. Surveillance result highlights included influenza widespread activity, increased influenza activity reported from urgent cares and several influenza cases reported within the NFL clinic. In addition, an investigation into a cyanide single event exposure was investigated and determined not to be a public health threat. Field surveillance efforts documented minor injuries at all events and sporadic cases of gastrointestinal and neurological (mostly headaches) disease. Enhanced animal surveillance reports included a cat suspected for plague and tularemia and an investigation of highly pathogenic avian influenza in a backyard chicken flock. Laboratory results in both instances were negative. Aberration detection algorithms detected an increase in measles reports associated with Disneyland exposure and syndromic surveillance systems were used during this investigation successfully.

## Conclusions

Coordinated enhanced epidemiologic surveillance during Super Bowl XLIX increased the response capacity and preparedness of the public health department to make informed decisions and take public health actions in a timely manner during this mass gathering event. MCDPH plans to continue development of novel tools and protocols for epidemiologic surveillance during mass gatherings to increase capacity for near real-time surveillance for situational awareness and early event detection.

## Keywords

Syndromic Surveillance; Mass Gatherings; Situational Awareness

## \*Aurimar Ayala

E-mail: [aurimarayala@mail.maricopa.gov](mailto:aurimarayala@mail.maricopa.gov)



# Estimating FluNearYou Correlation to ILINet at Different Levels of Participation

Eric V. Bakota\*, Eunice R. Santos and Raouf R. Arafat

Health Department, City of Houston, Houston, TX, USA

## Objective

Our objective is to provide evidence for the data quality of Flu Near You (FNY) by evaluating the national and Houston datasets against CDC ILI data.

## Introduction

Flu Near You allows individuals to volunteer to be a sentinel node of the syndromic surveillance (SyS) network. The platform has the potential to provide insight into the spread of influenza-like illness (ILI). CDC's ILINet is the gold standard for tracking ILI at the national level, but does not track into the local level. Local health departments (LHD) frequently express a need for granular data specific to their jurisdictions. FNY attempts to meet this need by collecting and sharing data at the zip code level. Knowing how well FNY data correlates to ILINet data will give local health departments an important tool to communicate the arrival of influenza to their jurisdiction. However, there is significant skepticism at the quality of FNY data as compared to validated datasets.

## Methods

FNY pushes out a weekly survey to each user. The survey tracks if and when a user (and his or her family) has received a flu shot and experienced ILI. The data were deidentified and provided by the Skoll Global Threats Fund to the Houston Health Department (HHD). The FNY data were compared to ILINet's national summary of influenza-like illness and influenza positive tests by estimating the correlation coefficient for the 2014-2015 influenza season. FNY total ILI counts were correlated to total positive influenza tests and FNY percent ILI was compared to ILINet's unweighted percent ILI. The mean correlation coefficients were estimated by bootstrapping FNY data ( $n = 1000$  at each stratum). Mean correlation coefficients over 1000 bootstraps were estimated for a sequence of weekly participation rates from  $N=10$  to  $N= 10435$  in increments of 10. Bootstrapped samples were stratified by ZIP code to account for fluctuations in weekly participation for both FNY and ILINet, as both datasets see an increase in user participation during influenza season. R version 3.2 was used for all analyses; HHD received the line-list dataset from FNY that contained nearly 400,000 entries. Each entry corresponds to a single person (either the user or the user's family member) and his or her symptoms for the preceding week. FNY is voluntary and not all users contribute each week; with the data being deidentified there is no way to connect entries to user profiles or user families. As such, each entry is treated as independent. ILINet data came from CDC.

## Results

### Key Finding:

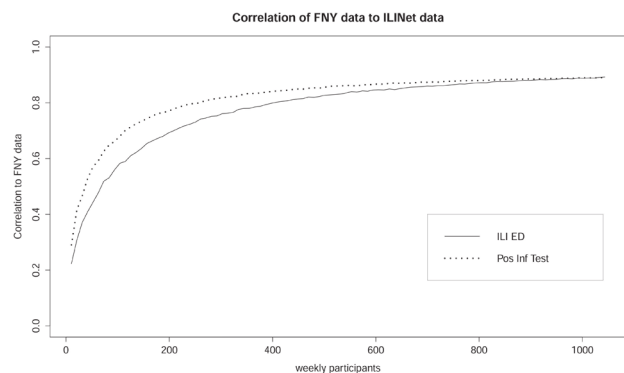
- Correlation of the full FNY dataset against ILI is very high ( $r^2 = .94$ ).
- Correlation of the full FNY dataset against positive influenza tests is also high ( $r^2 = .92$ ).
- Weekly reports from  $< 200$  weekly users have high variance in their correlation to ILINet and a moderate correlation coefficient ( $r^2: 0.3 - 0.7$ ).

- Reports from  $\geq 200$  weekly users seems to be the inflection point for diminishing returns with respect to improving mean correlational coefficient of the pseudo-replicated data.

- FNY correlates well with both ILI visits as well as positive influenza tests.
- At low participation counts, ( $< 400$  per week) FNY correlates better with positive influenza tests than percentage with ILI.
- Overall, FNY data correlates well with national ILINet data, even at limited participation levels.

## Conclusions

Approximately two-thirds of the counties within the United States have a population of  $< 50,000$ . As such, FNY provides a simple, low-cost opportunity for public health officials within those jurisdictions to obtain data that reasonably mirrors ILINet. For larger jurisdictions, FNY is another tool available to track and identify seasonal influenza and engage the public on prevention. This comparison supports the idea that FNY will give local officials in smaller jurisdictions more confidence to guide public health action in their community.



## Keywords

Influenza; Flu Near You; Local Data

## Acknowledgments

I would like to thank Skoll Global Threats Fund for sharing the Flu Near You data.

\*Eric V. Bakota

E-mail: eric.bakota@gmail.com



# Performance of Early Outbreak Detection Algorithms in Public Health Surveillance from a Simulation Study

Gabriel Bedubourg<sup>\*1,2</sup> and Yann Le Strat<sup>3</sup>

<sup>1</sup>French Armed Forces Center for Epidemiology and Public Health, Marseille, France; <sup>2</sup>UMR 912 SESSTIM, Aix Marseille University, Marseille, France; <sup>3</sup>French Institute for Public Health Surveillance, Saint Maurice, France

## Objective

Evaluate the performance of 8 statistical methods for outbreak detection in health surveillance with historical data.

## Introduction

Early detection of outbreaks is crucial in public health surveillance in order to enable rapid control measures. Statistical methods are widely used for outbreak detection (1) but no study has proposed to evaluate and compare thoroughly the performance of these methods.

## Methods

We tested 23 outbreak detection algorithms from a thorough simulation study. Time series were generated using a negative binomial model under 42 scenarios depending on different trends, baseline frequencies of reports, seasonalities (annual or biannual) and dispersion (2). The simulated dataset included 231,000 624-week time series (TS): 4,200 TS without outbreak, 16,800 TS with 3 outbreaks in the past only, 42,000 TS with current outbreak only and 168,000 TS with 3 past and 1 current outbreak. A current outbreak means that it occurred in the last 50 weeks. Each simulated outbreak varied in duration and amplitude with tuning coefficients:  $k_1 = 0, 2, 5$  or  $10$  for past outbreaks and  $k_2 = 1$  to  $10$  for current outbreaks.

We focused on 8 detection methods, some methods being only variants: CDC algorithm, RKI3, Bayes3, CUSUM GLM Rossi, OutbreakP, and GLR Poisson, which are implemented in the R Surveillance package (3), and a periodic Poisson GLM based algorithm. For each algorithm, we used the same tuning parameters for all TS.

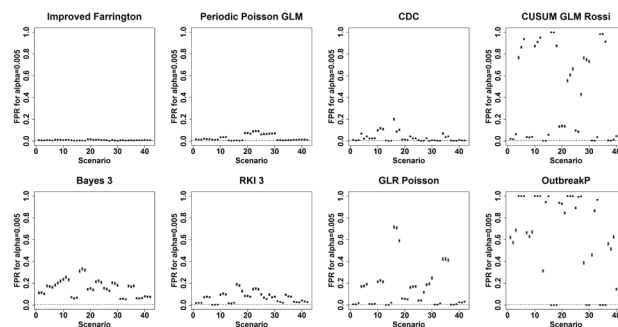
Each method was evaluated through its false positive rate (FPR) and its probability of detection (POD): at least one alarm during the outbreak period), for the different scenarios and outbreak sizes. The nominal FPRs were 0.005 for all the analyses.

## Results

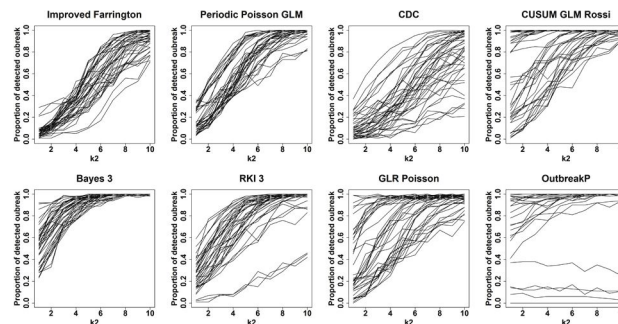
For each of the 42 scenarios, Figure 1 represents the mean of FPRs with  $k_1 = 5$  and Figure 2 represents the POD with  $k_2$  varying from 1 to 10. Only the Farrington, periodic Poisson GLM, and RKI3 algorithms presented a  $POD > 80\%$  for the largest outbreaks ( $k_2 > 8$ ) combined with a  $FPR < 20\%$ , for each scenario. Bayes3 method presented high POD with a  $FPR > 20\%$  for some scenarios. CDC algorithm presented heterogeneous POD depending on the scenario with a  $FPR < 20\%$ . For the other 3 methods, FPR and POD greatly depend on the scenario.

## Conclusions

We presented a systematic assessment of performance of 8 outbreak detection algorithms using a simulated dataset, large enough to include time series observed in the real surveillance systems. We also simulated a high diversity of outbreaks in terms of amplitude and duration. Since no single algorithm has presented sufficient performance for all scenarios, combinations of methods must be investigated to achieve predefined minimum performance. Other criteria of performance should be proposed in order to improve the choice of algorithms to be implemented in the surveillance systems.



False positive rate for 8 outbreak detection algorithms (42 simulated scenarios – Past outbreak amplitude  $k_1 = 5$ )



Probability of detection of 8 outbreak detection algorithms according to current outbreak amplitude ( $k_2$ ) (Past outbreak amplitude  $k_1 = 5$ ) (each curve corresponds to a simulated scenario)

## Keywords

Health surveillance; Outbreak detection algorithm; Statistical method; Performance evaluation; Simulation study

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**\*Gabriel Bedubourg**

E-mail: gabrielbedubourg@hotmail.fr



# Modernization of Epi Surveillance in Kazakhstan: Transition to Risk Assessment and Real-Time Monitoring Based on Situational Center

Zhandarbek Bekshin<sup>2</sup>, Aizhan Esmagambetova<sup>2</sup>, Stanislav Kazakov<sup>3</sup>, Alexry Burdakov<sup>\*1</sup>, Damir Kobzhasarov<sup>2</sup> and Andrey Ukharov<sup>1</sup>

<sup>1</sup>Black & Veatch, Overland Park, KS, USA; <sup>2</sup>Committee on Consumer Rights Protection of the Ministry of National Economics, Astana, Kazakhstan; <sup>3</sup>Scientific-Practical Center of Sanitary-Epidemiological Expertise and Monitoring, Almaty, Kazakhstan

## Objective

Development of a concept for sanitary-epidemiological monitoring system reinforcement in Kazakhstan based on the deployed electronic surveillance system, risk assessment and management approach, and establishment of a Situational Center.

## Introduction

The sanitary-epidemiological monitoring system in Kazakhstan is passive and statistical in nature. Due to the modern threats, activation and emergence of new and recurring diseases (corona virus, Ebola, etc.) it is vital to transition from current epidemiological surveillance approaches to new prognostic, epi risk probability assessment, and bio risk management technologies, and in addition to urgent response develop preventive measures procedures to minimize the consequences of potential epi outbreaks.

## Methods

A set of measures for epi surveillance system improvement and modernization was developed based on the following initiatives:

1) Implementation of a unified open-source Electronic Integrated Disease Surveillance System (EIDSS) (eidss.codeplex.com) in the epi surveillance and monitoring service [1]

2) Development of Regional Sanitary-Epidemiological Passports (RSEP) [2, 3]

3) Creation of a republican Situational Center (SC)

The concept of SC creation is new for epidemiology in Kazakhstan. The SC will be a 24/7 working department with special staff collecting and aggregating epi information from all available internal and external sources.

The external threat assessment is based on the current situation in bordering territories, diseases in other countries that have international proliferation potential (confidential IHR 2005 site through the network of national WHO coordinators), and infectious diseases in other countries (ProMed, CDC networks and Ministry of Health websites).

The internal threat assessment is based on the currently used surveillance system Sanitary-Epidemiological Surveillance-1987, the implemented unified epi program EIDSS for 64 diseases, the developed RSEP, natural especially dangerous disease foci in Kazakhstan (available through maps and electronic geo-information systems), and the current state and capabilities of the national infection diagnostic laboratories.

## Results

The following tasks will be executed based on the collected data:

1) Situational monitoring: information collection and analysis on the epi situation in real-time

2) Improvement and development of new risk prognosis methodology based on multi-factor analysis of internal and external sources [3]

3) Coordination of territorial units on emergency response: assessment of the situation regarding foci and in the country at large, readiness preparation monitoring of response units, coordination of services and units, and international cooperation

4) State authorities information brief (immediate access to emergency situations information, available through a website)

## Conclusions

Active surveillance, risk assessment and prediction with a unified monitoring system within a Situational Center (SC) will improve epi situation control level. The SC will become the main source of reliable information on the epi situation in Kazakhstan as well as for trans-boundary epi risks to the republic. The SC can become the foundation for multi-sectoral One Health collaboration on zoonotic diseases, as well the base element for regional cooperative systems within Global Health Security Agenda.

## Keywords

risk assessment; real-time monitoring; situational center

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**\*Alexry Burdakov**

E-mail: burdakov@usa.net





# Analysis of Alternatives for Combined and/or Collaborative Syndromic Surveillance Within DoD and VA

Robert E. Bell<sup>\*1</sup>, Mark Holodniy<sup>2</sup> and Julie A. Pavlin<sup>3</sup>

<sup>1</sup>Defense Health Agency, Department of Defense, Falls Church, VA, USA; <sup>2</sup>Department of Veteran's Affairs, Palo Alto, CA, USA;

<sup>3</sup>Henry M Jackson Foundation and Uniform Services University, Bethesda, MD, USA

## Objective

Determine an optimal course of action for achieving a more mission and cost-effective model for implementing combined or collaborative biosurveillance across the Departments of Veterans Affairs (VA) and Defense (DoD).

## Introduction

The Joint Incentive Fund (JIF) Authorization creates innovative DoD/VA sharing initiatives. In 2009, DoD and VA commenced a biosurveillance JIF project whose principle objectives include improved situational awareness of combined VA/ DoD populations<sup>1</sup> and determining the optimal business model allowing both agency biosurveillance programs to operate more efficiently by: 1) consolidating information technology assets; 2) targeting enhanced collaboration for improved public health outcomes; and 3) improving buying power, and return on investment. We analyzed various interoperability models aimed at biosurveillance data sharing, asset consolidation and enhanced collaboration. Potential end states to be evaluated include maintaining separate Departmental systems, bidirectional exchange of data to separately managed systems, consolidation of data within one Department and shared access to a common system, consolidation of data in a neutral repository accessed by separately run legacy systems, or a custom developed biosurveillance solution utilizing a common data repository.

## Methods

Our analysis complied with US Office of Management and Budget's Circular A-94, which promotes efficient resource allocation through well-informed decision-making by providing guidance for conducting cost-benefit and cost-effectiveness analyses. Our analysis utilized the Analytical Hierarchy Process (AHP), which is a decision support methodology for solving complex decision problems using a multi-level hierarchical structure of objectives, criteria, sub-criteria, and alternatives. Pertinent data are derived using a set of pairwise comparisons to obtain weights of importance for decision criteria, and relative performance measures of alternatives for individual decision criterion. Additionally, we used the Delphi technique to solicit input from DoD/VA program leadership, current ESSENCE users, and an independent executive leadership team who formerly served in key positions across both agencies. To assess the merits of current information technology assets, we included a combination of standardized questionnaires as well as "hands on" evaluations and interviews. A wide array of biosurveillance program information was collected from both agencies.

## Results

We identified 6 top level decision criteria and 26 sub-criteria and determined relative importance weighting among this criterion, which formed the basis of an AHP model. Five alternative courses of action as well as the current state were evaluated and scored by public health subject matter experts. These experts scored the alternatives within three discrete timeframes, representing: 1)FY2015-2016; 2)

FY2017-2018; 3)FY2019-2024. In addition, an overall score was computed for the entire timeframe spanning from FY2015 through 2024. Dual one-way data feeds was the highest scoring alternative for the overall timeframe, however however scores were also very high for the period FY2019-2024, involving the creation of a Cloud based joint data repository. The DoD and VA will endeavor to pursue these alternatives to improve syndromic biosurveillance efforts in the future.

## Conclusions

This project identified six possible end states for VA and DoD future biosurveillance activities. Subject matter experts have determined the criteria which are most important in evaluating alternative scenarios. The two highest scoring solution set's will be pursued in the future in order to improve syndromic biosurveillance across the agencies.

## Keywords

ESSENCE; Biosurveillance; decision support

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**\*Robert E. Bell**

E-mail: robert.bell@dha.mil



# Utility of Syndromic Surveillance in Detecting Potential Human Exposures to Rabies

Kelley Bemis\*, Megan T. Patel, Mabel Frias and Demian Christiansen

Communicable Disease, Cook County Department of Public Health, Forest Park, IL, USA

## Objective

To determine whether unreported cases of potential human exposure to rabies can be detected using an emergency department (ED) syndromic surveillance system and to assess both reporting completeness and compliance with clinical guidelines related to rabies exposures in suburban Cook County.

## Introduction

Rabies post-exposure prophylaxis (PEP) can prevent fatal encephalitis associated with exposure to the rabies virus. However, overuse and inappropriate administration of rabies PEP are common.<sup>1</sup> Mandatory reporting of potential rabies exposures provides opportunities for public health practitioners to monitor the appropriateness of PEP administration and offer recommendations. In Illinois, potential human exposure to rabies, including any person started on PEP and any person with contact to a bat, must be reported to the local health authority. Previous investigations into the completeness of rabies reporting have concluded that active surveillance in addition to mandatory reporting may be useful.<sup>2</sup> As rabies PEP is often given in an emergency department setting, syndromic surveillance records may provide a basis for estimating completeness of reporting and identifying candidates for active surveillance follow up.

## Methods

Emergency department records from 45 local hospitals between 1/1/2013 and 6/30/2015 were queried for chief complaints or discharge diagnoses pertaining to rabies, PEP, or contact with a bat. Exclusionary terms and manual record review eliminated unrelated visits. Cases of potential human exposure to rabies reported to the Cook County Department of Public Health (CCDPH) during the same time period were extracted from the Illinois National Electronic Disease Surveillance System. Cases were matched to ED records based on provider, visit date, age, sex, and zip code. The remaining unmatched individuals with  $\geq 2$  visits were considered probable unreported instances of PEP initiation. Demographics of unreported individuals were compared to reported individuals using chi square.

## Results

Between 1/1/2013 and 6/30/2015, 241 individuals visited local EDs with a chief complaint or discharge diagnosis related to bat contact or rabies PEP. Of these 241, 63 (26%) were previously reported to CCDPH. Of the remaining 178, 81 (46%) had  $\geq 2$  visits suggesting a true instance of unreported PEP initiation. Reporting of these individuals was less common in winter compared to spring, summer, and fall (19% versus 52%, 48%, 54%, respectively,  $p=.03$ ). Region of patient residence also exhibited an association with reporting ranging from 92% in the South District to 28% in the North District ( $p<.01$ ). Regional trends likely reflect differential reporting behaviors among hospitals in the area, ranging from 100% to 0%. Of note, the 63 previously reported individuals identified by syndromic surveillance queries represented only 62% of the individuals reported to CCDPH during the same time period, suggesting that underreporting as measured here remains a significant underestimate. Based on these results, CCDPH instituted a new active surveillance

policy for individuals visiting local EDs with a chief complaint or discharge diagnosis related to bat contact or rabies PEP, retroactive to 1/1/2015. Individuals identified through active surveillance will be compared with individuals reported through passive surveillance to assess differences in whether PEP was given in accordance with recommendations and administered correctly.

## Conclusions

A large proportion of potential human exposures to rabies in Suburban Cook County are not reported. Analysis of syndromic surveillance records is an effective tool for evaluating reporting completeness, identifying targets for active surveillance, and ensuring compliance with clinical best practice and reporting requirements.

## Keywords

Syndromic surveillance; Rabies; Post-exposure prophylaxis; Evaluation

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## \*Kelley Bemis

E-mail: kbemis@cookcountyhhs.org



# Disproportionate Emergency Room Use as an Indicator of Community Health

Kelley Bemis\*, Samantha Gray, Megan T. Patel and Demian Christiansen

Communicable Disease, Cook County Department of Public Health, Forest Park, IL, USA

## Objective

To identify geographic clustering of elevated emergency room (ER) usage rates for incorporation into community health assessments (CHA) in suburban Cook County and to validate this metric as a potential sub-county level community health indicator.

## Introduction

Community health assessments are a foundation of public health practice and a prerequisite to achieving public health accreditation. Best practice dictates that CHAs must incorporate qualitative and quantitative data and utilize a number of indicators to create a detailed picture of a community's health. Metrics may describe demographics, social and economic factors, health behaviors, health outcomes, and healthcare access and utilization. Commonly used indicators facilitate cross-jurisdiction comparisons and simplify decision-making. However, while many readily available indicators exist on a county level, few have been made available on the sub-county level<sup>1</sup>. Syndromic surveillance messages, typically emergency room visit records, contain sub-county level data on patient residence, such as zip code or municipality. As hospitals progress towards meeting Stage 2 Meaningful Use requirements, transmission of syndromic surveillance data to public health entities will become standard. Analysis of emergency room visit data, either in aggregate or by specific syndromes, may be a valuable sub-county level indicator of community health status and access to care that can be standardized across jurisdictions.

## Methods

Emergency room visits in 2014 for suburban Cook County residents were extracted from a syndromic surveillance system, ESSENCE, containing records from 45 hospitals in Northern Illinois. All hospitals in suburban Cook County report to the system. Crude and age-adjusted rates of ER usage by zip code were calculated using population estimates from the 2013 American Community Survey. Rates were further stratified by sex and age. ArcGIS 10.1 was used to visualize and analyze spatial clustering of rates, including identification of hot spots using Getis-Ord Gi\* hot spot analysis.

## Results

In 2014, 767,282 residents of suburban Cook County visited emergency rooms reporting to ESSENCE for an age-adjusted rate of 281 visits per 1,000 persons. Rates varied by zip code of residence, with higher rates in the South District. The aggregate rate of zip codes in the South District was 377 visits per 1,000 persons compared to 240 in the North District, 273 in the West District, and 288 in the Southwest District. A similar trend was seen across all age groups and genders, with the exception of persons 65 years and older who exhibited higher rates in the North and Southwest Districts. Hot spot analysis of age-adjusted rates identified a large cluster of 27 zip codes, spanning the South and Southwest Districts, with significantly elevated ER usage (Figure 1,  $p < .01$ ). Median age-adjusted rate of this cluster was 382 visits per 1,000 persons with a range of 204 to 807. Areas with elevated ER visit rates are consistent with areas of need identified by other community health indicators, such as high infant mortality or low socioeconomic position.

## Conclusions

Spatial analysis of emergency room visit rates by zip code can identify neighborhoods that may have greater public health or medical needs. Syndromic surveillance data has the potential to provide public health departments with a useful and widely available community health indicator at the sub-county level.

## Hot Spot Analysis of Age-Adjusted Emergency Room Visit Rates, Suburban Cook County, 2014

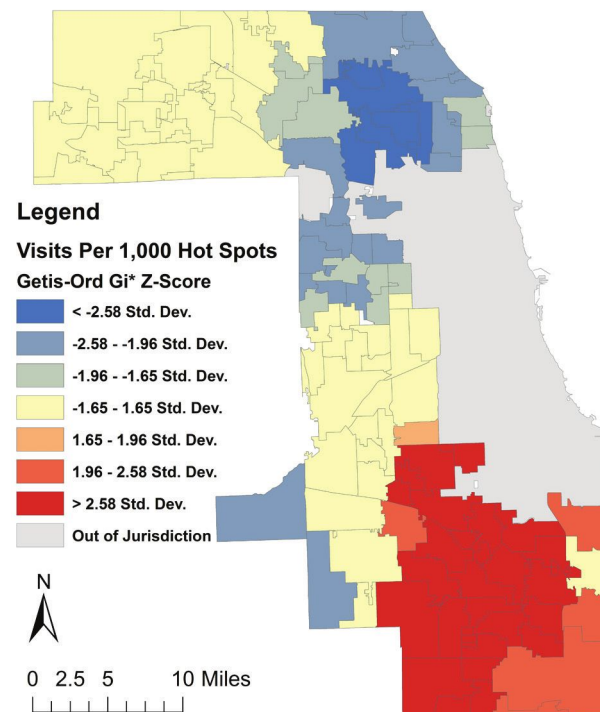


Figure 1. Hot Spot Analysis of Age Adjusted Emergency Room Visit Rates, Suburban Cook County, 2014

## Keywords

Syndromic surveillance; Disparities; GIS; Community health assessment

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## \*Kelley Bemis

E-mail: kbemis@cookcountyhhs.org



## Is There a Need for One Health Surveillance (OHS)?

John Berezowski<sup>\*1</sup>, Judy Akkina<sup>2</sup>, Victor D. Vilas<sup>3</sup>, Katrina DeVore<sup>4</sup>, Fernanda C. Dórea<sup>5</sup>, Céline Dupuy<sup>6</sup>, Melody J. Maxwell<sup>3</sup>, Vivek Singh<sup>7</sup>, Flavie Vial<sup>1</sup> and Laura Streichert<sup>4</sup>

<sup>1</sup>University of Bern, Bern, Switzerland; <sup>2</sup>United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Fort Collins, CO, USA; <sup>3</sup>Pan American Center for Foot-and-Mouth Disease, Pan American Health Organization, Rio de Janeiro, Brazil; <sup>4</sup>International Society for Disease Surveillance, Boston, MA, USA; <sup>5</sup>Swedish Zoonosis Centre, Department of Disease Control and Epidemiology, National Veterinary Institute (SVA), Uppsala, Sweden; <sup>6</sup>French Ministry of Agriculture, Lyon, France; <sup>7</sup>Public Health Foundation of India (PHFI), Indian Institute of Public Health (IIPH), Hyderabad, India

### Objective

The primary purpose of this study was to explore the attitudes of surveillance stakeholders from different domains to:

- determine whether there is a perceived need for OHS
- identify significant surveillance gaps
- assess the motivation to change (fill the gaps)

A secondary purpose was to gather a group of surveillance stakeholders to identify and prioritize strategies to move One Health Surveillance forward.

### Introduction

As interest in One Health (OH) continues to grow, alternative surveillance infrastructure may be needed to support it(1). Since most population health surveillance is domain specific; as opposed to OH which crosses multiple domains, changes to surveillance infrastructure may be required to optimize OH practice. For change to occur there must be a strong motivation that propagates from a perceived need. Since the purpose of surveillance is to produce information to support decision making, the motivation for change should relate to a lack of surveillance information needed to make OH decisions, or a gap in the surveillance infrastructure required to produce the information (2).

### Methods

The study had two parts:

1) An electronic questionnaire emailed to surveillance stakeholders working in different health domains around the world, to assess their attitudes towards integrated OHS.

Questions included:

- Would OHS be a benefit in your jurisdiction?
- Is OHS a challenge in your jurisdiction?
- How difficult would it be to make improvements in OHS?
- What priority does OHS have in your jurisdiction?

2) A workshop was held at the Annual Conference of the International Society for Diseases Surveillance (ISDS) held in Philadelphia, PA, on Dec 10-11, 2014, where a formal identification and prioritization of solutions to OHS implementation was conducted.

### Results

A total of 185 questionnaires were returned by respondents from 44 countries including low income countries (58, 31%) and high income countries (127, 69%). Respondents reported working primarily in public health (96, 52%), followed by animal health (36, 19%) and environmental health (4, 2%). Forty six (25%) respondents reported working in multiple domains.

The majority (158, 85%) of respondents reported that OHS would benefit them in their work. There were no significant differences in the perceived need for OHS across domains, or between low and high income countries.

Almost half of the respondents (87, 47%) reported that assessing the risk of transmission across domains was a frequent or ever present challenge indicating that a gap in surveillance may exist in some

jurisdictions. Most (129, 70%) reported that improvements would be somewhat difficult or very difficult. Many (120, 65%) reported that making improvements was a medium to high priority indicating that some respondents were motivated to change.

There were 61 workshop participants from 6 countries who identified solutions, including: cross domain staff exchanges, tools for data integration, and making diseases that require multi-domain collaborative responses or control programs reportable in multiple domains.

### Conclusions

This study provides some support that among surveillance stakeholders, OHS is valued. It also provides support for the existence of surveillance gaps, and the presence of motivation among some stakeholders to improve existing surveillance to meet the information needs of OH.

The study population included respondents who worked in public health, animal health and multiple domains, and from many countries. However the sample was not large and it is not known how well this sample represents the biosurveillance community in general.

### Keywords

One Health Surveillance; One Health; Integrated surveillance

### Acknowledgments

This work was supported by the ISDS: <http://www.syndromic.org/> and the Skoll Global Threats Fund: <http://www.skollglobalthreats.org/>

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### \*John Berezowski

E-mail: [john.berezowski@gmail.com](mailto:john.berezowski@gmail.com)





# Classification and Capture of Work-Related Non-Fatal Injuries Through a Real-Time Syndromic Surveillance System

Marija Borjan\* and Margaret Lumia

New Jersey Department of Health, Trenton, NJ, USA

## Objective

The New Jersey Department of Health (NJDOH), Occupational Health Surveillance (OHS) Unit staff proposes to evaluate a real-time surveillance tool to track a variety of occupationally-related emergency room visits throughout the state via EpiCenter, the NJDOH's existing real-time surveillance system.

## Introduction

Syndromic surveillance has been used by state agencies to collect real-time information on disease outbreaks but has not been used to collect data in the occupational setting. Therefore, OHS staff has begun evaluating a real-time surveillance tool to track a variety of occupationally-related emergency room visits throughout the state via EpiCenter, the NJDOH's existing real-time surveillance system. This proposal applies established epidemiologic techniques to a different set of circumstances than they have been applied to in the past. Incorporating Syndromic Surveillance data with hospital discharge data will enhance the ability to classify and capture work-related non-fatal injuries and improve efforts of prevention. By employing a real-time, independent data source such as EpiCenter, the classification of work-related injuries and illnesses could be greatly enhanced, leading to a better understanding of the burden of non-fatal work-related injuries and illnesses, and allowing for quicker intervention.

## Methods

A work-related injuries and illness classifier will be developed to trigger EpiCenter to alert staff of an occupational event. Classifiers are specific to certain events such as, heat related illness or chemical exposure; are composed of keywords related to those events; and are searchable in the chief complaint fields. Once an initial draft classification is developed, the historic data will be surveyed for the defined keywords or International Classification of Diseases (ICD) codes to refine the inclusion/exclusion keywords. Using a modified SAS code, keywords and ICD codes will be pulled from the historic data set. Once the syndrome classification is developed and validated, preliminary alert thresholds for work-related injury or illness events based on counts of Emergency Department (ED) events which meet the occupational syndromes will be determined. These alert thresholds may be based on absolute number of events or based on the number of cases needed for NJDOH Public Employee Occupational Health and Safety (PEOSH) to respond to. OHS staff will conduct sensitivity analysis to identify threshold cut-offs and long-term surveillance to detect trends in injuries.

## Results

OHS currently receives automatic real-time electronic notifications when three or more cases of chemical exposures are seen in the same ED or among residents in the same county in NJ, within a 24-hour period. OHS staff quickly reviews the cases using the secure EpiCenter website and contacts the ED Nurse Manager to obtain information on the chemical the patients were exposed too, how they were exposed, and if it was work-related. Recently, OHS staff began exploring using EpiCenter as a real-time surveillance system for

occupationally related chemical exposures. This real-time surveillance of occupational events has detected diverse exposures and illnesses including: exposure to toluene vapor at a nail polish manufacturing plant; six cases of pesticide exposure at a produce repacking facility; and carbon monoxide poisoning of two police officers due to exhaust problems in their vehicle.

## Conclusions

This use of the EpiCenter chief complaint reporting system has shown that it can yield real-time knowledge of incidents and local conditions for OHS to assist with and identify prevention opportunities. Occupational surveillance currently involves collecting data on potential cases on a quarterly or yearly basis, often long after the diagnosis was made. However, EpiCenter allows staff to identify illnesses early so a rapid response can be initiated, reducing further risk of occupational injuries and illness. The use of multiple data sources can help identify populations, occupations and industries at high risk of a work-place injury and illness in real-time, along with providing data to help monitor trends of work-related injuries and illness over time.

## Keywords

occupational; injuries; surveillance

## Acknowledgments

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\*Marija Borjan

E-mail: Marija.Borjan@doh.state.nj.us



# Role of Influenza in ED Visits and Hospitalizations of Adults Over 65 Years in France

Vanina Bousquet\*<sup>1</sup>, Larissa Vernier<sup>1</sup>, Yann Le Strat<sup>1</sup>, Isabelle Bonmarin<sup>1</sup>, Christophe Leroy<sup>2</sup>, Maurice Raphaël<sup>3</sup>, Gilles Viudes<sup>5</sup>, André de Caffarelli<sup>4</sup> and Céline Caserio-Schönemann<sup>1</sup>

<sup>1</sup>French Institute for Public Health Surveillance, St Maurice, France; <sup>2</sup>Louis Mourier Hospital Emergency Department, Colombes, France; <sup>3</sup>French Society of Emergency Medicine, Paris, France; <sup>4</sup>Bastia Hospital Emergency Department, Bastia, France; <sup>5</sup>Federation of Regional Observatories for Emergency Activities, Paris, France

## Objective

To estimate the real burden of influenza epidemic on emergency departments (ED) attendances and hospitalizations among patients over 65 years in order to better understand determinants of overcrowding and mortality excess.

## Introduction

While the link between excess winter mortality and winter respiratory diseases in the elderly is well described, the impact of the epidemic of influenza in the elderly is mainly assessed in France through specific surveillance in the general population. Syndromic surveillance data enables to monitor ED attendances and hospitalizations for various diagnostic codes groupings throughout the influenza epidemic, some of which often cited as influenza proxies, such as cardiorespiratory diagnostic groups<sup>1-2</sup>.

In mainland France, the 2014-15 season was characterized by an intense influenza epidemic in the community (sub-type A(H3N2) dominant virus). Hospital overcrowding was early reported, partly linked to serious clinical presentations among the elderly, and leading to the triggering of a national emergency plan.

We hypothesized that ED numbers of clinical influenza cases underestimate the influenza burden among patients aged 65 years and over, especially when a A(H3N2) influenza subtype circulates.

## Methods

In October 2014, the French syndromic surveillance system based on the ED (OSCOUR® network) included about 550 ED (45,000 daily attendances), recording 85% of the national total attendances. About 270 ED transmitted daily during the whole study period (20,500 daily attendances).

Numbers of visits and hospitalizations for influenza proxy variables were extracted from the national database for the period October 2010 to April 2015 and aggregated to a weekly level for patients aged 65 years and over. Weekly isolates of influenza viral subtypes were obtained from reference laboratories. Diagnostic codes groupings were selected based on their association with either influenza symptoms or complications of an influenza infection. Visual examination of times series correlation with influenza positivity rate along with spearman correlation were performed to select principal influenza proxy variables.

Attendances and hospitalizations of patients aged 65 years and over were modeled separately as a function of each selected proxy variables for influenza, seasonality and trend using a negative binomial regression model<sup>2</sup>.

Two surrogate's measures for influenza activity were tested: clinical influenza attendances and laboratory confirmed influenza identifications (positivity rate). Numbers of visits for bronchiolitis among children under 2 years old were used as a proxy of RSV activity.

## Results

For the entire study period, visits were significantly associated with influenza positivity rate for acute bronchitis (IRR=2.0 95% CI=1.7;2.3), pneumonia (IRR=1.4 95% CI=1.2;1.5), chronic obstructive pulmonary disease (COPD) (IRR=1.4 95% CI=1.3;1.6), dyspnea (IRR=1.2 95% CI=1.2;1.3), asthma (IRR=1.5 95% CI=1.3;1.8), acute cardiac failure (IRR=1.2 95% CI=1.1;1.3), and dehydration (IRR=1.2 95% CI=1.1;1.4). Similar measures of associations were found for hospitalizations.

## Conclusions

Our study shows that the burden of influenza is underestimated among the elderly, due to the lack of sensitivity of coding, especially during A(H3N2) seasons, partly explained by the large panel of influenza clinical presentations in this age group.

Based on our results, a diagnostic codes grouping will be specifically built to monitor influenza epidemic in ED and to estimate its burden among patients aged 65 years and over.

## Keywords

influenza; emergency departments; flu proxy variables

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## \*Vanina Bousquet

E-mail: v.bousquet@invs.sante.fr



# Openness, Transparency and Equity in Public Health Surveillance Data Sharing

Matthew Brack\*, Michael Edelstein, Asha Herten-Crabb and David R. Harper

<sup>1</sup>Centre on Global Health Security, Chatham House, London, United Kingdom;

## Objective

To address both the policy and technical issues of sharing public health surveillance data across national borders with the aim of establishing new norms so that data can be shared in an open, transparent and equitable way.

## Introduction

The outbreaks of Severe Acute Respiratory Syndrome (SARS) in 2003, influenza A (H1N1) in 2009 and Ebola in 2014 have shown increasingly that infectious diseases can spread globally in a short timeframe, affecting both high- and low-income countries. Taking action to mitigate the impact of future crises relies on sharing public health surveillance data across national borders in an efficient and effective way. However, data users, particularly in high-income countries, often use surveillance data, particularly from low- and middle-income countries, with little or no benefit to the data generator. As Indonesia's refusal to share influenza virus sequences during the 2006 H5N1 outbreak illustrates, this imbalance increases reluctance to share and jeopardizes the global good that can be achieved. In order to share public health surveillance data internationally in an equitable way, technical, political, ethical, and legal issues need to be addressed. The Centre on Global Health Security at Chatham House is producing guidance that will address both the policy and technical issues with the aim of establishing new norms so that data can be shared in an open, transparent and equitable way.

## Methods

We have developed key principles on the technical, legal, ethical, and political implications of cross-border data sharing. These draw on the published literature and expert advice gained through interviews and a series of thematic roundtables.

## Results

Open, transparent and equitable public health surveillance data sharing requires the engagement of three groups of stakeholders: those generating the data; those who interpret data generated by others; and those facilitating the data-sharing process. These categories are not mutually exclusive. We have outlined seven key principles that encourage optimal global public health surveillance data sharing and promote the equal distribution of benefits: (i) articulating the value proposition; (ii) planning for data sharing; (iii) ensuring high-quality data production; (iv) collaborating in creating data-sharing agreements; (v) building trust and being consistent; (vi) understanding the global legal landscape; and (vii) monitoring and evaluating progress. In addition, standards, capacity building, and ethical considerations, such as those concerning equity, are themes that span these principles and have to be embedded in each of them.

## Conclusions

Surveillance is a cornerstone of public health. Increasingly, public health surveillance data need to cross national borders to address international public health crises - the traditional health security approach of protecting national borders clearly does not work in a globalized world. The Ebola crisis in West Africa has demonstrated that a local event in a remote location can have widespread

consequences, and that global health security is only as strong as its weakest point. Cross-border public health surveillance data that are both high quality and timely are essential in supporting efforts to mitigate the impact of such crises. The Chatham House guidance, scheduled for launch in October 2016, is expected to play a key role in the global community's management of future threats.

## Keywords

data sharing; surveillance data; equity; International

## \*Matthew Brack

E-mail: mbrack@chathamhouse.org





# An eHARS Dashboard for State HIV Surveillance

Elliott S. Brannon<sup>\*1</sup>, Tera Reynolds<sup>2,3</sup>, Sunyang Fu<sup>2,3</sup>, Kristen Harden<sup>3</sup>, Dolorence Okullo<sup>2,3</sup> and Shreyas Ramani<sup>2,3</sup>

<sup>1</sup>University of Michigan Medical School, Ann Arbor, MI, USA; <sup>2</sup>University of Michigan School of Information, Ann Arbor, MI, USA;

<sup>3</sup>University of Michigan School of Public Health, Ann Arbor, MI, USA

## Objective

Describe the development process and function of a data dashboard for state HIV surveillance and discuss the benefits of creating interactive data dashboards in the R software environment.

## Introduction

State HIV offices routinely produce fact sheets, epidemiologic profiles, and other reports from the eHARS (Enhanced HIV/AIDS Reporting System) database which was created and is maintained by the CDC.<sup>1</sup> The eHARS software is used throughout the United States to monitor the HIV epidemic and evaluate HIV prevention programs and policies. Due to limited variability of eHARS throughout the United States, software developed to analyze and visualize data using the eHARS database schema may be useful to many state HIV offices. Software developed based on the eHARS database schema could reduce the time required for analysis and production of reports.

The R software environment for statistical computing is an open source project with a thriving community of users who continue to expand R's analysis capacity through the addition of packages. A package is "a standardized collection of material extending R, e.g. providing code, data, or documentation".<sup>2</sup> Shiny is one example of a user-developed package which easily allows R users to create interactive web applications from analytical software.

## Methods

An open source R package is under development for state HIV offices. The package is being developed in the open on the Github repository. The *eharsDash* package will create a data dashboard based on the eHARS database schema and will rely on the Shiny package to create interactive data visualizations from the data in eHARS. The *eharsDash* package will also contain software to import data from eHARS into R for analysis and visualization.

Once developed, state HIV offices may use the software in several ways including the following:

- 1) Users may install the software locally for individual analyses
- 2) Offices may install the software on an intranet for use by multiple users in the office
- 3) Offices may install the the software on a publicly available website, allowing the public to interact with HIV data

Developers will work with state HIV offices to determine the visualization needs of the office and will also create plots based on HIV epidemiological profiles available from the websites of state HIV offices. If state HIV offices find the *eharsDash* package useful, the number of data visualizations can easily be expanded through the continuation of the community-driven process. State HIV offices and the CDC could provide feedback and work together with the developers to create an open-source data visualization package for the eHARS database.

## Conclusions

The R software environment will be used to create a powerful data dashboard for the eHARS database schema. The *eharsDash* package will contain software which imports data from eHARS into the R environment and analyzes and visualizes the data. It will also enable reproducibility of analyses. Due to this reproducibility, the use of the

*eharsDash* package may reduce the time state HIV offices require to complete analyses for reports. State HIV offices may then have additional resources to pursue research and prevention activities and reduce the burden of HIV in their state.

The *eharsDash* package will also encourage a more open structure for presenting HIV surveillance data while maintaining anonymity. Although traditionally state health departments have relied on SAS software for analysis and data management, consideration should be given to the R software environment due to its open environment, user community, and cost. Data transparency and access are essential to understanding and reducing the health inequalities which exist in diseases such as HIV.

## Keywords

eHARS; Shiny; Visualization

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**\*Elliott S. Brannon**

E-mail: [ebrann@umich.edu](mailto:ebrann@umich.edu)



# Sharing Situational Awareness of the 2014-2015 Highly-Pathogenic Avian Influenza Outbreak Across Government

Yandace K. Brown\* and Teresa Quitugua

National Biosurveillance Integration Center, Department of Homeland Security, Washington DC, DC, USA

## Objective

The National Biosurveillance Integration Center (NBIC) coordinated information sharing with the U.S. Department of Agriculture (USDA/APHIS) and the Department of Interior (DOI/NWHC) to integrate information and provide shared situational awareness of the 2014-2015 Highly Pathogenic Avian Influenza (HPAI) outbreak in the U.S. across all levels of government.

## Introduction

NBIC integrates, analyzes, and shares national biosurveillance information provided from capabilities distributed across public and private sectors. The integration of information enables early warning and shared situational awareness of nationally significant biological events to inform critical decisions directing response and recovery efforts.

The 2014-2015 HPAI H5 outbreak in the U.S. was the largest HPAI outbreak in the country's history and resulted in the culling of millions of domestic birds and significant economic losses through loss wages, direct production losses, cost of recovery, consumer price increases, and trade restrictions.

NBIC worked closely with liaisons from USDA/APHIS and DOI/NWHC over the course of the outbreak to integrate information from both agencies and open source reporting into reports and data sets providing early and sustained shared situational awareness to over 1400 federal, state, and local authorities.

## Methods

NBIC collects data from numerous sources by automated and manual methods. Most information gathered is unstructured data, such as media reports and is collected, analyzed, and visualized using government funded and publically available information technology tools. Whenever possible, open source reports are verified, validated, and contextualized through consultation of reports from interagency partners, communication with interagency liaisons and other subject matter experts, or through formal interagency Requests For Information. Results of integrated, collaborative analyses of the aggregated data are communicated in reports disseminated to all levels of government through secure automated feeds to government systems, posts on government information sharing portals, or direct email.

## Results

In mid-December 2014, DOI/NWHC reported the first confirmation of HPAI H5 in a captive gyrfalcon in Whatcom County, Washington at a site near an area of British Columbia, Canada where an outbreak of HPAI H5N2 occurred earlier that month. NBIC began reporting on the outbreak through the National Biosurveillance Integration System (NBIS) Monitoring List, a daily summary of high-priority events distributed to federal, state, and local partners. The next day, NBIC issued its first Biosurveillance Event Report, a more extensive report that includes assessment of potential impact and comprehensive background information.

Over the course of the outbreak, NBIC analysts communicated closely with DOI/NWHC and USDA/APHIS liaisons and continuously monitored open-source media; including state and federal government, industry, and academic reports, and updates to provide timely and accurate information to a broad range of stakeholders. NBIC integrated data made available by individual federal authorities into a single map that was updated regularly to reflect the most current information available on the locations of HPAI detections in wild, backyard, captive, and commercial birds. NBIC provided structured datasets to the Department of Health and Human Services Office of the Assistant Secretary for Preparedness and Response, which were used to generate maps for sharing within the GeoHealth platform. NBIC also worked with the Federal Emergency Management Administration to communicate situational updates to regional planning and response personnel.

By June 2015, HPAI H5 was identified in wild, captive, backyard, or commercial birds in 21 U.S. states. Detections in backyard and commercial poultry were confirmed in 15 U.S. states with over 48 million domestic birds affected.

## Conclusions

NBIC's ongoing efforts to cultivate and maintain interagency relationships across the federal government to enhance biosurveillance capabilities facilitated situational awareness. NBIC provided integrated maps not available elsewhere and coordinated timely reporting shortly after initial notification by the responsible authorities. NBIC continues to coordinate with DOI/NWHC and USDA/APHIS through agency liaisons and provide situational awareness to its government partners and department leadership.

## Keywords

HPAI; outbreak; situational awareness; government

## \*Yandace K. Brown

E-mail: Yandace.Brown@hq.dhs.gov



# Developing the Scalable Data Integration for Disease Surveillance (SDIDS) Platform

David Buckeridge\*<sup>1</sup>, Maxime Lavigne<sup>1</sup>, Kate Zinszer<sup>2</sup>, Anya Okhmatovskaia<sup>1</sup>, Samson Tu<sup>3</sup>, Csongor Nyalus<sup>3</sup>, Mark Musen<sup>3</sup>, Wilson Lau<sup>4</sup>, Lauren Carroll<sup>4</sup> and Neil Abernethy<sup>4</sup>

<sup>1</sup>Epidemiology and Biostatistics, McGill University, Montreal, QC, Canada; <sup>2</sup>Harvard University, Boston, MA, USA; <sup>3</sup>Stanford University, Stanford, CA, USA; <sup>4</sup>University of Washington, Seattle, WA, USA

## Objective

To develop a scalable software platform for integrating existing global health surveillance data and to implement the platform for malaria surveillance in Uganda.

## Introduction

Electronic data that could be used for global health surveillance are fragmented across diseases, organizations, and countries. This fragmentation frustrates efforts to analyze data and limits the amount of information available to guide disease control actions. In fields such as biology, semantic or knowledge-based methods are used extensively to integrate a wide range of electronically available data sources, thereby rapidly accelerating the pace of data analysis. Recognizing the potential of these semantic methods for global health surveillance, we have developed the Scalable Data Integration for Disease Surveillance (SDIDS) software platform. SDIDS is a knowledge-based system designed to enable the integration and analysis of data across multiple scales to support global health decision-making. A 'proof of concept' version of SDIDS is currently focused on data sources related to malaria surveillance in Uganda.

## Methods

SDIDS is a web-based, ontology-driven software platform that automates the integration of heterogeneous data from multiple sources, and supports the discovery, retrieval, visualization, and analysis of these data. A data set is first "mapped" or linked explicitly to the ontologies used within SDIDS, and then the data are ingested into the system and stored in a manner that supports complex queries based on the concepts and relationships defined in the ontologies. Data in the system can be accessed via the SDIDS application program interface (API) for data visualization and analysis.

## Results

**Annotation and ingestion of data:** A software client was created to guide a user through the semi-automated process of mapping a dataset to the SDIDS ontologies. This mapping process identifies the correspondence of each column: to a domain concept (e.g., 'Age', 'Symptom'), to a data type (e.g., 'Integer', 'Categorical'), and possibly to a unit of measurement. For some data types, such as categorical variables, each unique value (e.g., 'Female', 'Male') must also be explicitly linked to a concept in the ontology. Natural language processing methods facilitate the identification of ontology concepts that are likely to correspond to elements of a dataset. Once the linkages are identified, mapping rules are automatically generated in the W3C standard language R2RML. When executed, these rules transform the data into RDF triples expressed in terms of the SDIDS ontologies. The R2RML mapping files are saved so that the provenance of all data is always accessible.

**Retrieval and analysis of data:** External applications can connect directly to SDIDS via an API to request data for further processing or to request the results of analyses applied to the integrated data. Within SDIDS, other server components facilitate the retrieval of data using SPARQL (a query language for semantic data), the

transformation of data (e.g., aggregation, projection, joins, unions), and the calculation of indicators. Two software clients have been developed to demonstrate the functionality of SDIDS. One client addresses the needs of a malaria monitoring and evaluation manager tasked with following indicators of disease and control activities. The second client addresses the need of a funding officer in assessing malaria research activity and disease control measures in different geographical areas.

## Conclusions

Our vision for global health surveillance is that data are easily shared and analyzed across diseases, countries, organizations, and data sources by a variety of users and client applications. SDIDS is a scalable platform that offers an initial step towards this vision. It is not a replacement for current systems, but a bridging technology that can help to integrate existing data now and encourage convergence of data models in the future. The next stage of the project will focus on scaling-up SDIDS to integrate surveillance data for the leading causes of under-5 mortality in Africa.

## Keywords

surveillance; global health; ontology; data integration; malaria

## Acknowledgments

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## \*David Buckeridge

E-mail: david.buckeridge@mcgill.ca



# Equine Syndromic Surveillance in Colorado Using Veterinary Laboratory Test Order Data

Howard Burkom<sup>\*1</sup>, Yevgeniy Elbert<sup>1</sup>, Jerrold Dietz<sup>1</sup>, Barbara Powers<sup>2</sup>, Cynthia Johnson<sup>3</sup>, Leah Estberg<sup>3</sup> and Judy Akkina<sup>3</sup>

<sup>1</sup>Johns Hopkins Applied Physics Laboratory, Laurel, MD, USA; <sup>2</sup>Vet Teaching Hospital, Colorado State University, Fort Collins, CO, USA; <sup>3</sup>Center for Epidemiological and Animal Health, US Dept. of Agriculture, Fort Collins, CO, USA

## Objective

Establish a laboratory-based syndromic surveillance system for horses in Colorado.

## Introduction

The Risk Identification Unit (RIU) of the US Dept. of Agriculture's Center for Epidemiology and Animal Health (CEAH) conducts weekly surveillance of national livestock health data and routine coordination with agricultural stakeholders. In an initiative to increase the monitored species, health issues, and data sources, CEAH epidemiologists are building a surveillance system based on weekly counts of laboratory test orders along with Colorado State Univ. laboratorians and statistical analysts from the Johns Hopkins Univ. Applied Physics Lab. Initial efforts used 12 years of equine test records from 3 state labs covering most Colorado horse testing. Trial syndrome groups were formed based on RIU experience and published articles<sup>1</sup>. Data analysis, stakeholder input, and discovery of laboratory workflow details were needed to modify these groups and filter test records to eliminate alerting bias. Customized statistical monitoring methods were sought based on specialized lab information characteristics and on likely presentation and health significance of syndrome-associated diseases.

## Methods

Data transformation and syndrome formation focused on test names, order completion status, submitting organization, specimen type, analyte measured, animal owner zip code, and lab unit that received the order. We analyzed time series of weekly counts of tests included in candidate syndrome groups and conducted an iterative process of data analysis and veterinary consultation for syndrome refinement and record filters. This process produced a rule set in which records were classified into syndromes using only test name when possible and otherwise, the specimen type or related body system was used with test name to determine the syndrome. Test orders associated with government regulatory programs, veterinary teaching hospital inpatient testing protocols, or research projects, rather than clinical concerns, were excluded.

We constructed a testbed for sets of 1000 statistical trials and applied a stochastic injection process assuming lognormally distributed incubation periods to choose an alerting algorithm with the syndrome-required sensitivity and an alert rate within the specified acceptable range for each resulting syndrome. Alerting performance of the EARS C3 algorithm traditionally used by CEAH was compared to modified C2, CuSUM, and EWMA methods, with and without outlier removal and adjustments for the total weekly number of non-mandatory tests.

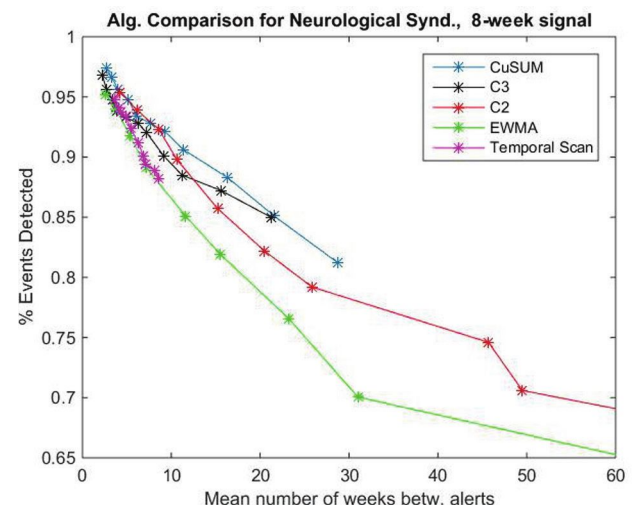
## Results

The equine syndrome groups adopted for monitoring were abortion/reproductive, diarrhea/GI, necropsy, neurological, respiratory, systemic fungal, and tickborne. Data scales and seasonality differed widely among syndrome series. Removal of mandatory tests reduced weekly observed counts by up to 80%. The RIU group studied

outcomes associated with each syndrome and called for detection of single-week signals for most syndromes with expected false-alert intervals >8 and <52 weeks, 8-week signals for neurological and tickborne monitoring (requiring enhanced sensitivity), 6-week signals for respiratory, and 4-week signals for systemic fungal. From the test-bed trials, recommended methods, settings and thresholds were derived. Figure 1 shows a performance comparison based on 8-week signals for the neurological time series.

## Conclusions

Understanding of laboratory submission sources, laboratory workflow, and of syndrome-related outcomes are crucial to form syndrome groups for routine monitoring without artifactual alerting. Choices of methods, parameters, and thresholds varied by syndrome and depended strongly on veterinary epidemiologist-specified performance requirements.



Algorithm Performance Comparison for Neurological Syndrome

## Keywords

livestock surveillance; veterinary syndrome; alerting algorithm; animal health; detection performance

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**\*Howard Burkom**

E-mail: howard.burkom@jhuapl.edu





# Enhanced Mosquito Surveillance for *Aedes* spp. in Santa Cruz County, Arizona

Mariana G. Casal<sup>\*1, 2</sup>, Jose Arriola<sup>3</sup>, Steven Erly<sup>1, 2, 4</sup>, Nicolette Dent<sup>1, 5</sup>, Shelly Jacobs<sup>3</sup>, Kacey Ernst<sup>4</sup>, Kathleen Walker<sup>4</sup> and Mary Hayden<sup>6</sup>

<sup>1</sup>Office of Border Health, Arizona Department of Health Services, Tucson, AZ, USA; <sup>2</sup>Binational Border Infectious Disease Surveillance Program, Tucson, AZ, USA; <sup>3</sup>Santa Cruz County Health Services, Nogales, AZ, USA; <sup>4</sup>University of Arizona, Tucson, AZ, USA; <sup>5</sup>Centers for Disease Control and Prevention, Office for State, Local, Territorial, and Tribal Support, Atlanta, GA, USA; <sup>6</sup>National Center for Atmospheric Research, Fort Collins, CO, USA

## Objective

The objective of this work is to develop an efficient community-based strategy to enhance mosquito surveillance for *Aedes* spp., vector for chikungunya and dengue viruses, in Santa Cruz County on the U.S.-Mexico border. We aim to determine vector presence, distribution, and seasonality by using ovitraps maintained by community members.

## Introduction

Since 2003 some Arizona counties have followed mosquito surveillance protocols to trap the West Nile Virus vector, *Culex* spp., using CO<sub>2</sub> traps. Despite low sensitivity of these traps to detect *Aedes* spp., one out of seven CO<sub>2</sub> traps deployed in Santa Cruz County detected *Aedes aegypti* in 2014. Enhancing surveillance for *Aedes* spp. in this region is critical, given that local transmission of dengue has occurred across the border in Nogales, Sonora. Limited resources in Santa Cruz County have previously inhibited efforts to enhance mosquito surveillance<sup>1</sup>. To broaden the reach of county surveillance, we implemented a community participatory project by engaging residents to conduct ovitrapping, a non-technical trap that attracts *Aedes* spp.<sup>2</sup>

## Methods

Multiple strategies were employed to recruit community members to conduct the ovitrapping. Key groups approached included high school science clubs, International Baccalaureate programs, and senior citizen groups. During the sessions, program staff reviewed the project and the importance of enhancing *Aedes* spp. surveillance. Volunteers were instructed on the ovitrap use including how to make a hay infusion, put together the ovitrap, identify eggs, and store and transport specimens for identification. Protocols for ovitrapping were developed jointly by the BIDS program, the University of Arizona, and National Center for Atmospheric Research. Recruitment of participants began in March 2015. Traps were placed as individuals were recruited and data was collected on a weekly basis. Tracking of the frequency of reporting from the community participants was conducted. As samples were sent in, the county reported positive traps to the state and eggs were reared and identified to species. All trap locations were mapped and the presence of *Aedes* spp. was noted for each collection period.

## Results

As of August 3, 2015 a total of 43 trapping sites were set and maintained by community members. These 43 sites supplemented 11 county-maintained sites, seven of which were housed at fire stations. Participants included community members from senior citizen groups (n=24), local high schools (n=12), and other local residents (n=7). The geographic trap distribution included 17 sites in the Nogales area closest to the border, two in the central Patagonia area, and 24 in the Tubac area approximately 25 miles north of the border. Traps were kept in participants' backyards. Of the 43 community participants,

72% (n=31) collected data systematically and according to the protocol. Participation rates varied among community members. While senior citizen groups had regular participation rates, a barrier to retaining high school participation was the overlap of summer vacation with the surveillance season.

## Conclusions

By recruiting community members to maintain ovitraps, we tripled the county's surveillance capacity for *Aedes* spp. Citizen science projects are challenging, but strong protocols and an engaging educational component can harness community labor and gather baseline vector data within a county. Data acquired through this project will allow epidemiologists to anticipate and prevent possible outbreaks at the border.



Ovitrap distribution in Santa Cruz County

## Keywords

*aedes* spp. surveillance; ovitraps; citizen science; mosquito

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\*Mariana G. Casal

E-mail: mariana.casal@azdhs.gov





# Impact Assessment of a Terrorist Attack Using Syndromic Surveillance, France, 2015

Céline Caserio-Schönemann<sup>1</sup>, Marc Ruello<sup>1</sup>, Delphine Casamatta<sup>2</sup>, Guillaume Debaty<sup>3</sup>, Pascal Chansard<sup>4</sup>, Magali Bischoff<sup>5</sup>, Carlos El Khoury<sup>5</sup>, Philippe Pirard<sup>1</sup>, Anne Fouillet<sup>1</sup> and Hervé Le Perff<sup>2</sup>

<sup>1</sup>French Institute for Public Health Surveillance, Saint Maurice, France; <sup>2</sup>French Institute for Public Health Surveillance, Rhône-Alpes Régional Office, Lyon, France; <sup>3</sup>Emergency department, University hospital of Grenoble, Grenoble, France; <sup>4</sup>SOS Médecins France, Paris, France; <sup>5</sup>RESUVAL, Vienne, France

## Objective

To timely assess the potential health impact on the population living or working in a terrorist attack area using syndromic surveillance

## Introduction

Since the terrorist attacks against the satirical newspaper Charlie Hebdo in January 2015, France has activated the highest level of its national anti-terrorist security plan. A new terrorist attack occurred the 26th of June at 9:50 AM in a gas production plant located in the industrial area of Saint Quentin Fallavier nearby Lyon (East -South-of France). The plant produces several different chemical products like gas and plastics and employed 40 people. The attack resulted in an explosion followed by fire. The French Institute for Public Health Surveillance (InVS) was alerted at 11 AM and decided to implement with its Rhône-Alpes regional office a protocol to timely assess the potential health impact on the population living or working around the attack area on emergency health care facilities (EHCF).

## Methods

The French SurSaUD® system is national syndromic surveillance system led by InVS and based on the daily collection of data from emergency departments (ED) network OSCOUR® and General practitioner's emergency associations SOS Médecins. Individual data including medical diagnoses are analyzed by InVS through syndromic groups of interest for public health surveillance, including groups related with potential CBRNE exposure. In the 26th of June attack, the analysis focused on CBRNE groups related with potential respiratory and cutaneous exposure or psychological effects in selected structures in the perimeter of the attack.

At the same time, a labelling protocol already tested in a situation of natural disaster was implemented. For each visit identified as related to the attack, it was requested to emergency physicians to use a specific labelling code as associated diagnosis in addition to the main medical diagnosis. The code was different for ED (ICD10 code W40 "explosion") and for SOS Médecins association (specific code dedicated to exceptional events E99). The analysis began the 27th of June (Dday+1) and was performed up to a week afterwards.

## Results

Main health threats (industrial chemical or toxic release, air pollution) were rapidly excluded and the health impact assessment focused on psychological impact. Nine ED involved in the OSCOUR® network and located in the area of interest were contacted directly or by InVS regional partners to implement the labelling protocol. The Lyon SOS Médecins association and the national SOS Médecins Federation were contacted for the same task. The labelling procedure was completely implemented at 4 PM.

No significant increase in the global indicators (numbers of all-causes ED attendances and SOS Médecins visits) nor in the specific indicators (numbers of attendances/visits for conjunctivitis, burns, malaise, dyspnea, anxious troubles, stress) was observed in the

selected structures. A few SOS Médecins visits (n=11) with the specific labelling code were recorded from the 26<sup>th</sup> of June to the 2<sup>nd</sup> of July. However since early 2015 we found out that this code was already used by SOS Médecins in other circumstances. It was not possible, retrospectively, to distinguish visits associated to the event.

## Conclusions

The surveillance implemented during the 26th of June terrorist attack in France is in favor of no significant impact on the EHCF. This study shows that a labelling procedure to assess a potential impact of an intentional event like a terrorist attack can be implemented fairly rapidly. However, the attack was limited in terms of modus operandi, geographical area and population concerned. One limitation was the non-specificity of the labelling code chosen for SOS Médecins, which has been used in other circumstances. The use of this specific code has to be evaluated with the partners. Some other aspects should be assessed, particularly the acceptability of ED and SOS Médecins physicians to implement the labelling protocol and its feasibility in a most severe situation.

## Keywords

impact assessment; intentional event; emergency data; terrorist attack

## Acknowledgments

To the emergency departments, the RESUVAL regional network, the Emergency Medical Service of Grenoble (SAMU 38) and the Lyon SOS Médecins association for providing data and for their contribution to the surveillance.

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E-mail:



# Impact of the 2015 July Heat Waves in France on Heat-Related Causes

Céline Caserio-Schönemann\*, Anne Fouillet, Aymeric Ung, Manuel Zurbaran, Vanina Bousquet, Karine Laaidi, Mathilde Pascal, Sébastien Denys, Thierry Cardoso and Anne Gallay

French Institute for Public Health Surveillance, Saint Maurice, France

## Objective

To present the evolution of heat-related pathologies during heat waves occurring in July 2015 in France

## Introduction

Two major heat waves occurred in France in July 2015. A first episode characterized by early onset, intensity, large geographical coverage and duration occurred between 29<sup>th</sup> of June 8<sup>th</sup> of July. A second episode less intense was localized on the South-East of the country from 15<sup>th</sup> to 23<sup>rd</sup> of July.

The French heat warning system has been operating by InVS since 2004 as part of the French National Heat Wave Plan. Warnings are based on meteorological forecasts and on real-time follow-up of specific health indicators to support decision-making. The evolutions in emergency health care facilities during the July heat waves are presented.

## Methods

Real-time morbidity indicators are produced by the French national syndromic surveillance system SurSaUD® which is based on the daily collection of data from emergency department (ED) involved in the OSCOUR® network and from General practitioner's emergency associations SOS Médecins (GPSM). Individual data are automatically recorded and transmitted daily to InVS including administrative, demographic and medical information (coded medical diagnosis) [1].

ED attendances and GPSM visits for all-causes and for heat-related causes are specifically followed during heat waves. Heat-related causes include heat stroke/hyperthermia, dehydration and hyponatremia in ED and heat stroke and dehydration in GPSM. These pathologies only represent a small part of the potential health impact during heat waves. They were selected for their reactivity and to provide indications on the spatio-temporal dynamics of the health impacts. Indicators are investigated by age, with a special focus on people aged 75 and over. The proportion of hospital admissions (HA) for heat-related diagnoses in the total of HA was also followed. Indicators analyses are performed at local and national levels during heat waves, which are defined at the local level when forecasted biometeorological indicators have a high probability of exceeding warning thresholds [2].

## Results

During both episodes, we observed a sharp increase in the number of ED attendances and GPSM visits for heat-related causes.

During the first heat wave there were a total of 3 729 ED attendances and 1 456 GPSM visits for diagnoses related to heat, representing respectively 1% and 2.5% of total national activity (in comparison respectively with 0.3% and 0.6% in June 2015). A peak was recorded on the 4<sup>th</sup> of July with 497 ED attendances and 205 GPSM visits representing up to 3% and more than 8% of total activity in the most affected regions. All age groups were concerned but the elderly were mostly represented in ED visits while children and adults less than 75 years old were mostly represented in GPSM visits. ED attendances

for dehydration and hyponatremia were higher in the elderly while visits for hyperthermia/heat stroke were mostly recorded in children and adults less than 75 years old.

Heat indicators reached lower levels during the second heat wave, which affected a most restricted geographical area. About 3 000 ED attendances and 610 GPSM visits (respectively 0.6% and 1.2% of total activity) were recorded.

The proportion of HA for heat-related diagnoses represented locally up to 8,2% of total HA during the first episode and up to 5,2% during the second episode in the most affected regions.

## Conclusions

An increase in all heat-related indicators was observed in all age groups and particularly in the elderly during the July 2015 heatwaves. This confirms that heat-related indicators are specific and sensible.

A high proportion of HA for diagnoses related to heat in the total of HA is an indicator of severity and could generate local and occasional situations of tensions in the health care system, as observed during the July heat waves.

Since 2003, improvements have been made to prevent the health impacts of heat (communication, training of health professionals, access to cool rooms in nursing homes...). However, heat waves remain hazardous for population health with potential impact on ED attendances and hospitalizations.

## Keywords

heat wave; impact assessment; emergency departments; health-related indicators

## Acknowledgments

To OSCOUR® emergency departments and SOS Médecins associations

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\*Céline Caserio-Schönemann

E-mail: c.caserio-schonemann@invs.sante.fr



# Leptospirosis in Bangladesh: An Urgent Need for Coordinated Surveillance System

Shovon Chakma<sup>1,2</sup> and Sultan Mahmood\*<sup>1,2</sup>

<sup>1</sup>Institute of Epidemiology, Disease Control & Research, Dhaka, Bangladesh; <sup>2</sup>Massey University, Palmerston North, New Zealand

## Objective

To evaluate the necessity of a coordinated *leptospira* surveillance in Bangladesh through a systematic review.

## Introduction

Fever is a top cause of morbidity in all age groups in Bangladesh and often classified as fever of unknown origin (FUO) in absence of any pathognomonic sign (1). Bangladesh with its long monsoon, frequent flooding, stagnant water, high temperature, humidity and largest density of animal and human population serves as an ideal place for zoonotic transmission of *Leptospira* (2).

## Methods

We searched three different data bases- PubMed, Web of Science and Google Scholar using the search term Leptospir\* OR “Weil’s disease” AND Bangladesh which yielded 9, 11 and 2590 articles respectively. We screened the titles first for relevance and later abstracts. Two articles were written in Russian language and the texts were inaccessible. These two articles were not reviewed along with other articles that did not discuss the evidence of *leptospira* infection in Bangladesh. Five articles met our criteria and were finally chosen for review.

## Results

Leptospirosis was evident in different geographical locations of Bangladesh such as south-eastern, central and north-western part with different landscapes such as highland, plain land and flood prone areas. It was distinctly frequent during bridging period of later winter, start of monsoon, and after monsoon (3-6). Leptospirosis was an eminent cause of fever in urban and rural Bangladesh causing hospitalization (4, 6). A study conducted in two hospitals in Dhaka showed 18% of the dengue-negative patients were positive for leptospirosis (5). Other studies have showed that 2-44% of febrile outpatients had leptospirosis in Bangladesh (4, 6). Furthermore, fever or FUO causes an average of 6.3 work days loss among Bangladeshis (1). Moreover, case fatality rate was higher in leptospirosis (5%) than dengue (1.2%) (5). All these epitomize the necessity of a coordinated leptospirosis surveillance in Bangladesh. A battery of serogroups such as Sarmin, Mini, Australis, Icterhaemorrhagiae, Cynopteri, Autumnalis, Shermani, Javanica, Djasiman, Pyrogenes, Sejroe, Celledoni and Pamana were found in Bangladesh. However, study suggested undifferentiated serovars may be circulating in Bangladesh which resulted in underreporting of Leptospirosis burden (4).

In animal, leptospirosis was common in high yield and pregnant dairy cattle. Farmer’s education level, semen source, farm placed at peri-urban area, farm size and employee number were the driving force of leptospirosis at farm level. Serovar Hardjo was found in dairy cattle which confirms the presence of leptospirosis in animal population (7). The allied evidence of leptospirosis in other species as well as risk factors, dynamics of transmission, human animal interfaces, environmental drivers and disease impact can only be generated through a well-established surveillance system. Thus the need of establishment of an immediate surveillance is highlighted to mitigate the risk and disease burden human.

## Conclusions

Our review shows that current study findings do not provide conclusive evidence regarding leptospirosis transmission, circulating serovars and impact in human. Thus a well-coordinated surveillance should be accommodated in the routine surveillance in Bangladesh to alleviate disease risk and morbidity.

## Keywords

Leptospirosis; Surveillance; Bangladesh

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## \*Sultan Mahmood

E-mail: dr.sultanmahmood@yahoo.com



# Data Exchange Between Immunization Registry and Disease Surveillance System

Hwa-Gan Chang<sup>\*1</sup>, Griffin Jacqueline<sup>2</sup>, Hans Proske<sup>2</sup>, Megan Meldrum<sup>1</sup> and Elizabeth Rausch-Phung<sup>1</sup>

<sup>1</sup>New York State Department of Health, Albany, NY, USA; <sup>2</sup>NTT Data, Albany, NY, USA

## Objective

To establish the infrastructure to provide a linkage between the immunization registry and disease surveillance system using standard for data exchange.

## Introduction

New York State Department of Health (NYSDOH) implemented a Communicable Disease Electronic Surveillance System (CDESS), a single and secure application used by 57 local health departments (LHDs), hospital infection control programs and NYSDOH staff to collect, integrate, analyze, and report data for infectious disease surveillance. New York State Immunization Information System (NYSIIS) is a mandated application for providers to report all vaccinations of persons < 19 years old residing in New York State (excluding New York City). Currently, LHD staff must manually search NYSIIS for vaccine preventable disease case investigations and re-enter the immunization histories into CDESS. NYSIIS has built a HL7 query functionality which can be used to automate the data exchange between NYSIIS and CDESS.

## Methods

The business rules and data specifications for exchange of vaccine histories of reported pertussis cases between NYSIIS and CDESS were developed. A process was established, a daily HL7 query file of reported pertussis cases from CDESS was generated and the file was matched against NYSIIS by patient's last name, first name, date of birth, gender, and address. NYSIIS utilized its process of generating a HL7 response file that contains vaccine history on matched cases to send back to CDESS. CDESS then processes the response file and loads vaccine history into its vaccine table for the matched pertussis cases.

## Results

An automated process was developed and implemented in April 2015. Between April 1 through July 31, 2015, there were 166 pertussis cases reported through CDESS, 32 cases over aged 19 years old were excluded, and 80 (60%) cases were matched in NYSIIS. All pertussis vaccine related information (such as vaccine date, vaccine type, manufacturer, and vaccine lot number) from NYSIIS were populated in CDESS corresponding data fields for matched cases. Fifty-four cases were not found as matches in NYSIIS due to not matching address, no NYSIIS record, or no pertussis vaccine.

## Conclusions

By using existing NYSIIS query functionality, this is an easy process to establish an automated linkage for data exchange between NYSIIS and disease surveillance systems. This process provides a more timely and efficient way to assist LHD staff to get vaccine information for vaccine preventable cases. NYSIIS does not contain all vaccine information (eg. manufacturer, vaccine lot number) and LHD staff may still be required to contact providers.

## Keywords

Surveillance system; Immunization registry; Data exchange

## Acknowledgments

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## \*Hwa-Gan Chang

E-mail: hwagan.chang@health.ny.gov



# Social Media Analytics for Post-Disasters Disease Detection in the Philippines

Lauren Charles-Smith<sup>\*3</sup>, Corinne Ringholz<sup>1</sup>, Benjamin Brintz<sup>3,2</sup> and Courtney D. Corley<sup>3</sup>

<sup>1</sup>USAID, Washington, DC, USA; <sup>2</sup>Oregon State University, Corvallis, OR, USA; <sup>3</sup>Pacific Northwest National Laboratory, Richland, WA, USA

## Objective

To determine the potential of Twitter data as an early warning of a likely communicable disease outbreak following a natural disaster, and if successful, develop an open-source algorithm for use by interested parties.

## Introduction

Previous research identifies social media as an informal source of near-real time health data that may add value to disease surveillance systems by providing broader access to health data across hard-to-reach populations. This indirect health monitoring may improve public health professionals' ability to detect disease outbreaks faster than traditional methods and to enhance outbreak response. The Philippines consists of over 7,000 islands and is prone to meteorological (storms), hydrological (floods), and geophysical disasters (earthquakes and volcanoes). In these situations, evacuation centers are used for safety and medical attention and often house up to 50K people each for 2 or more months, sometimes with unclean water sources and improper sanitation. Consequently, these conditions are a perfect venue for communicable disease transmission and have been proposed to cause disease outbreaks weeks after the original disaster occurred. Coined the social media capital of the world<sup>1</sup>, the Philippines provides a perfect opportunity to evaluate the potential of social media use in disease surveillance.

## Methods

The social media analyzed consists of 50 million geotagged tweets from the Philippines between 2012 and 2013. Monthly disease outbreak case counts by location were collected from the Filipino Department of Health. Disaster data was identified through the National Operational Assessment of Hazards and the International disaster database website, EM-Dat. All data were split into 17 national regions to improve spatial resolution and decrease social variation within populations. Outbreaks of interest were identified if they occurred 1-2 months following a natural disaster. Topic modeling and theme identification methods were used to explore and understand Filipino Twitter use and language. To identify tweets of interest, lexicons were developed in English, Tagalog, Taglish, and other native dialects. The final disease lexicon, verified by visual confirmation, was used to filter the tweets and create histograms of tweet counts per day per region. This data was modeled by time series analyses to identify change points indicative of disease outbreaks (R BreakoutDetection). The data was analyzed on multiple spatial scales and compared to known disease outbreak counts and natural disasters with 4 potential spatiotemporal correlations between disease and disaster identified. Autoregressive integrated moving average model was used to forecast spikes and enhance outbreak detection (Fig. 1). This tweet model identified 1 potential correlation between tweet, disaster, and outbreak in 2012 and 4 in 2013, potentially illustrating the increase of power in social media as twitter use increases over time. Monthly outbreaks were regressed against various predictors including tweets (past and current), disasters (type, time since last occurrence), and region-specific characteristics (population density).

## Conclusions

Current models using monthly disease outbreak data lack significant correlation, which is most likely due to the loss of information when aggregating data to a monthly scale. In effort to increase outbreak detection, models will be developed using newly acquired continuous weekly case counts by region. In addition, disease-specific outbreaks will be regressed against disease-specific filtered tweets and disaster information to determine the best combination of predictors by region. The final goal is to create a model that integrates historical disaster data with disease-related Twitter counts to be used as a disease forecast system for streaming Twitter data. This effort, funded by USAID, will be transitioned to regional universities and the Government of the Philippines.

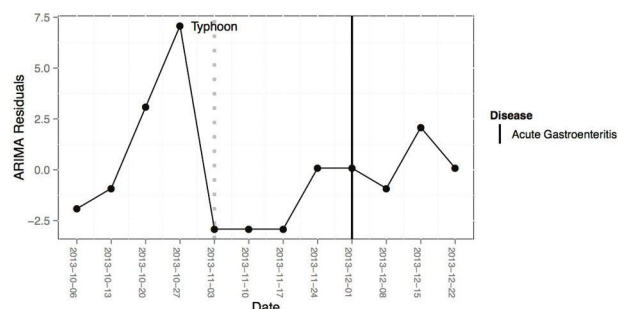


Figure 1. Histogram of disease tweets and acute gastroenteritis outbreak post Typhoon Yolanda in the Philippines Eastern Visayas region.

## Keywords

Health surveillance; disasters; social media; Biosurveillance

## Acknowledgments

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\*Lauren Charles-Smith

E-mail: lauren.charles-smith@pnnl.gov



# Towards Influenza Surveillance in Military Populations Using Novel and Traditional Sources

Lauren Charles-Smith\*<sup>1</sup>, Alexander Rittel<sup>1,2</sup>, Umashanthi Pavalanathan<sup>1,3</sup> and Courtney D. Corley<sup>1</sup>

<sup>1</sup>Data Sciences and Analytics Group, Pacific Northwest National Laboratory, Richland, WA, USA; <sup>2</sup>Yale School of Public Health, New Haven, CT, USA; <sup>3</sup>Georgia Institute of Technology, Atlanta, GA, USA

## Objective

To integrate existing influenza surveillance data sources and social media data into an accurate and timely outbreak detection model embedded into dashboard biosurveillance analytics for the Department of Defense.

## Introduction

Influenza-like illness (ILI) remains a significant public health burden to both the general public and the U.S. Department of Defense. Military personnel are especially susceptible to disease outbreaks owing to the often-crowded living quarters, substantial geographic movement, and physical stress placed upon them.<sup>1</sup> Currently, the military employs syndromic surveillance on electronic reporting of clinical diagnoses. While faster than traditional, biologically-focused monitoring techniques, the military surveillance system proved inadequate at detecting outbreaks quickly enough in a recent study conducted by the CDC.<sup>2</sup> Recently, research has included novel data sources, like social media, to conduct disease detection in real-time and capture communities not traditionally accounted for in current surveillance systems. Data-mining techniques are used to identify influenza-related social media posts and train a model against validated medical data.<sup>3</sup> By integrating social media data and a medical dataset of all ILI-related laboratory specimens and doctor visits for the entire military cohort, a more comprehensive model than presently exists for disease identification and transmission will be possible.

## Methods

For analyses, the Armed Forces Health Surveillance Center (AFHSC) provided about 1000 military health facilities' Defense Medical Surveillance System data, recorded between December 1999 and 2014. This data included laboratory results and medical clinical visits coded with an International Classification of Disease, 9th edition (ICD-9) code under the AFHSC's syndromic definition of ILI. Health facilities were mapped in ESRI ArcGIS with a 25-mile buffer. To determine specific locations of interest for historical Twitter data purchase and analyses, facilities within each buffer were condensed into a merged location and areas with substantial medical data, military populations, and social media usage were targeted. From this analysis, 25 U.S. and 6 international condensed locations were chosen as study sites. Three additional non-military locations, based on comparative attributes, were identified as control sites. Geo-tagged tweets, from November 2011 to June 2015, were purchased within a 25-mile radius of the centroid for each of the 31 identified locations of interest.

Descriptive summary statistics for each location, time series analyses, and correlation studies of ICD-9 codes and laboratory data against regional CDC ILI-NET and city-level Google Flu Trends were conducted. Social media analytics on military and non-military tweets identified differences in Twitter discourse between the 2 cohorts, including common language, sentiment and health-related topics (Table 1).

## Conclusions

Twitter flu-related discourse from military members and electronic medical data will be incorporated into a robust outbreak detection model. This model will continually ingest new health and social media data to nowcast and forecast influenza activity on military bases. A user-friendly application will provide military analysts with tools required to allocate resources efficiently and effectively.

Table 1. Differences in Twitter health-related terminology between military and non-military populations.

Category	Mean (Military)	Mean (Control)	T-statistic	P-value
Self-related health experience	0.0037	0.0031	3.907	9.74E-05
ILI-specific symptoms	0.0008	0.0008	0.261	7.94E-01
Disease names and terms	0.0012	0.0012	0.668	5.04E-01
Entities	0.0012	0.0012	0.559	5.77E-01
Parts of body and related	0.0003	0.0003	-1.216	2.24E-01
Non-ILI specific symptoms	0.0006	0.0006	-0.382	7.01E-01

## Keywords

social media; Influenza-like illness; ICD9; HL7; military

## Acknowledgments

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## \*Lauren Charles-Smith

E-mail: lauren.charles-smith@pnnl.gov



## ED Visits Related to Marijuana Exposures in the Denver Metropolitan Area of Colorado

Yushuan Chen\*<sup>1</sup>, Michele Askenazi<sup>1</sup>, Kathryn H. DeYoung<sup>2</sup>, Bernadette Albanese<sup>1</sup>, Lourdes W. Yun<sup>2</sup> and Todd Hockenberry<sup>1</sup>

<sup>1</sup>Emergency Preparedness and Response, Tri-County Health Department, Greenwood Village, CO, USA; <sup>2</sup>Denver Public Health, Denver, CO, USA

### Objective

Adverse health effects related to marijuana (MJ) use may disproportionately impact populations based on age or gender. To explore whether disparities exist among persons seeking emergency department (ED) care related to MJ use, Tri-County Health Department (TCHD) and Denver Public Health (DPH) developed MJ use case definitions, described patient demographics, mapped patients' geographic distribution relative to marijuana dispensary locations, evaluated access to healthcare, and investigated the potential impact of MJ on pediatric health.

### Introduction

Assessing health disparities and access to healthcare has been an important issue for emergency preparedness and response efforts in the Denver metropolitan area. There have been several high profile MJ-related illness outbreaks in the US over the past 2 years. The legalization and retail sale of recreational MJ in Colorado necessitates enhanced surveillance for adverse effects from MJ use. TCHD and DPH coordinated to use syndromic surveillance data to provide situational awareness and timely outbreak detection related to MJ, including health disparities and overall impacts on population health.

### Methods

We used syndromic surveillance data from ED visits to 15 hospitals in Adams, Arapahoe, Denver, and Douglas counties; census poverty data; education and school data from Colorado; and locations of medical and recreational MJ dispensaries. An MJ-related case (MJC) was defined as a case where text in the chief complaint, provider's diagnosis, and/or diagnosis ICD9 code contained terms including "Marijuana," "MJ," "Cannabis," "Edible," "E854.1," "304.3," "969.6," and "305.2."

We used the Electronic Surveillance System for the Early Notification of Community Based Epidemic (ESSENCE) to identify and evaluate MJ cases and created maps in ArcGIS to illustrate the distribution of pediatric and adult MJC relative to MJ dispensaries and healthcare facilities. The patient identifier number was used for deduplication and provider's diagnosis, chief complaint, and diagnosis code were verified accordingly. Access to healthcare facilities was assessed by comparing aggregated patient zip code and county code information to ED locations.

All MJCs were included and the demographic attributes of MJCs were analyzed after a manual review and de-duplication process. After October 2015, ICD-10 codes will be employed and adjustments will be made to examine the MJ search terms.

### Results

After two additional hospitals began reporting data in August 2015, the total number of monthly ED visits increased 23.9% for a total of 85,357 visits. There were 279 (3.3%) MJCs identified. By age group, persons 18-44 years represented 54% of MJCs as compared to persons aged 5-17 years (22.3%), 45-64 years (21.7%), and 65 years or older (1.9%). A higher percentage of MJCs were males (66.2%). MJCs were residents in Denver County (43%), Adams

(15%), Arapahoe (15%) and Douglas (3%) counties, and Denver and Arapahoe Counties had a higher percentage of pediatric MJCs (7.29% and 4.58%, respectively) than the other two counties. Ongoing MJC analyses, including patients' proximity to healthcare facilities and MJ dispensaries and impacts on school-aged patients, will be presented in December.

### Conclusions

Preliminary results provide an overview of the prevalence of ED visits related to MJ use and identify differences in MJCs by age, gender, and geographic location. Males and persons aged 18 to 44 years constituted a higher proportion of MJCs, which may be related to differences in usage patterns as identified by population health surveys such as the Behavioral Risk Factor Surveillance System (BRFSS). There were also geographic disparities, with Denver and Arapahoe Counties having a higher percentage of pediatric MJ cases. Additionally, Denver County had the most recreational marijuana dispensaries. More advanced spatial analysis will describe any association between distribution of MJ dispensaries and pediatric cases.

The study identified limitations in using syndromic surveillance data for this purpose, including the lack of a standardized case definition or ICD-9 code to identify for MJCs. Additionally, MJ-related health outcomes might be underreported in ICD-9 codes. TCHD and DPH will continue monitoring syndromic surveillance data quality for a 180-day baseline period and add ICD-10 codes to the search criteria to create more specific case definitions.

### Keywords

Syndromic Surveillance; Marijuana; ESSENCE; Cannabis

### \*Yushuan Chen

E-mail: ychen@tchd.org



# Washington State One Health Initiative: A Model Framework to Put One Health in Action

Wayne Clifford\*

Washington State Department of Health, Tumwater, WA, USA

## Objective

This presentation describes a model of the process used to form Washington State's One Health Initiative. We will provide three examples of how the One Health model is being applied to three emerging pathogen issues. Our objective for this information is to provide this model for others to consider who may be seeking to establish One Health Initiatives in their own regions.

## Introduction

Motivated by the global One Health movement, the Washington State Department of Health began a strategic effort to form a One Health Initiative for the state in early 2014. Early research on the topic found that many states were working on One Health, but we did not find any published models of the processes used to establish it as an initiative.

## Methods

The process that we developed has seven basic components:

- **Authorizing Environment.** The initiative was authorized and supported by senior leadership.
- **Conceptualization.** The development team researched, and conceptualized what One Health would look like for Washington State.
- **Narrowing Scope.** Initial brainstorming resulted in an overwhelming scope that was narrowed down to a manageable size. Our structure started with a strategic level steering committee.
- **Personalization.** We met individually with senior leadership from each organization that we thought should be on the steering committee to gain buy-in.
- **Visioning.** We used an interview tool to help the steering committee create their vision and mission.
- **Committee Charter.** We developed a committee charter that provided the framework for how the committee would do its work.
- **Meetings.** The committee held in-person meetings and worked together to identify issues.
- **Issue Prioritization.** The committee members engaged in a process that focused on identifying the highest priority issues. The committee selected antimicrobial resistance/stewardship, and One Health surveillance and data systems as the two top priorities.
- **Implementation.** The committee now has a three year action agenda with two workgroups focused on priority issues. Two workgroups were formed to focus on antimicrobial data and stewardship, and One Health surveillance data. That work is ongoing.

## Results

The results of this effort include:

- **Formation of Washington State's One Health Steering Committee.** The committee has a strategic focus that provides guidance and direction.
- **Formation of Two Workgroups.** Out of the strategic direction of the steering committee, we formed two tactical workgroups: the *Antimicrobial Stewardship Workgroup*, and the *Surveillance and Data Systems Workgroup*.
- **Increased Internal Collaboration.** Within the Department of Health, human Communicable Disease Epidemiology and

Environmental Public Health Sciences are separated organizationally in different divisions, and geographically by 75 miles of congested freeway. Our internal focus on increased collaboration has helped us bring the two divisions closer together.

- **Increased External Collaboration.** Agencies, academic institutions, and organizations are working closer together on projects.
- **Application of the Model to Other One Health Issues.** Awareness of the One Health model has increased within the agency resulting in an interest in applying the model to other health issues.

## Conclusions

1) The cornerstone to One Health is Collaboration. Collaboration is a time investment. Project managers need to build that time in to projects to make collaboration effective.

2) Healthy leadership is critical to forming and maintaining relationships. Conflicts occur, and success depends on staying focused on constructive outcomes.

3) As collaboration increases, so do the needs that are being served. Collaborators need to be transparent with the team about what their needs are from the project.

## Keywords

Health; Zoonotic; Collaboration

## Acknowledgments

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 Hanna Oltean, Washington State Department of Health  
 Melissa Kemperman, Washington State Department of Health  
 One Health Workgroup Members

## \*Wayne Clifford

E-mail: wayne.clifford@doh.wa.gov



# Using Bayesian Networks to Assist Decision-Making in Syndromic Surveillance

Felipe J. Colón-González\*<sup>1</sup>, Iain Lake<sup>1</sup>, Gary Barker<sup>2</sup>, Gillian E. Smith<sup>3</sup>, Alex J. Elliot<sup>3</sup> and Roger Morbey<sup>3</sup>

<sup>1</sup>School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom; <sup>2</sup>Institute of Food Research, Norwich, United Kingdom; <sup>3</sup>Public Health England, Birmingham, United Kingdom

## Objective

To analyse the use of Bayesian network structural learning to identify relations between syndromic indicators which could inform decision-making processes

## Introduction

Syndromic surveillance systems often produce large numbers of detections due to excess activity (alarms) in their indicators. Few alarms are classified as alerts (public health events that may require a response). Decision-making in syndromic surveillance as to whether an alarm requires a response (alert) is often entirely based on expert knowledge. These approaches (known as heuristics) may work well and produce faster results than automated processes (known as normative), but usually rely on the expertise of a small group of experts who hold much of their knowledge implicitly. The effectiveness of syndromic surveillance systems could be compromised in the absence of experts, which may significantly impact their response during a public health emergency. Also, there may be patterns and relations in the data not recognised by the experts. Structural learning provides a mechanism to identify relations between syndromic indicators and the relations between these indicators and alerts. Their outputs could be used to help decision makers determine more effectively which alarms are most likely to lead to alerts. A normative approach may reduce the reliance of the decision making process on key individuals

## Methods

We used Bayesian network structure learning to represent and quantify relations between indicators used by the English Real-time National Syndromic Surveillance System for classifying and investigating public health alerts. Summary data were obtained from four national syndromic surveillance systems coordinated by Public Health England. The network structure was initially learnt from the data using score-based algorithms. Temporal tiers were defined to separate variables on a timeline based on expert knowledge. Networks were constructed using a greedy search and iteratively adding, deleting, or reversing arcs, assessing the accuracy of the final network. The Bayesian Information Criterion was used to evaluate goodness of fit. Joint probability distribution for the data was estimated once the algorithm learnt the network structure. We evaluated how different algorithms and data features influence alert classification. The ability of the learnt networks for classifying alerts of public health importance was assessed retrospectively using 1000 bootstrap samples from the summary dataset for 2014

## Results

Provisional results show that our networks effectively evidenced the relations between variables and trends in the data known by the experts. The algorithm identified relations between variables that were unknown. The decision as to whether an alarm leads or not to an epidemiological alert was sensitive to several characteristics of the data stream and the period when such extra activity was detected. Different algorithms showed different degrees of specificity but most of them showed similar levels

## Conclusions

Decision-making methods may be difficult to maintain and replicate if they exclusively rely on expert knowledge. Bayesian networks may be useful to explicitly decompose and graphically describe the relationships among variables that are more useful for deciding whether extra activity in a syndromic indicator requires a response. When Bayesian networks are able to closely mimic the behaviour of syndromic surveillance variables, they may offer a useful explanation of how variables interact with each other which could assist syndromic surveillance teams for training, diagnostic and predictive purposes

## Keywords

Syndromic Surveillance; Bayesian Networks; Structural Learning

## Acknowledgments

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\*Felipe J. Colón-González

E-mail: f.colon@uea.ac.uk





# Surveillance Strategies During Low Ebola Transmission in a District in Sierra Leone

Allison M. Connolly\*, Alyssa J. Young, Brooke Mancuso, Mary-Anne Hartley, Adam Hoar, Guddu Kaur, John Mark Esplana, Laura Fisher and Anh-Minh A Tran

GOAL, Dublin, Ireland

## Objective

Describe the evolution of Ebola Virus Disease (EVD) surveillance from a largely reactive system structured primarily around responding to reports of illness and death, to one that was more methodical, proactive and comprehensive.

## Introduction

Port Loko District has had over 1400 confirmed EVD cases during this outbreak. However, transmission declined rapidly in early 2015; by mid-April, a few weeks had passed with no known cases. Simultaneously, reporting of sick persons had plummeted across the district and the number of deaths reported in some areas was fewer than expected. These circumstances signaled the need for the EVD surveillance system to broaden its focus from using district surveillance officers (DSOs) to respond to reports of ill and deceased persons (hereafter, “sick and death alerts”) to a more proactive and comprehensive system that relied strongly on community engagement and surveillance through existing structures such as Peripheral Health Units (PHUs), schools and local authorities. While the involvement of local authorities and the community had been central to reporting suspected EVD cases earlier in the outbreak, the decrease in alerts suggested that engagement was diminishing. The reopening of schools and reemergence of the primary healthcare system provided opportunities to decentralize surveillance and strengthen the involvement of these structures. The primary objective was improving EVD surveillance, but the effort was also used to bolster routine surveillance, in preparation for implementing Integrated Disease Surveillance and Reporting.

## Methods

- GOAL, WHO and district staff developed a Standard Operating Procedure to guide surveillance activities during periods of low EVD transmission.
- DSOs received 5 sessions of training, in addition to mentoring in the field.
- The district has 11 chiefdoms, divided into a total of 162 sections. A qualitative survey was developed for DSOs to assess and validate the engagement of key partners such as local authorities, social mobilizers and contact tracers in surveillance-related activities in each section.
- Tools were used to assess surveillance and provide training at PHUs, schools and border areas.
- Expected mortality rates (pre-EVD outbreak) were compared to the number of death alerts received. Sections with the highest levels of under-reporting were prioritized.
- PHU staff were trained on the importance of using diagnostic tests for malaria, and following up on patients to ensure that no EVD cases were missed due to incorrect diagnosis or co-infection. Registers were used to record symptoms for all ill patients, as well as test results, treatment and follow up for those with malaria. Weekly reports to the district of reportable diseases were checked for completeness. Health screening for arriving clients and basic infection prevention and control (IPC) protocols were verified, as were knowledge of the case

definition and reporting expectations for suspected EVD. Community engagement efforts were discussed.

- DSOs were trained to review trends in absenteeism at schools as an indicator of potential disease outbreaks. Also, to ensure active surveillance and IPC were done correctly.
- In villages bordering other districts, enhanced cross-border monitoring was used as an essential tool to minimize risk of EVD infiltrating from other districts.

## Results

- DSOs needed more training than anticipated to implement new practices. On-site mentoring was a critical supplement to formal training.
- After initial difficulties adapting to new expectations for using the registers, documentation improved, which permitted monitoring the implementation of the protocol for malaria patients, as well as active case search for numerous conditions.
- Follow-up actions for symptomatic children were unclear to school staff. Concerns that direct follow up by DSOs might jeopardize school participation indicated that community-supported alternatives were crucial.
- Using attendance registers to look for disease trends was difficult since attendance hadn't yet stabilized due to the outbreak itself.
- Use of expected vs reported deaths to prioritize surveillance efforts is now routine in the district.

## Conclusions

This system has been effective in guiding district surveillance activities. Additional technology, data and staff have allowed its implementation to become more targeted. Capacity for routine surveillance in the post-Ebola period has improved.

## Keywords

surveillance; Ebola; EVD; Sierra Leone; Community; Malaria

## Acknowledgments

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## \*Allison M. Connolly

E-mail: [allison.connolly@thepalladiumgroup.com](mailto:allison.connolly@thepalladiumgroup.com)





# Day of Week Analysis of Myocardial Infarctions Using ESSENCE-FL Emergency Department Data

Allison B. Culpepper\*, David Atrubin, Janet J. Hamilton and Dongming Cui

Bureau of Epidemiology, Florida Department of Health, Tallahassee, FL, USA

## Objective

To investigate the day of week effect on myocardial infarctions (MI) in the age group of 18 – 64 years using ESSENCE-FL emergency department (ED) data.

## Introduction

Syndromic surveillance ED data has historically shown the highest number of visits on Mondays, with decreasing volumes throughout the week. Previous studies have shown that increased negative health outcomes have occurred on Mondays (Barnett and Dobson, 2004). A study in the European Journal of Epidemiology provided evidence that suggests a higher incidence of cardiovascular events on Mondays compared to other days of the week (Witte et al., 2005).

## Methods

The Florida Department of Health (FDOH) utilizes the Electronic Surveillance System for the Early Notification of Community Based Epidemics (ESSENCE-FL) as its statewide syndromic surveillance system. Visits from 210/237 emergency departments and 33 urgent care centers are analyzed by FDOH epidemiologists each day.

A query was created in ESSENCE-FL to identify MI related chief complaints and discharge diagnoses:

MI,or,^MI^,or,^MI,or,MI^,or,^heart attack^,or,^cardiac arrest^,or,^myocardial infarction^,or,^acute myocardial infarction^,or,^cardiopulmonary arrest^,or,^stemi alert^,or,^stemi^,or,^nSTEMI^,or,^subendocardial infarction^

This analysis focused on individuals 18 – 64 years of age. MI related terms were used to query ED visits from the time period of December 1, 2012 to August 10, 2015. The total number of ED visits analyzed in this study was 25,448,785.

Exponentially weighted moving average (EWMA) detection algorithms in ESSENCE-FL were used to determine anomalies in the targeted data, which generated alerts signaling a larger than expected number of MI related ED visits for a given day.

## Results

The created MI query detected 18 red alerts and 57 yellow alerts for the time period of December 1, 2012 to August 10, 2015. A total of 33% of the red alerts occurred on Monday. The total of red and yellow alerts demonstrated that 29% of these flagged days occurred on a Monday. In comparison to all other days of the week, Monday was shown to have the highest proportion of red and yellow statistical alerts. Additionally, the daily mean analysis demonstrated that Monday, followed by Tuesday, showed the largest positive deviation from the overall daily mean (Table 1). Saturday, followed by Sunday, proved to be the two days with the lowest proportion of red and yellow statistical alerts.

## Conclusions

Results from this analysis provide evidence that a disproportionate number of individuals aged 18 – 64 years with MI related complaints present to the ED on Mondays. This study supports the results that were found by previous researchers (Witte et al., 2005).

A similar analysis of chest pain visits in ESSENCE-FL presented analytic validity of a day of the week effect, with the highest

proportion of visits occurring on Mondays. Efforts to understand the periodicity of FDOH's syndromic surveillance data have resulted in epidemiology staff that are better able to respond to both chronic and infectious disease public health threats.

Additionally, this study suggests that there is a reduced incidence of myocardial infarction and chest pain on Saturday and Sunday. This study assumes that an individual having a myocardial infarction, or believed to be having a myocardial infarction, will present to the ED regardless of the day of the week. Many ED patients with lesser morbidities, or those who are using the ED for primary care, appear to preferentially select days to go to the ED (Faryar, 2013). One limitation of this study is that it relied on, at least in part, chief complaint data. Further study of heart attacks by day of the week using a hospital discharge data set would help confirm this finding.

Day of Week Effect for Total Volume and MI Query Volume December 1, 2012 - August 10, 2015 (983 days)				
Day of Week	Daily mean volume	Deviation from total daily mean	Daily mean - MI Query	Deviation from MI daily mean
Monday	28532	10.20%	86	7.00%
Tuesday	26681	3.10%	82.1	2.20%
Wednesday	26061	0.70%	79.6	-0.90%
Thursday	25484	-1.60%	79.2	-1.40%
Friday	25389	-1.90%	78.6	-2.10%
Saturday	24274	-6.20%	76.6	-4.60%
Sunday	24801	-4.20%	80.2	-0.20%

Table 1

## Keywords

myocardial infarction; heart attack; day of the week effect

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\*Allison B. Culpepper

E-mail: Allison.Culpepper@flhealth.gov



# Key Challenges for Eradication of Poliomyelitis in Ukraine

Oksana Cyganchuk\*

State sanitary and epidemiological service of Ukraine, Kyiv, Ukraine

## Introduction

According to the World Health Organization (WHO), the epidemic situation on poliomyelitis in the world is not good. Ukraine is on the list of countries certified by WHO as the territory free of polio, and previously, population coverage with scheduled vaccination against polio was 95%.

## Methods

Annual official reports on morbidity and reports on prophylactic vaccination and medical cards of the patients with acute flaccid paralysis over a period of 10 years in the Carpathian region were used to perform analysis in our study. The Carpathian region belongs to risk group as it is the area of intensive migration and a low rate of immunization. Our research was focused on the following: to study current surveillance over poliomyelitis and to analyze the implementation of actions regarding the status of Ukraine to be free of polio.

## Results

In the past, from 2 to 305 (in 1957) cases of polio were registered in Zakarpattye region. From 1999- 2014, sixty-one cases of acute flaccid paralysis (AFP) were registered there. The number of registered AFP cases varies from 3 to 7 in different years.

We conducted analysis on vaccination coverage against polio among children of one year-old (polio-4) and obtained the following results: in 2005 - 97,4% of children were vaccinated, in 2006- 99,6%, in 2007 - 98,6%, in 2008 - 96,2%, in 2009 - 88,4%, in 2010 - 65,5%, in 2011- 61,6%, in 2012 - 48,0%, in 2013 - 82,2% and in 2014 the percentage of vaccinated children made up only 42,1%.

In 2014, the total scope of vaccination of the Ukrainian population was less than 60 %.

## Conclusions

As a result of our study, we found there were a large number of unvaccinated children who should be vaccinated. According to the WHO, Ukraine is one of the countries with high risk of spreading “wild” polio virus if it is imported.

A national strategy designed to support the polio-free status of Ukraine should include high vaccination coverage using OPV (oral polio vaccine), developing additional mass vaccination actions or introducing national days of immunization, and developing effective surveillance and immunization among risk groups.

## Keywords

poliomyelitis; vaccination; surveillance

\*Oksana Cyganchuk

E-mail: ocsana.4@mail.ru



# An Improved EWMA-Based Method for Outbreak Detection in Multiple Regions

Sesha K. Dassanayaka\* and Joshua French

Mathematical and Statistical Sciences, University of Colorado Denver, Denver, CO, USA

## Objective

To propose a computationally simple and a fast algorithm to detect disease outbreaks in multiple regions

## Introduction

Emerging disease clusters must be detected in a timely manner so that necessary remedial action can be taken to prevent the spread of an outbreak. The Exponentially Weighted Moving Average method (EWMA) is a particularly popular method, and has been utilized for disease surveillance in the United States [1].

A spatio-temporal EWMA statistic is proposed for on-line disease surveillance over multiple geographic regions. To capture spatial association, disease counts of neighboring regions are pooled together, similar to a method originally proposed by Raubertas [2] for a different control chart. Also to increase statistical power in testing multiple EWMA statistics simultaneously, false discovery rate (FDR) is used instead of the traditional family-wise error rate (FWER).

## Methods

First, an acceptable false alarm rate is set by the user to define the false discovery rate. Then, at each time  $t$ , disease counts for each of the  $m$  regions  $Y_{1t}, Y_{2t}, \dots, Y_{mt}$  are collected; the weighted counts of immediate neighbors are pooled to form regional neighborhoods with counts  $Y'_{1t}, Y'_{2t}, \dots, Y'_{mt}$ . Then, the corresponding EWMA statistics for the regional neighborhoods  $E'_{1t}, E'_{2t}, \dots, E'_{mt}$  are calculated.

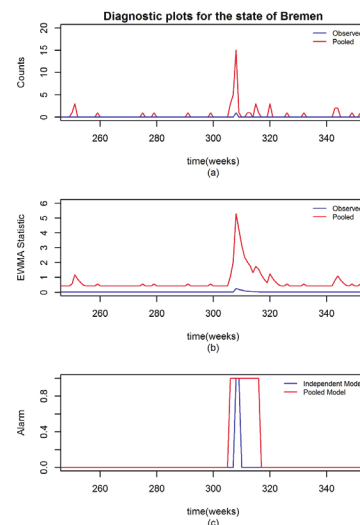
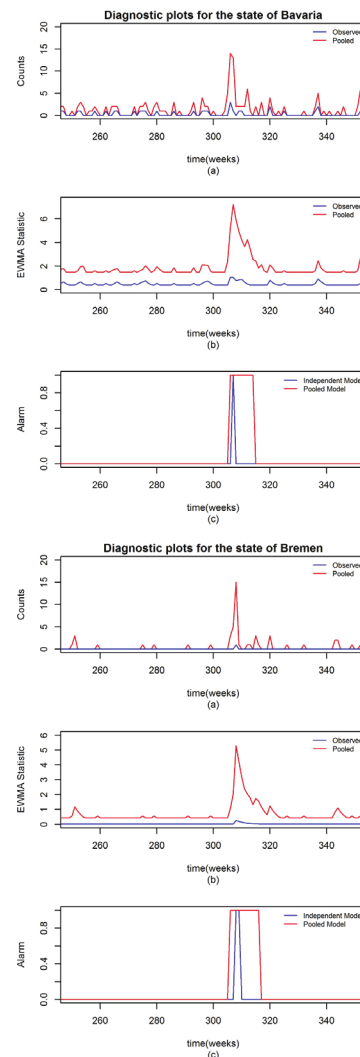
To construct empirical in-control distributions for each region,  $B$  bootstrap samples are drawn with replacement, respecting spatial order, from an initial time period with no outbreaks. For the bootstrap samples, the corresponding EWMA statistics are computed for each region to determine the empirical in-control distributions from which the corresponding p-values  $p'_{1t}, p'_{2t}, \dots, p'_{mt}$  are calculated. Finally, a state-of-the-art multiple comparison procedure is used to determine the alarms with the pooled model. This model is compared to a baseline model using independent regional counts using a standard multiple comparison procedure. Simulation studies provide strong evidence that the pooled model using the more powerful and current multiple testing procedure detects outbreaks faster than the independent model using the standard multiple testing procedure.

## Results

The proposed method was applied to a data set of Salmonella Newport cases reported weekly from 16 German federal states between years 2004-2014. The first two years of data (2004-2005) were used to estimate the in-control distribution in each state since there were no unusually high disease counts reported from any of the states during this period. Plots of the disease counts (a), the EWMA statistics (b), and the corresponding alarms (c) are shown for two states Bavaria (Figure 1) and Bremen (Figure 2); the blue lines depict the independent model and the red lines show the pooled model. Both plots illustrate the rapid detection ability of the proposed method.

## Conclusions

The proposed method of pooling regional neighborhood counts increases the speed of detection compared to the baseline model using independent regional counts. More statistical power can be gained using a more innovative multiple testing procedure.



## Keywords

Spatio-temporal EWMA charts; biosurveillance; prospective disease surveillance; control charts; false discovery rate

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\*Sesha K. Dassanayaka

E-mail: sesha.dassanayaka@ucdenver.edu



# Evaluation of Point of Need Diagnostic Tests for Use in California Influenza Outbreaks

Ashlynn Daughton\* and Alina Deshpande

A1, Los Alamos National Lab, Los Alamos, NM, USA

## Objective

Evaluate utility of point of need diagnostic tests in relationship to current standard influenza detection methods.

## Introduction

Each year several thousands contract the seasonal flu, and it is estimated that these viruses are responsible for the deaths of over six thousand individuals [1]. Further, when a new strain is detected (e.g. 2009), the result can be substantially more dramatic [2]. Because of the potential threats flu viruses pose, the United States, like many developed countries, has a very well established flu surveillance system consisting of 10 components collecting laboratory data, mortality data, hospitalization data and sentinel outpatient care data [3]. Currently, this surveillance system is estimated to lag behind the actual seasonal outbreak by one to two weeks. As new data streams come online, it is important to understand what added benefit they bring to the flu surveillance system complex. For data streams to be effective, they should provide data in a more timely fashion or provide additional data that current surveillance systems cannot provide.

Two types of multiplexed diagnostic tools designed to test syndromically relevant pathogens and wirelessly upload data for rapid integration and interpretation were evaluated to see how they fit into the influenza surveillance scheme in California.

## Methods

### Data Acquisition

Percent influenza like illness data was obtained for California from the CDC website as well as local California public health websites from 2014 to 2015. Point of need (PON) data was obtained by the Biosurveillance Ecosystem and included data about tests run, and results of tests.

### Outbreak identification

Flu data from California was split into discrete outbreaks based on the CDC's current flu outbreak definition [3].

### Data Stream Analysis

For each outbreak, the date that point of need diagnostic data is available was compared to the CDC's flu surveillance data. Further analyses will examine outbreak trends between PON data and the CDC's data to determine if PON data is capable of detecting outbreaks earlier than standard methods.

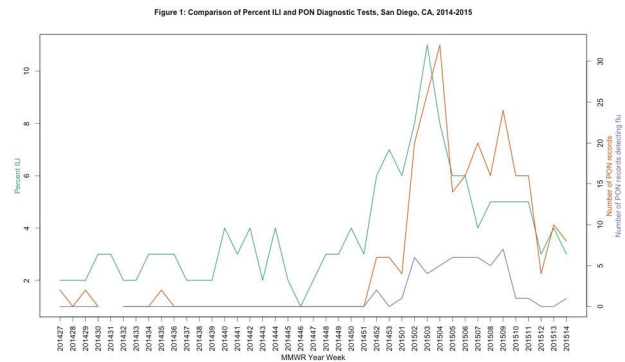
## Results

Figure 1 shows one comparison of point of need (PON) data to the current public health standard in San Diego. The green line shows the weekly percent ILI in San Diego during the 2014 to 2015 flu season. The orange line show the total number of PON records (or number of PON tests conducted) during the same outbreak, and the purple line shows the number of those records that detected the flu (i.e. were positive). Similar analyses will be conducted for the upcoming 2015-2016 flu season, and will be conducted for other locations in California, both retrospectively and prospectively.

## Conclusions

This data will be used to evaluate point of need data streams in influenza outbreaks in California. We will be able to determine if

they provide additional useful data that can be used to identify outbreaks earlier, or if they do not add beneficial data to the influenza surveillance system.



**Figure 1:** Shows a comparison of influenza like illness data in San Diego from 2014 to 2015 (green), corresponding point of need records/ tests run (orange), and the number of records that were positive (purple)

## Keywords

Point of need diagnostic; Influenza; Surveillance; California

## Acknowledgments

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\*Ashlynn Daughton

E-mail: [adaughton@lanl.gov](mailto:adaughton@lanl.gov)





# Military and Civilian Disease Outbreaks: A Comparative Analysis

Ashlynn Daughton<sup>\*2</sup>, Nileena Velappan<sup>2</sup>, Esteban Abeyta<sup>2, 1</sup> and Alina Deshpande<sup>2</sup>

<sup>1</sup>University of New Mexico, Albuquerque, NM, USA; <sup>2</sup>Los Alamos National Laboratory (LANL), Los Alamos, NM, USA

## Objective

Compare and contrast military and civilian outbreaks for malaria and influenza like illness to identify indicators for early warning and detection.

## Introduction

Using influenza like illness (ILI) data from the repository held by AFHSC, and publically available malaria data we characterized similarities and differences between military and civilian outbreaks. Pete Riley et al. utilized a similar ILI dataset to investigate civilian and military outbreaks similarity during the 2009 flu epidemic [1]. They found, overall, high similarity between civilian and military outbreaks, with military peaking roughly one week after civilian. Our analysis is meant to extend their analysis temporally, geographically, and to see if such trends hold true for other diseases.

## Methods

ILI data from January 2000 to December 2014 was obtained from AFHSC. This dataset included any records where the ILI ICD-9 diagnostic code was included in the top 8 diagnostic codes reported by the healthcare facility. Malaria data was collected from peer reviewed literature and official public health reports. Sources included the CDC's MMWR, AFHSC's MSMR, and public health websites.

Military and civilian outbreaks with data from the same location (country or state) and the same time were 'paired'. Outbreaks were compared with respect to time of peak. Additional comparisons including outbreak duration, and comparisons of similarity to laboratory confirmed data, are planned to be completed shortly. All analyses are done using R.

Of note, locations were limited to places where the U.S. military travels that additionally report malaria or ILI. Further, temporal granularity was limited to the highest "timestep" (i.e. if one dataset was reported in months, the 'pair' dataset was aggregated to monthly data as well).

## Results

'Paired' civilian and military malaria and ILI data were available for locations listed in Table 1. Figure one shows data in Afghanistan and South Korea for 2009 to 2012. There is visual similarity between military and civilian data (see Figure 1), but it is not statistically significant. Among the 10 malaria pairs, civilian outbreaks peak between 3 months before and 2 months after military, with an average of 0.1 months after.

We currently have 23 pairs of ILI outbreaks in the United States, Japan and South Korea. Additional data is available and will be analyzed shortly. In the current dataset, there is an average of 5.7 weeks difference in peak, with military peaks typically occurring first. As with malaria, this average has a substantial range (95% CI: 1.8 - 9.5 weeks). Similarity of peak difference depends on location (see Figure 2). In South Korea, civilian outbreaks peak on average 1.6 weeks after military outbreaks (95% CI: -1.34 - 4.55), while in Japan, civilian outbreaks peak an average of 6.4 weeks after military outbreaks (95% CI: 1.53 - 11.22).

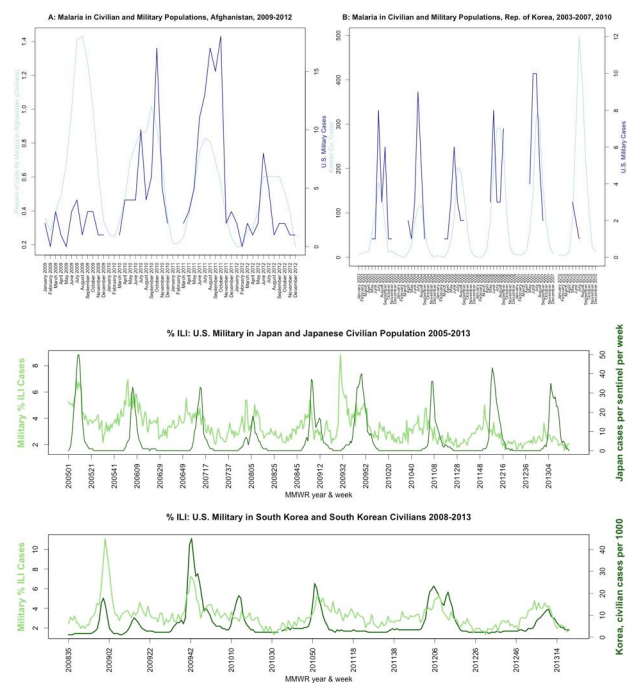
## Conclusions

This data indicates potential trends among diseases occurring in a particular location, with military outbreaks tending to peak earlier than

civilian outbreaks. There is extensive variability between malaria and ILI, as well as variability between locations. Conclusions, especially for malaria, are limited by a lack of granular temporal data and a general lack of military data. Additional data analyses are ongoing to further substantiate these observations and will be completed before the ISDS meeting.

Table 1: Malaria and ILI 'Pairs' and Peak Comparison

Disease	# Military/Civilian Outbreak	Locations of Military/Civilian Outbreak	Peak comparison (Civilian - Military) Average (95% confidence interval) (min-max) (units)
Malaria	10	South Korea Afghanistan	0.11 (-0.84, 1.06) (-3, 2) (months)
Influenza	23	US (North Carolina, California, Texas) South Korea Japan	5.7 (1.8, 9.5) (-14, 39) (weeks)



## Keywords

Influenza like illness; Malaria; Military; Surveillance

## Acknowledgments

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\*Ashlynn Daughton

E-mail: adaughton@lanl.gov





# Enhancing the BioSense Platform: Findings from an ESSENCE and SAS Pilot Project

Cassandra N. Davis\*

Division of Health Informatics and Surveillance, Centers for Disease Control and Prevention, Atlanta, GA, USA

## Objective

To describe the results of a pilot project that examined selected BioSense 2.0 data processing rules and tested SAS and ESSENCE products in the BioSense platform.

## Introduction

BioSense was launched in 2003 by CDC with its primary aim to establish an integrated system of nationwide public health surveillance for the early detection and prompt assessment of potential bioterrorism-related syndromes or other public health emergencies. With the release of CDC's Surveillance Strategy, BioSense evolved into the National Syndromic Surveillance Program (NSSP). To overcome the challenges experienced throughout the integration of local and state level data to produce a real-time national all-hazards surveillance, CDC sought input from the National Syndromic Surveillance Community of Practice (NSSP CoP). They requested that CDC provide advanced syndromic surveillance functionalities and analytical applications, such as ESSENCE and SAS to improve the BioSense Platform. In response, CDC led this pilot project to: 1) conduct security testing of SAS[1] and ESSENCE[2] in order to identify vulnerabilities; 2) test and improve a limited set of processes that occur before data are transformed; and 3) conduct testing of ESSENCE's functions to ensure the tool worked as intended, and that it will meet user needs.

## Methods

The pilot project was initiated on December 3, 2014 and concluded on May 15, 2015 with a proposed course of action for review by CDC's Division of Health Informatics and Surveillance and the NSSP CoP.

CDC engaged eight jurisdictions and two federal agencies via weekly calls and project activities. Each week, jurisdictions provided feedback and recommendations on outputs generated by CDC from analyzing the pre-locker processing, including facility table master clean-up, data element profiling, data landscape and flow, documenting current rules, and collapsing of records into visits. Simultaneously, installation and vulnerability scanning of SAS and ESSENCE took place.

Once complete, jurisdictions assessed ESSENCE's functions, data sharing and permissions, usability, timeliness, and ESSENCE user satisfaction. Each jurisdiction self-identified as novice, intermediate, or advanced user based on their ESSENCE experience. Data views and data sharing permissions were preset by CDC. Users were provided with a use case that included real-world tasks to test different system features. Users recorded their answers on an online survey and follow-up in-depth interviews were conducted.

## Results

There were several major outcomes. ESSENCE successfully completed vulnerability scanning, and results indicated that it has many strengths. Users, overall, had a good experience using the tool and it provided flexibility to streamline data workflows, customize data views, share analyses with others, and generally meet the functional needs of users. We identified the data processing flow and components of the locker including the rules and codes that send data

to different tables, views and transport mechanisms. The users also identified different segments needed to populate a few key data fields. Lastly, we identified the specific fields that should be included in the master facility list.

While there were many strengths, some weaknesses were also identified. SAS had three occurrences of high vulnerability that needed remediation. ESSENCE has no data sharing control for local administrators, data sharing and data source identification were not intuitive, the user interface did not explicitly provide information about navigating through screens, and there was a learning curve for new and intermediate users.

## Conclusions

Overall, the pilot proved successful in providing suggestions for specific actions. These include data clean-up (ensuring all priority data fields are processed and stored properly), developing a new data staging environment, developing a local administration tool for data access control for ESSENCE, alpha and beta testing of ESSENCE and SAS, and technical assistance and training for transitioning jurisdictions.

## Keywords

ESSENCE; Pilot Project; BioSense Platform

## Acknowledgments

Michael Coletta, Roseanne English, Alan Davis, David Walker, Peter Hicks, Alejandro Perez, Paul McMurray, Miguel Torres-Urquidy, Julie Zajac-Cox, Aaron Kite-Powell, Caleb Weideman, Matthew Schwei, Carla Winston, Martha Sanchez, Amanda Wahnich, Katie Arends, Harold Gil, Atar Baer, Yushien Chen

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\*Cassandra N. Davis

E-mail: [vts4@cdc.gov](mailto:vts4@cdc.gov)



# French National Health Insurance Information System for Malaria Surveillance

Francois Delon<sup>\*1</sup>, Marc C. Thellier<sup>2</sup>, Aurélie Mayet<sup>1</sup>, Eric Kendjo<sup>2</sup>, Aïssata Dia<sup>1</sup>, Rémy Michel<sup>1</sup>, Gilles Chatellier<sup>3</sup> and Guillaume Desjeux<sup>4</sup>

<sup>1</sup>Epidemiologic surveillance department, French armed forces Center for epidemiology and public health, Marseille, France; <sup>2</sup>French national reference center for malaria, Paris, France; <sup>3</sup>Department of Clinical Epidemiology, European Hospital Georges Pompidou, Paris, France; <sup>4</sup>French military health insurance, Toulon, France

## Objective

Estimate the accuracy of the French national health insurance information system (SNIIRAM) as a support for a nationwide malaria surveillance.

## Introduction

The estimated incidence of imported malaria in France is about 4,000 cases per year (1). The epidemiological surveillance of malaria in France is mainly based on a hospital laboratory surveillance network, which captures around 50% of cases. There is no comprehensive population surveillance. The SNIIRAM provides data about hospital stays and outpatient drug reimbursements, procedures, examinations and sickness leaves for almost the whole French population(2). We aimed to evaluate the usefulness of the SNIIRAM for implementing epidemiological surveillance of malaria.

## Methods

A case-identification algorithm was built in a two-steps process. Firstly, an expert panel defined sensitive inclusion criteria, built using hospital discharge diagnoses, emergency department admissions, outpatient biological procedures and drug deliveries. In case of malaria-nonspecific care events, we considered sequences of events. Secondly, we described data to identify clusters of cases and outliers. Based on this description, we defined exclusion rules, aiming to reduce the number of false-positive and to increase specificity. Results were validated comparing some characteristics of our data with those from the French National Reference Center for Malaria (NRC).

## Results

The algorithm we built was reusable and automated. From July 1, 2013 to June 30, 2014, we identified 4,248 malaria cases corresponding to 4,099 distinct patients (figure 1). The SNIIRAM allowed us to collect data about the demographic characteristics of cases, the date and place of cares, the duration of hospital stays, the diagnoses, the medical procedures and drug deliveries of outpatients. Hospitalization and outpatient drug deliveries data allowed to capture more than 95% of the cases (table 1). Time-lapse from initial cares to data availability into the SNIIRAM was up to six months.

Our results appeared close to those from NRC: no statistically significant difference was observed in the distribution of age, gender, localization and date at onset.

## Conclusions

We elaborated an accurate algorithm to implement an epidemiological surveillance of malaria based on the French National Health Information System. It allowed to study the population living in France as a whole, including sub-populations not accurately covered by existing surveillance methods. The long latency of the SNIIRAM data availability does not permit early alert. Our approach should be thus considered as an addition to the traditional epidemiological surveillance, through a formal validation framework for case-identification algorithms is still necessary.

Table 1: Distribution of care events among identified malaria cases (n=4,248)

Health insurance refund				n	%
Hospitalizations	Outpatient drug delivery	Laboratory tests	Emergency department admissions		
&#9679;				2,639	62.12
&#9679;	&#9679;			136	3.20
&#9679;		&#9679;		307	7.23
&#9679;	&#9679;	&#9679;		48	1.13
&#9679;			&#9679;	4	0.09
&#9679;	&#9679;		&#9679;	13	0.31
&#9679;		&#9679;	&#9679;	1	0.02
&#9679;	&#9679;	&#9679;	&#9679;	9	0.21
	&#9679;			977	23.00
	&#9679;	&#9679;		75	1.77
	&#9679;		&#9679;	28	0.66
	&#9679;	&#9679;	&#9679;	11	0.26

n: number of cases

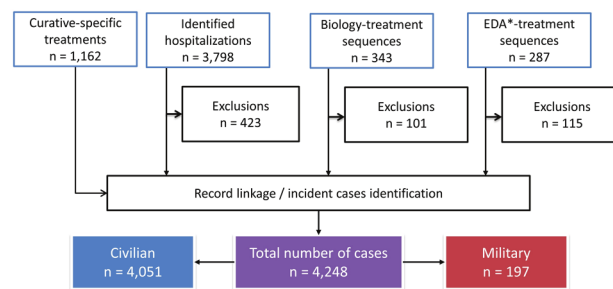


Figure 1: Flowchart illustrating malaria cases identification

## Keywords

Malaria; Surveillance; Database; Health insurance

## Acknowledgments

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## \*Francois Delon

E-mail: francois.delon@laposte.net



# Evaluation of Case Detection of Marijuana-Related Emergency Department Visits

Kathryn H. DeYoung\*<sup>1</sup>, Robert Beum<sup>1</sup>, Yushuan Chen<sup>2</sup>, Moises Maravi<sup>1</sup>, Lourdes W. Yun<sup>1</sup>, Michele Askenazi<sup>2</sup>, Judith Shlay<sup>1</sup> and Arthur Davidson<sup>1</sup>

<sup>1</sup>Epidemiology & Preparedness, Denver Public Health, Denver, CO, USA; <sup>2</sup>Tri-County Health Department, Greenwood Village, CO, USA

## Objective

To evaluate methods of measuring marijuana-related emergency department visits at Denver metropolitan area hospitals participating in the National Syndromic Surveillance Program (NSSP).

## Introduction

NSSP, a Centers for Disease Control and Prevention (CDC) surveillance system, allows timely detection of emergency department (ED) trends by matching chief complaint (CC) text or diagnosis (DX) codes to established syndrome criteria [1, 2]. No CDC syndrome definition currently exists for marijuana-related visits. Accidental child ingestions and over-consumption of edible products are an emerging concern [3, 4]. A validated marijuana syndrome will allow health departments with access to ED data to measure relative trends and disparities in marijuana-related ED visits.

## Methods

A marijuana syndrome definition which incorporates CC and DX variables was developed and evaluated with data from 15 hospitals in Adams, Arapahoe, Denver, and Douglas counties reporting to NSSP. Preliminary marijuana cases were identified based on DX and CC criteria. CC criteria included terms like “marijuana,” “canna,” and “edible.” The DX code variable was searched for International Classification of Disease 9 codes regularly used to identify marijuana-related cases: 969.6, E854.1, 304.3, and 305.2 (excluding 304.33 and 305.23, which indicate conditions in remission) [5].

The sensitivity of CC and DX criteria were compared by evaluating the percent of preliminary cases matched on CC, DX, or both and examining frequency of matches on specific search terms. Two reviewers then assessed specificity by examining age-stratified case samples (20 cases per age group or all cases if there were less than 20) and categorizing the suspected relationship of marijuana to the visit: 1) directly related, 2) incidental, 3) unrelated, and 4) unclear. Findings were used to refine the case criteria and develop a method to exclude or adjust for incidental, unrelated, and unclear cases.

## Results

From January to July 2015, 1717 preliminary marijuana cases (an average of 245 per month) were identified. Of these, 73% were identified by DX alone, 19% by CC alone, and 8% by both CC and DX. The DX code 305.2 (“nondependent cannabis abuse”) and CC text “marijuana” and “THC” were the most sensitive, respectively returning 1320, 189, and 113 cases (including ones which matched multiple criteria). Among cases with an age reported, 20-29 year-olds represented the greatest share of cases (35%). Cases were detected in all age groups.

Several hospitals were working to consistently report key variables during the evaluation period. Age was missing for 749 cases; CC was missing for 1249 cases; and DX was missing for 333 cases. During the month of August 2015, overall completeness of age improved to 99.5% and DX code increased to 75.6%. CC completeness continues to improve as hospitals resolve reporting issues.

## Conclusions

The use of CC text and DX code criteria in the marijuana syndrome definition gave sensitivity despite limitations in data completeness. Evaluating cases identified after August 2015 will permit more accurate assessment of the syndrome’s specificity. With states around the country exploring or legalizing retail marijuana, a sensitive but specific measurement of temporal and demographic trends in marijuana-related ED visits is needed. Applying a validated marijuana syndrome definition to NSSP data will help monitor emerging trends and inform policies.

## Keywords

Marijuana; Cannabis; Syndromic surveillance

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\*Kathryn H. DeYoung

E-mail: [kathryn.deyoung@dhha.org](mailto:kathryn.deyoung@dhha.org)



# Hospital Readmissions Among the Homeless Population in Albuquerque, New Mexico

Victoria F. Dirmyer\*

State of New Mexico, NMDOH, Santa Fe, NM, USA

## Objective

To analyze a homeless population, demographically and by health condition, over a 3-year time period who were admitted to an Albuquerque area hospital.

## Introduction

It is estimated that there are 1.7 million homeless individuals in the United States; 36% are families with children under the age of 18. Due to lack of resources, homeless individuals frequent emergency departments for immediate health care needs. Homeless individuals are hospitalized more often, and once hospitalized have longer lengths of stay and incur higher hospital costs compared to non-homeless individuals<sup>1-2</sup>.

## Methods

This study is a retrospective analysis of hospital inpatient and discharge data from 50 non-federal hospitals across the state of New Mexico. The primary outcome for this analysis was a 30-day readmission for a homeless individual, counted from the date of hospital discharge to the date of the next hospital admission. A homeless record was defined by the patient's address; either recorded as 'homeless', 'none', or an address for a shelter in Albuquerque. Patient records that had at least one instance of being homeless and an admission to an Albuquerque hospital were included in the analysis. Once identified as a homeless patient, all records for that patient were included in the readmission analysis. Records were analyzed from 2010-2012. The comparison group for this analysis consists of homeless individuals who were admitted to Albuquerque area hospitals, but did not have a 30-day readmission during the analysis time period.

## Results

In all three years, males were proportionately higher in number. The overall mean age over the three year time period was 43.8 years. The predominant admitting primary diagnosis for homeless patients was Neuro-Psychiatric conditions, followed by Digestive Diseases and Alcohol and Drug Related conditions. Most readmissions occurred early after discharge, with two-thirds of the readmissions occurring prior to 10 days after discharge (66.3%).

Roughly, one third of the homeless patients experienced a 30-day readmission as an inpatient during the three year time period. Approximately 45% of patients had multiple inpatient admissions each year, with some patients being admitted more than 10 times in one calendar year (2% of patients). The average 30-day readmission rate among Bernalillo County residents (who did not identify as homeless) was 12.3% over the same time period.

In adjusted analyses, factors significantly associated with an increased odds of a 30-day readmission included age, gender, certain primary diagnoses, and the number of admissions per patient (Table 2).

## Conclusions

In this three year, city centric study, the 30-day inpatient readmission rate among patients who identified as homeless was 30.1 percent. Given the high readmission rate observed in this study and the work conducted by prior researchers with a similar population, hospitals need to take appropriate steps to identify this population as they come through their doors and create a suitable discharge plan of action for this population to prevent costly readmissions.

Calendar Year	Number of Patients with a 30-Day Readmission	Total Number of Patients	% of Patients with a 30-Day Readmission
<b>Homeless Patients</b>			
2010	107	368	29.1
2011	82	253	32.4
2012	93	317	29.3
Overall*	256	850	30.1
Number of Records	720	2,068	34.8
<b>Bernalillo County Residents</b>			
Overall*	17,798	144,710 <sup>†</sup>	12.3

\*Overall combines all 3 years.  
<sup>†</sup>Total number of patients.

## 30-Day Readmission Rates by Year, Bernalillo County, 2010-2012

Patient Characteristics	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
<b>Gender</b>		
Male	Ref.	Ref.
Female	0.65 (0.46-0.93)*	0.77 (0.58-1.03)
<b>Age Groups (Years)</b>		
0-19	Ref.	Ref.
20-29	3.90 (1.18-12.98)*	2.52 (0.90-7.07)
30-39	4.66 (1.44-15.07)*	2.89 (1.05-7.97)*
40-49	4.26 (1.33-13.65)*	2.65 (0.97-7.28)
50-59	4.54 (1.42-14.48)*	2.68 (0.98-7.35)
60+	5.69 (1.66-19.58)*	3.23 (1.11-9.37)*
<b>Race/Ethnicity</b>		
White	Ref.	Ref.
Black	0.99 (0.54-1.82)	0.94 (0.59-1.52)
Native American	0.78 (0.46-1.33)	0.77 (0.52-1.17)
Hispanic	0.84 (0.58-1.22)	0.79 (0.59-1.06)
Other	0.60 (0.31-1.17)	0.82 (0.48-1.40)
<b>Hospitalization Characteristics</b>		
Number of Admissions	1.38 (1.31-1.43)*	1.37 (1.31-1.43)*
Length of Stay (LOS)	1.00 (0.99-1.00)	1.00 (0.99-1.00)
<b>Diagnosis Category</b>		
Neuro-Psychiatric Condition	Ref.	Ref.
Digestive Disease	0.92 (0.59-1.44)	0.89 (0.59-1.35)
Alcohol or Drug Related Disease	0.72 (0.44-1.19)	0.76 (0.48-1.20)
Respiratory Disease	0.48 (0.27-0.84)*	0.49 (0.29-0.83)*
Injury	0.48 (0.25-0.89)*	0.62 (0.35-1.10)
Cardiovascular Disease	0.48 (0.27-0.84)*	0.62 (0.37-1.03)
Poisoning	0.92 (0.52-1.63)	0.75 (0.42-1.32)
Other	0.98 (0.70-1.37)	1.03 (0.76-1.40)
<b>Discharge Status</b>		
Routine Discharge	0.83 (0.64-1.08)	1.02 (0.58-1.80)
Discharge Against Medical Advice	1.44 (0.98-2.13)	1.79 (0.93-3.44)
Discharge to Specialty Facility <sup>β</sup>	0.98 (0.69-1.38)	1.18 (0.63-2.22)

<sup>β</sup> Facilities include: Skilled Nursing, Intermediate Care, Rehabilitation, and Psychiatric.  
 \* P ≤ 0.05

Patient Hospitalization Characteristics and Odds of 30-Day Readmission, Bernalillo County, 2010-2012

## Keywords

Homelessness; Health Inequalities; Readmission; Hospital Stay

## Acknowledgments

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\*Victoria F. Dirmyer

E-mail: victoria.dirmyer@state.nm.us





# Better, Stronger, Faster: Why Add Fields to Syndromic Surveillance? New Jersey, 2015

Pinar Erdogdu\*, Teresa Hamby and Stella Tsai

New Jersey Department of Health, Trenton, NJ, USA

## Objective

Describe the inclusion of triage notes into a syndromic surveillance system to enhance population health surveillance activities.

## Introduction

In New Jersey, real-time emergency department (ED) data are currently received from EDs by Health Monitoring Systems Inc.'s (HMS) EpiCenter, which collects, manages and analyzes ED registration data for syndromic surveillance, and provides alerts to state and local health departments for surveillance anomalies.

EpiCenter receives pre-diagnostic chief complaint data from 78 of 80 acute care and satellite EDs. The need for more specific information raises the possibility that other data elements from EDs such as triage notes can be of utility in detecting outbreaks without a significant delay [1]. This study evaluates the inclusion of triage notes in EpiCenter to detect a recent increased usage of synthetic cannabinoids. At the time of this evaluation, three New Jersey hospitals were providing triage notes in their EpiCenter data.

## Methods

In April 2015, the New Jersey Poison Information and Education System (NJPIES) reported an increase in calls to their center for consultation regarding synthetic cannabinoid reactions in ED patients. This increase in calls resembled an outbreak [2], so the Department of Health (DOH) surveillance staff used the opportunity to compare chief complaints and triage notes to call data provided by NJPIES.

NJDOH created a custom classification in EpiCenter to detect synthetic cannabinoid-related ED visits using chief complaint data. DOH staff included the keywords "black magic", "black mamba", "cloud 9", "cloud 10", "incense", "k2", "legal high", "pot potpourri", "spice", "synthetic marijuana", "voodoo doll", "wicked x", and "zombie" which were obtained from the New York City Department of Health and Mental Hygiene. Staff also included the keywords, "agitation", "k-2", "moon rocks", "seizure", "skunk", and "yucatan" to characterize the related event.

NJDOH performed a text search comparison using the same keywords in the triage notes field from three EDs currently providing that data to evaluate the synthetic cannabinoid related ED visits.

## Results

Using the keywords, out of 50 NJPIES calls, 18 (36%) were identified via chief complaint data and 32 (64%) of the ED visits were not captured due to the non-specificity of the keywords used. Among the 18 visits, the most common keywords were "seizure" and "marijuana".

Of the 50 calls, 6 ED visits were admitted to hospitals that submitted triage notes data in EpiCenter. Using the same keywords in a triage notes query, 5 (83 %) out of 6 ED visits were identified. The most common keywords were "k2" and "marijuana".

Overall, based on the chief complaints and triage notes from these three EDs (figure 1 and table 1), triage notes are able to provide more information about ED visits related to synthetic cannabinoid between March 27 and May 16, 2015.

## Conclusions

Review of NJPIES synthetic cannabinoid calls suggests that triage notes in syndromic surveillance systems included more specific keywords than the chief complaints and captured most of the calls related to synthetic cannabinoid. Triage notes inclusion has been initiated in New Jersey. This new data source will provide vital information to syndromic surveillance, which is expected to lead to earlier detection and response to health events like Ebola, Enterovirus D68, and drug overdose surveillance.

Table 1: Number of ED visits from 3 hospitals submitted both triage notes and chief complaint data between March 27, 2015 and May 16, 2015. Triage notes captured more ED visits compared to chief complaints.

	Triage Notes Data	Chief Complaint Data
Hospital 1	96	0
Hospital 2	254	116
Hospital 3	84	0

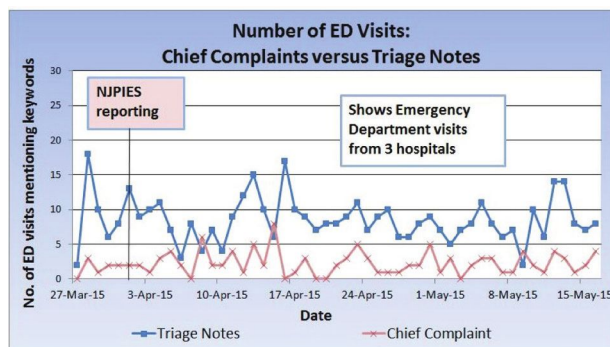


Figure 1: Number of ED visits by data type from three hospitals submitting both triage notes and chief complaint data between March 27, 2015 and May 16, 2015. Related to synthetic cannabinoid use, triage notes included more visits most days than chief complaints. On some dates, chief complaints included more ED visits.

## Keywords

Syndromic Surveillance; EpiCenter; New Jersey

## Acknowledgments

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\*Pinar Erdogdu

E-mail: [pinar.erdogdu@doh.state.nj.us](mailto:pinar.erdogdu@doh.state.nj.us)





## New Master Mapping Reference Table (MMRT) to Assist ICD-10 Transition for Syndromic Surveillance

Brooke Evans\*<sup>1</sup>, Peter Hicks<sup>3</sup>, Julie A. Pavlin<sup>4</sup>, Aaron Kite-Powell<sup>7</sup>, Atar Baer<sup>5</sup>, David J. Swenson<sup>6</sup>, Rebecca Lampkins<sup>2</sup>, Achala U. Jayatilleke<sup>3</sup> and Laura Streichert<sup>1</sup>

<sup>1</sup>ISDS, Boston, MA, USA; <sup>2</sup>CSTE, Atlanta, GA, USA; <sup>3</sup>CDC, Atlanta, GA, USA; <sup>4</sup>Infectious Disease Clinical Research Program & HJF, USUHS, Bethesda, MD, USA; <sup>5</sup>Public Health - Seattle & King County, Seattle, WA, USA; <sup>6</sup>State of New Hampshire, Concord, NH, USA; <sup>7</sup>Armed Forces Health Surveillance Center, Silver Spring, MD, USA

### Objective

To describe the process undertaken to translate syndromic surveillance syndromes and sub-syndromes consisting of ICD-9 CM diagnostic codes to syndromes and sub-syndromes consisting of ICD-10-CM codes, and how these translations can be used to improve syndromic surveillance practice.

### Introduction

As of October 1, 2015, all HIPAA covered entities transition from the use of International Classification of Diseases version 9 (ICD-9-CM) to version 10 (ICD-10-CM/PCS). Many Public Health surveillance entities receive, interpret, analyze, and report ICD-9 encoded data, which will all be significantly impacted by the transition. Public health agencies will need to modify existing database structures, extraction rules, and messaging guides, as well as revise established syndromic surveillance definitions and underlying analytic and business rules to accommodate this transition. Implementation challenges include resource, funding, and time constraints for code translation and syndrome classification, and developing statistical methodologies to accommodate changes to coding practices.

To address these challenges, the International Society for Disease Surveillance (ISDS), in consultation with the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE), has conducted a project to develop consensus-driven syndrome definitions based on ICD-10-CM codes. The goal was to have the newly created ICD-9-CM-to-ICD-10-CM mappings and corresponding syndromic definitions fully reviewed and vetted by the syndromic surveillance community, which relies on these codes for routine surveillance, as well as for research purposes. The mappings may be leveraged by other federal, state, and local public health entities to better prepare and improve the surveillance, analytics, and reporting activities impacted by the ICD-10-CM transition.

### Methods

ISDS coordinated a multi-stakeholder working group to revisit existing syndromic surveillance definitions and compile ICD-9-CM codes that originated in BioSense that map to these categories. The individual ICD-9-CM codes within each category were then mapped to the 2013 ICD-10-CM using General Equivalence Mappings (GEMs). Subsequently, we followed a reverse translation validation process to ensure that the appropriate codes were correctly identified. The resulting Master Mapping Reference Table (MMRT) relates syndromic classifications to both code groupings. The code mappings were then reviewed by the surveillance community and partner agencies, leveraging clinical and epidemiological expertise, to reach consensus.

### Results

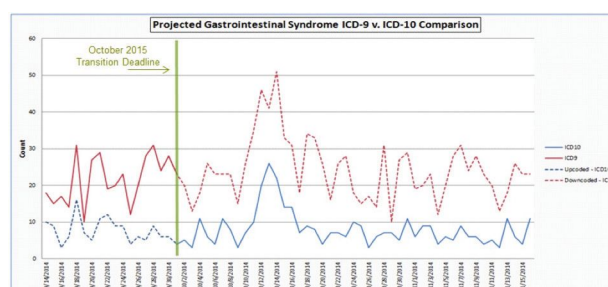
The new MMRT tool, released in August 2015, provides a key resource to public health practitioners that use syndromic surveillance to update their systems and to correctly identify trends over time

that span the transition period by using both code sets, as well as surveillance activities using exclusively ICD-10 CM.

### Conclusions

The development of a consensus-driven MMRT assists entities with the complex task of translating ICD-9-CM to ICD-10-CM codes. It is anticipated that the higher level of detail inherent to ICD-10-CM codes will improve the specificity of syndromic surveillance. The code translations will also serve to develop standardized syndrome definitions based on conceptual mappings and a deductive development approach from concept to diagnostic codes to syndromes.

Finally, the mappings will enable users to address challenges associated with changes in baseline trends (Figure 1) as a result of the transition. Leveraging the MMRT, jurisdictions can quickly map forwards and backwards across the two coding systems to ensure continuity of analytics and reporting during the transition period.



### Keywords

ICD-10; syndrome definitions; syndromic surveillance; code-mapping; ICD-10 transition

### Acknowledgments

We thank the surveillance professionals that assisted with the code set review. This work was supported by the CDC.

### \*Brooke Evans

E-mail: bevens@syndromic.org



## Secondary Data Analysis of HIV/AIDS Control Programme Data, Enugu State, (2010-2013)

Chinyere C. Ezeudu\*, Patrick M. Nguku and Abisola Oladimeji

Nigeria Field Epidemiology and Laboratory Training Programme, Abuja, Nigeria

### Objective

- To determine the percentage and trends of newly diagnosed HIV positive pregnant women
- To determine the percentage of pregnant women that are counseled tested with result.
- To determine the percentage and trend in the uptake ART among HIV positive pregnant women.
- To determine the average no of individual that are counseled and tested for HIV.
- To determine the average no of individual that are HIV positive
- To estimate the average no of individual currently on ART, newly started on ART and those enrolled into HIV care.

### Introduction

As of 2012, 3,400 000 million people (all ages) are living with HIV in Nigeria. The estimated new HIV infections is 260,000 and estimated AIDS death is 240,000. The reported number of adults on ART (Anti-retroviral treatment) was 459,465 and the ART coverage based on WHO guideline was 36%. The number of pregnant women living with HIV who received antiretroviral for preventing mother-to-child –transmission was 33,323 and the percentage coverage was 17%. Enugu State has the highest prevalence (6.5%) of HIV/AIDS in the South East and the fourth in Nigeria. To implement the commitments in the 2011 United Nations Political Declaration on HIV and AIDS and increase progress towards universal access to HIV prevention, treatment, care and support, Nigeria has developed the president's Comprehensive Response Plan (PCRP). PCRP aims to bridge the current gap in service provision and funding. It assesses needs and gaps, identifies focus areas, and set targets for Prevention of mother to child transmission (PMTCT), ART and HIV Counseling and Testing (HCT) services. We determined the implementation of these preventive services by health care providers in Enugu State.

### Methods

We reviewed 2010-2013 HIV/AIDS Surveillance data of Enugu State. We conducted descriptive analysis of ART utilization, PMTCT services and HCT services using Microsoft Excel 2007.

### Results

The total number of all individuals that accessed HCT services from 2010 to 2013 was 87,000, 104,344, 161,517, and 113,903 respectively. The total number of HIV positive individuals from 2010 to 2013 was 8,965 (10.3%), 7695 (7.3%), 9233 (5.7%), and 6110 (5.4%) respectively. The overall total number of individual newly started on ART from 2010 to 2013 was 15,629. The percentage of pregnant women counseled, tested with result was 23,100, 41,000, 45,318, and 38,440 respectively for 2010 -2013 and those that tested positive are for 2010-2013 are 1,059 (4.6%), 1,363 (3.3%), 1,845 (4.1%), and 1,036 (2.7%). Among the pregnant women that tested positive, the number that are receiving ART for 2010-2013 are 1,028 (92.0%), 1,041 (76.4%), 1,640 (88.9%), and 719 (69.4%) respectively.

### Conclusions

The state AIDS and STI control Programme, though has achieved success in the prevention of HIV/AIDS as evidenced by decreased

percentage of HIV/AIDS positive individuals over the years under study and decreased percentage of newly diagnosed HIV positive cases among pregnant women, the State still need to scale up the ART coverage among pregnant women by increasing the number of facilities that renders ART services in the state.

### Keywords

Surveillance; Human immuno deficiency virus; Acquired immunodeficiency syndrome; Anti retroviral therapy; HIV Counselling and Testing

### Acknowledgments

Nigeria Field Epidemiology and Laboratory Training Program

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\*Chinyere C. Ezeudu

E-mail: chiezeudu@hotmail.com



## Evaluation of HIV/AIDS Surveillance System (2010-2013) in Enugu State April 2014

Chinyere C. Ezeudu\*<sup>1</sup>, Patrick M. Nguku<sup>1</sup>, Abisola Oladimeji<sup>1</sup> and Olufunmilayo Fawole<sup>2</sup>

<sup>1</sup>Nigeria field epidemiology and laboratory training programme, Enugu, Nigeria; <sup>2</sup>Department of Epidemiology and Medical Statistics University of Ibadan, Ibadan, Nigeria

### Objective

- To determine the public health importance and relevance of the surveillance system.
- To describe the process of operation and purpose of the system and assess its key attributes.
- To determine the effectiveness and efficiency of the surveillance system.
- To make appropriate recommendations to stakeholders for its improvement.

### Introduction

Evaluation of a public health surveillance system is one of the major outputs of the field attachment of the Nigeria Field Epidemiology and Laboratory Training Programme. To conduct this activity, the HIV/AIDS surveillance system in Enugu State, Nigeria was evaluated. The evaluation was conducted from February to March 2014. The objectives of the evaluation were to describe the attributes and process of operation of HIV/AIDS surveillance system in Enugu State, determine if the set objectives for establishing HIV/AIDS surveillance are being met or not, determine the efficiency and effectiveness of the HIV/AIDS surveillance system and to make appropriate recommendations for improving the surveillance system.

### Methods

The evaluation was conducted using the “ CDC,s Updated Guidelines for Evaluating Public health Surveillance System,2001<sup>1</sup>. We qualitatively assessed the surveillance system’s key attributes. We interviewed five key informants at state level and reviewed 2010-2013 data from the Enugu State HIV/AIDS surveillance system.

### Results

The HIV/AIDS surveillance system is a passive system. Reporting mechanism entails data flow from the health facilities HIV/AIDS monitoring and evaluation officers to the Local Government Area M&E officers, State AIDS/STI Control Programme(SASCP), M&E officer and finally the M&E officer in the National AIDS and STI control programme. Data on HIV Counseling and Testing (HCT), Prevention of Mother to Child Transmission (PMTCT) and Anti-Retroviral Treatment (ART) are collected, collated and transmitted to the National level. The data generated serve to guide decision making at the state and LGA level regarding planning, implementation and coordination of AIDS/STI control strategies. The system is useful, stable, acceptable, flexible, timely, but not representative, sensitive or simple. Data quality is poor and inadequate data for analysis of Sexually Transmitted Disease. There is lack of proper integration with integrated disease surveillance and response(IDSR) system at the State and LGA level.

### Conclusions

The HIV/AIDS Surveillance System is useful, fairly stable, flexible, timely but not representative because not all health facilities are captured for example the Military hospitals in the state, rendering all HIV/AIDS services, don’t send their data to the SASCP unit. The system is not sensitive because of the Rapid Diagnostic test that is

used to detect the disease. The System is not simple because the data elements are numerous and some of the stakeholders complained of incomplete filling of forms. The data quality is poor because of missing data. The resources to maintain the system are sometimes inadequate at the state and Local Government level and they are donor driven. Some of the recommendations that was made to the state was the state ministry of health should provide fund for transport and to strengthen data collection at LGA level, adequate staffing of the M&E unit at the LGA level, emphasis on training and retraining of the M&E officers and data clerks at state and LGA level and the training should be periodic due to frequent staff attrition. Frequent supportive supervision at the health facility and LGA levels for data quality assurance. Strengthening data collection from private health facilities and LGA level by providing funds for transport and review and analysis of data for decision making.

### Keywords

Surveillance; Evaluation; Acquired Immunodeficiency Syndrome; Human Immunodeficiency Virus; Nigeria

### Acknowledgments

Thanks to Nigeria Field Epidemiology and Laboratory Training Programme and State HIV/AIDS Control Programme, Enugu State ministry of Health

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- 1 Centres for Disease Control updated guidelines for evaluating surveillance system, 2001.

### \*Chinyere C. Ezeudu

E-mail: chiezeudu@hotmail.com



# Triage Notes in Syndromic Surveillance – A Double Edged Sword

Zachary Faigen\*<sup>1</sup>, Amy Ising<sup>2</sup>, Lana Deyneka<sup>1</sup> and Anna E. Waller<sup>2</sup>

<sup>1</sup>NC Department of Health and Human Services, Raleigh, NC, USA; <sup>2</sup>North Carolina Center for Health Informatics, Chapel Hill, NC, USA

## Objective

This roundtable will provide a forum for the ISDS community to discuss the use of emergency department (ED) triage notes in syndromic surveillance. It will be an opportunity to discuss both the benefits of having this variable included in syndromic surveillance data feeds, as well as the drawbacks and challenges associated with working with such a detailed data field.

## Introduction

The advent of Meaningful Use (MU) has allowed for the expansion of data collected at the hospital level and received by public health for syndromic surveillance. The triage note, a free text expansion on the chief complaint, is one of the many variables that are becoming commonplace in syndromic surveillance data feeds. Triage notes are readily available in many ED information systems, including, but not limited to, Allscripts, Cerner, EPIC, HMS, MedHost, Meditech, and T-System. North Carolina's syndromic surveillance system, NC DETECT, currently collects triage notes from 33 out of 122 hospitals in the State (27%), and this number is likely to increase.

## Description

Representatives from the Carolina Center for Health Informatics (CCHI) in the University of North Carolina Department of Emergency Medicine, and the North Carolina Division of Public Health (DPH) will describe their experiences with triage notes to date and engage the audience in the discussion. There are unique rewards and challenges for both groups. Presenting these issues in an organized manner will allow participants to be part of a robust conversation that covers numerous topics, from informatics to public health surveillance practice.

The CCHI team will describe current approaches to triage note processing, including the use of open source tools the Emergency Medical Text Processor (EMT-P) and the negation tool NegEx. Pros and cons of the current approach will be presented with attendee discussion of potential alternative approaches.

The epidemiologists at DPH, who review the syndromic surveillance data on a daily basis, benefit greatly from the addition of triage notes. They provide a wealth of information that can lead to the identification of disease clusters, outbreaks, cases related to ongoing outbreaks, or other events of public health importance that would otherwise not be detected. They can also aid in the follow-up and investigation process. However, this plethora of text can also cause many issues for the reviewer, such as increasing the amount of time it takes to review records and the alteration in the behavior of established signal/alert and report processes.

## Audience Engagement

Experiences and activities regarding the use of triage notes in North Carolina will be presented to the audience from both the data processor and data reviewer perspectives. Examples of triage notes and their application in surveillance practice will be provided. Current status, successes, and lessons learned will be identified. An open discussion will be encouraged so that the audience will have an opportunity to share their own experiences, practices, and questions

regarding the use of triage notes in syndromic surveillance. The outcome of the roundtable will be the identification of best practices and the potential creation of a triage note working group to build upon the current successes that North Carolina and other jurisdictions have achieved.

Example facilitation questions include the following:

What are the pros and cons of collecting triage notes?

How do you handle negation in triage notes?

How did you handle the documentation of Ebola screens that often appear in triage notes?

## Keywords

Informatics; Syndromic Surveillance; Triage Notes; Emergency Department Data

\*Zachary Faigen

E-mail: zachary.faigen@dhhs.nc.gov



# Eliciting Disease Data from Wikipedia Articles

Geoffrey Fairchild<sup>\*1,3</sup>, Lalindra De Silva<sup>2</sup>, Sara Y. Del Valle<sup>1</sup> and Alberto M. Segre<sup>3</sup>

<sup>1</sup>Analytics, Intelligence, and Technology Division, Los Alamos National Laboratory, Los Alamos, NM, USA; <sup>2</sup>University of Utah, Salt Lake City, UT, USA; <sup>3</sup>University of Iowa, Iowa City, IA, USA

## Objective

To improve traditional outbreak surveillance systems by utilizing the content of Wikipedia articles.

## Introduction

Traditional disease surveillance systems suffer from several disadvantages, including reporting lags and antiquated technology, that have caused a movement towards internet-based disease surveillance systems. Recently, Wikipedia access logs (e.g., McIver 2014<sup>1</sup>, Generous 2014<sup>2</sup>) have been shown to be effective in this arena. Much richer Wikipedia data are available, though, including the entire Wikipedia article content and edit histories.

We study two different aspects of Wikipedia content as it relates to unfolding disease events: 1) we demonstrate how to capture case, death, and hospitalization counts from the article text, and 2) we show there are valuable time series data present in the tables found in certain articles.

We argue that Wikipedia data cannot only be used for disease surveillance but also as a centralized repository system for collecting disease-related data in near real-time.

## Methods

Most outbreak articles we surveyed contained a variety of useful information in the text (e.g., dates, locations, case and death counts, demographics). These data are generally swiftly updated as new information become available, and sources are often provided so that external review can occur. In order to recognize certain key phrases in the Wikipedia article narrative, we trained a *named-entity recognizer* (NER). NERs are *sequence labelers* (they label sequences of words). We trained Stanford's NER to automatically identify three entity types: 1) DEATHS, 2) INFECTIONS, and 3) HOSPITALIZATIONS.

We demonstrated the viability of tabular data using the Ebola virus epidemic in West Africa article. We elicited 39 unique tables from the 5,137 revisions made to the article from March 29, 2014 to October 14, 2014. For each affected country, each table contained case and death count time series.

## Results

To test the NER's performance, we averaged precision, recall, and F1 score results from 10-fold cross-validation. Our 14-article training set achieved precision of 0.812 and recall of 0.710, giving us an F1 score of 0.753. The classifier's performance is respectable and will likely improve given a larger, more expansive training set.

To determine the accuracy and timeliness of the Wikipedia West African Ebola epidemic time series, we used Caitlin Rivers' crowd-sourced Ebola data as ground truth. We compared the 39 Wikipedia epidemic time series to the ground truth data by computing the root-mean-square error (RMSE). The average RMSE values for each country's time series are listed in Table 1. The RMSE values are low, indicating that the time series found on the Wikipedia article are both timely and accurate.

## Conclusions

Internet data are becoming increasingly important for disease surveillance because they address some of the existing challenges, such as the reporting lags inherent in traditional disease surveillance

data, and they can also be used to detect and monitor emerging diseases. Additionally, internet data can simplify global disease data collection. We envision this work being incorporated into a community-driven open-source emerging disease detection and monitoring system. A community-driven effort to improve global disease surveillance data is imminent, and Wikipedia can play a crucial role in realizing this need.

Average cases and deaths RMSE across all table revisions.

Country	Mean Cases RMSE	Mean Deaths RMSE
Guinea	3.790	2.701
Liberia	18.168	11.983
Nigeria	0.310	0.189
Senegal	0.403	0.008
Sierra Leone	18.847	12.015
Spain	18.243	0.050
United States	0.174	0.000

## Keywords

natural language processing; named-entity recognition; Ebola; Wikipedia; disease surveillance

## Acknowledgments

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## \*Geoffrey Fairchild

E-mail: gfairchild@lanl.gov





## One Health in Action: Lyme Disease

Veronica A. Fialkowski\*, Erik Foster, Kim Signs and Mary Grace Stobierski

Emerging and Zoonotic Infectious Diseases Section, Michigan Department of Health and Human Services, Lansing, MI, USA

### Introduction

Lyme disease is an emerging disease in Michigan and is the most commonly reported vector-borne illness. The bacterium causing Lyme disease, *Borrelia burgdorferi*, is transmitted to humans or dogs through the bite of an infected tick. In the spring of 2015, a veterinarian from an island on Lake Michigan began to see locally-acquired Lyme disease in pets. In previous years the vector of Lyme disease, *Ixodes scapularis*, had not been found on the island. The Michigan Department of Health and Human Services (MDHHS) was invited to the island to conduct an environmental investigation and provide health education to local residents.

### Methods

To determine the tick population on the island, tick drags were conducted, which is a method for collecting ticks. The method involves dragging a 1-square-meter strip of white cloth mounted on a dowel tied to rope through terrain that may harbor ticks. Tick drags were done in multiple locations on the island.

### Results

Multiple life stages of *Ixodes scapularis* were found on the island. In total, 24 *I. scapularis* ticks were collected on the day of the island visit and two were positive (8.3 percent) for *B. burgdorferi*. Health education was presented at a town meeting and included information about Lyme disease, the vector for the disease, and methods on how to prevent tick-borne disease in humans and pets. "Ticks and your health" brochures and tick identification cards were provided to the residents.

### Conclusions

The intersection of people, animals, and the environment is well represented in this response to public concern of Lyme disease. Animal health surveillance for Lyme disease prompted environmental surveillance for ticks and led to proactive health education. By collaborating effectively with individuals from many fields, the One Health approach allowed for a comprehensive response of the emergence of Lyme disease on the island.

### Keywords

One Health; Lyme disease; Ticks

### Acknowledgments

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\*Veronica A. Fialkowski

E-mail: FialkowskiV@michigan.gov



# Evaluation of the Michigan Disease Surveillance System for Histoplasmosis Reporting

Veronica A. Fialkowski\*, Leigh M. Tyndall Snow, Kimerbly Signs and Mary Grace Stobierski

Emerging and Zoonotic Infectious Diseases Section, Michigan Department of Health and Human Services, Lansing, MI, USA

## Introduction

Histoplasmosis is an infectious disease caused by a fungus called *Histoplasma capsulatum*. Fungal spores are found in the soil, mostly associated with bird and bat droppings, and if inhaled can cause lung infection. Histoplasmosis is a reportable disease in Michigan and a case definition was implemented in 2007. Cases are reported into the Michigan Disease Surveillance System (MDSS), a web-based electronic database, and investigated by local health departments (LHD). An evaluation of the histoplasmosis surveillance system was conducted.

## Methods

The histoplasmosis surveillance system was evaluated using the 2001 *Centers for Disease Control and Prevention Updated Guidelines for Evaluating Public Health Surveillance Systems*. Acceptability was assessed by matching a comprehensive list of hospitals in Michigan to hospitals that directly report into MDSS. To evaluate timeliness, average times between diagnosis date, date reported to LHD, and investigation completion date were calculated. Completed cases from 2014 were reviewed to determine if cases met the case definition criteria. Positive predictive value (PPV) was then calculated for cases classified as a case in MDSS, but that did not meet the case definition upon review.

## Results

From 2004 to 2014, a total of 1,608 confirmed or probable cases were reported into MDSS, with a slight increasing trend in case numbers over time. Overall, MDSS is simple to use and fairly flexible, allowing for changes and adaptations to the case report form. Overtime the proportion of cases classified as not a case to cases classified as confirmed or probable has increased. In 2014, 72% of histoplasmosis cases reported into MDSS did not meet the case definition. Between 50 and 70% of hospitals in each region of Michigan use MDSS to report, which shows a reasonable acceptance of the Michigan reporting system. Cases were reported to MDSS or a LHD a mean of 14 days after diagnosis (n=729). On average, case investigations took 35 days to complete (n=1,145). Prior to 2007, case investigation time averaged 48 days, and decreased to a mean of 31 days after the implementation of the case definition in 2007. In 2014, 124 cases were reported as confirmed or probable, and were marked completed at the end of the respective year. After the state's review of cases, 50 cases (40 percent) were classified incorrectly and needed follow-up. The PPV was 79.84% (95% CI: 71.7%-86.5%).

## Conclusions

Michigan's histoplasmosis surveillance system is relatively simple, but the misclassification of cases is troublesome. Development of tools for LHDs to aid in classification of cases may improve the PPV and decrease case investigation time. Increasing the number of hospitals that report directly to MDSS would indicate more acceptability, and increase sensitivity. There are advantages of increased use of electronic laboratory and the shift toward electronic medical records, such as an increase in number of cases reported to

public health, however, the number of cases classified as 'not a case' increases as well, which may increase LHD workload.

## Keywords

surveillance; evaluation; fungal disease

## Acknowledgments

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\*Veronica A. Fialkowski

E-mail: FialkowskiV@michigan.gov



# Development of Food Hygiene Surveillance System in Plantation Sector, Sri Lanka

Lahiru S. Galgamuwa<sup>\*1</sup>, Devika Iddawela<sup>1</sup> and Samath D. Dharmaratne<sup>2, 3</sup>

<sup>1</sup>Department of Parasitology, Faculty of Medicine, University of Peradeniya, Kandy, Sri Lanka; <sup>2</sup>Department of Community Medicine, Faculty of Medicine, University of Peradeniya, Kandy, Sri Lanka; <sup>3</sup>Institute for Health Metrics and Evaluation, University of Washington, Washington, WA, USA

## Objective

To develop a food hygiene surveillance system to improve food safety measures within food establishments in the plantation sector of Sri Lanka.

## Introduction

Wholesome food in adequate quantities is essential to human beings for their existence (1). However, diseases spread due to contaminated food are a common problem throughout the world and an important cause of reduced economic productivity (2,3). Food borne illness can, therefore, be considered a major international health problem and a significant cause of economic loss (4,5). Approximately 10 to 20% of food-borne disease outbreaks cause due to contamination by the food handlers. In Sri Lanka, information about food hygiene practices in plantation sector is scarce. Therefore, this study was designed as a preliminary study to identify hygiene practices in food processing in the plantation sector for the establishment of a surveillance system in Sri Lanka.

## Methods

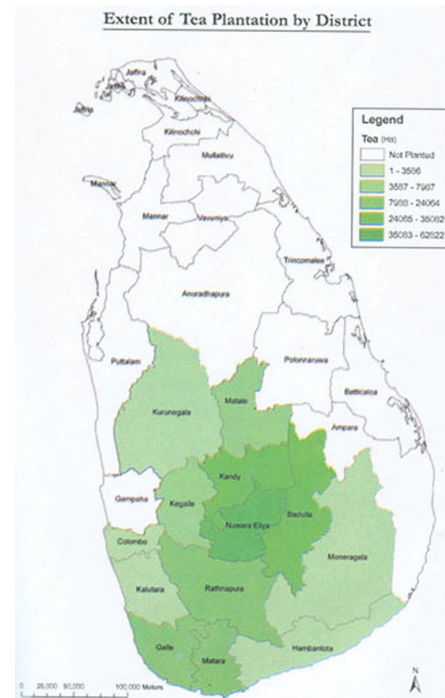
This cross-sectional study was carried out in tea plantation sector in Kandy, Sri Lanka from July to September 2013. Information regarding sanitary conditions, hygiene behavior, education status and de-worming date was obtained from food handlers using structured and pre-tested questionnaire. The data was analyzed with the SPSS version 17 statistical software.

## Results

375 food handlers from 18 to 53 years were enrolled. 59.6% of them had primary education or below whereas others had secondary education. Majority (91.3%) wash their hands with soaps after the use of toilets while only 16% wash with soap before meals. When food handling, 58% wash their hands always with soaps while others wash rarely. 52% of them wash vegetables with water and 48% used salt water to wash vegetables prior to preparing the meals. 66% of them had a habit of eating raw vegetables and only 32% trim their nails in regular pattern. More than half of food handlers (54%) wash equipments and tools with soap rarely before and after food handling while others use soaps every time. Only 6% of them undergo regular deworming treatment.

## Conclusions

This study revealed that knowledge of food hygiene practices among food handlers is poor. Community - Health education programs, promoting better food hygiene and improved sanitation should be considered, when planning a food hygiene surveillance system.



## Keywords

Food hygiene Surveillance; Sri Lanka; Food borne illness

## Acknowledgments

We would like to express thanks to University of Peradeniya for material and financial support to conduct this study. Our sincere thanks also goes to food handlers who have voluntarily participated in this study.

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**\*Lahiru S. Galgamuwa**

E-mail: lahiruahs@yahoo.com



# From Ebola to Heroin; the Use of EMS Data for Near Real Time Alerting and Surveillance

Alexander Garza\*

<sup>1</sup>Environmental and Occupational Health, Saint Louis University College for Public Health and Social Justice, Saint Louis, MO, USA;

<sup>2</sup>FirstWatch Inc, Encinitas, CA, USA

## Objective

The objective of this oral presentation is to describe the use of near real time 911 Emergency Medical Services data in looking for suspected cases of Ebola and heroin cases in the community.

## Introduction

Arguably the two most significant public health issues over the past two years have been the outbreak of ebola in West Africa and the rising epidemic of heroin use and overdoses. In the case of Ebola, the CDC issued guidance for inpatient facilities to screen for potential cases, however, there was little guidance for screening patients that presented to EMS workers. The West African patient first presented to the Emergency Department in Dallas was transported, unknowingly, by EMS, potentially exposing them and others to this deadly disease. Likewise, heroin has become an exploding epidemic in the United States with deaths from overdoses skyrocketing across the country. There are few data sources for overdoses that can alert and track real time instances of heroin overdose which are arguably the highest risk patients in the community. This will make it difficult for interventions in the community as expressed recently by the White House.

## Methods

This is a descriptive study of using multiple different EMS data sources for surveillance of emerging infectious disease and acute opioid overdose. For Ebola, data were reviewed over a six month period using search terms that reflected the definition used by health care facilities as issued by the CDC. Over 40 different EMS agencies agreed to have their data included in the surveillance program. The algorithm for identifying potential ebola cases included data from 911 dispatch, emergency medical dispatch codes, physical symptoms as documented by the treating paramedic and free text searches for countries of interest. For the surveillance of opioid overdoses, data was reviewed for one month in a high volume urban EMS system. All calls were reviewed for key search terms including 911 dispatch data and emergency medical dispatch data for overdose codes. Likewise the patient care records were surveyed in real time for paramedic diagnosis of overdose, respiratory rate and glasgow coma scale, whether the opioid reversal agent Naloxone was used and a free text search for opioid drugs of abuse. Multiple logistic regression was used to identify the most predictive terms. Variables included dispatch code, narcotic use, free text search, change in respiratory rate, change in glasgow coma scale and paramedic impression of overdose

## Results

For ebola, there were 1,532 unique cases identified from October 2014 – March 2015. None of these tested positive for Ebola. The range of cases per EMS agency was 1 – 1026 with the majority (42, 95%) having < 30 cases. Cases ranged from 107 to 331 cases per month. The most common documented physical complaint, area of travel and dispatch diagnosis were “fever”, “Africa” and “sick” respectively.

For heroin, there were 165 cases that fit the search criteria. All patient care records were reviewed by medical experts to determine whether there was, in fact, a suspected overdose. 96 cases were

identified as true overdoses based on the patient record. The most predictive model for identifying opioid overdose included Naloxone use (OR 5.51,  $p < 0.005$ ), and free text search for opioids ((OR 3.890,  $p < 0.005$ ))

## Conclusions

For multiple different public health challenges, EMS data is a rich data source for specific information that can be delivered in near real time. Patients with emerging infectious disease and opioid overdose may first present to EMS personnel. It is important the EMS agencies be involved in surveillance activities. This study describes the EMS data used for surveillance to identify potential Ebola patients and opioid overdoses. This study shows that it is possible for EMS agencies to utilize unique data sources for near real-time identification of patients with an emerging infectious disease and opioid overdoses. This study was limited by the differences in definitions for identification of cases for ebola, however the majority used definitions resembling the CDC. The model used to identify opioid overdose cases was very predictive using search terms including use of Naloxone and a free text search. More research is required to better refine the abilities of EMS data to serve as a surveillance node for disease status within the population.

## Keywords

ebola; heroin; EMS

## Acknowledgments

Mr. Todd Stout at Firstwatch Inc

\*Alexander Garza

E-mail: agarza@slu.edu



# Global Disease Monitoring and Forecasting with Wikipedia

Nicholas Generous\*, Geoffrey Fairchild, Alina Deshpande, Sara Y. Del Valle and Reid Priedhorsky

Los Alamos National Laboratory, Los Alamos, NM, USA

## Objective

To explore the use of Wikipedia as a data source for disease surveillance.

## Introduction

Infectious disease remains costly in human and economic terms. Effective and timely disease surveillance is a critical component of prevention and mitigation strategies. The limitations of traditional disease surveillance systems have motivated new techniques based upon internet data sources such as search queries and social media. However, 4 challenges remain before internet-based disease surveillance models can be reliably integrated into an operational system: openness, breadth, transferability, and forecasting. We evaluated a new data source, Wikipedia access logs, in these 4 challenges for global disease surveillance and forecasting.

## Methods

We used Wikipedia article access logs and disease incidence reports to build linear models to analyze 3 years of data for 14 disease-location contexts. Access logs for all Wikipedia articles are freely available online [1]. We used official epidemiological reports available from government health agencies and the World Health Organization.

As Wikipedia does not provide article access counts for specific countries, we used language as a proxy. We selected articles by examining the English Wikipedia article for the disease, enumerated relevant linked articles and identified corresponding articles in each language by following the inter-language wiki link.

To nowcast, we aligned the article access counts with the incidence data in order to yield time series with the same frequency. For each article we computed Pearson's correlation  $r$  against the disease time series and selected the 10 highest correlated articles. We then built a linear multiple regression model. We assessed forecasting potential by repeating the process with the article time series shifted 28 days forward and backward in 1 day increments. To evaluate whether model transferability is possible, we computed a metric  $r_t$ , the Pearson's  $r$  computed between the correlation scores  $r$  of each article found in both languages, for each pair of locations tested on the same disease.

## Results

Among the 14 contexts we analyzed, 8 of the models succeeded for nowcasting and forecasting, 3 cases failed because patterns in the official data were too subtle to capture and 3 failed because the signal-to-noise ratio in the Wikipedia data was too subtle to capture. Performance fell along disease lines: all influenza and dengue models were successful, 2 of the 3 tuberculosis models were, and cholera, ebola, HIV/AIDS, and plague were unsuccessful. Table 1 summarizes the nowcasting and forecasting performance of the models. Table 2 lists the transferability scores  $r_t$  for each pair of countries tested on the same disease. In the case of influenza, both Japan/Thailand and Thailand/USA show promising preliminary results.

## Conclusions

Human activity on the Internet leaves traces that contain real and useful evidence of disease dynamics. Wikipedia data are one of the few Internet data sources that can meet all 4 challenges. Wikipedia data are freely available to anyone (openness), they work in multiple locations for multiple diseases around the world with model success of  $r^2$  up to 0.92 (breadth), Wikipedia based models can possibly be transferable to different locations with similarity of up to 0.81 (transferability), and they have forecasting value through a horizon of 28 days (forecasting).

This preliminary study has several limitations. The methods need to be tested in more contexts, a better article selection procedure is needed, and better geo-location is needed. Despite these limitations, Wikipedia access logs is a useful data source for global disease monitoring and forecasting.

Disease	Location	Result	$r^2$ at forecast				Best forec. Days	$r^2$
			0	7	14	28		
Cholera	Haiti	Failure (DNI)	0.45	0.39	0.41	0.48	26	0.50
Dengue	Brazil	Success	0.85	0.81	0.77	0.65	-3	0.86
	Thailand	Success	0.55	0.54	0.57	0.74	28	0.74
Ebola	Uganda/DRC	Failure (DNI)	0.02	0.01	0.02	0.02	5	0.14
HIV/AIDS	China (PRC)	Failure (Official data)	0.62	0.48	0.34	0.31	-1	0.63
	Japan	Failure (Official data)	0.15	0.19	0.15	0.05	8	0.23
Influenza	Japan	Success	0.82	0.92	0.86	0.52	8	0.92
	Poland	Success	0.81	0.86	0.88	0.72	12	0.89
	Thailand	Success	0.79	0.76	0.67	0.48	-2	0.80
Plague	United States	Success	0.98	0.90	0.85	0.66	5	0.91
Tuberculosis	China (PRC)	Failure (DNI)	0.23	0.03	0.05	0.07	0	0.23
	China (PRC)	Success	0.66	0.66	0.52	0.25	-9	0.78
	Norway	Failure (Official data)	0.31	0.41	0.40	0.42	20	0.48
	Thailand	Success	0.68	0.68	0.69	0.69	9	0.69

Table 1: Summary of model performance

Disease	Location 1	Location 2	$r_t$
Dengue	Brazil	Thailand	0.39
HIV/AIDS	China (PRC)	Japan	-0.06
Influenza	Japan	Poland	0.45
	Japan	Thailand	0.81
	Japan	United States	0.62
	Poland	Thailand	0.48
	Poland	United States	0.44
	Thailand	United States	0.76
Tuberculosis	China (PRC)	Norway	0.19
	China (PRC)	Thailand	-0.20
	Norway	Thailand	n/a

Table 2: Summary of transferability scores

## Keywords

Wikipedia; Disease Surveillance; Internet data; search queries; global

## Acknowledgments

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\*Nicholas Generous

E-mail: generous@lanl.gov





# Alert-Enabled Application Integrating Data Quality Monitoring for Multiple Sources

Harold Gil\* and Nicholas L. Michaud

Marion County Public Health, Indianapolis, IN, USA

## Objective

An interactive, point-and-click application was developed to facilitate the routine assessment of known data quality factors that compromise the integrity and timeliness of data sets used at the Marion County Public Health Department (MCPHD). The code (and associated documentation) for this application is being made available for other surveillance practitioners to adopt.

## Introduction

Data sets from disparate sources widely vary in the number and type of factors which most hamper integrity and timeliness of the data. To maintain high quality data, data sets must be regularly assessed, particularly for those vulnerabilities that each is especially prone to due to the methods involved in collecting the data. For surveillance practitioners charged with monitoring data from multiple data sources, keeping track of the issues that each data set is susceptible to, and quickly identifying any inconsistencies or deviations from normal trends, may be a challenge. An application that can track all those issues, and trigger alerts when patterns diverge from what is expected, could help to enhance the efficiency and effectiveness of the surveillance efforts.

## Methods

MCPHD data sets that have experienced recurrent and well-defined issues were identified and subsequently prioritized based on the impact to public health surveillance and response efforts. Our electronic lab report data, with its pattern of consistent delays and missing positive cases, was selected as the highest priority. Originally the intention was for our solution to be utilized by personnel whom are not expected to be literate in a programming language; therefore, the potential solution needed to be user-friendly and easy-to-use.

R is a statistical computing application, known for its versatility and ability to create powerful visualizations. Shiny is an R package that facilitates the creation of interactive, easy-to-use point-and-click applications. For end users, Shiny applications eliminate the need to be familiar with the R programming language and retain the ability to harness R's analytic tools. We looked to R and its Shiny package extension as a candidate solution.

## Results

The R-Shiny application was developed and is presently in use at MCPHD. The application in its current state allows the user to select 1) the time frame for analysis, 2) the sliding window size used by the analysis as the number of days, and 3) the alert threshold as the number of standard deviations. Upon selection of any of these parameters, the program will automatically recalculate alerts for the selected time frame and plots them as red dots on the disease-specific trend lines. A dynamic table is also displayed in which the user can sort variables (date, disease name, count, alert status).

## Conclusions

In the past, MCPHD has had a significant period of time go by without realizing that certain electronic lab reports were not being received. The alert-enabled R-Shiny application that was developed in this project allows us to check report trends on a daily basis in order

to confirm whether the expected number of reports is being submitted. Further metrics and visualizations will be added to the application in order to monitor other aspects of the data that have been problematic.

We are next looking to integrate two other MCPHD data sets (HIV and Vital Records) into the application. Based on our initial success, we are also beginning to create an online library of code in order to facilitate the adoption of this R-Shiny tool.

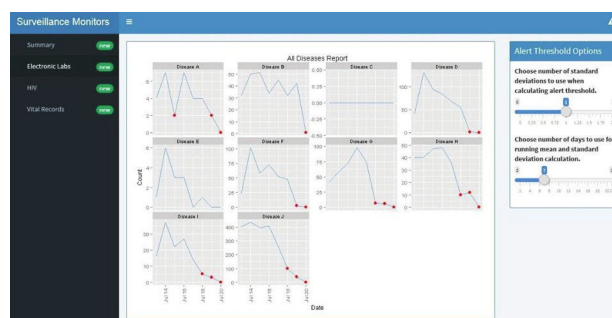


Figure 1

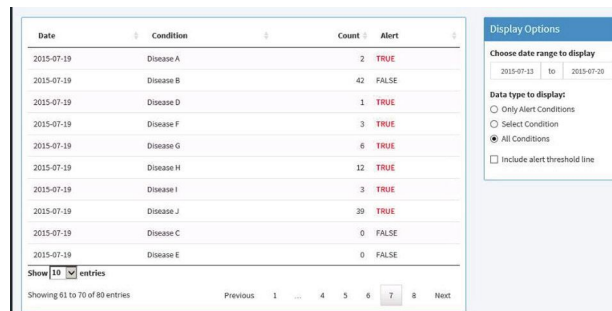


Figure 2

## Keywords

Data Quality; R; Shiny

\*Harold Gil

E-mail: hgijl@marionhealth.org

# Evaluation of Vaccine Preventable Diseases (Measles and Diphtheria) Surveillance System - Delhi, India, 2013

**Kapil Goel\***

National Center for Disease Control, Delhi, India

## Objective

The specific objective was to evaluate the VPD surveillance system of Delhi, focusing on measles and diphtheria.

## Introduction

The vaccine preventable diseases (VPDs) of measles and diphtheria in India were responsible for 47% of global measles mortality and 20% of global diphtheria mortality in 2010. We evaluated the VPD surveillance system of Delhi, focusing on measles and diphtheria.

## Methods

We evaluated the Health Management Information System (HMIS) and reviewed the available data for measles and diphtheria surveillance from North Delhi district from 2012 to 2013. Primary data were collected by interviewing key state and district level stakeholders using a semi-structured questionnaire. Documents like protocols, operational manuals, training documents and hospital and dispensary records were also reviewed.

## Results

HMIS is a web-based reporting system started in Delhi in April 2008. Data are collected through passive surveillance. The system uses standard definitions and reporting mechanisms. Data validation is standardized and documented. The system is useful and simple to use; the system has shown flexibility in adapting to needed changes over time. The system is acceptable due to involvement of field staff in the process. We observed completeness in reporting of forms (93.8% [845/900]) and systemic support (manpower, infrastructure, funds) for effective functioning of HMIS. The surveillance system is sensitive enough to see trends but data are not available at the population level to know the true burden of disease. The data quality is good for case data but poor for mortality data. The system provides incomplete representation for private sector [captures only 3.3% of reporting units (15/450)]. Only 42% (38/90) of reporting units reported on time for January 2013.

## Conclusions

The overall quality of the surveillance system is good, and it is meeting its objectives. However timeliness of reporting and representativeness needs further improvement.

## Keywords

Measles; Diphtheria; Surveillance; Vaccine; System

## Acknowledgments

None

\*Kapil Goel

E-mail: drkapil123@gmail.com



# Validation of SyS Data to Inform Surveillance of Health Disparities in Nebraska

Sandra Gonzalez<sup>\*1, 2</sup>, Ashley Newmyer<sup>1</sup> and Ming Qu<sup>1</sup>

<sup>1</sup>Division of Public Health, Epidemiology & Informatics Unit, Nebraska Department of Health and Human Services, Lincoln, NE, USA;

<sup>2</sup>University of Nebraska-Lincoln, Lincoln, NE, USA

## Objective

This pilot study evaluates Nebraska Department of Health and Human Services (NDHHS) emergency department (ED) syndromic surveillance (SyS) data quality by cross-validating reported external cause of injury codes (ECODES) associated to racial/ethnic injury health disparities in Nebraska. The percent completeness of core data elements in SyS data and hospital discharge data (HDD) was also determined.

## Introduction

Achieving health equality is a national priority. The surveillance of health disparities in minority populations is key for the advancement of health equality. However, the need for improvement in documentation of race and ethnicity has been identified across various public health data sets. Currently, due to the lack of reporting of race and ethnicity in HDD, the NDHHS mainly depends on analyses of the statewide Behavioral Risk Factor Surveillance System and Vital Records data for the surveillance of health disparities among minority populations. An alternative data set that might help inform the surveillance of health disparities is SyS data. This near-real-time electronic health record data is characterized by required core data elements that provide information about the date and time of patient encounter, treating facility, clinical information, and patient demographics.

Previously, we demonstrated statistically significant correlations between the 2011 and 2012 NDHHS ED SyS and ED HDD data for ICD9-CM ECODES corresponding to motor vehicle crash related injury, which is a relevant cause of health disparities. Our new objective was to determine the reporting consistency of ICD9-CM ECODES associated with other injury related health disparities between 2013 NDHHS SyS and HDD ED data. We also sought to determine if near-real-time ED and IP SyS data provide a more complete documentation of race and ethnicity than HDD.

## Methods

Completeness of core data elements was assessed for 2013 NDHHS ED HDD and IP, and for 2013-2015 NDHHS SyS ED and IP data from Hospital A. Core data elements for the SyS and HDD datasets included facility ID, patient ID, visit ID, visit date, patient's age, patient's sex, patient's race, patient's ethnicity, patient's zip code of residence, and diagnostic codes. The completeness of chief complaint was also analyzed for SyS data. The timeliness of SyS data was determined by calculating the mean time in hours between patient visit and receipt of ED SS record at NDHHS. The consistency of ICD9-CM reporting was assessed by comparing 2013 NDHHS SyS ED to 2013 HDD ED data from Hospital A. The cross-validation focussed on 2 causes of racial/ethnic injury related health disparities: assault-related injury, and suicide and self-inflicted injury. The corresponding ICD9-CM ECODES were: E960–E969, E979 and E999.1 (assault-related injury), and E950-E959 (suicide and self-inflicted injury). Pearson correlation coefficients were used to compare the frequency distribution of monthly counts for the specified diagnostic codes.

## Results

For Hospital A 2013 NDHHS SyS data, the percent of completeness of most core data elements was 100%. The percent of completeness for race and ethnicity was 100% and 92% respectively for the 2013 SyS IP data and 100% and 0% for ED data. An improvement in the percent of completeness for ethnicity was observed for the 2015 IP and ED SyS data, with 100% for both the 2015 NDHHS ED and IP SyS data. On the other hand, for the 2013 ED and IP HDD data, while the completeness of most core data elements was 100%, a 0% of completeness was observed for race and ethnicity. Statistically significant correlations were observed between Hospital A 2013 ED HDD and NDHHS ED SyS data for assault-related injury ( $r = 0.72$ ,  $p = 0.008$ ), and suicide and self-inflicted injury ( $r = 0.76$ ,  $p = 0.004$ ). The timeliness of reporting was 12 hours for the 2013 NDHHS SyS ED data and 2 weeks for the SyS IP data.

## Conclusions

Results suggest that NDHHS SyS 2015 data provides more complete documentation of race and ethnicity than HDD. In addition, significant correlations were observed for the conditions analyzed. Therefore, the ability to identify and describe injury inequalities can potentially be improved by using SyS ED data to complement the surveillance of health disparities. These results also indicate that SyS ED data could also be used for the timely identification and monitoring of intentional injuries in Nebraska.

## Keywords

syndromic surveillance; emergency department; health disparities; injury

## Acknowledgments

Other contributors: Bryan Buss, DVM, MPH; Gary White, and Anthony Zhang, MA

## \*Sandra Gonzalez

E-mail: Sandra.Gonzalez@nebraska.gov



# Early Estimation of the Basic Reproduction Number Using Minimal Outbreak Data

Carl Grafe\*

<sup>1</sup>Salt Lake County Health Department, Salt Lake City, UT, USA; <sup>2</sup>University of Utah, Salt Lake City, UT, USA

## Objective

To present a modification to an established approach to estimating the basic reproduction number to allow estimates to be obtained at any point during an outbreak using only the current case count, number currently ill, and the size of the at-risk population.

## Introduction

The basic reproduction number represents the number of secondary infections expected to be caused by an infectious individual introduced into an entirely susceptible population.<sup>1</sup> It is a fundamental measure used to characterize infectious disease outbreaks and is essential in developing mathematical models to determine appropriate interventions.<sup>2</sup> Much work has been done to investigate methods for estimating the basic reproduction number during the early stages of infectious disease outbreaks.<sup>3</sup> However, these methods often require data that may not be readily available at the beginning of an outbreak.<sup>3</sup> An approach developed by Becker<sup>4</sup> has been widely used to estimate the basic reproduction number using only the final case count and size of the at-risk population.<sup>5</sup> A modification to this approach is proposed that allows estimates to be obtained earlier in an outbreak using only the current case count, number currently ill, and the size of the at-risk population.

## Methods

The formula derived by Becker includes the number of infected subjects who have subsequently recovered, which is assumed to be known only after the outbreak has concluded. However, the number who are currently ill may also feasibly be known during an outbreak. Simply subtracting this number from the current case count yields an estimate of the current number who have recovered, allowing the formula to be applied in the same manner as designed, only using earlier data.

A stochastic SIR (susceptible, infectious, removed) compartmental mathematical model was developed in order to test the performance of the original approach compared with the proposed modification to the approach. The model was run 1,000 times at each of nine assumed basic reproduction numbers from 1 to 5 at 0.5 intervals, which were randomly sampled from a gamma distribution throughout each outbreak in order to simulate individual variation. The duration of illness was generically allowed to vary between 1 and 5 days. The standard approach was applied after the conclusion of each outbreak, and the modified approach was applied at a randomly selected point between the beginning and end of each outbreak. The mean of these estimates was then taken to obtain an estimate for each selected basic reproduction number. Confidence intervals were built around these estimates using the standard error formula developed by Becker and a similar subtraction of the number currently ill to calculate the modified standard error. The model was run using R 2.1.3.

## Results

The original approach yielded estimates that were not statistically significantly different from the basic reproduction numbers selected for the model from 1 to 4. However, estimates were significantly lower for the model runs with basic reproduction numbers of 4.5 and 5. The modified approach yielded estimates for the basic reproduction

number that were not significantly different from any of the basic reproduction numbers from the original approach, though estimates were significantly lower than those selected for the model for the selected basic reproduction numbers of 4.5 and 5.

## Conclusions

The modified approach appears to yield valid estimates of the basic reproduction number within a reasonable margin of error, and performs at least as well as the original approach derived by Becker. Both approaches are vulnerable to the same instability when the case count is low or approaches the size of the at-risk population (as shown in the results for the original approach when applied at higher basic reproduction numbers), but this is less likely to be an issue when taking estimates toward the middle of an outbreak as in the modified approach instead of at the end.

## Keywords

Mathematical Modeling; Transmission Dynamics; Basic Reproduction Number

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## \*Carl Grafe

E-mail: cgrafe@slco.org



# Literature Review of Mental Health and Psychosocial Aspects of Ebola Virus Disease

Anna Grigoryan<sup>\*1</sup>, Rebecca Bitsko<sup>2</sup>, Ha Young Lee<sup>3</sup>, Barbara Lopes-Cardozo<sup>3</sup> and Ruth Perou<sup>2</sup>

<sup>1</sup>National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA; <sup>2</sup>National Center on Birth Defects & Developmental Disabilities, CDC, Atlanta, GA, USA; <sup>3</sup>Center for Global Health, CDC, Atlanta, GA, USA

## Objective

To present the summary results of a literature review pertinent to mental health and psychosocial aspects of Ebola virus disease (EVD).

## Introduction

The 2014 outbreak of EVD is the largest and most complex Ebola outbreak since 1976 affecting several countries in West Africa. The mental health and psychosocial implications of the 2014 Ebola outbreak are serious and multifaceted, impacting survivors, families, communities, healthcare providers, and the public health response. In addition, psychosocial support is a key priority to the Ebola response. CDC's Ebola Mental Health Team (EMHT) was activated in September 2014. This study has been conducted to support the CDC's EMHT tasks.

## Methods

We searched on-line CDC libraries and public websites for "mental health and Ebola" and "psychosocial and Ebola" word combinations. The scope of the search was expanded to include press releases and newspaper articles due to the urgent nature of the 2014 Ebola outbreak. This review was conducted during November 2014-February 2015 and was limited to information published in English. Particular emphasis was placed on the mental health and psychosocial issues of EVD that might provide further guidance to health care personnel and Ebola responders.

## Results

A total of 140 documents were identified, including peer-reviewed research, newspaper articles, pamphlets, and guidelines/training manuals. As of March 1, 2015 the review of different library resources and websites showed that there are three broad categories of mental health issues: 1) Ebola patients; 2) healthcare providers and Ebola responders; 3) Ebola survivors.

One of the main obstacles in reducing the outbreak has been the widespread ignorance, and potential panic over EVD, leading to fear, isolation, and stigmatization. Using results of this review the CDC's EMHT developed stigma mitigation related messaging, which addressed psychosocial support and stress management for Ebola survivors and responders. Results of the study can help readers to compare identified mental health and psychosocial aspects of Ebola outbreaks to other severe epidemics in order to plan on important public health issues.

## Conclusions

The results of this literature review can be used by healthcare personnel and public health professionals to complement CDC's other guidance documents on EVD. This review could assist with further studies and publications, and facilitate intergovernmental collaboration in the areas of Ebola mental health and psychosocial support and public health practice.

**Disclaimer:** The views expressed are those of the authors and should not be construed to represent the positions of the Centers for Disease Control and Prevention.

## Keywords

Ebola Virus Disease (EVD); Mental Health; Psychosocial support; Literature Review; Population Health

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**\*Anna Grigoryan**

E-mail: Ffg7@cdc.gov





# Weather Outlook: Cloudy with a Chance of... — Classification of Storm-Related ED Visits

Teresa Hamby\*, Stella Tsai, Hui Gu, Gabrielle Goodrow, Jessie Gleason and Jerald Fagliano

New Jersey Department of Health, Trenton, NJ, USA

## Objective

To introduce and describe methods for evaluating and refining custom classifier keyword lists for syndromic surveillance of several post-severe weather event conditions and to report findings from New Jersey's syndromic surveillance of selected conditions in the aftermath of Hurricane Sandy.

## Introduction

Hurricane 'Superstorm' Sandy struck New Jersey on October 29, 2012, causing harm to the health of New Jersey residents and billions of dollars of damage to businesses, transportation, and infrastructure. Monitoring health outcomes for increased illness and injury due to a severe weather event is important in measuring the severity of conditions and the efficacy of state response, as well as in emergency response preparations for future severe weather events. Following the experience with Hurricane Sandy and the foreseeable need to be prepared for future severe weather events, NJDOH initiated a project to develop a suite of 20 indicators in EpiCenter, an online system which collects emergency department chief complaint data in real-time, to perform syndromic surveillance of extreme weather-related conditions.

## Methods

The development of 20 severe weather event indicators followed a two-stage evaluation of keyword lists using diagnostic codes. The statistical measures of sensitivity, specificity, and positive predictive value were computed for both the initial keyword list and the final keyword list. Application of nine identified severe weather event classifiers was performed by comparing graphs of one-month, three-months, and one-year time periods following Hurricane Sandy compared against the same time period from the following year.

## Results

The updated keyword lists for anxiety/adjustment disorders, disrupted outpatient medical care (dialysis and medication refills), gastrointestinal illness, upper respiratory illness, asthma, and substance abuse resulted in improved accuracy when compared to initial keyword lists and are recommended for use as new customized classifiers when analyzing severe weather events. Evaluation did not significantly improve accuracy of the initial EpiCenter classification for CO Poisoning, and further research is recommended for the application of disrupted outpatient medical care: oxygen needs.

When the time period after Hurricane Sandy was compared to the same time period during the following year, the impact of the extreme weather event on increases of ED visits for each of the evaluated classifiers became clear. Though ED visits for gastrointestinal disease were anticipated to be a post-storm concern, no peak was seen relative to preceding or following months.

## Conclusions

Overall, this endeavor has provided NJDOH with a clearer picture of the effects of Hurricane Sandy and has yielded valuable information on how the state should prepare to monitor the effects of the next severe weather event.

## Keywords

severe weather; weather classification; classification development; Superstorm Sandy

## Acknowledgments

Alvin Chu, PhD, Health Monitoring Systems, Inc.

## \*Teresa Hamby

E-mail: Teresa.Hamby@doh.state.nj.us



# A Digital Platform for Local Foodborne Illness and Outbreak Surveillance

Jared B. Hawkins\*<sup>1</sup>, Gaurav Tuli<sup>1</sup>, Sheryl Kluber<sup>1,4</sup>, Jenine Harris<sup>2</sup>, John S. Brownstein<sup>1,3</sup> and Elaine Nsoesie<sup>2</sup>

<sup>1</sup>Boston Children's Hospital, Boston, MA, USA; <sup>2</sup>Washington University in St. Louis, St. Louis, MO, USA; <sup>3</sup>Harvard Medical School, Boston, MA, USA; <sup>4</sup>Boston University, Boston, MA, USA

## Objective

Develop a platform to enable local surveillance of foodborne illness reported on social media and restaurant review sites for supplementing traditional foodborne disease surveillance programs. In this presentation, we will discuss our collaboration with local public health departments to develop a foodborne disease surveillance Dashboard.

## Introduction

Foodborne illness affects 1 in 4 Americans, annually. However, only a fraction of affected individuals seek medical attention. To supplement traditional approaches to foodborne disease surveillance, researchers and public health departments are considering reports of foodborne illness on social media sites [1, 2]. In this project, we work with local public health departments to develop a platform that uses digital data sources such as, Twitter and Yelp, to supplement foodborne disease surveillance efforts. In addition to monitoring reports of illness, this platform can also be used to respond to suspected foodborne illness reports and spur restaurant inspections to ensure food safety. To this end, we have developed a Dashboard that monitors social media chatter for reports of food poisoning in real-time. The Dashboard facilitates responding to illness reports and contacting consumers to provide additional information through a reporting form. The Dashboard is low cost, easy to use and designed to enable easy implementation for any region.

## Methods

Our database currently consist of 1.5 million foodservice reviews and 680 million tweets. For the tweets, approximately 10% have a geo-coordinate provided by the users. We inferred the geo-coordinates of another 46% of tweets using the 'location' field from the Twitter user profile by querying the Google Maps API. For automated detection of foodborne illness reports, we first develop a list of keywords consisting of foodborne disease symptoms and disease names. Next, we use text matching to filter the reports that contain at least one of the keywords. We then use a supervised machine learning classifier to extract the relevant reports. A report, for example, in which an individual mentions experiencing food poisoning after eating at a restaurant is considered relevant. However, a report is considered irrelevant when a keyword is used in another context (e.g. "this restaurant is sick!"). We developed a support vector machine classifier (SVM) that aims to create maximum separation between the irrelevant and relevant reports by identifying the optimal hyperplane. The process of developing a reliable classifier is iterative and requires refinement over multiple rounds of feature selection and parameter configuration.

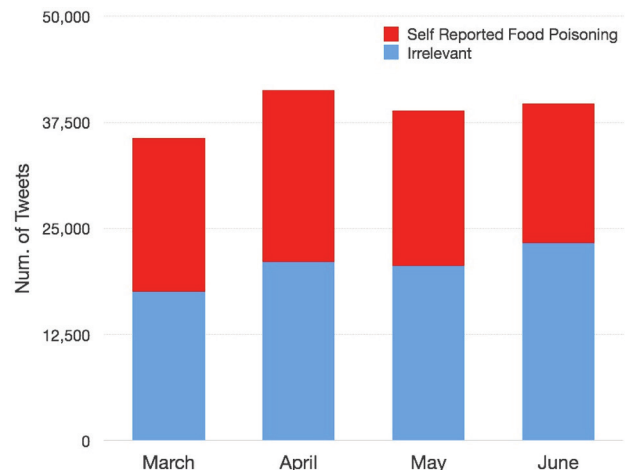
## Results

The SVM classifier was evaluated using 6084 tweets. The classifier had an accuracy and precision of 85% and 82%, respectively. These performance results are promising, especially since the training set was unbalanced and relevant and irrelevant tweet classes were extremely similar. We next ran the classifier on a real-time Twitter

stream of tweets containing at least one foodborne illness keyword. Over a four-month period in 2015, approximately 50% of the tweets were identified by the classifier as being true self-reported food poisoning incidents (Figure 1).

## Conclusions

Restaurants with lower food safety scores have been associated with higher outbreak reports [3]. Real-time surveillance of foodborne illness reports can aid local public health departments to identify and limit the spread of foodborne disease outbreaks.



## Keywords

Foodborne illness; Surveillance; Social media; Outbreak

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\*Jared B. Hawkins

E-mail: jared.hawkins@childrens.harvard.edu



## Tick-Borne Encephalitis Virus, *Coxiella burnetii* & *Brucella* spp. in Milk, Kazakhstan

John Hay<sup>1</sup>, Christina Farris<sup>2</sup>, Phil Elzer<sup>3</sup>, Alexei Andrushchenko<sup>4</sup>, Sue Hagius<sup>3</sup>, Allen Richards<sup>2</sup> and Timur Ayazbayev<sup>4</sup>

<sup>1</sup>State University of New York, Buffalo, Buffalo, NY, USA; <sup>2</sup>Naval Medical Research Center, Silver Spring, MD, USA; <sup>3</sup>Louisiana State University, Baton Rouge, LA, USA; <sup>4</sup>Uralsk Anti-plague Station, Uralsk, Kazakhstan

### Introduction

*Brucella* spp., *Coxiella burnetii*, and tick-borne encephalitis virus (TBEV) are believed to be enzootic in the Republic of Kazakhstan, and pose a particular public health risk due to their transmissibility in unpasteurized milk and dairy products. We established a milk surveillance methodology employing immuno and molecular assays to identify these agents, and applied this methodology to milk samples collected in western Kazakhstan in winter 2014-2015.

### Methods

Raw milk was collected from cows in the area around Uralsk in western Kazakhstan over the winter of 2014-2015. Samples were defatted and frozen at -20C, then tested as follows for the presence of infectious agents. For TBEV, 65 samples were tested using the VectorBest TBEV antigen capture kit. For *C. burnetii*, 50 samples were assayed using a species-specific qPCR assay. For *Brucella* spp., PCR, ELISA and FPA testing was initiated and is ongoing.

### Results

For TBEV, of 65 samples tested, nine percent were found to be positive, indicating that these milk samples contained the virus at the time of collection and thus that the source animals were infected. Source animals of TBEV negative samples may or may not have been infected, suggesting a need for blood sample collection for antibody assessment in conjunction with milk sample collection in future studies. This additional activity may also provide valuable information regarding how long infected animals shed the virus. For *C. burnetii*, all 50 samples tested were found to be negative, though positive controls were consistently positive. Because *C. burnetii* exhibits seasonal increases in bacterial load during parturition, these results may be related to the time of sample collection during winter months and may not be representative of year-round presence of *C. burnetii* in milk, such that additional samples from other seasons will be tested in future studies. For *Brucella* spp., ongoing testing has yielded some positive results by PCR, ELISA and FPA.

### Conclusions

Our data suggest that consumption of raw cow's milk in western Kazakhstan is a risk factor for tick-borne encephalitis and brucellosis. The risk for Q fever seems to be small during winter, but may be present at other times of the year. Milk samples will be collected year-round in future work, and may be accompanied by collection of blood samples for comparative analysis.

### Keywords

Tick-borne encephalitis; Q fever; Brucellosis; surveillance; milk

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E-mail:



# Emerging Infectious Diseases and Health Surveillance at U.S. Air Travel Ports of Entry: Perspective From Within the Department of Homeland Security

Andrew Hickey\*, Diana Y. Wong, Tyann Blessington, Asher Grady, Chandra Lesniak, Sarah Cheeseman Barthel, Scott Teper, William Bilado, Jayme Henenfent, Tiana Garrett, Neil Bonzagni, Mark Freese and Teresa Quitugua

NBIC/DHS, Bethesda, MD, USA

## Objective

NBIC analysts evaluated the options and effectiveness of airport symptom-based health screening programs available during emerging disease outbreaks occurring outside the U.S.

## Introduction

The National Biosurveillance Integration Center (NBIC) has the responsibility to integrate, analyze, and share the nation's biosurveillance information provided from capabilities distributed across public and private sectors. The integration of information enables early warning and shared situational awareness of biological events to inform critical decisions directing response and recovery efforts. In addition to its interagency partners, NBIC supports the Office of Health Affairs and DHS components responsible for safeguarding U.S. ports of entry. More than 150 U.S. international airports process an estimated two billion passengers and 50 million metric tons of cargo arriving in the U.S. from more than 1,000 international airports located outside the U.S. Entry and customs screening are points where travelers from international destinations pass; a logical location for assessing health of incoming travelers in order to identify and control import of diseases of emerging diseases. NBIC examined peer-reviewed literature, region-specific disease spectrum/frequency, and air travel patterns to assess options for ports of entry health screening as well as the challenges and potential benefits for active screening programs.

## Methods

Analysts reviewed information from peer-reviewed publications and open data/information sources to assess disease characteristics and spatial distribution. Regional relative proportion of Ebola virus, MERS-CoV, and other common regional infectious diseases was estimated using data from the Global Infectious Diseases and Epidemiology Network (Gideon). Flight passenger volume information was obtained from Customs and Border Protection (CBP). A crude estimate of the number of cases for a particular disease transiting a U.S. airport was obtained from disease frequency and total passenger volume data. In addition, analysts reviewed available peer-reviewed literature to evaluate health screening programs at airports and the potential effectiveness for controlling import of emerging diseases.

## Results

The initial symptoms of MERS-CoV and Ebola virus infections are common to many respiratory and enteric infectious illnesses. In Saudi Arabia, published literature indicates at least 50% of travelers experience an episode of influenza-like illness during travel and more than 80% of the infectious causes of febrile illness among travelers to Saudi Arabia and the United Arab Emirates are common agents also endemic in the U.S. Peer-reviewed literature indicates that 11-47% of travelers to sub-Saharan Africa experience at least one episode of febrile illness during their travel, and more than 90% of

the infectious causes of febrile illness among travelers to West Africa (Guinea, Sierra Leone, and Liberia) are common agents also endemic in the U.S. Based on historical travel trends, at least 150 passengers from West Africa (Guinea, Liberia, and Sierra Leone) and 1,500 Middle East passengers (Saudi Arabia and United Arab Emirates) arrive each day at U.S. airports. Given the frequency of febrile illness among travelers to these regions as well as the relative proportion of infectious disease causes, symptom-based screening alone would be unlikely to identify targeted rare emerging pathogens and would be confounded by a large portion of non-infectious health conditions and common infections endemic to the U.S.

## Conclusions

In agreement with models and meta-analyses found in the peer-reviewed literature, symptom based health screening, in the absence of additional screening measures such as exposure history or physical examination, is an inefficient method for identifying rare targeted illnesses. Furthermore, additional factors contribute to the effectiveness and practicality of symptom-based health screening programs: including impact to employee safety, impact to passenger safety and entry procedures, disease syndrome and ease of distinguishing, program coordination, and outcomes of introducing the screening program. Additional studies are needed to determine the best practices and support policy development to guide the use of health screening options at airports.

## Keywords

Airport; Travel; Biosurveillance; Emerging Infectious Disease

## \*Andrew Hickey

E-mail: [andrew.hickey@hq.dhs.gov](mailto:andrew.hickey@hq.dhs.gov)



# Preliminary Look into the ICD9/10 Transition Impact on Public Health Surveillance

Peter Hicks<sup>1</sup>, Julie A. Pavlin<sup>6</sup>, Atar Baer<sup>2</sup>, David J. Swenson<sup>\*7</sup>, Rebecca Lampkins<sup>5</sup>, Achala U. Jayatilleke<sup>1</sup>, Aaron Kite-Powell<sup>3</sup>, Brooke Evans<sup>4</sup> and Laura Streichert<sup>4</sup>

<sup>1</sup>Division of Health Informatics and Surveillance, Centers for Disease Control & Prevention, Atlanta, GA, USA; <sup>2</sup>Communicable Disease Epidemiology & Immunizations Section, Public Health – Seattle & King County, Seattle, WA, USA; <sup>3</sup>Division of Integrated Biosurveillance, Armed Forces Health Surveillance Center, Baltimore, MD, USA; <sup>4</sup>International Society of Disease Surveillance, Brighton, MA, USA; <sup>5</sup>Council of State and Territorial Epidemiologists, Atlanta, GA, USA; <sup>6</sup>Infectious Disease Clinical Research Program and Henry M Jackson Foundation, Uniformed Services University of the Health Sciences, Bethesda, MD, USA; <sup>7</sup>New Hampshire Department of Health & Human Services, Concord, NH, USA

## Objective

This roundtable will provide a forum for the syndromic surveillance Community of Practice (CoP) to discuss the public health impacts from the ICD-10-CM conversion, and to support jurisdictional public health practices with this transition. It will be an opportunity to discuss key impacts on disease surveillance and implementation challenges; and identify solutions, best practices, and needs for technical assistance.

## Introduction

On October 1, 2015, the number of ICD codes will expand from 14,000 in version 9 to 68,000 in version 10. The new code set will increase the specificity of reporting, allowing more information to be conveyed in a single code. It is anticipated that the conversion will have a significant impact on public health surveillance by enhancing the capture of reportable diseases, injuries, and conditions of public health importance that have traditionally been the target of syndromic surveillance monitoring. For public health departments, the upcoming conversion poses a number of challenges, including: 1) Constraints in allocating resources to modify existing systems to accommodate the new code set, 2) Lack of ICD-10 expertise and training to identify which codes are most appropriate for surveillance, 3) Mapping syndrome definitions across code sets, 4) Limited understanding of the precise ICD-10 CM codes that will be used in the US Healthcare system, and 5) Adjusting for changes in trends over time that are due to transitions in usage of codes by providers and billing systems. To accommodate the ICD-9 to ICD-10 transition, the Centers of Disease Control and Prevention (CDC) partnered with the International Society of Disease Surveillance (ISDS) CoP to form a workgroup to develop the Master Mapping Reference Table (MMRT). This tool maps over 130 syndromes across the two coding systems to assist agencies in modifying existing database structures, extraction rules, and messaging guides, as well as revising established syndromic surveillance definitions and underlying analytic and business rules.

## Description

Representatives from the ICD10 workgroup will lead a discussion of ICD-10-CM coding impact since October 1, 2015 (including feedback and stories from Local, State, and Federal Public Health as well as from EHR vendors and other partners) to share experiences using the MMRT tool, and impacts, challenges, and best practices relating to the ICD 9/10 transition.

## Audience Engagement

A slide presentation will feature how jurisdictions have prepared for and integrated ICD-10 coding and mapping into their surveillance systems, as well as share ICD 9/10 conversion experiences. The CoP audience will be queried on specific questions during the discussion such as: 1) How did the transition impact dataflow and content from

hospital emergency departments?, 2) What was the conversion impact on surveillance systems (such as downtime, improvement in accuracy, etc.)?, 3) What methods did your health department use to try to analyze data before/after the conversion?, 4) How did you use the MMRT tool developed by the ISDS ICD10 working group to accommodate changes in syndrome definitions?, and 5) Did you attempt to develop more precise syndrome definitions, and how do you plan to validate syndromic categories? An audience response “clicker” system will be used to collect answers to these questions as a catalyst for further discussion. The answers will be compiled and presented to the audience, followed by discussion aimed at identifying conversion challenges faced by the audience, solutions, and best practices.

## Keywords

Surveillance; Methodologies; Public Health; Analytics

**\*David J. Swenson**

E-mail: dswenson@dhhs.state.nh.us





# An Exploration of Public Events and Alcohol Related Incidents

Briana A. Holliday\*

Undergraduate, University of Illinois at Urbana-Champaign, Kankakee, IL, USA

## Objective

The objective for this research project was to see if there are predictable patterns for certain annual events in Champaign County, Illinois. The focus was on how alcohol intoxication effected the population and whether or not its effects were dangerous to the community at an alarming rate.

## Introduction

Champaign County is one of the largest counties in central Illinois with a population of ~207,000 and is home to the University of Illinois at Urbana-Champaign which currently has 44,500 students. In the fall the university hosts Big Ten football games which have recently been drawing an average attendance of ~45,000 people, many traveling from Chicago or other parts of the Midwest<sup>1</sup>. The twin cities host a number of community events and festivals throughout the Spring and Summer. Typically the community festivals have liquor licenses whereas no alcohol is served in the football stadium. Despite the lack of alcohol availability in the stadium many fans drink during tailgate parties before and after the game.

## Methods

In order to assess the impact of alcohol at Champaign-Urbana mass gatherings we extracted records of patients seeking alcohol-intoxication related treatment at Carle Foundation Hospital from INDICATOR<sup>2</sup> between 2011 and 2014. We also obtained police citation data for driving under the influence (DUI) and minor in possession (MIP) from the Urbana, Champaign, and University of Illinois Police Departments over the same period. The number of patient visits and citations for home football games were compared using an unmatched t-test to Fall weekends without a home game. The number of patient visits and citations for the Illinois Marathon, Taste of Champaign, Boneyard Creek Arts Festival, Urbana Sweetcorn Festival, and Rhythm and Brews Music Festival were compared against the event-less 2 weekends before and after the event.

## Results

Over the 4 year period of the study there were 29 Fall Saturdays with a home football game and 24 without. Of these the difference in the number of minor in possession citations were highly significant (mean=20.72 v 5.04,  $p < 0.0001$ ) whereas there was no statistical difference in number of DUI citations (mean=1.21 v 1.25,  $p > .1$ ) or hospital emergency department visits (mean=5.24 v 4.33,  $p > 0.1$ ).

Over the same 4 year period there were 25 Spring weekend days with City Festivals and 47 weekend days without them. Of these the difference in the number of minor in possession citations were significant (mean=8.68 v 4.27,  $p < 0.05$ ) as were the number of DUI citations (mean=1.44 v 0.91,  $p < .05$ ). Hospital emergency department visits were not significantly different (mean=3.4 v 3.23,  $p > 0.1$ ).

During the summer months when the population of Champaign-Urbana is significantly reduced by the absence of students there were 57 days with city festivals and 123 days without them. Again the difference in MIP cases was significant (mean=3.72 v 1.53,  $p < 0.0001$ ), whereas there was no statistical difference in number of DUI citations (mean=0.631 v 0.642,  $p > .1$ ) or hospital emergency department visits (mean=2.68 v 2.93,  $p > 0.1$ ).

## Conclusions

The results from this research have started looking at how alcohol effects the Champaign County community. While minor in possession counts are significantly increased during home football games there does not seem to be immediate danger to the community, considering driving under the influence and reported acute alcohol intoxication hospital visits were not significantly above background. It is interesting however that on preliminary analysis there is a significant increase in the number of DUI citations during Spring Festivals. Further work will seek to confirm the validity of these observations and develop predictive models of the number of alcohol related cases taking into account additional factors such as weather, attendance, and the team's record.

### Home Football Games

	Home Football Games	Home Football Game	No Home Games	No Home Game	P-Value
	Mean (n=29)	Standard Deviation	Mean (n=24)	Standard Deviation	
MIP	20.72	11.0033	5.041	4.0979	< 0.0001
DUI	1.21	1.0770	1.2500	1.0260	.8912
Carle ED	5.24	3.3493	4.33	3.6818	.351

## Keywords

alcohol; mass gatherings; college; street festivals

## Acknowledgments

We would like to thank Carle Foundation, Urbana Police Department, Champaign Police Department, and University of Illinois Police Department for sharing data and a special thanks to I3 for funding this project.

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\*Briana A. Holliday

E-mail: hollida2@illinois.edu



# Mantle: An Open Source Platform for One Health Biosurveillance and Research

Andrew G. Huff\*<sup>1,2</sup> and Toph Allen<sup>1</sup>

<sup>1</sup>EcoHealth Alliance, New York, NY, USA; <sup>2</sup>Columbia University, New York, NY, USA

## Objective

Mantle will be an open-source, cloud-compatible platform for storing, studying, and sharing data on infectious diseases across plants, animals, and humans. It will meet the needs of three groups of users: scientists, policymakers, and the general public. For scientists, Mantle will make datasets portable and connected. Scientists will be able to upload datasets to the Mantle website or collect data from the field using a mobile app. Users in Mantle will be able to easily make datasets entirely private, publicly accessible, or shared with specific users or groups.

## Introduction

The One Health approach suggests that humans, animals, and the environment are closely tied together. Human interaction with wildlife and the environment contributes to increased risk for human, plant, and animal infectious disease outbreaks. Since human, animal, and ecosystem health are linked, interdisciplinary and holistic approaches are needed to prevent future infectious disease outbreaks. Despite the movement towards One Health, the software currently available to manage, analyze, and communicate the vast amount of One Health data is grossly inadequate. One Health data are continually growing in size and complexity, and new technologies must be developed to address the magnitude of the problem. Furthermore, the desire of single entities to control and leverage information for greater personal and organizational wealth and power directly opposes the goals of biosurveillance, One Health, and science. Open access and open source software are needed to address these complex One Health problems, and to improve data accessibility, interoperability, and information communication.

## Methods

Mantle will handle tabular data, and other widely used spatial data formats. It will visualize and explore data in useful ways, and allow data to be downloaded as the originally uploaded file or in a customizable format for use in analytical software. Mantle will store metadata—information about a dataset and its contents—using development standards for linked data (e.g., JSON-LD and WCSV, part of the overarching Resource Description Framework). Tapping into the emerging semantic web enables richer interactions with datasets, streamlining many common data tasks. Mantle will natively understand a number of data types common to One Health data, including spatial and temporal elements, taxonomic names, and case counts, and associates these with published ontologies. Mantle will also work seamlessly with any numeric, categorical, and textual data. Mantle will store metadata—information about a dataset and its contents—using development standards for linked data (e.g., JSON-LD and WCSV, part of the overarching Resource Description Framework). Tapping into the emerging semantic web enables richer interactions with datasets, streamlining many common data tasks. Mantle will natively understand a number of data types common to One Health data, including spatial and temporal elements, taxonomic names, and case counts, and associates these with published ontologies. Mantle will also work seamlessly with any numeric, categorical, and textual data.

## Conclusions

Policymakers and decision makers will be able to view real-time visualizations of Mantle data feeds in dashboards. Researchers will be able to upload datasets representing the output of models built in other analytical software, which can be shared with policymakers, who can also view and interact with the output of custom-built modeling modules to view timely and meaningful summaries of public health data feeds. Potential use cases for the general public include browsing day-to-day textual and syndromic surveillance information, viewing the predictions of a one-time study, and monitoring the latest calculated epidemic curve in an outbreak or ongoing epidemic. Mantle will facilitate crosscutting collaborations between disciplines and institutions. Users will be able to create, manage, and join organizations and groups. Groups of users will access and collaborate on collections of datasets, grouped manually or by specified properties. For instance, users interested in *Ranavirus* can view and contribute to the Global *Ranavirus* Reporting System, a collaborative effort by scientists worldwide to aggregate observed cases of *Ranavirus* across species and locations (a Mantle prototype).

## Keywords

Metadata; One Health Surveillance; Open Source; Data Sharing; One Health Research

\*Andrew G. Huff

E-mail: [andrewgeorgehuff@gmail.com](mailto:andrewgeorgehuff@gmail.com)



# Augmenting Surveillance to Minimize the Burden of Norovirus-Like Illness in Ontario: Using TeleHealth Ontario Data to Detect the Onset of Community Activity

Stephanie L. Hughes\* and Andrew Papadopoulos

University of Guelph, Guelph, ON, Canada

## Introduction

Norovirus, commonly referred to as the winter vomiting disease, is the most common cause of gastroenteritis worldwide, with the total number of cases reported per year in Ontario second only to the common cold. The disease is highly infectious, requires a low infectious dose, and is well-known to cause large outbreaks in closely confined populations. While deaths are rare, hospitalization and long-term sequelae are more likely to occur in at-risk populations, such as the elderly or immunocompromised. Action to reduce the number of norovirus infections per year is required due to its health and economic burden. It is estimated that norovirus infections cost the United States 2.5 billion CAD and the United Kingdom close to 200 million CAD per year in health care costs alone. While laboratory surveillance is practiced in Ontario to detect norovirus outbreaks, early detection remains a challenge. This project aims to utilize syndromic surveillance with TeleHealth Ontario data in order to develop an early warning system mitigating the impact of norovirus outbreaks.

## Methods

TeleHealth Ontario call data, using vomiting as the predominant symptom for calling, will be obtained for September 2009 – August 2015. Call volumes preceding the winter vomiting season will be analysed such that “normal” call proportions (vomiting calls/total calls) can be determined, and a threshold can be identified. An alarm will be triggered when the proportion of calls with vomiting as a predominant symptom surpasses this threshold for two consecutive weeks, thus signifying the start of the norovirus winter vomiting season, typically October – April. Norovirus laboratory reports in Ontario for the same time period will be used as a comparison to identify the confirmed norovirus season.

## Results

From this work, an early warning system will be created to detect norovirus outbreaks earlier than the conventional laboratory-confirmed surveillance methods, as vomiting calls to TeleHealth Ontario will precede provincial norovirus laboratory reports. In creating such a system, public health agencies can notify hospitals, long-term care homes, and other vulnerable populations of impending outbreaks.

## Keywords

Norovirus; Surveillance; TeleHealth

## Acknowledgments

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\*Stephanie L. Hughes

E-mail: shughes@uoguelph.ca



# Product Landscape of Rapid Diagnostic Tests for Viral Hemorrhagic Fever Pathogens

Noah Hull\*<sup>2</sup>, Andrew Hickey<sup>1</sup> and Teresa Quitugua<sup>1</sup>

<sup>1</sup>National Biosurveillance Integration Center, Office of Health Affairs, United States Department of Homeland Security, Washington, DC, USA; <sup>2</sup>University of Wyoming, Laramie, WY, USA

## Objective

Provide a succinct review of potential developmental and commercial viral hemorrhagic fever diagnostic assays published in peer-reviewed literature and open-source platforms.

## Introduction

As the lead for coordinating domestic incident management across all Federal departments and agencies, Department of Homeland Security is responsible for identifying emergency response resources. The 2014 Ebola – Zaire outbreak in West Africa that became a Public Health Emergency of International Concern highlighted the need to understand the current and potential availability of diagnostic assays for a number of viral hemorrhagic fevers that may require similar response actions. A concatenated list of publically reported potential viral hemorrhagic fever diagnostic assays was therefore compiled. Etiologic agents in the families of *Arena-*, *Bunya-*, *Filo-*, and *Flaviviridae* were included in the analysis. This list identifies assays in various stages of development that could be submitted, at some point, to the Food and Drug Administration (FDA) under an Emergency Use Authorization (EUA) should such a need arise.

## Methods

Boolean logic formatted searches were conducted using PubMed, Google Scholar, and Google to identify open-source reports of diagnostic assays for viral hemorrhagic fevers. The general Boolean search term was [(PATHOGEN OF INTEREST AND Diagnostic) (Rapid OR Point of Care OR “Assay Development” OR Validation OR POC OR Evaluation OR Clinical OR Deploy\* OR Testing OR Detect\*)]. Returned results were screened for data elements that provided adequate information to derive test performance statistics (limit of detection, sensitivity with 95% confidence interval, specificity with 95% confidence interval, positive predictive value, and negative predictive value). Assays were qualitatively analyzed based on limit of detection, sensitivity, and specificity estimates. Genus level etiologic agents by family are: *Arenaviridae* (Chapare, Guanarito, Junin, Lassa, Lujo, Lymphocytic choriomeningitis, Machupo, Sabia, and Whitewater Arroyo), *Bunyaviridae* (Crimean-Congo, Hantavirus, and Rift Valley Fever), *Filoviridae* (Ebola and Marburg), and *Flaviviridae* (Dengue, Kyasanur Forest Disease, Omsk, and Yellow Fever).

## Results

Through the use of the Boolean logic, 312 unique assay data sources were identified and examined. One hundred seventeen sources contained adequate information to derive diagnostic test statistics for examination as part of this review. Inadequate information was identified for Chapare Hemorrhagic Fever, Whitewater Arroyo Virus, and Omsk Hemorrhagic Fever, so diagnostic information for these agents was not included in the final table. Assays were dichotomized as either academic/government or commercial assays. Of the 212 total assays, 136 (64%) resided in academic or government laboratories. Of those, the vast majority addressed the *Arena-*, *Bunya-*, and *Filoviridae* families (35%, 34%, and 26% respectively), compared to the commercial assays addressing the *Filo-* and *Bunyaviridae* families

(43% and 27.6% respectively). The disproportionate weight of the commercial assays on *Filoviridae* is likely a function of the 2014 Ebola-Zaire outbreak. In the academic/government validated assays, 82% were validated on clinically derived samples, in comparison to 57% from the commercial assays. Clinically validated assays are the “gold-standard” validation technique as recommended by the FDA.

## Conclusions

The potential product landscape for rapid diagnostics of viral hemorrhagic fevers is extensive. However, the vast majority of these assays were developed in academic or government laboratories and have not progressed further toward commercialization or broad public health use. Subsequently, should an EUA be sought for these diagnostic assays, their approval may be delayed due to the lack of validation and standardization required for deployment as a reliable diagnostic tool. Lastly, the validation methods by which each assay was tested varied greatly, resulting in difficulty drawing direct comparisons amongst assays.

## Keywords

Viral Hemorrhagic Fever; Diagnostic Test; Product Landscape

## Acknowledgments

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## \*Noah Hull

E-mail: Nhull@uab.edu



# What's the Buzz About Arboviral Disease Syndromic Surveillance?

Jenna Iberg Johnson\* and Christine Scott-Waldron

Louisiana Office of Public Health, Infectious Disease Epidemiology, New Orleans, LA, USA

## Objective

To validate arboviral syndromes and evaluate the utility and practicality of detecting and monitoring arboviral disease using ED chief complaint, admit reason and diagnosis text data.

## Introduction

The Louisiana Office of Public Health (OPH) Infectious Disease Epidemiology Section conducts emergency department (ED) syndromic surveillance using the Louisiana Early Event Detection System (LEEDS). LEEDS automatically processes electronic chief complaint, admit reason and diagnosis data to identify ED visits indicative of specific syndromes. In response to local transmission of chikungunya virus in the Caribbean and the first travel-associated case in Louisiana in May of 2014, OPH conducted an arboviral syndromic surveillance study to validate arboviral syndromes and evaluate the utility and practicality of detecting and monitoring arboviral disease using ED chief complaint, admit reason and diagnosis text data.

## Methods

OPH developed four syndromes that were applied to statewide ED chief complaint, admit reason and diagnosis text data from April 19, 2014 through August 8, 2015 to monitor arboviral febrile illness: a travel syndrome to capture mentions of international travel, particularly travel to the Caribbean; a chikungunya syndrome to capture specific mentions of chikungunya; an arboviral syndrome to capture other arboviral diseases or insect bites and fever; and a fever and joint pain syndrome. OPH conducted chart reviews of a sample of the records captured by the four syndromes to evaluate if they may have been arboviral cases. Each case reviewed was classified as a confirmed arboviral case, possible arboviral, or non-arboviral based on clinical presentation and any lab work done. OPH also reconciled reported cases of chikungunya and dengue over the period with the syndromic surveillance data to identify which, if any, were captured by the four syndromes.

## Results

The four syndromes captured a total of 165 patients during the study period. The majority of the patients (129) were captured by the arboviral syndrome, followed by 33 fever and joint pain (one patient fell under both arboviral and fever and joint pain syndromes), 2 chikungunya and 2 travel. Of the 165 patients, OPH conducted chart reviews of 67 patients: 5 were classified as confirmed arboviral cases, 3 as possible arboviral, and 59 as non-arboviral. 48 of the 129 patients captured by the arboviral syndrome were reviewed: 2 were confirmed arboviral, 3 were possible arboviral, and 43 were non-arboviral. 16 of the 33 patients captured by the fever and joint pain syndrome were reviewed: 1 was possible arboviral and 15 were non-arboviral. 2 patients were captured by the chikungunya syndrome, both of which were confirmed arboviral, and 2 by the travel syndrome, 1 of which was confirmed arboviral and 1 non-arboviral. The confirmed arboviral cases consisted of 3 chikungunya cases and 2 West Nile cases. Reconciliation of reported chikungunya and dengue cases against the syndromic surveillance data revealed that most were not captured because of lack of specificity in the chief complaint or admit reason, for example "fever," "generalized weakness," or "viral illness."

## Conclusions

This study demonstrated that using ED chief complaint, admit reason and diagnosis text data to monitor and detect arboviral disease is a difficult task. Arboviral illness usually begins with common symptoms that could be indicative of many different diseases, and a review of reported chikungunya and dengue cases confirmed that chief complaint and admit reason are often non-specific and therefore difficult to capture with text syndromes. The arboviral and fever and joint pain syndromes were too sensitive, often picking up insect bites resulting in abscesses or allergic reactions (arboviral) or chronic conditions (fever and joint pain). Alternatively, the travel and chikungunya syndromes were too specific, since chief complaint and admit reason data rarely include specific arboviral disease names or travel history information. While specific arboviral disease can be detected in diagnosis information, diagnosis is not always included in syndromic surveillance data. Due to these constraints, in this study only 7% of reviewed cases were confirmed arboviral cases, 4% were possible arboviral, and 88% were non-arboviral. Therefore, while a small number of confirmed arboviral cases were detected, ED syndromic surveillance based on chief complaint, admit reason and diagnosis text data is not a practical method for detecting arboviral disease and does not provide an accurate indicator to monitor arboviral disease.

## Keywords

arboviral; syndromic surveillance; Chikungunya

## \*Jenna Iberg Johnson

E-mail: [jenna.ibergjohnson@la.gov](mailto:jenna.ibergjohnson@la.gov)





# Regional Syndromic Surveillance Data Sharing Workshops: Process and Early Outcomes

Charlie Ishikawa\*<sup>1</sup>, Katrina DeVore<sup>2</sup>, Scott Gordon<sup>3</sup>, Mark Sum<sup>3</sup> and Laura Streichert<sup>2</sup>

<sup>1</sup>Ishikawa Associates, Roslindale, MA, USA; <sup>2</sup>International Society for Disease Surveillance, Brighton, MA, USA; <sup>3</sup>Association of State and Territorial Health Officials, Crystal City, VA, USA

## Objective

Promote inter jurisdictional syndromic surveillance (SyS) data sharing practices with a training model that engages participants in collaborative learning.

## Introduction

Sharing public health (PH) data and practices among PH authorities enhances epidemiological capacities and expands situational awareness at multiple levels. Ease of data sharing through the BioSense application, now part of the National Syndromic Surveillance Program (NSSP), and the increased use of SyS nationwide have provided opportunities for region-level sharing of SyS data. In addition, there is a need to build workforce competence in SyS given powerful new information technology that can improve surveillance system capacities. Peer-to-peer learning builds the relationships and trust among individuals and organizations that are required for inter jurisdictional data sharing.

## Methods

The SyS data sharing workshops are based on a training model in which participants first share a limited amount of SyS data, learn for one another, and then make plans to grow inter jurisdictional SyS data sharing (Figure 1). Workshop objectives and agenda were developed by Ishikawa Associates, ISDS, ASTHO, and CDC. HHS regions for workshops were selected based on SyS data availability, BioSense participation, and interest in SyS data sharing.

Each data sharing workshop was tailored to participant needs for the knowledge and skills necessary for SyS data sharing. Using a non-formal education approach<sup>1</sup>, participants selected a syndrome(s) to share limited emergency department visit data before the workshop. The workshop agenda then includes sharing those data, exchanging best practices, documenting perceived benefits and barriers to SyS data sharing, and brainstorming solutions and setting next steps.

## Results

Regional SyS data sharing workshops have been conducted in 8 of the 10 HHS Regions, reaching 98 surveillance professionals from 63 state and 35 local PH agencies. Across the workshops, influenza-like-illness (ILI) was the most frequently selected syndrome of interest, primarily because many jurisdictions already used SyS for ILI surveillance and the data was available for analysis and sharing. Additionally, the regular flu season experienced nationwide helped to choose a timeframe for analysis. Other selected syndromes reflected the diversity of SyS applications, including CO poisoning, drug overdose, asthma, heat-related illness, and gastrointestinal illness.

Perceived benefits to SyS data sharing included cross-border case-finding, identification of regional patterns and trends, enhanced national situational awareness, hypothesis generation and testing, and retrospective analyses to improve PH practice<sup>2</sup>. Data quality, legal issues, lack of metadata, and the absence of specific functionalities in BioSense were listed as barriers.

Action items have included work on a green paper on barriers to data sharing, presentations at national conferences, regular information exchanges, syndrome definitions, and increased data

sharing with CDC and other stakeholders through the BioSense application.

## Conclusions

The outcomes of these workshops include demonstration of an effective training format for engaging PH surveillance professionals through relationship building, trial data sharing, and collaborative priority setting and action planning as a necessary first step to identifying and addressing barriers to data sharing. Ongoing training will be required as new jurisdictions use SyS and experienced ones seek to improve their practice.

## SyS Data Sharing Workshop Process

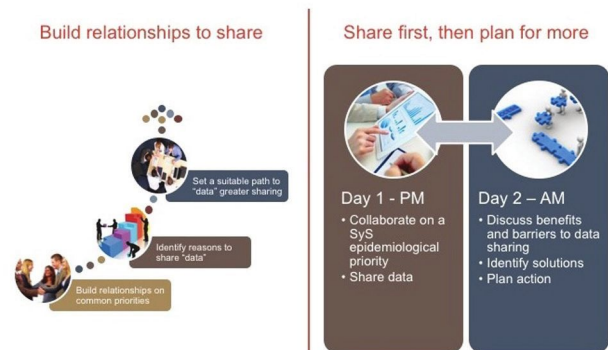


Figure 1: Illustration of the syndromic surveillance data sharing workshop model.

## Keywords

Data sharing; Syndromic surveillance; Non-formal education; Training

## Acknowledgments

DHIS/CELS/CDC for sustained workshop support and engagement. The workshop participants and their agencies for in-kind contributions of work and enthusiasm.

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\*Charlie Ishikawa

E-mail: [Charlie@Ishikawa.Associates](mailto:Charlie@Ishikawa.Associates)



# Knowledge Management Tools for the ISDS Community of Practice

Amy Ising<sup>\*1</sup>, Wayne Loschen<sup>2</sup> and Laura Streichert<sup>3</sup>

<sup>1</sup>Emergency Medicine, UNC Chapel Hill, Chapel Hill, NC, USA; <sup>2</sup>Applied Physics Laboratory, Johns Hopkins University, Laurel, MD, USA; <sup>3</sup>International Society for Disease Surveillance, Boston, MA, USA

## Objective

The purpose of the roundtable is to seek feedback from attendees on the components needed to improve syndromic surveillance practice through access to the shared knowledge, practices, and tools of the ISDS Community of Practice (CoP).

## Introduction

Knowledge Management is defined as “the process of capturing, distributing, and effectively using knowledge.” [1] ISDS members have varying degrees of experience with public health surveillance and syndromic surveillance specifically, and will all benefit from more structured access to documentation on components related to syndromic surveillance, including but not limited to, the onboarding of facilities, data quality monitoring tools, case definitions, and data processing tools. To build a knowledge management capability, the first step is to gather initial requirements and priorities from the CoP.

## Description

The roundtable will begin with a brief introduction to knowledge management and the requirements gathering goals of the roundtable. Participants will be organized into small groups and tasked with identifying the types of information needed for a syndromic surveillance knowledge management repository for capturing current and future knowledge. Some ideas that may be generated include syndrome definitions, data processing tools (ETL, negation processing, etc.), onboarding best practices, data source pros and cons, visualization tools, data analysis tools, and data quality tools and metrics.

## Audience Engagement

Small groups will ensure participation among all participants. Each group will be asked to brainstorm the components that should be included in a knowledge management product. Groups will also discuss how content is contributed, vetted, maintained, and accessed by the CoP. The larger group will discuss prioritization for the knowledge management system and next steps for community engagement in this endeavor.

## Keywords

knowledge management; community of practice; syndromic surveillance; best practices

## References

- [1] Davenport, Thomas H. (1994), Saving IT's Soul: Human Centered Information Management. Harvard Business Review, March-April, 72 (2)pp. 119-131

## \*Amy Ising

E-mail: [ising@ad.unc.edu](mailto:ising@ad.unc.edu)



# Injury Surveillance with District Health Information System 2 (DHIS2)

Achala U. Jayatilleke<sup>\*1</sup>, Megha Ganewatta<sup>1</sup>, Pamod Amarkoon<sup>1</sup>, Roshan Hewapathirana<sup>2</sup> and Achini Jayatilleke<sup>3</sup>

<sup>1</sup>Postgraduate Institute of Medicine, Colombo 7, Sri Lanka; <sup>2</sup>Health Informatics Society of Sri Lanka, Colombo, Sri Lanka; <sup>3</sup>University of Tokyo, Tokyo, Japan

## Objective

To customize and pilot an open source public health information tool (DHIS2) for injury surveillance in a resource constrained setting, Sri Lanka.

## Introduction

Injuries are a major but neglected global public health problem. In the low- and middle-income countries (LMIC), the problem is particularly acute due to disproportionately high incidence of injuries. Most of these injuries are preventable with appropriate interventions. Lack of complete, accurate and timely injury data is one of the main obstacle for injury prevention in LMICs. In 2001, World Health Organization (WHO) published injury surveillance guidelines emphasizing the importance of injury surveillance at country levels to cope with this grave problem. Although most of the developed countries have developed their own injury surveillance systems, there is no customizable generic injury surveillance system which can be used in LMICs. However, *District Health Information System 2* (DHIS2) is a free and open source application used in many countries to collect aggregated public health data. Although it is being used for aggregated public health data it has not being used for injury surveillance.

## Methods

DHIS2 is mainly used for aggregated data and it has a tracker module still in the development. For injury surveillance the tracker module was used to create the data entry form in order to capture individual patient records. Then these records were aggregated to generate custom reports.

Data elements were created according to WHO injury surveillance guidelines and categorized according to the recommended data-sets. Data entry form was designed according to the end user requirements. Javascript was used to customize the data entry form and enhance user friendly layout. Some hard coding was done to further enhance the usability of the data entry form speeding up the data entry.

In Sri Lanka, injury data are collected on a paper based form and are subsequently entered into computer systems. In March and April 2013, we collected data from 654 patients with injuries admitted to a base-hospital which has a group of Nurses trained on (basic) injury surveillance.

## Results

We commenced the paper based data collection process at the time of admission and continued until the patient was disposed. Subsequently, the data were entered into the customized DHIS2 application. Out of 654 patients, 27% were injured due to road traffic crashes, 13% due to violence, and the other 60% due to unintentional causes.

Customized DHIS2 solution provided following features 1. comply with the changing data and process needs without a major retooling; flexible enough to capture new data items and reporting/care process as needed, 2. data validation, 3. handling missing information, 4. data backing-up, and 5. flexible report generation. By piloting in the

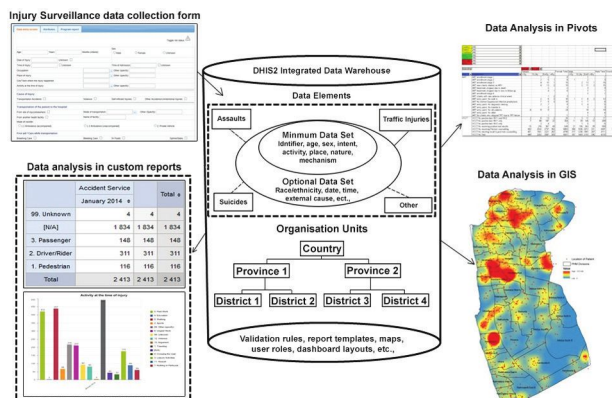
tertiary care setup, it was noted that an injury surveillance system has to have an effective mechanism to identify duplicates during the transfer process. Also, the time taken to reporting was an important consideration among the participating nurses.

## Conclusions

Our experience reveals that the open source public health information tool, DHIS2 has the potential to be customized for injury surveillance in resource constrained countries like Sri Lanka and it is a sustainable option for injury surveillance in such countries.

This study shows that the DHIS2 is a cost-effective solution for resource constrained contexts. Being an open source framework, it has a potential to be customized to different requirements/scenarios. The flexibility of the DHIS2 allowed system designers to accommodate any changes in the business process quickly in the system.

Human Computer Interaction should be a major concern in designing such a system since the information system (electronic reporting forms) may consume majority of the time taken in the reporting process.



## Keywords

Injury surveillance; DHIS2; trauma

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\*Achala U. Jayatilleke

E-mail: achala@pgim.cmb.ac.lk



# How to Effectively Validate an HL7 Syndromic Surveillance Interface

Jeffrey Johnson\*, Brit Colanter and Marjorie Richardson

Public Health Services, County of San Diego, San Diego, CA, USA

## Objective

This presentation highlights the necessary steps to effectively validate a Health Level 7 (HL7) syndromic surveillance interface during the onboarding and implementation process.

## Introduction

Current local, state, and national initiatives related to meaningful use and the modernization of electronic health records, and the growing availability of electronic information exchanges, have become important drivers to establishing syndromic surveillance systems. Effective implementation of electronic syndromic surveillance interfaces requires approaches that ensure the receipt of quality, timely, and reliable information.

While there are published specifications for the HL7 ADT message and National Institute of Standards and Technology (NIST) validation tools, there has been little documentation about the necessary steps for a local public health department to validate and confirm that an interface that is producing consistent and quality information. The lack of effective validation efforts has led to incomplete or inconsistent data utilized by syndromic systems and their intended audiences.

The County of San Diego has developed and utilized a framework for validating new syndromic interfaces. This presentation will highlight several pragmatic methods to validate the HL7 message content, provide specific examples of validation, and describe the pitfalls that could result from a poorly validated syndromic interface.

## Methods

Message content validation involves reviewing, configuring and achieving meaningful content within the HL7 syndromic surveillance messages. The content validation process is viewed across similarly linked messages tied to patient encounter workflows.

The method of validation involves several validation domains that are applied to the syndromic messages on a per hospital basis. These validation methods are:

- Higher complexity syndromic use case development,
- Validation of selective priority constraining and encoding,
- Message timeliness and time sequence validation,
- Validity of trace back data elements,
- Completeness and validity of priority message segments,
- Validation of organization location information,
- Validation of content useful for syndromic category mapping,
- Internal consistency of the message, and
- External parallel validation with hospital medical records or other external surveillance systems.

When applied, these methods are often the catalyst for message re-configurations. In turn, additional rounds of validation can be applied to ensure message changes meet criteria.

A set of syndromic message content validation guidelines have been developed to guide the validation work. These tools describe the corresponding steps to validation with criteria established to determine success or indicate improvements needed. In addition, a message content worksheet has been developed as a tool to track and document each data provider's validation activity and outcomes.

## Results

During onboarding for syndromic surveillance, the County of San Diego actively engaged with hospitals, their electronic health record (EHR) vendors, and a local health information exchange (HIE). Numerous best practices have been identified. Hospitals have different information workflows, usage of message types, and assignments of patient status. When assigning a patient treatment location, several different approaches are used across hospitals or by the EHR rules-based workflows. These differences also include differing classifications of inpatient and ambulatory related messages, message segment values, and the sequence of timeliness regarding the patient's syndromic message versus the patient's actual encounter experience.

## Conclusions

Public health agencies across the United States vary in their capacity to onboard meaningful use syndromic data. Public health agencies should not rely on EHR vendors alone or other system implementation surrogates to validate the quality of the syndromic information.

The County of San Diego has highlighted the importance and value in systematic validation of an HL7-based syndromic data source. Following these steps has led to optimized technical approaches to onboarding future hospitals, as well as insights into how the data can be used in a meaningful way. Preliminary outcomes have shown that it is valuable to have public health involved in the onboarding process and, more importantly, during the HL7 message content validation activities.

## Keywords

Syndromic; surveillance; validation; interface; meaningful use

## \*Jeffrey Johnson

E-mail: Jeffrey.Johnson@sdcounty.ca.gov





# SAVSNET: Collating Veterinary Electronic Health Records for Research and Surveillance

Philip H. Jones\*, Alan D Radford, Peter-John M Noble, Fernando Sánchez-Vizcaíno, Tarek Menacere, Bethaney Heayns, Susan Bolan, Maya Wardeh, Rosalind M Gaskell and Susan Dawson

University of Liverpool, Neston, United Kingdom

## Objective

SAVSNET—the Small Animal Veterinary Surveillance Network—collects and collates real-time data from veterinary diagnostic laboratories and veterinary practices across the UK to support research and disease surveillance in companion animals.

## Introduction

Statutory veterinary disease surveillance generally focuses on food animals with only minimal resources committed to companion animals. However, the close contact between owners and pets suggests that disease surveillance in these species could benefit both animal and human health.

Following a successful pilot, SAVSNET Ltd. was set up as a joint venture between the University of Liverpool (UoL) and the British Small Animal Veterinary Association (BSAVA) to deliver companion animal health data for research and surveillance. SAVSNET consists of two projects: the first collates results from commercial diagnostic laboratories whilst the second collects data from enrolled veterinary practices for consultations where owners have provided consent by opt-out. Both projects have been approved by the UoL's Research Ethics Committee and the aims are supported by the Royal College of Veterinary Surgeons (RCVS), the UK's regulatory body for the veterinary profession.

Applications to use the data are encouraged and are assessed by a panel consisting of BSAVA, UoL and independent members. Data access attracts a nominal fee that is used for long-term sustainability. Currently, SAVSNET data is being used for a wide range of projects by academic collaborators, PhD researchers, undergraduate students and commercial companies.

## Methods

The data collected from laboratories is provided in a variety of formats using different protocols. The supplied data is parsed using bespoke algorithms and stored in a common database. The data includes available animal signalment, postcode area of the submitting veterinary practice (121 areas in the UK), tests performed, results and the interpretation of those results.

The data from veterinary practices is collected in real-time directly from the consultation room. SAVSNET works closely with practice management software (PMS) providers so that, at the end of a consultation, the system displays a modal window that displays web-content retrieved from SAVSNET servers. The window requires that the veterinarian characterises the reason for the animal's presentation using a panel of simple buttons. In a small random sample of consultations (5–10%), additional questions are asked to further characterise the consultation. The data submitted to the database includes the syndrome code and questionnaire data, animal and practice identifiers, signalment, full owner's postcode (street level) and the free text entered by the veterinarian. In theory, this mechanism allows two-way communication directly into the consultation room although the full potential of this has not yet been explored.

In order to maintain interest in the project and ensure data quality, data providers—both laboratories and veterinary practices—receive summaries of the data they have provided through interactive, real-time web-based portals that display a range of statistics, tables, graphs and other graphics, relating to the data they have supplied. For veterinary practices, the portal displays such data in comparison to other anonymous practices.

## Results

The experiences of SAVSNET to-date indicate that commercial laboratories and veterinary practices are prepared to provide large volumes of data. Such collaboration is largely altruistic but is likely to be enhanced by SAVSNET's independence, the minimal effort required to contribute data and the benefits provided by the data portals. In addition, our experiences show that PMS providers are prepared to co-operate to modify their software to present a modal window at the end of a consultation to enable data to be collected in real-time.

## Conclusions

Collecting data from commercial laboratories and veterinary practices is feasible and provides an important data resource for research and surveillance. The model used by SAVSNET is well-tolerated by data-providers, is scalable and provides the potential for two-way communication into the consultation room. Many of the techniques and methods being used and developed could easily be cascaded to other veterinary fields.

## Keywords

Companion animals; Electronic health records; Surveillance; Informatics; Database

## Acknowledgments

The authors would like to thank: the BSAVA and the University of Liverpool for their continued support; all our data providers (laboratories and veterinary practices) for contributing to the project; and the PMS providers with whom we work to deliver SAVSNET compliance in their software.

\*Philip H. Jones

E-mail: p.h.jones@liverpool.ac.uk





# Motor Vehicle Crash (MVC) Case Definitions and How They Impact MVC Surveillance

Jennifer L. Jones\*, Dennis M. Falls, Clifton A. Barnett, Amy Ising and Anna E. Waller

University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

## Objective

Identify and describe how the case definition used to identify MVC patients can impact results when conducting MVC surveillance using ED data. We compare MVC patients identified using external cause of injury codes (E-codes), text searches of triage notes and chief complaint, or both criteria together.

## Introduction

In 2012, an estimated 2.5 million people presented to the ED for a MVC injury in the U.S.<sup>1</sup> National injury surveillance is commonly captured using E-codes.<sup>2</sup> However, use of E-codes alone to capture MVC-related ED visits may result in a different picture of MVC injuries compared to using text searches of triage or chief complaint notes.

## Methods

MVC-related ED visit data were obtained from the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) from one central county in NC for the year 2013. Data were categorized based on case definition used to identify the record as pertaining to an MVC. The three case definitions were: 1) MVC injuries identified using E-codes (E810-E825), 2) text searches for MVC-related key words in either the triage note or chief complaint field, and 3) MVC injuries identified using both text searches and E-codes. Demographic and descriptive characteristics included: sex, age, disposition, transport mode, payor source, visit time, and injury diagnosis (based on the Barell Injury Matrix<sup>3</sup>). Descriptive statistics were used to describe differences in patient characteristics based on the case definition used to identify MVC injury. Analyses were conducted using SAS Version 9.2 (Cary, NC) and Microsoft Excel 2007.

## Results

Most ED visits contained both MVC-text and MVC-related E-codes (n=13422, 76%). Another 4265 visits were identified by including the additional case definitions of text only (n=2139, 12%) or E-code only (n=2101, 12%). Patients identified using E-codes only were more likely to be male, arrive by ambulance, and admitted to the hospital compared to patients identified by text searches or both text and E-codes. Review of triage notes for those patients without E-codes suggests that patients identified with text searches are more likely to be presenting to the ED for late effects or chronic injuries from MVCs in the past.

## Conclusions

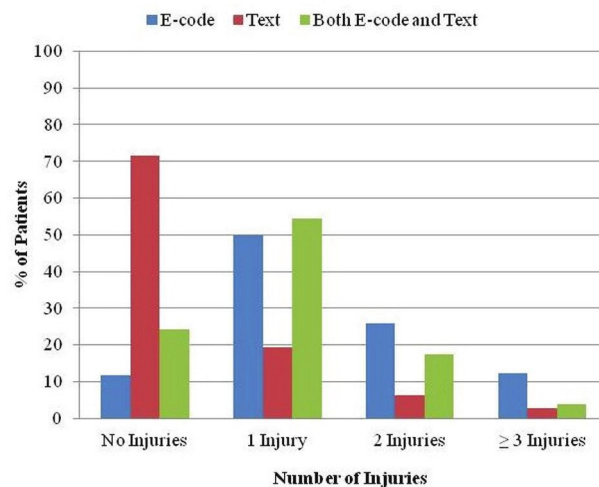
The choice of case definition used for MVC surveillance appears to impact the picture of MVC injury severity. When developing a research question or surveillance project, it is important that public health researchers are aware of the impact case definition has on their results.

Table 1: Comparison of 2013 MVC injuries presenting to the ED based on case definition, N (%)

Patient Characteristic	Case Definition			Total N=17662
	E-codes N=2101	Text Fields* N=2139	E-codes & Text N=13422	
<b>Sex</b>				
Male	1180 (56.2)	990 (46.3)	6000 (44.7)	8170 (46.3)
Female	921 (43.8)	1148 (53.7)	7422 (55.3)	9491 (53.7)
<b>Age</b>				
0-15	225 (10.7)	170 (7.9)	1411 (10.5)	1806 (10.2)
16-20	224 (10.7)	161 (7.5)	1528 (11.4)	1913 (10.8)
21-35	750 (35.7)	749 (35.0)	5034 (37.5)	6533 (37.0)
36-55	639 (30.4)	741 (34.6)	3997 (29.8)	5377 (30.4)
56+	263 (12.5)	318 (14.9)	1452 (10.8)	2033 (11.5)
<b>Disposition</b>				
Discharged home	1561 (75.7)	1713 (82.8)	12522 (94.7)	15796 (91.0)
Transferred to another unit	29 (1.4)	53 (2.6)	68 (0.5)	150 (0.9)
Left without being seen or against medical advice	15 (0.7)	136 (6.6)	229 (1.7)	380 (2.2)
Admitted	436 (21.1)	149 (7.2)	364 (2.8)	949 (5.5)
Other (including deaths)	22 (1.1)	19 (0.9)	37 (0.3)	78 (0.5)
Missing	38	69	202	309
<b>Transport Mode</b>				
Ambulance	375 (20.1)	144 (10.1)	1045 (9.4)	1564 (8.9)
Walk-in	859 (46.1)	905 (63.5)	5771 (51.9)	7535 (42.7)
Other	119 (6.4)	197 (13.8)	1527 (13.7)	1843 (10.4)
Unknown	510 (27.4)	180 (12.6)	2782 (25.0)	6720 (38.0)
<b>Payor Source</b>				
Private	672 (32.0)	631 (29.5)	4402 (32.8)	5705 (32.3)
Medicare	179 (8.5)	172 (8.0)	710 (5.3)	1061 (6.0)
Medicaid	332 (15.8)	250 (11.7)	1508 (11.2)	2090 (11.8)
Self-pay	800 (38.1)	914 (42.7)	6099 (45.4)	7813 (44.2)
Other <sup>b</sup>	102 (4.9)	114 (5.3)	622 (4.6)	838 (4.7)
Unknown	16 (0.8)	58 (2.7)	81 (0.6)	155 (0.9)
<b>Visit Time</b>				
0-5:59	221 (10.5)	147 (6.9)	822 (6.1)	1190 (6.7)
6:00-11:59	473 (22.5)	532 (24.9)	2939 (21.9)	3944 (22.3)
12:00-17:59	810 (38.6)	849 (39.7)	5137 (38.3)	6796 (38.5)
18:00-23:59	597 (28.4)	611 (28.6)	4524 (33.7)	5732 (32.5)

\*Text used in search: MVC, MVTA, MVTC, MVA, MVCA, MCTC, MCTA, MCC, MCA, m otor vehicle, m otorcycle, car accident, m otorcycle accident, car crash, m otorcycle crash, car wreck, m otorcycle wreck, pedestrian, auto accident, autom obile accident, autom obile roll, moped  
<sup>b</sup>Other includes: Workers' comp and other government payments

## Barell Injury Diagnoses Among MVC-related ED Visits



## Keywords

MVC Injury; surveillance; ED visit data

### Acknowledgments

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\*Jennifer L. Jones

E-mail: [jjones86@live.unc.edu](mailto:jjones86@live.unc.edu)



# Creating a Universal Data Release Policy Across Programs in a State Health Department

**Ekaette Joseph-Isang\***

Kentucky Department for Public Health, Frankfort, KY, USA

## Objective

To describe the process of producing a universal data release policy for use by different programs in a state health department

## Introduction

The introduction of electronic health systems has led to easier collation, compilation, and analysis of data as well as easier access. For data to be put to be impactful use, it must be shared both for research and decision making purposes. Data sharing and release should neither compromise privacy nor lead to wrong conclusions. The need to share information that guides policies and decision making should be balanced with the need for the data to be reliable. The aim was to produce a data release policy to be used as a baseline tool to guide the practice of data release and sharing across programs and with outside requesters.

## Methods

Data release policies take into consideration different parameters as determined by the sponsoring organization. Data release policies were collected from different programs within and outside the state department of health. Spreadsheets and cohort brainstorming session were employed. Parameters, suppression rules and cautionary release rules were tabulated and analyzed on spreadsheets to compare similarities and differences. A data release work group was constituted. Preliminary findings showed that most data release policies were based on a variety of parameters. Most used a combination of parameters

Parameters included the total population, number of count, relative standard errors, confidence intervals and in some cases geographical areas. Program areas were consulted with regard their preferred parameters.

Program policies were also compared with those available on national data sites e.g. NCHS and CDC wonder. Survey data and data from counts were treated using different parameters with the aim of preserving confidentiality and endure reliability. Based on the most frequent data requests, parameters that guaranteed confidentiality and reliability were agreed upon by the work group. This report outlines the process for creating a universally acceptable data release policy for the state health department and the advantages and disadvantages of using certain parameters.

## Results

A universal data release policy acceptable to different programs was produced with allowances for tightening the protocol where specific programs required more stringent data release policies.

## Conclusions

Data release policies make for ease of handling data requests. There is no one size fits all. Having a data release policy allows program managers to have a reference point for evaluating data requests. A data release algorithm provides an easily comprehensible visual tool. Programs can be more stringent as their program peculiarities dictate but the data release policy serves as the minimum necessary to guide the process.

## Keywords

data release; data sharing; state health department; data policy; data sharing agreement

## \*Ekaette Joseph-Isang

E-mail: ejosephisang@gmail.com



# Syndromic Surveillance of Emergency Department Visits for the 2015 Special Olympics

Emily Kajita\*, Monica Z. Luarca, Choiyuk Chiang, Han Wu and Bessie Hwang

Los Angeles County Department of Public Health, Los Angeles, CA, USA

## Objective

To describe how syndromic surveillance was used to monitor health outcomes in near real-time during the 2015 Special Olympics in Los Angeles County (LAC), California.

## Introduction

LAC hosted the 2015 Special Olympics (SO) which welcomed approximately 6,500 athletes from 165 countries, as well as 30,000 volunteers and 500,000 spectators from July 25 to August 2, 2015. International athletes were not required to show proof of vaccinations and were housed in dormitories for nine days, creating potential for infectious disease outbreaks. In response to these unique public health challenges, we describe how LAC's syndromic surveillance system (SSS), which captures over 65% of all Emergency Department (ED) visits, was used to detect potential emerging health events congruent with SO games and pre-game events.

## Methods

The SSS team queried ED visit databases for key terms within chief complaint, triage notes and diagnosis fields during the surveillance period of July 20 to August 7, 2015. In addition to monitoring events of particular interest in the SO setting such as Category A bioterrorism agents, meningitis and measles, one additional query was created to identify SO attendees. In order to increase response rates, we requested that ED staff proactively tag within an SO attendee's chief complaint record the phrase "Special Olympics." Upon request, we worked with hospital staff to pinpoint where in the ED registration software keywords could be entered for capture within the syndromic feed. Line lists were reviewed daily.

For syndromes with common or multifactorial symptoms such as gastrointestinal, rash, neurological, respiratory, heat, syncope and seizure, we performed 120 day trend analyses. We focused the analyses geographically by determining the EDs that served the most patients in the five regions where dormitories and competition venues were located. We calculated signal thresholds using modified cumulative sum algorithms.

All surveillance results were created using SAS and summarized in a customized SO syndromic surveillance report generated in Microsoft Word, consisting of manually reported short synopses of case detection results as well as graphs and signal summary tables that automatically updated as source files were output by SAS.

## Results

The SO syndromic surveillance report was created daily for a three week time period (one week before, during and after the SO). No ED visits due to measles or Category A bioterrorism agents were detected during the surveillance period. There were 37 visits with mention of meningitis, however they were unrelated to the SO.

Four hospitals were able to provide screenshots and test patient validation, from which 16 SO labeled ED patients were detected. Of these, two had symptoms consistent with possible gastrointestinal illness, and the rest had physical injury or symptoms such as syncope, seizure and chest pain with nonspecific causes.

Of syndromes that we monitored for regional trends, there were cumulatively eleven signals over three regions. None were sustained

for over one day, and counts were close to thresholds and comparable to intermittent peaks in the past 120 days.

## Conclusions

Although the SSS did not detect increases in any syndromes routinely monitored nor in overall ED visits per hospital during the surveillance period, the customized report was a useful tool for summarizing surveillance results for multi-day special events.

Relatively low response rates for SO tagged ED visits may be explained by patients visiting non-syndromic participating EDs, or athletes receiving medical care through SO organized poly clinics and medical stations. Hospitals may also have had experienced barriers to tagging ED records such as the lack of free text based chief complaint data fields or not having enough implementation time in the approximately two weeks given. Others may have tagged patient records but used data fields not captured by the syndromic feed. In the future, we would select fewer but strategically important hospitals to enable more time with each ED to determine eligibility, validate test patients and provide instruction specific to their systems. In the case of the SO, this would have meant soliciting only hospitals closest to the competition venues and dormitories. Although time consuming to implement, proactive tagging of keywords will increase the capture of data specific to special event monitoring.

## Keywords

emergency department; mass gathering; case detection; trend analysis

## Acknowledgments

Many thanks to ACDC's Hospital Outreach Unit nurses for their assistance with hospital outreach in this project and beyond.

## \*Emily Kajita

E-mail: ekajita@ph.lacounty.gov



# Washington's Methods for Analytics Interoperability and Metrics (AIM), Approaches to Data Integration and Dissemination in Population Health

Bryant Thomas Karras\*<sup>1</sup>, Ali H. Mokdad<sup>2</sup>, Adam Aaseby<sup>3</sup> and William Lober<sup>2</sup>

<sup>1</sup>Informatics Office, WA State, Dept Of Health, Shoreline., WA, USA; <sup>2</sup>University of Washington, North West Center for Public Health Practice, Seattle, WA, USA; <sup>3</sup>Washington State Health Care Authority, Olympia, WA, USA

## Objective

Washington is leading the way in especially novel approaches. Our goal is to share some of these innovative methods and discuss how these are used in State and Local monitoring of Health

## Introduction

This year's conference theme is "Harnessing Data to Advance Health Equity" – and Washington State researchers and practitioners at the university, state, and local levels are leading the way in especially novel approaches to visualize health inequity and the effective translation of evidence into surveillance practice.

## Description

The Panel will engage in a discussion on how the methodologies and data analytic approaches will be utilized in the surveillance and Healthcare transformation activities in Washington State.

The discussion will include best practice to combine different data sources to provide a better picture of health at the local level. Local health departments need local data to base their policies and programs on and to monitor the impact of their effort. Currently, there are several projects in Washington State and King County to produce burden estimates at the census tract level. We will show some of the early results and share lessons learned so far.

Approaches at the UW including methods of gathering information from EHRs via HIE for population health issues such as healthy weight (BMI) work done with CDC and some work with developmental screening/early intervention and hearing screening standards as outlined by Integrating the Healthcare Enterprise (IHE) Quality, Research and Public Health Committee –with analysis of the problem and an architectural model

## Audience Engagement

Ali Mokdad (University of Washington) will share information about the Institute for Health Metrics and Evaluation (IHME),

Ian Painter (University of Washington) will share research from the North West Center for Public Health Practice (NWCPHP),

Adam Aaseby, (Washington State Health Care Authority(HCA)), will share progress on collaborations with DOH and IHME on the Assessment, Interoperability and Measurement (AIM) Initiative, to support the Healthier Washington initiative,

Bryant thomas Karras (Washington State Department of Health (DOH)) will share development and planning around the Informatics Interoperability Roadmap and several data visualization and mapping activities.

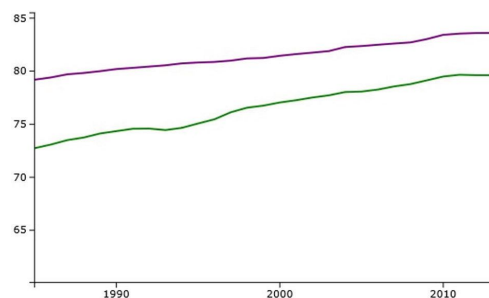


Figure 1: Male and Female life expectancy for King county WA

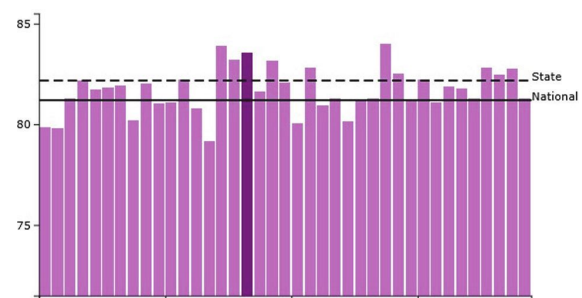


Figure 2 Female life expectancy for WA counties in 2013

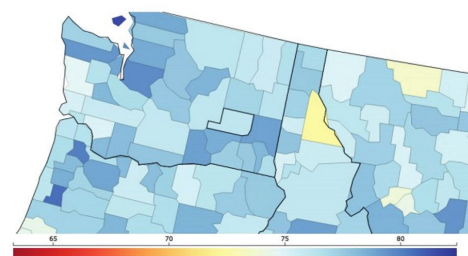


Figure 3 Male Life Expectancy 2013

## Keywords

Population Health; Big Data Analytics; Visualization; Informatics; Health Disparity

## Acknowledgments

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## \*Bryant Thomas Karras

E-mail: bryant.karras@doh.wa.gov



# Electronic Surveillance for Injury Prevention Using a Physician-Operated System

Amir Kimia<sup>1,2</sup>, Assaf Landschaft<sup>3</sup>, Maria Jorina<sup>1</sup>, Lois Lee<sup>1,2</sup> and AI Ozonoff<sup>1,2</sup>

<sup>1</sup>Boston Children's Hospital, Boston, MA, USA; <sup>2</sup>Harvard Medical School, Boston, MA, USA; <sup>3</sup>Harvard Extension School, Cambridge, MA, USA

## Objective

- Describe injury-related surveillance using clinical narratives within electronic health records
- Present a user friendly, physician transferrable operated natural language processing (NLP) module, which can identify injury related events from electronic health record narratives
- Present a variety of use cases and results

## Introduction

When hazardous materials or products emerge in the market, injury prevention researchers take action to promote awareness and legislation with the goal to prevent further injuries. This cannot be achieved without reliable data on trends and outcomes identifying large cohorts with the injury of interest. Lags in providing such data will delay knowledge sharing to prevent avoidable and potentially fatal injuries.

Glass tables and earth magnets are two examples of consumer products with potential for significant injuries, particularly to children. Magnet toys caused a large number of injuries with associated morbidity and mortality. For months there were no available data to support policy or prevention initiatives. Similarly, certain disease and injury mechanisms such as penetrating oral trauma are not included as structured data and cannot be collected using ICD-9/ICD-10 codes. Data on these types of injury mechanisms exist exclusively within the clinical narrative.

## Methods

Central to our methodological approach is the belief that those people creating the data (i.e. physicians) are the best people to guide and direct surveillance from clinical narrative. We created a case identification software module which we named "Dr. T" (Document Reviewing Tool).

The module uses a combination of two NLP methods: Regular expressions<sup>1,2</sup> (RegEx) and bag of words classifier<sup>3</sup>. The module uses a RegEx wizard accessible to researchers through innovative user interface elements, to generate strings to match in the EMR text. Cases identified using RegEx do not suffer the usual shortcomings associated with ICD-9 code based systems. We use these cases to form powerful training and validation sets for a bag of words classifier. We train the classifier and assess its performance on the validation set. Finally, the classifier is applied to unclassified data, which then presents the results to the user/reviewer.

## Results

Physicians of different levels and computer user skills have used the system. Training time on the module has ranged from 1-4 hours with residents, fellows, and young faculty trained within less than an hour. Administrator support (mini help-desk) ranges from 1-5 hours per project. Table 1 presents selected projects and their impact.

## Conclusions

Although only used at a single center thus far, we have demonstrated feasibility of NLP based surveillance used by clinicians for injury prevention, research, and advocacy. Our findings have been

well-received by the medical literature and have made an impact on pediatric safety. NLP-based modules can make surveillance applications from the narrative form available to clinicians who otherwise would not use NLP. Our methods are open source and scalable, and dissemination of this concept answers the call for timely data in the field of injury prevention.

Table 1: Publications; Time to Complete

Injury Hazards	
Magnet related injuries increase <sup>4</sup>	Agbo et al. 4 weeks
Glass table injuries <sup>5</sup>	Kimia et al. 3 months
Christmas ornaments injuries <sup>6</sup>	Kimia, et al. 9 months
Glass thermometer injuries <sup>7</sup>	Aprahamian et al. 7 months
Injury mechanism	
Penetrating palate injury <sup>8</sup>	Hennelly et al. 1 year

## Keywords

Injury surveillance; Natural language processing; Case identification; Software; Pediatric injury prevention

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E-mail:



## Surveillance for Lyme Disease in Canada, 2009-2012

Jules Koffi<sup>\*1</sup>, Robbin Lindsay<sup>3</sup> and Nicholas Ogden<sup>2</sup>

<sup>1</sup>Centre for Food-Borne, Environmental and Zoonotic Infectious Diseases, Public Health Agency of Canada, Saint-Hyacinthe, QC, Canada; <sup>2</sup>National Microbiology Laboratory, Public Health Agency of Canada, Saint-Hyacinthe, QC, Canada; <sup>3</sup>National Microbiology Laboratory, Public Health Agency of Canada, Winnipeg, MB, Canada

### Objective

To summarize the first 4 years (2009-2012) of national surveillance for LD in Canada and to conduct a preliminary comparison of presenting clinical manifestations in Canada and the United-States.

### Introduction

LD, caused by *Borrelia burgdorferi* in North America is transmitted to humans from wild animal reservoir hosts by *Ixodes* spp. ticks<sup>1</sup> in their woodland habitats<sup>2</sup>. LD risk in Canada occurs where tick vectors are established in southern British Columbia (*I. pacificus*) and in southern parts of central and eastern Canada where *I. scapularis* is spreading from the United States (US)<sup>3</sup>. LD became nationally notifiable in Canada in 2009 and demographic data on human cases is submitted by provinces to Canadian Notifiable Disease Surveillance System of the Public Health Agency of Canada (PHAC). A Lyme Disease Enhanced Surveillance system was initiated by PHAC in 2010 to obtain more detailed data on LD cases. These surveillance systems aim to identify changing trends in LD incidence, the population at risk and the types of clinical disease in Canada.

Surveillance data for 2009-2012 are analyzed to describe the early patterns of LD emergence in Canada. Patterns of LD cases (age, season of acquisition and presenting manifestations) were compared against those reported in the US.

### Methods

The numbers and incidence of reported cases by province, month, year and sex were calculated. Logistic regression was used to examine trends over time. Acquisition locations were mapped and presenting clinical manifestations reported for jurisdictions where data was available. Variations by province, year, age and sex as well as presenting clinical symptoms were explored by logistic regression. An initial comparative analysis was made of presenting symptoms in Canada and the US.

### Results

The numbers of reported cases rose significantly from 144 in 2009 to 338 in 2012 (coefficient = 0.34, standard error = 0.07,  $P < 0.05$ ), mostly due to an increased incidence of infections acquired in Canada. Most cases occurred in locations where vector tick populations were known to be present. Incidence was highest in adults aged 55 to 74 years and in children aged 5 to 14 years. Most cases (95%) were acquired from April to November. Of cases acquired in endemic areas, 39.7% had manifestations of early LD, while 60.3% had manifestations of disseminated LD. The proportion of cases acquired in endemic areas presenting with early LD was lower than that reported in the US.

### Conclusions

LD incidence is increasing in Canada. Most cases are acquired where vector tick populations are spreading and this varies geographically within and among provinces. The lower proportion of cases presenting with early LD in Canada compared with the US suggests lower awareness of early LD in Canada, but this requires further study.

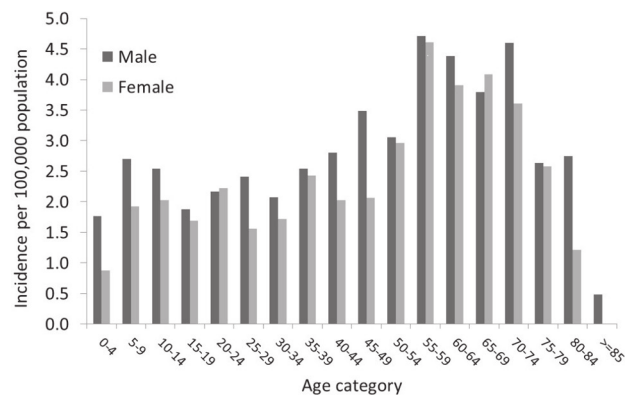


Figure: The incidence of reported LD cases per 100,000 population during 2009-2012 by age and sex.

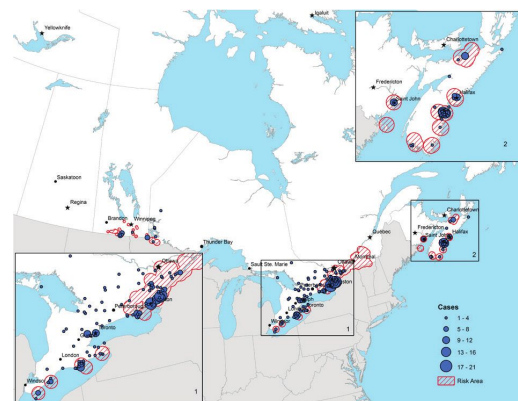


Figure: The reported location of acquisition of LD cases acquired in Canada from 2009-2012

### Keywords

Lyme disease; Surveillance; tick-borne disease

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\*Jules Koffi

E-mail: jules.konan.koffi@phac-aspc.gc.ca



# Resolving Disconnected Patient Records to Support Patient Care and Population Health

Jacob Krive<sup>2, 3, 4</sup>, Annamarie Hendrickx<sup>\*1</sup> and Terri Godar<sup>1</sup>

<sup>1</sup>Advocate Health Care, Rolling Meadows, IL, USA; <sup>2</sup>Valence Health, Chicago, IL, USA; <sup>3</sup>University of Illinois at Chicago, Chicago, IL, USA; <sup>4</sup>Nova Southeastern University, Fort Lauderdale, FL, USA

## Introduction

Population health relies on tracking patients through a continuum of care with data from disparate sources. An assumption is made that all records of a patient from all the sources are connected<sup>1</sup>. As was realized during the process of operationalizing algorithms for population health, not all patient records are connected<sup>2</sup>. Disconnected records negatively impact results: from individual patient care management through population health's predictive analytics<sup>3,4</sup>. An enterprise master patient index (EMPI) system can be employed to connect a patient's records across disparate systems<sup>5</sup>, but it requires comprehensive tuning to maximize the number of connected records. This presentation describes how one large healthcare integrated delivery network tuned their EMPI system to maximize the number of connected patient records across all sources.

## Methods

Several methods were employed to reduce the number of disconnected records. The 5 sources containing the most disconnected records were chosen from the 32 sources of data in the system that represented 10.5 million records. Retention rules were developed for removing records from the EMPI database that did not meet the criteria for retention and those records were removed. Using sampled data, the weighting factors applied to the data elements used to determine a score to allow the EMPI system to link records together (autolink), and the score at which an autolink occurs were reconfigured to allow the EMPI system to link more records. The matching algorithm was enhanced for combining the patient records into a single entity for sources that were sending a high rate of duplicate patient records with differing patient IDs and identical demographics. A cross-matching function was executed to force the re-evaluation of all the linkages between all the records within the EMPI database. The Data Stewardship Team used the Delphi method to determine false positive and false negative rates.

## Results

The number of disconnected records was reduced by 99.8% (Tables 1, 2, 3).

## Conclusions

An IDN can employ several tactics to address unmatched patient records across multiple sources without manually reviewing all patient records for possible matches. This project represented the first pass of data standardization and reconciliation. During project execution, additional data quality issues were discovered. This led to a number of follow-on interventions, such as the development of a new source onboarding policy, development of a go-live data validation checklist, inclusion of third party software to validate addresses, and developing guidelines for reducing data errors and the number of duplicate patient records sent to the EMPI system at patient intake.

Table 1. EMPI Drop Records Statistics

Advocate Source of Information	Records Original	Records Dropped	Records Reloaded Back Into EMPI System	Records Remaining Per Source	Number of Disconnected Records Before Drop	Number of Disconnected Records After Drop
Source 1	1,899,469	1,899,469	267,645	267,645	3,277,289	2,048,322
Source 2	122,519	122,519	-	0	2,048,322	2,035,808
Source 3	283,259	22,678	-	260,581	1,982,819	1,979,287
Source 4	233,058	94,444	-	138,614	1,979,287	1,973,809
Source 5	2,045,208	662,731	-	1,382,477	1,920,652	1,859,692
Total	4,583,513	2,801,841	267,645	2,049,317		

Table 2. EMPI Cross-Match Statistics

Source	Number of Disconnected Records Before Cross-Match	Number of Disconnected Records After Cross-Match
All Sources	1,859,692	396,569

Table 3. EMPI Final Statistics

Source	Starting Number of Disconnected Records	Ending Number of Disconnected Records	Percent Reduction
All Sources	3,277,289	396,569	99.8%

## Keywords

Enterprise Master Patient Index; Patient Data Linkage; Data Governance

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## \*Annamarie Hendrickx

E-mail: annamarie.hendrickx@advocatehealth.com



# Evaluating Syndromic Surveillance Systems

Iain Lake<sup>1</sup>, Felipe J. Colón-González<sup>\*1</sup>, Roger Morbey<sup>2</sup>, Alex J. Elliot<sup>2</sup>, Gillian E. Smith<sup>2</sup>  
and Richard Pebody<sup>3</sup>

<sup>1</sup>School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom; <sup>2</sup>Public Health England, Birmingham, United Kingdom; <sup>3</sup>Public Health England, London, United Kingdom

## Objective

To devise a methodology for evaluating the effectiveness of syndromic surveillance systems

## Introduction

While results from syndromic surveillance systems are commonly presented in the literature, few systems appear to have been thoroughly evaluated to examine which events can and cannot be detected, the time to detection and the efficacy of different syndromic surveillance data streams. Such an evaluation framework is presented.

## Methods

A number of possible public health scenarios were identified (e.g. outbreak of pandemic influenza, *Cryptosporidium* outbreak and deliberate anthrax release) and deterministic compartmental models were used to simulate the number of disease cases generated for a range of severities. Data were used from four national syndromic surveillance systems (a non-emergency medical number, emergency department records, and information from family doctor in and out of hours consultations) coordinated by Public Health England. For each of these four surveillance systems, simulation data were estimated based upon transmission models. Such simulation data were superimposed onto baseline syndromic surveillance data to create a test dataset. Random noise was added to these test data to represent expected variability. Existing statistical detection algorithms currently used for near-real time syndromic surveillance were used to evaluate these simulations. For each scenario, timeliness was assessed as the number of days between the start of the simulation and extra activity being detected by syndromic surveillance. Timeliness was assessed for a range of disease severities. The efficacy of different syndromic data streams and reported syndromes was assessed.

## Results

An evaluation methodology was developed enabling the thorough evaluation of syndromic surveillance systems. Using the system developed for England this indicated that for an outbreak of pandemic influenza (AH1N1) a national family doctor-based syndromic system would be the first to detect such an event. Specific times to detection will be reported as well as results from *Cryptosporidium* outbreaks and anthrax events. The outputs are sensitive to changes in parametrization of the compartmental model and the proportion of people reporting to each data stream.

## Conclusions

We have developed an effective methodology for the systematic evaluation of syndromic surveillance systems in terms of their ability to detect events and their timeliness to detection. We argue that this methodology can be widely adopted to provide more empirical analysis of the effectiveness of syndromic surveillance systems worldwide.

## Keywords

Syndromic Surveillance; Evaluation; Detection

## Acknowledgments

We acknowledge support from Royal College of Emergency Medicine, EDs participating in the emergency department system (EDSSS), Ascribe Ltd and L2S2 Ltd; OOH providers submitting data to the GPOOHSS and Advanced Health & Care; TPP and participating SystemOne practices and University of Nottingham, ClinRisk, EMIS and EMIS practices submitting data to the QSurveillance database; and NHS 111 and HSCIC for assistance and support in providing anonymised call data that underpin the Remote Health Advice Syndromic Surveillance System. We thank the PHE Real-time Syndromic Surveillance Team for technical expertise. The authors received support from the National Institute for Health Research Health Protection Research Unit in Emergency Preparedness and Response. The views expressed in this abstract are those of the authors and not necessarily those of the NHS, the NIHR, the Department of Health or Public Health England

**\*Felipe J. Colón-González**

E-mail: f.colon@uea.ac.uk





# Three Years of Population-Based Cancer Registration in Kumasi: Providing Evidence for Population-Based Cancer Surveillance in Ghana

Dennis O. Laryea<sup>\*1, 2</sup>, Fred K. Awittor<sup>2</sup>, Cobbold Sonia<sup>2</sup> and Kwame O. Boadu<sup>3</sup>

<sup>1</sup>Public Health Unit, Komfo Anokye Teaching Hospital, Kumasi, Ghana; <sup>2</sup>Kumasi Cancer Registry, Kumasi, Ghana; <sup>3</sup>Kumasi South Regional Hospital, Kumasi, Ghana

## Objective

To describe the operations and review data from the Kumasi Cancer Registry for the period 2012 to 2014

## Introduction

Cancer Registration is the systematic collection of data on cancers and the use of such information for action. Population-based cancer registration is not common practice in developing countries. Ghana has had no population-based cancer registry till 2012 when the Kumasi Cancer Registry was established. Established initially as a hospital-based cancer registry, the KsCR has made significant strides in the collection and analysis of data on cancers in Kumasi. We describe the operations of the registry and provide information on data analysis from information collected by the registry for the three year period 2012 to 2014.

## Methods

Data from the Kumasi Cancer Registry for the years 2012, 2013 and 2014 was reviewed. The reference population for the registry is the city of Kumasi as designated by the 2010 Ghana Population and Housing Census. The registry collects data on cancers seen at the clinical departments of the Kumasi South Regional, Manhyia District, Tafo Government, Suntreso Government and the Komfo Anokye Teaching Hospitals. The Pathology and Haematology laboratories of KATH were also sources of data as was the Kumasi Birth and Deaths Registry. Demographic, clinical and laboratory data was abstracted from the folders of all identified cases of cancers. Cancer sites were coded using the International Classification of Diseases for Oncology (ICD-O) 3rd Edition and entered into processed electronically using Canreg 5 software. Data analysis involved the use of Canreg 5 and Epi Info Version 7.1.4.

## Results

A total of 1,078 cases of cancer were recorded among residents of Kumasi over the three year period. The majority of cases were among females (64.2%). The mean age at incidence in males was 50.4 years and that for females 51.2 years. Breast (35.1%), Cervix (23.7%), Ovary (7.9%), Liver (3.8%) and Endometrium (3.2%) were the top five cancers among females. Among males, the commonest cancers were Liver (21.8%), Prostate (17.9%), Stomach (4.1%), Lung (3.4%) and Bone marrow (2.9%). Out of the total cases recorded, 54 (5%) were in children 14 years and below. Bone marrow (18.52%), Kidney (14.8%), Abdomen (9.3%), Head, face or neck (9.3%) and Retina (7.4%) were the common cancers in children. The majority of the diagnoses were based on the histology of primary site (58.7%), clinical diagnosis (19.2%) death certificates (11.5%), Clinical investigation (8.3%) and cytology or haematology (1.7%).

## Conclusions

Population-based cancer surveillance targeting a properly defined geographic area provides better opportunity for good quality data on cancers in Ghana. This three year data from Kumasi provides evidence to support this. There is the need to establish more such

registries to improve data quality for planning cancer prevention and control programmes in Ghana.

## Keywords

Cancer registration; surveillance; Ghana

## Acknowledgments

All staff of the Public Health Unit and the Oncology Department of the Komfo Anokye Teaching Hospital. We wish to also acknowledge the support of Health Information officers of the Kumasi South, Manhyia, Suntreso, Tafo and MCH Hospitals in Kumasi

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**\*Dennis O. Laryea**

E-mail: denola@live.com





# Impact of Interventions on Influenza A(H7N9) Virus Activity in Live Poultry Markets

Eric H.Y. Lau<sup>\*1</sup>, Jun Yuan<sup>2</sup>, Kuibiao Li<sup>2</sup>, Connie Leung<sup>3</sup>, Zhicong Yang<sup>2</sup>, Caojun Xie<sup>2</sup>, Yufei Liu<sup>2</sup>, Biao Di<sup>2</sup>, Benjamin Cowling<sup>1</sup>, Xiaoping Tang<sup>4</sup>, Gabriel Leung<sup>1</sup>, Malik Peiris<sup>1</sup> and Ming Wang<sup>2</sup>

<sup>1</sup>School of Public Health, University of Hong Kong, Hong Kong, China; <sup>2</sup>Guangzhou Center for Disease Control and Prevention, Guangzhou, China; <sup>3</sup>Laboratory Animal Unit, University of Hong Kong, Hong Kong, China; <sup>4</sup>The Eight People's Hospital of Guangzhou, Guangzhou, China

## Objective

This study assessed the effect of disinfection and closing live poultry markets in China on avian influenza A(H7N9) virus detection and viability in a natural setting. We characterized virus detection at different sampling sites to assess exposure risk to the general public and live poultry traders.

## Introduction

H7N9 virus emerged in Eastern China in March 2013, which led to >550 human cases and >200 deaths in 2 years. Live poultry markets (LPMs) are considered as a major source of human H7N9 infections. In late 2013, the virus had spread to the southern provinces including Guangdong. Its provincial capital Guangzhou, detected its first local H7N9 human case in mid-January 2014 and reaching 10 cases in a month. As a response, Guangzhou government announced a two-week city-wide market closure, banning trading and storing of live poultry. Guangzhou Center for Disease Control and Prevention took this opportunity to establish enhanced surveillance on top of the existing routine LPM surveillance, to assess the impact of such on H7N9 viral isolation and survival.

## Methods

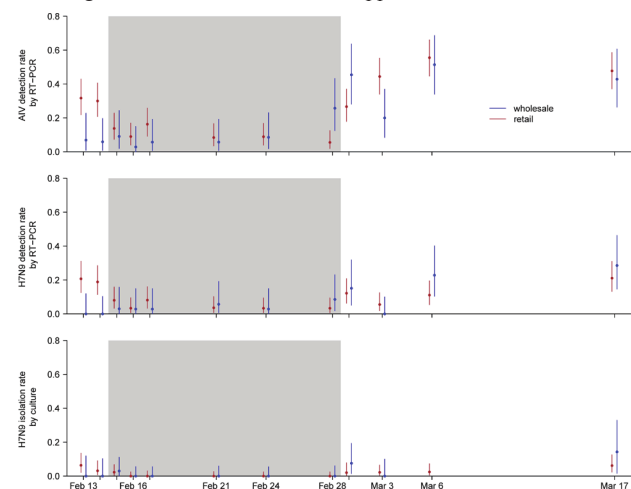
We analyzed environmental samples in routine surveillance from 4 retail LPMs collected on the same day immediately before and after disinfection. To further assess the impact of market closure and disinfection on virus activity, enhanced surveillance with 12 rounds of intensive sampling were carried out before, during and after the 2-week city-wide LPM closure, in 3 retail and 1 wholesale LPMs. Samples were collected from different sites, including poultry cages, drinking water for chicken, inner surface of defeathering machines, barrels holding poultry meat, chopping boards, surfaces of processing tables and wastewater. Samples were tested for AIVs by rRT-PCR and also H7N9 by culture.

## Results

Based on the 214 environmental samples collected from the routine surveillance, the pooled estimated reduction ratios were 58.0% (95% CI 8.9% – 80.6%) and 64.2% (95% CI 30.6% – 81.5%) for H7N9 and AIV respectively after disinfection. A total of 1466 environmental samples were collected from the targeted enhanced LPM sites. The figure shows the AIV and H7N9 detection and isolation rates before, during and after the market closure (period shaded in gray). We also found a higher H7N9 virus detection in chopping boards in retail LPMs and wastewater in wholesale LPMs. During the market closure, H7N9 viral RNA detection and isolation rates in retail markets decreased by 79% (95% CI, 64% – 88%) and 92% (95% CI, 58% – 98%), respectively. Viable H7N9 virus could be cultured from wastewater samples collected up to 2 days after market closure. Our findings indicate that poultry workers and the general population are constantly exposed to H7N9 virus at these markets and that market closure and disinfection rapidly reduces the amount of viable virus.

## Conclusions

Market closure and disinfection reduced H7N9 viral RNA contamination in the LPM environment by >70% and infectious virus by >90%. However, live virus could be detected for around 2 days after the intervention, especially in wastewater sources. To strike the balance between minimizing human infection risk, demands of live poultry from the general public and interest of the poultry industry, coordination between the public health and veterinary sector should be strengthened under a “one-health” approach.



## Keywords

avian influenza; influenza A(H7N9); live poultry markets; surveillance; disinfection

## Acknowledgments

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## \*Eric H.Y. Lau

E-mail: ehylau@hku.hk



# Using Health-Seeking Pattern to Estimate Disease Burden from Sentinel Surveillance

Eric H.Y. Lau\*, Qiqi Zhang, Kin On Kwok, Irene O. Wong, Dennis K. Ip and Benjamin J. Cowling

School of Public Health, University of Hong Kong, Hong Kong, China

## Objective

This study described health-seeking behavior of the general population specific to different symptoms, at different times of the year. This information allows the estimation of population disease burden over the year using sentinel surveillance data. We will use influenza-like illness (ILI) as an example.

## Introduction

The general health-seeking behavior has been well described in different populations. However, how different symptoms have driven health-seeking behavior was less explored. From the patient's perspective, health-seeking behavior tends to be responsive to discomfort or symptoms rather than the type of diseases which is unknown before medical consultation, hence symptom-specific behavior may more realistically reflect responses from the public which is subsequently captured by syndromic surveillance.

In Hong Kong, sentinel surveillance of common diseases, such as ILI and acute diarrhoeal diseases, consists of general practitioners (GP), general outpatient clinics (GOPC) and Chinese medicine practitioners (CMP). These existing sources of syndromic surveillance data are affected by the choice of health services and health seeking behavior and hence may over- or under-represent actual disease burden. By understanding health-seeking behavior at different times of the year, we could estimate the disease burden in the population, and population subgroup from multiple surveillance data.

## Methods

We conducted 4 rounds of longitudinal randomized telephone surveys over 1.5 year, to describe symptom-specific health-seeking behavior at times with different level of disease activity (Figure 1). We collected information if healthcare service was being sought for and types of medical consultation after onset of different symptoms. The information were further utilized to estimate the ILI burden in specific age groups, by the following relation:

$$\begin{aligned} k_1 s_1 &= c_{11} N_1 + c_{12} N_2 + c_{13} N_3 \\ k_2 s_2 &= c_{21} N_1 + c_{22} N_2 + c_{23} N_3 \\ k_3 s_3 &= c_{31} N_1 + c_{32} N_2 + c_{33} N_3 \end{aligned}$$

where  $s_i$ ,  $k_i$ ,  $c_{ij}$  and  $N_i$  represent ILI consultation rates from sentinel surveillance of health service type  $i$ , scaling factor from surveillance data to the population with ILI seeking health service type  $i$ , likelihood of consultation to health service type  $i$  for age group  $j$  with ILI, and the population size of age group  $j$  with ILI. From the longitudinal survey, we obtained estimates for  $c_{ij}$  and  $k_i$  during the survey period. Using the surveillance data from GP, GOPC and CMP, we obtained estimates  $N_i$  by solving the above relations.

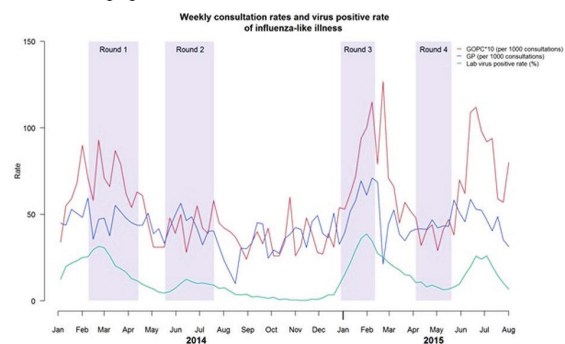
## Results

Fever is the symptom most likely to prompt people to seek medical attention. We further focused on ILI, defined as fever  $\geq 37.8$  plus either cough or sore throat. There were 111 episodes of ILI in the study period. Of which, 85.6%, 6.3% and 18.9% visits GP, GOPC and CMP respectively (some have sought for multiple health service types), while 9% did not seek for any medical attention. Based on the relation in the Methods, we estimated the weekly age-specific ILI burden over time from GP, GOPC and CMP surveillance (Figure 2).

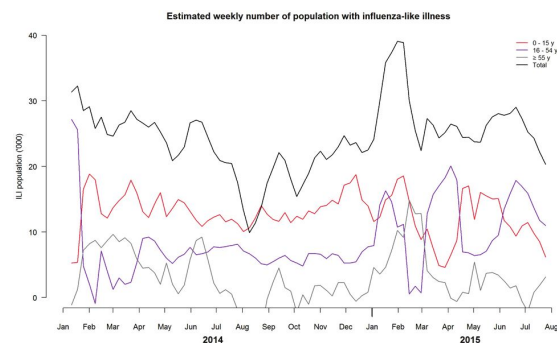
The estimated ILI burden for the population aged  $\leq 15$  and  $\geq 55$  years captured the peak in February-March in 2015 from surveillance of ILI institutional outbreaks (e.g. schools, elderly care centers). However, no such increased ILI burden was observed in the 16-54 years age group in the period.

## Conclusions

Syndromic surveillance data from different sources (e.g. medical consultation or google flu trends) were affected by different health seeking or reporting behavior. By understanding and quantifying these behaviors at different times, it is possible to estimate disease burden in the population.



Timing covered by the 4 rounds of survey



Estimated weekly age-specific burden of ILI

## Keywords

Health seeking behaviour; symptoms; influenza like illness; sentinel surveillance

## Acknowledgments

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\*Eric H.Y. Lau

E-mail: ehylau@hku.hk



# Increase in Adverse Health Effects Related to Synthetic Cannabinoid Use

Royal K. Law\*<sup>1</sup>, Josh Schier<sup>1</sup>, Colleen Martin<sup>1</sup>, Arthur Chang<sup>1</sup>, Amy Wolkin<sup>1</sup> and Jay Schauben<sup>2</sup>

<sup>1</sup>Centers for Disease Control and Prevention, Chamblee, GA, USA; <sup>2</sup>American Association of Poison Control Centers, Alexandria, VA, USA

## Objective

The Centers for Disease Control and Prevention analyzed all calls to poison centers about synthetic cannabinoid use from January to May 2015 to identify risk factors and adverse health effects related to this emerging public health threat.

## Introduction

Synthetic cannabinoids include various psychoactive chemicals that are sprayed onto plant material, which is then smoked or ingested to achieve a “high.” These products are sold under a variety of names (e.g., synthetic marijuana, spice, K2, black mamba, and crazy clown) and are sold in retail outlets as herbal products and are often labeled not for human consumption. Law enforcement agencies regulate many of these substances; however, manufacturers may frequently change the formulation and mask their intended purpose to avoid detection and regulation.

On April 6, 2015, automated surveillance algorithms via surveillance through the National Poison Data System (NPDS), a web-based surveillance system of all calls to United States (US) poison centers (PCs), identified an increase in calls to PCs related to synthetic cannabinoid use. To identify risk factors and adverse health effects, CDC analyzed all calls to PCs about synthetic cannabinoid use from January to May, 2015.

## Methods

We defined a synthetic cannabinoid call as any human exposure to a PC where use of a synthetic cannabinoid product was known or suggested during January to May 2015. We identified calls using NPDS and compared total and monthly call volumes during the study period to the same months in the previous year. Descriptive statistics for sex, age, most frequent signs and symptoms, medical outcome, and route of exposure were calculated. NPDS medical outcome designations utilized for this study included one of the following: 1) death, 2) major (signs or symptoms that are life-threatening or result in substantial residual disability or disfigurement), 3) moderate (signs and symptoms which are not likely to be life-threatening or result in severe disability), 4) minor (signs or symptoms that are minimally bothersome and generally resolve rapidly with no residual disability or disfigurement), or 5) not followed (the patient likely exhibited only minimal toxicity based on clinical judgment). We identified the most common drugs used when multiple substance use was reported. We compared demographic characteristics of calls reporting more severe medical outcomes (major effect and death) to calls reporting less severe outcomes (moderate effect, minor effect, no effect, not followed).

## Results

During the 2015 study period, PCs reported 3,572 calls related to synthetic cannabinoid use, a 229% increase from the 1,085 calls during the same January–May period in 2014. The number of monthly calls spiked notably in April (1,501 [42.0%]) before decreasing nearly to 2014 levels by the end of May. Most calls concerned use among males (2,882 [80.7%]). Among 3,442 (96.4%) calls where age of the

user was recorded, the median age was 26 years (range = 7 months–72 years). Agitation was the most frequently reported health effect (1,262 [35.3%]), followed by tachycardia (1,035 [29.0%]), drowsiness or lethargy (939 [26.3%]), vomiting (585 [16.4%]), and confusion (506, [4.2%]). Among 2,961 calls for which a medical outcome was reported, the majority had either moderate (1407 [47.5%]) or minor outcomes (1,095, [37.0%]). There were 15 (0.5%) reported deaths.

Inhalation by smoking was the most common route of exposure (2,870 [80.3%]), followed by ingestion (698 [19.5%]). Most reported use was intentional (3,310 [92.7%]). Among 626 calls reporting use of synthetic cannabinoids in combination with one or more other substances, alcohol was most commonly reported (144 [23.0%]), followed by plant-derived marijuana (103 [16.5%]), and benzodiazepines (69 [11.0%]). One of the 15 deaths included reports of multiple substance use.

Males were significantly more likely to have a severe outcome (88.6%) than a less severe outcome (80.1%) ( $p < 0.001$ ). Age group and severity were significantly associated with each other ( $p < 0.001$ ); persons aged 30–39 years and aged >40 years were significantly more likely than those aged 10–19 years to report a severe outcome ( $p = 0.001$  and  $p < 0.001$ , respectively).

## Conclusions

Increased calls related to synthetic cannabinoid use likely related to availability of new variants suggest that synthetic cannabinoids pose an emerging public health threat. The increase in calls described here suggest a need for greater public health surveillance and awareness and targeted public health messaging.

## Keywords

Synthetic; Marijuana; Cannabinoid; Surveillance; Poison Center

## \*Royal K. Law

E-mail: hua1@cdc.gov



# Using National Health Insurance Claims Data to Supplement Notifiable Infectious Disease Surveillance System

Heeyoung Lee<sup>1</sup>, Kwan Lee<sup>2</sup>, Seon-ju Yi<sup>\*1</sup>, Gichan Park<sup>1</sup>, Hwami Kim<sup>1</sup>, SoYoon Min<sup>1</sup>, Jee soo Suh<sup>1</sup>, Young-Man Kim<sup>1</sup>, Soojung Jo<sup>1</sup> and Daeun Jeong<sup>1</sup>

<sup>1</sup>Gyeonggi Infectious Disease Control Center, Seongnam-si, Korea (the Republic of); <sup>2</sup>Department of Preventive Medicine, Dongguk University College of Medicine, Gyeongju, Korea (the Republic of)

## Objective

This study will determine opportunity of using the National Health Insurance (NHI) claims data for supplemental notifiable infectious disease surveillance system at national or regional levels.

## Introduction

Infectious disease surveillance is very important as an element in public health system in the prevention and control of infectious diseases. Results of the Korean National Notifiable Disease Surveillance System (KNNDSS) has contributed to the reduction of amount of infectious disease. Nevertheless, the “reporting rate” is continuously being debated [1].

The KNNDSS classifies 77 infectious diseases into 6 groups: Group I for those requiring immediate control measures; Group II for vaccine-preventable diseases; Group III for diseases that need routine monitoring; Group IV for emerging diseases in Korea; Group V for parasitic infections; and Group VI for disease that need monitoring outbreaks. Group I – VI diseases are monitored by mandatory surveillance system that requires obligatory reporting on infectious diseases ‘without delay’ to a district health center [2].

The using the National Health Insurance (NHI) claims data is the important source of information for healthcare service research in South Korea, since South Korea achieves universal coverage of its population. In the aspects of data quality and standard, the sixth revision of the Korean Classification of Disease (KCD-6) has been used in Korea since 2011, and 99.9% of healthcare providers use to claims to insurers utilizing Electronic Data Interchange transactions. In this respects, NHI claims data is an opportunity as a supplement for NDDSS data.

In this study, we explored the difference between NNDSS data and NHI claim data and determined opportunity and challenges using NHI data for estimation the magnitude of national infectious disease incidence.

## Methods

Cases in NNDSS data and NHI claim data were aggregated yearly from 2011 to 2014. The trends between two data were compared using Spearman’s rank correlation coefficient. And also, we classified infectious diseases into four groups according to appearance or trends: (1) disease that there is no incidence in world and Korea, so the use of claims data is difficult, (2) diseases that the trend is coincided or similar between NNDSS data and NHI claim data, (3) diseases that recently the reporting rate increase and it can be used as evaluation index to improve the reporting rate, (4) Etc.

## Results

The First, there were claims for small pox, polio, diphtheria, etc. in NHI data, and they were classified type I. For these, process of error checking of NHI claim data is needed.

Brucellosis(R= 1.000), malaria(R= 0.943), hepatitis A(R= 0.943), typhoid fever(R= 0.886), etc. were classified type II, but their reporting rate is low, efforts for increase of the reporting rate is required.

Diseases that recently the reporting rate increase, such as chicken pox, mumps, and scarlet fever were classified type III, and it can be used as evaluation index to improve the reporting rate.

## Conclusions

The NHI claims data is the important source of information for healthcare service research in South Korea. Diseases classified type II and III could be used for supplemental NNDSS. Nevertheless, we suggests that comparison between NNDSS data and NHI data for type I and IV is not appropriate.

## Keywords

Korean National Notifiable Disease Surveillance System; Notifiable Disease; National Health Insurance claim data

## \*Seon-ju Yi

E-mail: yiseonju@gidcc.or.kr





# WHISPers, the USGS-NWHC Wildlife Health Information Sharing Partnership Event Reporting System

Julianna B. Lenocho\*

National Wildlife Health Center, Madison, WI, USA

## Objective

The USGS National Wildlife Health Center in conjunction with federal, state, tribal partners proposed an event reporting system with current and historic information on wildlife morbidity and mortality events in North America. The vehicle to accomplish this goal is *WHISPers*, the *Wildlife Health Information Sharing Partnership event reporting system*. This system depicts laboratory confirmed wildlife mortality events using geospatial mapping capability. Data are collected by multiple partners to collectively enhance the understanding of disease in wildlife populations.

## Introduction

Although national surveillance systems are maintained for human health (CDC) and for livestock disease (USDA); there is no network or data repository in the area of wildlife disease surveillance. Because emerging and re-emerging diseases severely affect wildlife populations, impact domestic and agricultural animals, and are a reservoir for zoonotic transmission, it is crucial to have early notification and recognition of disease patterns in wildlife populations. Due to fragmented systems of wildlife management, inconsistent investigation into sudden mortality events, and limited laboratory availability, there is not a single entity that is responsible for reporting disease events in North American wildlife populations.

## Methods

In effort to create a readily available data repository for wildlife disease events, NWHC created a partner-driven online database for recording on-going and historical wildlife morbidity and mortality events. Although the system was initially populated with NWHC's 30+ year database on US wildlife morbidity and mortality events, a portal for data entry by other wildlife professionals is currently underway. The software system continuously updates reported events. The database can be used to improve recognition of seasonally or cyclically epidemic diseases. Many diseases are quite predictable, occurring in the same locations at similar times each year. By chronicling these "typical" events, we can develop a better picture of disease impacts on wildlife across North America. Knowledge of "typical" events also make it easier to identify new diseases as they emerge and potentially spread across the landscape. A centralized repository of this information promotes better awareness of wildlife disease and augments opportunity for both proactive and timely reactive response by natural resource managers.

## Results

The data informatics team at the USGS National Wildlife Health Center created WHISPers to meet the National need for a singular reporting system for wildlife disease events. Confirmed events that meet these guidelines:

- 1) 5 or more animals with illness or death in a defined geographic area
- 2) Laboratory confirmed cases
- 3) Reportable at the county level to protect sensitive information and landowner privacy

4) Diagnosis is categorically attributed to infectious origin (viral, bacterial, fungal, parasitic), traumatic, nutritional, toxic, or other

Sick or dead animals must be observed, collected, submitted to a diagnostic laboratory, and the information shared in WHISPers in order to appear on the map and in the associated database. WHISPers may be used to report morbidity events, mortality events from infectious disease (like avian cholera) and sudden die-offs following environmental toxicity (Harmful Algal Blooms).

The collected data in WHISPers is available publically and free of charge. This information may be used by wildlife scientists, researchers, and natural resource managers. The data may also serve to alert of events that may affect agricultural animal or human populations, supportive the concept of OneHealth surveillance.

## Conclusions

Technological challenges prevent wildlife agencies, diagnostic laboratories, and other organizations from sharing knowledge of mortality events. The introduction of WHISPers should improve the access to data for wildlife mortality events in the United States. A long-term goal for WHISPers is to grow the numbers of contributing partners and make it easier for data to be shared.

Improved usage and submission to WHISPers by partners at the federal, state, tribal and local level will help improve accuracy and completeness of the surveillance system.

## Keywords

Wildlife; Surveillance; Management; Detection; Zoonotic

## Acknowledgments

The concept for WHISPers was developed by the USGS National Wildlife Health Center, in partnership with federal, state, tribal, non-governmental, and academic partners. System software was developed by the USGS National Wildlife Health Center.

## References

<https://www.nwhc.usgs.gov/whispers/>

\*Julianna B. Lenocho

E-mail: [julielenocho@gmail.com](mailto:julielenocho@gmail.com)





# Evaluation of Hepatitis C Surveillance in Washington State

Natalie Linton\*

Washington State Department of Health, Shoreline, WA, USA

## Objective

To evaluate the surveillance system for hepatitis C virus in Washington State using the Centers for Disease Control and Prevention guidelines for evaluating public health surveillance systems. Based on the findings of the evaluation, recommendations will be made for changes in practice.

## Introduction

Hepatitis C is a nationally notifiable viral infection that occurs as a result of *parenteral* contact with *infected* body fluids. An estimated 3.5 million persons are currently infected with HCV.<sup>1</sup> Infection status is divided into acute (short-term, onset within 6 month of exposure) and chronic (long-term). For most people (75-85%), acute HCV infection leads to chronic infection.<sup>2</sup> Those with chronic infection remain relatively asymptomatic until the infection becomes severe enough to be recognized or the infected individual is screened for infection with hepatitis C. Major causes of morbidity and mortality associated with HCV are liver cirrhosis and hepatocellular carcinoma. Treatment is available, but it is expensive and not recommended for some vulnerable populations, such as those with ongoing injection drug use (IDU), who account for the majority of new HCV infections in the United States.<sup>3-5</sup> Washington State records cases of both acute and chronic HCV infection, but the system is fragmented.

## Methods

The evaluation will involve key informant interviews as well as review of data repositories such as the Public Health Issue Management System in order to assess the simplicity, flexibility, data quality, acceptability, sensitivity, positive predictive value, representativeness, timeliness, and stability of HCV surveillance in Washington State.

## Results

The evaluation is currently in progress. Preliminary results are expected by November 2015.

## Conclusions

The findings of this surveillance evaluation will inform the restructuring of other state and local HCV surveillance systems. Improved surveillance and care can lead to reductions in the incidence of cirrhosis, hepatocellular carcinoma, and liver transplantation as well as prevent transmission.

## Keywords

surveillance evaluation; hepatitis C; HCV

## Acknowledgments

Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, WA; Office of Infectious Disease, Washington State Department of Health, Tumwater, WA; Scott Lindquist, State Epidemiologist, Washington State Department of Health.

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\*Natalie Linton

E-mail: natalie.linton@doh.wa.gov



# Experience Report: Association Between Flow Chart, Electronic Patient Record and Telephone Monitoring in the Success of Fighting Dengue Fever in the Hospital and Emergency Services in São Bernardo do Campo, Brazil

Andrea M. Losacco\*, Eliana V. Miranda, Renata Martello, Karla Possendoro, Meire A. Pinheiro and Gabriela Falchi

Hospital e Pronto Socorro Central, São Bernardo do Campo, Brazil

## Objective

Report successful experience in fighting dengue fever in the Hospital and Emergency Services in São Bernardo do Campo, joining the flowchart included, telephone monitoring and Electronic Patient Records.

## Introduction

Dengue fever is a dynamic infectious disease, allowing the patient to rapidly move from one stage to another during its course. Proper management of patients depends on early recognition of warning signs, continuous monitoring and re-staging cases and prompt fluid replacement. The telemedicine and Electronic Patient Records (EPR) belong to a series of advances of new features such as decision-making support systems including efforts on health monitoring, in view of the EPR as a support tool to allow the association of welfare activities as a database for the management of epidemiological information and monitoring. In addition, telemonitoring systems can be used for the monitoring of patients with chronic diseases in their homes which leads to cost savings in hospitalization and ensures appropriate care and the proper development of these patients. The continuous remote monitoring of these patients decreases the amount of hospital visits for monitoring procedures, also facilitating successful treatment, as in the fever dengue cases.

## Methods

This study, descriptive in character, was conducted at the Hospital and Emergency Services, in the municipality of São Bernardo do Campo, São Paulo, which deals with coronary emergency cases, trauma, infectious and chronic diseases with prolonged hospitalization; composed of 150 beds, 10 beds for general adult ICU and 05 beds for pediatric ICU. Suspected cases of dengue fever treated in the months of January to May 2015 formed the study population. Validation, training and implementation of a screening flowchart of suspected dengue fever cases treated at hospital was performed using a patient identification form and collection of signs and symptoms including the tourniquet test, related to the disease. For Tourniquet Test training, posters were made describing the proper technique for performing the test, and the QR Code\* of the educational video on the technique was placed on the poster so that each employee could view the instructional video on their own smartphone. There was a daily tracking of all records in the EPR, tracking the medical and nursing history and laboratory results, and the records selected that contained in their records the words Dengue and/or the words Fever, Retro-orbital Pain, Headache, Myalgia or Arthralgia, recording 1,298 cases; of which 38 had signs and symptoms of severity and required hospitalization, progressing satisfactorily. For each selected event, phone monitoring was conducted, with information on the progress of the case, timely collection of general serology and guidelines such

as the need for adequate hydration during the course of the disease, in addition to warning patients for them to return to the emergency room if they exhibit signs of worsening.

## Results

1,298 patients were attended with suspected dengue fever. The main symptoms exhibited were fever in 99% of cases, accompanied by myalgia in 89% of cases, headache in 82% and retro-orbital pain in 71%. Symptoms more closely related to severe forms were vomiting, and bleeding. The prevalence of positivity was 41% which can be low when compared to other services, but the lack of timely collection of the serology may have inhibited this data. Comparing the patients with positive serology with those with negative serology, but who developed a feverish state similar to dengue, it was found that the symptoms of retro-orbital pain, itching and rash exhibited statistically significant differences in dengue fever cases.

## Conclusions

The monitoring to guide appropriate measures regarding the disease were decisive, we managed to notify and 100% of the cases in a timely manner, thus avoiding complications and keeping the deaths at zero. The EPR use in order to improve the quality of the epidemiological indicators produced as part of the local surveillance of all cases of diseases of compulsory notification, is essential.

## Keywords

Dengue Fever; Data Record Patient; Surveillance

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\*Andrea M. Losacco

E-mail: a.losacco@gmail.com



# Data Sharing Across Jurisdictions Using ESSENCE Federated Queries

Wayne Loschen\*, Rekha Holtry and Sheri Lewis

Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA

## Objective

The objective of this presentation is to describe the new federated query capability in ESSENCE and describe how this could affect public health practice in the future. Specifically, this presentation will describe how a federated set of disease surveillance systems across the country could help improve national disease surveillance situational awareness along with its potential to connect non-ESSENCE systems in the future for even more complete coverage. It will also describe how this capability is different than other data sharing projects that attempt to centralize data, but how there is room for both to benefit from each other.

## Introduction

There are currently over 25 installations of ESSENCE across the US. Among these, there are 3 instances of multi-jurisdictional implementations. These include a centralized regional system in the National Capital Region for MD, DC, and VA, a Missouri system that includes hospitals and users from the St. Louis area in Illinois, and soon the National Syndrome Surveillance Program (NSSP) version of ESSENCE which will centralize data from many jurisdictions. While each of these systems provides valid ways to share data across jurisdictions, they require data to be sent to another jurisdiction. There are some jurisdictions which have legal or philosophical or technical issues with these types of data sharing arrangements. Programs like Distribute attempted to solve this by only sharing pre-aggregated data. This caused issues though for surveillance of new and emerging issues that requires a more ad-hoc query capability. This gap can be filled with a locally-ran system that has the ability to perform queries into remote systems and perform a federated query across other jurisdictions.

## Methods

A new capability has been developed for ESSENCE systems that allow local administrators to publish their data sources for use by another jurisdictions ESSENCE users. When this occurs, all data remains in the local ESSENCE system, but other ESSENCE users can send requests to that system. These requests, such as time series or data details requests, can be accepted or denied based on access control permissions on an individual user or jurisdiction basis. Using this new technology that can connect ESSENCE systems to other ESSENCE systems, it will become possible technically to query for new and emerging disease trends by performing ad-hoc queries across many different jurisdictions. Additionally, any current multi-jurisdictional system, such as the future NSSP ESSENCE system, would also be able to technically participate in this new federate query framework. This provides local systems, which may want a customized ESSENCE system, the ability to share with multi-jurisdictional systems, which may provide ESSENCE to jurisdictions that can't support a local system.

## Results

While the technology to perform federated queries across ESSENCE systems has now been developed, it will not be deployed into an active system until late 2015. Early results on how the system has performed can be presented then. However, the potential

ramifications of having this technology will be discussed along with potential future enhancements to support non-ESSENCE disease surveillance system federated query support.

## Conclusions

Data and information sharing is not simple. Many jurisdictions desire it and many projects have succeeded in many aspects of it. This is another piece of the data and information sharing puzzle that will allow jurisdictions that prefer not to centralize their data to still participate in a data and information sharing collaboration.

## Keywords

Data Sharing; Information Sharing; ESSENCE; Federated Queries

## \*Wayne Loschen

E-mail: Wayne.Loschen@jhuapl.edu



# Improving the Value Proposition of Surveillance Tools: Innovative Uses for VA ESSENCE

Cynthia A. Lucero-Obusan\*<sup>1</sup>, Patricia Schirmer<sup>1</sup>, Gina Oda<sup>1</sup> and Mark Holodniy<sup>1,2</sup>

<sup>1</sup>Department of Veterans Affairs, Washington, DC, USA; <sup>2</sup>Stanford University, Stanford, CA, USA

## Objective

To describe VA's experience developing innovative and alternative uses of a surveillance system and improve the overall value proposition of this tool for the agency.

## Introduction

VA began using ESSENCE as a public health surveillance tool in 2005. The system offered alerting capability for pre-defined syndromes and querying capability for outpatient ICD-9 diagnosis codes. Herein, we highlight examples of how we have invested in upgrades to analytic capabilities and expanded data sources available to ESSENCE in order to augment the overall utility of this system within VA.

## Methods

We reviewed use cases for new data added since 2009 (additional outpatient, plus inpatient, procedure, surgery, and telephone triage data) as well as enhancements to system analytics, geospatial mapping and general functionality. We also describe novel use cases for the original outpatient data elements and document examples of how we've merged query results from ESSENCE with data from other VA data sources to answer important surveillance questions.

## Results

The evaluation was divided into three themes. First, and a top priority, was enhancing influenza surveillance capability. A number of innovative use cases for this theme were reviewed. Pulling procedure codes (ICD-9 and CPT) provided the ability to track immunizations in outpatient and inpatient settings. The availability of outpatient clinic location details allowed us to calculate %ILI specifically for our primary care clinics. Telephone triage data gave us more timely insight into the rise and peak of influenza activity compared to outpatient visit data alone. The addition of inpatient data assisted us in characterizing the severity of each season by tracking admitting and discharge diagnosis codes for influenza as well as other severity elements, such as ward details (intensive care stays), overall lengths of stay, mechanical ventilation requirements (via intersecting time series of influenza diagnosis query and mechanical ventilation procedure query) and patient disposition (specifically, deaths) for influenza-coded hospitalizations. New geospatial capabilities enabled us to map hospitalizations and telephone triage calls by VA facility and region. Finally, we merged our inpatient ESSENCE data with pharmacy and laboratory data from other VA data sources to assess the proportion of hospitalized Veterans who had influenza testing performed and/or received antiviral medications.

The second theme was epidemiologic reviews and lookbacks. Here we sought to identify Veterans with an exposure or procedure of interest. Most recently, we conducted a review of Veterans with Carbapenem-resistant Enterobacteriaceae (CRE) infections having undergone specific endoscopy procedures (Endoscopic Retrograde Cholangiopancreatography, ERCP). We queried for ERCP procedure codes in ESSENCE then merged this with CRE laboratory data to generate a cohort of patients requiring further epidemiologic review.

The third theme was infection control activities. Here, in partnership with facility Infection Preventionists, we identified procedures, events

or diagnoses of interest for specific surveillance questions. We used procedure codes in ESSENCE to identify operative procedures defined by the National Healthcare Safety Network to generate Surgical Site Infection (SSI) surveillance denominators. In another example, we sought to assess whether patients with healthcare-associated pneumonia were being appropriately tested for Legionella. We used inpatient diagnosis codes to identify pneumonia hospitalizations in ESSENCE and merged that with laboratory data as a starting point for the analysis. Finally, at the request of our local accident review committee, we used existing outpatient diagnosis codes in ESSENCE to identify needlestick injury visits that may not have been properly reported.

## Conclusions

We've highlighted new and innovative uses of a public health surveillance tool within VA. System evaluations such as these are essential for demonstrating usefulness as well as maintaining funding and support for these applications. Through the mechanisms described, we have optimized the functionality of this tool to the greatest extent possible. In order to continue to innovate and harness the power of big data available to us, we have begun transitioning to a new surveillance platform (Praedico, Bitscopic Inc.) which provides additional flexibility and system architecture needed to accommodate the volume of data available from multiple sources and improve our analytic, event detection, geospatial and forecasting capabilities into the future.

## Keywords

Public Health Surveillance; Veterans; System Enhancement; Influenza surveillance; Epidemiology

\*Cynthia A. Lucero-Obusan

E-mail: cynthia.lucero@va.gov



# Interplay of Socio-Cultural and Environmental Factors on Microbial Contamination of Food in Samaru, Kaduna State, Nigeria

Beatty V. Maikai\* and Mujtaba A. Salman

Ahmadu Bello University, Zaria, Nigeria

## Objective

To study the effect of socio-cultural and environmental factors on microbial contamination of food and the understanding of food-related risks, food safety knowledge and practices

## Introduction

In most disadvantaged communities in Northern Nigeria, adolescent girls engage in economic activities so that they can save money for household items to be bought for them when they are given out for marriage. These girls right from before they reach teenage age hawk items which include ready-to-eat foods<sup>(1)</sup>. Various socio-cultural and environmental factors reinforce vulnerability of foods to microorganisms. Food safety awareness, knowledge and practices among food vendors can be affected by interplay between individual and outdoor factors. Teenagers engage in hawking food without understanding food-related risks for the preservation of their health and the health of others. Food hygiene is the conditions and measures necessary to ensure the safety of food from production to consumption. Lack of adequate food hygiene can lead to foodborne diseases and death of the consumer<sup>(2)</sup>. Mishandling of food can occur during food preparation, handling and storage; and studies show that consumers have inadequate knowledge about measures needed to prevent food-borne illness<sup>(3)</sup>. There are a number of factors which are likely to contribute to outbreaks of food-borne illness in the home, including a raw food supply that may be contaminated, a lack of food safety knowledge among the general public, mistakes in food handling and preparation at home<sup>(4)</sup>.

## Methods

Fifty-four food samples comprising Rice and Beans meals as well as local delicacies made from maize, soyabeans and others were collected within Samaru in Kaduna State, Nigeria. The samples were pre-enriched and enriched with buffered peptone water and tetrastatate broth respectively before plating on Desoxycholate Citrate Agar. Structured questionnaires were also administered to the food vendors in form of an interview. Questions covered method of food preparation, reheating prior to sale, food safety measures, awareness of food safety, knowledge and behavioral practices that may enhance foodborne illness.

## Results

Of the 54 samples, 20 (37%) were non-lactose fermenters. Two (10%) out of these 20 suspected organisms showed reactions consistent with that of *Salmonella* species upon characterizing them biochemically. The remaining 18 (90%) that were not *Salmonella* showed reactions typical of *Proteus* 5 (9.3%), *Citrobacter* 8 (14.8%), *E. coli* and *Arizona* spp 1 (1.9%) each and 3 (5.6%) unidentified spp. For food-related risks, a low level of awareness and bad behavioural practices such as playing around food sale points, exposure of food to dusty and unhygienic environment, not washing of utensils and cutleries with clean water prior to serving consumers, hand contact with served foods and a low level of perceived vulnerability to foodborne illness were observed. Particular lack of knowledge was

identified regarding the impact of temperature on microorganisms as the food sold were either already cold or lukewarm and ignorance on possible health hazards with unprotected wounds on their hands as was seen on some. Though more females 43(79.6%) were seen selling foods than males 11(37.0%), but the foods sold by male vendors were more contaminated probably because factors observed in females were more elaborate in males.

## Conclusions

Understanding of food safety practices is helpful in reducing food-borne illness. Preventive health strategies that make use of good behavioral and hygienic environment should be targeted. Food vendors should be given the time, tools and training necessary to facilitate proper food handling practices to know basic food safety measures early in life.

## Keywords

Food; Safety; Microorganisms; Environment; culture

## Acknowledgments

Laboratory staff and the Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria for laboratory materials and technical assistance

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\*Beatty V. Maikai

E-mail: Beatt18@yahoo.com





# Disease Surveillance by Private Health Providers in Nigeria: A Research Proposal

Olusesan A. Makinde\*<sup>1</sup> and Clifford O. Odimegwu<sup>2</sup>

<sup>1</sup>Viable Knowledge Masters, Abuja, Nigeria; <sup>2</sup>University of the Witwatersrand, Johannesburg, South Africa

## Objective

To investigate the compliance of private health facilities to the integrated disease surveillance and response (IDSR) system in Nigeria.

## Introduction

The outbreak of the Ebola Virus Disease (EVD) in Africa in 2014 presented a major threat and concern across the world, spreading to two other continents (Europe and North America). Though the epidemic is on a downward trend, there is a need to evaluate the performance of the systems in place to detect and control such outbreaks and determine the need for improvement in countries affected.

With its first traceable case reported to have been in Guinea, the outbreak spread to Nigeria through an air traveler from Liberia which led to an outbreak in the country that luckily, was quickly contained (1). This imported case was initially managed at a private health facility (PHF) eventually leading to 20 cases and eight deaths, four of which were health workers from the initial managing PHF (1). Despite effort to contact the authorities about the suspected imported case by the PHF, it reportedly took some time before the health authorities could be reached and action at control instituted. This might suggest an inefficiency of the IDSR system which was previously adopted by Nigeria as a means of implementing the International Health Regulation (IHR) of 1969. The IHR is a set of regulations that the World Health Assembly uses to implement its constitutional responsibility to prevent the international spread of diseases.

Hemorrhagic fevers like EVD ought to be reported immediately upon suspicion to the health authorities but the delay despite effort suggests this system is not efficient. This is important as PHFs are noted to attend to over 60% of the Nigerian population. Thus, it is important to carry out an assessment of the IDSR system in PHFs to forestall a repeat episode and limit the impact of outbreak of infectious diseases in future.

## Methods

This study will be carried out in the South-West of Nigeria where about 40% of PHFs in the country are located (2). We intend to carry out a mixed-methods study which will include desk reviews, key informant interviews, focus group discussions, analysis of routine data, a cross sectional study of health workers and health facility assessments. Desk review will be completed to understand the legislation and policies establishing the IDSR in Nigeria and opportunities for improvement. Key informants at the federal, state and local government level will be interviewed to understand more about the regulation and implementation of the IDSR across the different levels of governance in the country. Routine health data will be pulled from the national health information system to assess reporting of PHFs. In addition, health facility assessments will be completed along with assessment of the knowledge of health workers in PHFs on the country system for notifiable diseases.

## Results

The study will critically assess the legislation that establishes the IDSR as the means of implementing the IHR in Nigeria. It will provide

the status of implementation of the regulation for implementing the IHR. The study will further assess the knowledge of private healthcare providers on the IDSR system in Nigeria and the factors that affect their compliance with this regulation. Furthermore, it will provide information for the readiness of PHFs to report notifiable diseases and will also investigate the differences in reporting rate between public and private health facilities.

## Conclusions

The study will provide a snapshot of the status of PHFs on participation in the IDSR in Nigeria and factors that may be affecting them. It will also highlight areas of inadequate legislation and system failures and will make proposals aimed at addressing these shortfalls.

## Keywords

Surveillance; Communicable Diseases; Research Proposal; Global; Nigeria

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\*Olusesan A. Makinde

E-mail: [makindeo@viableknowledgemasters.com](mailto:makindeo@viableknowledgemasters.com)



# Towards Automated Risk-Factor Surveillance: Using Digital Grocery Purchasing Data to Measure Socioeconomic Inequalities in the Impact of In-Store Price Discounts on Dietary Choice

Hiroshi Mamiya\*, Erica Moodie, Deepa Jahagirdar and David Buckeridge

Epidemiology, Biostatistics, and Occupational Health, McGill University, Montreal, QC, Canada

## Objective

To assess the influence of in-store price discounts on soda purchasing by neighborhood socio-economic status in Montreal, Canada using digital grocery store-level sales data.

## Introduction

Obesity and related chronic diseases cost Canadians several billion dollars annually<sup>1</sup>. Dietary intake, and in particular consumption of carbonated sweetened drinks (soda), has a strong effect on the incidence of obesity and other illness<sup>2</sup>. Marketing research suggests that in-store promotion, and more specifically price discounting, has a strong effect on the purchase of energy-dense products such as soda<sup>3</sup>. Attempts by public health authorities to monitor price discounts are currently limited by a lack of data and methods. Although rarely used in public health surveillance, electronic retail sales data collected around the world by marketing companies such as the Nielsen Corporation have an immense potential to measure dietary choices at high geographical resolution. These scanned sales data are recorded in real-time and they include a detailed product description, price, purchased quantity, store location, and product-specific advertising activities.

## Methods

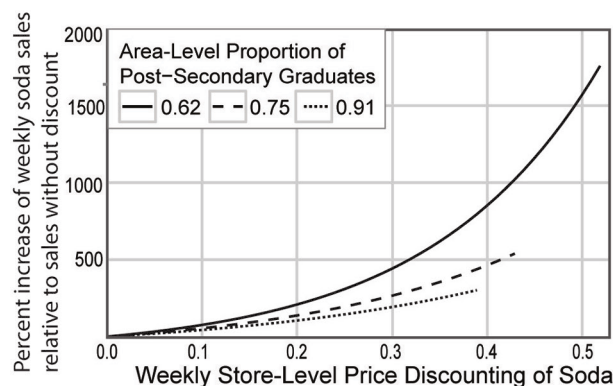
We obtained from the Nielsen corporation data on weekly store-specific sales and price discounting of non-diet soda items from 83 sampled grocery stores in Montreal, Canada between January 2008 and December 2013. To account for the correlation within stores and chains, we used linear mixed regression to model the log-transformed weekly sum of soda serving sales as a function of store-level weekly price discounting, which is defined as the average discount fraction over all soda items in each store. To examine the moderating effect of SES on price discounting, we added an interaction term between discount magnitude and area-level measures of SES for the three-digit postal code in which stores were located. Factors examined were the proportion of population with post-secondary qualification and the median household income. We used month, year, and statutory holiday indicator variables as covariates. Using the fitted model, we plotted predicted percent increase of soda sales in response to price discounting at various levels of the SES indicators.

## Results

The regression coefficient of price discounting and area-level education attainment was 10.17 (95% Confidence Interval [CI]: 9.41 to 10.94) and 1.47 (95% CI: -3.05 to 5.99) respectively, and the coefficient of their interaction term was significant and negative (-10.07, 95% CI: -11.68 to -8.46), indicating that the impact of discounting on soda sales was more pronounced among stores located in areas with lower educational attainment as demonstrated in the figure. Area-level income and its interaction term with price discounting showed modest effect on sales (0.18, 95% CI: 0.09 to 0.27 and -0.11, 95% CI: -0.35 to 0.13, respectively).

## Conclusions

Our analysis of digital scanner data from grocery stores found that consumer sensitivity to price discounting of soda was inversely associated with neighborhood education attainment. This finding demonstrates the utility of electronic point-of-sales data to monitor the influence of in-store price discounting on purchasing of unhealthy foods, an important environmental risk factor for obesity and related illness.



Note: Maximum observed discount magnitude is 0.52, 0.43, and 0.39 for low, middle, and high-education neighborhood, respectively.

Figure: Predicted percent growth of soda sales from the joint effect of price discounting and neighborhood education (grouped into tertile levels).

## Keywords

Obesity; Soda Consumption; Digital Purchase Data; Diet; Health Disparity

## Acknowledgments

We appreciate Dr. Aman Verma for providing neighborhood-level social economic status.

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\*Hiroshi Mamiya

E-mail: hiroshi.mamiya@mail.mcgill.ca



## “Koman i lé” : An Online Self-Reported Symptoms Surveillance System in Reunion Island

Nadège Marguerite<sup>1</sup>, Pascal Vilain<sup>\*1</sup>, Etienne Sévin<sup>2</sup>, Farid Sahridji<sup>2</sup> and Laurent Filleul<sup>1</sup>

<sup>1</sup>French Institute for Public Health Surveillance, Saint-Denis Cedex 9, Réunion; <sup>2</sup>Epiconcept, Paris, France

### Objective

To describe a new surveillance system based on an online self-reported symptoms and to present the first results.

### Introduction

During the past ten years, the syndromic surveillance has mainly developed thanks to clinical data sources (i.e. emergency department, emergency medical call system, etc.). However, in these systems, the population doesn't play an active role. It is now important that the population becomes an actor of this surveillance; especially since several European experiences about influenza showed that the population could participate to an internet-based monitoring.

In Reunion Island, the population is very sensitive to public health concerns. In this context, the health authorities implemented since April 2014 a web-based surveillance system, called “Koman i lé”, that allows to follow the perceived health among people who don't systematically see their general practitioner.

### Methods

The surveillance system is based on the use of the Internet-based cohort. Individual volunteers aged over 18 with internet access and living in Reunion Island are included. During the registration, socio-demographical data are collected. Upon registration, each user is sent a weekly email, taking them to the “Koman i lé” website. They fill in a short survey asking if they had any of the 17 symptoms during the previous week: fever, cough, headache, diarrhea, vomiting, nausea, stomach ache, sore throat, muscle pain, weakness, skin rash, red eyes, asthma attack, asthenia, rhinorrhea, dyspnoea, joint pain.

Indicators are constructed from syndromic groups. Each week, epidemiologists analyse the symptoms and indicators by age group, gender, occupational category and zip code; and make a report as a feedback to the participants (Figure1). Moreover, in the website a custom feedback is given to each volunteer so that they can compare their health to that of the population. In addition, it is also possible to make ad hoc surveys on various public health subjects.

### Results

As of August 6, 2015, there are 359 participants from 22 of the 24 cities of the island. Among them, 67% are women, and 46% are between 30 and 44 years old. Thirty-three percent of the users live in Saint-Denis, the capital of Reunion Island. Since the beginning of “Koman i lé”, the three most frequently reported symptoms are tiredness, rhinorrhea, and headache. The weekly monitoring of the different indicators highlighted an increase in the percentage of participants who presented an influenza-like illness in weeks 24 and 25 in 2014. This increase coincided with the start of an ILI outbreak detected by the other surveillance systems. Moreover, “Koman i lé” also allowed to observe an increase in participants who had red eyes during a major outbreak of conjunctivitis that occurred from January to April 2015.

### Conclusions

The surveillance system allows the setting up of a volunteers' cohort in general population. The first results show that it is possible from the data collected each week to monitor the health of the

population and to detect unusual or expected health events and to follow an epidemic, despite the low number of participants. With a larger user base, systems like “Koman i lé” will help to improve the health surveillance on Reunion Island. In conclusion, the sentinel population project is original because for the first time the general population participates to syndromic surveillance. Information reported by individuals can increase traditional public health methods for more timely detection of disease outbreaks. Finally, the sentinel population allows the population of Reunion Island to take an active part in the health regional policy.

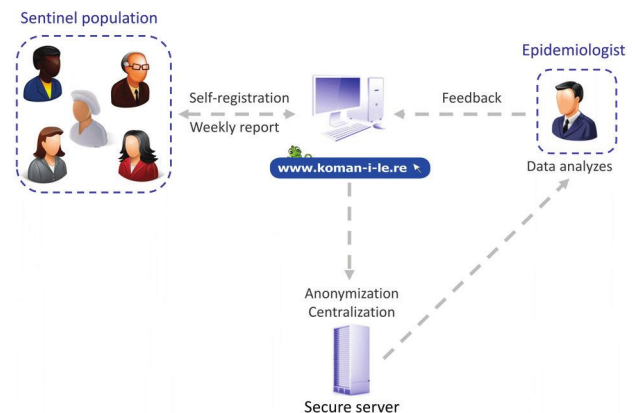


Figure1. Organization of the population sentinel project

### Keywords

Sentinel population; Web-based monitoring; Syndromic surveillance

### Acknowledgments

All “Koman i lé” users who have contributed information.

### \*Pascal Vilain

E-mail: pascal.vilain@ars.sante.fr



# Building the Road to a Regional Zoonoses Strategy: a Survey of Zoonoses Programs in the Americas

Melody J. Maxwell<sup>\*1, 2</sup>, Mary Hofmeister Freire de Carvalho<sup>2</sup> and Victor del rio vilas<sup>2</sup>

<sup>1</sup>The Ohio State University, Columbus, OH, USA; <sup>2</sup>PANAFTOSA (PAHO/WHO), Rio de Janeiro, Brazil

## Objective

To take the first step in identifying how American countries can strengthen their capacities to manage zoonoses risks by capturing information regarding their national zoonoses programs and priorities.

## Introduction

Zoonoses account for over 70% of emerging infectious diseases in humans<sup>1</sup>. In recent years, global public health security has been threatened by zoonotic disease emergence as exemplified by outbreaks of H5N1 and H1N1 influenza, SARS, and most recently Ebola. The occurrence of a number of these zoonoses, and their spread to new areas, is related to globalization, environmental changes, and marginalization of populations. This phenomenon holds true for Latin American and the Caribbean countries (LAC), where 70% of the events public health emergencies reported to the WHO from 2007 to 2008 in the Americas were classified as zoonoses or communicable diseases common to humans and animals<sup>2</sup>. Despite this record, there are no national or regional disease burden estimates in LAC for many zoonoses<sup>3</sup>. To start filling this void, the Pan American Health Organization (PAHO) conducted a survey of LAC countries to collect information on priority emerging and endemic zoonoses, countries prioritization criteria and methodologies, and suggestions to strengthen countries capacities and regional approaches to zoonoses control.

## Methods

An online questionnaire was sent to the zoonoses program managers of the Ministries of Health (MOH) and Ministries of Agriculture (MAG) of all 33 LAC countries from January to April of 2015. The questionnaire comprised 36 single, multiple choice and open-ended questions to inform the objectives of the survey. A descriptive exploratory analysis was completed in R (i386 3.1.2).

## Results

Fifty-four ministries (26 MOH, 25 MAG, and 3 combined responses) in 31 LAC countries responded to the survey. Within the ministries, 22 (85%) MOH, 5 (20%) MAG, and 2 (67%) combined entities indicated they had specialized zoonoses units.

For endemic zoonoses, 32 ministries responded that they conduct formal prioritization exercises, most of them annually (69%). The three priority endemic zoonoses for the MOHs were leptospirosis, rabies, and brucellosis while the three priorities for the MAGs were brucellosis, rabies, and tuberculosis. Diagnosis for rabies and leptospirosis were cited as the capacities most in need of development. The most wanting cross-cutting capacity was coordination between stakeholders.

For emerging zoonoses, 28 ministries performed formal prioritization exercises. The top prioritization criteria were probability of introduction into the country and impact. The three priority emerging zoonoses for the MOHs were Ebola, avian influenza, and Chikungunya while for the MAGs were avian influenza, bovine spongiform encephalopathy (BSE) and West Nile Virus disease. Surveillance for avian influenza and Ebola, and diagnosis for BSE were quoted as the capacities most wanting.

For all zoonoses, the majority of respondents (68%) ranked their relationship with the other Ministry as productive or very productive, and 31% minimally productive. Many countries demanded greater regional coordination, the constitution of a regional group to handle emerging zoonoses, and recommended the dissemination of reports on zoonoses occurrence and capacities across the region.

## Conclusions

The survey is the first comprehensive effort to date to inform the status of zoonoses programs in LAC, and provides the evidence to build a regional strategy and identify capacity needs. A number of improvements appear evident: i) standardization of prioritization approaches, surveillance definitions and evaluation processes to support comparisons, ii) greater communication and coordination between countries, and iii) a platform to inform zoonoses occurrence in the region and the status of the region's capacities.

## Keywords

zoonoses; prioritization; capacity building; survey; Pan American

## Acknowledgments

Boren Fellowship.

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**\*Melody J. Maxwell**

E-mail: melody.j.maxwell@gmail.com





# Towards Self Validation: Progress and Roadmap for Automating the Validation of BioSense Partner Facilities

Travis Mayo<sup>1</sup>, Matthew Dollacker<sup>1</sup>, Corey Cooper<sup>1</sup> and Sara Imholte<sup>2</sup>

<sup>1</sup>CDC Contractor, InductiveHealth Informatics, Atlanta, GA, USA; <sup>2</sup>Arizona Department of Health Services, Phoenix, AZ, USA

## Objective

This session will inform the BioSense Community about data validation advancements implemented this past year as well as future plans to improve the BioSense validation process to achieve emergency department representativeness goals.

## Introduction

One of the greatest hurdles for BioSense Onboarding is the process of validating data received to ensure it contains Data Elements of Interest (DEOI) needed for syndromic surveillance. Efforts to automate this process are critical to meet existing and future demands for facility onboarding requests as well as provide a foundation for data quality assurance efforts. By automating the validation process, BioSense hopes to:

1. Reduce costs associated with the iterative validation process.
2. Improve BioSense response times for assistance with onboarding.
3. Improve documentation to partners about requirements and communicate changes to DEOI.
4. Provide a better foundation for data quality initiatives.

Efforts to improve data validation are being developed in alignment with BioSense future initiatives and will apply to both BioSense, Essence and other BioSense program applications.

BioSense Onboarding identified critical success factors by participating in ISDS workgroup initiatives for Onboarding and Data Quality and soliciting feedback from key jurisdictional partners. These critical success factors include; improved documentation, access to raw data, and faster validation response time.

## Description

Panelists will review the critical success factors and discuss the improvements and advancements made to the onboarding validation process.

Issues discussed will include:

- Documentation
- Data Access
- Validation Response Time

Documentation improvements include the release of the first BioSense Onboarding Implementation Guide and a new BioSense Data Validation Compliance Report and Facility Approval Tracking Report.

Data access is important to Jurisdiction Administrators so that they can perform initial quality assurance during onboarding, assess continuous facility reporting, and perform continuous data quality initiatives. BioSense Onboarding has advanced this initiative by working to provide jurisdiction administrators with direct access to raw data within their jurisdictional SFTP folders as well as providing access to Stage\_1 database tables which hold the raw form of pre-processed DEOI data values that are extracted from the HL7 file.

Validation Response Time improvements include a new helpdesk portal to better track requests and ensure quick response times. Additionally, the newly developed Data Validation Compliance Report provides jurisdiction administrators and developers with better feedback about DEOI compliance rates to enable faster issue

resolution. Further improvements are being planned to include sets of automated SQL validation queries, validation description information, as well as proposed plans to create a portal to perform self-validation utilizing these tools thereby providing immediate validation feedback.

## Audience Engagement

Audience participation will focus on discussion of the continued improvements to BioSense Data Validation process and how they impact jurisdictional onboarding initiatives. Feedback will be used to help facilitate the continuous improvement initiatives for the BioSense Onboarding Community.

## Keywords

NSSP; Onboarding; Validation; Automation

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3. BioSense Data Validation Compliance Report
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E-mail:

