Integrating Automated Reporting into the National Outbreak Reporting System: Benefits and Barriers

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Background
The National Outbreak Reporting System (NORS) is a web-based interface implemented in 2009 to improve reporting of enteric outbreaks by state and territorial public health agencies to the Centers for Disease Control and Prevention (CDC). Recently, CDC has focused on developing capacity to use the Public Health Information Network Messaging System (PHINMS) for automated, electronic data transmission to NORS. This platform aims to provide improved functionality including 1) the ability to upload outbreak data from existing stand-alone disease surveillance systems directly into NORS, 2) automation of data cleaning using embedded data validation and quality control, and 3) improved sharing of foodborne disease outbreak surveillance data among federal agencies.

Objective
To better understand the challenges associated with vertically integrating surveillance systems that consist of highly relational outbreak surveillance data.

Methods
We evaluated PHINMS user instances to assess state and local information technology (IT) capacity to transfer outbreak surveillance data to NORS.

Results
NORS is a complex relational database, collecting 688 variables—many with free text or multiple entries—to which nearly 850 users report voluntarily. Only 28 health departments, 10 of which receive direct funding from the Emerging Infections Program for enteric disease surveillance, currently transmit information about individual cases of enteric diseases using PHINMS. Implementation of automated transmission of outbreak data may be complicated by the need to 1) increase the use of PHINMS for automated data transmission, 2) aggregate information and map to outbreak report data fields, 3) reconcile text fields to standard NORS variables, 4) automatically validate transmitted data, and 5) accommodate disparate state and local surveillance systems.

Conclusion
While providing numerous benefits, automated transmission of outbreak data requires local resources to utilize PHINMS and raises many data aggregation and integrity issues that will require close collaboration between CDC, state epidemiologists and IT specialists.

Presenter: Virginia Roberts, MSPH

NORS-Water: Partnering to Improve Waterborne Disease Outbreak Surveillance

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Background: To improve the national Waterborne Disease and Outbreak Surveillance System (WBDOSS), CDC has recently pursued state and federal partnerships in epidemiology, environmental health, and public health laboratory sciences. A multidisciplinary working group, including the Centers for Disease Control and Prevention (CDC), the Environmental Protection Agency, the Council of State and Territorial Epidemiologists, and the Environmental Health Specialist Network-Water program was established in 2004 to work toward a shared vision for waterborne disease outbreak reporting. CDC has expanded its efforts to build stronger state and federal partnerships to improve waterborne disease outbreak surveillance.

Methods: CDC hired the first full-time WBDOSS coordinator in 2006 and the first full-time surveillance epidemiologist in 2007. The electronic National Outbreak Reporting System (NORS) was launched in 2009, based on an electronic reporting application used for the Foodborne Disease Outbreak Surveillance System (FDOSS) from 1998-2008. In 2008, staff managing WBDOSS released the first issue of a public health newsletter to state waterborne disease coordinators. In 2010, a webinar series was launched for waterborne disease coordinators and NORS users. In 2011, a WBDOSS/NORS-Water working group composed of CDC and state-based epidemiologists was initiated.

Results: NORS has required ongoing collaboration across CDC programs for system management, resulting in improved coordination between WBDOSS and FDOSS, and a partnership with CDC’s Division of Viral Diseases. Full-time management for WBDOSS and collaboration with other CDC programs have strengthened the WBDOSS network, as demonstrated by attendance and partnership with CDC on the webinar and newsletter series. Outreach has primarily focused on state epidemiologists, with more limited efforts to reach environmental health staff and laboratorians.

Conclusions: Utilizing the WBDOSS network will improve CDC’s ability to collect complete, timely, and accurate data through NORS. CDC could better engage state environmental health and laboratory staff. CDC should continue to work with partners, strive to incorporate feedback, and evaluate impacts on outbreak reporting.
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Background

The Centers for Disease Control and Prevention collects data obtained from investigations of foodborne disease outbreaks (FBDOs). During 1998–2008, local, state, and territorial health departments voluntarily submitted data using a standard reporting form through a web-based application: the electronic Foodborne Outbreak Reporting System (eFORS).

Methods

We analyzed FBDOs reported to eFORS, including number of illnesses, hospitalizations, deaths, etiologies, and foods.

Results

There were 13,405 FBDOs causing 273,120 illnesses, 9,109 hospitalizations, and 200 deaths reported to eFORS. An average of 1,219 (968 – 1403) outbreaks were reported each year. Among the 7,998 (60%) outbreaks for which etiology was reported, most were caused by viral (3,633; 45%) and bacterial etiologies (3,613; 45%). Norovirus increased from 73 (6%) outbreaks in 1998 to 353 (35%) in 2008. The most common bacterial pathogen was Salmonella, causing 1,449 outbreaks (40% of bacterial outbreaks), of which Enteritidis was the most common serotype reported. Salmonella outbreaks caused the most hospitalizations (4,034; 44% of hospitalizations) and deaths (60; 27% of deaths). Listeria outbreaks resulted in the highest proportion of outbreak-related illnesses hospitalized (83%). A food vehicle was reported for 7,724 (58%) outbreaks. Among the 3,259 outbreaks for which the food vehicle could be attributed to a single commodity, poultry (19%), fish (19%), and beef (12%) were most commonly implicated.

Conclusions

Over these 11 years, most foodborne disease outbreaks with a known etiology were caused by norovirus and Salmonella. Poultry, fish, and beef were the most common food commodities associated with outbreaks. Salmonella continues to be a major cause of hospitalizations and deaths. Outbreak surveillance provides insights into the pathogens and foods, for which effective control strategies may yield the greatest benefit.
Antimicrobial resistance among *Salmonella* strains that caused outbreaks, United States, 2004–2008

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**Background:** Investigations of foodborne outbreaks of *Salmonella* infections provide information about the major food vehicles. Testing outbreak isolates for antimicrobial susceptibility can help determine which food vehicles are commonly associated with resistant strains. We described antimicrobial resistance among *Salmonella* outbreaks.

**Methods:** Local, state, and territorial health departments reported *Salmonella* outbreaks to CDC through the Foodborne Disease Outbreak Surveillance System. CDC categorized foods implicated in outbreak reports into 17 commodities. States submitted outbreak isolates to the National Antimicrobial Resistance Monitoring System for susceptibility testing to 15 agents using broth microdilution. We linked outbreak data to isolate resistance data using a combination of variables including outbreak identification number, state, year, month, and serotype. We used the PulseNet-assigned *XbaI* pattern and cluster code to validate isolates as being part of an outbreak.

**Results:** During 2004–2008, 592 non-typhoidal *Salmonella* outbreaks with known serotype information were reported and 484 outbreak isolates were received. We linked 103 (17%) outbreaks to 402 (83%) outbreak isolates. Among the 47 outbreaks attributed to a single food commodity, 8 (17%) were caused by a resistant strain. Four (50%) of these 8 were caused by strains that were resistant to ≥5 agents. Six (75%) of 8 outbreaks caused by resistant *Salmonella* and 22 (56%) of 39 outbreaks caused by pansusceptible strains were attributed to land animal commodities (e.g., beef, poultry, eggs, dairy) (p=0.44).

**Conclusions:** A somewhat higher proportion of outbreaks caused by resistant than pansusceptible *Salmonella* were attributed to land animals. However, the small proportion of outbreaks that had isolates submitted for antimicrobial resistance testing indicates that those studied may not be representative of all outbreaks. Obtaining antimicrobial resistance data on all *Salmonella* outbreak isolates and collecting this information in outbreak reports will inform analyses of associations between commodity groups and resistance.
Outbreaks associated with FDA/CFSAN-regulated foods: 1996-2010

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Coordinated Outbreak Response and Evaluation Network (CORE)
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Background:
Each year multiple foodborne illness outbreaks associated with FDA-regulated products are reported. This poster presents information on outbreaks reported to FDA’s Center for Food Safety and Applied Nutrition (CFSAN) from 1996-2010.

Methods:
Outbreaks are reported to FDA by CDC, State/Local Health Departments and FDA District Offices and are entered into an Epi Info™ database (2004-2010) if an FDA/CFSAN-regulated product is implicated in causing human illness. Information on outbreaks/illnesses before 2004 was compiled from paper records. The data exclude information on outbreaks/illnesses where the point of contamination is the retail food setting or home, and illnesses transmitted from person-to-person. The data also exclude sporadic Vibrio infections. Due to lags in reporting of illnesses, some differences in numerical tallies may exist between FDA and CDC data.

Results:
Between 1996 and 2010, a total of 562 outbreaks involving FDA/CFSAN-regulated products were reported to the Agency, involving a total of 33,288 cases of human illness. During this time period, outbreaks associated with eggs/egg products (37.4%), seafood (26.3%), and produce (17.3%) accounted for the greatest number of outbreaks, while produce (36.0%), eggs/egg products (27.5%), and processed foods (17.4%) accounted for the greatest number of illnesses. Bacteria were implicated most often as the cause of outbreaks during this time period (70.7%). In addition, bacterial agents accounted for 73.1% of the illnesses associated with outbreaks between 1996 and 2010, while parasitic agents, viral agents, and chemical/toxin agents accounted for a minority of the illnesses.

Conclusion:
Outbreaks associated with bacterial agents have constituted the majority of reported outbreaks and outbreak-associated illnesses reported to FDA/CFSAN between 1996 and 2010. While a variety of products are implicated, produce, eggs/egg products, and processed foods accounted for the greatest number of foodborne illnesses.
Introducing FDA’s Coordinated Outbreak Response and Evaluation Network (CORE) - A New Approach to Managing FDA’s Foodborne Outbreak Surveillance, Response and Post-Response Efforts

Poster Presenter:

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Background:
In August, 2011, FDA will officially launch CORE, the Coordinated Outbreak Response and Evaluation Network. CORE was created to manage surveillance, response, and post-response activities related to incidents of illness linked to FDA-regulated human and animal food. The goal of the CORE Network is to streamline incident-related processes, which were previously dispersed throughout the FDA, and to enhance transparency and working relationships with our internal and external stakeholders.

Methods:
In September 2010, a workgroup was launched by FDA to coordinate and implement the logistics associated with creating a new FDA organizational unit. This new unit would be responsible for surveillance, coordination of response efforts, and post response activities for outbreaks of illness associated with human and animal food. In accordance with parameters set forth by Mike Taylor, FDA’s Deputy Commissioner for Foods, the new foodborne outbreak team would: retain established best practices regarding response and investigation of foodborne outbreaks, incorporate lessons learned from previous response efforts, and expand our monitoring and post-response capabilities.

Results:
The CORE Network is located within FDA CFSAN and is lead by the CORE Chief Medical Officer. CORE is organized into two primary areas of operation: Prevention and Response.

The Prevention function is comprised of two multidisciplinary teams, a Signals and Surveillance Team and a Post-Response Team, which are dedicated to surveillance and detection of potential incidents, conducting environmental assessments, documenting lessons learned, collaborating on policy recommendations, and publishing findings.

The Response function is comprised of three multidisciplinary Response Teams that are assigned to respond to incidents on a rotational basis to ensure continuity of effort and promote strong team building, both within CORE and with our stakeholders. The Response Teams coordinate, facilitate and collaborate with internal and external partners to respond to incidents related to illnesses associated with human and animal food. Each
Response Team includes a Team Leader and expertise in epidemiology, environmental health, lab science, and emergency coordination.

**Conclusion:**
The goals of CORE are goals all of us at FDA share when outbreaks occur: streamlined decision-making and quicker response time; seamless coordination and enhanced communication; and, ultimately, even better public health protection and preventive food safety policies.
Title: FDA Rapid Response Teams Project – Working with Partners to Improve Responses to All-Hazards Food and Feed Emergencies.

Authors: Shuen G. Chai, Joseph Reardon

Affiliation: US Food and Drug Administration

Background: Over the past several years, improving the national food safety and defense system across its many stakeholders has continued to be a key national interest, as demonstrated by efforts such as the President’s Food Safety Working Group and the Food Safety Modernization Act.

The FDA Rapid Response Teams (RRT) Project seeks to develop best practices and models of state food program infrastructure and multi-jurisdictional responses for all-hazards food and feed emergencies.

Methods: The RRT Project is a three to five year cooperative agreement between FDA and nine selected pilot states: California, Florida, Massachusetts, Michigan, Minnesota, North Carolina, Texas, Virginia, and Washington. Recipients receive up to $500,000 a year to work to strengthen state food safety program infrastructure to national standards and to collaborate with their food safety partners (e.g., laboratories, epidemiologists, local jurisdictions, industry, law enforcement) to build foundational and innovative capabilities for responding to food and feed emergencies.

Examples of activities include conducting multiagency meetings, improving training programs, exploring information sharing tools, exercising response plans, and incorporating Incident Command System (ICS) concepts. These RRTs also work in multi-disciplinary working groups to identify and document project-wide best practices and metrics for these capabilities.

Results: The nine pilot RRTs have each made significant progress in developing both foundational and innovative response capabilities and infrastructure within their states. The RRTs have also completed a nationally reviewed, seven-chapter manual of best practices, which shares concepts and tools that these RRTs have found to be key to their effective responses to food/feed emergencies.

Conclusions: These nine pilot RRTs are demonstrating continually accelerating progress in their successful development of models of rapid response and food program infrastructure. These models will serve as the basis for building improvements in programs across the nation in the coming years.
**Foodborne Disease Outbreak Investigation System**

**Authors:** Cyrus Chee, Palantir Technologies; Andrew Girvin, PhD., Palantir Technologies; Casey Ketterling, Palantir Technologies

**Background**
Between August 2010 and February 2011, the Outbreak Response and Prevention Branch of the Centers for Disease Control and Prevention launched the Foodborne Disease Outbreak Investigation System (FDOIS). FDOIS helps the CDC understand outbreaks in real time. Using the Palantir enterprise platform as infrastructure, FDOIS allows CDC analysts to integrate multiple data sources, analyze them, visualize them, and collaborate securely with state health departments and regulatory agencies.

**Methods**
Palantir allowed the CDC to integrate several key datasets into one analytical environment, including PulseNet, National Outbreak Reporting System (NORS), outbreak investigation details and hypothesis-generating survey results. Epidemiologists can rapidly analyze this data using a variety of Palantir applications. Outbreaks can be studied geospatially by dragging individual isolates from the graph application to the map. Isolates can be aggregated by geographic region to generate choropleth maps that are animated over time. The Dashboard application provides a quick overview of vital statistics, allowing for easy comparison of different groups of isolates within an outbreak. Finally, data can be exported as simple tables for use in spreadsheets, as template reports or as slides in presentations.

**Results**
Palantir currently has 51 registered users at the CDC. The data sets incorporated include: 169,173 PulseNet isolates from 2005-2011, scrubbed of zip codes, keys and precise isolate dates, 7,981 PulseNet outbreaks, 12,380 NORS outbreaks, and the full results from two hypothesis-generating surveys. Data can be imported manually into the system or synchronized against databases. The system was successfully tested with an outbreak simulation in which epidemiologists from six FoodCORE sites logged on and updated data on isolates from their states while securely viewing read-only data from other states. Palantir has been used repeatedly to answer queries on the historical trends of different pulsed field gel electrophoresis (PFGE) patterns.

**Conclusions**
The Foodborne Disease Outbreak Investigation System provides numerous enhanced capabilities, leveraging the Palantir enterprise platform to track the spread of the disease over time, perform traceback analysis, and help state and local health authorities collaborate securely.
Surveillance for gastrointestinal illness outbreaks, Puerto Rico, 2008-2010

Background:
Gastroenteritis is an important cause of illness in Puerto Rico (PR). The PR Department of Health (PRDOH) receives weekly reports from health care providers on the number of gastroenteritis cases. These reports ranged from 1,898 cases in week number 1 in January 2010 to 8,040 cases in week 14 in April 2010. However, much of these cases are considered sporadic and only a small proportion is identified as associated with outbreaks.

Methods:
This summary includes outbreaks reported from 2008 to 2010. Gastrointestinal illness outbreaks are investigated at the regional level and are notified to the state coordinator who gives advice and guidance and leads complex investigations. Reported outbreak data include the number of illnesses, hospitalizations and deaths associated with each outbreak; the etiologic agent, either confirmed or suspected and the primary mode of transmission among other variables. Population-based rates of reported outbreaks were calculated. Data analysis was performed with Epi Info.

Results:
Preliminary analysis shows that a total of 71 gastrointestinal illness outbreaks were reported to the PRDOH during the period 2008 to 2010. On 2008, 33 outbreaks were investigated, 16 on 2009 and 22 on 2010 with rates of 0.8, 0.4 and 0.6 per 100,000 population, respectively. The number of outbreaks reported by each of the eight health regions varied from 3 to 17 during 2008-2010. 56% of the outbreaks involved less than ten cases. Drinking water was identified as the primary mode of transmission in an outbreak of 2008 with confirmed etiology cyclospora and recreational water in an outbreak of 2009 with suspected etiology norovirus. On 2010, an island wide norovirus outbreak was investigated. Food was the primary mode of transmission in some outbreaks but the mode of transmission was indeterminate in several investigations.

Conclusions:
Surveillance for gastrointestinal illness outbreaks provides valuable information for prevention and control strategies. The delayed in reporting illnesses to the health department influences the capacity to identify the etiology, the mode of transmission and the vehicle.

Authors:
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Title: Standardize Outbreak Investigation Forms: Feasible in a large state with local rule?

Authors: Dina Hoefer, Madhu Anand, David Nicholas, Jessica Egan, Eric Wiegert, and the NYSDOH Forms WorkGroup.

Affiliation: New York State Department of Health (NYSDOH)

Background: In New York State (NYS), investigations of localized outbreaks are lead by local health department (LHD) staff. The goal of any outbreak investigation is to identify the cause of the outbreak, implement interventions to stop the spread of disease and gain knowledge to prevent future outbreaks. Standardized questions that use the same wording to collect information about specific exposures and standard variable attributes enhance analysis, data sharing, and the comparison of exposures across outbreaks and jurisdictions, as well as decrease time to develop forms and prevent errors in data collection. Although many similarities exist, there is no one set of standard questions used by all LHDs in NYS at this time. Moreover, there is no standard method of collecting, entering, and analyzing this data.

Methods: Over a one year period, NYSDOH epidemiologists and sanitarians worked together to develop standard forms that would need minimal modification at the onset of an outbreak investigation. The first step was the development of modules that could be shared across all forms. These modules were then assembled into full paper-based questionnaires. A guidance tool was also developed that states the purpose of each form and how to implement the form. Select forms have been field tested by LHDs during recent outbreak investigations.

Results: Fourteen modules and 6 standard paper questionnaires were developed. The questionnaires include: Gastrointestinal (GI) Hypothesis Generating Questionnaire (HGQ); GI Menu Specific; GI Resort/Event; GI Animal Exposure; Rash/Respiratory HGQ; Rash/Respiratory Event Specific. Limited feedback has been received at this time from LHDs; mostly focused on time needed to administer the questionnaire and need for additional guidance on how to use the forms appropriately.

Conclusion: NYSDOH will continue to work with LHDs to modify forms, initiate electronic development of the forms onto the statewide Communicable Disease Electronic Surveillance System (CDESS), and train staff on using forms during outbreak investigations.
**Title:** Tracking PFGE Clusters in a high volume state

**Authors:** Madhu Anand¹, Dina Hoefer¹, Jamie Sommer¹, Alexandra Newman¹, Bryon Backenson¹

**Background:** Since 2003, New York State Department of Health (NYSDOH) Wadsworth Center Laboratory (WC) has notified the NYSDOH Bureau of Communicable Disease Control (BCDC) of pulsed field gel electrophoresis (PFGE)-matching *Listeria, E.coli*, and *Salmonella* isolates. BCDC ensures investigations of PFGE-matching cases are completed so common exposures may be identified. PFGE data are also used to identify cases linked to multi-state clusters. Prior to 2010, BCDC had no formal process for tracking PFGE cluster investigations, linking PFGE patterns and cluster codes with electronic case investigation data, determining the outcome of PFGE investigations, or analyzing PFGE cluster investigations.

**Methods:** In 2010 BCDC created a database (DB) to record summary information on PFGE clusters. Clusters were defined as ≥2 two-enzyme matching cases within 60-90 days for *Listeria* and 60 days for *E. coli*, and ≥2 one-enzyme matching cases within 60 days for *Salmonella*. A PFGE analyst manually enters data into the DB for newly identified clusters and leads the cluster investigation until completion. PFGE patterns and cluster codes are entered into individual case investigation records to allow analysis of cluster demographic and exposure data.

**Results:** Between 7/1/10 and 7/1/11, 182 clusters were entered into the DB (6 *Listeria*, 21 *E. coli*, 155 *Salmonella*). Reports were generated and shared with investigation partners to assist in cluster follow-up, designating the outcome of the investigation, completing National Outbreak Reporting System forms, and characterizing BCDC workload. From 7/1/10–12/31/10, a common source was identified for 12/122 clusters. Summaries of data from the DB have been provided to NYSDOH administrators to justify personnel and equipment expenditures.

**Conclusion:** The DB has allowed BCDC to identify and track 182 clusters and generate reports which describe cluster investigations. The DB will be maintained and thresholds for investigation will be established. Data will be used to justify continued support of PFGE-based investigation.

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Evaluation of enteric disease laboratory reporting in New York City

**Background:**
The New York City Department of Health and Mental Hygiene (DOHMH) receives reports of notifiable diseases from laboratories and healthcare providers. We evaluated timeliness and completeness of laboratory and provider reporting for selected enteric diseases to determine whether both reports are necessary for high quality surveillance.

**Methods:**
Clinical laboratories are mandated to report electronically. Reports are uploaded to DOHMH’s Communicable Disease Surveillance System. Healthcare providers report via internet, mail, fax, or phone, and reports are manually data entered by DOHMH personnel. We analyzed reports of confirmed cases of hepatitis A, *Salmonella*, *Shigella*, *Campylobacter*, *Listeria*, *Vibrio*, and Shiga toxin-producing *Escherichia coli* infections diagnosed in 2010. Timeliness was assessed by comparing date of diagnosis to date of data entry into DOHMH’s systems. We defined a complete report as one containing patient name, date of birth, sex, street address, and zip code.

**Results:**
In 2010, 7,868 reports accounted for 3,008 cases. Of 7,868 reports, most (81%) were reported by laboratories. Of 3,008 cases, 1,721 (57%) were only reported by laboratories, 156 (5%) were only reported by providers, and 1,131 (38%) were reported by both. Eighty-eight (56%) of the cases reported only by providers were campylobacteriosis and were predominantly from one facility. For enteric diseases other than *Campylobacter*, 68 (2%) cases were reported only by providers. Of the 1,131 cases reported by both laboratories and providers, 749 (66%) were first reported from a laboratory. Laboratory reports were also faster (median of 8 days versus 9 days) and more complete (93% versus 86%) than provider reports.

**Conclusions:**
Most enteric disease reports were received from laboratories, and laboratory reports were more timely and complete than provider reports. Given the burden to providers of reporting and increasing use of electronic laboratory reporting, health departments should consider eliminating provider reporting of diseases that are reliably reported by laboratories. For jurisdictions with reliable electronic laboratory reporting systems, provider reporting should be limited to diseases, such as botulism, that require emergent public health response and/or that are initially diagnosed based on clinical criteria.

**Authors:**
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Title: Data ex nihilo: Creating an interview, laboratory and case report-specific dataset for FoodCORE metric reporting and quality assurance.

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Background: During the first year of the FoodCORE project the need to develop a system to collect interview data on the Salmonella, STEC and Listeria (SSL) cases was identified. Electronic data systems for case reporting of SLL’s, serotype and pulse-field gel electrophoresis (PFGE) testing were already place. No system existed to collect FoodCORE interviews electronically. This new system would allow for timely analysis to ensure quality of the data and reporting of grant metrics to CDC.

Methods: In order to assess the timeliness, completeness and quality of data and enhance the ability to rapidly analyze data for metric reporting, fillable *.pdf versions of the interview tools used for SSLs were created in collaboration with the CDC OutbreakNet staff. All variables present in these fillable *.pdf documents were mapped to allow for xml import into a SQL database. A business process was established where regional FoodCORE staff responsible for performing SSL interviews submit the completed *.pdf form to a secure agency email address. Data collected from the interviews were linked to case reports received into the Carolinas Health Electronic Surveillance System and also an existing Excel spreadsheet used by the SC DHEC Bureau of Laboratories to compile PFGE results from SSL isolates. Data are analyzed using SQL queries and SAS. Analysis included both FoodCORE grant-specific metric measures and quality assurance measures related to data collection.

Results: Quality assurance measures reports are run weekly and information provided to the regional FoodCORE staff via conference calls for. FoodCORE metric measures are run monthly and shared with Program staff and reported quarterly to the CDC.

Conclusions: These systems ensure timely submission of interview data and allow for data analysis of data housed in several systems. This methodology is also being explored for use in the future on other enteric diseases.
Title
Standardized Statewide Electronic Risk Factor Data Collection for Shiga Toxin-Producing Escherichia coli (STEC) in Florida

Authors
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Background
A recent large outbreak of E. coli O104:H4 and hemolytic uremic syndrome in Germany and France highlights the critical importance of continuous public health surveillance and rapid epidemiologic investigations to identify outbreaks. In Florida, delays in laboratory diagnosis and subtyping make case investigations critical to identify outbreaks. To address this, Florida integrated a standardized STEC case report form into our statewide web-based reportable disease surveillance system (Merlin).

Methods
STEC case reports and laboratory results are entered into the web-based notifiable disease surveillance system (Merlin) by county-level investigators, with state-level case review. In June 2009, an additional screen was added to STEC cases in Merlin to electronically capture risk factor data from Florida’s standardized paper case report form. Additional exposures can be added to the screen ad hoc and changes are immediately accessible to all Merlin users. Data collected from June 1, 2009-May 31, 2011 were reviewed.

Results
From June 1, 2009-May 31, 2011, a total of 499 STEC cases were reported in Florida, of which 438 (88%) were interviewed. A total of 311 primary, Florida-acquired cases were reviewed. Median time from disease onset to interview was 17 days. A total of 38 (12%) were reported as outbreak-associated (only primary cases were included in summary). The most common risk factors reported were: 77% consumed or handled meat products, 73% consumed fruits/vegetables, 48% consumed food at a restaurant, and 41% were exposed to animals. Differences in incidence and exposures for 311 primary, Florida-acquired cases by age, gender, race, and season will be presented.

Conclusion
Adding the extended data screen in Merlin allows county users to enter risk factor data in an environment used routinely, and data is immediately available in a statewide standardized electronic format. Capturing risk factor data electronically allows for real-time analysis of data collected across the state, so that outbreaks can be identified quickly, particularly in the absence of timely laboratory data.
Title: Outbreak of *Escherichia coli* O157:H7 associated with a recreational water facility in Alabama, 2011

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Background
On June 20, 2011, two pediatric patients presenting with bloody diarrhea, fever, and abdominal cramps were reported as having visited a recreational water facility (RWF) in Lee County, Alabama. This RWF features a large indoor pool, hot tub, concession stand, and a large interactive outdoor splash area for children.

Methods
Area surveillance staff and environmentalists conducted an investigation on the RWF and individuals who were associated with the RWF between the dates of June 4 and June 24, 2011. Information from 91 individuals was gathered. Stool specimens from 6 individuals were collected for culture with Pulsed Field Gel Electrophoresis (PFGE) testing on positives. Water samples from multiple sites at the RWF were collected for testing.

Results
Six confirmed *Escherichia coli* O157:H7 and 13 probable cases were identified with symptom onsets ranging from June 7 to June 22, 2011. Four children (21%) developed hemolytic uremic syndrome (HUS). PFGE results on five cases revealed two separate DNA fingerprints. Four had patterns indistinguishable from each other and one was unique. All water samples were negative for *E. coli* detection. Epidemiological analysis showed relative risks that were statistically significant for exposure to the indoor pool and exposure on the dates of June 9, 12, 14 and 16, 2011. The splash area showed borderline statistical significance. Exposure to both the indoor pool and the splash area showed the highest relative risk. Chlorination records of the RWF revealed many instances of suboptimal chlorination.

Conclusions
This was the first recorded outbreak of *E. coli* O157:H7 associated with a recreational water facility in Alabama. Investigation strongly suggests exposure to the indoor pool and splash area at the RWF facilitated the transmission of *E. coli*. 
Multi-state outbreak of *E. coli* O145:NM associated with romaine lettuce – Michigan, 2010

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**Background**
Incidence of non-O157 shiga toxin-producing *E. coli* (STEC) infection may be similar to or greater than that of O157 STEC infection, when laboratory methods sufficient for detection are used. Non-O157 STEC serotypes have thus far been associated with fewer foodborne outbreaks than O157 STEC. On April 15, 2010, a cluster of cases of bloody diarrhea was reported by a university health service and hospital to Washtenaw County Public Health (WCPH), representing the first indication of an outbreak of *E. coli* O145 in Michigan and subsequently four other states.

**Methods**
A case-control study was conducted among individuals associated with the university who consumed food from a local outlet of a Mexican-style chain restaurant. Environmental assessments were conducted at two locations of the chain. Food samples collected from the restaurant and leftover burritos from a university luncheon supplied by the restaurant were tested for STEC. A product traceback was performed to determine the source of the burrito ingredients.

**Results**
Twenty-five Michigan residents were identified as part of the outbreak (12 confirmed, one probable, and 12 suspect cases). The case-control study implicated romaine lettuce served by the restaurant chain (\(p=0.007\)). No other food item was associated with illness. Both locations of the chain were supplied with shredded romaine lettuce from a single processor in Ohio during the outbreak period. Food samples in Michigan were found to be negative for STEC.

**Conclusions**
This was the first documented foodborne *E. coli* O145 outbreak in the United States. Leafy green produce should be considered a potential vehicle in non-O157 STEC infections. CDC-recommended laboratory testing methods capable of detecting all STEC serotypes are crucial in recognizing the true burden of non-O157 STEC infections and detecting outbreaks.
Four cases of Ciprofloxacin-resistant shigellosis in New York City
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Background: Shigellosis is the third most common enteric bacterial infection in the United States (US). Although infection is generally self-limiting, empiric treatment is often started for diarrheal illness. Risk groups for infection include young children, men who have sex with men (MSM), and international travelers. Resistance to ciprofloxacin, often first line treatment for diarrheal illness, is increasing among *Shigella*. Among 2006-09 shigellosis cases in New York City (NYC), high levels of antibiotic resistance were detected, including 5 cases of non-travel associated ciprofloxacin-resistant *Shigella*, the first detected in the US. As a result, NYC is routinely tracking resistance in *Shigella* isolates.

Methods: In NYC, clinicians and laboratories are required to report laboratory-confirmed shigellosis. Isolates are forwarded to the Public Health Laboratory to confirm they are *Shigella*, for serogrouping, and for antibiotic susceptibility testing. Pulsed field gel electrophoresis was performed on three isolates that were ciprofloxacin resistant and clustered within a three week period. All patients with ciprofloxacin-resistant isolates were interviewed with a standard questionnaire to assess antibiotic use and international travel before illness.

Results: Among 122 *Shigella* isolates tested from January 1- June 27, 2011, 4 (3%) were resistant to ciprofloxacin. Case patients’ ages were 5, 43, 46 and 54 years; 2 were male. Two case patients reported international travel to areas of endemic resistance and were treated with antibiotics while abroad; PFGE patterns of these 2 isolates were indistinguishable. Of the remaining 2 patients, one was MSM and had no known travel; the other reported no travel or antibiotic use before illness.

Conclusion: Ciprofloxacin-resistant *Shigella* cases with no travel history to endemic regions or recent antibiotic use are now being detected in NYC. Most cases of shigellosis are self-limited, and do not require treatment unless illness is severe. Other jurisdictions, especially urban centers with high-risk groups, should consider monitoring ciprofloxacin resistance.
Assessing the Impact of Florida’s 2011 Campylobacteriosis Case Definition Change

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While not nationally notifiable, campylobacteriosis is reportable in nearly all states, including Florida. Due to the increased use of non-culture laboratory methods, Florida modified its case definition in January 2011. The revised case definition took into account both traditional culture-based methods and the use of non-culture methods (antigen detection) in place of culture for diagnosis of *Campylobacter*.

Methods
Campylobacteriosis case reports and laboratory results are entered into the web-based notifiable disease surveillance system (Merlin) by county health department (CHD) staff. *Campylobacter* laboratory results associated with reported cases for 1/1/11-6/27/11 were reviewed. Three types of evaluations were conducted: 1) entries in laboratory notes were compared to test type responses to determine test type selection accuracy; 2) laboratory test type was compared to case classification to determine case classification accuracy; and 3) a sample of 6 CHDs were surveyed to assess the work-load associated with the case definition change.

Results
A total of 1,056 cases and 1,120 associated laboratory results were reported from 1/1/11-6/27/11. Errors in assigned test type were identified in 125 laboratory results (11%) and errors in case classification were identified in 63 cases (6%). The case definition change resulted in the reporting of 288 additional probable cases, with no decrease in confirmed cases. The survey of CHDs indicated that each case takes an average of 1.75 hours, resulting in an additional 504 hours of case work this year statewide (19 hours/week).

Conclusions
In Florida, there is an increased use of non-culture testing methods for the identification of *Campylobacter*. The wide-spread adoption of these methodologies should be taken into account when determining which cases to investigate and document. Based on the findings of this review, training was conducted for case investigators on laboratory testing methodologies for *Campylobacter* identification and the case definition.
Title: Campylobacter outbreak among students consuming raw milk during a field trip

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Background: On Dec. 9th 2010, the Vermont Department of Health received reports of a middle-school student and teacher presenting to an emergency department with gastrointestinal symptoms. Both reported going on a field trip to a dairy farm where they consumed raw milk. Both tested positive for *Campylobacter jejuni*.

Methods: The school nurse, the principal, and the teachers were interviewed. All field trip attendees were asked to complete a questionnaire containing questions about clinical symptoms and exposures prior, during and following the field trip. A case was defined as an attendee of the farm field trip with onset of diarrhea between Dec. 4th and Dec. 10th 2010 or a laboratory-confirmed positive stool sample for *Campylobacter jejuni*. During an inspection of the farm, environmental, fecal and bulk tank milk samples were collected for *Campylobacter jejuni* testing at the VDH and NYSDOH laboratories.

Results: Among attendees of the field trip, 35 (54%) students and 7 (100%) staff completed a questionnaire. Eleven people met the case definition for this study, and all 11 cases reported drinking raw milk during the field trip. Of the 11 cases, 7 (64%) reported drinking more than one cup of raw milk as compared to 20% of controls (relative risk of illness 2.8, 95% CI 1.1, 7.2). The campylobacter isolates from the student and teacher matched two isolates collected from the farm when analyzed by pulsed field gel electrophoresis (PFGE). At the time of this report, 26 environmental isolates have been analyzed by PFGE. Of these isolates, 6 (23%) were newly identified patterns and 3 (12%) were previously shown to be associated with raw milk exposure. *Campylobacter sp.* was not isolated from the milk samples.

Conclusions: This was a small campylobacter outbreak in students and school staff who visited a local farm. Although the study was too small to be definitive, and the proportion of survey responses was low, consumption of raw milk was the most likely route of exposure.
**Clostridium perfringens at a Juvenile Correctional Facility, Kansas, May 2011**

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**Background:** On May 26, 2011 the Kansas Department of Health and Environment (KDHE) was notified of a foodborne disease outbreak among residents and staff of a juvenile correctional facility that occurred on May 25, 2011. The facility had experienced a similar outbreak in April 2011 that had gone unreported. A public health investigation was initiated to determine the source of illness and to provide prevention and control recommendations to the facility.

**Methods:** A cohort study was conducted. Residents and staff were interviewed in person and given a self-administered questionnaire. A case was defined as an individual who experienced diarrhea at least five hours after eating lunch at the correctional facility on May 25. Food samples were collected and tested at a private laboratory. The Kansas Department of Agriculture conducted a courtesy inspection of the facility.

**Results:** Of the 175 individuals interviewed, 152 reported illness and 115 met the case definition. Twenty-two individuals had incubation periods between 0-3 hours after the lunch meal and were excluded from this analysis. The most commonly reported symptoms were diarrhea, abdominal cramps, and nausea. Median incubation period was 11.5 hours (range 5 - 36 hours). The chili macaroni that was served for lunch was significantly associated with illness and tested positive for *Clostridium perfringens*. Upon inspection seven critical violations were observed, including improper hot and cold holding temperatures.

**Conclusions:** This outbreak likely caused by *C. perfringens* was associated with the consumption of chili macaroni served at lunch. In addition, 22 individuals became symptomatic within three hours of this meal which could indicate that a food item from May 24 might have also been contaminated. Given the results of this investigation, two similar outbreaks occurring within two months, a food service that is self-regulated, and significant food handling errors observed, KDHE recommends routine third-party food safety inspections to help identify equipment issues and improper food handling practices to ensure the safety of the foods served to children in their custody.
Trends in Salmonellosis, Pennsylvania, 2000 to 2010

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Background: Salmonella is one of the most common food-borne diseases, and a frequent cause of food-borne outbreaks.

Methods: Data from 2000-2002 were extracted from Pennsylvania’s legacy reportable disease surveillance application (PETSS) and combined with more recent data from the state’s current web-based disease surveillance system (PA-NEDSS) to provide annual Salmonella case counts for the past decade. Annual incidence rates were calculated per 100,000 population using U.S census data for 2000 and 2010, and intercensal estimates for the other years. Age-specific incidence rates per 100,000 person-years were calculated through 2009, the most recent year for which age-specific state population data are available.

Results: A total of 19,037 confirmed or probable Salmonella cases were reported from 2000 to 2010. During that time the incidence of salmonellosis increased from 11.3 to 15.0 cases/100,000. The highest rate was 16.4/100,000 in 2004, which was a year with three large tomato-related Salmonella outbreaks. Salmonellosis incidence was significantly higher among children age under 5 years compared to older persons (52.9 vs. 11.3 cases per 100,000 person-years, p<0.0001). A total of 995 cases (5.2% of all cases) were part of known Salmonella outbreaks. The proportion of outbreak-associated cases from 2004-2010 was significantly higher than in 2000-2003 (7.0% vs. 1.7%, p<0.0001). Extensive molecular typing of Salmonella isolates using pulsed-field gel electrophoresis (PFGE) began at the Pennsylvania state public health laboratory in 2004.

Conclusions: Salmonella continues to cause food-borne disease and outbreaks every year. The proportion of cases associated with outbreaks has increased over the past decade. This is likely a reflection of improved outbreak identification due to the increased use of molecular techniques.
Title
Case-Control Study of Sporadic Salmonellosis Cases in Florida: Early Results

Authors and Affiliations
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Background
During 2009, Florida reported 6,741 salmonellosis cases, more than any other state. The increase in cases in 2009 was concentrated in Central Florida and among infants and children. In Florida, approximately 90% of reported salmonellosis cases are not part of a recognized outbreak. In response to this issue, the Florida Department of Health initiated a case-control study to determine risk factors for sporadic cases of salmonellosis in children <5 years old in eight Central Florida counties.

Methods
Planning for the study consisted of creating a steering committee, establishing communication with participating counties and laboratories, developing and piloting a questionnaire, and determining the best control enrollment method. The study’s goal was to enroll 200 cases and 400 controls among those <5 years old residing in eight counties from Oct, 2010 to June, 2011. Cases and controls were frequency matched on age-group and interview month. The initial control enrollment method depended on targeted lists of land-line telephone numbers supplied by a commercial vendor.

During the study, enrollment data were routinely monitored. Inadequate control enrollment was discovered. In response, the primary control enrollment method was changed to a combination of targeted phone lists and birth certificate information (for controls under one year old)

Results
Data collection concluded in June of 2011 with enrollment of 200 cases and 407 controls. Some preliminary case findings: 79% used diapers, 25% attended daycare, and 33% rode in a grocery cart with meat or poultry. Serogroup D1 was the most common serogroup, accounting for 34% of all cases. The average time to complete one control interview for <1 year olds decreased from 30 hours to 1 hour with the change of enrollment method. Complete study results will be available in late 2011.

Conclusions
The knowledge gained from this study will be applied to future salmonellosis prevention efforts. Similar projects in future should conduct pilot studies to determine effective control enrollment methods as well as identify other challenge areas.
Outbreak Investigation of Human Salmonellosis Enteritidis Infection: Using Geographic Information System (GIS) and Pulsed Field Gel Electrophoresis (PFGE) Uploaded to PulseNet

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BACKGROUND: Through routine disease surveillance, the Barren River District Health Department’s Communicable Disease (CD) Team noted an increase in Salmonella cases in Hart County, Kentucky. Typical baseline rates for Hart County are 1-2 cases per year. By March 25, 2011 six cases were reported in Hart County, with two additional cases in neighboring Barren County.

METHODS: The CD Team conducted telephone interviews and medical record reviews of confirmed cases. Information was tabulated into Excel and analyzed using Epi Info. We used Geographic Information System (GIS) software to compare case locations with natural and manmade ground features.

RESULTS: This outbreak was initially identified as a typical cluster, but after GIS analysis revealed geographic proximity of the cases, further analysis was performed. The Kentucky Department for Public Health, Division of Laboratory Sciences (DLS) identified eight cases of Salmonella Enteritidis with xbal-pattern match for Pulsed Field Gel Electrophoresis (PFGE). Five cases were in Hart County, two in Barren County and one in Laure County, which borders Hart County. One Hart County case did not match the PFGE pattern.

Even though the xbal-pattern matched an ongoing outbreak in Wisconsin and Illinois, potentially linked to guinea pig exposure, the Center for Disease Control and Prevention (CDC) did not consider ours to be a match because they were only looking at the blnl-pattern matched cases. Using routine public health surveillance, and modern technology such as GIS and PFGE uploaded to PulseNet, we were able to determine that this was an outbreak.

CONCLUSION: This situation illustrates the importance of local health departments maintaining epidemiology capacity, establishing baseline data on all reportable diseases, and working closely with the state lab. Tools like GIS and PFGE can be used to identify relationships that are often overlooked. Disease investigators should correlate epidemiological investigation with laboratory findings and modern technology to assure a thorough investigation.
Outbreak of *Salmonella* Paratyphi B Variant L Tartrate + among Elementary School Students: Discordant Results for Interviews vs E-Ticket

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**Background:** During September 2010, an outbreak of *Salmonella* Paratyphi B Variant Tartrate + occurred in a central Oklahoma school system. An epidemiologic, environmental, and laboratory investigation ensued to determine the source.

**Methods:** A case-control study was conducted. Students were interviewed regarding food history and social activities from August 31 to September 13, 2010. A case was defined as laboratory confirmed *Salmonella* Paratyphi B Variant L Tartrate + with XbaI pattern JG6X01.0007OK and BlnI pattern JG6A26.0016OK. Probable cases had three or more days of diarrhea or bloody diarrhea that occurred between August 31 and September 13, 2010. The Acute Disease Service (ADS) conducted in-person and telephone interviews with the student and parent. ADS staff obtained school absentee and electronic meal ticket records to validate responses regarding school meal consumption. Individuals with discrepancies between the interview and school records were re-interviewed.

**Results:** Fourteen (21%) of the 68 elementary students interviewed were classified as confirmed (n = 9) or probable (n = 5) cases. Analysis of food items revealed elevated odds of consuming lettuce (OR = 2.3, 95% C.I. 0.58-9.43) served on the taco salad and watermelon (OR = 2.55, 95% C.I. 0.58, 11.08) among the cases compared to the controls. None of the school food items were significantly associated with illness among cases compared to controls. Electronic meal ticket records revealed 32 (47%) out of 68 children provided at least one incorrect response. Twenty-eight (5.5%) of 513 responses indicated the child ate, although records showed the child was absent or did not eat. Twenty-four (4.7%) of 513 responses indicated the child did not eat, although records showed the child did eat.

**Conclusions:** The electronic meal tickets and absentee records were useful tools to validate food histories from school-aged children. These resources are especially valuable if an extended period of time has elapsed between exposure and interview.
Investigation of a Salmonella anatum Outbreak in a Catered Luncheon in Houston, Texas.

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BACKGROUND: On February 24, 2011, more than 100 persons developed gastroenteritis after eating a catered luncheon, served to approximately 400 office workers in a high-rise building in Houston. No complaints were filed. On March 22, 2011, the Houston Bureau of Laboratory Services reported a Salmonella PFGE cluster (pattern JAGX01.0013) of three cases to regional epidemiologists; each case resided in a different health department jurisdiction. The first interview was conducted by Texas Department of State Health Service (DSHS) on March 28, 2011; the case-patient reported that she had attended the catered luncheon. The other two cases - one investigated by Houston Department of Health and Human Services (HDHHS) and the other by Harris County Public Health and Environmental Services (HCPHES) - reported eating at the same luncheon.

METHODS: A teleconference was held among the three health departments and the investigation was divided. HDHHS e-mailed a questionnaire to luncheon attendees to ascertain case status and food items consumed. DSHS assisted with interviews. HCPHES sanitarians conducted an on-site inspection of the caterer. Data on returned questionnaires were analyzed. The PFGE pattern was submitted to PulseNet.

RESULTS: Sixty questionnaires were received; eight were excluded and fifty-two were analyzed. Of these, 21 met the case definition (attack rate among respondents = 40%). Statistical analysis did not implicate any food item. The inspection report showed that raw chickens were placed on the rack above pre-cooked potato salad in the walk-in cooler.

CONCLUSION: The discovery of the outbreak was the result of an inter-agency communication between three local Houston-area health departments. Collaboration between jurisdictions was critical. Although a transmission vehicle was not definitively identified, a cross contamination practice consistent with the proliferation of salmonella was noted and corrected. Continued awareness and education of proper food handling techniques is needed to reduce opportunities for outbreaks.