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Title: Leveraging Electronic Health Records for Public Health: *From Automated Disease Reporting to Developing Population Health Indicators*

Organization and Meeting: PHSSR: PHSSR Research in Progress Webinar Series

Date: March 4, 2015

Leveraging Electronic Health Records for Public Health: From Automated Disease Reporting to Developing Population Health Indicators

Brian E. Dixon, MPA, PhD, FHIMSS

March 4, 2015



**RICHARD M. FAIRBANKS
SCHOOL OF PUBLIC HEALTH**

INDIANA UNIVERSITY
Indianapolis



**Regenstrief Center for
Biomedical Informatics**

Better Health Through Informatics

Agenda

- The Neolithic Revolution in Public Health
 - A change in how PH accesses data
- Leveraging the Digital Health Infrastructure
 - Challenges for PH agencies
 - RWJF-funded projects to address the challenges
- Questions and Discussion

A Neolithic Revolution in Population Health

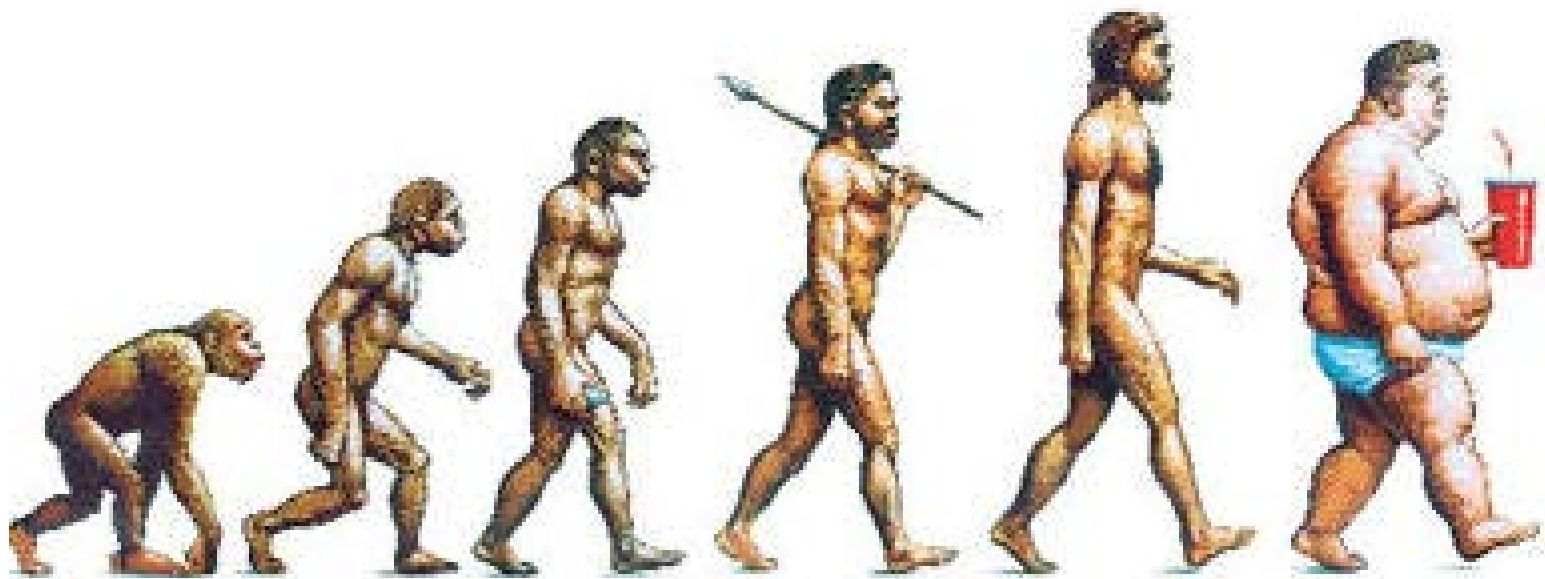


Photo from *El mono obeso* by JE Campillo; Accessed via
<http://www.uv.es/jgpausas/he.htm>

The Revolution is in Data and Information Acquisition



The Evolution Of Man

Where Health Care Used to Be (and in some places still is)



ZZ TESTER,PATIENT

Visit Not Selected

Primary Care Team Unassigned

000-00-1199 Nov 22,1949 (55)

Current Provider Not Selected

Flag
Remote Data

Postings

Active Problems

* Other Specified Disorders Of Nervous S:
 Bipolar Affective Disorder, Manic
 * Benign Neoplasm Of Breast
 Anemia, Chronic Disease
 Dementia

Allergies / Adverse Reactions

Sulfamethoxazole
 Penicillin
 Men

Postings

Allergies
 Legal Guardianship (w) Jun 05,2003
 Legal Guardianship (w) Jun 04,2003
 Organ Donation Declined (w)
 Pharmacy Alert (w) May 15,2002
 Pharmacy Alert (w) May 15,2002
 Va Living Will/Va Advance Directive

Active Medications

Sildenafil Citrate 100mg Tab Active
 Nitroglycerin 0.3mg Sl Tab Active
 Warfarin (coumadin) Na 1mg Tab Active
 Non-VA Acetaminophen Supp,Rtl Active

Clinical Reminders

* Diabetic Eye Exam Dec 31,96
 * Diabetic Lipid Control May 08,03
 * Diabetic Microalbumin Feb 11,04
 Cholesterol Screen (Female) May 08,04
 * Breast Cancer Screen DUE NOW
 * Cervical Cancer Screen DUE NOW
 PTSD Screen Mar 01,05
 * Alcohol Use Screen Nov 14,01
 Hypertension Screen/BP Check Nov 02,04
 * Influenza Vaccine 65 Sep 02,04
 Pneumococcal Mar 01,05
 Nutrition/Obesity Screen Oct 02,04
 * Diabetic Foot Exam DUE NOW
 * Diabetic Hemoglobin A1C DUE NOW
 Pain Assess/Reassess (Brief) DUE NOW

Due Date

Fictitious patient record

Recent Lab Results

Glucose Serum Sp Lb #576206 Nov 21
 Hep C Antibody(after 6/22/04) Serum Sp Lb #551620 Nov 01
 Hep B Surface Ag Serum Sp Lb #551620 Nov 01
 Hep B Core Ab-Total Serum Sp Lb #551620 Nov 01
 Hep B Surface Ab Serum Sp Lb #551620 Nov 01
 Hep A Antibody-Total Serum Sp Lb #551620 Nov 01
 Pt & Ptt Blood Plasma Sp Lb #518899 Sep 30
 Pt & Ptt Blood Plasma Sp Lb #518899 Sep 30

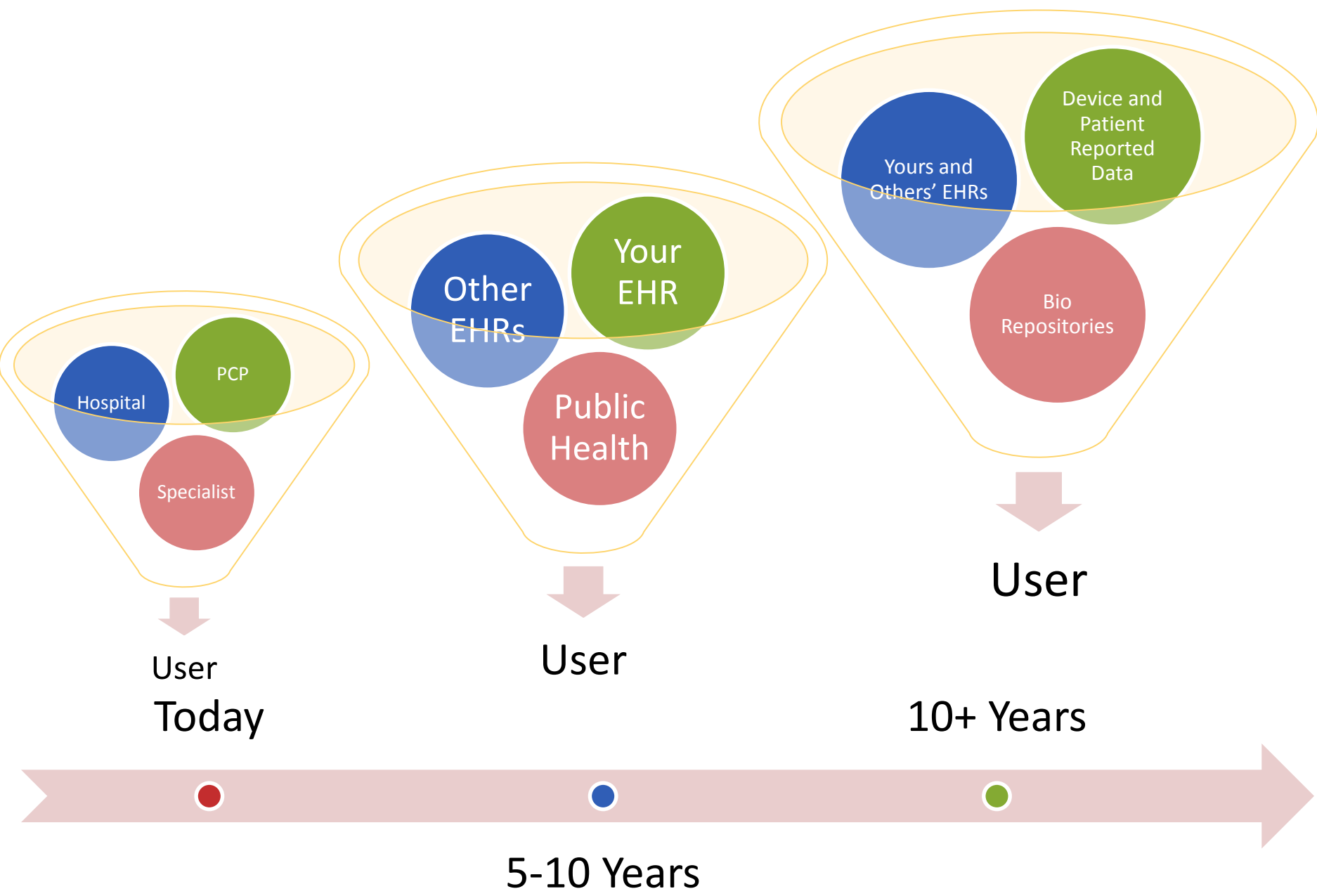
Vitals

T 98.9 F Oct 26,2004 14:46 (37.2 C)
 P 80 Oct 26,2004 14:46
 R 14 Oct 26,2004 14:46
 BP 122/76 Oct 26,2004 14:46
 HT 60 in Oct 26,2004 14:46 (152.4 cm)
 WT 200 lb Oct 26,2004 14:46 (90.9 kg)
 PN 5 Oct 26,2004 14:46

Appointments/Visits/Admissions

No data found

Cover Sheet
Problems
Med
Orders
Notes
Consults
Surgery
D/C Summ
Labs
Reports



Fueling the Revolution

- Meaningful Use
 - Incentive program from CMS to encourage adoption and use of EHR systems
 - \$21.6 billion paid to 355,000 EHs/EPs thru 2014
- Stage 2 MU requires HIE
 - Summary of care provided at least 10% of time
 - Laboratory reporting to public health

Meaningful Use

Eligible Hospitals and CAHs

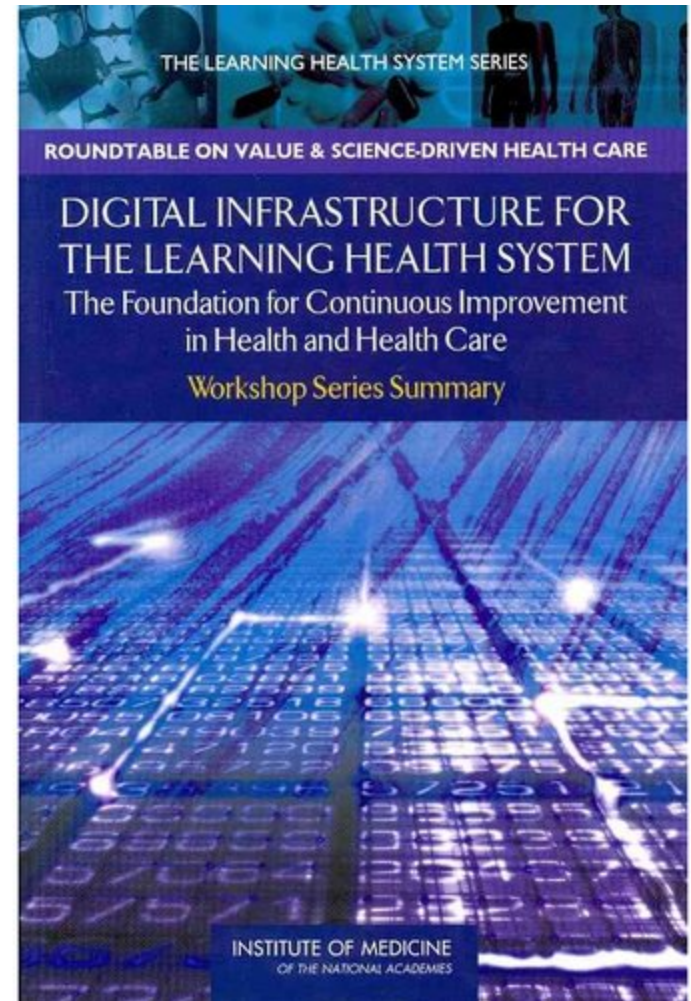
Report on all 16 Core Objectives:

1. Use computerized provider order entry (CPOE) for medication, laboratory and radiology orders
2. Record demographic information
3. Record and chart changes in vital signs
4. Record smoking status for patients 13 years old or older
5. Use clinical decision support to improve performance on high-priority health conditions
6. Provide patients the ability to view online, download and transmit their health information within 36 hours after discharge.
7. Protect electronic health information created or maintained by the Certified EHR Technology
8. Incorporate clinical lab-test results into Certified EHR Technology
9. Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach
10. Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate
11. Perform medication reconciliation
12. Provide summary of care record for each transition of care or referral
13. Submit electronic data to immunization registries
14. Submit electronic data on reportable lab results to public health agencies
15. Submit electronic syndromic surveillance data to public health agencies
16. Automatically track medications with an electronic medication administration record (eMAR)



The Learning Health System

- Learning Health System (LHS), a concept introduced by the Institute of Medicine
- Emphasizes health systems should leverage their data to continuously improve; and practice should inform research objectives
- EHR and HIE Systems lay the foundation for the LHS



LEVERAGING THE DIGITAL INFRASTRUCTURE FOR PUBLIC HEALTH



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Results from 2010 NACCHO Survey

Mechanism	Percent of LHDs			
	Individual	Syndromic	Outbreak	Laboratory

Mechanism	Percent of LHDs			
	Restaurant Inspections (n=210)	Water Wells (Licensing and/or Testing) (n=179)	Lead Testing (n=175)	Environmental Health Tracking (n=190)

Mechanism	Percent of LHDs		
	Immunization Records (n=244)	Vital Records (n=171)	Home Visits by Public Health Nurses (n=199)
Paper Records	62%	56%	72%
Standalone Spreadsheet or Database	14%	13%	17%
Local Data Warehouse	13%	11%	15%
In a Web-Based Database	65%	59%	28%
A Shared Database (Other than Web)	22%	23%	16%

Challenges for PH Agencies

- PH Organizations Lag Behind Medicine
 - Aging infrastructure
 - Workforce unprepared for Brave New World
- Old Paradigms Won't Work
 - 2010s an era of instant gratification
 - Data must be open and usable
- Capacity to Evolve Limited
 - Limited \$ available for investment
 - Limited workforce to advance systems

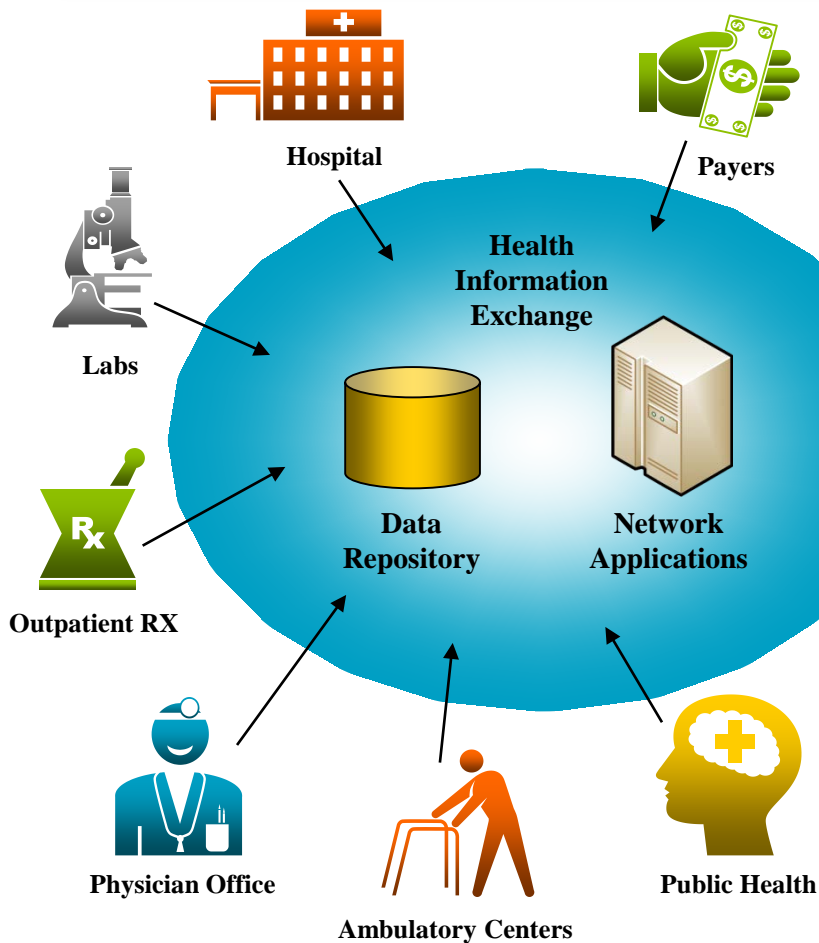
Two Projects

- Examining a provider intervention to automate reporting of vaccine-preventable diseases
 - Mentored Research Scientist Development Award No. 71596

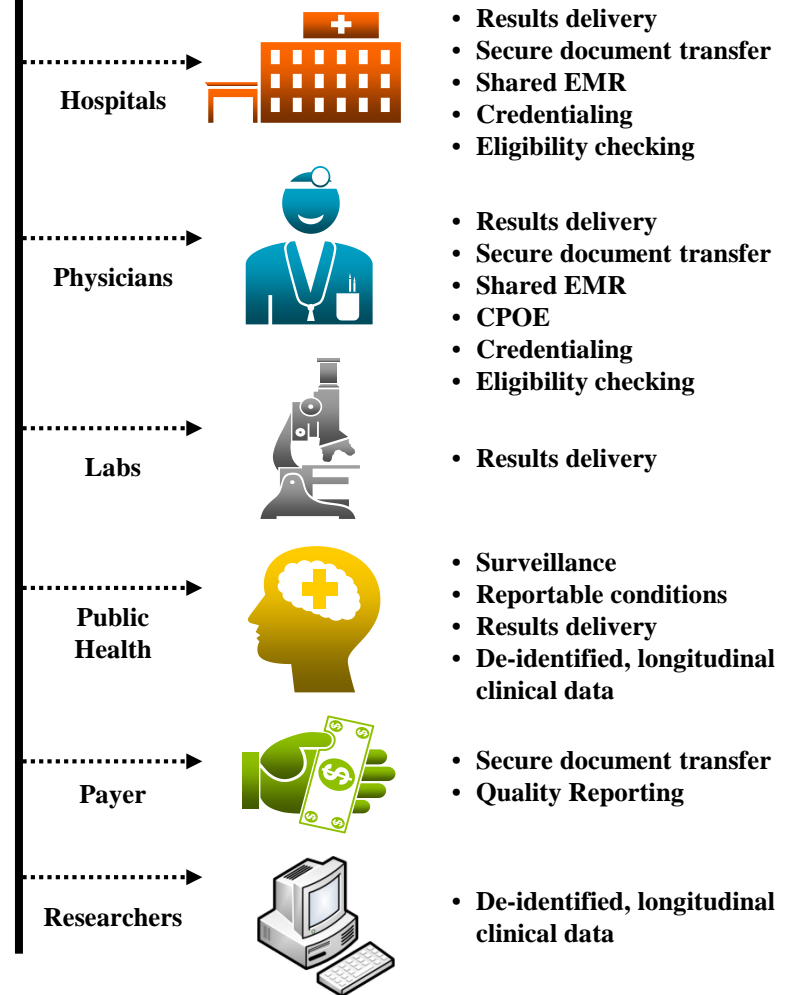
- Population EHR Data for Assessment at the Local level (PEDAL)
 - PHSSR No. 71271

Health Information Exchange

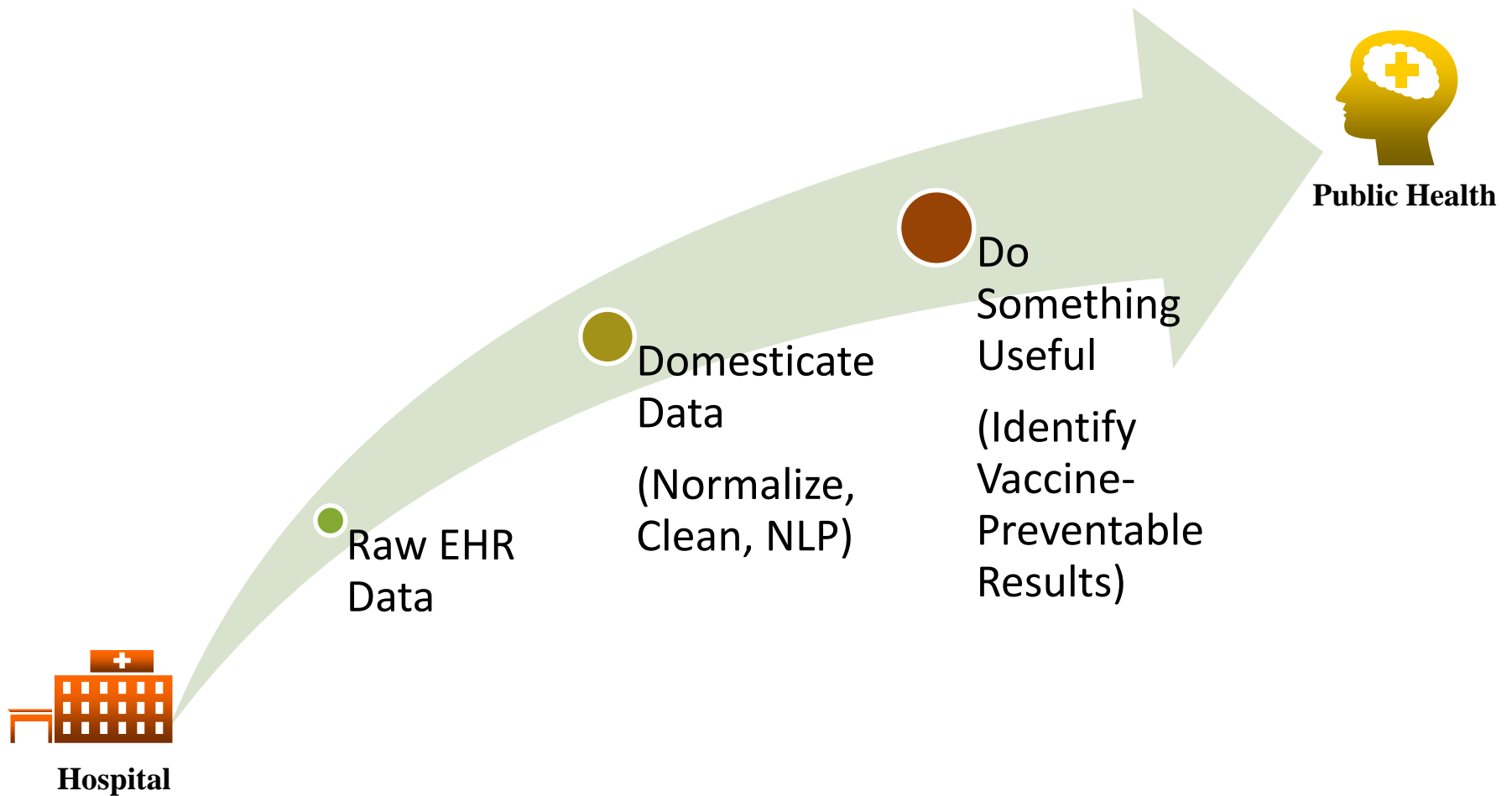
Data Management



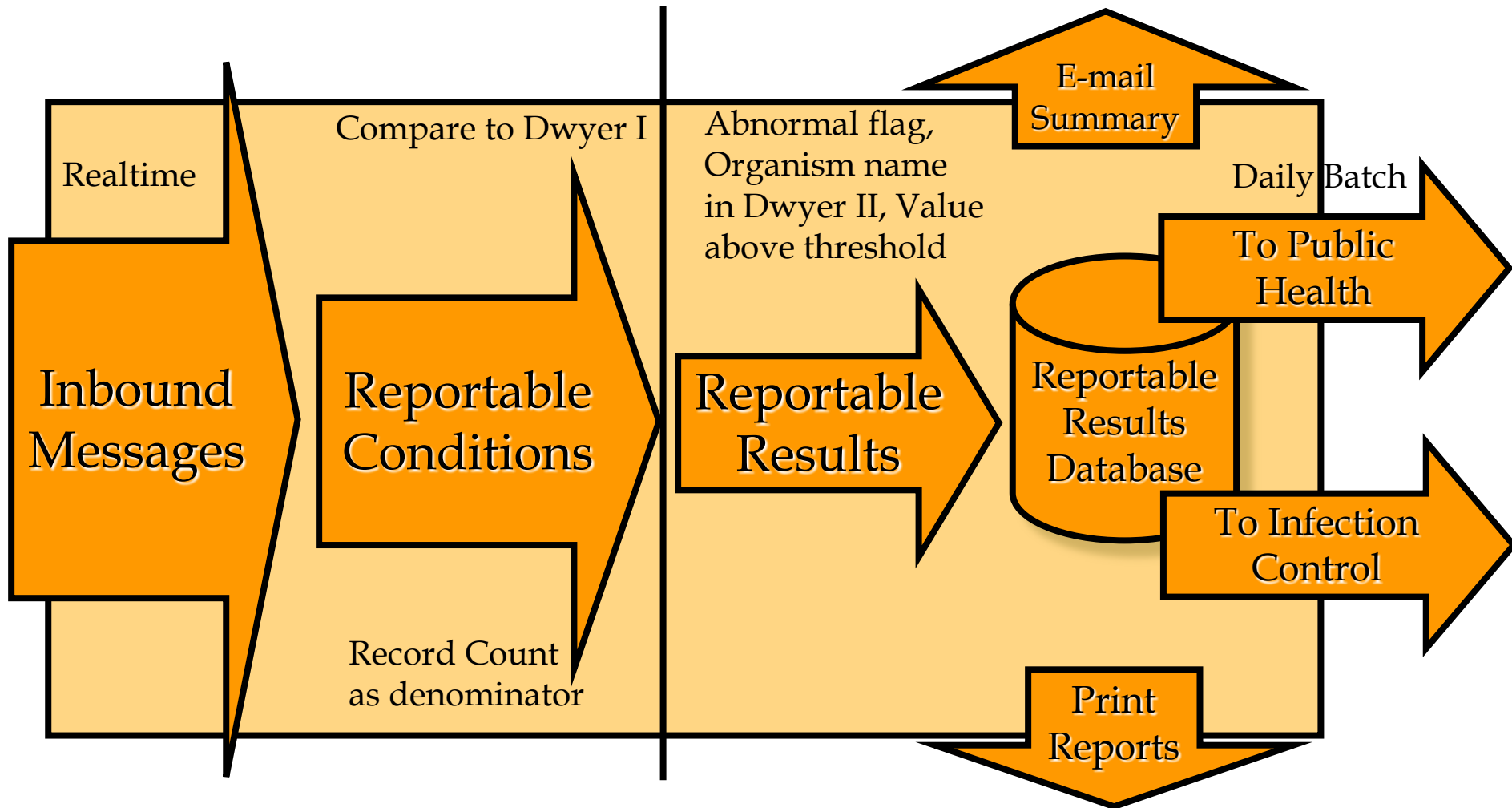
Data Access & Use



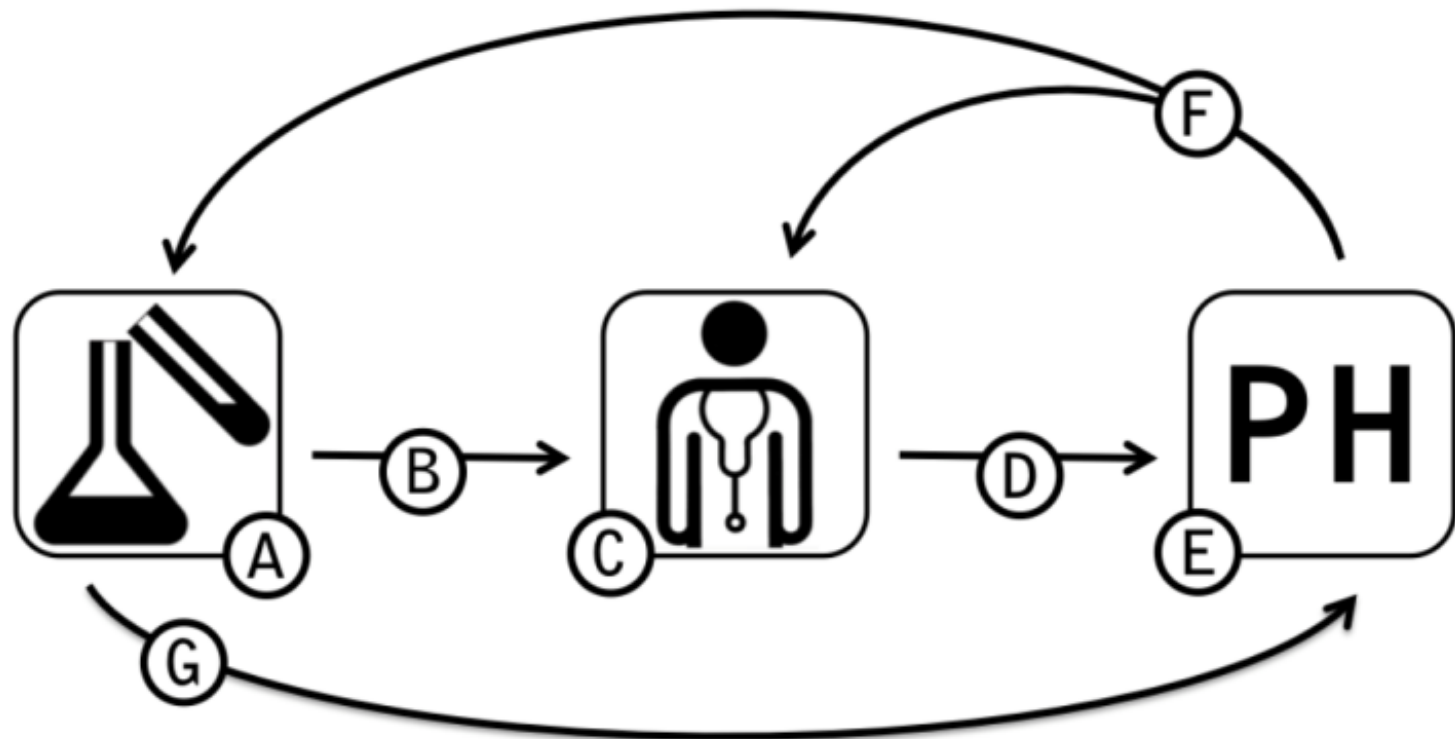
Domesticating Clinical Data



The Notifiable Condition Detector



Traditional PH Reporting Workflow



Official State CDR Form

CONFIDENTIAL REPORT OF COMMUNICABLE DISEASES
 State Form 43823 (R2 / 11-96)
 THIS FORM CONTAINS CONFIDENTIAL INFORMATION PER 410 IAC 3.1-2-18.

DISEASE

patient Information

Name (last, first, m.i.)
 If child, name of parent (last, first, m.i.)
 Address (number and street)
 City, ZIP code
 County
 Telephone number ()
 Date of birth (month, day, year)
 Age
 SEX: Male Female
 RACE: White Black Unknown Multi-Racial
 ETHNICITY: Hispanic Non-Hispanic Unknown
 (Not Required For STD's) Check all that apply:
 Health Care Worker
 Food Service
 School (student / staff)
 Day Care (attendant / staff)
 Name of school / day care?
 Pregnant? Yes No Unknown
 Part of an outbreak? Yes No Unknown

lab Information

Etiologic agent
 Date of diagnosis (month, day, year)
 Stage (syphilis only)
 Symptoms associated with infection? Yes No Unknown
 (Not Required for STD's) Onset date (month, day, year)
 Died? Yes No
 IF YES Pertinent symptoms, signs:
 Lab test(s) and result(s) Date(s)
 Treatment (name of antibiotic) Dosage Date initiated
 Antibiotic resistance Yes No NOT DONE If Yes, what antibiotic?

provider Information

Reporting Facility Code (see other side for codes)
 Name of physician and address
 Telephone number ()
 Date of report
 If hospital, name of hospital
 Record number
 Person reporting (other than physician)
 Telephone number ()
 Check here if you need more cards

LOCAL HEALTH DEPARTMENT USE ONLY

Date received (month, day, year)
 Name of investigator
 Follow-up initiated? Yes No

patient Information

Name
 Address
 Phone#
 DOB
 Gender
 Race/ethnicity

provider Information

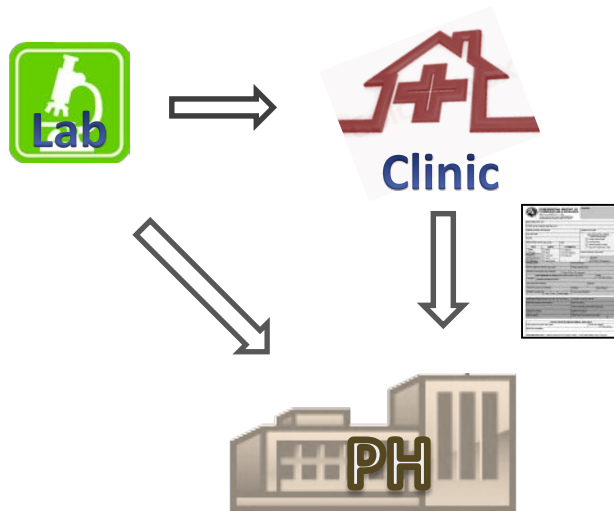
Physician name
 Physician address
 Phone#
 Reported by
 Report date

lab Information

Etiologic agent
 Test name
 Test date
 Treatment initiation date
 Treatment (drugs)

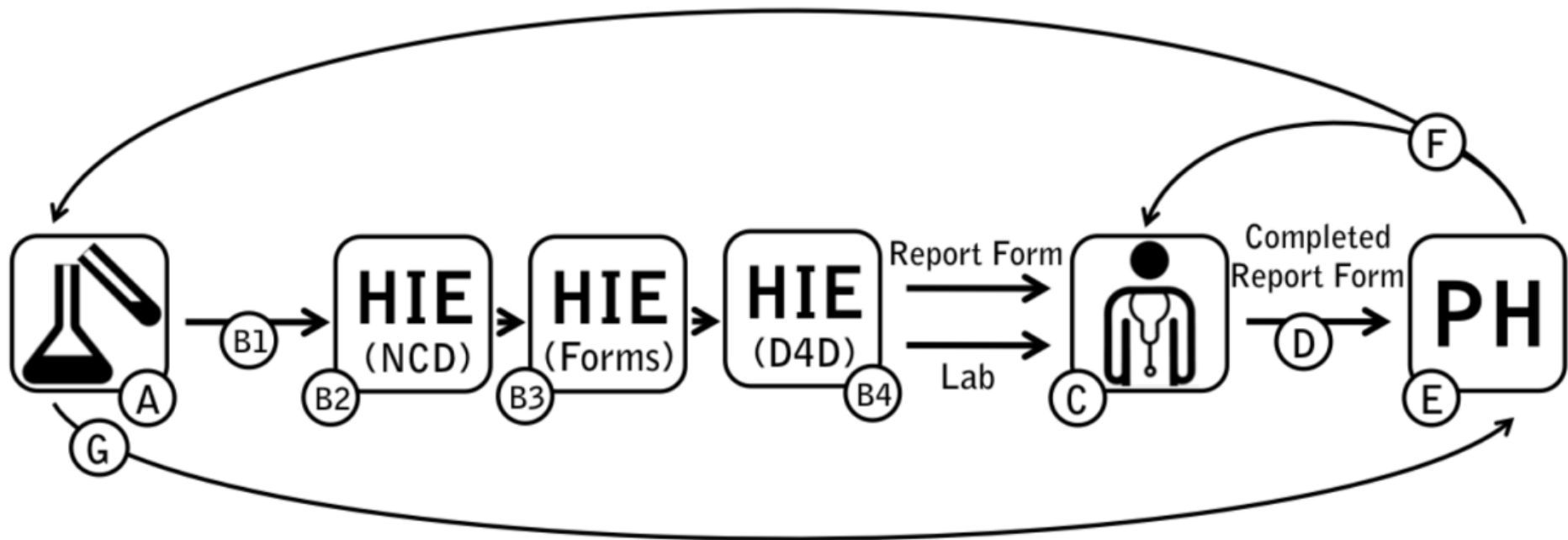
Study Objective

- Most reports to PH originate from labs



- We aim to increase reporting rates for providers using an automated process where CDR fields are pre-populated using EHRs

Enhanced PH Reporting Workflow



Pre-p

arms

Name (last, first, m.i.) LABTESTING, HARRY M							
If child, name of parent (last, first, m.i.) BUNNY, BUGS Z							
Address (number and street) 1 MAIN STREET	Telephone number (765) 555-1212						
City, ZIP code MAYBERRY, 46299	(Not Required For STD's) Check all that apply: <input type="checkbox"/> Health Care Worker <input type="checkbox"/> Food Service <input checked="" type="checkbox"/> School (student / staff) <input type="checkbox"/> Day Care (attendee / staff)						
County Marion							
Date of birth (month, day, year) 11 12 2005	Age 3						
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">SEX</th> <th style="width: 33%;">RACE</th> <th style="width: 33%;">ETHNICITY</th> </tr> </thead> <tbody> <tr> <td><input checked="" type="checkbox"/> Male <input type="checkbox"/> Female</td> <td><input type="checkbox"/> White <input type="checkbox"/> Black <input type="checkbox"/> Unknown <input checked="" type="checkbox"/> Other _____</td> <td><input checked="" type="checkbox"/> Hispanic <input type="checkbox"/> Non-Hispanic <input type="checkbox"/> Unknown</td> </tr> </tbody> </table>	SEX	RACE	ETHNICITY	<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female	<input type="checkbox"/> White <input type="checkbox"/> Black <input type="checkbox"/> Unknown <input checked="" type="checkbox"/> Other _____	<input checked="" type="checkbox"/> Hispanic <input type="checkbox"/> Non-Hispanic <input type="checkbox"/> Unknown	Name of school / day care?
SEX	RACE	ETHNICITY					
<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female	<input type="checkbox"/> White <input type="checkbox"/> Black <input type="checkbox"/> Unknown <input checked="" type="checkbox"/> Other _____	<input checked="" type="checkbox"/> Hispanic <input type="checkbox"/> Non-Hispanic <input type="checkbox"/> Unknown					
Pregnant? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	Part of an outbreak? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown						
Etiologic agent	Site of infection						
Date of diagnosis (month, day, year)	Stage (syphilis only)						
Symptoms associated with infection? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown							
IF YES	(Not Required for STD's) Onset date (month, day, year)						
	Died? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No						
Pertinent symptoms, signs:							
Lab test(s) and result(s) CHLAMYDIA BY RIA - POSITIVE	Date(s) 11 05 2008						
Treatment (name of antibiotic)	Dosage						
Date initiated							
Antibiotic resistance? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NOT DONE	If Yes, what antibiotic?						
Reporting Facility Code (see other side for codes) ST01W	If hospital, name of hospital						
Name of physician and address FLINTSTONE, FRED	Record number						
1001 W. 10th STREET, INDIANAPOLIS, IN 46205	Person reporting (other than physician)						
Telephone number	Telephone number						
Date of report	Check here if you need more cards <input type="checkbox"/>						
LOCAL HEALTH DEPARTMENT USE ONLY							
Date received (month, day, year)	Follow-up initiated? <input type="checkbox"/> Yes <input type="checkbox"/> No						
Name of investigator							

Docs4Docs - Windows Explorer

https://149...

File Edit View Favorites

DOCS4DOCS

General

- Inbox
- Inbox History
- Report Search
- Change Practice
- System Messages
- Dead Ltr Summary
- Document Track
- Delivery Status
- Message Status
- Help
- Logout

Practice Admin

- Users
- Providers
- Subscriptions
- Default Subscriptions

Administrative

- User Add
- User Edit/Remove
- Clin Mstr Search/Edit
- Clin Mstr Add
- Practice Add
- Practice Edit
- Practice Delete
- HL7 Delvry Agnt Services
- System Message Edit
- Dead Ltr Summary
- HL7 Exceptions
- User Alias Pools
- Status Commands
- Misc Commands
- Audit Commands
- Implementations
- Help

Maintainer

- Misc Commands

Contains commands for working w...

start

Print

12 (STD's) apply: cer staff ee / staff

Unknown

Yes No

tiated

Yes No

orter

100%

10:00 AM

Research Design

- Controlled implementation
 - Clinics will receive pre-populated physician reporting forms in addition to standard D4D clinical messages
 - Baseline info collected before clinic goes live
 - Future sites are controls for early adopters
- Mixed methods approach
 - Quantitative metrics
 - Qualitative interviews

What are we measuring?

- Quantitative
 - Data completeness
 - Time from report to disease investigation
 - Reporting rates by clinic, disease
- Qualitative
 - Perceived completeness, timeliness
 - Perceived workload
 - Satisfaction with prepopulated forms

Project Status

- Baseline data collection completed
 - Existing counts of disease cases, data quality, and processes within public health department
 - Analyzing baseline numbers
- Intervention went live Sept 2014
 - Collecting post-intervention data
 - Beginning analysis of post-intervention data

Issue / Lesson Learned

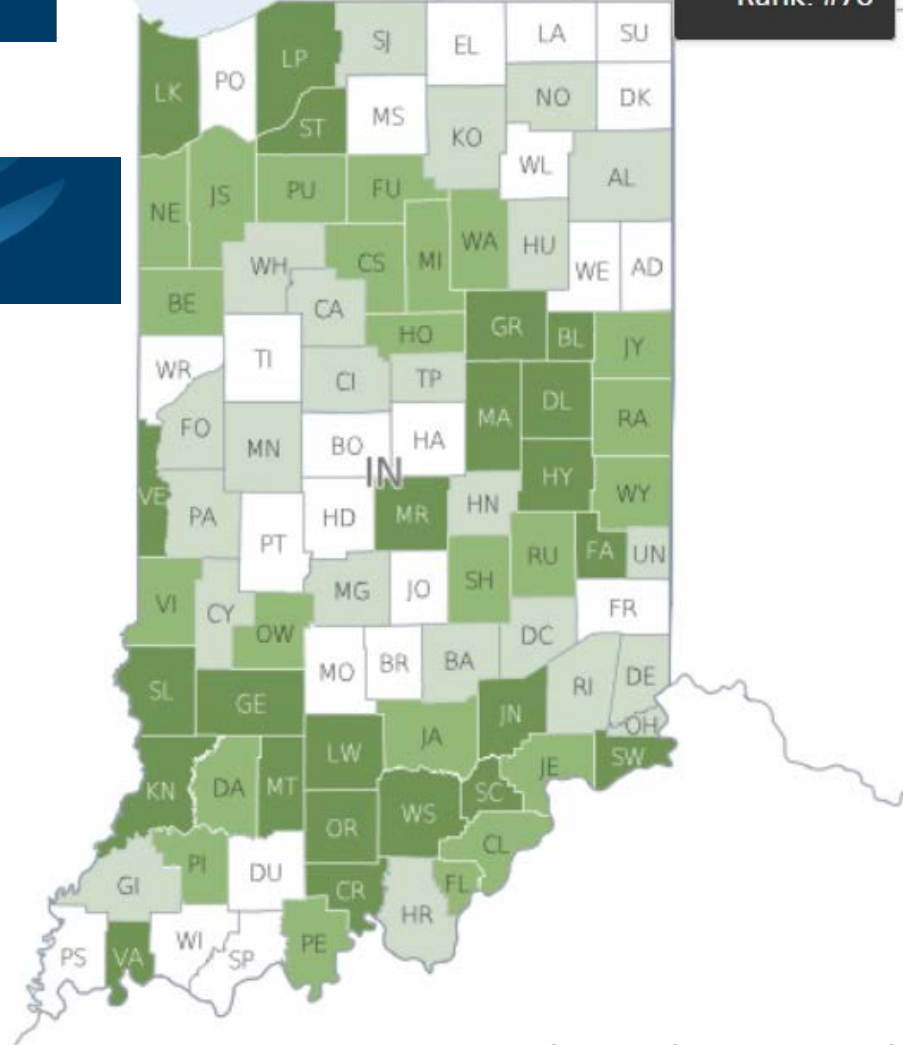
- Natural language processing of microbiology results is difficult
 - Labs serve multiple “customers” and PH is not at the top of their priority list
 - Standard outputs from LIS/LIMS hard to decipher using clear, standardized rules
- Although the codes for Rubella and Varicella IgG results are in the CDC RCMT, it does not mean that one should use them
 - Many false positive results

County Health Rankings & Roadmaps

Building a Culture of Health, County by County

Marion (MR)
Rank: #78

A Robert Wood Johnson Foundation program



<http://www.countyhealthrankings.org/app/indiana/2014/overview>

Overview

Rankings

Measures

Downloads

Compare Counties

Select a county

Print Help

Select a Measure:

Health Outcomes
Premature death

Premature death

Map | Data | Description | Data Source

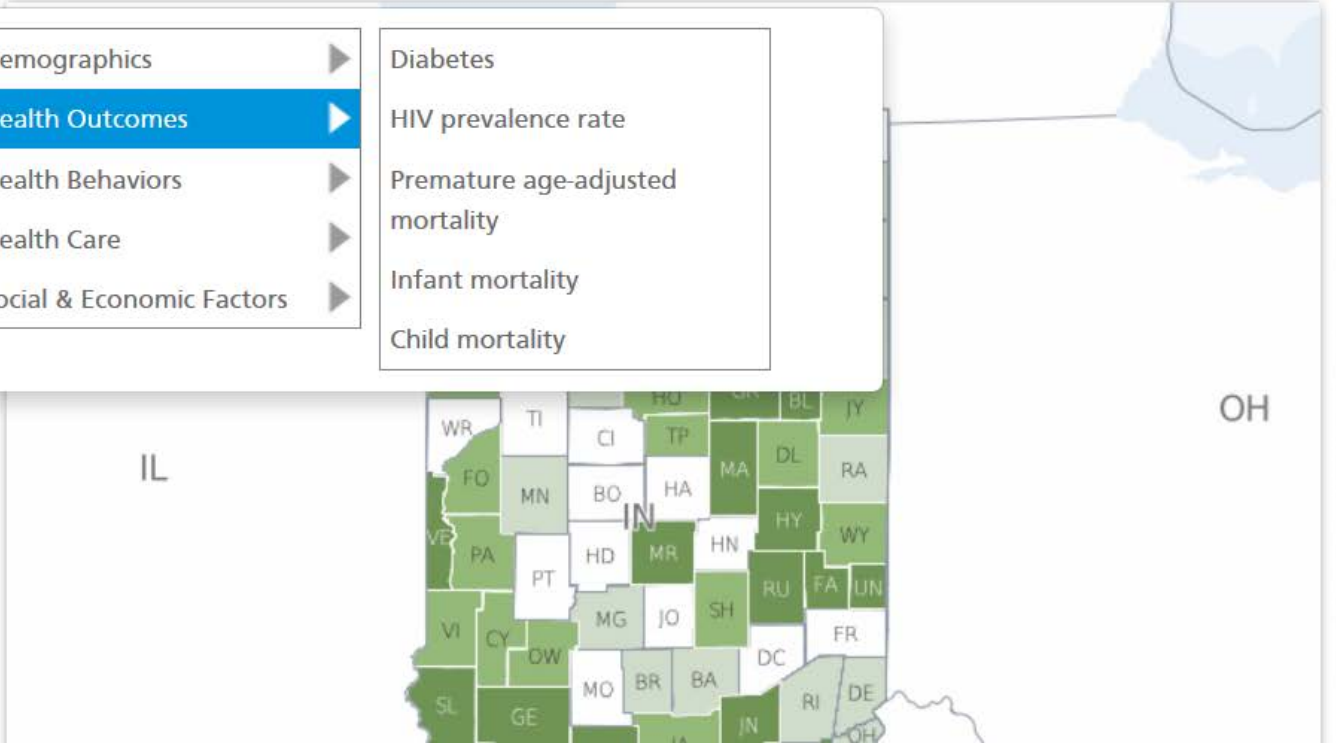
- Health Outcomes
- Health Factors
- Additional Measures

- Demographics
- Health Outcomes
- Health Behaviors
- Health Care
- Social & Economic Factors

- Diabetes
- HIV prevalence rate
- Premature age-adjusted mortality
- Infant mortality
- Child mortality

Measure:	Length of Life
Weight in Health Outcomes:	50%
Years of Data Used:	2008-2010

Summary Information



<http://www.countyhealthrankings.org/app/indiana/2014/overview>

PEDAL Project Aims

1. Develop neighborhood-level indicators of population health using EHR integrated with a community information system;
2. Evaluate neighborhood-level indicators with respect to reliability, validity, feasibility, and perceived usefulness; and
3. Generate an integrated view of neighborhood-level indicators of health within a local health department jurisdiction, enabling review of information for planning and policy.

Can we get to neighborhood level?

- Sub-county: anything smaller than a county
 - LHD Planning Area (~40,000-50,000)
 - Zip code (~8,000)
 - Census tract (~4,000)
 - Census block group (~1,500)
 - Neighborhood

- What is a neighborhood?



Search



Username or Email

Password

Login

Register

- DATA & TOOLS
- HOME
- ABOUT
- SERVICES
- RESOURCES
- CONTACT US
- HELP
- USE SAVI

- Quick Data**
View the most requested data as an interactive map, chart, or table.
- Community Profiles**
View a detailed report describing population, economy, health, etc.
- Data Tools**
Analyze data with indicators to create custom maps, charts, or tables.
- Available Data**
Review the list of data categories available in SAVI.
- USE SAVI**
Begin interacting with data and tools without login or registration.

SAVI is a free resource to help you make data-informed decisions. It provides data about Central Indiana communities, tools to analyze and visualize the data, and training to build your capacity to use it effectively.



Data Currently Available for 11 Central Indiana Counties

Learn More

Register Now

MT @npnews #Unemployment Rate Drops To 6.3 Percent, Lowest In 5 Years t.co/5Y1Hh4fDj



www.savi.org

Measures

- Prevalence of diabetes; asthma and COPD; depression; STIs; and hypertension as well as other cardiovascular diseases
- Chlamydia screening
- HbA1c Testing for Patients with Diabetes
- HbA1c Controlled at <8% for Patients with Diabetes
- LDL-C Screening for Patients with CVD
- LDL-C Levels < 100 mg/dL for Patients with CVD
- Emergency Room Utilization for People With Asthma

Choosing Measures

- Participatory design and process
 - Engage range of public health stakeholders
 - Coordination with CTSI CHEP, ISDH

- Cast broad net, then narrow list
 - What is feasible given population incidence?
 - What is feasible given EHRs?
 - What is feasible given INPC?
 - What is feasible given geography?

Measure Selection - Feasibility

1	Measure or Indicator	Likelihood of Electronic Capture in an EHR or PH System	Availability within a RHIO or IT Systems Accessible to Public Health	Prevalence of Disease or Occurrence per 1000 Population	Percentage of Health Care Market / Providers Contributing Data	Geographic Granularity, Enabling Use at Small Scales	Use for PEDAL?
2	Context for PEDAL	Captured in INPC Member Institutions	Transmitted to INPC by Member Institutions	Varies by Disease; Marion County, Indiana	~95% of Marion County	YES for PEDAL since data available at high quality (X,Y) coordinates	
19	HIV screening	10 - very likely; captured in structured format	10 - definitely available and likely all institutions		90%	10 - can definitely scale down to the smallest levels	Yes
20	HPV vaccination coverage (single dose & completed series)	7 - likely	3 - unlikely to be available	97.2 (male) 384.3 (female)	10%	10 - can definitely scale down to the smallest levels	No - Very challenging representative data small area
21	Emergency Room Utilization by People With Dental Pain/Infections	7 - likely	7 - available but may not for all institutions		95%	10 - can definitely scale down to the smallest levels	Yes
22	Prevalence of viral hepatitis – HBV and (especially) HCV	10 - very likely; captured in structured format	10 - definitely available and likely all institutions		95%	10 - can definitely scale down to the smallest levels	Yes
	Evidence of violence/trauma (e.g., domestic violence)	3 - unlikely to be captured electronically or captured in free	3 - unlikely to be			10 - can definitely scale down to the	No - Difficult to dete

Measure Definition

1	DIABETIC CARE: Comprehensive Diabetic Care (CDC)				
2					
3	DESCRIPTION				
4	Percentage of patients 18–75 years of age with type 1 or type 2 diabetes who had the following completed during the respective measurement period. Each is a separate measure.				
5	– (DC1) Hemoglobin A1c (HbA1c) testing				
6	– (DC8) HbA1c good control (<7.0%)				
7	– (DC2) HbA1c control (<=9.0%)				
8	– (DC3) LDL-C screening performed				
9	– (DC5) LDL-C controlled (<100 mg/dL)				
10	– (DC6) Kidney disease (nephropathy) monitored				
11	– (DC7) Retinal eye exam performed				
12					
13	MEASURE-SPECIFIC DATA RETURNED				
14	No.	Criteria	Values		
15	1	Age	18–75 years		
16	2	Denominator Period	24 months		
17	3	Measurement Period	12–24 months		
18					
19	No. 1	Identify patients whose date of birth is 18–75 years from the current month.			
20					
21	DATA RETURNED				
22	No.	Field Name	Description	Data Type	Notes
23	1	DiabetesEncounterDate	Date of diabetes diagnosis	Date	
24	2	DiabetesMedicationDate	Date insulin or oral hypoglycemic dispensed	Date	
25	3	VisitType	Visit Type	String	
26	4	HbA1cTestDate	Date of HbA1c test	Date	
27	5	HbA1cTestResult	Result of HbA1c test	String	
28	6	LDL-CTestDate	Date of LDL-C test	Date	
29	7	LDL-CTestResult	Result of LDL-C test	String	
30	8	UrineMicroalbuminTestDate	Date of urine microalbumin	Date	

Data Analysis

- Internal Validation
 - Statistical techniques to optimize the variance over the geographic regions of interest
 - Factor analysis in conjunction with self organizing maps (SOMs)
- External Validation
 - Compare with MCPHD surveys, BRFSS
 - Explore quality of INPC data

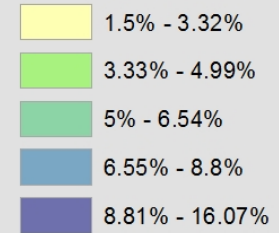
Status of PEDAL

- Selected broad set of measures
 - Initially bit off a bit more than we can digest
- Defined nearly all measures
 - Numerator, denominator
- Internal validation with data from the INPC and SAVI
 - Optimizing prevalence models; adj for population
- External validation with MCPHD and other PH stakeholders
 - Creating maps, analysis sets for review

Diabetes Rates

2011-2013

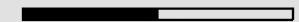
Percent of INPC Patient Population Diagnosed with Diabetes by Neighborhood



The Polis Center

Source: Indiana Network for Patient Care

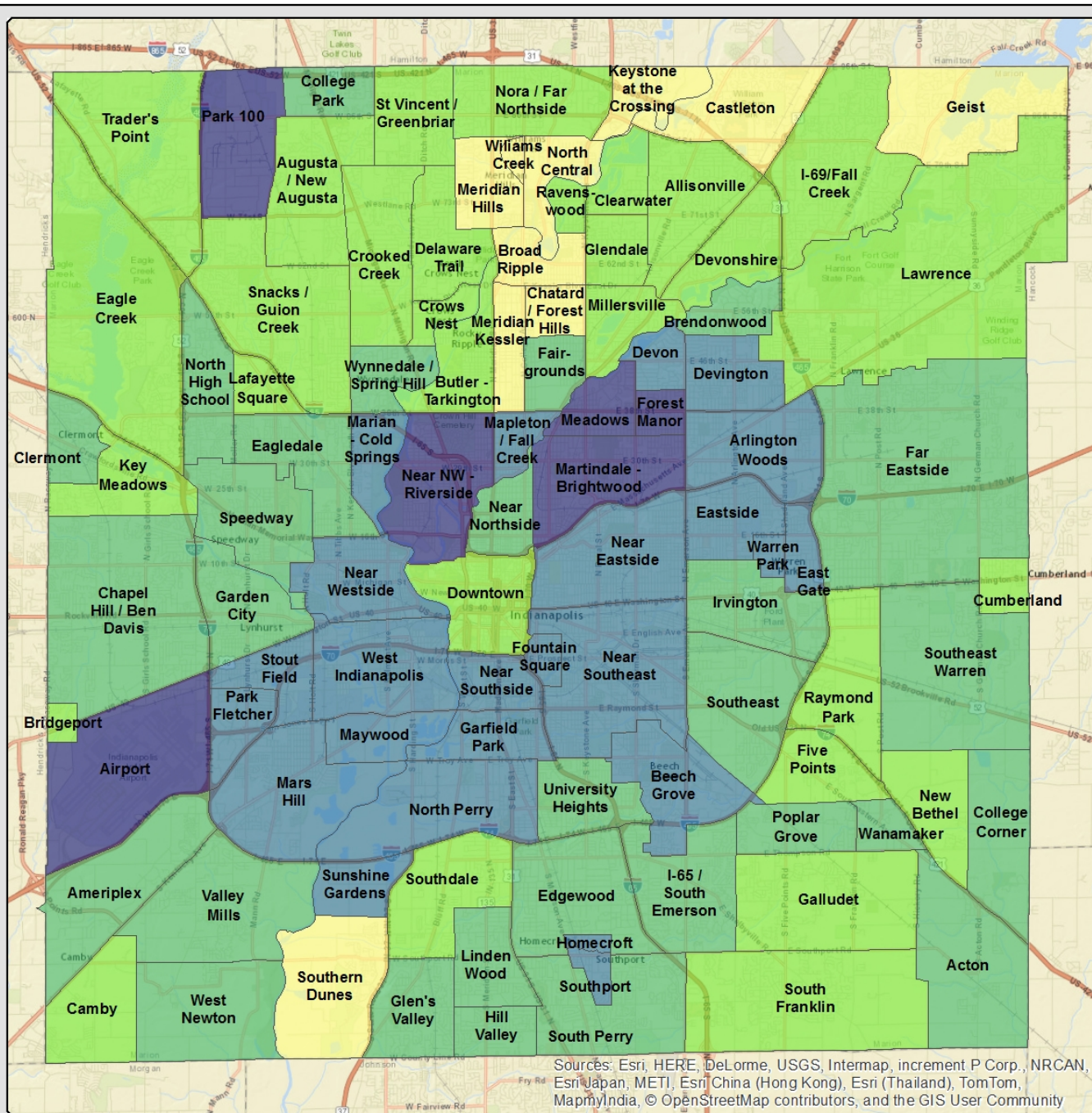
0 2.25 4.5



Miles

Map created 11/7/2014
by The Polis Center at IUPUI

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Successful Strategies for Innovation in PH Informatics

- Innovation = Feasible + Advance
 - Look at what is feasible given the digital infrastructure in your community
- Identify the biggest pain points
 - Ask providers what irks them
 - Ask PH system leaders what they need
- Don't boil the ocean
 - Start small then incrementally expand

Successful Strategies for Innovation in PH Informatics

- Standards are preferable
 - Select and utilize available, mature standards
 - Avoid creating new ones unless necessary
- Think critically about winners and losers
 - Where there is change, there is cost
- Don't let perfect be the enemy of the good
 - 80% complete can often be good enough

Acknowledgements

- Thank you to my mentors
 - Shaun Grannis, MD
 - Joe Gibson, PhD
- These organizations fund my work
 - U.S. Agency for Healthcare Research and Quality
 - Robert Wood Johnson Foundation
 - U.S. Centers for Disease Control and Prevention
 - Merck-Regenstrief Program
 - Indiana State Department of Health
 - U.S. Department of Veterans Affairs

Questions?

Answers

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Research Scientist, Regenstrief Institute;
Health Research Scientist, Department of Veterans Affairs

<http://tinyurl.com/fsphbed>

Twitter: @dpugrad01