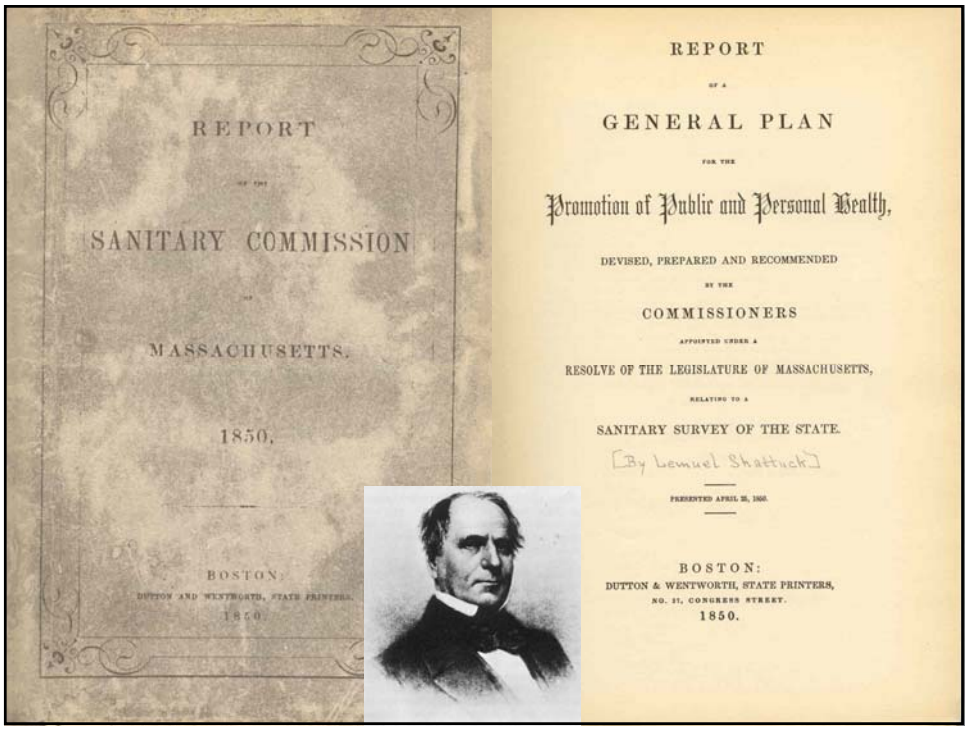
Public Health Surveillance Yesterday, Today and Tomorrow

Alfred DeMaria, Jr., M.D.
Massachusetts Department of Public Health



REPORT

OF THE

SANITARY COMMISSION

OF

MASSACHUSETTS.

1850.

BOSTON:
DUTTON AND WENTWORTH, STATE PRINTERS.
1850.

REPORT

OF A

GENERAL PLAN

FOR THE

Promotion of Public and Personal Health,

DEVISED, PREPARED AND RECOMMENDED

BY THE

COMMISSIONERS

APPOINTED UNDER A

RESOLVE OF THE LEGISLATURE OF MASSACHUSETTS,

RELATING TO A

SANITARY SURVEY OF THE STATE.

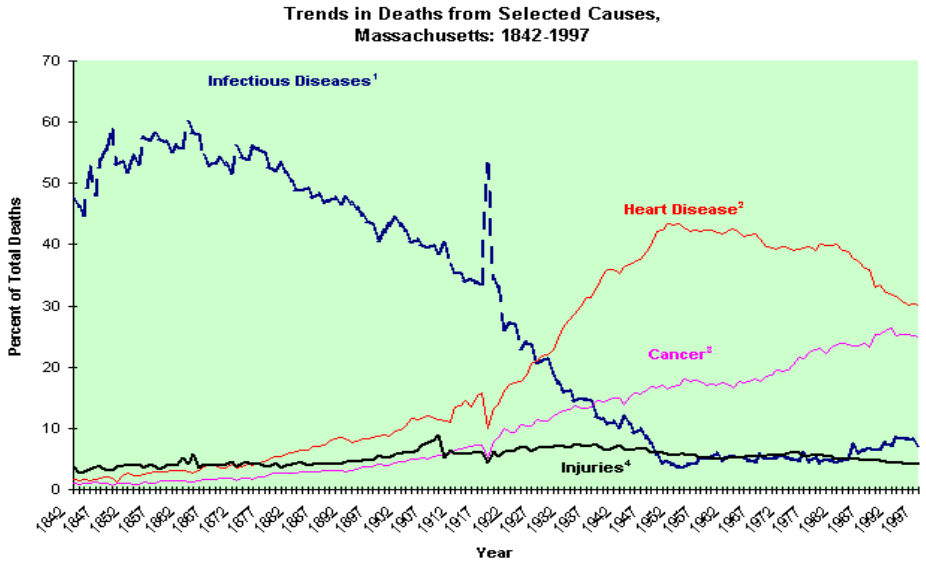
[By Lemuel Shattuck]

PRESENTED APRIL 25, 1850.

BOSTON:
DUTTON & WENTWORTH, STATE PRINTERS,
NO. 21, CONGRESS STREET.
1850.

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**



1. The category of infectious disease 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 390-398, 402, 404-429
3. Cancer, ICD-9 codes 140-208
4. Injuries, ICD-9 codes E800-E999

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

Babesiosis

Pertusis

Gonnorhea

Tuberculosis

Hepatitis C

Measles

Effective December 6, 2013

Summary of Reportable Diseases, Surveillance, and Isolation and Quarantine Requirements

Extracted from: 105 CMR 300.000 Department of Public Health

Massachusetts Department of Public Health
Bureau of Infectious Disease
305 South Street
Jamaica Plain, MA 02130

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

Section

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

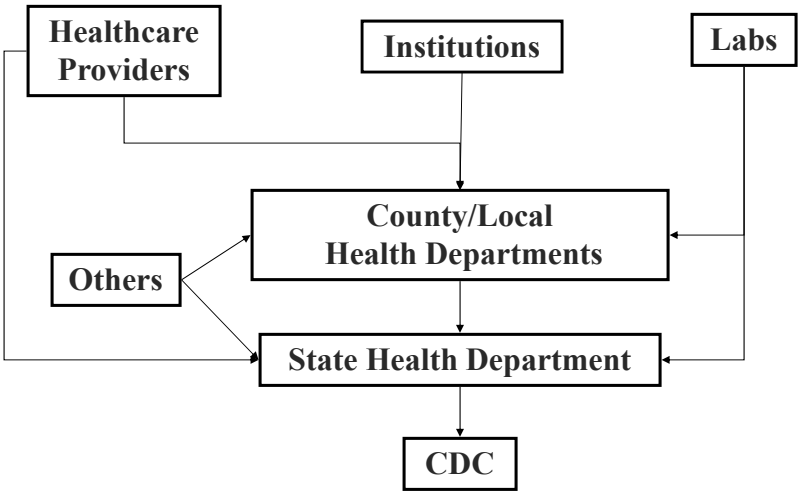
In addition to the diseases and conditions listed in 105 CMR 300.000 *et seq.*, the Commissioner, as necessary to reduce morbidity and mortality in the Commonwealth, shall require the reporting, authorize the surveillance and/or establish isolation and quarantine requirements, on a time-limited basis, 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)).

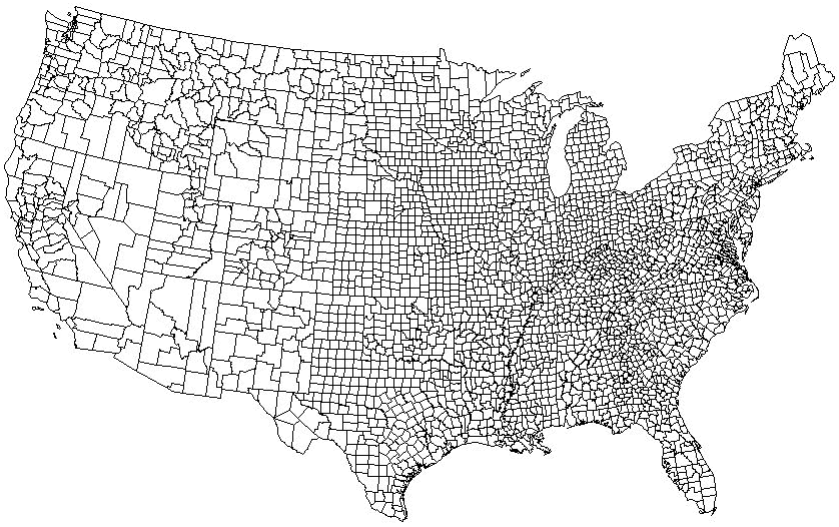
Models of Public Health Surveillance

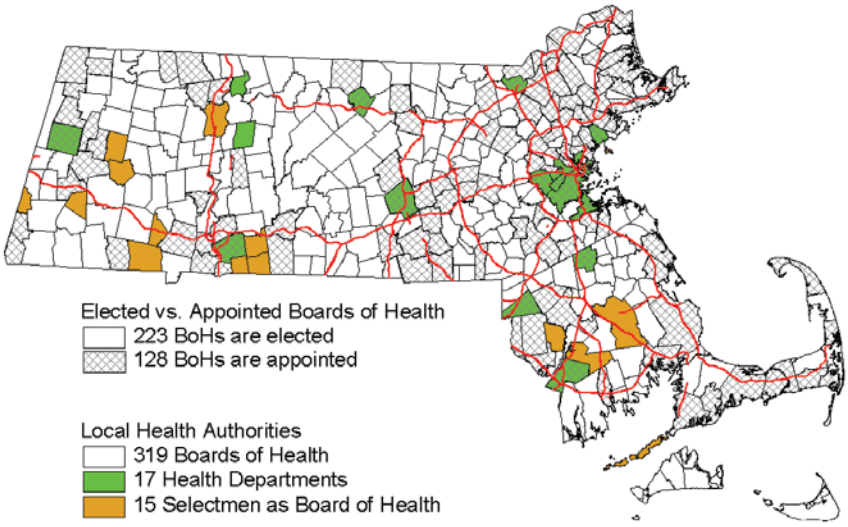
- Passive
  - notifiable diseases
- Active
  - routine contact
  - sentinel surveillance
  - linked data
- Sentinel event surveillance
- Special investigations
  - surveys
  - prevalence (cross-sectional) studies
- Laboratory reporting
- Registries and administrative databases

Disease Reporting Pathway



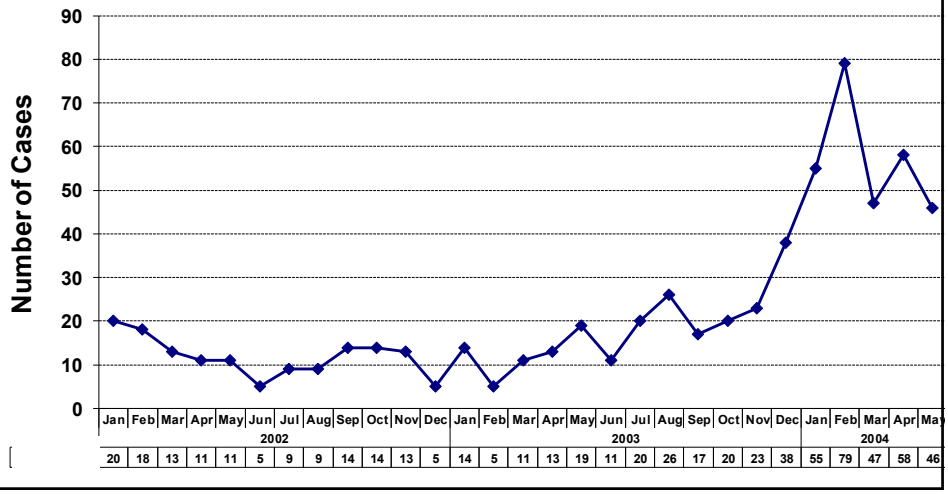
U.S. Counties

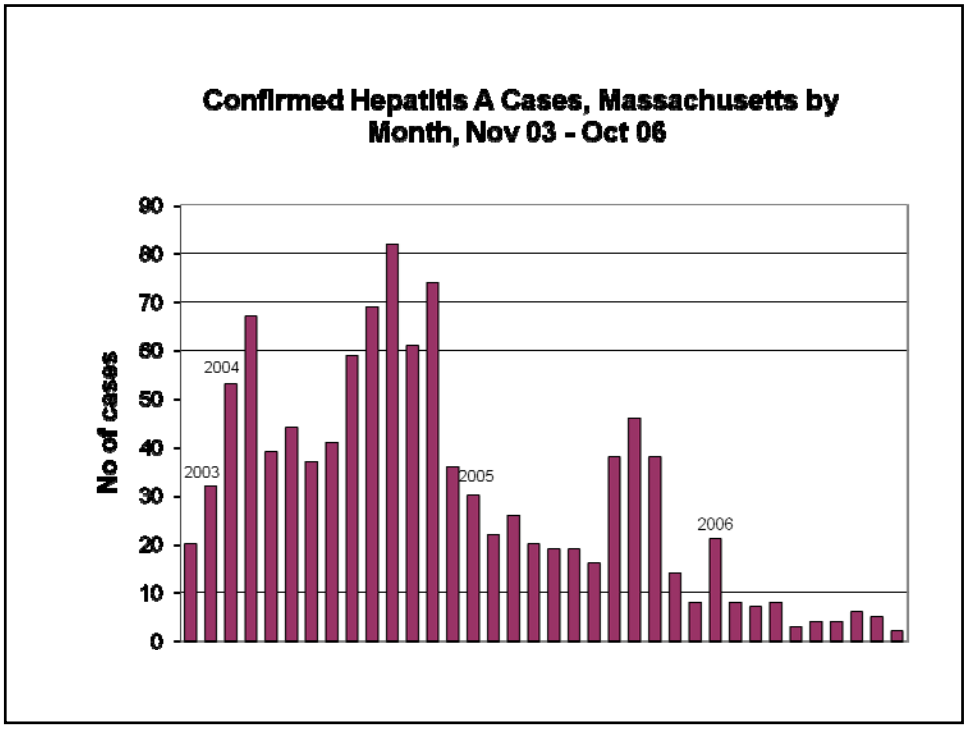


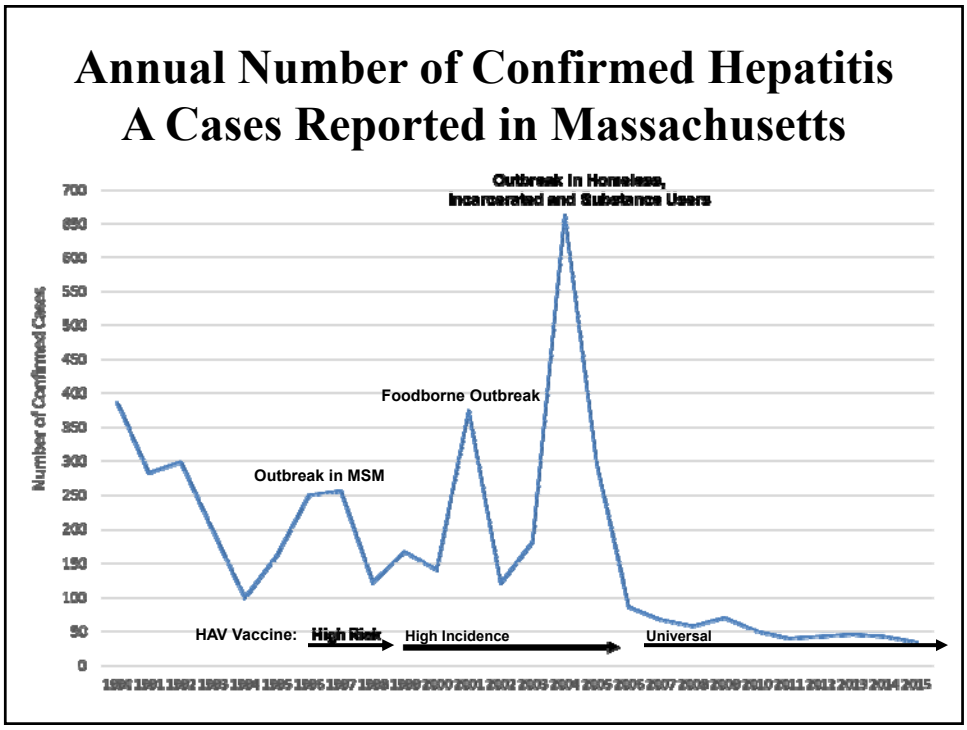


Massachusetts Association of Health Boards

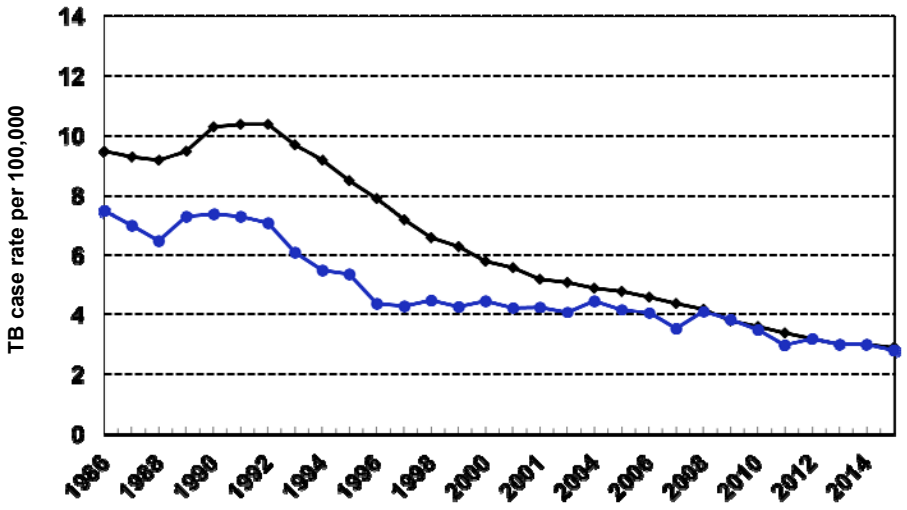
Reported Hepatitis A in Massachusetts by Month, 2002-2004 (Massachusetts Department of Public Health)




Confirmed Hepatitis A Cases, Massachusetts by Month, Nov 03 - Oct 06
No of cases
0
10
20
30
40
50
60
70
80
90
2003
2004
2005
2006


Annual Number of Confirmed Hepatitis A Cases Reported in Massachusetts
Number of Confirmed Cases
Outbreak in Homeless, Incarcerated and Substance Users
Foodborne Outbreak
Outbreak in MSM
HAV Vaccine:
High Risk
High Incidence
Universal

TB Case Rates, United States and Massachusetts, 1986-2015

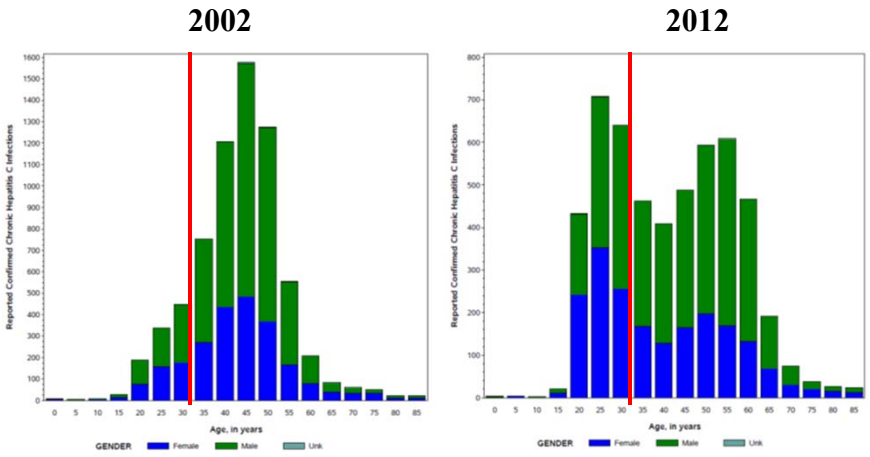


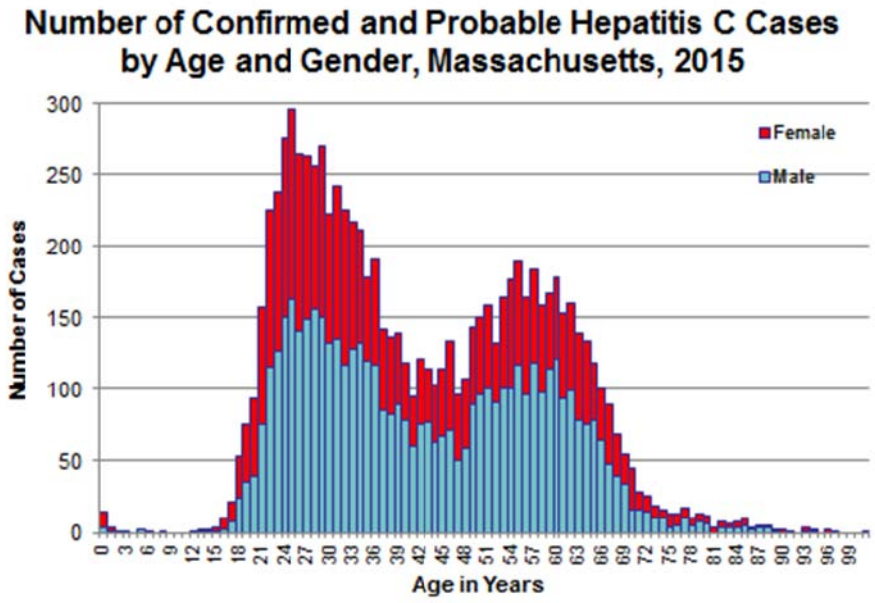
TB Case Rates by Race/Ethnicity, Massachusetts, 2014 (N=199)

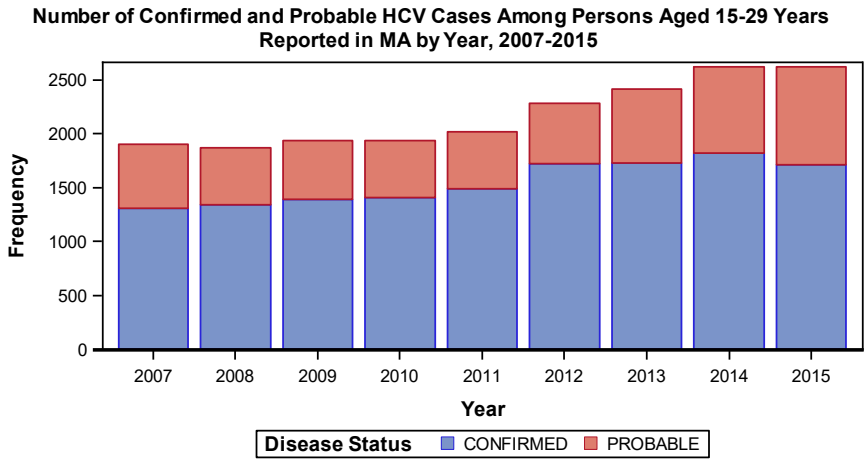
Race/Ethnicity	No. Cases	TB case rate	Rate Ratio (95% Confidence Interval)
White/NH	29	0.58	1 (reference)
Black/NH	47	8.39	14.5 (9.1, 23.0)
Hispanic	33	4.53	7.83 (4.8, 12.9)
Asian	90	21.19	36.6 (24.1, 55.6)

NH = Non-Hispanic
Population statistics from the Census 2014 ACS

Age Distribution of Confirmed Hepatitis C by Age Group

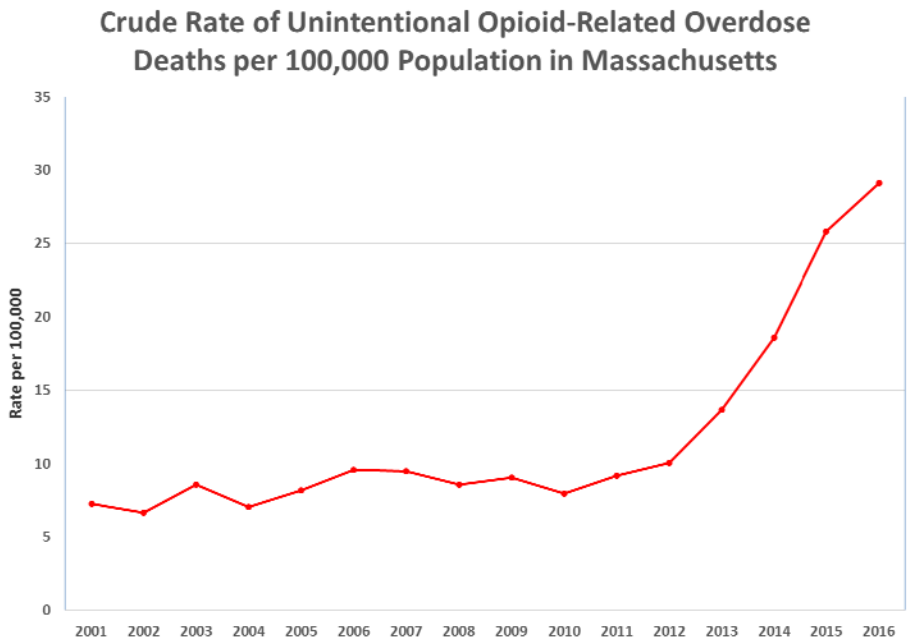






Hepatitis C in Massachusetts

- 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



2015 and 2016, estimates

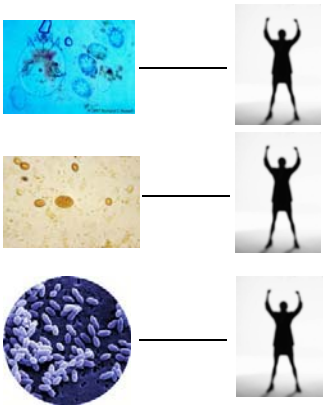
Disease Reporting

- 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

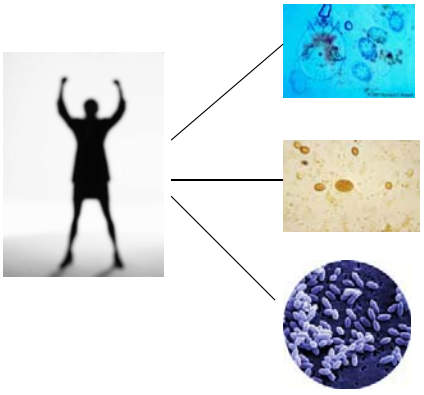
MAVEN: General Features

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

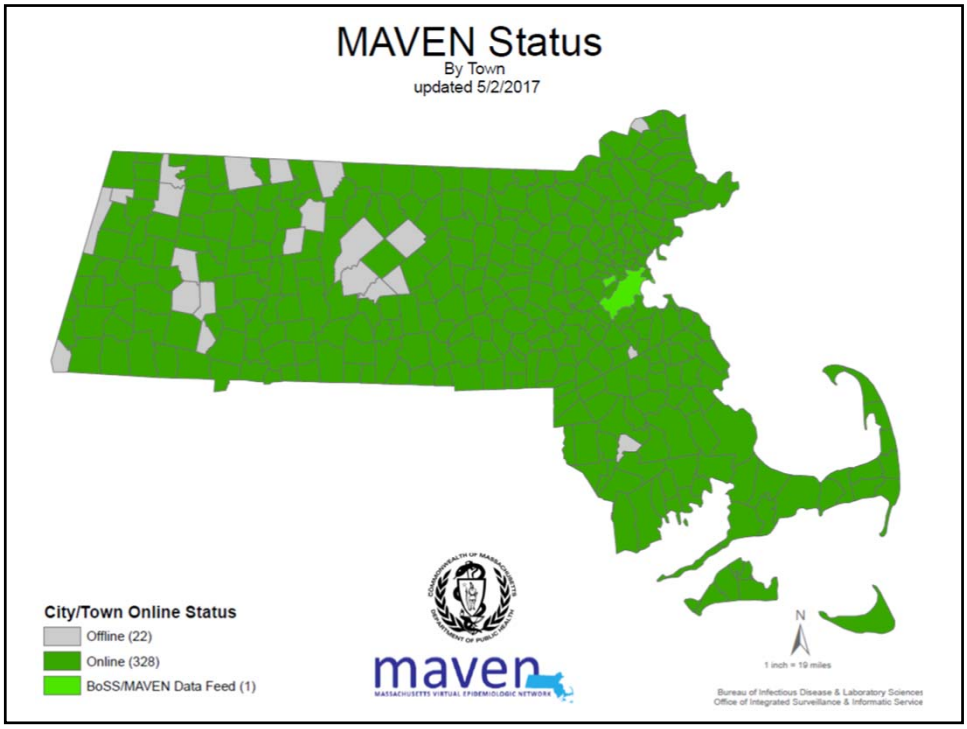
EVENT-BASED SYSTEM **VS.** **PERSON-BASED SYSTEM**



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



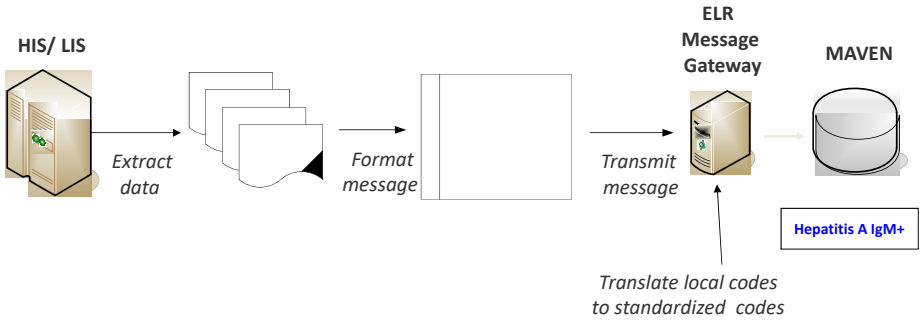
3 events linked together by the case. Appropriate demographic information on the case is shared across diseases/events for a single case.



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



Local Code	Local Description	Local Result	Local Description	LOINC Code	SNOMED Code
HAVIGM	Hepatitis A IgM	POS	Positive	22314-9	10828004

Electronic Laboratory vs Paper Reporting

Total Number of Reports

4.4 Fold Increase in Total Number of Reports

Paper reports **Electronic lab reports**

Time from Diagnosis to Report

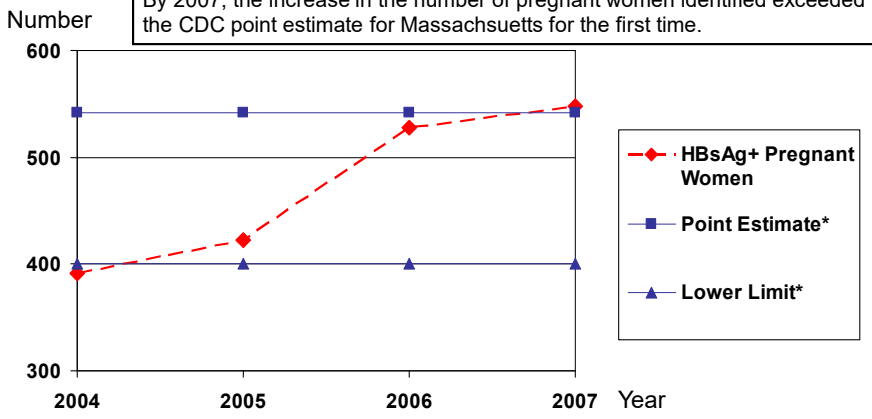
7.9 Day Decrease in Mean Time from Diagnosis to Report

Paper reports **Electronic lab reports**

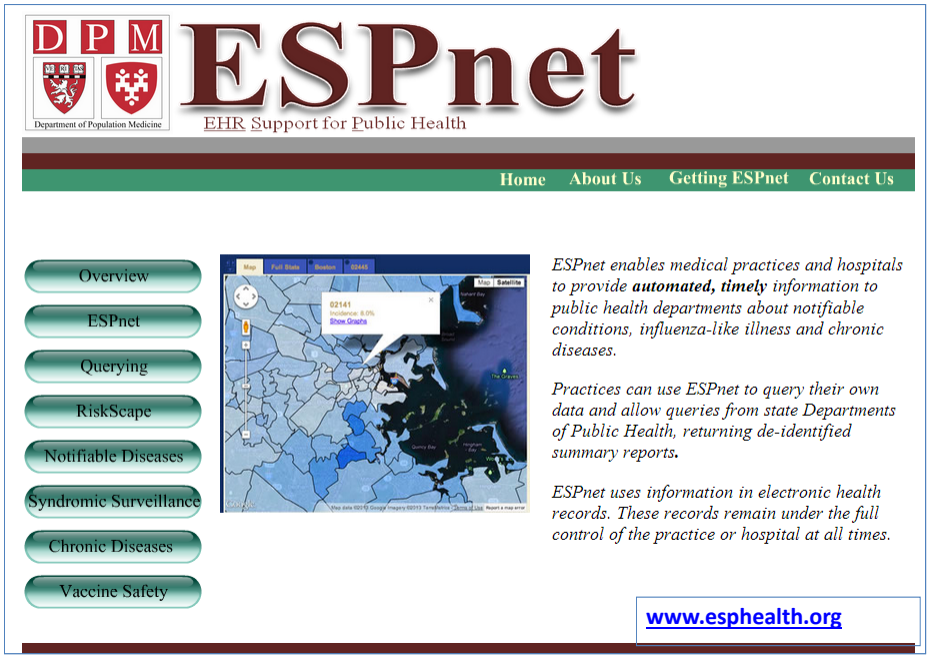
Am J Public Health 2008;98:344

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 Massachsuetts 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



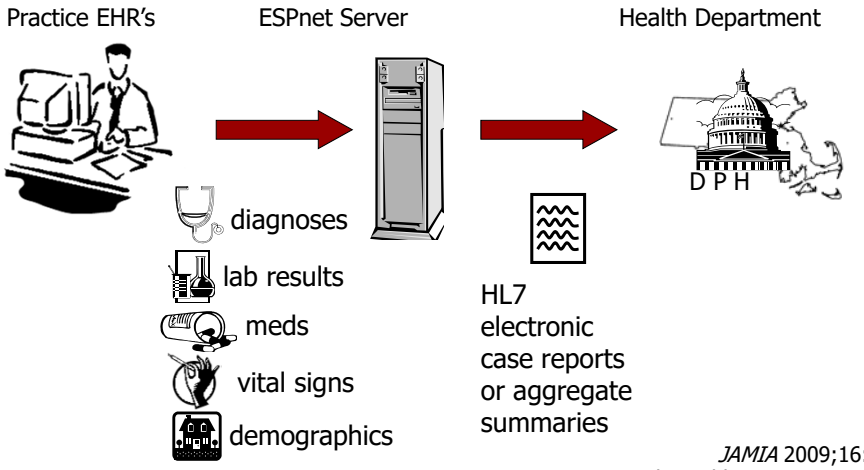
Development supported by CDC and ONC

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



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

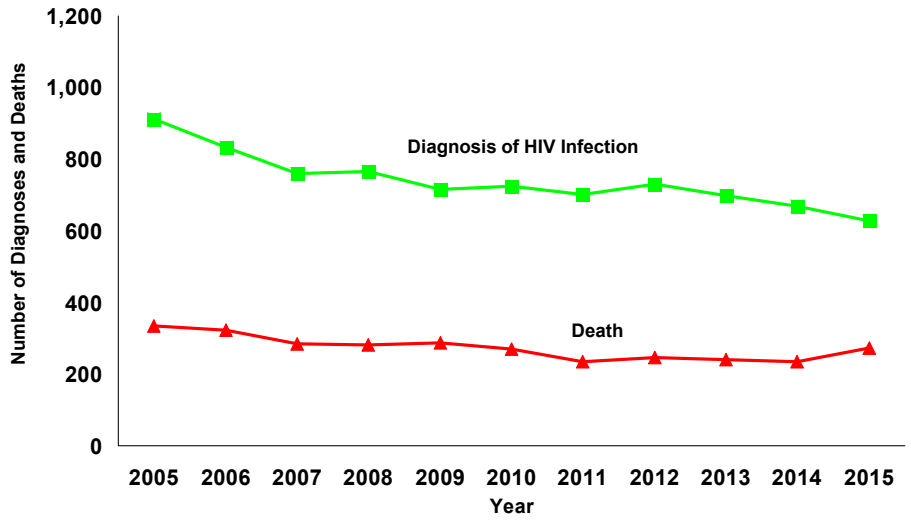
Manual versus electronic reporting

	Manual Reports*	ESPnet	Change
Chlamydia	545	758	↑ **39%**
Gonorrhea	62	95	↑ **53%**
Pelvic Inflammatory Disease	0	25	↑↑
Acute Hepatitis B	3	8	↑ **167%**
Acute Hepatitis C	14	38	↑ **171%**
Tuberculosis	13	14	↑ **8%**

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

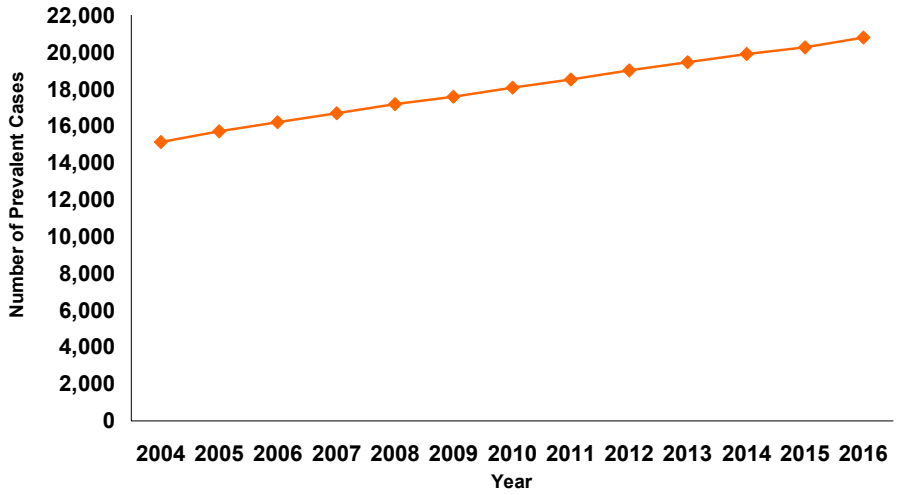
Atrius Health (variable time periods)

Trends in HIV Infection and Death in Massachusetts



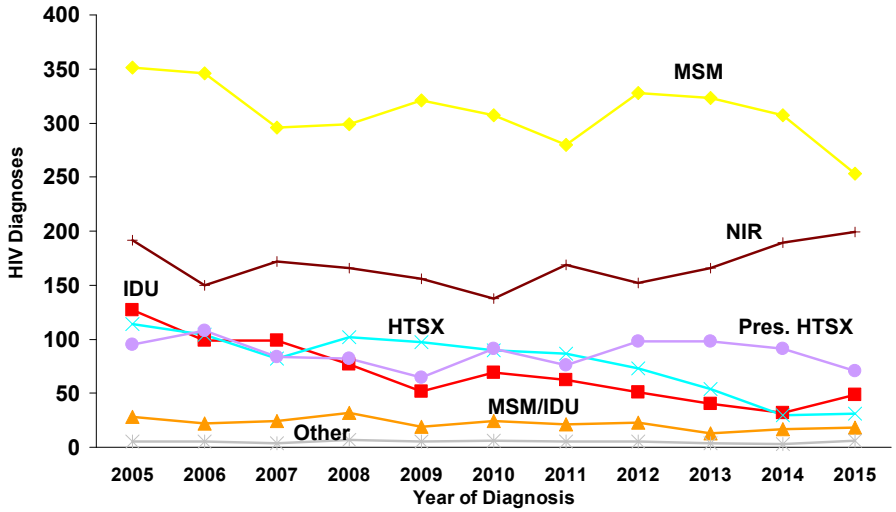
Data Source: MDPH HIV/AIDS Surveillance Program, Data as of 1/1/17

Trends in HIV/AIDS Prevalence in Massachusetts People Living with HIV/AIDS



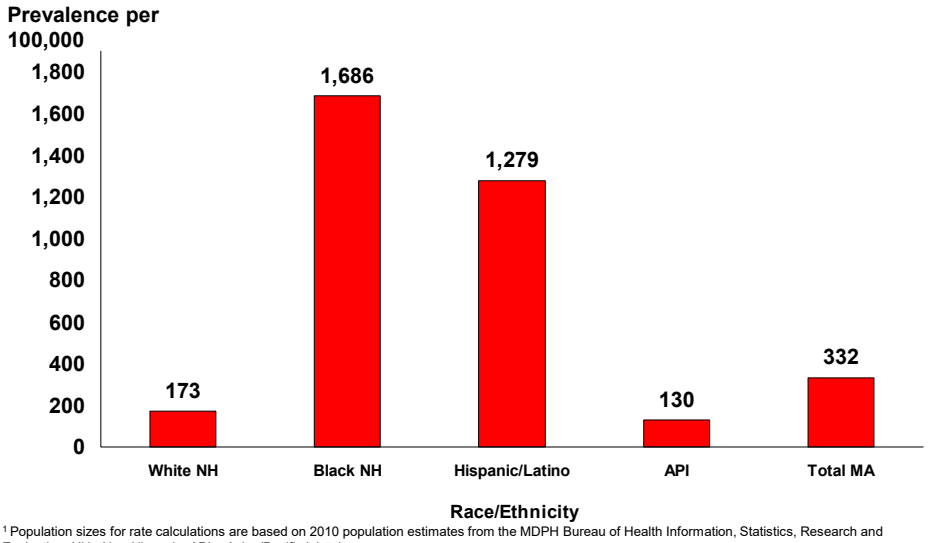
Data Source: MDPH HIV/AIDS Surveillance Program, Data as of 1/1/17

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



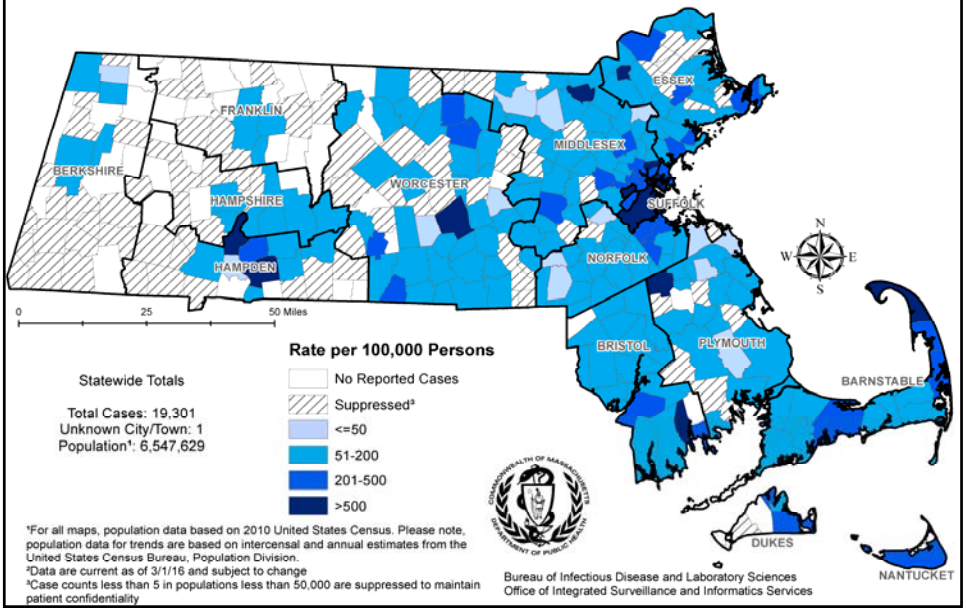
Data Source: MDPH HIV/AIDS Surveillance Program; Data as of 1/1/17

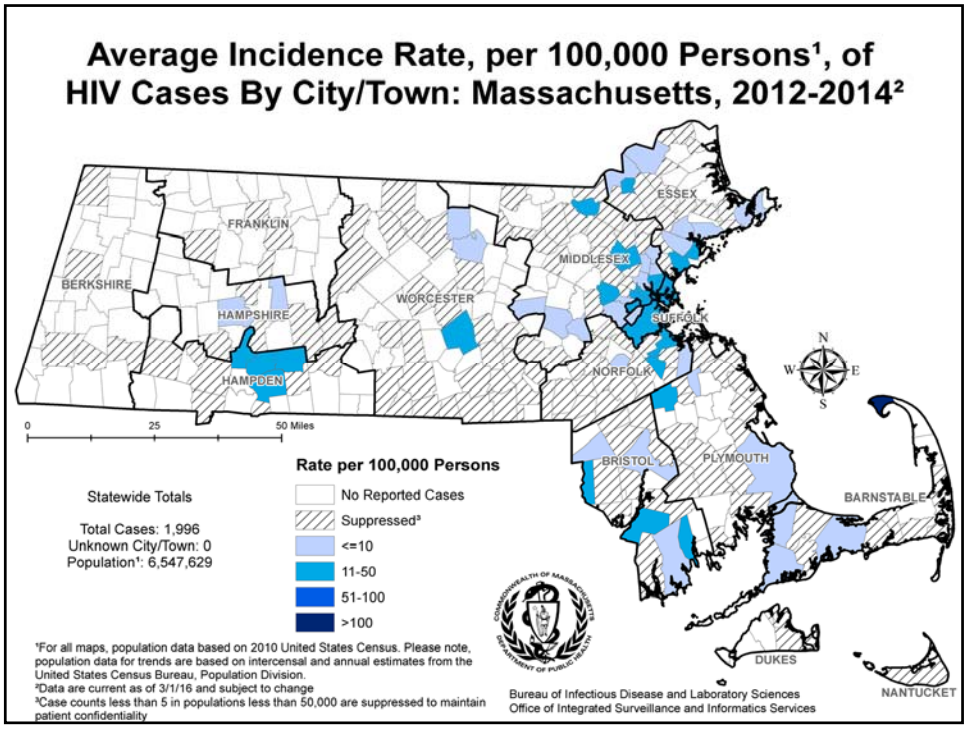
Age-Adjusted HIV/AIDS Prevalence Rate per 100,000[1] Population by Race/Ethnicity: Massachusetts

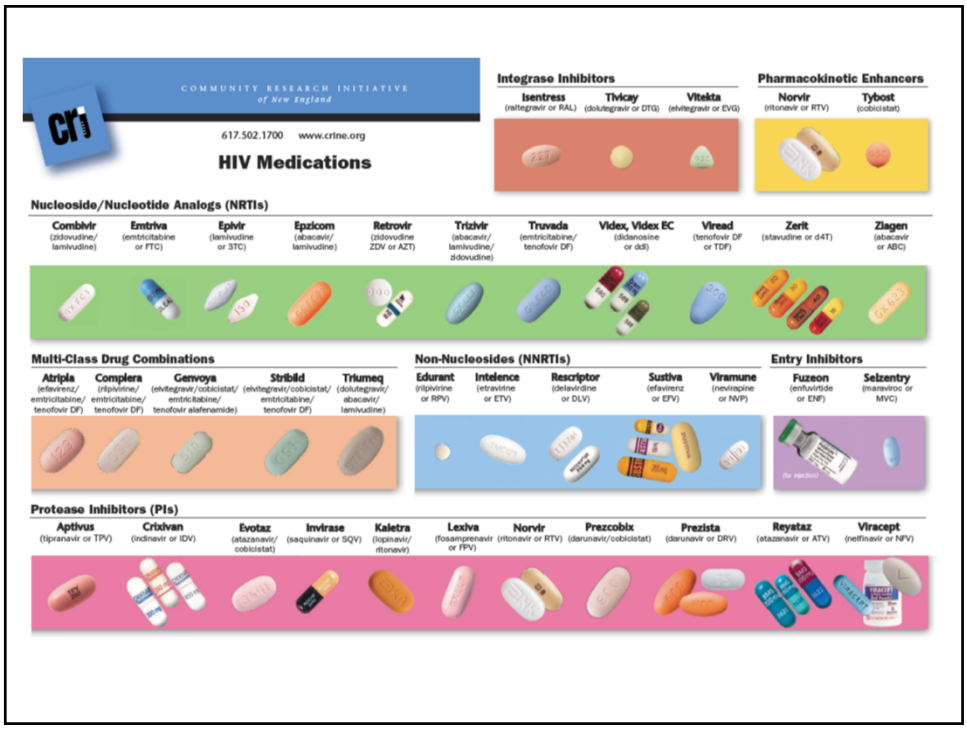


[1] Population sizes for rate calculations are based on 2010 population estimates from the MDPH Bureau of Health Information, Statistics, Research and Evaluation; NH= Non-Hispanic, API = Asian/Pacific Islander;
Data Source: MDPH HIV/AIDS Surveillance Program, data as of 2/23/16

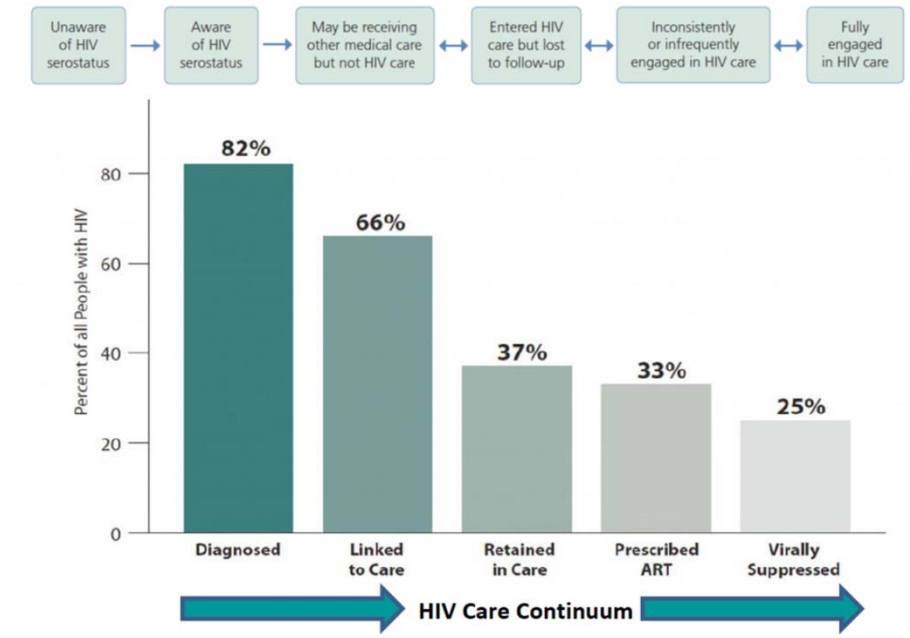
Prevalence Rate, per 100,000 Persons[1], of HIV Cases By City/Town: Massachusetts, 2015[2]



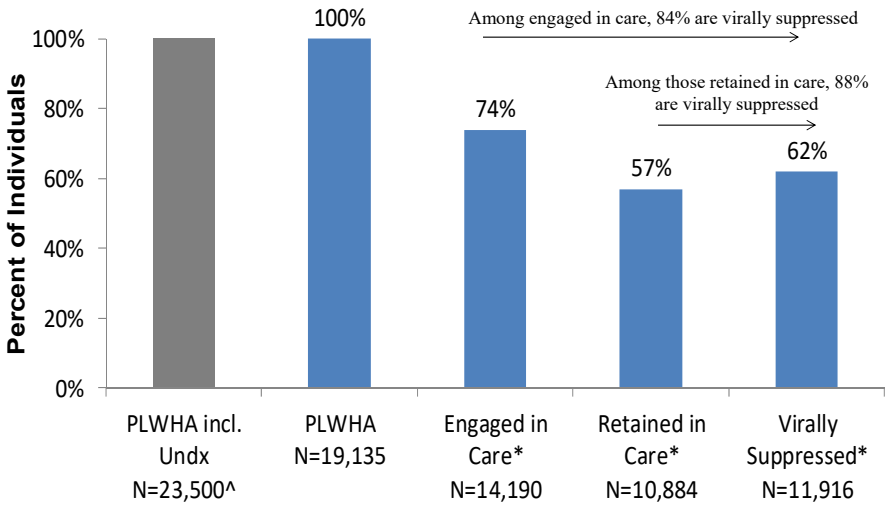

Average Incidence Rate, per 100,000 Persons¹, of HIV Cases By City/Town: Massachusetts, 2012-2014²
FRANKLIN
BERKSHIRE
HAMPSHIRE
HAMPDEN
WORCESTER
MIDDLESEX
ESSEX
SUFFOLK
NORFOLK
BRISTOL
PLYMOUTH
BARNSTABLE
DUKES
NANTUCKET
N
W
E
S
0
25
50 Miles
Rate per 100,000 Persons
No Reported Cases
Suppressed³
<=10
11-50
51-100
>100
Statewide Totals
Total Cases: 1,996
Unknown City/Town: 0
Population¹: 6,547,629
¹For all maps, population data based on 2010 United States Census. Please note, population data for trends are based on intercensal and annual estimates from the United States Census Bureau, Population Division.
²Data are current as of 3/1/16 and subject to change
³Case counts less than 5 in populations less than 50,000 are suppressed to maintain patient confidentiality
Bureau of Infectious Disease and Laboratory Sciences
Office of Integrated Surveillance and Informatics Services


COMMUNITY RESEARCH INITIATIVE
of New England
617.502.1700 www.crine.org
HIV Medications
Integrase Inhibitors
Isentress (raltegravir or RAL)
Tivicay (dolutegravir or DTG)
Vitekta (elvitegravir or EVG)
Pharmacokinetic Enhancers
Norvir (ritonavir or RTV)
Tybost (cobicistat)
Nucleoside/Nucleotide Analogs (NRTIs)
Combivir (zidovudine/lamivudine)
Emtriva (emtricitabine or FTC)
Epivir (lamivudine or 3TC)
Epzicom (abacavir/lamivudine)
Retrovir (zidovudine ZDV or AZT)
Trizivir (abacavir/lamivudine/zidovudine)
Truvada (emtricitabine/tenofovir DF)
Videx, Videx EC (didanosine or ddI)
Viread (tenofovir DF or TDF)
Zerit (stavudine or d4T)
Ziagen (abacavir or ABC)
Multi-Class Drug Combinations
Atripla (efavirenz/emtricitabine/tenofovir DF)
Complera (rilpivirine/emtricitabine/tenofovir DF)
Genvoya (elvitegravir/cobicistat/emtricitabine/tenofovir alafenamide)
Stribild (elvitegravir/cobicistat/emtricitabine/tenofovir DF)
Triumeq (dolutegravir/abacavir/lamivudine)
Non-Nucleosides (NNRTIs)
Edurant (rilpivirine or RPV)
Intelence (etravirine or ETV)
Rescriptor (delavirdine or DLV)
Sustiva (efavirenz or EFV)
Viramune (nevirapine or NVP)
Entry Inhibitors
Fuzeon (enfuvirtide or ENF)
Selzentry (maraviroc or MVC)
Protease Inhibitors (PIs)
Aptivus (tipranavir or TPV)
Crixivan (indinavir or IDV)
Evotaz (atazanavir/cobicistat)
Invirase (saquinavir or SQV)
Kaletra (lopinavir/ritonavir)
Lexiva (fosamprenavir or FPV)
Norvir (ritonavir or RTV)
Prezcobix (darunavir/cobicistat)
Prezista (darunavir or DRV)
Reyataz (atazanavir or ATV)
Viracept (nelfinavir or NFV)

Engagement in the HIV treatment cascade in the United States - 2011

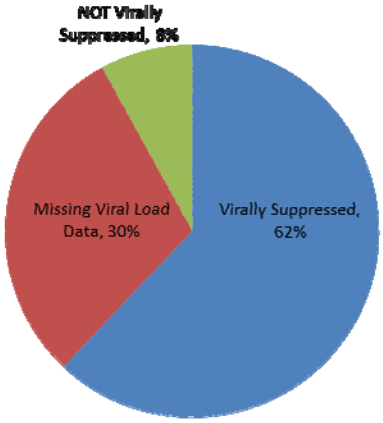


Massachusetts HIV Care Continuum



* 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.
^ John et al. National Ryan White Grantees Meeting 2016.

Viral Load Among PLWHA in Massachusetts

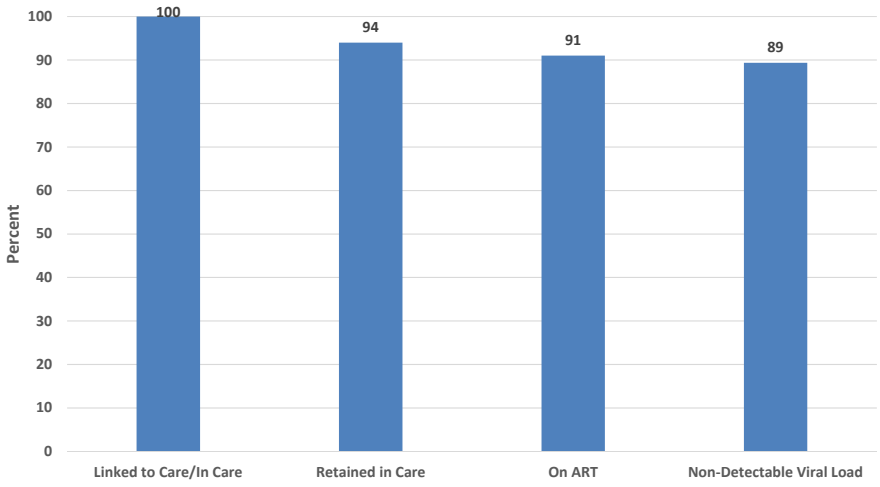


N=19,135

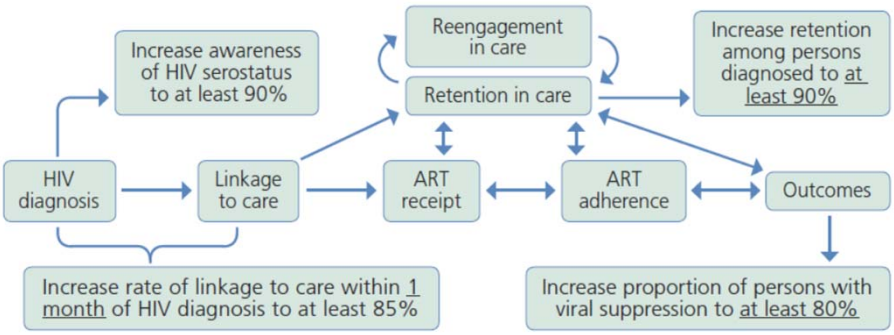
Includes individuals diagnosed through 2014 and living in MA as of 12/31/15, based on last known address, regardless of state of diagnosis
• Data Source: MDPH HIV/AIDS Surveillance Program, cases reported through 1/1/17

Care Continuum Among Patients in Care at Clinical Sites Funded in Part by MDPH

Based on Data from JSI Chart Audit for 2015, Preliminary

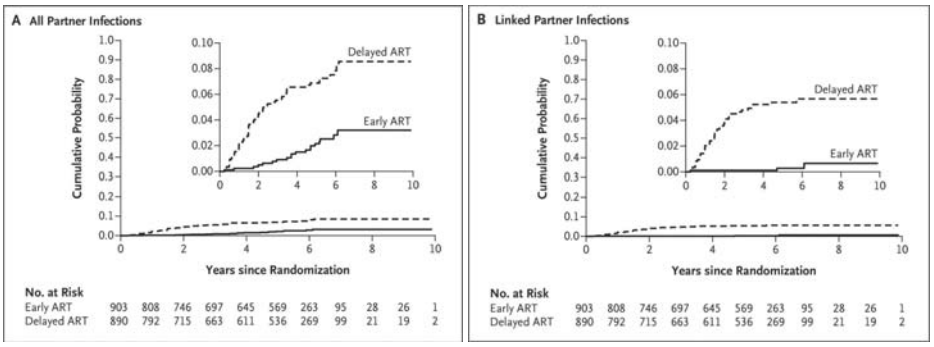


National AIDS Strategy



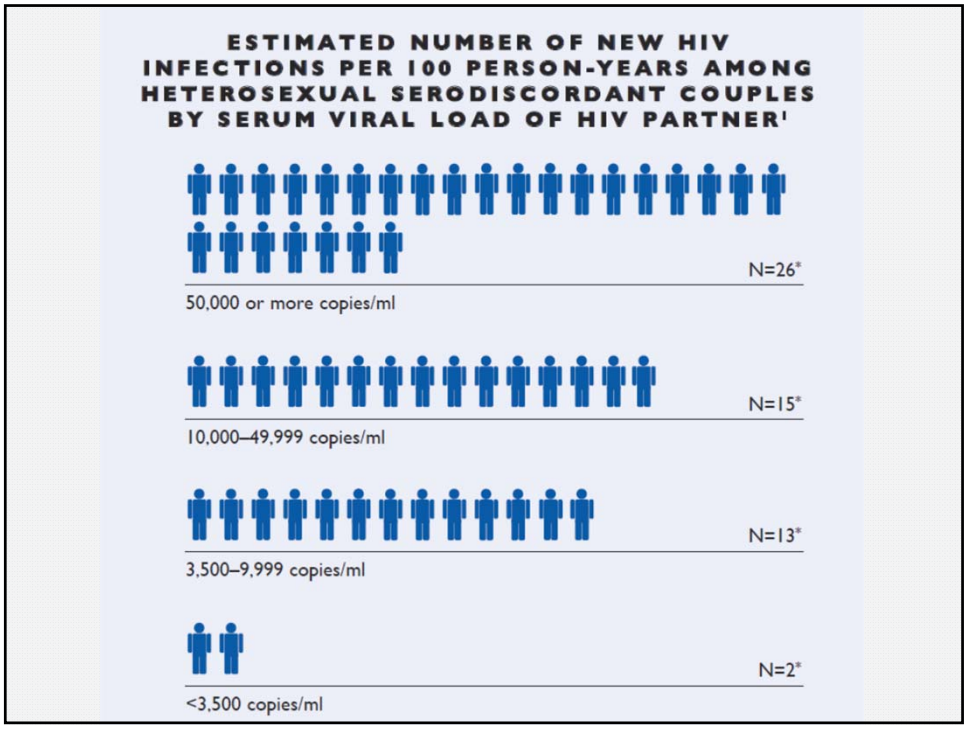
Kaplan–Meier Estimates of the Risk of HIV-1 Infection among Partners of Index Participants

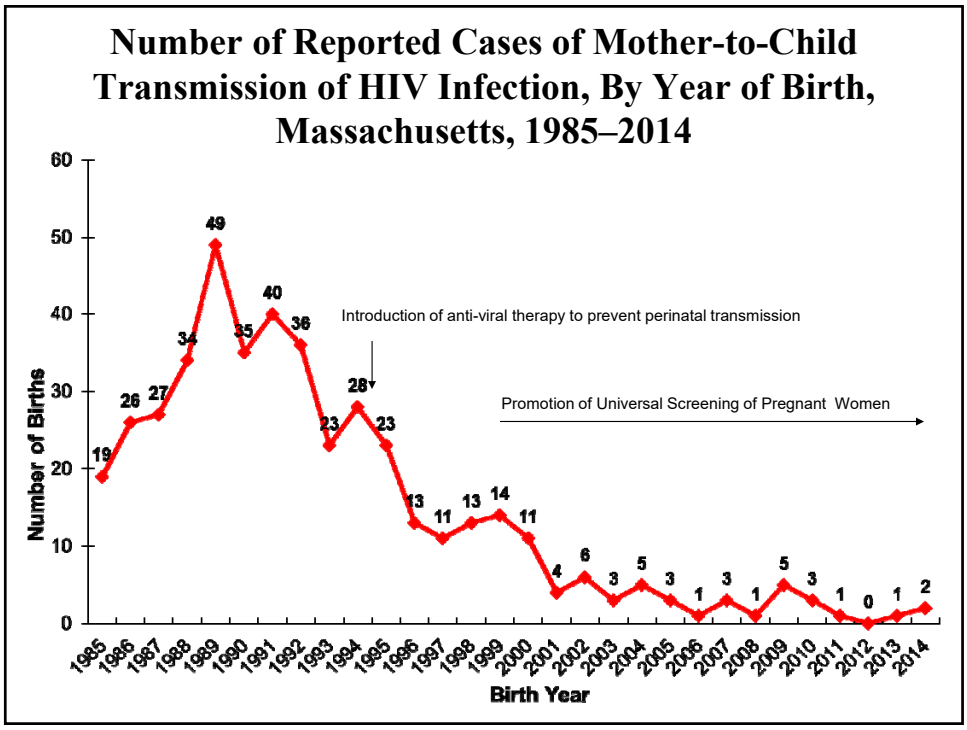
HPTN 052

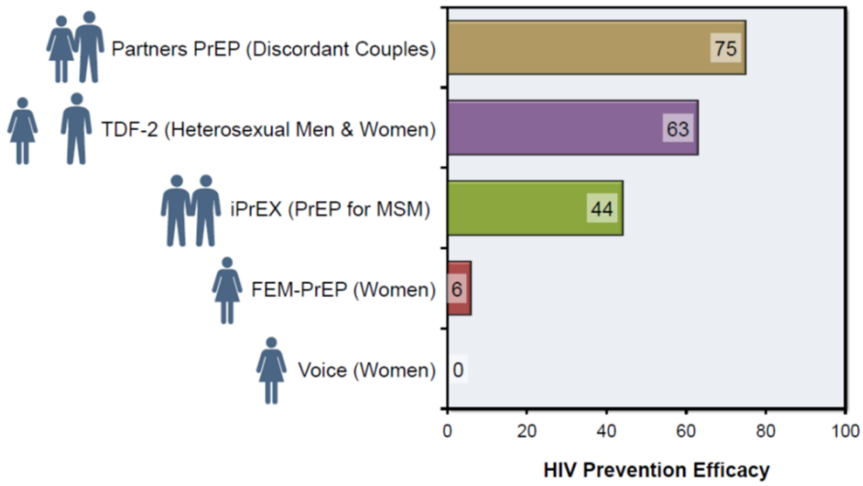


Cohen MS et al. N Engl J Med 2016;375:830-839

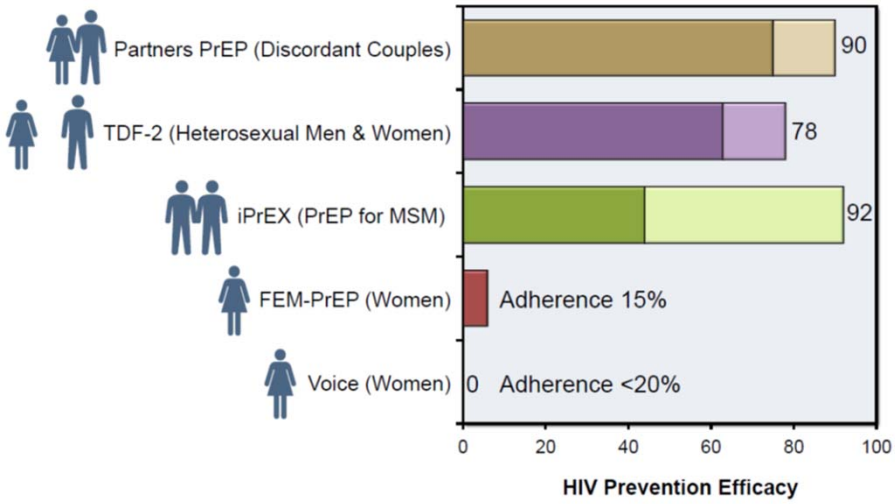
The NEW ENGLAND JOURNAL of MEDICINE


ESTIMATED NUMBER OF NEW HIV INFECTIONS PER 100 PERSON-YEARS AMONG HETEROSEXUAL SERODISCORDANT COUPLES BY SERUM VIRAL LOAD OF HIV PARTNER[1]
N=26*
50,000 or more copies/ml
N=15*
10,000–49,999 copies/ml
N=13*
3,500–9,999 copies/ml
N=2*
<3,500 copies/ml


Number of Reported Cases of Mother-to-Child Transmission of HIV Infection, By Year of Birth, Massachusetts, 1985–2014
Number of Births
Birth Year
Introduction of anti-viral therapy to prevent perinatal transmission
Promotion of Universal Screening of Pregnant Women
19 26 27 34 49 35 40 36 23 28 23 13 11 13 14 11 4 6 3 5 3 1 3 1 5 3 1 0 1 2



Source: Marrazzo JM, et al. JAMA. 2014;312:390-409.



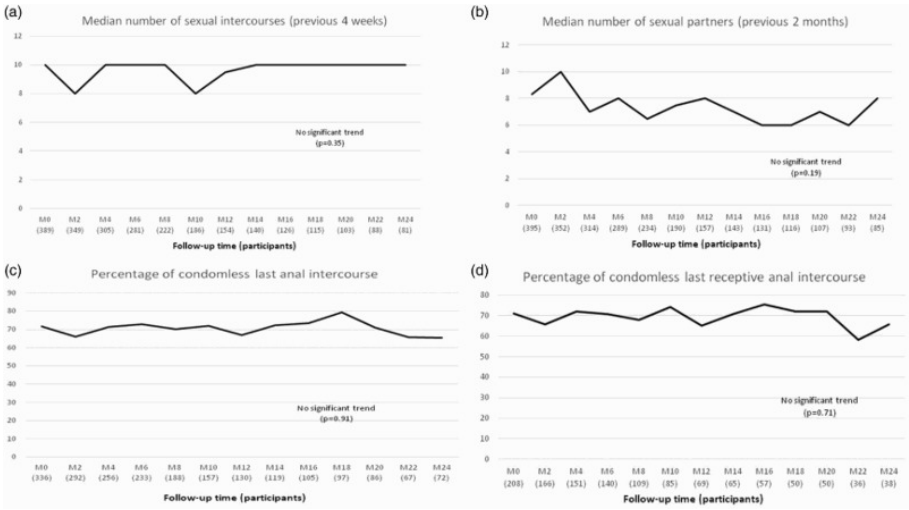
Source: Marrazzo JM, et al. JAMA. 2014;312:390-409.

PrEP Works...If You Take It

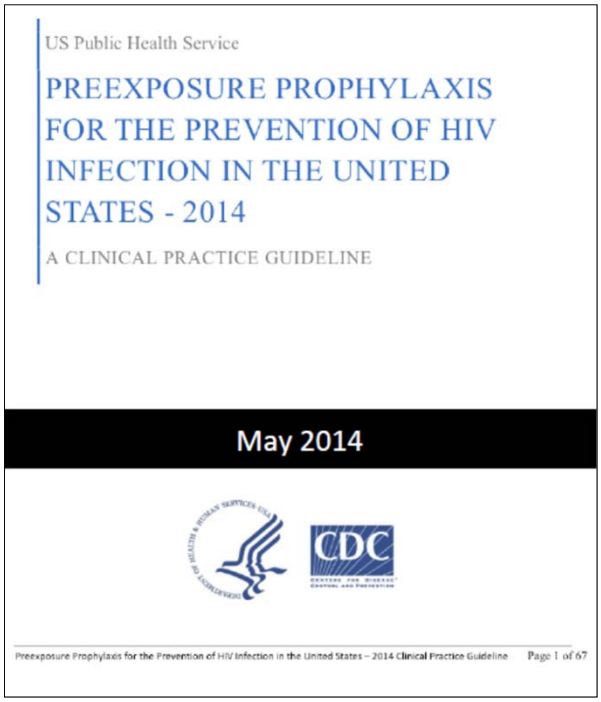
Trial	Efficacy	Adherence
CAPRISA 004[6]	1% tenofovir gel: 39%	51%
iPrEx[7]	Oral daily Truvada: 42%	51%
Partners PrEP[8]	Oral daily tenofovir: 67% Oral daily Truvada: 75%	83% 81%
TDF2[9]	Oral daily Truvada: 62%	81%
FEM-PrEP[10]	Oral daily Truvada: No Protection	24%
VOICE[2]	TFV gel: No protection Oral daily tenofovir: No protection Oral daily Truvada: No protection	23% 28% 29%

Behavior Over Time On Trial

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



Sagaon-Teyssier L, et al. AIDS Care. 2016; 28 Suppl 1:48-55.


US Public Health Service

PREEXPOSURE PROPHYLAXIS FOR THE PREVENTION OF HIV INFECTION IN THE UNITED STATES - 2014

A CLINICAL PRACTICE GUIDELINE

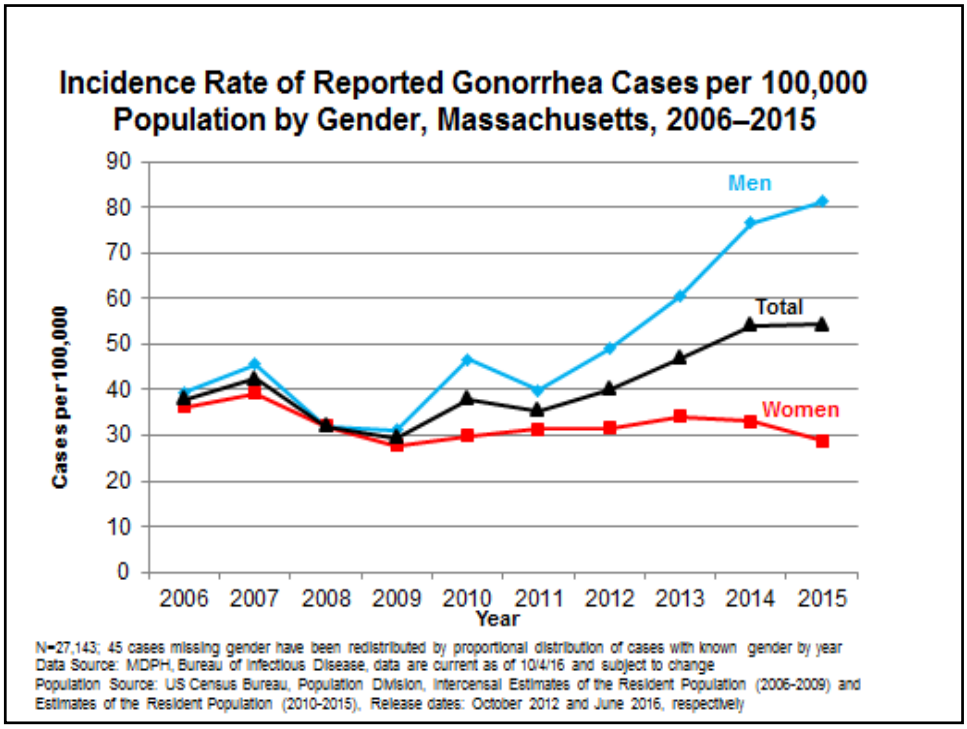
May 2014

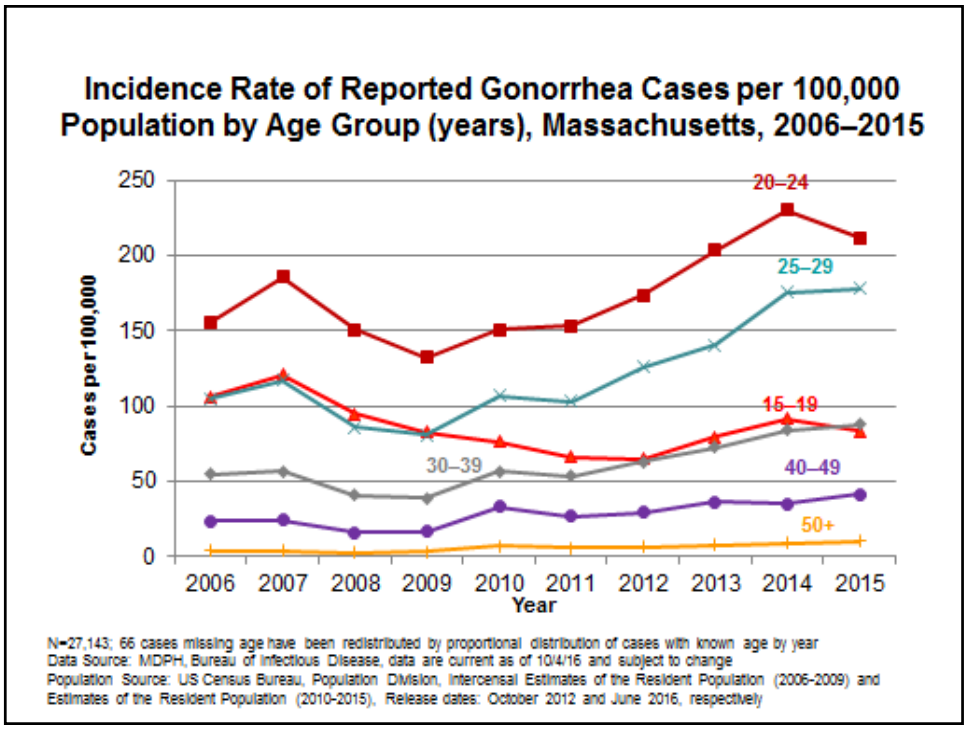
Preexposure Prophylaxis for the Prevention of HIV Infection in the United States – 2014 Clinical Practice Guideline Page 1 of 67

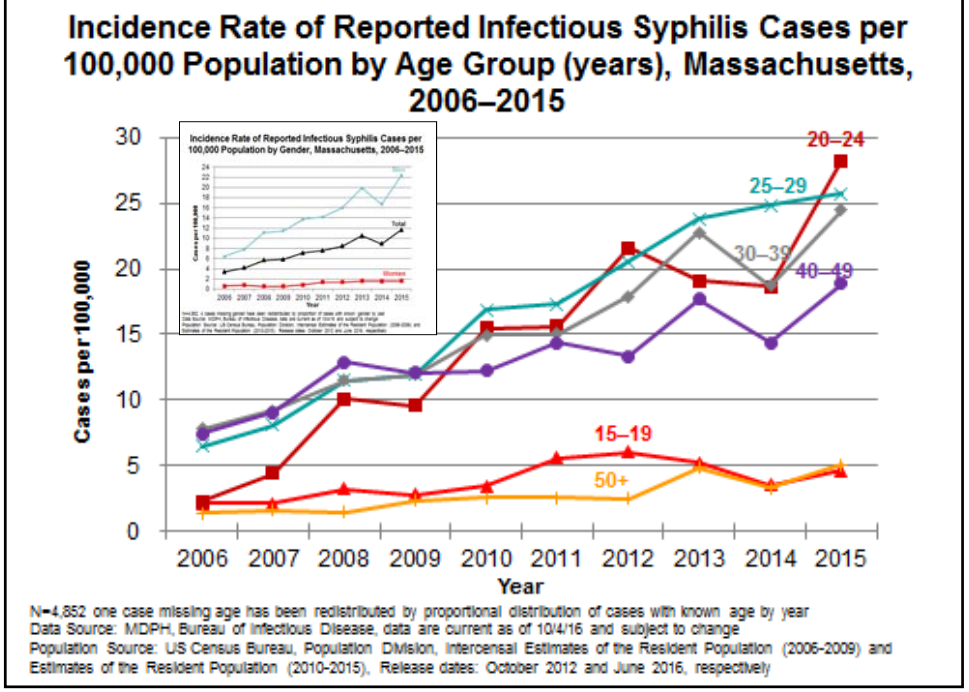
Estimated percentages and numbers of adults with indications for preexposure prophylaxis (PrEP), by transmission risk group United States, 2015

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

Smith DK, et al. MMWR Morb Mortal Wkly Rep. 2015 Nov 27;64(46):1291-5.


Incidence Rate of Reported Gonorrhea Cases per 100,000 Population by Gender, Massachusetts, 2006–2015
Cases per 100,000
90
80
70
60
50
40
30
20
10
0
Men
Total
Women
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year
N=27,143; 45 cases missing gender have been redistributed by proportional distribution of cases with known gender by year
Data Source: MDPH, Bureau of Infectious Disease, data are current as of 10/4/16 and subject to change
Population Source: US Census Bureau, Population Division, Intercensal Estimates of the Resident Population (2006-2009) and Estimates of the Resident Population (2010-2015), Release dates: October 2012 and June 2016, respectively


Incidence Rate of Reported Gonorrhea Cases per 100,000 Population by Age Group (years), Massachusetts, 2006–2015
Cases per 100,000
250
200
150
100
50
0
20–24
25–29
15–19
30–39
40–49
50+
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year
N=27,143; 66 cases missing age have been redistributed by proportional distribution of cases with known age by year
Data Source: MDPH, Bureau of Infectious Disease, data are current as of 10/4/16 and subject to change
Population Source: US Census Bureau, Population Division, Intercensal Estimates of the Resident Population (2006-2009) and Estimates of the Resident Population (2010-2015), Release dates: October 2012 and June 2016, respectively



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**


Getting to ZERO