More Information, Less Work: EHRs and Public Health Surveillance

CSTE 2013

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For the ESPnet team, led by Michael Klompas, MD, MPH
Diseases reportable by providers

Communicable and Other Infectious Diseases Reportable in Massachusetts by Healthcare Providers

- Reports promptly within 1-2 business days
  - Includes both suspected and confirmed cases
  - All cases should be reported to your local board of health
  - If unavailable, call the Massachusetts Department of Public Health:
    - Telephone: (617) 983-6000
    - Confidential Fax: (617) 983-6023

- Report immediately by phone:
  - This includes both suspect and confirmed cases
  - All cases should be reported to your local board of health
    - If unavailable, call the Massachusetts Department of Public Health:

- Anaplasmosis
- Atelectasis
- Any cause of an unusual illness thought to have public health implications
- Any unusual breakdown of illness, including but not limited to febrile illnesses
- Botulism
- Cholera
- Chagas disease
- Creutzfeldt-Jakob disease (CJD) and variant CJD
- Dengue
- Encephalitis, any cause
- Food poisoning and foodborne (includes poisoning by allergen, biotoxin, mushroom toxicity, tetrahydrofuran, paralytic shellfish, and amniotic fluiditis)
- Glomerulonephritis
- Group A streptococcus, invasive
- Herpesvirus
- Human immunodeficiency virus
- Influenza
- Influenza-like illness (ILI) defined as temperature > 100°F, and cough, sore throat, or myalgia
- Influenza-A (H1N1) and human influenza A (H3N2) viruses, including those subtypes as variant A virus in origin and those that cannot be subclassified with standard methods and agents
- Listeriosis
- Lymphadenopathy
- Malaria
- Measles
- Meningitis, viral (affecting CNS and other infections (non-bacterial))
- Meningococcal disease, invasive (Neisseria meningitidis)
- Monkeypox
- Other respiratory viruses
- Pneumonia
- Plague
- Polio
- Pulmonary tuberculosis
- Q fever
- Rabies in humans
- Rheumatic fever
- Rheumatoid arthritis
- Rickettsiosis
- Rocky Mountain spotted fever
- Rubella
- Severe acute respiratory syndrome (SARS)
- Sexually transmitted disease (STD)
- Typhoid
- Typhus fever
- Viral haemorrhagic fever
- West Nile Virus
- Yellow fever
- Zoonoses

- Isolates should be submitted to the designated local authority.

- Additional Notice: NMDSS is administered by the Massachusetts Department of Public Health and the local board of health. Individuals should contact their local health department for questions or clarification on specific reportable disease conditions. This list includes all reportable diseases, including those outlined in the state reportable disease list. Individuals should refer to the state reportable disease list for specific requirements. Individuals who are ill should contact their local health department or healthcare provider for guidance.

“REPORT PROMPTLY (WITHIN 1-2 BUSINESS DAYS)”
# Chlamydia case report form

<table>
<thead>
<tr>
<th>CHLAMYDIA</th>
<th>CASE REPORT FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PATIENT INFORMATION</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>DOB:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Name:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Address:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Phone:</strong></td>
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<tr>
<td></td>
<td><strong>Cell Phone:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Language:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Religious:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Other:</strong></td>
</tr>
</tbody>
</table>

| **CIRCUMSTANCES:** | | |
| **Date:** | **Time:** | | | | | |
| **Location:** | **Route:** | **Nature:** | | | | |

| **CONTACT INFORMATION:** | | |
| **Phone:** | **Email:** | **Website:** | | | | |

| **DIAGNOSIS:** | | |
| **Date:** | **Specimen:** | **Specimen Type:** | | | | |

| **RISK FACTORS:** | | |
| **Risk Group:** | **Sexual Activity:** | | | | | |

| **TREATMENT:** | | |
| **Drug:** | **Dosage:** | **Route:** | | | | |

| **TESTING AGENCY INFORMATION:** | | |
| **Name:** | **Address:** | | | | | |
| **Phone:** | | | | | | |
| **Specimen Type:** | | | | | | |

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This form is to be completed by the healthcare provider who conducted the CHLAMYDIA test. It should be submitted to the appropriate public health authority as required by law. The form is designed to collect information about the patient, the circumstances of the test, and the treatment plan. The form also allows for the recording of contact information for the testing agency and the patient. The completed form should be signed by the healthcare provider and submitted to the appropriate public health authority for review and follow-up.
Paper-based reporting

- Pertussis: 25 days
- Salmonella: 15 days
- Hepatitis A: 10 days

*BMC Public Health* 2004;4:29
*Am J Epidemiol* 2002;155:866
Paper-based reporting

- Time lag in days
  - Pertussis: 10
  - Salmonella: 15
  - Hepatitis A: 20

Completeness of reporting

References:
- BMC Public Health 2004;4:29
- Am J Epidemiol 2002;155:866
Electronic Laboratory vs Paper Reporting

Time from Diagnosis to Report

- 7.9 Day Decrease in Mean Time to Report

Number of Reports

- 4.4 Fold Increase in Total Number of Reports

Paper reports

Electronic lab reports

Am J Public Health 2008;98:344
Electronic laboratory reports – MA 2011

- STD: 35,020
- Hepatitis: 195,722
- Enteric: 37,850
ESPnet enables medical practices and hospitals to provide automated, timely information to public health departments about notifiable conditions, influenza-like illness and chronic diseases.

Practices can use ESPnet to query their own data and allow queries from state Departments of Public Health, returning de-identified summary reports.

ESPnet uses information in electronic health records. These records remain under the full control of the practice or hospital at all times.
ESPnet – EHR Support for Public Health

- Identify conditions of interest, create complete reports, and transmit them securely, all automatically
- Compatible with any EHR that can export data
- Compliant with national standards (ONC Query Health)
- Open source

JAMIA 2009;16:18-24
MMWR 2008;57:372-375
Am J Pub Health 2012;102:S325–S332
ESPnet Partners

- Massachusetts Dept of Public Health
- Dept of Population Medicine
  Harvard Medical School / Harvard Pilgrim Health Care Inst.
- Massachusetts eHealth Institute
- Atrius Health
- Cambridge Health Alliance
- Mass League of Community Health Centers
- MetroHealth
Current ESPnet installations

Northern Berkshires, MA Health Info Exchange
14 sites • 50,000 patients

Cambridge Health Alliance
20 sites • 400,000 patients

Atrius Health
27 Sites • 700,000 pts

Mass League of Community Health Centers
18 sites • 300,000 patients

MetroHealth Cleveland, OH
250,000 patients
MDPHnet - Distributed Data Analytics
Automated disease detection and reporting

Practice EHR’s → ESPnet Server → Health Department

- Diagnoses
- Lab results
- Medications
- Vital signs
- Demographics

HL7 electronic case reports or aggregate summaries

JAMIA 2009;16:18-24
Am J Pub Health 2012;102:S325–S332
## Decoupled architecture

<table>
<thead>
<tr>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatible with most EHRs (local codes translated to common nomenclature)</td>
</tr>
<tr>
<td>Offloads computing burden from EHR</td>
</tr>
<tr>
<td>Clinical practice controls access/use</td>
</tr>
</tbody>
</table>

- **Universal**
- **Unobtrusive**
- **Secure**
ESP’s Data Model

Person

Provider
- Person ID
- Date
- Code
- Name
- Etc.

Allergy
- Person ID
- Date
- Code
- Name
- Etc.

Medication
- Person ID
- Date
- Name/NDC code
- Refills
- Amt Etc.

Demographic
- Person ID
- Birth date
- Sex
- Race
- Address, Etc.

Social
- Person ID
- Date
- Tobacco
- Alcohol
- Etc.

Problem
- Person ID
- Date
- Diagnosis code
- Etc.

Problem (Hospital)
- Person ID
- Date
- Diagnosis code, POA
- Etc.

Pregnancy
- Person ID
- Date
- Gravida / Para
- Gest age @ deliv
- Birthweight, Etc.

Immunization
- Person ID
- Date
- Vaccine/Mfr/Lot
- CPT code
- Etc.
CASE IDENTIFICATION
Acute hepatitis B

- Strategy 1: ICD9 070.3 Viral hepatitis B without mention of hepatic coma
  - Review of 50 patients’ charts

Positive Predictive Value

0% (95% confidence interval, 0-6%)
Acute hepatitis B

- Strategy 2: current lab tests
  - ALT or AST > 5x normal AND
  - Positive hepatitis B surface antigen

Positive Predictive Value

47%
(95% confidence interval, 41-53%)

*PLoS ONE* 2008:3:e2626
Acute hepatitis B

- Strategy 3: current & past lab tests & ICD9 codes
  - ALT or AST > 5x normal AND
  - Positive hepatitis B surface antigen AND
  - No prior positive hepatitis B surface AND
  - No ICD9 code for chronic hepatitis B ever AND
  - Total bilirubin >1.5

Positive Predictive Value

97% (95% confidence interval, 94-100%)

Sensitivity 99% Specificity 94%
Hepatitis B Case Finding - ESP versus ELR

2648 positive test results for hepatitis B
Case Definition: Active Tuberculosis

Strategy: drug prescribing & lab test orders & ICD9 codes

• Prescription for pyrazinamide or

• Prescription of 2 or more anti-tuberculous medications plus ICD9 code for TB within 60 days or

• Order for (AFB smear or AFB culture) plus ICD9 code for TB within 60 days
### ESPnet Conditions Currently Being Reporting

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia</td>
</tr>
<tr>
<td>Gonorrhea</td>
</tr>
<tr>
<td>Pelvic inflammatory disease</td>
</tr>
<tr>
<td>Acute hepatitis A</td>
</tr>
<tr>
<td>Acute hepatitis B</td>
</tr>
<tr>
<td>Acute hepatitis C</td>
</tr>
<tr>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Syphilis</td>
</tr>
</tbody>
</table>
INFECTIOUS DISEASE
CASE REPORTING
Report to Health Department – HL7 format

- Patient demographics
- Responsible clinician, site, contact info
- Basis for condition being detected
- Treatment given
- Symptoms (ICD9 code & temperature)
- Pregnancy status (if pertinent)
ESPnet vs manual reporting

Increase % (log)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB</td>
<td>14/13</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>758/545</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>95/62</td>
</tr>
<tr>
<td>Acute Hep B</td>
<td>8/3</td>
</tr>
<tr>
<td>Acute Hep C</td>
<td>38/14</td>
</tr>
<tr>
<td>PID</td>
<td>25/0</td>
</tr>
</tbody>
</table>

Atrius Health (variable time periods)

MMWR 2008;57:372-375
PLoS ONE 2008;e2626
Public Health Reports 2010;125:843
Pregnancy status: Chlamydia & Gonorrhea

- Manual: 22/445 (5%)
- ESP: 649/649 (100%)

MMWR 2008;57:372-375
Pregnancy status: Chlamydia & Gonorrhea

**Status reported**
- Manual: 5/445
- ESP: 649/649

**Pregnancies identified**
- Manual: 1/445
- ESP: 86/649

*MMWR* 2008; 57:372-375

Treatment reports: Chlamydia & Gonorrhea

- Manual: 524/607 (88%)
- ESP: 873/873 (100%)

Patient name error: Chlamydia & Gonorrhea

*EHR spelling presumed as gold standard. Includes transposition of first and last name, incorrect first name, and spelling errors

MMWR 2008;57:372-375


Name error

Manual 34/607

ESP 0

*EHR spelling presumed as gold standard. Includes transposition of first and last name, incorrect first name, and spelling errors.
SYNDROMIC SURVEILLANCE
Influenza-Like Illness

Percent of patient visits with influenza-like illness

Oct-09 Jan-10 Apr-10 Jul-10 Oct-10 Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13

Atrius Health, 2009-2013
CHRONIC DISEASE SURVEILLANCE
Criteria for Frank Diabetes

• Laboratory tests
  – Hemoglobin A1C ≥ 6.5
  – Fasting glucose ≥126
  – Random glucose ≥200 on two or more occasions

• Diagnoses
  – ICD9 code 250.x (DM) on two or more occasions

• Prescribing
  – Insulin outside of pregnancy
  – Any of these oral agents:
    • Glyburide, gliclazide, glipizide, glimepridime
    • Pioglitazone, rosiglitazone
    • Repaglinide, nateglinide, meglitinide
    • Sitagliptin
    • Exenatide, pramlintide

Diabetes Care 2013; 36:914-21
Type 1 versus Type 2 Diabetes

• Among patients with frank diabetes, label as type 1 if any of these:
  – C-peptide negative
  – DM auto-antibodies positive
  – Prescription for urine acetone test strips
  – Ratio of type 1 : type 2 diabetes ICD9s > 0.5 and NOT on oral hypoglycemics
  – Ratio of type 1 : type 2 diabetes ICD9s > 0.5 and Rx for glucagon

• If not type 1 then type 2
ESPnet: Scheduled reporting

Practice EHR’s

Notifiable diseases
Influenza-like Illness
Chronic diseases

Notifiable diseases
Influenza-like Illness
Chronic diseases

DPH
Health Department
SENDING QUERIES TO AN EHR
ESPnet: ad hoc queries

Practice EHR’s

- Ectopic pregnancy
- Blood pressure
- Chlamydia screening rates

Infertility
- Asthma
- ALS

Health Department
1- User creates and submits query (a computer program)
2- Data partners retrieve query
3- Data partners review and run query against their local data
4- Data partners review results
5- Data partners return results via secure network
6 Results are aggregated
The RiskScape

ESPnet enables medical practices and hospitals to provide automated, timely information to public health departments about notifiable diseases. The system processes real-time data and allows queries from state Departments of Public Health, returning de-identified summary reports.

ESPnet uses information in electronic health records. These records remain under the full control of the practice or hospital at all times.

Development supported by CDC and ONC
Select an Outcome: Example Type 2 Diabetes
Type 2 Diabetes in Eastern Massachusetts

Riskscape

Current Dataset: General_Population - Change
Last Updated: 2011-12-07

Outcome: Type 2 Diabetes True
Filter: All

Map | Full State

Jump to Zip

Predefined advanced
Berkshire
Boston
Cape Cod
Central Mass
Fall River
Franklin
Lawrence
Lowell
Martha's Vineyard
Merrimack Valley
Metropolitan
Monterey
New Bedford
Northern Middlesex
Old Colony
Pine Barren Valley
Southeastern
Springfield
Worcester

Generate Smoothed Map
Obesity (BMI >30)
High blood pressure
Stratify by age, sex, race, BMI, BP, etc.

Type 2 diabetes under age 40 is most prevalent in Blacks.

Type 2 diabetes under age 40 is most prevalent among those with BMI > 30.
Drill Down on ZIP Codes
Hypertension more prevalent for all races in Greater Boston vs Central Mass

Hypertension more prevalent for all ages in Greater Boston vs Central Mass
Evaluate whether patients meet clinical targets

- 57% of people with type 2 diabetes have high blood pressure
- 51% of people with type 2 diabetes have hemoglobin A1C above 6.5
In progress

• Vaccine adverse event detection and reporting to CDC VAERS
• Send messages to clinician’s inbox to elicit additional information
  – via link to secure external site
• Ability to insert reports in EHR
Eliciting clinician input and reporting in EHR

Practice EMR's

Data from EHR
Request for info

ESPnet Server

- diagnoses
- lab results
- meds
- allergies
- vaccines
Dear Dr. JONES

Your patient BOB WIGGINS may have suffered an adverse effect from a recent vaccine. BOB WIGGINS was diagnosed with MENINGITIS on AUGUST 12, 7 days after receiving MEASLES VACCINE. If you think the MENINGITIS might have been due to the vaccine, we can automatically submit an electronic report to CDC / FDA’s Vaccine Adverse Event Reporting System on your behalf.

Please provide any additional clinical details on this event that you think might be helpful to CDC and FDA vaccine safety investigators:

[Submit] [Decline]
Eliciting clinician input and reporting in EHR

Data from EHR

Practice EMR's

Request for info

ESPnet Server

Clinician response

HL7 electronic VAERS report

Report to EHR

Diagnoses

lab results

Meds

Allergies

Vaccines
On the horizon

- Meaningful use stage 2 certification for ELR reporting
- Monitoring response to community-focused obesity prevention program
Just over the horizon

- Notification about overdue follow up (STD test of cure, gestational diabetes post-partum glucose tolerance test...)
- Meaningful use stage 3 certification
- Research support, e.g., comparative effectiveness, clinical trials
“No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring”

Introductory statement printed each week in Public Health Reports, 1913-1951
Welcome to the ESP Project web site, Wiki, and source code (Subversion) repository

This is a web site for the Electronic medical record Support for Public health (ESP) project, part of a CDC funded Center of Excellence in Public Health Informatics. The ESP project is a collaboration between Harvard Medical School, Harvard Pilgrim Health Care, Massachusetts Department of Public Health, Atrius Health, and the Channing Laboratory of Brigham and Women’s Hospital.

ESP is a secure, automated, and flexible system to exchange and store patient demographics data and clinical data in electronic medical record systems to public health agencies.

The system currently reports on all infectious diseases reported to Massachusetts Department of Public Health. The system has been continuously since, providing public health information to 120,000 obituary reports. In the last year, the system has generated over 10,000 reports.

The growing use of electronic medical records (EMRs) provides the unparalleled opportunity to support public health by integrating patient demographic data, clinical data, and laboratory information directly into the clinical process, offering an efficient, accurate, and consistent method of tracking and distributing patient information, as well as providing the necessary means for merging from electronic medical record systems.

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Source code and documentation available free of charge from esphealth.org

Project Publications

- Electronic Support for Public Health: Automated Detection and Reporting of Notifiable Diseases Using Electronic Medical Record Data to Facilitate Public Health Surveillance
- Electronic Medical Record Support for Public Health: Automated Detection and Reporting of Statutory Notifiable Diseases to Public Health Authorities
- Invited Commentary: Automated Public Health Reporting--A Familiar but Cantankerous Friend
- Kompas et al. Respond: Automated Public Health Reporting--Possible with a Coalition of the Willing

Key personnel in the project include:

- Richard Platt - principal investigator (Richard_Platt at harvard dot edu)
- Ross Lazarus - ESP informatics lead and ESP:VAERS principal investigator (Ross_Lazarus at channing dot harvard dot edu)
- Michael Kompas - clinical lead (mkompas at partners dot org)
- Julie Dunn - administrative lead (Julie_Dunn at harvardpilgrim dot org)

Project Details and resources

- Discussion Forums Once you've registered and confirmed your email address, you can post to the forums
- Software dependencies
ESPnet Team

Harvard Dept of Population Medicine
• Michael Klompas
• Ross Lazarus
• Emma Eggleston
• Julie Lankiewicz
• Michael Murphy
• Meghan Baker
• Richard Platt

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• Paul Oppedisano

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Massachusetts eHealth Institute
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• Laurance Stuntz

MetroHealth, OH
• David Kaelber
• Guptha Baskaran

Atrius Health
• Ben Kruskal
• Mike Lee

Cambridge Health Alliance
• Michelle Weiss
• Brian Herrick
• Jim LaPlante

Northern Berkshires eHealth Collaborative
• Don LeBreux

Massachusetts League of Community Health Centers
• Ellen Hafer
• Mark Josephson

Commonwealth Informatics

LincolnPeak Partners
Thank you!