Electronic Health Records, STD Surveillance, and Rapid Action

2017 STI Clinical Trials Group Technical Consultation
May 8-9, 2017

Michael Klompas MD, MPH
Department of Population Medicine
Harvard Medical School and Harvard Pilgrim Health Care Institute

Disclosures

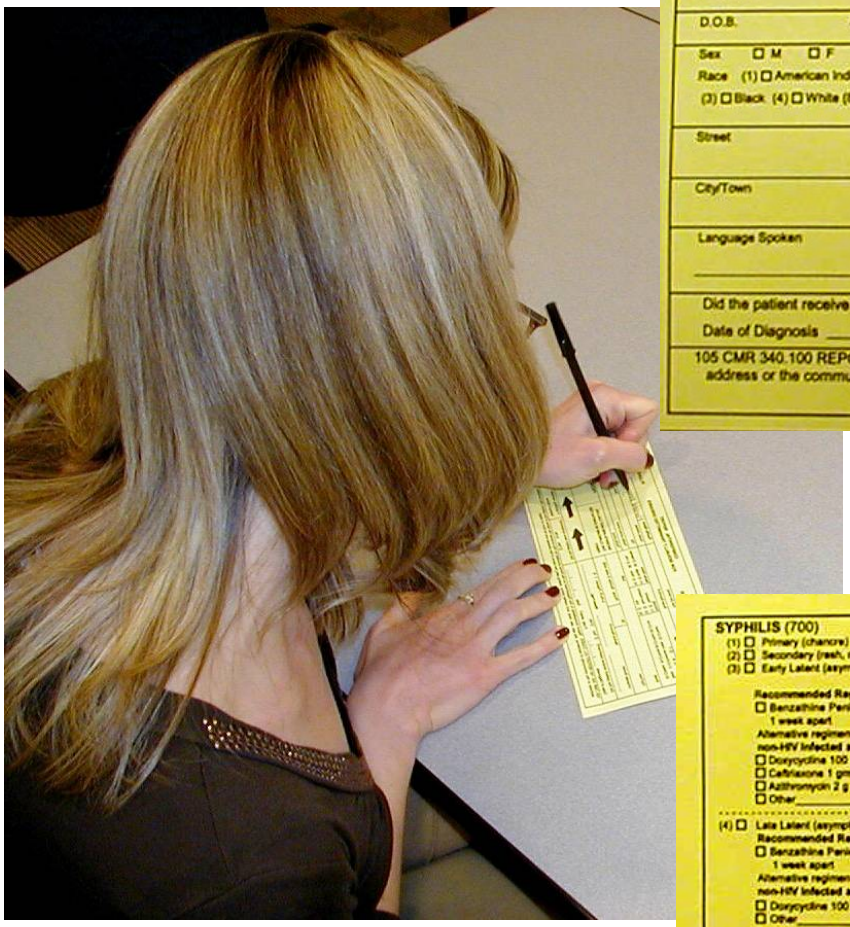
- Grant funding:
  - Massachusetts Department of Public Health
  - Centers for Disease Control and Prevention

Outline

- Strengths and limitations of traditional surveillance
- The ESP public health surveillance platform
- Case identification using EHR-data
- Tracking changes in care patterns
- Summarizing and visualizing population-level data
- Predictive analytics for clinical decision support

"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



MDPH/STD CONTROL
305 South St., Jamaica Plain, MA 02130
617-983-6940

CONFIDENTIAL REPORT FOR SEXUALLY TRANSMITTED DISEASES

PLEASE PRINT

Last Name | First (full name)

D.O.B. | Age | Social Security #

Sex ☐ M ☐ F
Race (1) ☐ American Indian (2) ☐ Asian (3) ☐ Black (4) ☐ White (8) ☐ Other (9) ☐ Unk

Ethnicity
(1) ☐ Hispanic
(2) ☐ Non-Hispanic
(9) ☐ Unk

Marital Status
(1) ☐ Single (2) ☐ Married (3) ☐ Other (9) ☐ Unk

Street | Apt#

City/Town | Zip | Phone Number & area code

Language Spoken | Medical Record # | Is this Pt. Pregnant Y N | Weeks Preg:

Did the patient receive treatment? ☐ Yes ☐ No
Date of Diagnosis ____/____/____ If yes, when? Date ____/____/____

Facility Name Harvard Vanguard Medical Associates
Facility Address
City | State | Zip Code
Facility contact person
Facility phone

PATIENTS ARE NOT CALLED, THE CLINICIAN IS CONTACTED FIRST!

PROVIDER CODE

Did the patient have symptoms? ☐ Yes ☐ No

If reporting neonatal: Mother's Name

105 CMR 340.100 REPORT ALL CASES. Report immediately to the Department on the forms provided for this purpose the name of the patient, the complete address or the community of residence, the age, sex, race, and marital status, stating also the name of the disease and its form or stage.

SYPHILIS (700)

(1) ☐ Primary (chancre) (710)
(2) ☐ Secondary (rash, other symptoms)(720)
(3) ☐ Early Latent (asymptomatic, less than 1 year) (730)

Recommended Regimen
☐ Benzathine Penicillin G 2.4 million units IM, 2 doses, 1 week apart
Alternative regimen for penicillin allergic non-pregnant non-HIV infected adult patients
☐ Doxycycline 100 mg po bid x 14 days or
☐ Ceftriaxone 1 gm IM or IV daily for 8-10 days or
☐ Azithromycin 2 g orally single dose or
☐ Other_____

(4) ☐ Late Latent (asymptomatic, over 1 year)(745)
Recommended Regimen
☐ Benzathine Penicillin G 2.4 million units IM, 3 doses, 1 week apart
Alternative regimen for penicillin allergic non-pregnant non-HIV infected adult patients
☐ Doxycycline 100 mg po bid x 28 days or
☐ Other_____

(5) ☐ Neurosyphilis (760)
Recommended Regimen
☐ Aqueous crystalline penicillin G 18 - 24 million units per day, administered as 3-4 million units IV every 4 hours or continuous infusion, for 10-14 days
☐ Other_____

(6) ☐ Congenital (Infant) (790)
Recommended Regimen
☐ Aqueous crystalline penicillin G 50,000 units/kg/dose IV every 12 hours for the first 7 days of life and every 8 hours thereafter for a total of 10 days

(7) ☐ Adult Congenital

GONORRHEA (300)

☐ Cervical	DX by culture	yes ☐	no ☐
☐ Urethral	DX by culture	yes ☐	no ☐
☐ Rectal	DX by culture	yes ☐	no ☐
☐ Pharyngeal	DX by culture	yes ☐	no ☐

☐ Other _____

Recommended Regimen for Uncomplicated Infections:
Because of continuing increases in the number of reported cases of fluoroquinolone resistant gonorrhea, Ceftriaxone 250 mg IM is the preferred regimen for the treatment of uncomplicated gonococcal infections.

Unless antibiotic susceptibility testing performed on a positive culture excludes resistance to quinolone, we no longer recommend the use of quinolones for the presumptive treatment of gonorrhea or treatment based on a non-culture test result.

☐ Ceftriaxone 250 mg IM or
☐ Other_____
PLUS (Treatment for Chlamydia trachomatis)
☐ Doxycycline 100 mg po bid x 7 days or
☐ Azithromycin 1 gm po single dose or
☐ Other _____

Questions about treatment for any STD?
Call the Division of STD Prevention at (617) 983-6940.

Disease control and prevention requires evaluation and treatment of partners.
Please counsel your patient to refer their partner(s).

The STD program can provide confidential partner notification services.
Do you want this service for your patient? ☐ Yes ☐ No
If yes, we will call you first!

If you are reporting a disease in a minor, did you file a 51A ? ☐ Yes ☐ No
If you would like more cards please check here ____

CHLAMYDIA (200)

☐ Cervical
☐ Urethral
☐ Rectal
☐ Pharyngeal
☐ Other

Recommended Regimen for Uncomplicated Infection (non-pregnant adult patient)
☐ Azithromycin 1 g po single dose or
☐ Doxycycline 100 mg po bid x 7 days or
☐ Other

Recommended Regimen for Uncomplicated Infection (pregnant patients)
☐ Erythromycin base 500 mg po qid x 7 days or
☐ Amoxicillin 500 mg tid x 7 days or
☐ Azithromycin 1 gm single dose or
☐ Other_____

PID (490)

☐ Gonococcal
☐ Chlamydia
☐ Agent Unknown

Treatment Provided

☐ Outpatient
_____
_____
_____

☐ Inpatient
_____
_____
_____

OTHER REPORTABLE SEXUALLY TRANSMITTED DISEASES

☐ CHANCROID (100) - Recommended Regimen
☐ Ceftriaxone 250 mg IM once or
☐ Azithromycin 1 gm po single dose or
☐ Other_____

☐ LYMPHOGRANULOMA VENEREUM (600) - Recommended Regimen
☐ Doxycycline 100 mg po bid X 21 days or
☐ Other_____

☐ GRANULOMA INGUINALE (500) - Recommended Regimen
☐ Doxycycline 100 mg po bid x at least 21 days or
☐ Trimethoprim-sulfamethoxazole 1 DS tablet (800mg/160mg) bid X at least 21 days or
☐ Other_____

☐ NEONATAL HERPES (850)
☐ OPHTHALMIA NEONATORUM
☐ CONDYLOMA ACUMINATA (EXTERNAL GENITAL WARTS) (800)

PHV-13 (Rev. 1/04)

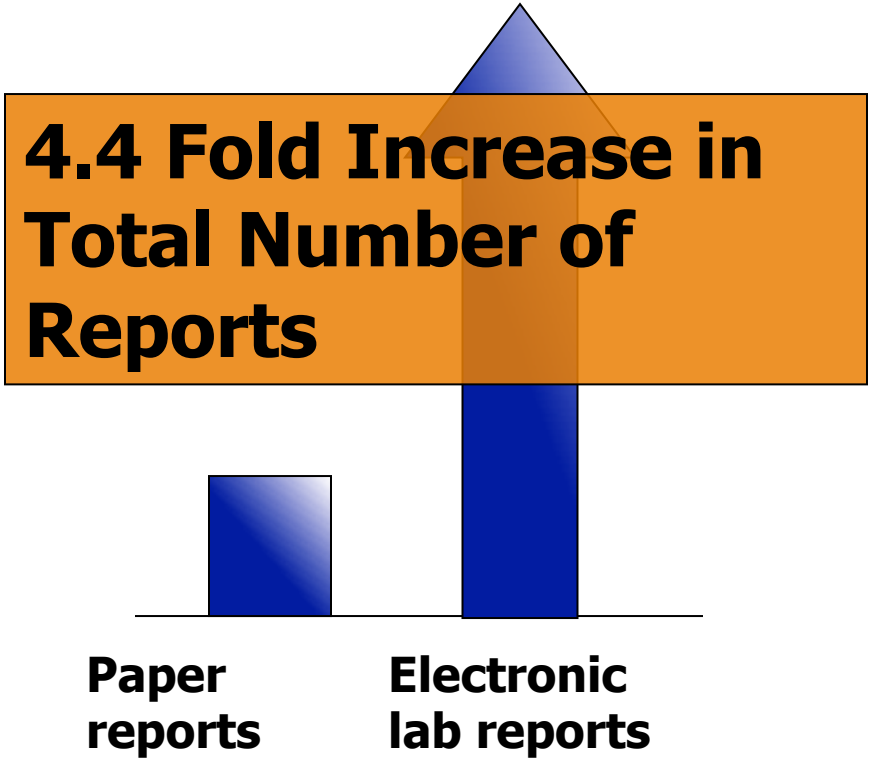
Paper-based reporting

Condition	Completeness of Reporting	Time from Diagnosis to Report
Pertussis	32%	23 days
Hepatitis A	33%	12 days
Salmonella	50%	16 days
Tuberculosis	60-80%	7-38 days

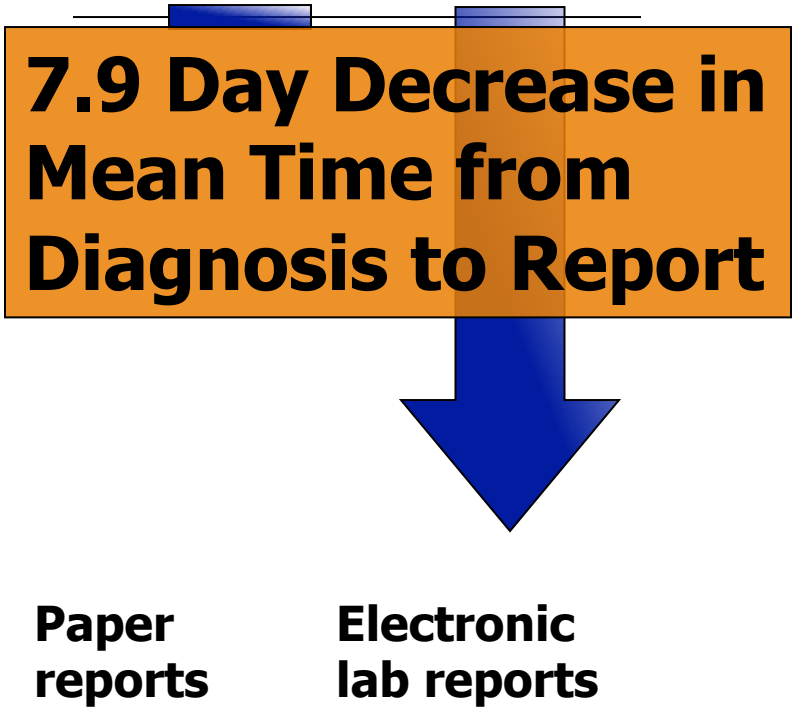
Am J Prev Med 2001;20:108
BMC Public Health 2004;4:29
Am J Epidemiol 2002;155:866

Electronic Laboratory versus Paper Reporting

Total Number of Reports



Time from Diagnosis to Report

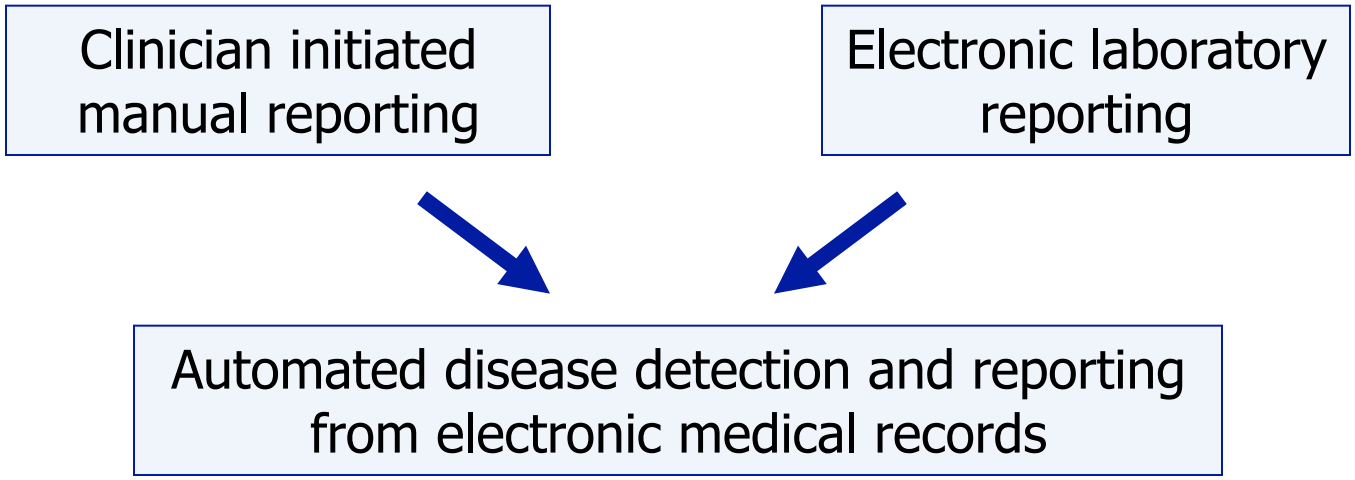


Am J Public Health 2008;98:344

Limitations of Labs

- Blind to purely clinical diagnoses
  - e.g. culture negative TB, early Lyme, PID
- Multiple reports for same episode
  - e.g. HIV, hepatitis B & C, syphilis
- Poor discriminator between active & resolved, acute & chronic disease
  - e.g. acute vs chronic HIV or hep B & C, current vs remote Lyme, new versus old syphilis

Our goal



Combine the best of traditional clinician-initiated reporting and electronic laboratory reporting systems:

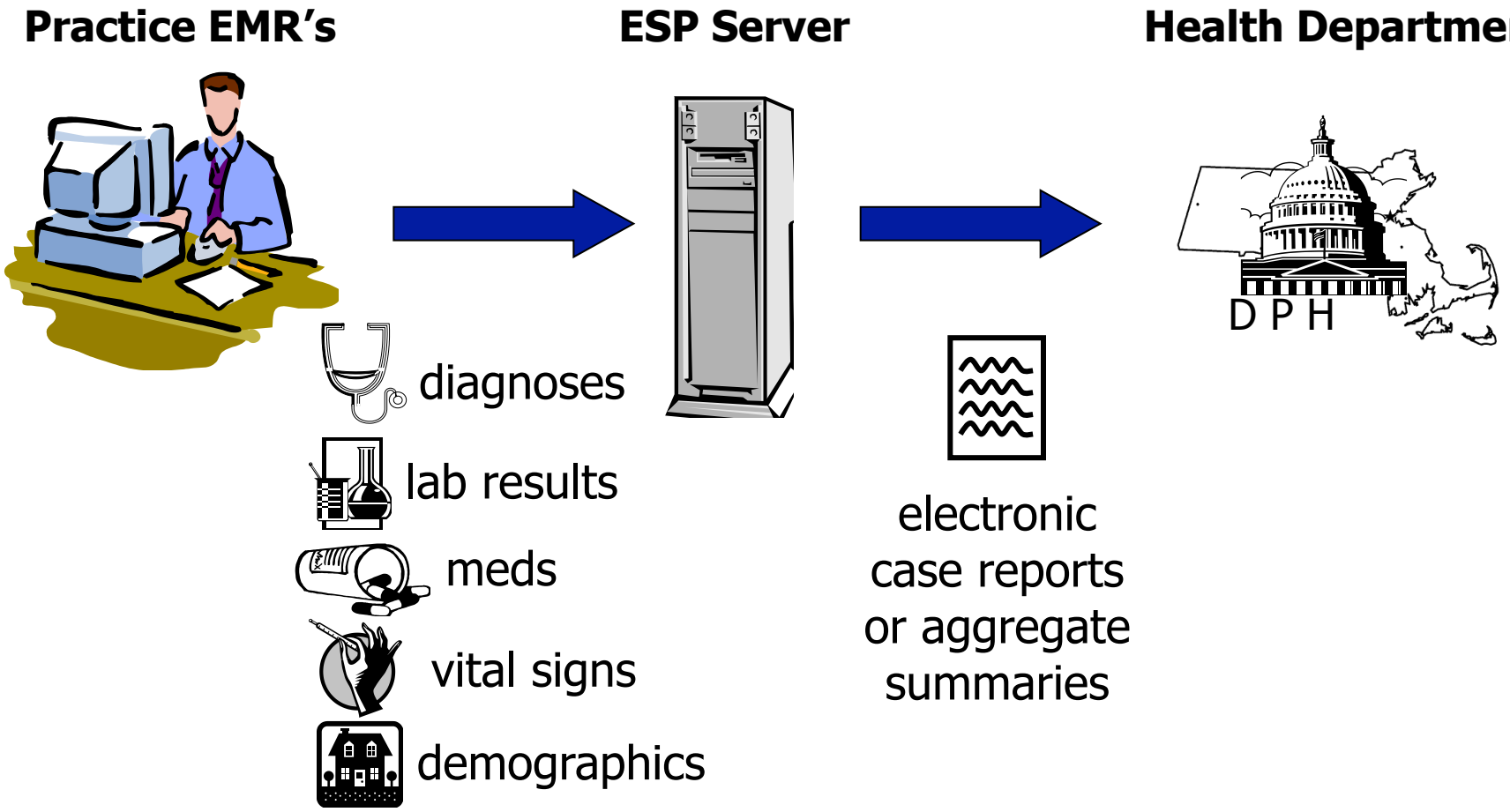
- Fast, accurate, clinically detailed, digital reports
- Generalizable model

Electronic Support for Public Health (ESP)

- Software and architecture to extract, analyze, and transmit electronic health information from providers to public health.
  - Surveys codified electronic health record data for patients with conditions of public health interest
  - Generates secure electronic reports for the state health department
  - Designed to be compatible with any EHR system

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

ESP: Automated disease detection and reporting for public health

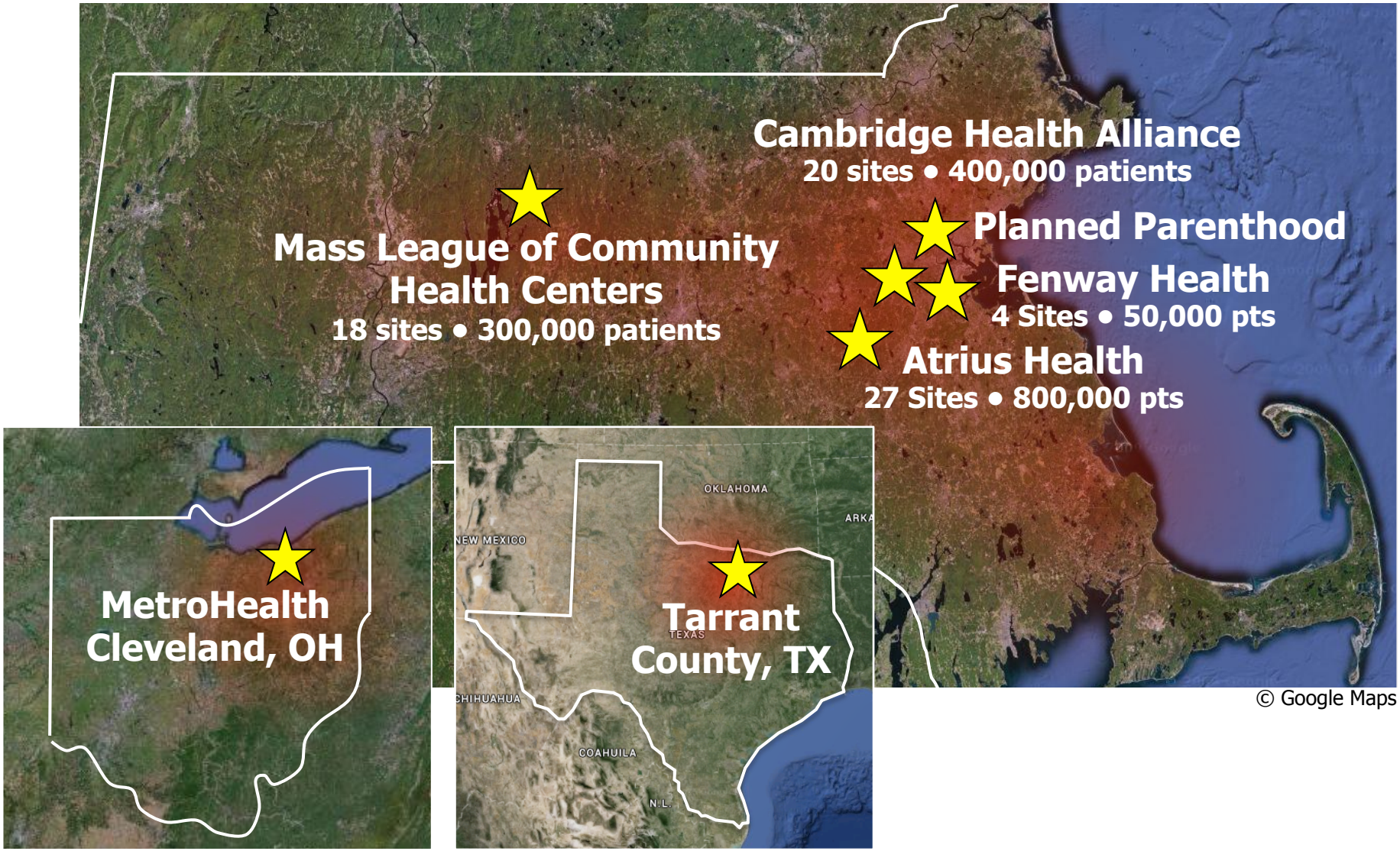


JAMIA 2009;16:18-24
Am J Pub Health 2012;102:S325–S332

Report to Health Department

- Patient demographics
- Responsible clinician, site, contact info
- Specimen source (oral, rectal, genital)
- Treatment given
- Symptoms (ICD codes & temperature)
- Pregnancy status (if pertinent)

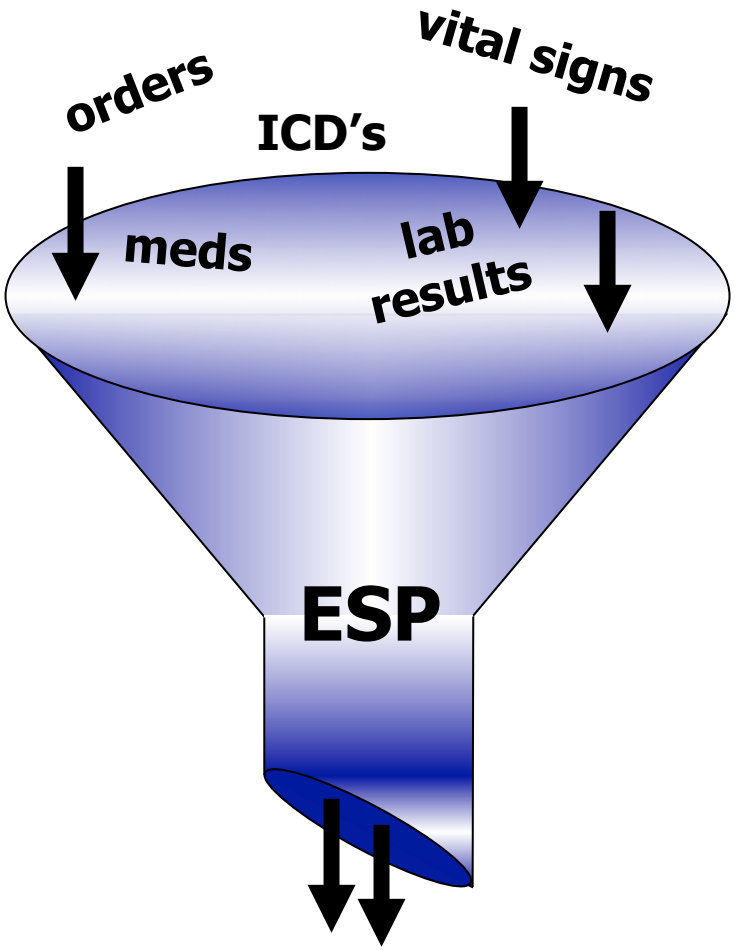
Current ESP Installations



Current Modules

- Notifiable diseases
- Influenza-like illness
- Chronic diseases
- Vaccine adverse events

Case Identification



HIV

Acute Hepatitis B

Chlamydia

Syphilis

Limitations of Diagnosis Codes

Condition	Sensitivity	Positive Predictive Value
Chlamydia	75%	80%
Acute hepatitis C	63%	22%
Tuberculosis	100%	17%
Syphilis	93%	47%
HIV	96%	96%

Solution

- Integrate multiple streams of data from the EMR to increase sensitivity and specificity
  - Lab orders
  - Lab results (present and past)
  - Diagnosis codes (present and past)
  - Medication prescriptions
  - Vital signs

Case Identification Logic: Chlamydia

Any of the following:

- Positive culture for *Chlamydia trachomatis*

OR

- Positive NAAT for *Chlamydia trachomatis*

Case Identification Logic: Syphilis

Any of the following:

- ICD9 for syphilis and prescription for (penicillin G or doxycycline or ceftriaxone)

OR

- Serum RPR ≥ 1:8 and (TP-IGG or TPPA or FTA-ABS positive)

OR

- Positive CSF test (VDRL≥1:1, TPPA, or FTA-ABS)

Potential Approaches to HIV Detection

Diagnosis codes for HIV

- Not perfectly sensitive
- Sometimes (inappropriately) used for HIV exposure or testing

Positive lab tests

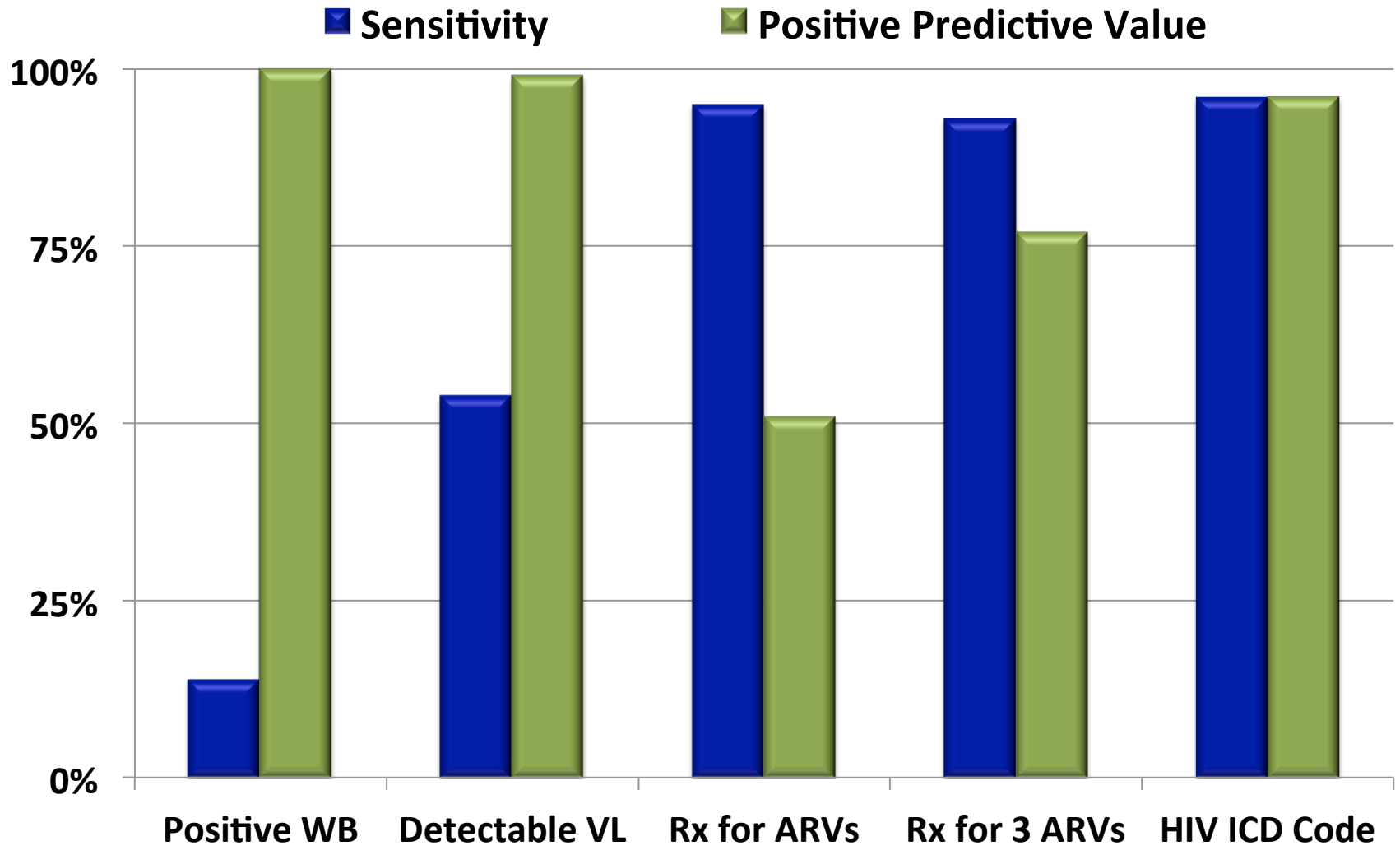
- Positive ELISA / WB / Ab-Ag may be remote or done elsewhere
- Viral load on meds may be undetectable

Medications

- False positives: PEP, PrEP, Hepatitis B

Accuracy of Potential HIV Surveillance Criteria

Atrius Health, 2006-2015



Notifiable Disease Reporting

ESP Case Reporting

Atrius, CHA, MetroHealth, Fenway, Planned Parenthood of MA 2006-2016

Condition	Total Cases
Chlamydia	34,725
Gonorrhea	8,028
Pelvic inflammatory disease	359
Acute hepatitis A	40
Acute hepatitis B	131
Acute hepatitis C	316
Syphilis	1973

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports / Vol. 64 / No. 3
June 5, 2015

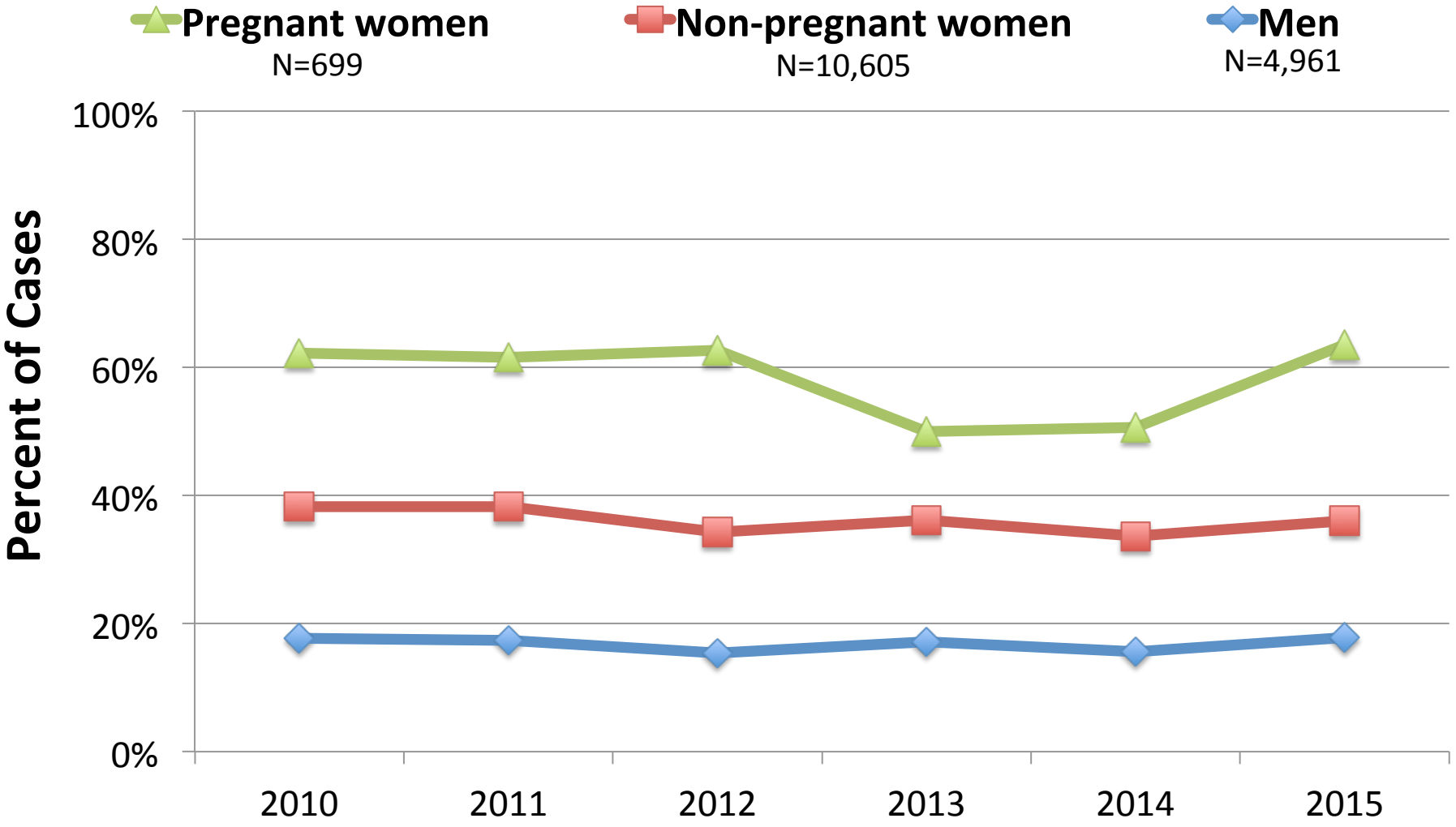
Sexually Transmitted Diseases Treatment Guidelines, 2015

Men and women who have been treated for chlamydia should be retested approximately 3 months after treatment, regardless of whether they believe that their sex partners were treated (*480,481*).

Chlamydia Test of Reinfection

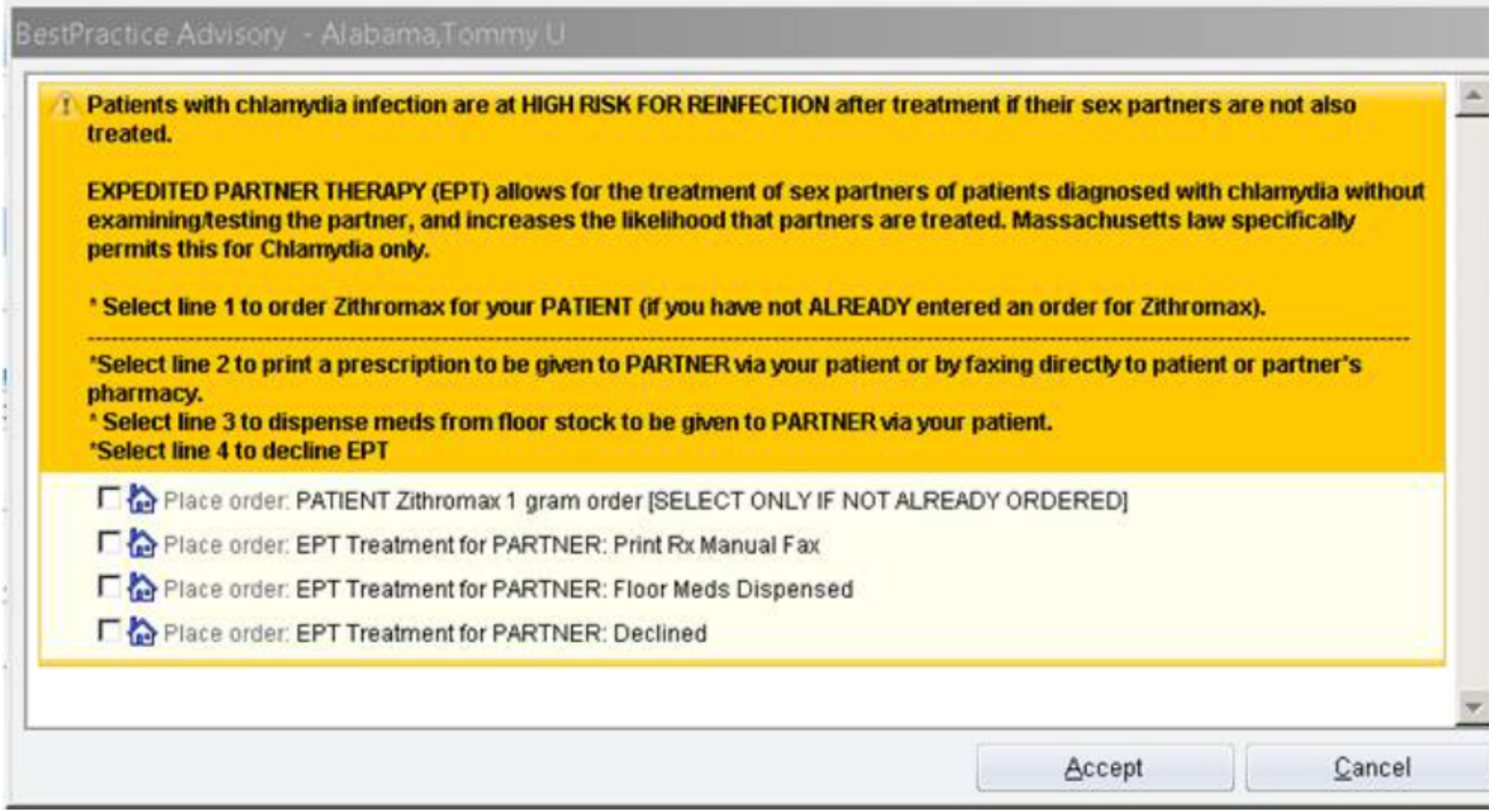
Repeat Testing within 29-120 Days of Infection

Atrius Health, Cambridge Health Alliance, Mass League of Community Health Centers
~1.5 million patients under surveillance

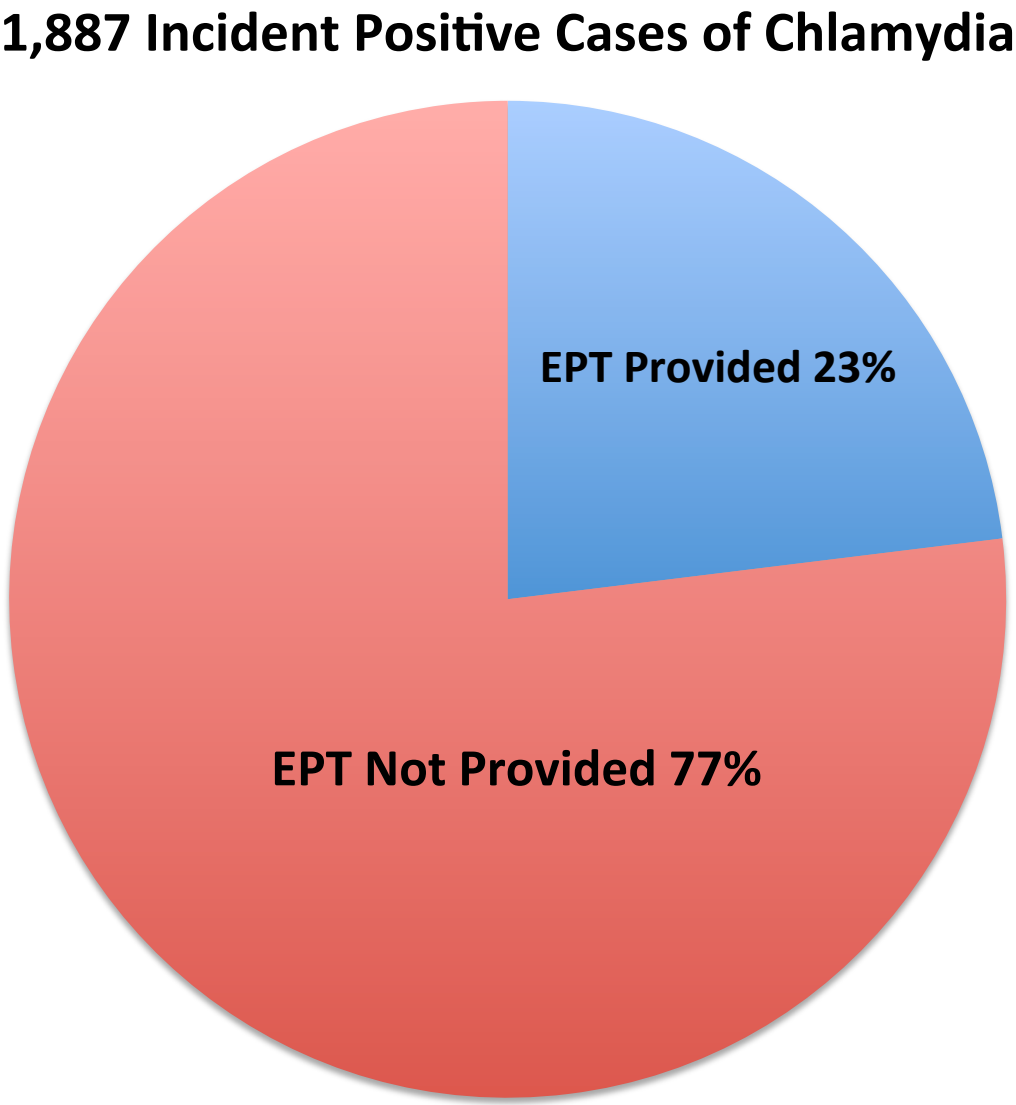


Clinical Alerts to Spur EPT

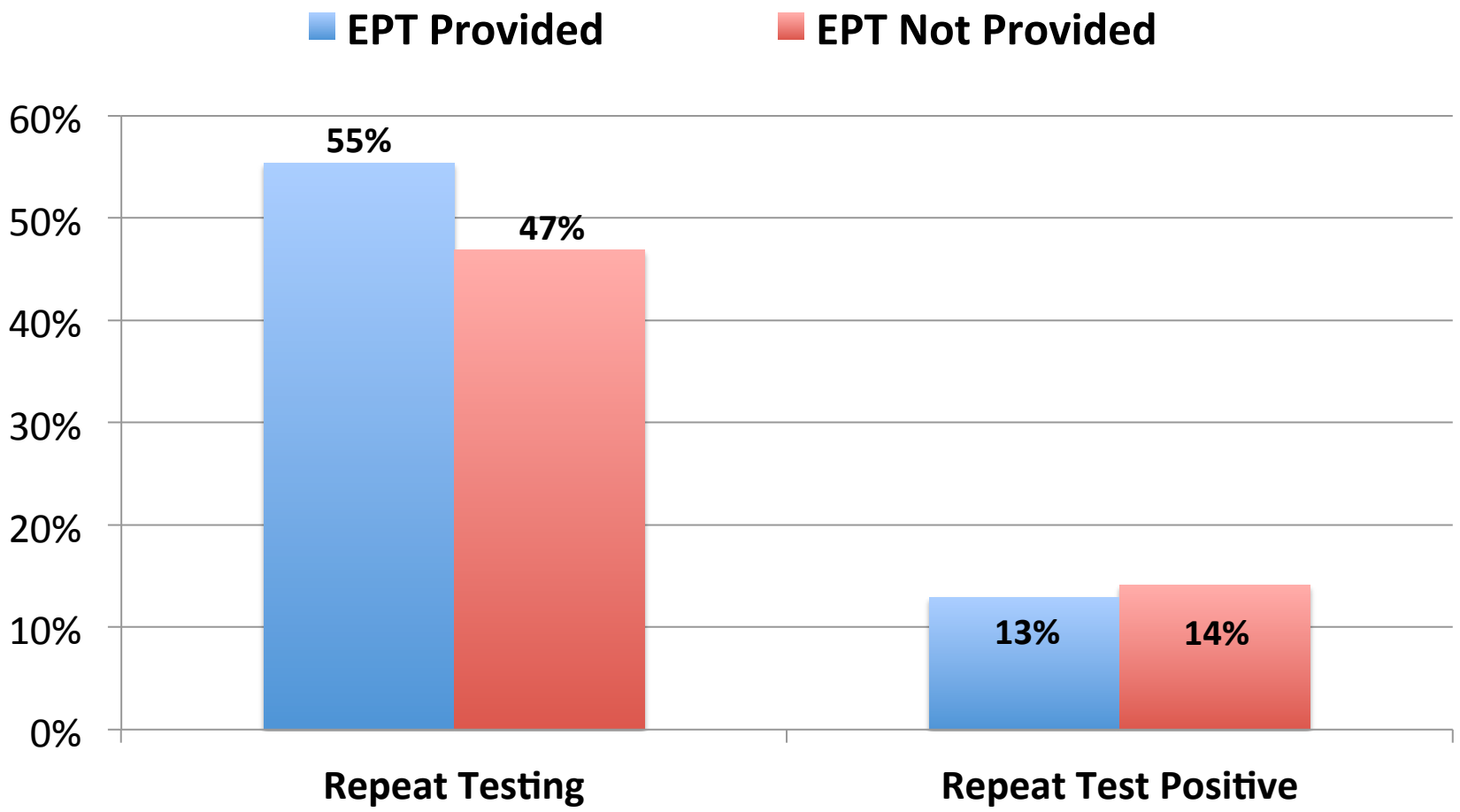
Atrius Health, Boston



Impact of EPT on Chlamydia Reinfection



Reinfection Testing & Positivity Rates by EPT Status



Real-time Monitoring

https://riskscape.esphealth.org

RiskScape

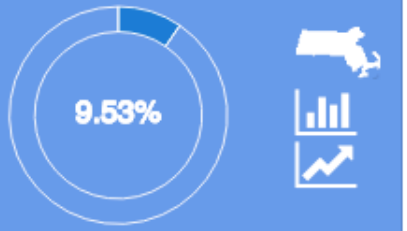
MDPHNET

Data Last Updated May 4, 2017
Population Under Surveillance: 1,513,663

- Dashboard
- Pick Conditions
- Map
- Demographics & Comorbidities
- Timeseries
- Continuity of Care
- Condition Definitions
- About

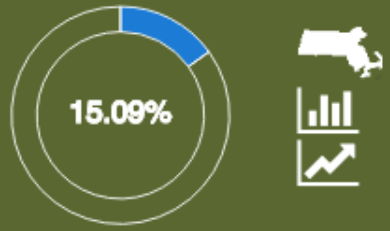
Select Condition Definition or Create your Own

TYPE 2 DIABETES



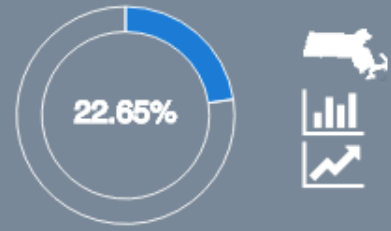
Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

SMOKING



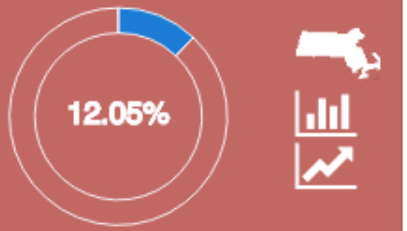
Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

HYPERTENSION



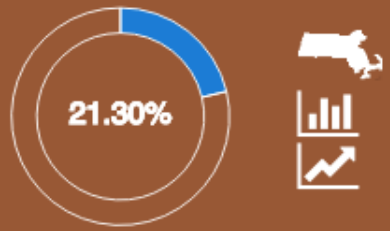
Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

PEDIATRIC ASTHMA



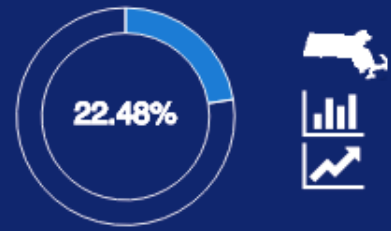
Inclusion Criteria
Age Group: <20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

OBESITY (BMI >30)



Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

OVERWEIGHT (BMI 25-30)



Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

https://riskscape.esphealth.org

RiskScape

MDPHNET

- Dashboard
- Pick Conditions
- Map
- Demographics & Comorbidities
- Timeseries
- Continuity of Care
- Condition Definitions
- About

Select Condition Definition or Create your Own

Data Last Updated May 4, 2017
Population Under Surveillance: 1,513,663

INFLUENZA VACCINATION, CURRENT SEASON

Inclusion Criteria
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

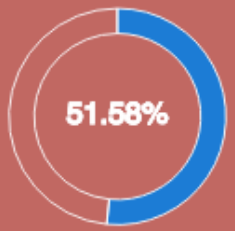
DEPRESSION

Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

OPIOID PRESCRIPTION

Inclusion Criteria
Age Group: ≥20
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

SYPHILIS SCREENING IN PREGNANT WOMEN



Inclusion Criteria
Sex: Female
Pregnant: Yes
Lifetime Encounters: ≥1

HEPATITIS C SCREENING IN PATIENTS BORN 1945-1965

Inclusion Criteria
Birth Cohort: 1945-1965
Lifetime Encounters: ≥1
Recent Encounters: ≥1 in the past 2 years

CHLAMYDIA SCREENING IN WOMEN AGED 15-24

Inclusion Criteria
Age Group: 15-24
Sex: Female
Lifetime Encounters: ≥1

Chlamydia Testing Rates by Zip Code

Dashboard

Pick Conditions

Map

Demographics & Comorbidities

Timeseries

Continuity of Care

Condition Definitions

About MDPHnet

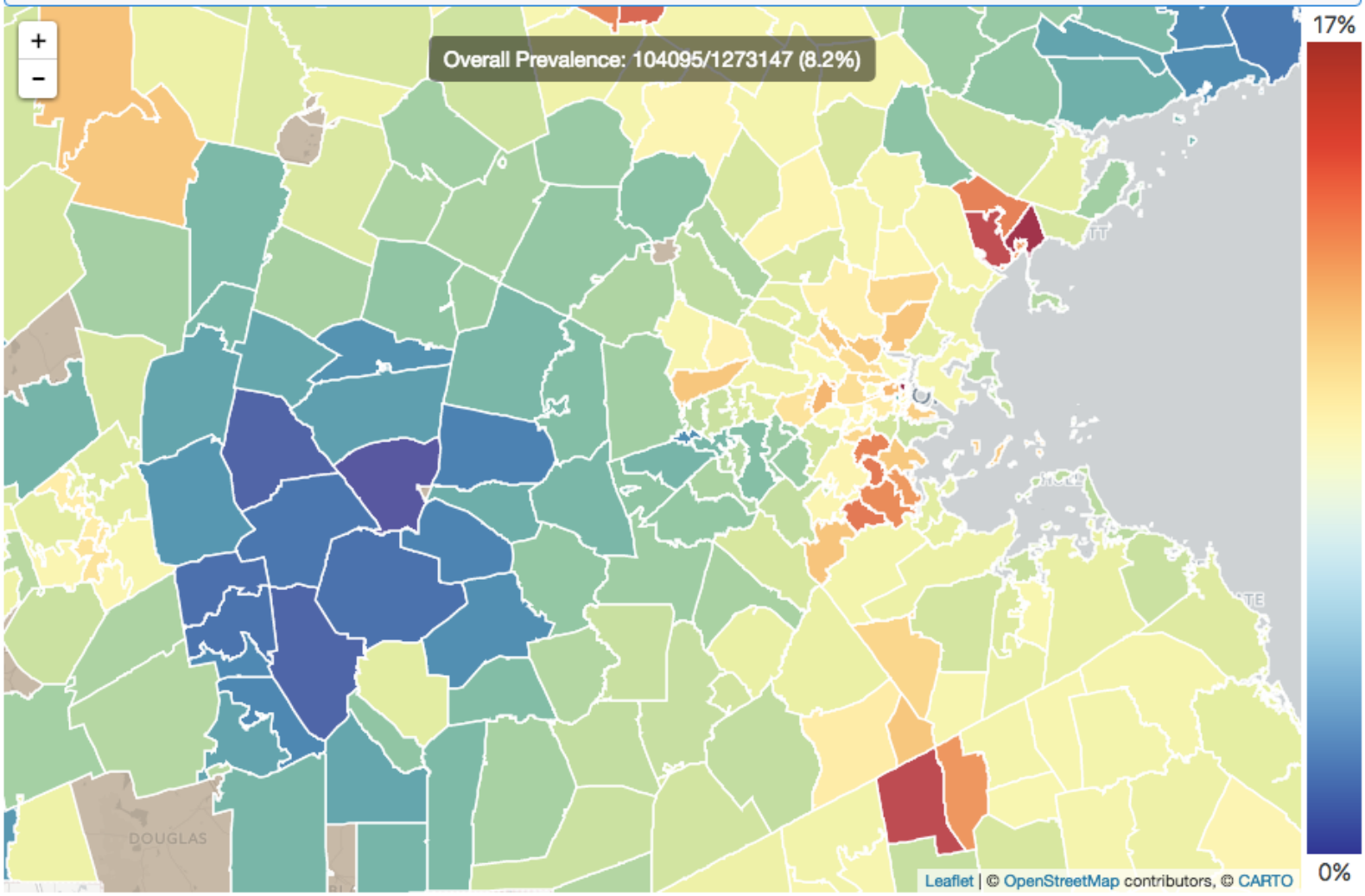
Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Hide Map Underlay

Highlight Zip

Highlight



Chlamydia Testing Rates Stratified by Race in Newton vs Boston

Map

Demographics & Comorbidities

Timeseries

Continuity of Care

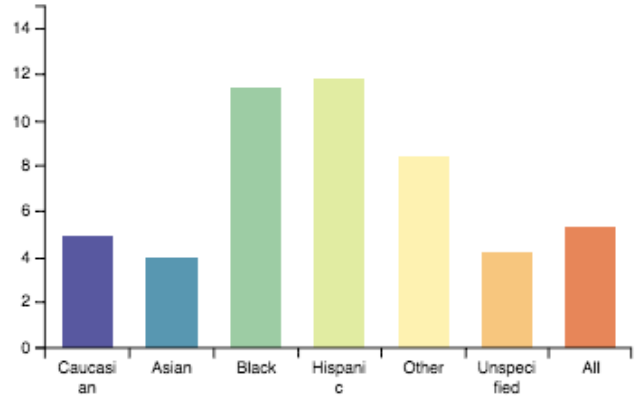
Condition Definitions

About MDPHnet

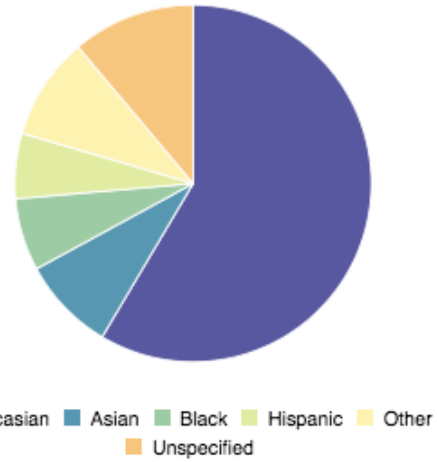
Logout

Newton

Prevalence of the Selected Outcome by Race

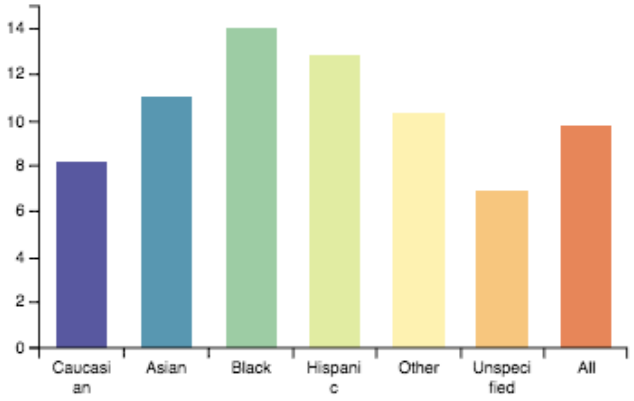


Race of Patients with the Selected Outcome

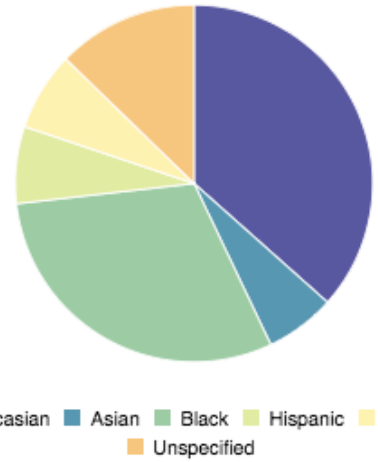


Boston

Prevalence of the Selected Outcome by Race



Race of Patients with the Selected Outcome

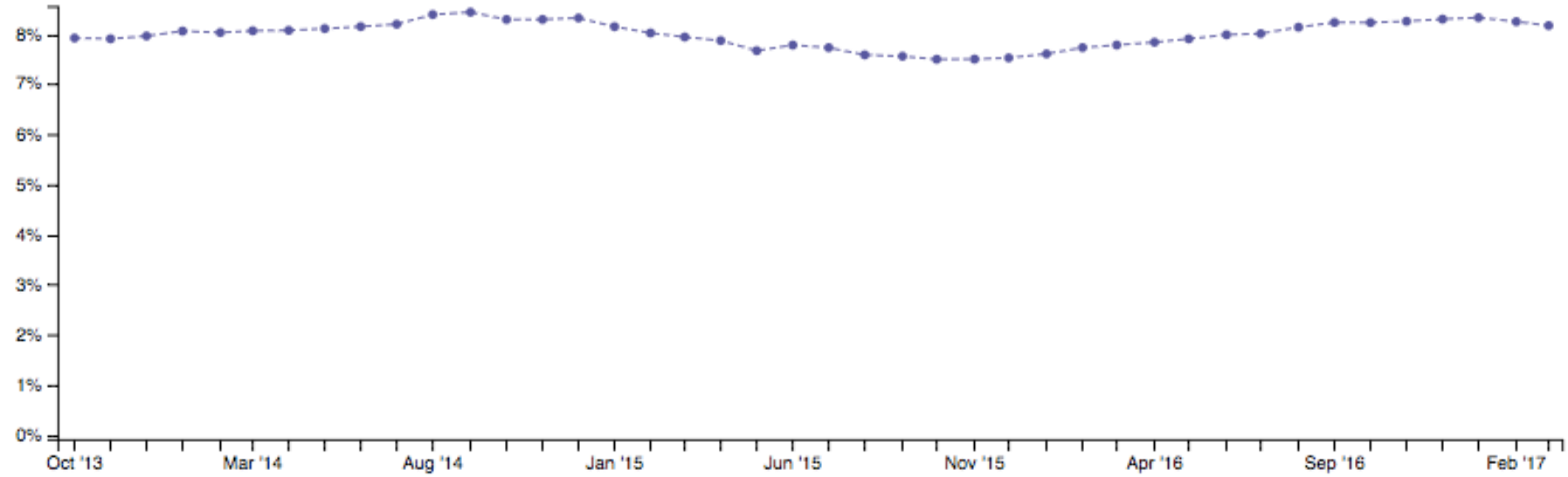


Changes in Chlamydia Testing Rates Over Time

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
In: **Massachusetts** / *From:* **Oct `13** *To:* **Mar `17**



Show Trendlines | Click on Graph to select Inflection Point

	All
Massachusetts	

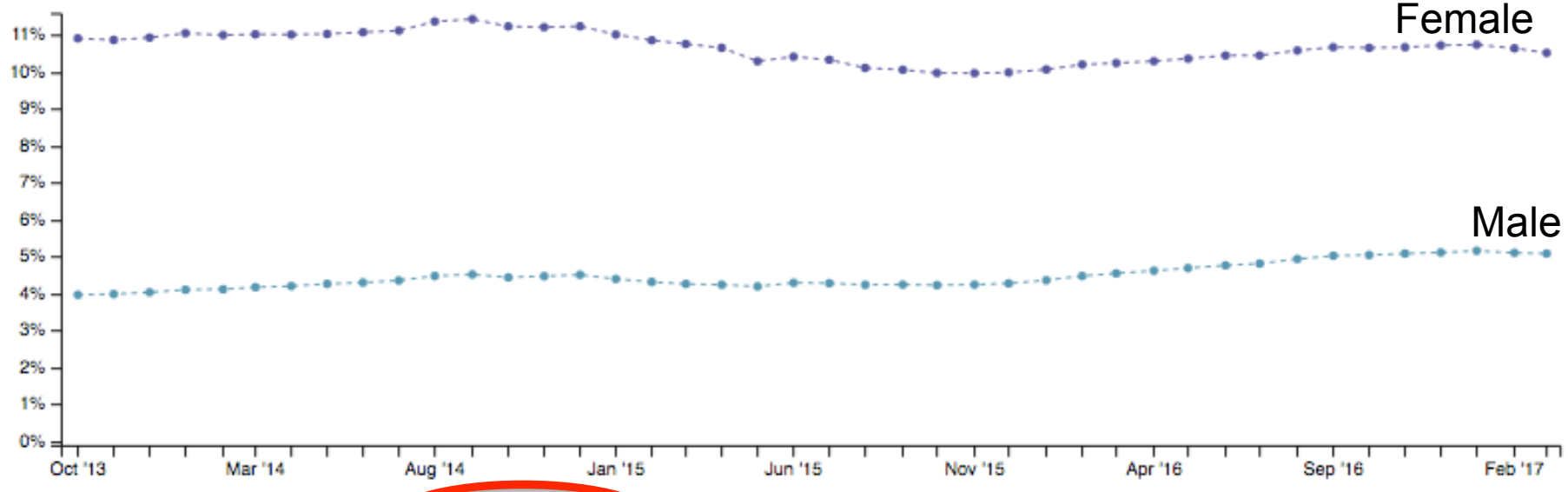
Changes in Chlamydia Testing Rates Over Time

Stratified by Sex

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
By: **Sex** / *In:* **Massachusetts** / *From:* **Oct `13** *To:* **Mar `17**



Show Trendlines | Click on Graph to select Inflection Point

	Female	Male
Massachusetts		

Changes in Chlamydia Testing Rates Over Time

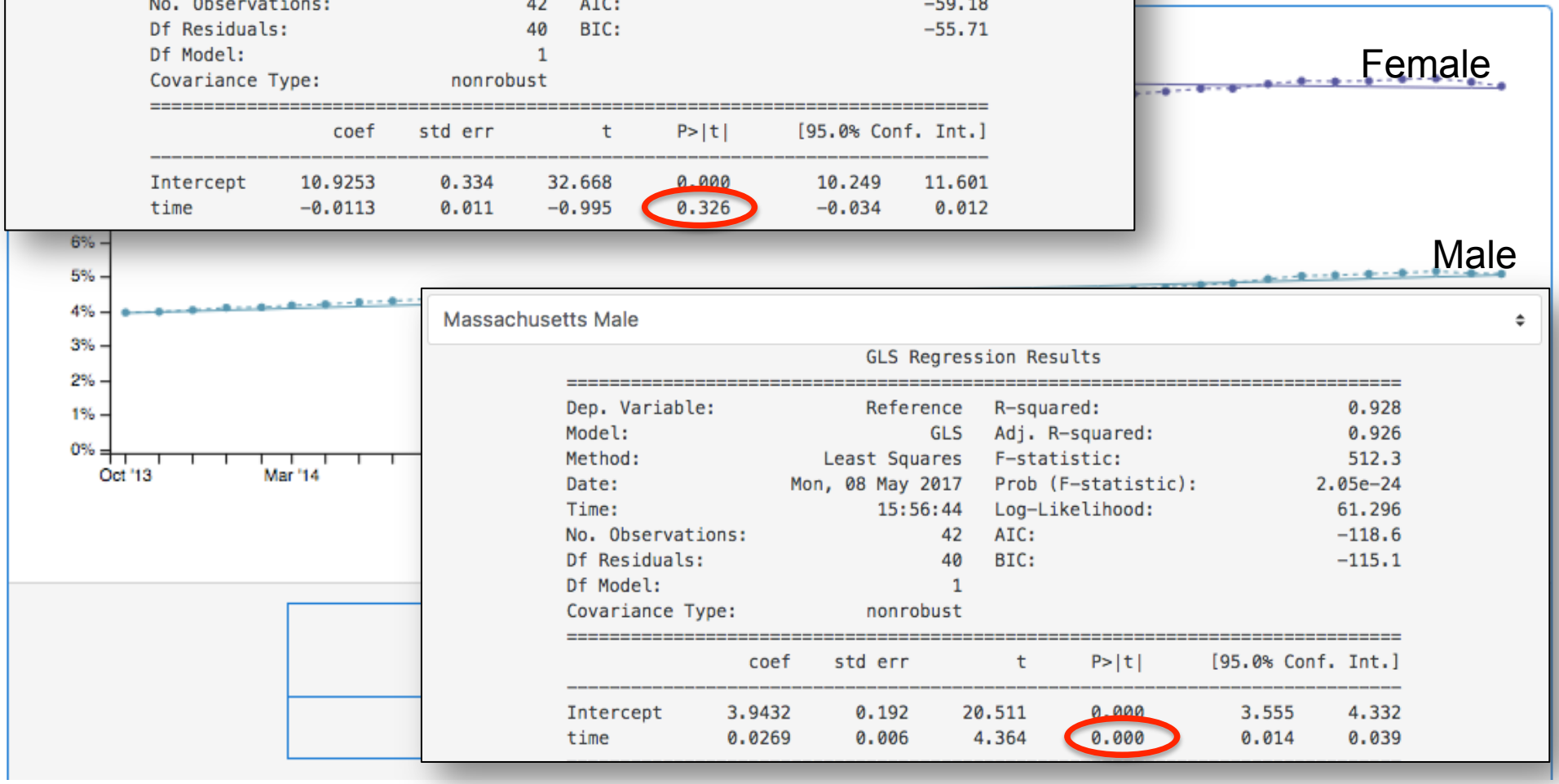
Stratified by Sex

Massachusetts Female

GLS Regression Results

Dep. Variable:	Reference	R-squared:	0.938
Model:	GLS	Adj. R-squared:	0.936
Method:	Least Squares	F-statistic:	603.5
Date:	Mon, 08 May 2017	Prob (F-statistic):	9.59e-26
Time:	15:56:44	Log-Likelihood:	31.591
No. Observations:	42	AIC:	-59.18
Df Residuals:	40	BIC:	-55.71
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[95.0% Conf.	Int.]
Intercept	10.9253	0.334	32.668	0.000	10.249	11.601
time	-0.0113	0.011	-0.995	0.326	-0.034	0.012



Massachusetts Male

GLS Regression Results

Dep. Variable:	Reference	R-squared:	0.928
Model:	GLS	Adj. R-squared:	0.926
Method:	Least Squares	F-statistic:	512.3
Date:	Mon, 08 May 2017	Prob (F-statistic):	2.05e-24
Time:	15:56:44	Log-Likelihood:	61.296
No. Observations:	42	AIC:	-118.6
Df Residuals:	40	BIC:	-115.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[95.0% Conf.	Int.]
Intercept	3.9432	0.192	20.511	0.000	3.555	4.332
time	0.0269	0.006	4.364	0.000	0.014	0.039

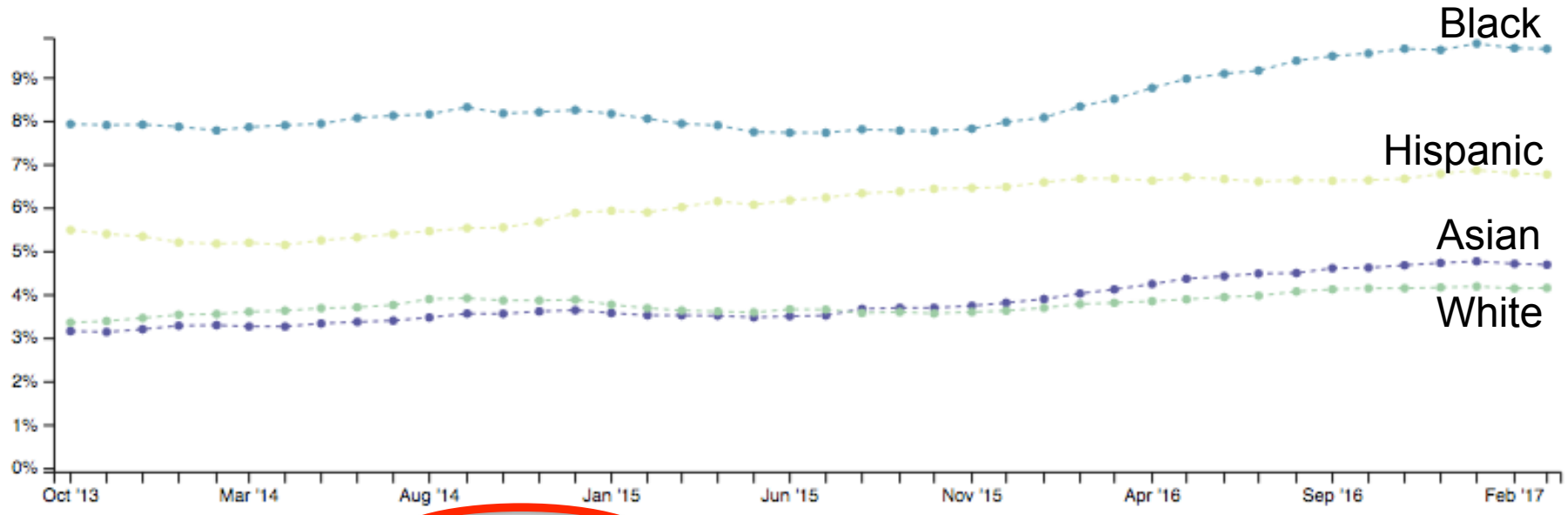
Changes in Chlamydia Testing Rates in Men Over Time

Stratified by Race-Ethnicity

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Sex: Male / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
By: **Race** / *In:* **Massachusetts** / *From:* **Oct `13** *To:* **Mar `17**



Show Trendlines Click on Graph to select Inflection Point

	Asian	Black	Caucasian	Hispanic	Other	Unspecified
Massachusetts						

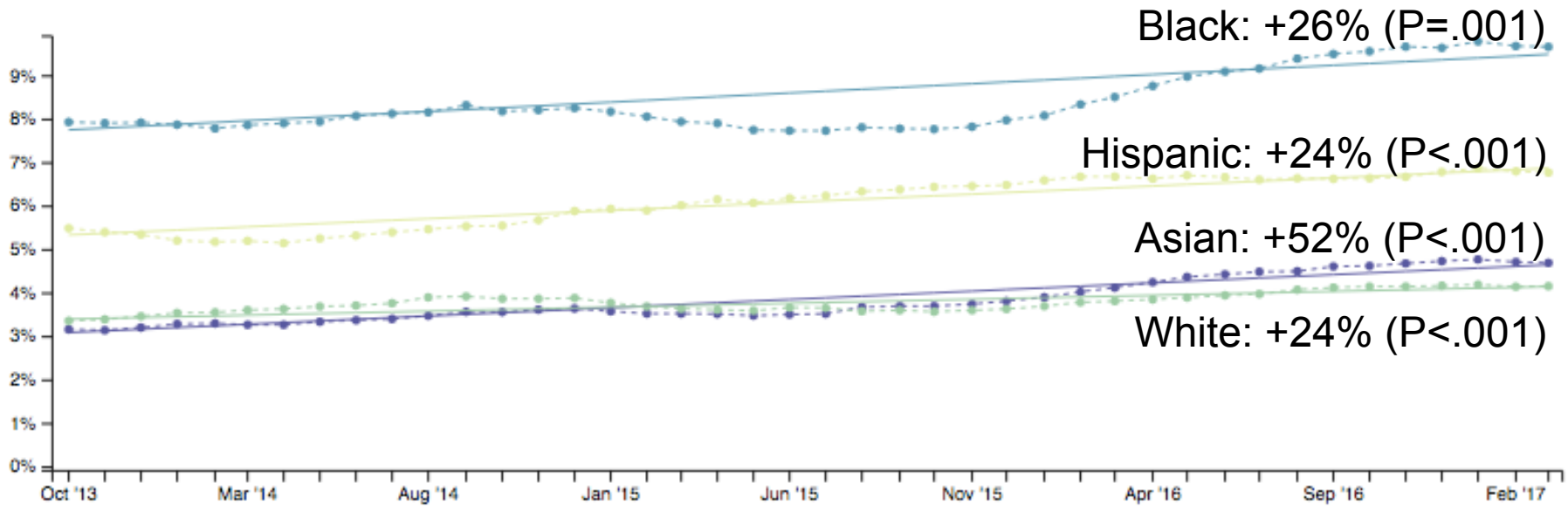
Changes in Chlamydia Testing Rates in Men Over Time

Stratified by Race-Ethnicity

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Sex: Male / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
By: **Race** / *In:* **Massachusetts** / *From:* **Oct `13** *To:* **Mar `17**



Hide Trendlines | Click on Graph to select Inflection Point

	Asian	Black	Caucasian	Hispanic	Other	Unspecified
Massachusetts ✓						

Gonorrhea Testing Rates in Men by Zip Code

- Dashboard
- Pick Conditions
- Map
- Demographics & Comorbidities
- Timeseries
- Continuity of Care
- Condition Definitions
- About MDPHnet

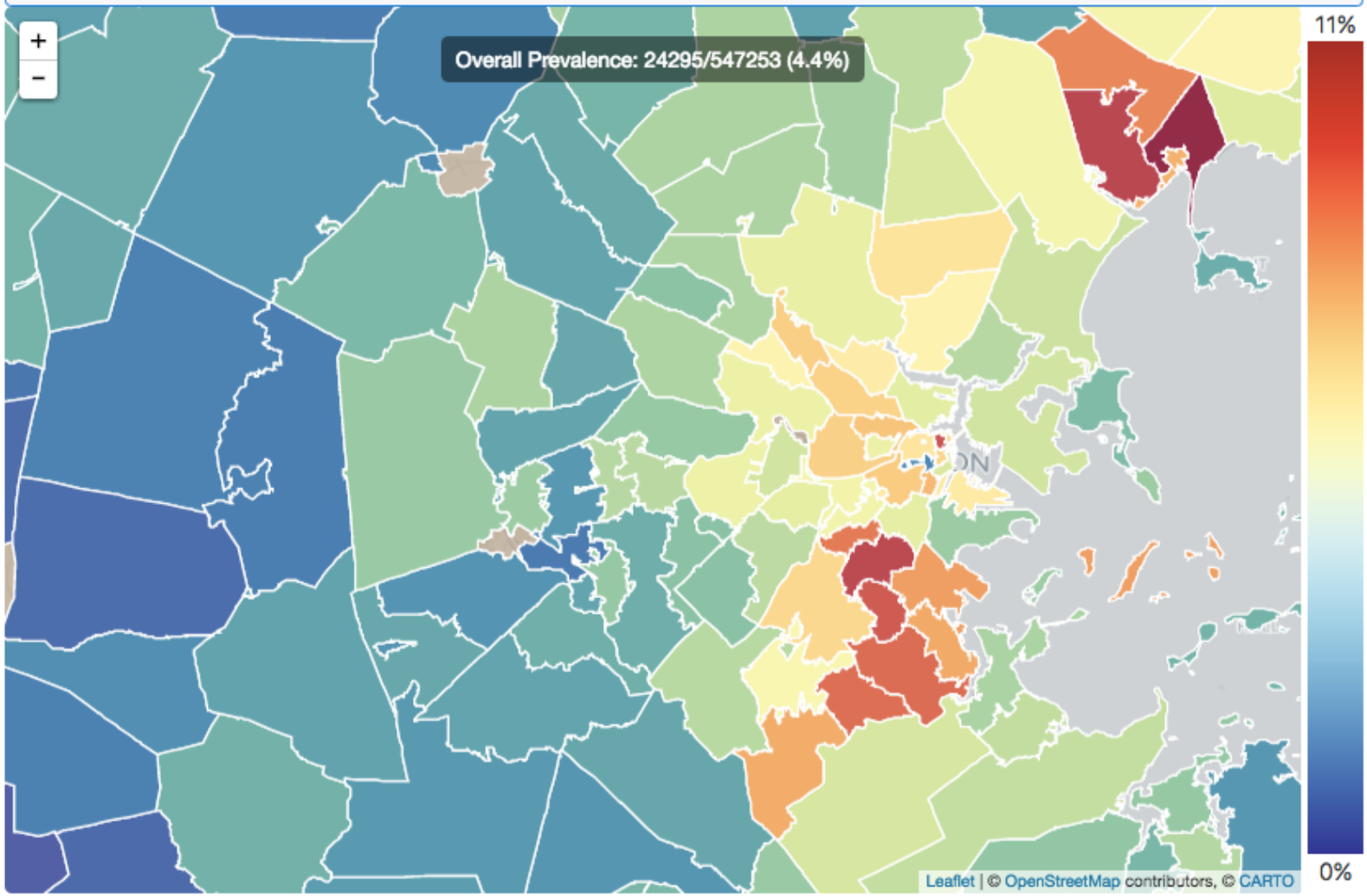
Outcome(s) of Interest
Gonorrhea Test

Inclusion Criteria
Age Group: ≥15 / Sex: Male / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Hide Map Underlay

Highlight Zip

Highlight

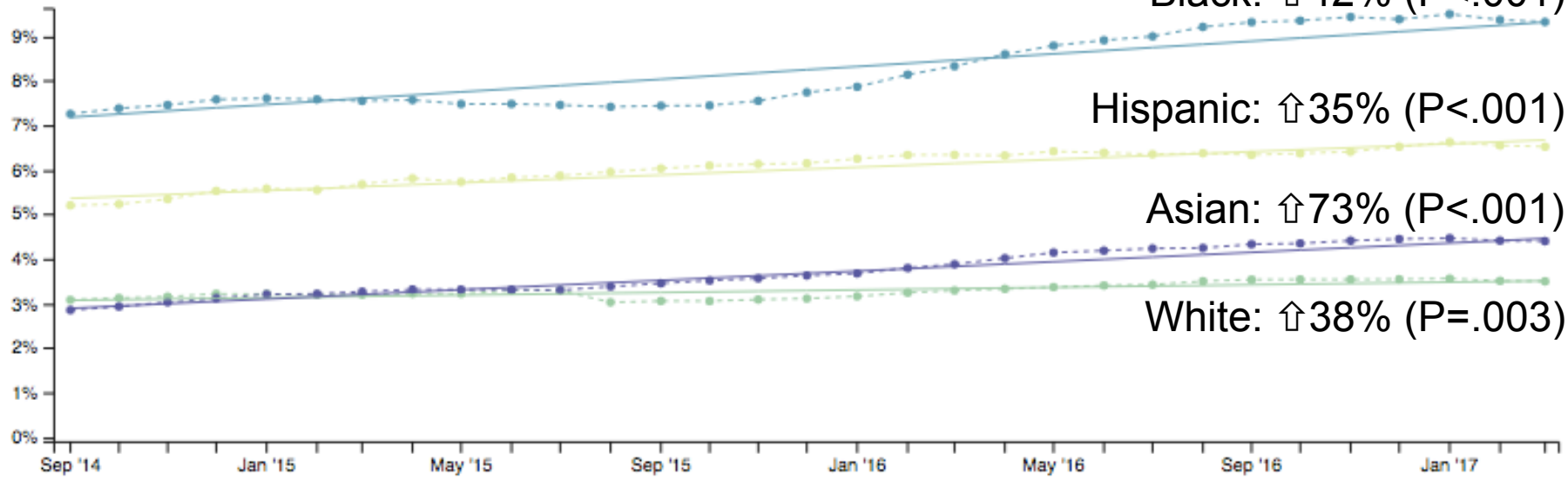


Changes in Gonorrhea Testing Rates in Men over Time

Outcome(s) of Interest
Gonorrhea Test

Inclusion Criteria
Age Group: ≥15 / Sex: Male / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
By: **Race** / *In:* **Massachusetts** / *From:* **Sep `14** *To:* **Mar `17**



Hide Trendlines | Click on Graph to select Inflection Point

	Asian	Black	Caucasian	Hispanic	Other	Unspecified
Massachusetts ✓						

Hepatitis C Testing in the 1945-1965 Birth Cohort by Zip Code

- Dashboard
- Pick Conditions
- Map
- Demographics & Comorbidities
- Timeseries
- Continuity of Care
- Condition Definitions
- About MDPHnet

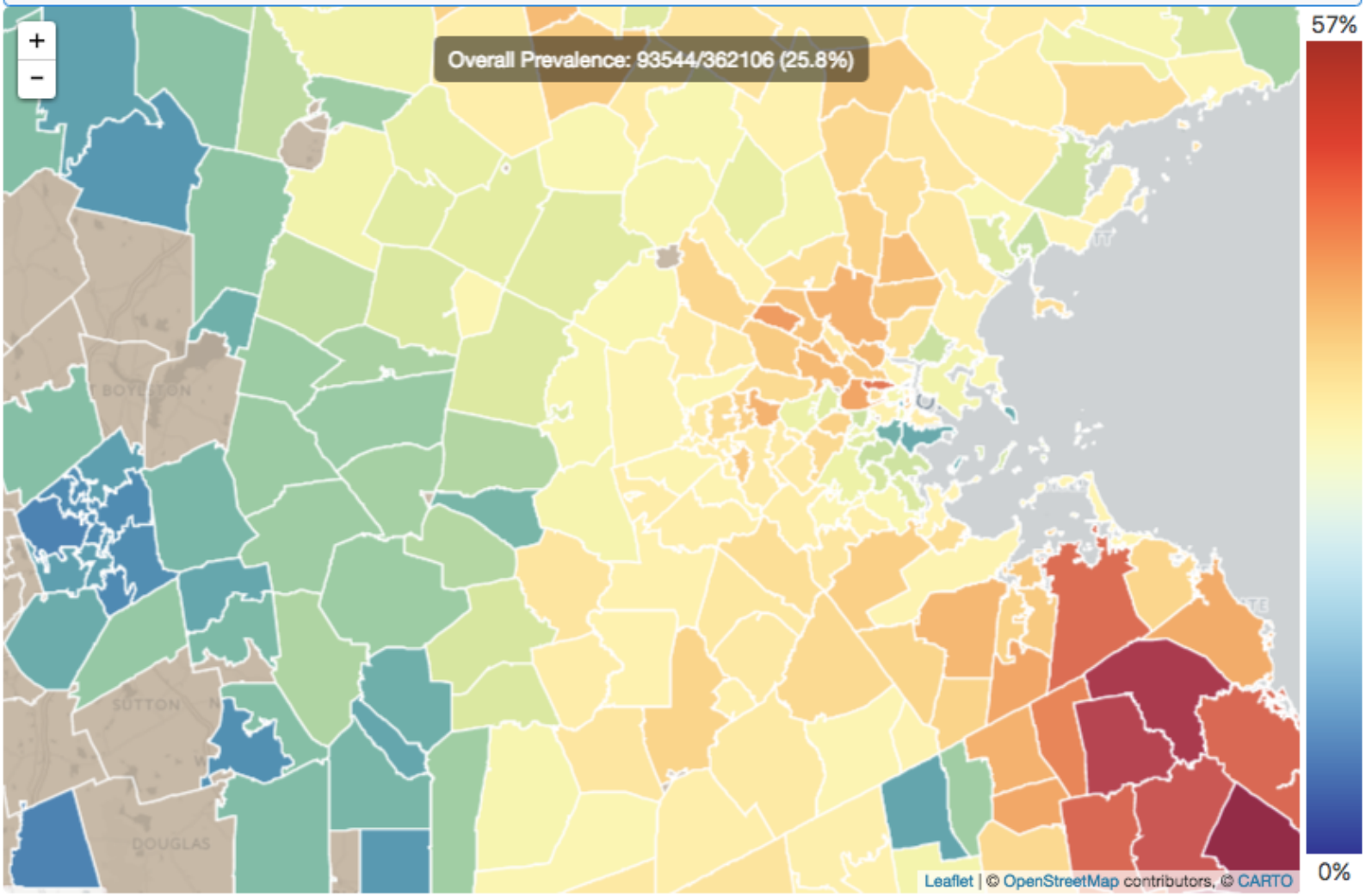
Outcome(s) of Interest
HCV Elisa or RNA Test

Inclusion Criteria
Birth Cohort: 1945-1965 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

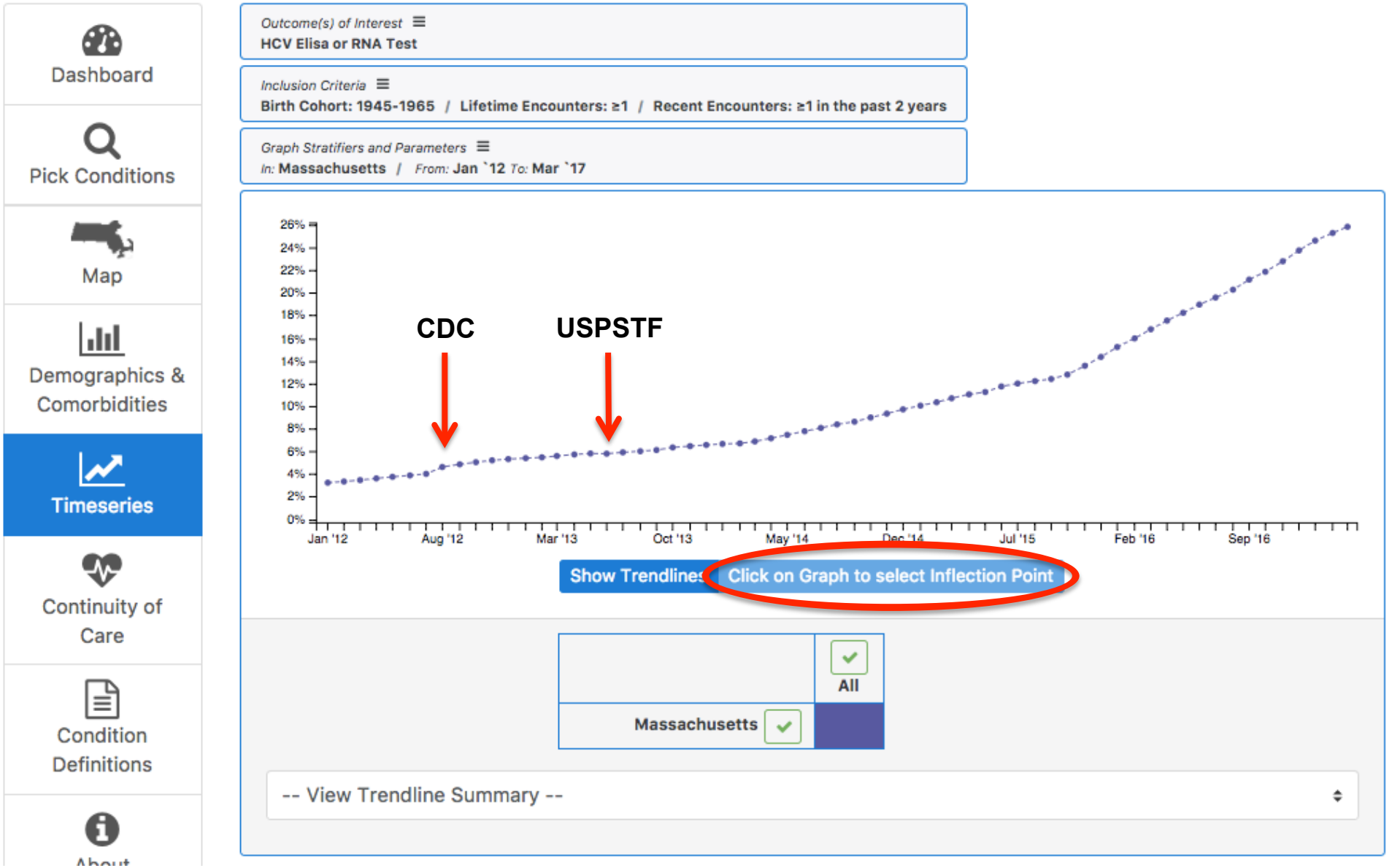
Hide Map Underlay

Highlight Zip

Highlight



Prevalence of Hepatitis C Testing in the 1945-1965 Birth Cohort over Time

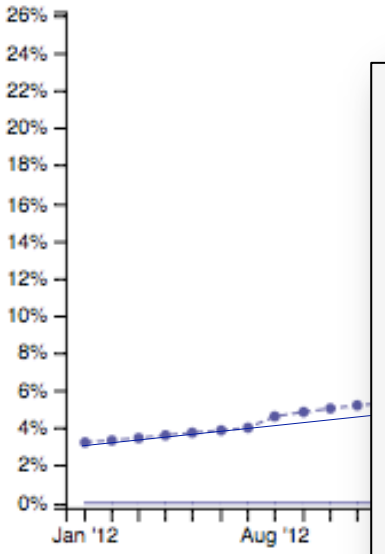


Prevalence of Hepatitis C Testing in the 1945-1965 Birth Cohort over Time

Outcome(s) of Interest
HCV Elisa or RNA Test

Inclusion Criteria
Birth Cohort: 1945-1965 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
In: **Massachusetts** / *From:* **Jan `12** *To:* **Mar `17**



Massachusetts All after inflection point

GLS Regression Results

Dep. Variable:	Reference	R-squared:	0.846
Model:	GLS	Adj. R-squared:	0.838
Method:	Least Squares	F-statistic:	107.8
Date:	Mon, 08 May 2017	Prob (F-statistic):	6.54e-24
Time:	11:41:55	Log-Likelihood:	-1.5358
No. Observations:	63	AIC:	11.07
Df Residuals:	59	BIC:	19.64
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[95.0% Conf.	Int.]
Intercept	2.6408	1.447	1.825	0.073	-0.255	5.537
time	0.1513	0.059	2.558	0.013	0.033	0.270
lvchg	-0.4752	0.253	-1.875	0.066	-0.982	0.032
trchg	0.2939	0.072	4.108	0.000	0.151	0.437

Omnibus:	4.661	Durbin-Watson:	0.331
Prob(Omnibus):	0.097	Jarque-Bera (JB):	3.966
Skew:	-0.517	Prob(JB):	0.138
Kurtosis:	2.336	Cond. No.	84.4

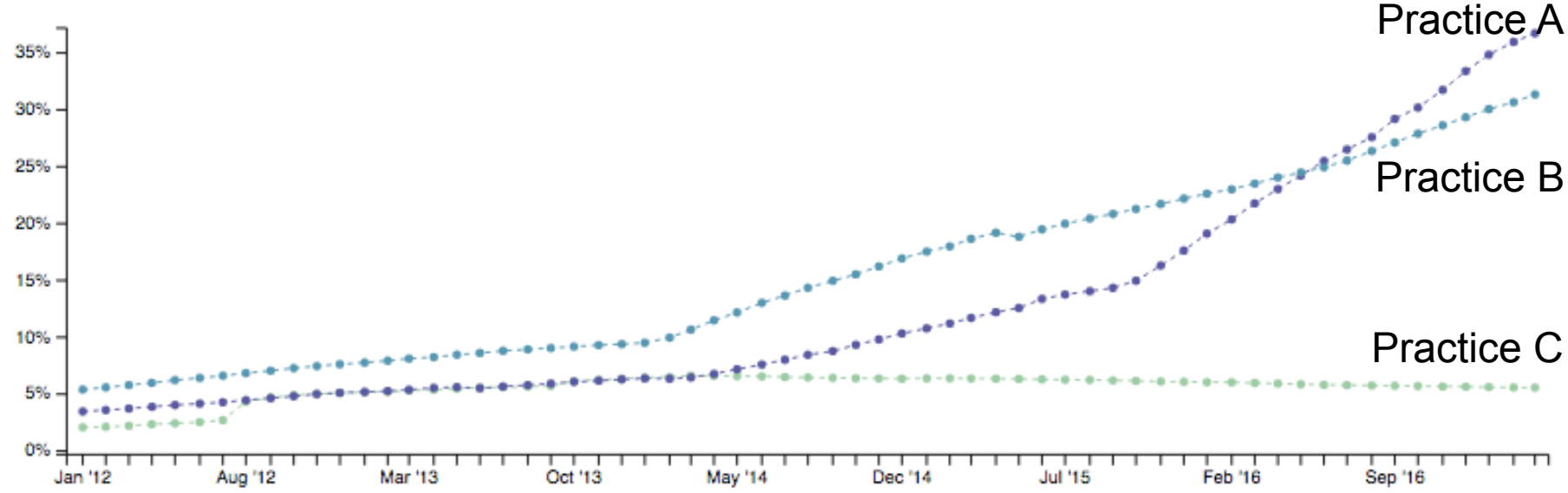
Prevalence of Hepatitis C Testing in the 1945-1965 Birth Cohort over Time

Stratified by Practice Group

Outcome(s) of Interest
HCV Elisa or RNA Test

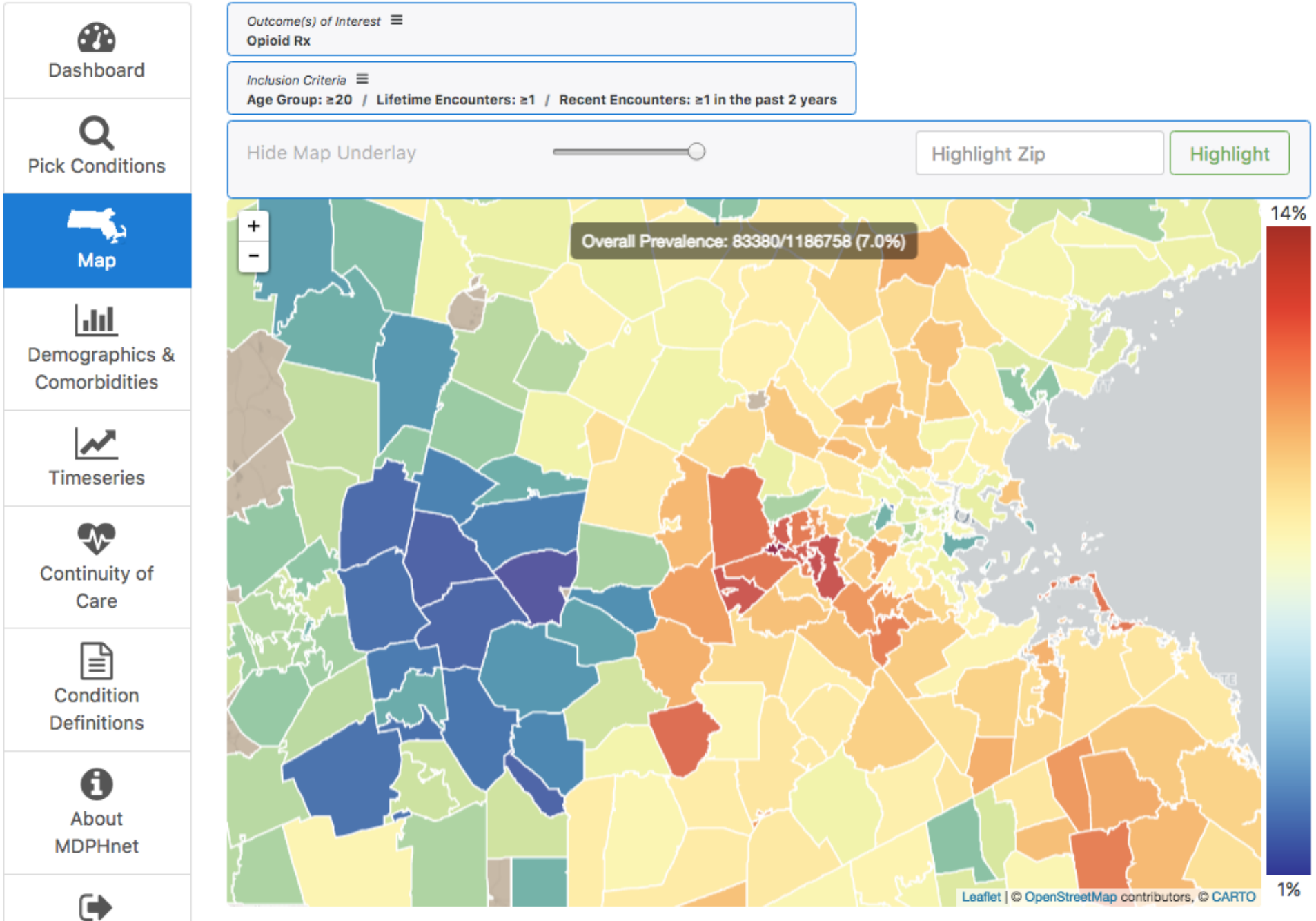
Inclusion Criteria
Birth Cohort: 1945-1965 / **Lifetime Encounters: ≥1** / **Recent Encounters: ≥1 in the past 2 years**

Graph Stratifiers and Parameters
By: **Practice Group** / *In:* **Massachusetts** / *From:* **Jan `12** *To:* **Mar `17**



Show Trendlines | Click on Graph to select Inflection Point

Opioid Prescribing Rates by Zip Code



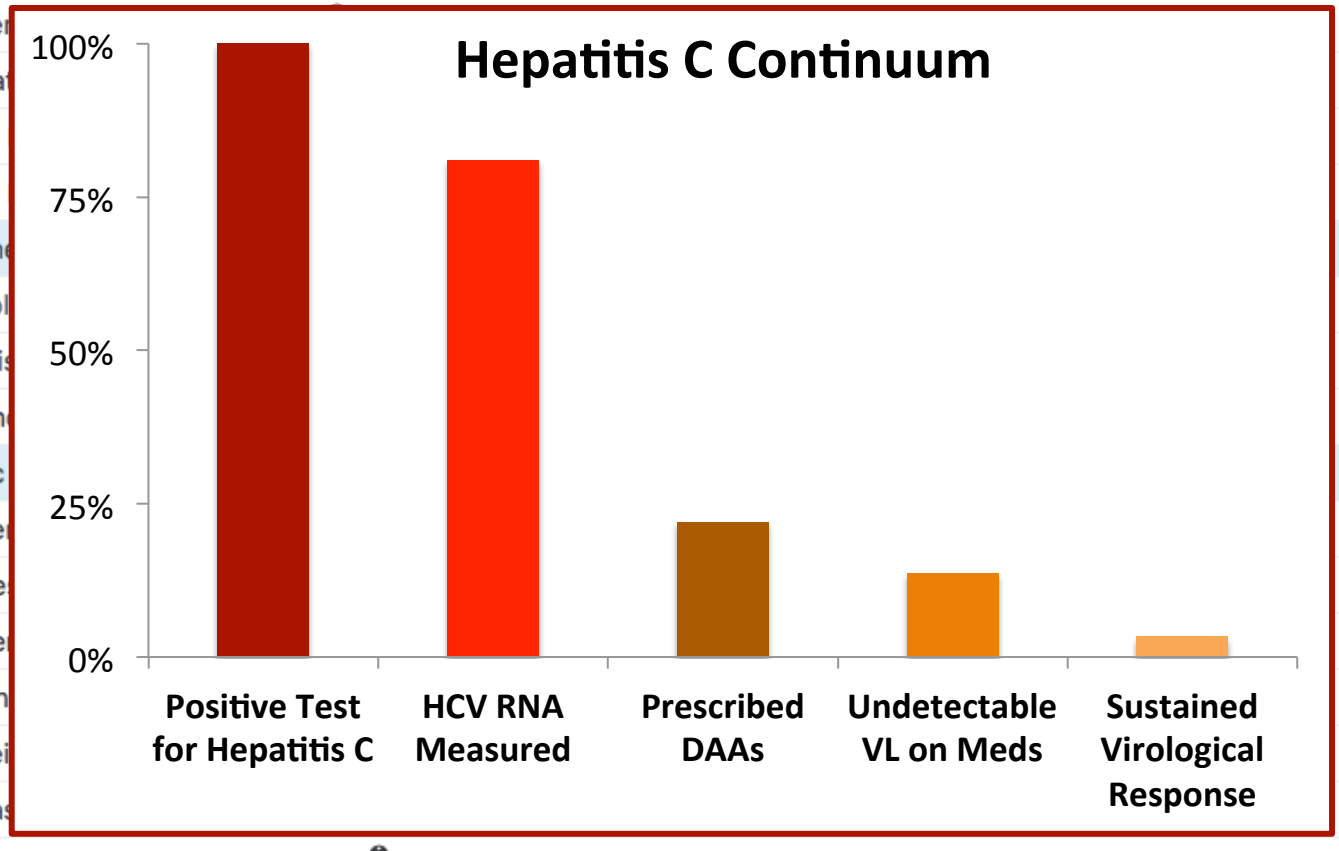
Hepatitis C and HIV Continuum of Care

- Dashboard
- Pick Conditions
- Map
- Demographics & Comorbidities
- Timeseries
- **Continuity of Care**
- Condition Definitions
- About MDPHnet

Site	Year	Age Group	Birth Cohort	Sex	Race/Ethnicity
All	All	All	All	All	All

Update Table | Reset

Hepatitis C	Count	Percent
Total Population Under Surveillance	1674514	100%
Patie		12.6%
Pat		2.7%
		80.9%
		37.8%
Acute he		3.8%
Resol		10.5%
Persis		14.6%
Unkn		50.7%
Chronic		85.8%
Never		78.0%
Re		0%
Pe		47.0%
Un		28.3%
Recei		22.0%
Las		13.7%
Sustained virological response	36	3.3%
Unknown status	212	19.4%



Predictive Analytics

Can we leverage the ESP platform to provide advanced clinical decision support?

ESP to Identify Potential Candidates for PrEP

1. Identify patients with newly diagnosed HIV
2. Use machine learning to characterize their electronic footprint
   - Age, sex, race/ethnicity, frequency of encounters, frequency of STD testing, results of STD testing, anatomical sites of STD testing, etc.
3. Create an HIV risk prediction score using these data and machine learning
4. Identify patients with high risk scores who have not been diagnosed with HIV
5. Share this information with the patient's PCP

Variables Assessed (Partial List)

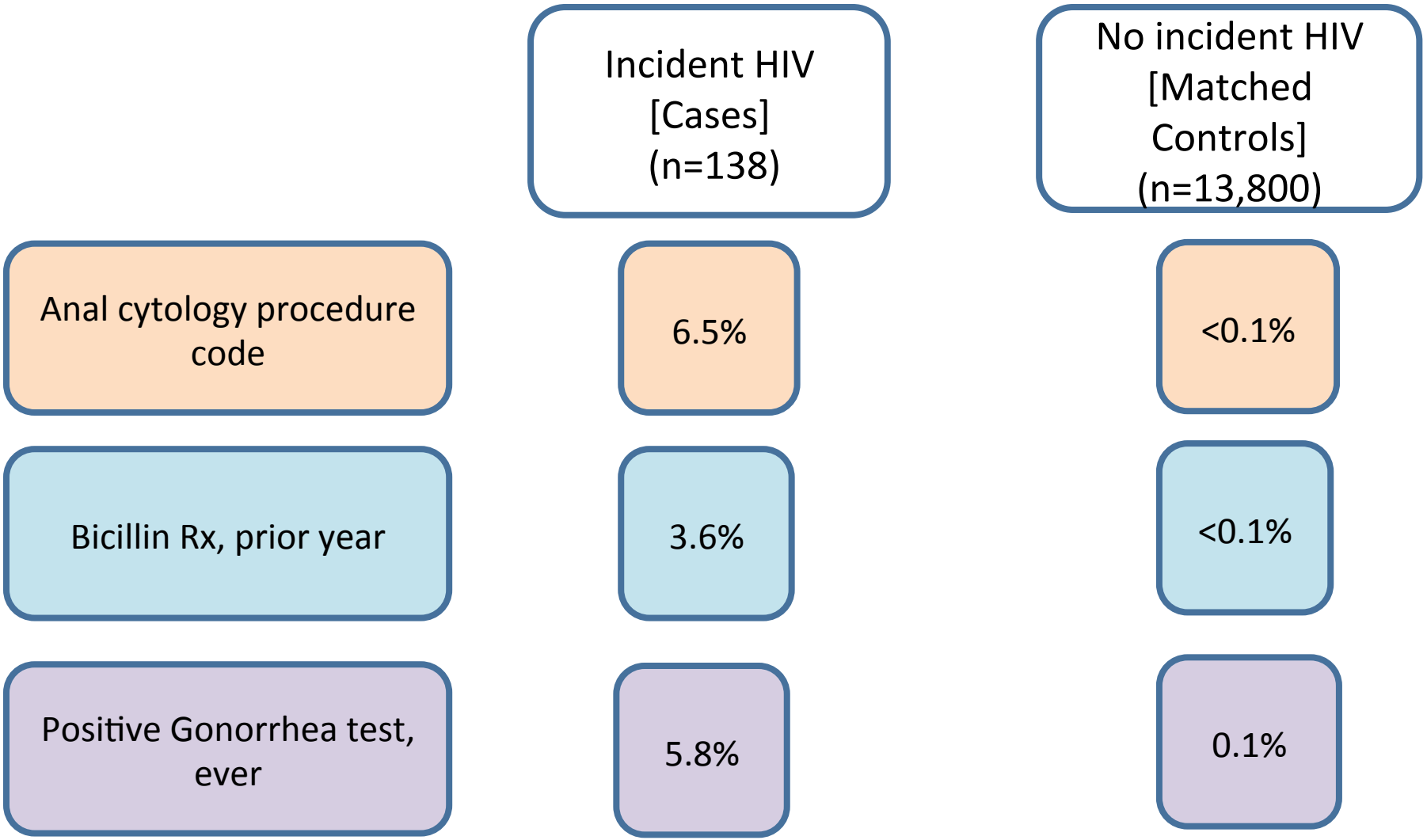
Demographics

Laboratory Results

Diagnoses

Prescriptions

Selected Predictors of HIV Risk

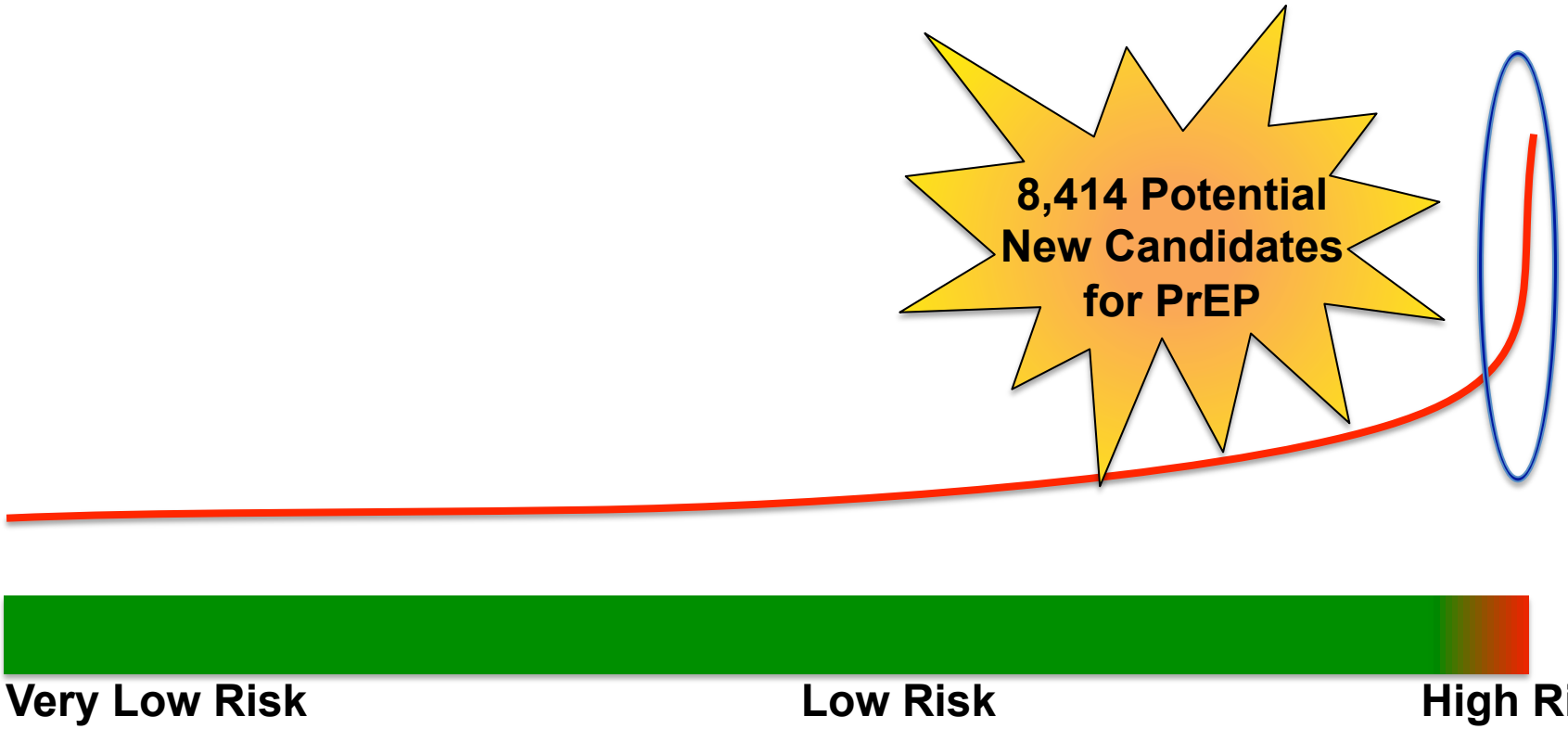


Slide courtesy of Doug Krakower MD

Distribution of Risk Scores for Acquiring HIV

Atrius Health

800,000 patients
1,000 already diagnosed with HIV
~250 currently receiving PrEP



Summary

Automated analysis of EHR data can facilitate timely, accurate public health surveillance

- Notifiable diseases
- Patterns and trends in disease and care
- Rates of adherence to recommended practices
- Geographic clusters of disease
- Continuum of care monitoring
- Predictive analytics for clinical decision support

Could automated EHR monitoring facilitate more pragmatic clinical trials?

Thank You!

Harvard Medical School/
Harvard Pilgrim Health Care Institute
- **Micaela Coady**
- **Noelle Cocoros**
- **Libby Dee**
- **JT Menchaca**
- **Aileen Ochoa**

Massachusetts Department of Public Health
- **Heather Elder**
- **Gillian Haney**
- **Katherine Hsu**
- **Liisa Randall**
- **Hannah Rettler**
- **Kathleen Roosevelt**
- **Sita Smith**

Atrius Health
- **Benjamin Kruskal**

Commonwealth Informatics
- **Karen Eberhardt**
- **Chaim Kirby**
- **Catherine Rocchio**
- **Bob Zambarano**

Massachusetts League of Community Health Centers
- **Diane Erani**
- **Ellen Hafer**
- **Mark Josephson**

Cambridge Health Alliance
- **Brian Herrick**
- **James Watt**
- **Michelle Weiss**

Beth Israel Deaconness / Fenway Health
- **Doug Krakower**

Contact: mklompas@bwh.harvard.edu

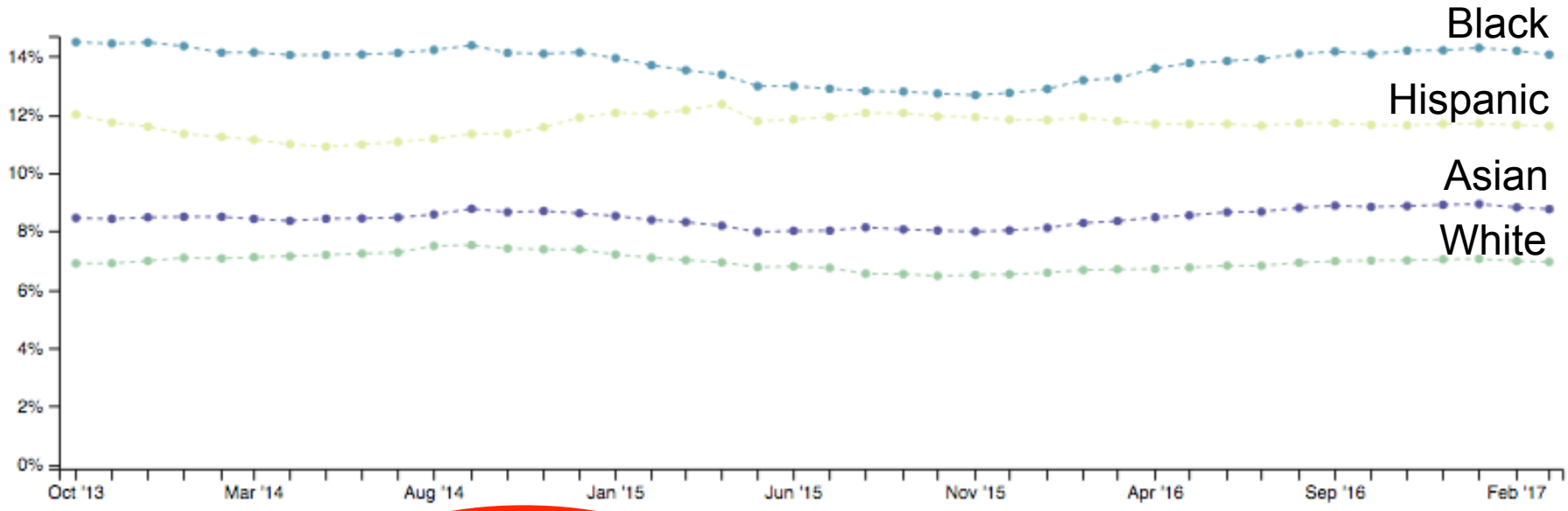
Changes in Chlamydia Testing Rates Over Time

Stratified by Race-Ethnicity

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers and Parameters
By: **Race** / *In:* **Massachusetts** / *From:* **Oct `13** *To:* **Mar `17**



Show Trendlines Click on Graph to select Inflection Point

	Asian	Black	Caucasian	Hispanic	Other	Unspecified
Massachusetts	✓	✓	✓	✓	⊘	⊘

Changes in Chlamydia Testing Rates Over Time

Stratified by Race-Ethnicity

Outcome(s) of Interest
Chlamydia Test

Inclusion Criteria
Age Group: ≥15 / Lifetime Encounters: ≥1 / Recent Encounters: ≥1 in the past 2 years

Graph Stratifiers
By: **Race** / *In:*

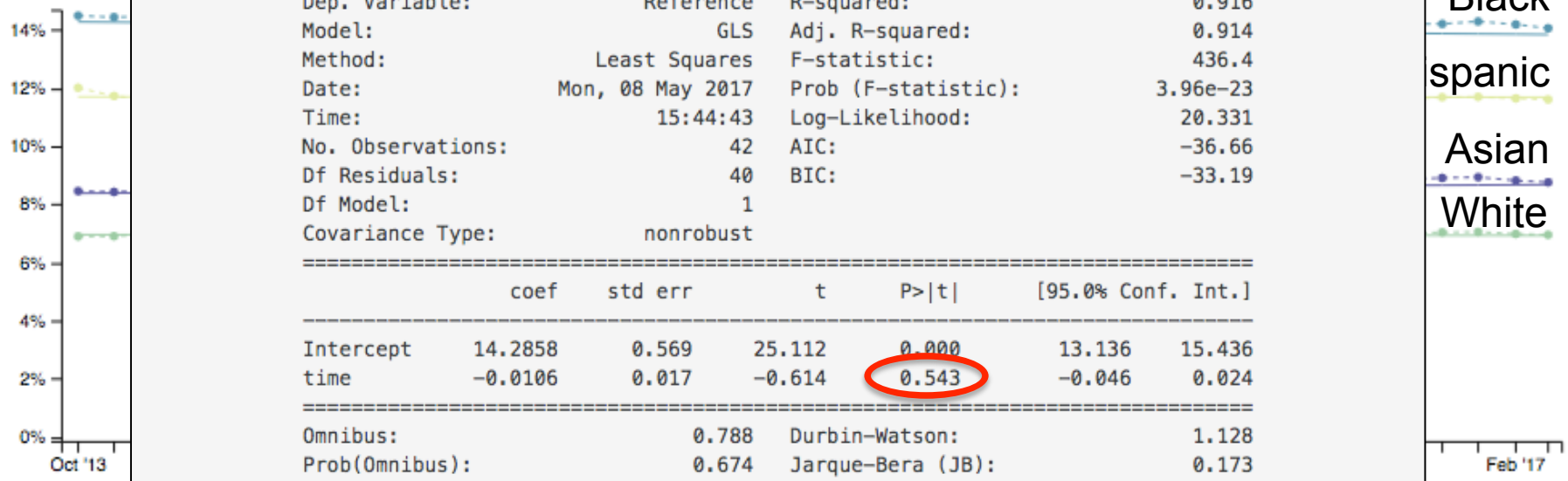
Massachusetts Black

GLS Regression Results

Dep. Variable:	Reference	R-squared:	0.916
Model:	GLS	Adj. R-squared:	0.914
Method:	Least Squares	F-statistic:	436.4
Date:	Mon, 08 May 2017	Prob (F-statistic):	3.96e-23
Time:	15:44:43	Log-Likelihood:	20.331
No. Observations:	42	AIC:	-36.66
Df Residuals:	40	BIC:	-33.19
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[95.0% Conf.	Int.]
Intercept	14.2858	0.569	25.112	0.000	13.136	15.436
time	-0.0106	0.017	-0.614	0.543	-0.046	0.024

Omnibus:	0.788	Durbin-Watson:	1.128
Prob(Omnibus):	0.674	Jarque-Bera (JB):	0.173
Skew:	-0.002	Prob(JB):	0.917
Kurtosis:	3.314	Cond. No.	42.1



	Asian	Black	Caucasian	Hispanic	Other	Unspecified
Massachusetts						