Public Health Surveillance Yesterday, Today and Tomorrow

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History of Notifiable Diseases in Massachusetts

1842 Registration of births and deaths
1850 *Report of the Massachusetts Sanitary Commission* (Shattuck)
1874 Sentinel surveillance, 168 physicians, 14 diseases
1884 Requirement to report “diseases dangerous to the public health”, with fines
1918 Sexually transmitted diseases reportable directly to the state

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1. The category of infectious diseases includes Infectious and Parasitic Diseases, ICD-9 codes 001-139, and Pneumonia and Influenza, ICD-9 codes 480-487.
2. Heart Disease, ICD-9 codes 390-399, 425, 404-429
3. Cancer, ICD-9 codes 140-239
4. Injuries, ICD-9 codes E800-E969
Basis for Public Health Authority

- **Reserved Powers to Sovereign States**
  - “Police power”- broad, expansive authority of a state to protect health, safety and welfare of population
  - State may delegate to local authorities the ability to safeguard public health and safety

- **Federal Constitution – Enumerated Powers for Federal Government**
  - Tax and spend for common defense/general welfare
  - Regulate interstate/international commerce
300.100: Diseases Reportable to Local Boards of Health

Cases or suspect cases of the diseases listed below shall be reported by household members, physicians and other health care providers as defined by M.G.L. c.111, § 1, and other officials designated by the Department, by telephone, in writing, by facsimile or other electronic means, as deemed acceptable by the Department, immediately, but in no case more than 24 hours after diagnosis or identification, to the board of health in the community where the case is diagnosed or suspect case is identified. When available, name, date of birth, age, sex, address, place of employment, school and disease must be included for each report. The local board of health’s responsibility, upon receipt of a report, is set forth in 105 CMR 300.110 and 105 CMR 300.160.

- Anaplasmosis
- Amebiasis
- Anthrax
- Arbovirus infection, including but not limited to, infection caused by dengue, Eastern equine encephalitis virus, West Nile virus and yellow fever virus
- Babesiosis
- Botulism
- Brucellosis
- Campylobacteriosis
- Chagas disease (American trypanosomiasis)
- Cholera
- Etc.

105 CMR 300.000: REPORTABLE DISEASES, SURVEILLANCE, AND ISOLATION AND QUARANTINE REQUIREMENTS

300.134: Illness Believed to Be Part of a Suspected or Confirmed Cluster or Outbreak

In addition to the diseases listed in 105 CMR 300.100, every person who is a health care provider or who is in a supervisory position at a school, day care, hospital, institution, clinic, medical practice, laboratory, labor or other camp who has knowledge of the occurrence of any suspected or confirmed cluster or outbreak of any illness, shall report the same immediately by telephone, by facsimile or other electronic means to the local board of health in the community in which the facility is located. If the local board of health is unavailable, contact the Department directly.

300.150: Declaring a Disease or Condition Immediately Reportable, Under Surveillance and/or, Subject to Isolation and Quarantine; Temporary Reporting, Surveillance and/or Isolation and Quarantine

In addition to the diseases and conditions listed in 105 CMR 300.000 et seq., the Commissioner, as necessary to reduce morbidity and mortality in the Commonwealth, shall require the reporting, authorize the surveillance and/or establish isolation and quarantine requirements, on a time-limited basis, of confirmed and suspect cases of diseases or conditions which are newly recognized or recently identified or suspected as a public health concern. Such declarations shall be authorized for a period of time not to exceed 12 months. Such requirements for a particular disease or condition beyond this time period shall be continued pursuant to revised regulation under 105 CMR 300.000 et seq.
A Health Insurance Portability and Accountability Act (HIPAA) Covered Entity is permitted to disclose protected health information (PHI) without individual authorization to a “public health authority” that is authorized by law to collect or receive such information for the purpose of preventing or controlling disease, injury or disability, such as for purposes of reporting disease, injury, or vital events, or for public health surveillance, investigations, or interventions; or, at the direction of a public health authority, to an official of a foreign government agency that is acting in collaboration with a public health authority. (45 CFR 164.512(b)(1)(i)).

Models of Public Health Surveillance

- Passive
  - notifiable diseases
- Active
  - routine contact
  - sentinel surveillance
  - linked data
- Sentinel event surveillance
- Special investigations
  - surveys
  - prevalence (cross-sectional) studies
- Laboratory reporting
- Registries and administrative databases
Disease Reporting Pathway

Healthcare Providers -> Institutions -> County/Local Health Departments -> State Health Department -> CDC

Labs

Others

U.S. Counties
Reported Hepatitis A in Massachusetts by Month, 2002-2004
(Massachusetts Department of Public Health)
Annual Number of Confirmed Hepatitis A Cases Reported in Massachusetts
TB Case Rates, United States and Massachusetts, 1986-2015

TB Case Rates by Race/Ethnicity, Massachusetts, 2014 (N=199)

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>No. Cases</th>
<th>TB case rate</th>
<th>Rate Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White/NH</td>
<td>29</td>
<td>0.58</td>
<td>1 (reference)</td>
</tr>
<tr>
<td>Black/NH</td>
<td>47</td>
<td>8.39</td>
<td>14.5 (9.1, 23.0)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>33</td>
<td>4.53</td>
<td>7.83 (4.8, 12.9)</td>
</tr>
<tr>
<td>Asian</td>
<td>90</td>
<td>21.19</td>
<td>36.6 (24.1, 55.6)</td>
</tr>
</tbody>
</table>

NH = Non-Hispanic
Population statistics from the Census 2014 ACS
Age Distribution of Confirmed Hepatitis C by Age Group

2002

2012

Number of Confirmed and Probable Hepatitis C Cases by Age and Gender, Massachusetts, 2015

N=6715, excludes 357 missing age/gender/tranogender
Data Source: MDPH, Bureau of Infectious Disease, data are current as of 6/19/16 and subject to change
Hepatitis C in Massachusetts

- Large number of “baby boomers” aging out
- High mortality
- Complications of cirrhosis, liver failure and transplant
- New wave of cases under 30 years old
  - Driven by injection drug use
  - Prescription opiates to cheaper heroin
  - Poor infection control practices
Disease Reporting

- Process approximately 100,000 lab reports, morbidity and case reports per year
  - Paper and electronic format
- Under-reporting and incomplete data
  - Depending on disease, 5-80% of cases reported; e.g., gastrointestinal illness is under-reported
  - Can still be used to detect key trends/sources of infection
- Reporting bias
MAVEN: General Features

- Person based
- Disease specific question packages
- ELR interface
- Workflows
- Contact investigations
- Full data extracts
- Outbreak Management System

EVENT-BASED SYSTEM VS. PERSON-BASED SYSTEM

3 diseases/events for the same person, but in the system as 3 different, unrelated events

3 events linked together by the case. Appropriate demographic information on the case is shared across diseases/events for a single case.
Enhanced Data Quality and Information Sharing

- Real-time information sharing
  - between state and local boards of health
  - within state
- Complete data capture in single system
  - standardized case investigation materials for all users (case report forms, Event Classification and data entry Manual)
- Developed QA protocols:
  - mechanisms for deduplication and address verification and geocoding
  - reports for data entry checks, notifications, electronic laboratory reporting, audit trail
- Specific data queries available to end users
ELR Operational Flow

Translate local codes to standardized codes

Electronic Laboratory vs Paper Reporting

4.4 Fold Increase in Total Number of Reports
7.9 Day Decrease in Mean Time from Diagnosis to Report

Am J Public Health 2008;98:344
IMPACT OF MAVEN and ELR:
Pregnant Hepatitis B Cases Identified for Follow-up

By 2007, the increase in the number of pregnant women identified exceeded the CDC point estimate for Massachusetts for the first time.

*Point estimates and lower limits are based on 1994 NHANES hepatitis B seroprevalence data and seroprevalence data from medical literature review applied to National Center for Health Statistics birth data.

www.esphealth.org
Development supported by CDC and ONC
**ESPnet – EHR Support for Public Health**

- Distributed networking software to transform extracted EHR data, identify conditions of interest, and securely transmit electronic reports to public health
- Compatible with EHR systems that can export data
- Compliant with ONC’s Query Health S&I Framework
- Open source

_JAMIA 2009;16:18-24
MMWR 2008;57:372-375
Am J Pub Health 2012;102:S325–S332_

**Automated disease detection and reporting**

Practice EHR's ➔ ESPnet Server ➔ Health Department

- diagnoses
- lab results
- meds
- vital signs
- demographics
- HL7 electronic case reports or aggregate summaries

_JAMIA 2009;16:18-24
Am J Pub Health 2012;102:S325–S332_
Manual versus electronic reporting

<table>
<thead>
<tr>
<th></th>
<th>Manual Reports*</th>
<th>ESPnet</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia</td>
<td>545</td>
<td>758</td>
<td>↑39%</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>62</td>
<td>95</td>
<td>↑53%</td>
</tr>
<tr>
<td>Pelvic Inflammatory Disease</td>
<td>0</td>
<td>25</td>
<td>↑↑</td>
</tr>
<tr>
<td>Acute Hepatitis B</td>
<td>3</td>
<td>8</td>
<td>↑167%</td>
</tr>
<tr>
<td>Acute Hepatitis C</td>
<td>14</td>
<td>38</td>
<td>↑171%</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>13</td>
<td>14</td>
<td>↑8%</td>
</tr>
</tbody>
</table>

MMWR 2008;57:372-375
PLoS ONE 2008;e2626
Public Health Reports 2010;125:843

Atrius Health (variable time periods)

Trends in HIV Infection and Death in Massachusetts

Data Source: MDPH HIV/AIDS Surveillance Program, Data as of 1/1/17
Trends in HIV/AIDS Prevalence in Massachusetts People Living with HIV/AIDS

![Graph showing trends in HIV/AIDS prevalence in Massachusetts from 2004 to 2016.](image)

Data Source: MDPH HIV/AIDS Surveillance Program, Data as of 1/1/17

Individuals Diagnosed with HIV Infection by Exposure Mode and Year of Diagnosis: Massachusetts, 2005–2015

![Graph showing HIV diagnoses by exposure mode from 2005 to 2015.](image)

Data Source: MDPH HIV/AIDS Surveillance Program; Data as of 1/1/17
Age-Adjusted HIV/AIDS Prevalence Rate per 100,000\(^1\)
Population by Race/Ethnicity: Massachusetts

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Prevalence per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>White NH</td>
<td>173</td>
</tr>
<tr>
<td>Black NH</td>
<td>1,686</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>1,279</td>
</tr>
<tr>
<td>API</td>
<td>130</td>
</tr>
<tr>
<td>Total MA</td>
<td>332</td>
</tr>
</tbody>
</table>

Race/Ethnicity

\(^1\)Population sizes for rate calculations are based on 2010 population estimates from the MDPH Bureau of Health Information, Statistics, Research and Evaluation; NH = Non-Hispanic, API = Asian/Pacific Islander.

Data Source: MDPH HIV/AIDS Surveillance Program, data as of 2/23/16

Prevalence Rate, per 100,000 Persons\(^1,2\), of HIV Cases
By City/Town: Massachusetts, 2015

* For all maps, population data based on 2010 United States Census. Please note, population data for tracts are based on intercensal and annual estimates from the United States Census Bureau, Population Division.

* Data are current as of 2/23/16 and subject to change.

* New counts for communities with populations less than 50,000 are suppressed to maintain patient confidentiality.
Engagement in the HIV treatment cascade in the United States - 2011

Massachusetts HIV Care Continuum

* Lab received by MDPH
1 Includes individuals diagnosed through 2014 and living in MA as of 1/1/16, based on last known address, regardless of state of diagnosis
* Data Source: MDPH HIV/AIDS Surveillance Program, data reported through 1/1/16.
Viral Load Among PLWHA in Massachusetts

- NOT Virally Suppressed, 8%
- Missing Viral Load Data, 30%
- Virally Suppressed, 62%

N=19,135

Includes individuals diagnosed through 2014 and living in MA as of 12/31/15, based on last known address, regardless of state of diagnosis
• Data Source: MDPH HIV/AIDS Surveillance Program, cases reported through 1/1/17

Care Continuum Among Patients in Care at Clinical Sites Funded in Part by MDPH
Based on Data from JSI Chart Audit for 2015, Preliminary

- Linked to Care/In Care: 100%
- Retained in Care: 94%
- On ART: 91%
- Non-Detectable Viral Load: 89%
National AIDS Strategy

Kaplan–Meier Estimates of the Risk of HIV-1 Infection among Partners of Index Participants
HPTN 052

Number of Reported Cases of Mother-to-Child Transmission of HIV Infection, By Year of Birth, Massachusetts, 1985–2014

Introduction of anti-viral therapy to prevent perinatal transmission

Promotion of Universal Screening of Pregnant Women
# PrEP Works...If You Take It

<table>
<thead>
<tr>
<th>Trial</th>
<th>Efficacy</th>
<th>Adherence</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPRISA 004&lt;sup&gt;6&lt;/sup&gt;</td>
<td>1% tenofovir gel: 39%</td>
<td>51%</td>
</tr>
<tr>
<td>iPrEx&lt;sup&gt;7&lt;/sup&gt;</td>
<td>Oral daily Truvada: 42%</td>
<td>51%</td>
</tr>
<tr>
<td>Partners PrEP&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Oral daily tenofovir: 67%</td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td>Oral daily Truvada: 75%</td>
<td>81%</td>
</tr>
<tr>
<td>TDF2&lt;sup&gt;9&lt;/sup&gt;</td>
<td>Oral daily Truvada: 62%</td>
<td>81%</td>
</tr>
<tr>
<td>FEM-PrEP&lt;sup&gt;10&lt;/sup&gt;</td>
<td>Oral daily Truvada: No Protection</td>
<td>24%</td>
</tr>
<tr>
<td>VOICE&lt;sup&gt;2&lt;/sup&gt;</td>
<td>TFV gel: No protection</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Oral daily tenofovir: No protection</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td>Oral daily Truvada: No protection</td>
<td>29%</td>
</tr>
</tbody>
</table>

## Behavior Over Time On Trial

(ANRS IPERGAY sexual activity-based PrEP trial, n = 400 participants)

Estimated percentages and numbers of adults with indications for preexposure prophylaxis (PrEP), by transmission risk group

United States, 2015

<table>
<thead>
<tr>
<th>Transmission risk group</th>
<th>% with PrEP indications*</th>
<th>Estimated no.</th>
<th>(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men who have sex with men, aged 18–59 yrs†</td>
<td>24.7</td>
<td>492,000</td>
<td>(212,000–772,000)</td>
</tr>
<tr>
<td>Adults who inject drugs, aged ≥18 yrs§</td>
<td>18.5</td>
<td>115,000</td>
<td>(45,000–185,000)</td>
</tr>
<tr>
<td>Heterosexually active adults, aged 18–59 yrs§</td>
<td>0.4</td>
<td>624,000</td>
<td>(404,000–846,000)</td>
</tr>
<tr>
<td>Men**</td>
<td>0.2</td>
<td>157,000</td>
<td>(62,000–252,000)</td>
</tr>
<tr>
<td>Women</td>
<td>0.6</td>
<td>468,000</td>
<td>(274,000–662,000)</td>
</tr>
<tr>
<td>Total</td>
<td>—</td>
<td>1,232,000</td>
<td>(661,000–1,803,000)</td>
</tr>
</tbody>
</table>

Data to Care Projects

SPECTRuM

- Use surveillance data to identify people who have not had an HIV-related medical appointment for over 6 months or have a detectible viral load

P4C

- Re-engagement activities with community health center patients
- HIV medical care in primary care

CoRECT

- Evaluate success of health department intervention vs health care facility standard of care practices to re-engage out of care patients