



# Electronic Support for Public Health Public Health Surveillance System (ESP)

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# Learning Objectives

- To examine the ESP software as an example of public health informatics.
- To review the advantages of electronic disease/case reporting over manual reporting or electronic lab reporting for public health purposes.
- To discuss lessons learned and the future of electronic health records for public health purposes.

## Disclosures

- I receive no compensation from Epic, although tens of millions of dollars of institutional funds and my academic career are committed to Epic 😊.



***“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)			Facility Name <i>Harvard Vanguard Medical Associates</i>		
D.O.B.			Age			Facility Address		
Social Security #			City			State Zip Code		
Sex <input type="checkbox"/> M <input type="checkbox"/> F		Ethnicity		Marital Status		Facility contact person		
Race (1) <input type="checkbox"/> American Indian (2) <input type="checkbox"/> Asian (3) <input type="checkbox"/> Black (4) <input type="checkbox"/> White (8) <input type="checkbox"/> Other (9) <input type="checkbox"/> Unk		(1) <input type="checkbox"/> Hispanic (2) <input type="checkbox"/> Non-Hispanic (9) <input type="checkbox"/> Unk		(1) <input type="checkbox"/> Single (2) <input type="checkbox"/> Married (3) <input type="checkbox"/> Other (9) <input type="checkbox"/> Unk		Facility phone		
Street			Apt#			PATIENTS ARE NOT CALLED, THE CLINICIAN IS CONTACTED FIRST!		
City/Town			Zip			PROVIDER CODE		
Phone Number & area code			Is this Pt. Pregnant Y N			Weeks Preg: _____		
Language Spoken			Medical Record #			Did the patient receive treatment? <input type="checkbox"/> Yes <input type="checkbox"/> No		
Date of Diagnosis ___/___/___			If yes, when? Date ___/___/___			Did the patient have symptoms? <input type="checkbox"/> Yes <input type="checkbox"/> No		
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						If reporting neonatal: Mother's Name _____		

Over 100 mandatory reportable disease in the State of Ohio!

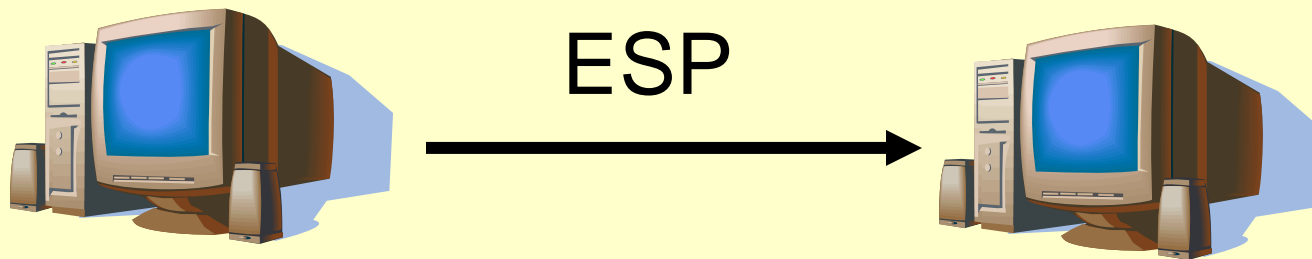
<p><b>SYPHILIS (700)</b></p> <p>(1) <input type="checkbox"/> Primary (chancre) (710)  <input type="checkbox"/> Secondary (rash, other symptoms) (720)  <input type="checkbox"/> Early Latent (asymptomatic, less than 1 year) (730)</p> <p>Recommended Regimen  <input type="checkbox"/> Benzathine Penicillin G 2.4 million units IM, 2 doses, 1 week apart</p> <p>Alternative regimen for <b>penicillin allergic</b> non-pregnant non-HIV infected adult patients  <input type="checkbox"/> Doxycycline 100 mg po bid x 14 days or  <input type="checkbox"/> Ceftriaxone 1 gm IM or IV daily for 8-10 days or  <input type="checkbox"/> Azithromycin 2 g orally single dose or  <input type="checkbox"/> Other _____</p> <p>(4) <input type="checkbox"/> Late Latent (asymptomatic, over 1 year) (743)  Recommended Regimen  <input type="checkbox"/> Benzathine Penicillin G 2.4 million units IM, 3 doses, 1 week apart</p> <p>Alternative regimen for <b>penicillin allergic</b> non-pregnant non-HIV infected adult patients  <input type="checkbox"/> Doxycycline 100 mg po bid x 28 days or  <input type="checkbox"/> Other _____</p> <p>(5) <input type="checkbox"/> Neurosyphilis (760)  Recommended Regimen  <input type="checkbox"/> 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  <input type="checkbox"/> Other _____</p> <p>(6) <input type="checkbox"/> Congenital (infant) (790)  Recommended Regimen  <input type="checkbox"/> 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</p> <p>(7) <input type="checkbox"/> Adult Congenital</p>	<p><b>GONORRHEA (300)</b></p> <p><input type="checkbox"/> Cervical DX by culture yes <input type="checkbox"/> no <input type="checkbox"/>  <input type="checkbox"/> Urethral DX by culture yes <input type="checkbox"/> no <input type="checkbox"/>  <input type="checkbox"/> Rectal DX by culture yes <input type="checkbox"/> no <input type="checkbox"/>  <input type="checkbox"/> Pharyngeal DX by culture yes <input type="checkbox"/> no <input type="checkbox"/>  <input type="checkbox"/> Other _____</p> <p>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.</p> <p>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.</p> <p><input type="checkbox"/> Ceftriaxone 250 mg IM or  <input type="checkbox"/> Other _____</p> <p>PLUS (Treatment for Chlamydia trachomatis)  <input type="checkbox"/> Doxycycline 100 mg po bid x 7 days or  <input type="checkbox"/> Azithromycin 1 gm po single dose or  <input type="checkbox"/> Other _____</p> <p>Questions about treatment for any STD?  Call the Division of STD Prevention at (617) 983-6940.</p> <p>Disease control and prevention requires evaluation and treatment of partners.  <b>Please counsel your patient to refer their partners!</b></p> <p>The STD program can provide confidential partner notification services.  Do you want this service for your patient? <input type="checkbox"/> Yes <input type="checkbox"/> No  If yes, we will call you first</p> <p>If you are reporting a disease in a minor, did you file a S1A? <input type="checkbox"/> Yes <input type="checkbox"/> No  If you would like more cards please check here _____</p>	<p><b>CHLAMYDIA (200)</b></p> <p><input type="checkbox"/> Cervical  <input type="checkbox"/> Urethral  <input type="checkbox"/> Rectal  <input type="checkbox"/> Pharyngeal  <input type="checkbox"/> Other _____</p> <p>Recommended Regimen for Uncomplicated Infection (non-pregnant adult patient)  <input type="checkbox"/> Azithromycin 1 g po single dose or  <input type="checkbox"/> Doxycycline 100 mg po bid x 7 days or  <input type="checkbox"/> Other _____</p> <p>Recommended Regimen for Uncomplicated Infection (pregnant patients)  <input type="checkbox"/> Erythromycin base 500 mg po qid x 7 days or  <input type="checkbox"/> Amoxicillin 500 mg bid x 7 days or  <input type="checkbox"/> Azithromycin 1 gm single dose or  <input type="checkbox"/> Other _____</p> <p><b>OTHER REPORTABLE SEXUALLY TRANSMITTED DISEASES</b></p> <p><input type="checkbox"/> CHANCROID (100) - Recommended Regimen  <input type="checkbox"/> Ceftriaxone 250 mg IM once or  <input type="checkbox"/> Azithromycin 1 gm po single dose or  <input type="checkbox"/> Other _____</p> <p><input type="checkbox"/> LYMPHOGRANULOMA VENEREUM (600) - Recommended Regimen  <input type="checkbox"/> Doxycycline 100 mg po bid X 21 days or  <input type="checkbox"/> Other _____</p> <p><input type="checkbox"/> GRANULOMA INGUINALE (300) - Recommended Regimen  <input type="checkbox"/> Doxycycline 100 mg po bid at least 21 days or  <input type="checkbox"/> Trimethoprim-sulfamethoxazole 1 DS tablet (800mg/160mg) bid X at least 21 days or  <input type="checkbox"/> Other _____</p> <p><input type="checkbox"/> NEONATAL HERPES (850)  <input type="checkbox"/> OPHTHALMIA NEONATORUM  <input type="checkbox"/> CONDYLOMA ACUMINATA (EXTERNAL GENITAL WARTS) (800)  PHV-13 (Rev. 1/04)</p>	<p><b>PID (490)</b></p> <p><input type="checkbox"/> Gonococcal  <input type="checkbox"/> Chlamydia  <input type="checkbox"/> Agent Unknown</p> <p>Treatment Provided</p> <p><input type="checkbox"/> Outpatient  _____  <input type="checkbox"/> Inpatient  _____  _____</p>
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# Public Health Reporting

Old



New



**Metrohealth**

**Ohio Department of Health**



## Electronic Support for Public health (ESP)

- Generalizable (open-source) 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 and sends secure electronic reports to the state health department
  - Designed to be compatible with any EHR system

*JAMIA* 2009;16:18-24

*MMWR* 2008;57:372-375

*Advances Disease Surveillance* 2007;3:3



## Meaningful use criteria

- Centers for Medicaid & Medicare Services offering incentives to providers with electronic health record systems capable of “meaningful use” starting FY2011
  - Penalties for failure to implement by FY2015
- Some Stage I Criteria:
  - Electronically capture coded health information
  - Track key clinical conditions
  - Implement clinical decision support tools
  - Report outcomes for public health purposes



## ESP – history and current directions

- Funded by CDC starting in 2005
- Originally created for notifiable disease reporting
  - Syndromic surveillance
- Primary installation in Atrius Health, Boston
  - Multispecialty practice, 27 sites, 700 docs, 600K pts
  - Additional installations underway
- Secondary installations at MetroHealth and in Massachusetts



esphealth.org



CDC Center of Excellence in Public Health Informatics  
Electronic Support For Public Health

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## 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 system that analyzes electronic medical record (EMR) data to identify and report patients with notifiable diseases to the Massachusetts Department of Public Health. This [pre-print](#) provides a technical overview. The system was initially deployed at Atrius Health in January 2007 and has been operating continuously since, providing valid, comprehensive, secure, automated reporting, described in this [MMWR](#) brief report and in other publications available below.

The growing use of electronic medical record systems (EMRs) permits efficient re-use of data already being collected by clinicians during routine private practice, offering an unparalleled opportunity to improve public health practice. Information held in EMR systems includes diagnoses, procedures, laboratory test, and treatment information, as well as patient demographic data. In order to use this valuable information, we have developed systems and software, to permit secure, simple, robust, messaging from electronic medical record systems to public health authorities.

The system currently reports cases of chlamydia, gonorrhea, pelvic inflammatory disease, acute hepatitis A, acute hepatitis B, acute hepatitis C, and active tuberculosis. In collaboration with the Massachusetts Department of Public Health, we have created and validated algorithms to identify each of these conditions using combinations of laboratory orders and results, ICD9 diagnostic codes, and medication prescriptions. Algorithms to detect and report additional diseases are currently under development.

### Project Publications

Electronic Support for Public Health: Validated case finding and reporting for notifiable diseases using electronic medical data	<a href="#">PDF</a>
Automated Identification of Acute Hepatitis B Using Electronic Medical Record Data to Facilitate Public Health Surveillance	<a href="#">HTML</a>
Automated Detection and Reporting of Notifiable Diseases Using Electronic Medical Records Versus Passive Surveillance: Massachusetts, June 2006--July 2007	<a href="#">PDF</a>
Electronic medical record Support for Public health (ESP: Automated Detection and Reporting of Statutory Notifiable Diseases to Public Health Authorities	<a href="#">PDF</a>
Invited Commentary: Automated Public Health Reporting-- A Familiar but Cantankerous Friend	<a href="#">PDF</a>
Klompas et al. Respond: Automated Public Health Reporting-- Possible with a Coalition of the Willing	<a href="#">PDF</a>

### 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 Klompas - clinical lead (mklompas 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](#)

# Translating & Disseminating ESP...



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



**Cambridge Health Alliance**  
20 sites • 400,000 patients

**Atrius Health**  
27 Sites • 600,000 pts



**MetroHealth  
Cleveland, OH**  
375,000 patients,  
16 sites, 1 hospital

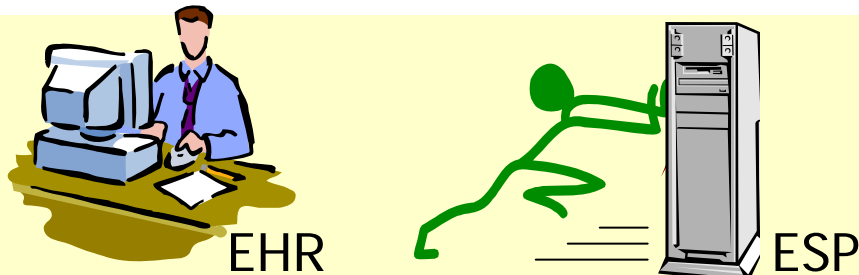
© Google Maps



## Challenges in creating a generalizable disease EHR-based surveillance system

- Compatibility with different EHR systems
- Cannot interfere with practitioners' workflow
- Cannot slow the clinical information system
- Security of clinical data
- Heterogenous coding for similar tests
- Test codes change over time
- Disease identification

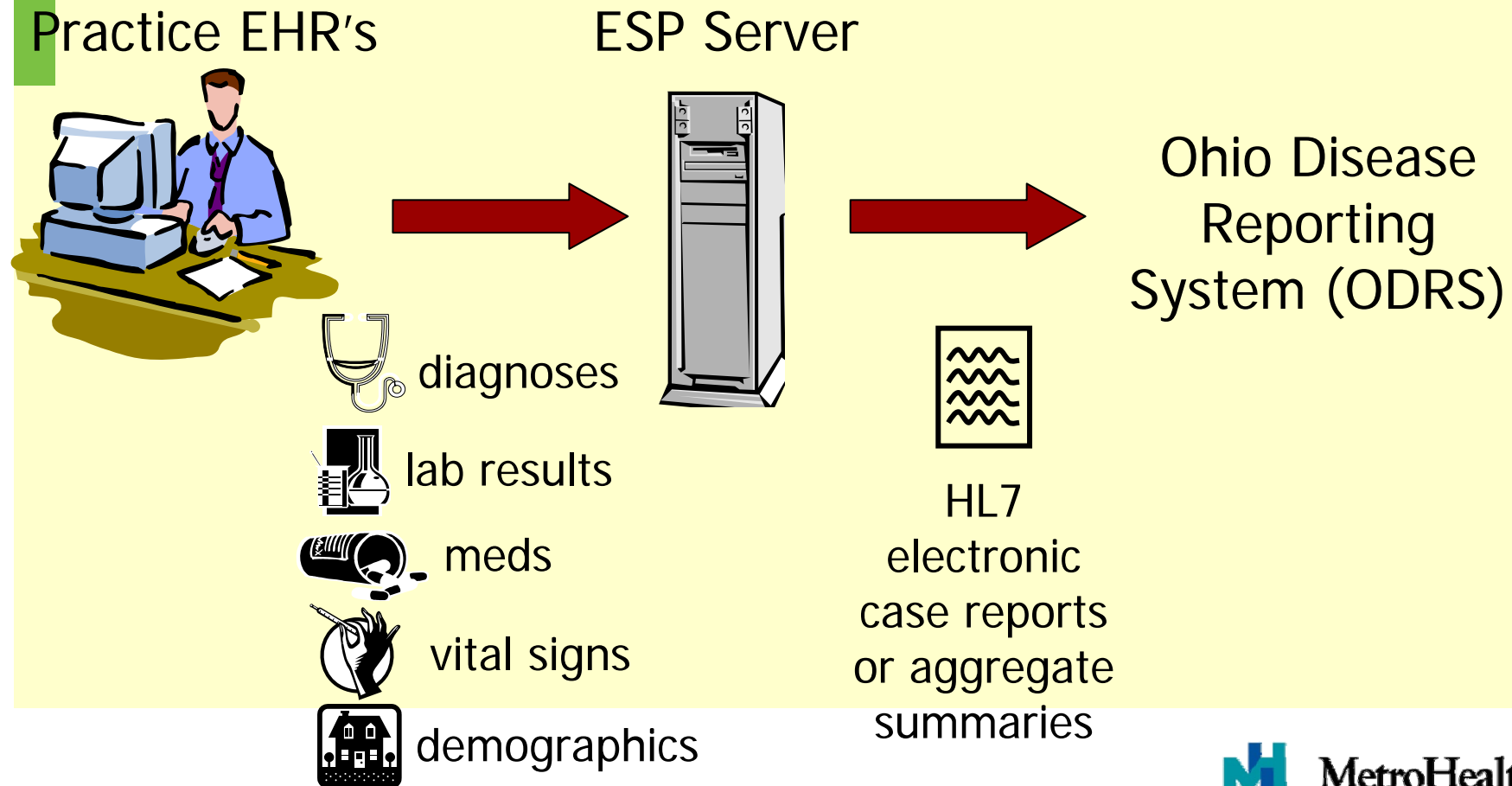
# Decoupled architecture

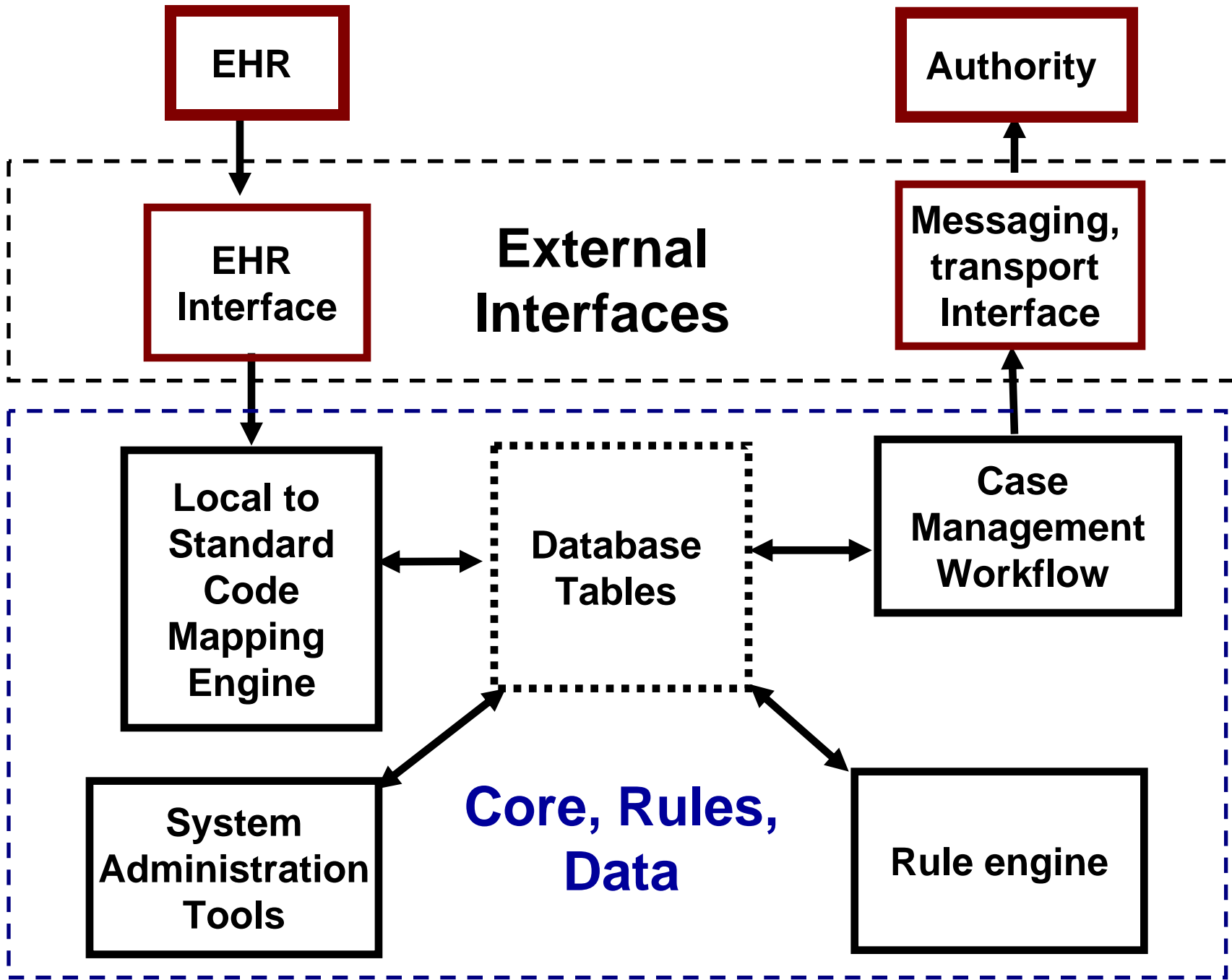


## ESP decoupled from host electronic health record

	<b>Implications</b>
Allows system to be agnostic to the source EHR (local codes translated to common nomenclature)	<b>Universal</b>
Offloads computing burden from clinical systems (and keeps ESP invisible to clinicians)	<b>Unobtrusive</b>
Can still remain within host practice's firewall	<b>Secure</b>

# ESP: Automated disease detection and reporting for public health







## Report to Health Department

- Patient demographics
- Responsible clinician, site, contact info
- Basis for condition being detected
- Treatments prescribed
- Symptoms (ICD9 code & temperature)
- Pregnancy status (when pertinent)
- Vaccine history (when pertinent)

# ESP Case Reporting

Atrius, June 2006-March 2010

<b>Condition</b>	<b>Total Cases</b>	<b>False Positives*</b>	<b>Positive Predictive Value</b>
Chlamydia	3389	0	<b>100%</b>
Gonorrhea	380	0	<b>100%</b>
Pelvic inflammatory disease	55	1	<b>97%</b>
Acute hepatitis A	15	0	<b>100%</b>
Acute hepatitis B	18	1	<b>94%</b>
Acute hepatitis C	37	0	<b>100%</b>
Tuberculosis	26	1	<b>96%</b>
Syphilis	167	0	<b>100%</b>

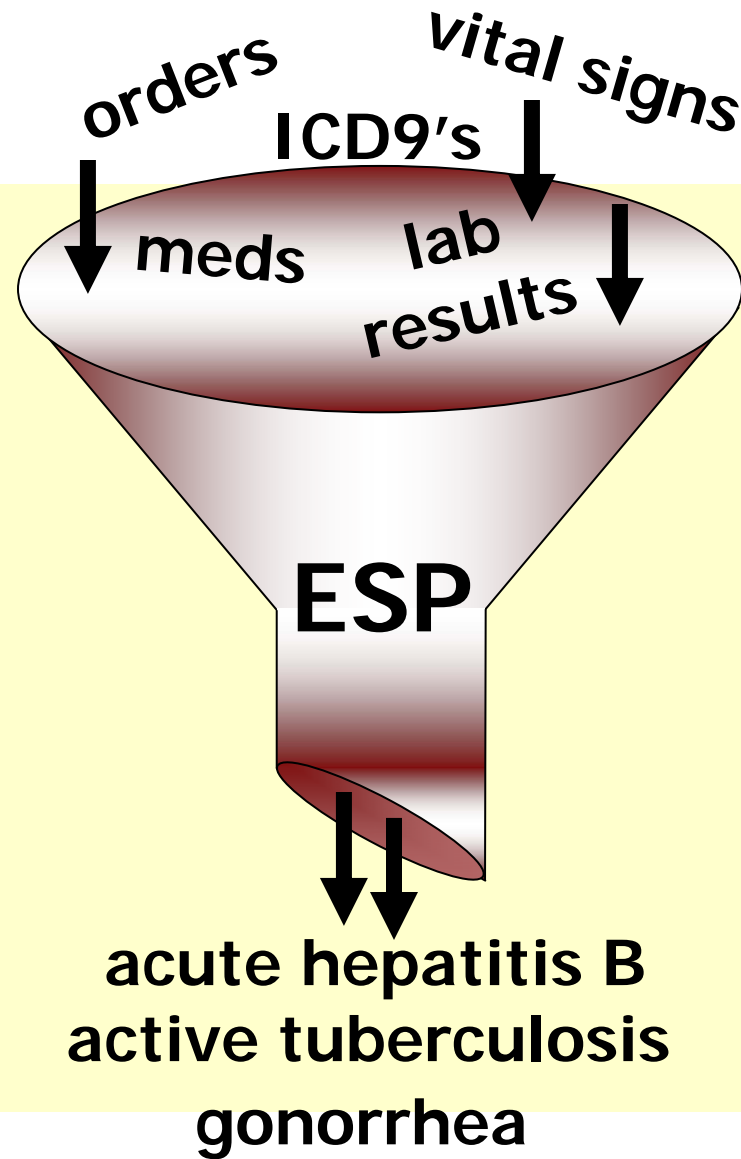
False positives defined as non-reportable cases

# Manual versus electronic reporting

## Atrius, June 2006 - July 2007

	<b>Manual Reports</b>	<b>ESP</b>	<b>Change</b>
<b>Chlamydia</b>	545	758	↑ 39%
<b>Gonorrhea</b>	62	95	↑ 53%
<b>Pelvic Inflammatory Disease</b>	0	25	↑ ↑
<b>Acute Hepatitis B</b>	3	8	↑ ↑
<b>Acute Hepatitis C</b>	0	37	↑ ↑
<b>Tuberculosis</b>	13	14	↑ 8%

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




## Limitations of diagnosis by ICD9's

<b>Condition</b>	<b>Sensitivity</b>	<b>Positive Predictive Value</b>
Acute hepatitis C	63%	22%
Postherpetic neuralgia	59%	84%
Gestational diabetes	~90%	38%



## Solution

- Integrate multiple streams of data from the EHR to increase sensitivity and specificity
  - Lab orders
  - Lab results (present and past)
  - ICD9 diagnoses (present and past)
  - Medication prescriptions



## Case Identification Logic: Acute Hepatitis B

- **Both** of the following:


- ICD9 for jaundice OR liver function tests > 5x normal
- IgM to core antigen

**OR**

- **All four** of the following:

- ICD9 for jaundice OR liver function tests > 5x normal
- Hep B surface antigen or 'e' antigen present
- No prior positive Hep B specific lab tests
- No present or prior ICD9 code for chronic hepatitis B

*PLoS ONE* 2008;3:e2626



# Case Identification Logic Active Tuberculosis

- **Any** of the following:
  - Prescription for pyrazinamide
  - OR**
  - Order for (AFB smear or AFB culture) followed by ICD9 code for TB within 60 days
  - OR**
  - Order for 2 or more anti-tuberculous medications followed by an ICD9 code for TB within 60 days

*Public Health Reports 2010*



# ESP @ MetroHealth

- Goals:
  - Implement ESP in a new setting with inpatient + outpatient data
  - Adapt ESP's reporting module to Ohio Health Department's HL7 specification
  - Assess generalizability of ESP's disease detection algorithms
  - Create a new ESP module for electronic laboratory reporting
  - Assess the financial impact of ESP



# ESP @ MetroHealth

- Issues:
  - New team
  - Different HL7 specifications
  - Different state reporting database
  - Different required reportable diseases
  - Focusing more on electronic lab reporting (ELR) as opposed to disease reporting

# ESP Case Reporting

The MetroHealth System, January 2009-December 2009

<b>Condition</b>	<b>Total Cases</b>	<b>False Positives*</b>	<b>Positive Predictive Value</b>
Chlamydia	1118	0	<b>100%</b>
Gonorrhea	248	0	<b>100%</b>

\* - False positives defined as non-reportable cases

# Manual versus electronic reporting

MetroHealth, January 2009 – December 2009\*

	<b>Manual Reports</b>	<b>ESP</b>	<b>Change</b>
<b>Chlamydia</b>	1046	1118	↑ 7%
<b>Gonorrhea</b>	248	278	↑ 12%
<b>Acute Hepatitis B</b>	7	10	↑ 43%
<b>Acute Hepatitis C</b>	1	5	↑ 500%

\*The Ohio Department of Health is ~6 months behind entering Chlamydia and Gonorrhea data.

# Time savings

## The MetroHealth System

	<b>Time per case</b>
<b>MHS Record Positive Lab Information</b>	<b>74 sec</b>
<b>MHS Record Additional Patient Information</b>	<b>87 sec</b>
<b>MHS "Push" paper</b>	<b>60 sec</b>
<b>MHS Envelope/Postage</b>	<b>30 sec</b>
<b>ODH Data Re-Entry</b>	<b>420 sec</b>
<b>TOTAL</b>	<b>671 sec (~11 min)</b>

# Annual cost savings The MetroHealth System

	<b>Annual Savings*</b>
<b>MetroHealth</b>	<b>\$4,698</b>
<b>Ohio Department of Health</b>	<b>\$8,316</b>
<b>Total for THIS ESP project</b>	<b>\$13,014</b>
<b>TOTAL for United States</b>	<b>\$7 million</b>

\*Only accounts for costs associated with Chlamydia and Gonorrhea.



## Case Identification Logic:

### Pertussis

- Either an ICD9 for Pertussis or lab order for a Pertussis test, in addition to specific antibiotic prescription within 7 day window

OR

Positive culture or PCR for Pertussis

- Pertussis ICD-9 Codes:
  - 033.0 Bordetella Pertussis
  - 033.9 Whooping cough, unspecified organism
- Pertussis tests:
  - Pertussis Culture
  - Pertussis PCR
  - Pertussis Serology
- Pertussis Antibiotics:
  - Azithromycin
  - Clarithromycin
  - Erythromycin
  - Trimethoprim-sulfamethoxazole



## Case Testing Results: Pertussis

Tracking System	MHS	ODRS	ESP
# of Pertussis Cases	10	13	78

8 fold increase in reporting!!!!

Now we can report SUSPECTED diseases  
and not just confirmed disease  
(very helpful from a public health perspective)!

# MetroHealth ESP Reporting

Conditions	Calendar Year	365 days	Ever
Acute Hep A	0	0	1
Acute Hep B	5	9	35
Acute Hep C	4	10	28
Chlamydia	1396	2238	5573
Giardiasis	5	8	24
Gonorrhea	401	691	1586
Lyme	2	3	12
Pertussis	21	46	99
Syphilis	16	32	107
TB	28	41	141



## Future Directions

- Increasing the number of labs/diseases that ESP supports
- Looking for additional partners (inside OH and outside OH – Cleveland Clinic?)
- Using ESP for chronic disease surveillance
- Using ESP for vaccine reaction surveillance



# Case Identification Gestational Diabetes

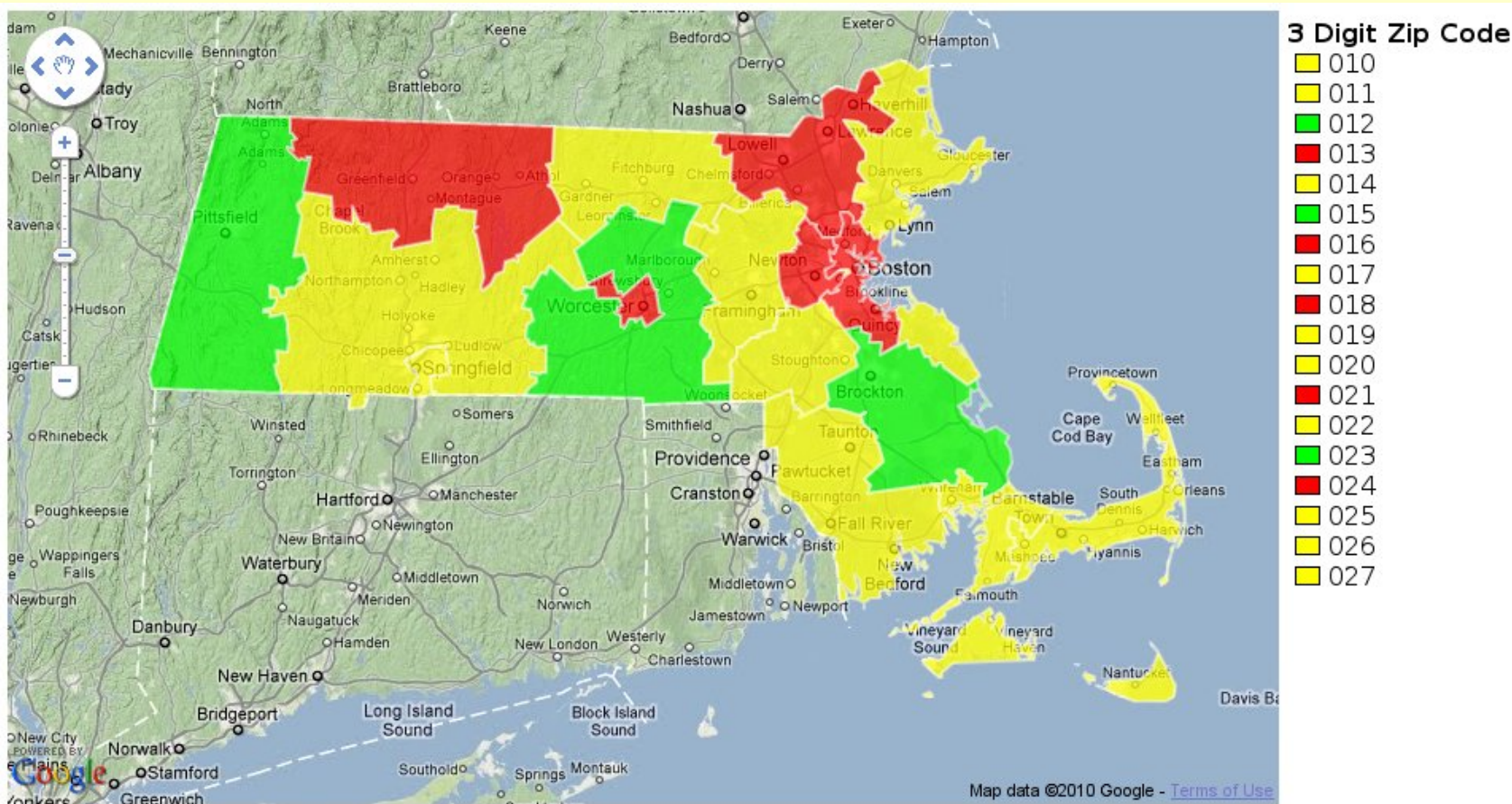
- Patient pregnant
- AND
- Positive oral glucose tolerance test



# Reporting Diabetes to the Health Department

- Developing tools for aggregate reporting
  - Case reporting not suitable for diabetes surveillance
- Statistical tools for cluster analysis on incidence & care by geography, race/ethnicity, age, etc.
- Mechanisms for health department to manipulate and extract summary data

# Gestational diabetes incidence by location



# Patterns of Care for Gestational Diabetics

## Atrius Health, 2006-2010

	Percent
Referral for medical nutrition therapy	70%
Prescription for insulin	28%
Postpartum OGTT within 12 weeks	25%
Postpartum OGTT positive	
As percentage of all who were tested	5%
As percentage of all gestational diabetics	1%



# Informatics Ontology Discovery

Wegener's Disease

Wegner's Disease



## Eponyms Finding

- Wegner's Disease - osteochondritis with epiphyseal separation associated with congenital syphilis
- Wegener's Disease – type of vasculitis
- Providers where not picking the right disease



# Eponyms Finding

- Andersen's/Anderson's
- Frei's/Frey's
- Gregg's/Grieg's

Intelligent Medical Objects (IMO) supports Diagnosis Long Description

For example:

Hunt's Disease = Primary Cerebellar Degeneration

Hunt's Syndrome = Geniculate Herpes Zoster

- Pott's/Potter's
- Pic's/Pick's
- Wegener's/Wegner's (our index case)



## ESP Conclusions

- ESP provides more accurate reporting of diseases (and labs)
- ESP provides more timely reporting of diseases (and labs)
- ESP provides more economical reporting of diseases (and labs)
- ESP is the future of public health reporting, both theoretically and practically



# ESP Team

## Harvard Dept of Population Medicine

- Richard Platt
- Emma Eggleston
- Julie Dunn
- Michael Murphy

## MetroHealth, OH

- David Kaelber
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- Myrtle Burton
- Marilyn Zahniser
- Diana D'Alessandro
- Peter Greco

## Ohio Department of Health

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- Raphael Lullis
- **Michael Klompas**

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## Cambridge Health Alliance

- Claire Pierre

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- Dave Delano

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Questions?  
Comments?

