

Futures of health IT: Vignettes from the Regenstrief Institute

Titus Schleyer, DMD, PhD, FACMI

Shaun Grannis, MD, MS, FACMI

The vignettes

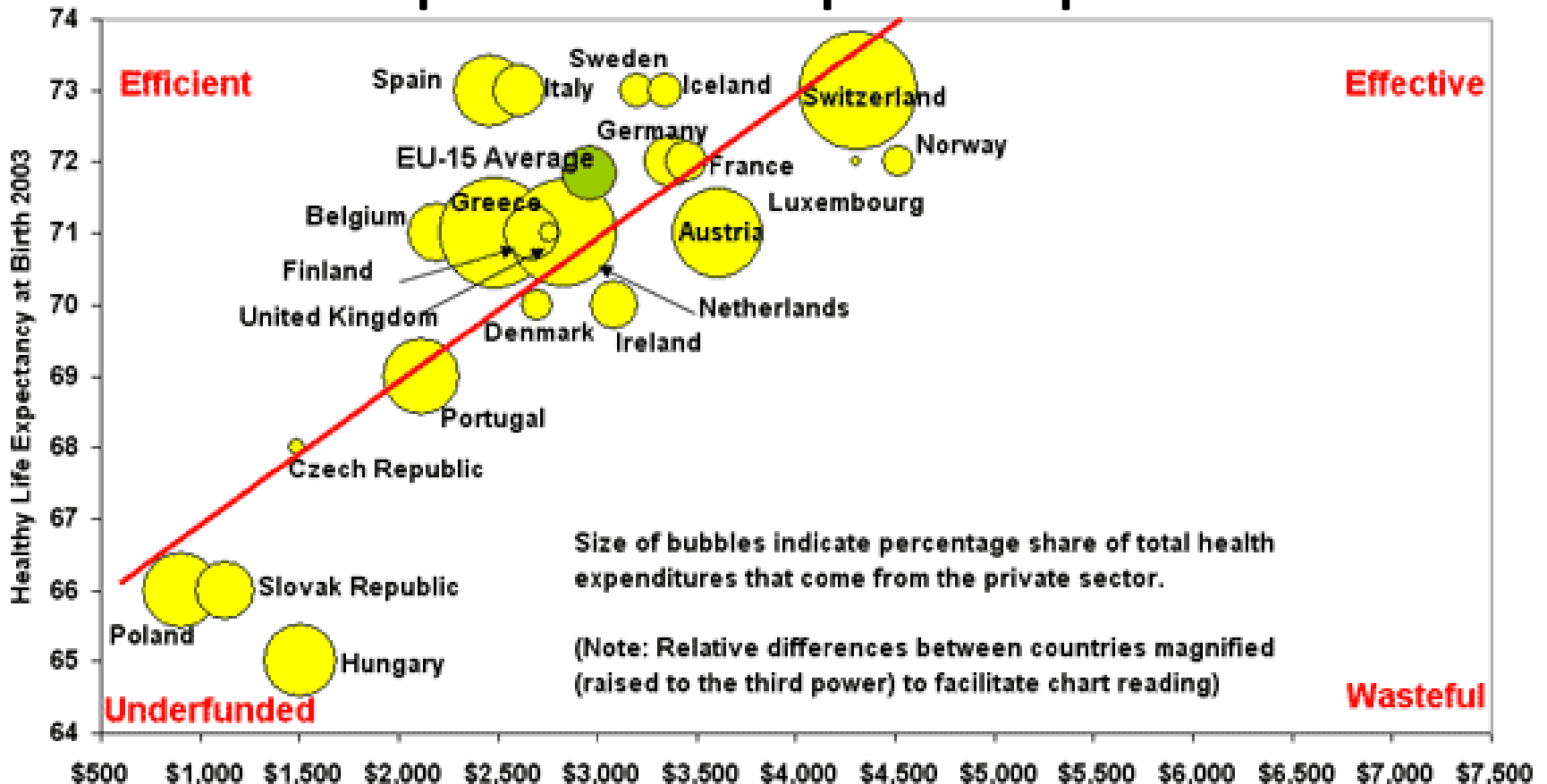
- Addressing infant mortality
- Identifying (maternal) smoking status in electronic health records
- Monitoring and addressing obesity trends
- Combating opioid/prescription drug abuse with data analytics
- Integrating data across health IT systems:
Patient-facing medication reconciliation

National health outcomes: A reflection of our local environment

- Inefficient Care
- Suboptimal Outcomes

- Identify and Act

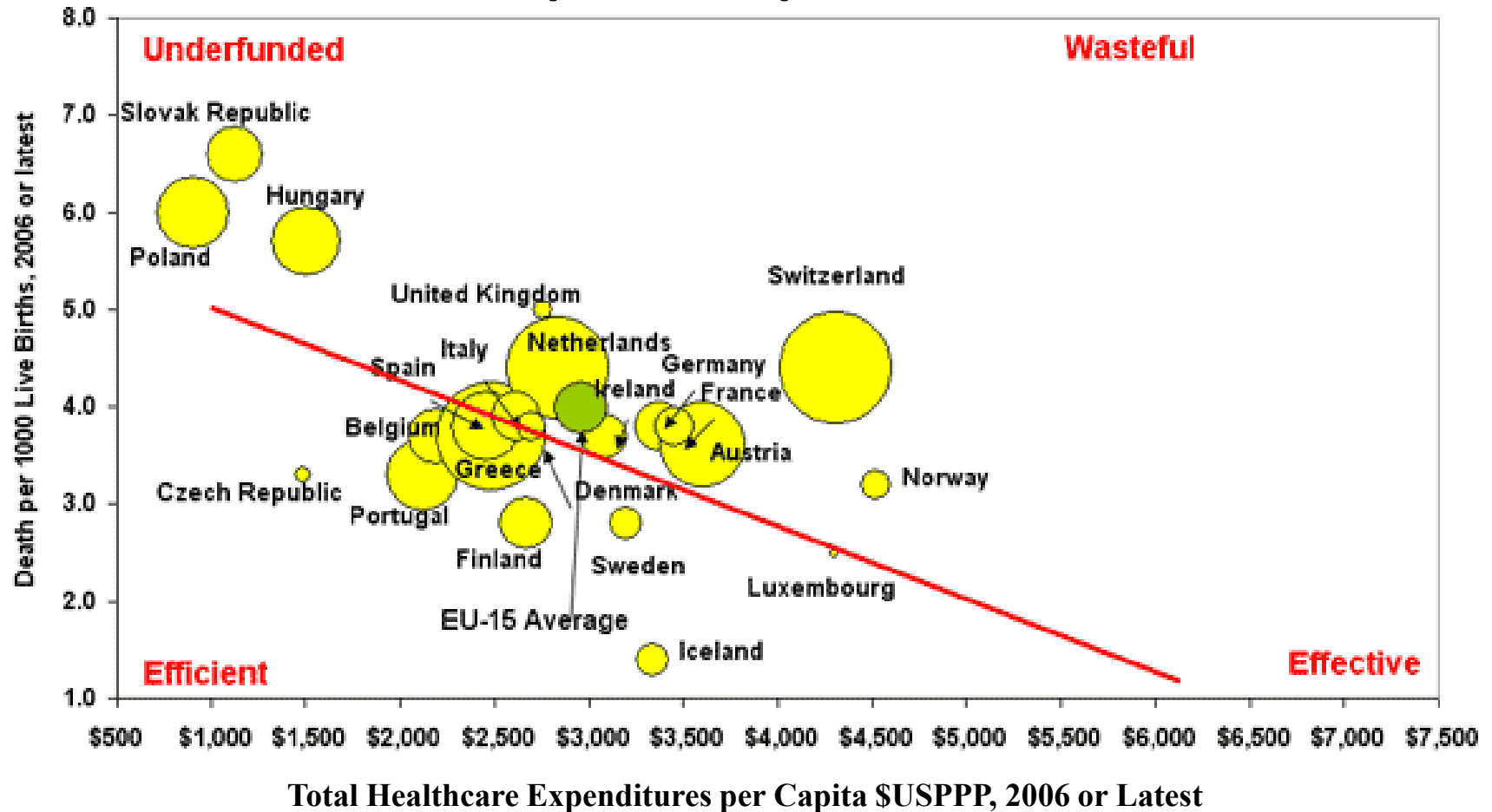
Healthy Life Expectancy versus Expenditure per capita



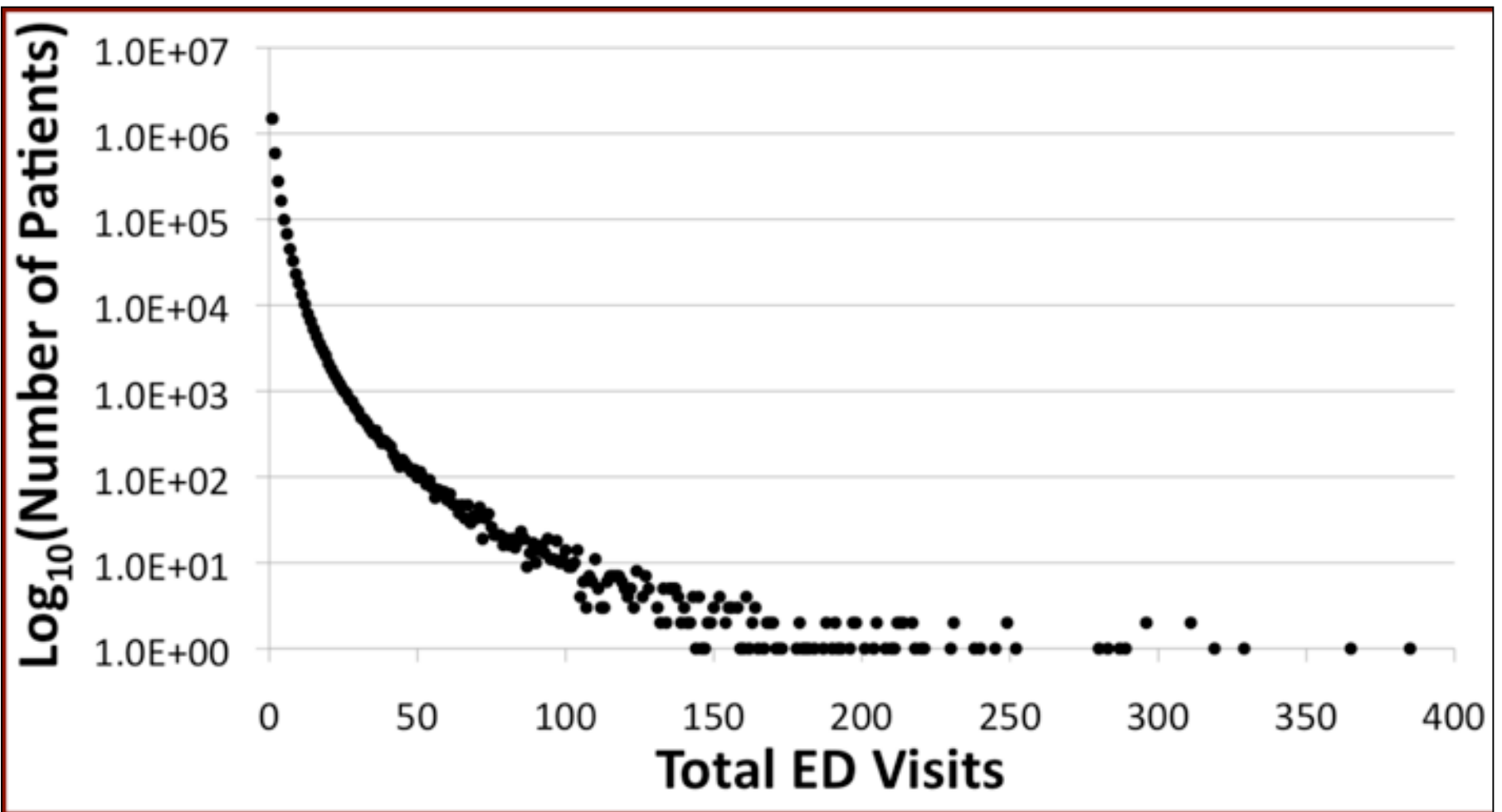
Total Healthcare Expenditures per Capita \$USPPP, 2006 or Latest

Source: OECD Health Database, June 2008 version; WHO World Health Data 2008; EU-15 average is the GDP weighted average

Infant mortality versus expenditure per capita



Source: OECD Health Database, June 2008 version; WHO World Health Data 2008; EU-15 average is the GDP weighted average

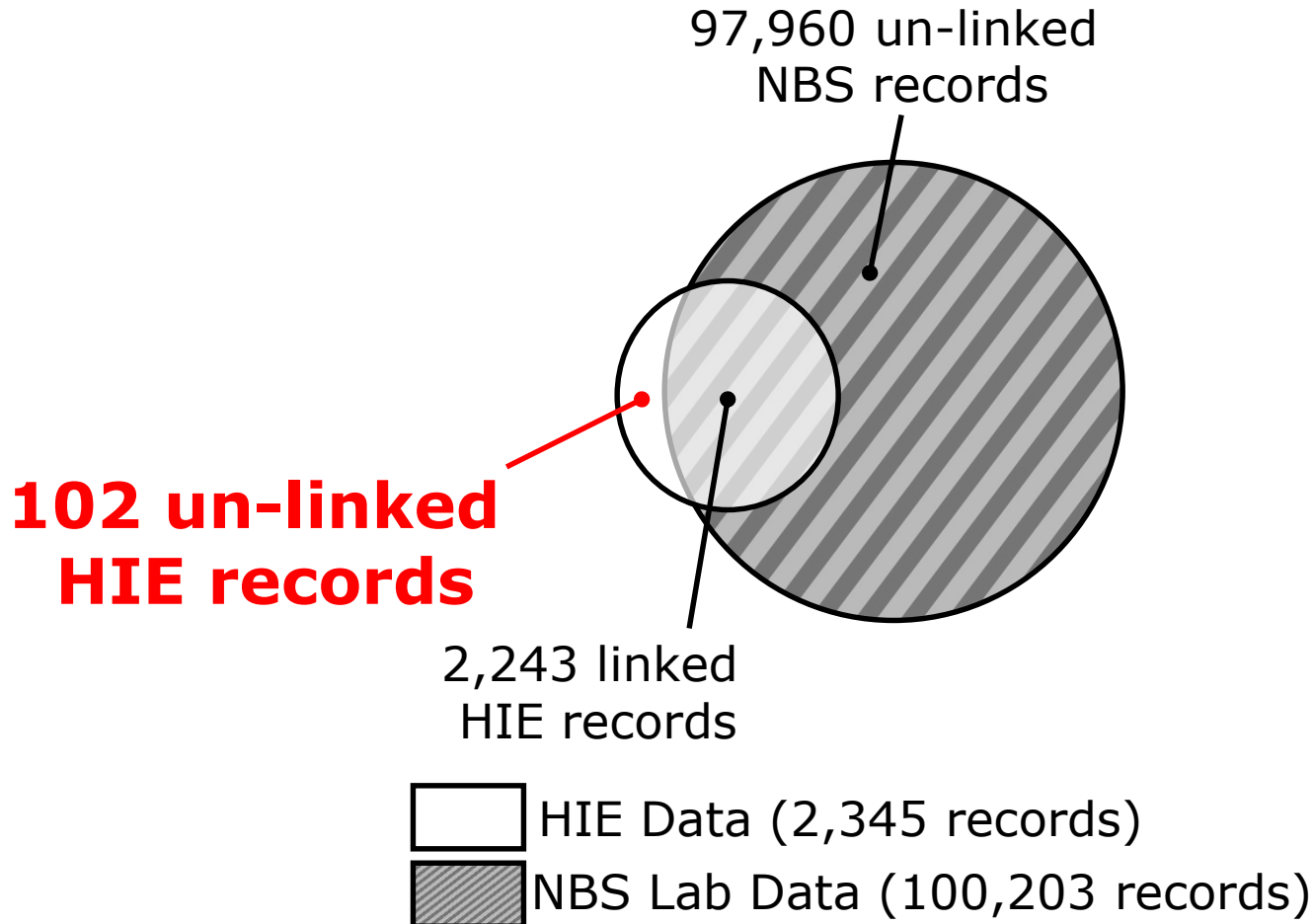


Distribution of patients stratified by the total number of ED visits. Note that six patients visited the ED more than 300 times and a single patient accumulated 385 visits for the 3-year study period.

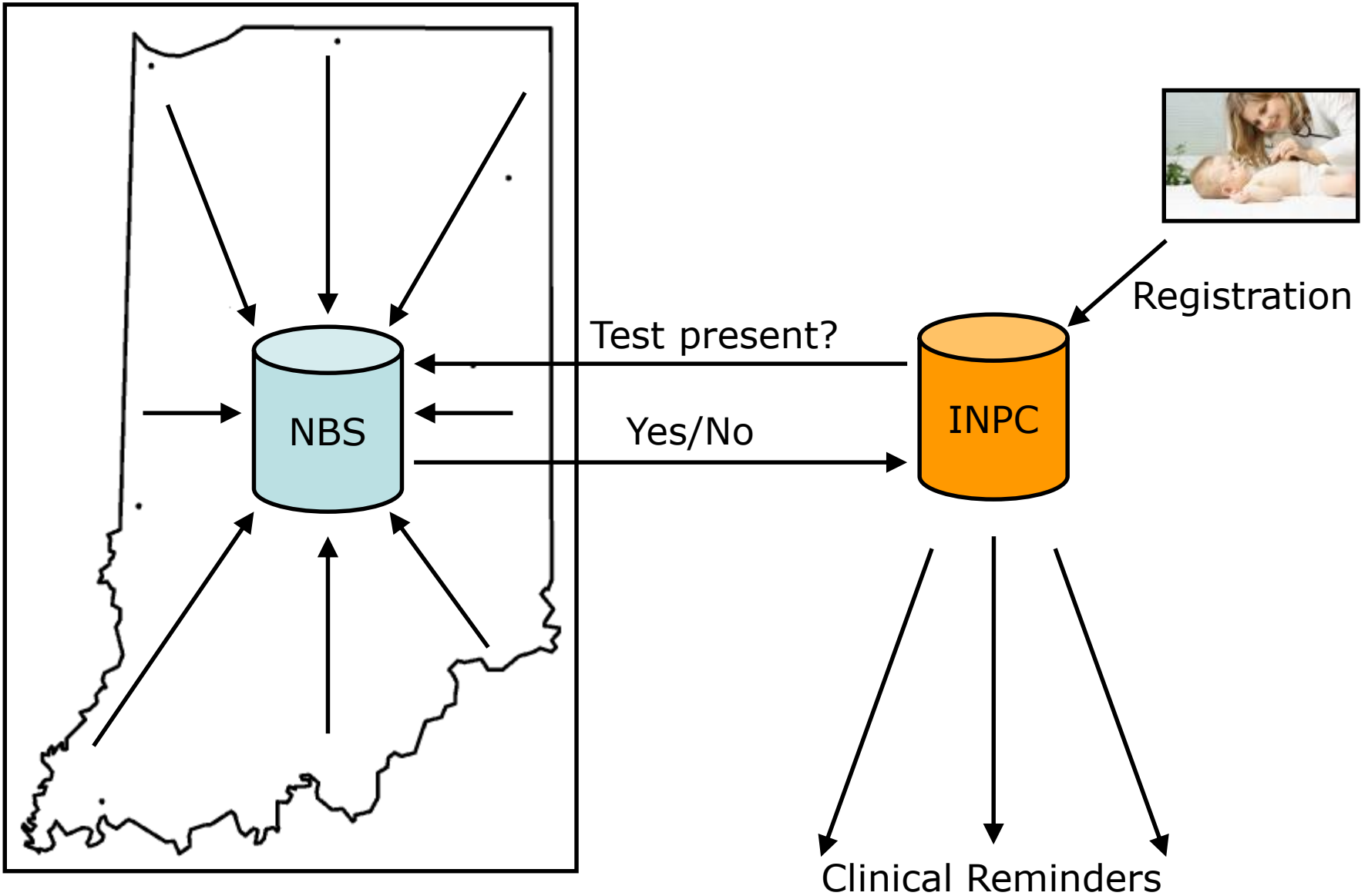
Newborn screening: The challenge

- Not all infants are appropriately screened for harmful or potentially fatal disorders that are otherwise unapparent at birth.
- Although PH can link vital records data with newborn screening results to identify unscreened infants, such processes may be delayed and some cases may remain undetected by this process .

Newborn screening



Grannis S, Biondich P, Downs S, Shelley M, Anand V, Egg J. Leveraging Open-Source Matching Tools and Health Information Exchange to Improve Newborn Screening Follow-up. Public Health Information Network Annu Symp Proc. Atlanta, GA; 2008.



Maternal smoking among hoosiers

- Approximately 17 percent (16.5%) of pregnant women in Indiana smoke.
- This is nearly twice the national average (9.1%), making Indiana one of the highest among all US states.

Cost of maternal smoking:

Health impact

- Maternal smoking is associated with increased risk for:
 - preterm birth
 - low birth weight
 - birth defects
 - sudden infant death
 - increased risk for children smoking as adults
 - increased risk for NICU admission

Adams EK, Miller VP, Ernst C, Nishimura BK, Melvin C, Merritt R. Neonatal health care costs related to smoking during pregnancy. *Health Econ.* 2002 Apr 11(3):193-206.

Ncube CN, Mueller BA. Daughters of Mothers Who Smoke: A Population-based Cohort Study of Maternal Prenatal Tobacco use and Subsequent Prenatal Smoking in Offspring. *Paediatr Perinat Epidemiol.* 2017 Jan;31(1):14-20.

Cost of maternal smoking: Indiana economic impact

- Total cost: ~\$3.3B
- Healthcare cost: ~\$1.8B
- Lost productivity: ~\$300M
- Lost productivity due to mortality: ~\$1.2B

Max W, Sung HY, Shi Y, Stark B. The Cost of Smoking in California. *Nicotine Tob Res.* 2016 May;18(5):1222-9. Population-adjusted results for Indiana.

Identify and assist maternal smokers

- Implement machine learning methods to identify woman at risk for smoking during pregnancy
- Enroll those at risk in cessation support programs

Cost of obesity: Economic impact

- \$190.2 billion or nearly 21% of annual medical spending in the United States.¹
- Childhood obesity accounts for \$14 billion in direct medical costs.
- Obesity-related medical costs are expected to rise significantly, because today's obese children are likely to become tomorrow's obese adults.^{2,3}
- If obesity rates were to suddenly stabilize, the projected savings for medical expenditures would be \$549.5 billion over the next two decades.⁴

1. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. *Journal of Health Economics*. 31(1):219-230. 2012.

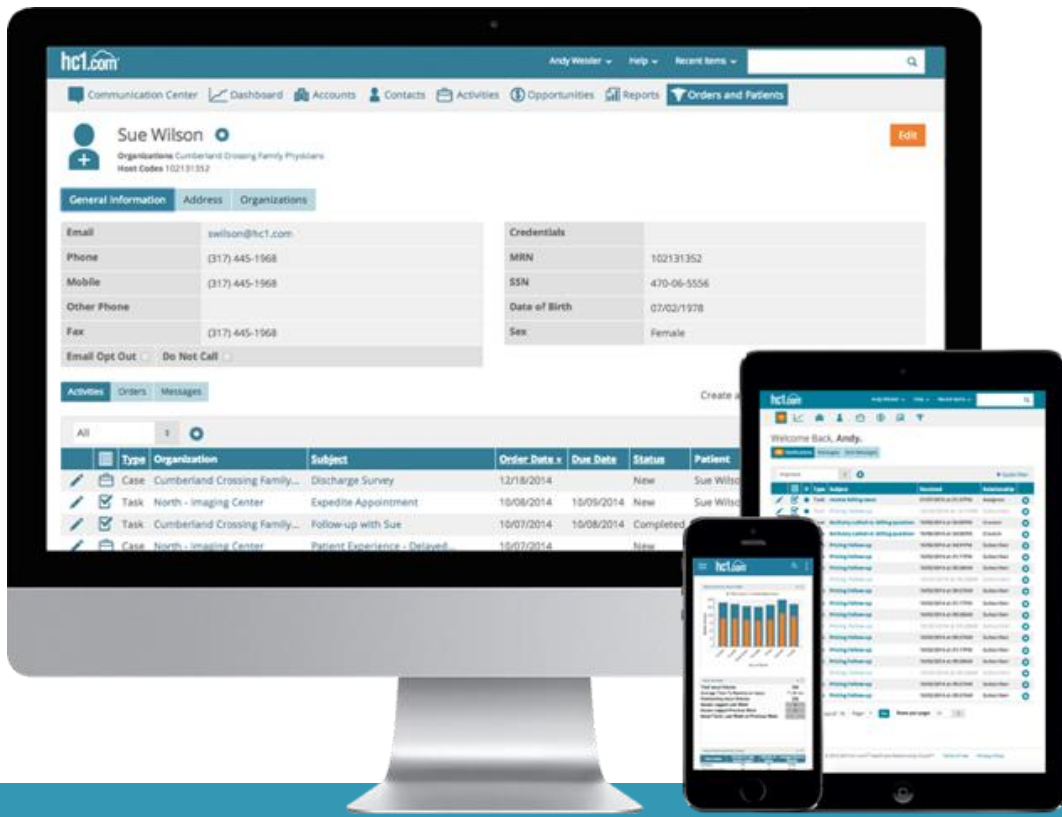
2. Marder W and Chang S. Childhood Obesity: Costs, Treatment Patterns, Disparities in Care, and Prevalent Medical Conditions. Thomson Medstat Research Brief, 2006. www.medstat.com/pdfs/childhood_obesity.pdf (accessed May 2009).

3. Wang LY, Chyen D, Lee S, et al. "The Association Between Body Mass Index in Adolescence and Obesity in Adulthood." *Journal of Adolescent Health*, 42(5): 512–518, 2008.

4 Finkelstein et al. Obesity and Severe Obesity Forecasts Through 2030: *Am J Prev Med* 2012; 42(6): 563-570.

Identify patients at risk for obesity

- Treating obesity is challenging.
- Can we predict and prevent?



Combatting opioid/prescription drug abuse
with data analytics

The US is suffering from an unprecedented prescription drug/opioid abuse epidemic.

- drug overdose (OD) death rates x5 since 1980
- OD deaths > motor vehicle deaths since 2009
- 2011: 1.4m ED visits due to drug mis-/abuse
- Indiana
 - 2015: 595 OD deaths
 - 2014: 2,822 people visited ED for OD
 - Indiana Prescription Drug Monitoring Program (INSPECT)
 - 2016: Indiana Commission to Combat Drug Abuse

- Drug abuse is a multifaceted problem without an easy solution.
- One significant challenge: Information that is:
 - fragmented (healthcare system, social services, police, etc.)
 - siloes (not easily connected)
 - difficult to interpret and navigate
- One potential solution: data integration and analytics

Toxicology Insights

What are the key toxicology highlights by drug, geography, test volume and positivity rate?

Provider Profiles

Are we profiling our targets correctly and what can we learn from prescribing and plan trends that can serve us to better profile?

Patient Profiles

What is the composition of the patient population that we are targeting?

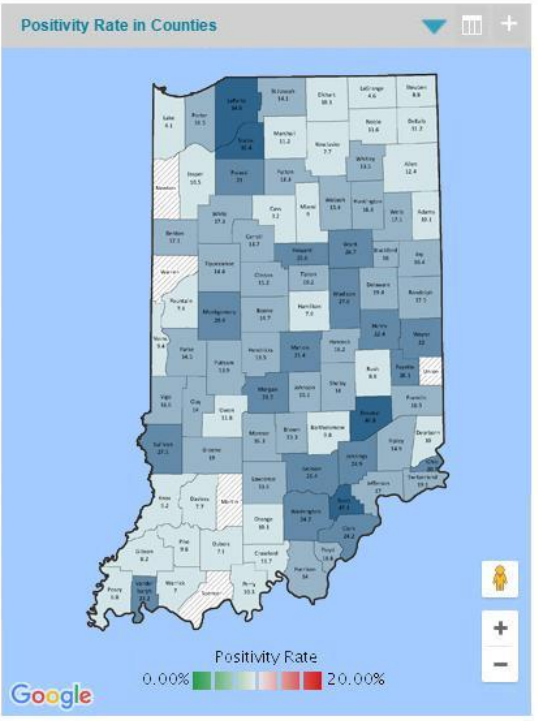
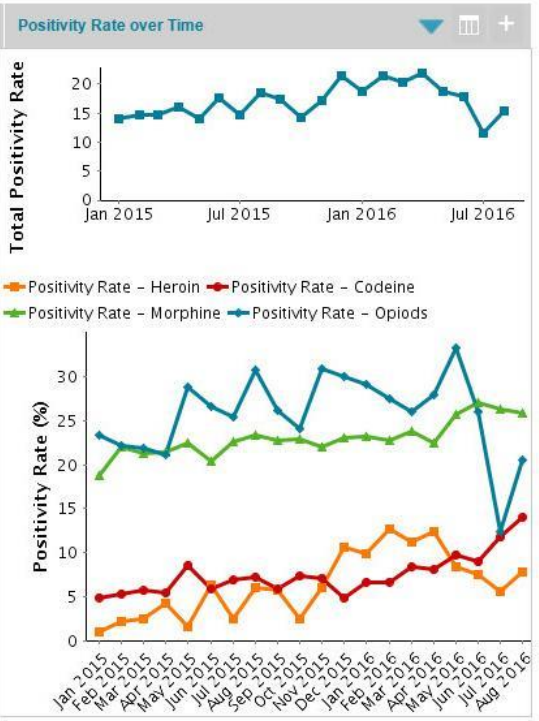
Prescription Insights

What are the prescribing trends for our providers?

Summary Metrics

Universe: [State] Tox Lab Data

137,179 Patients
 182,743 Lab Orders
 791,731 Total Results
 17.45% Positivity Rate



Filters

Result Date: 01 / 01 / 2015 To: 02 / 14 / 2017

Test:

- Buprenorphine
- Cocaine
- Codeine
- Fentanyl
- Heroin
- Hydrocodone
- Methadone
- Morphine
- Naloxone
- Norbuprenorphine
- Opiod
- Oxycodone

 Select: All | None

Patient Gender:

- Female
- Male
- Unknown

 Select: All | None

Patient Age:

- 0-20
- 21-40
- 41-60
- 61-80
- 81-100
- > 100

 Select: All | None

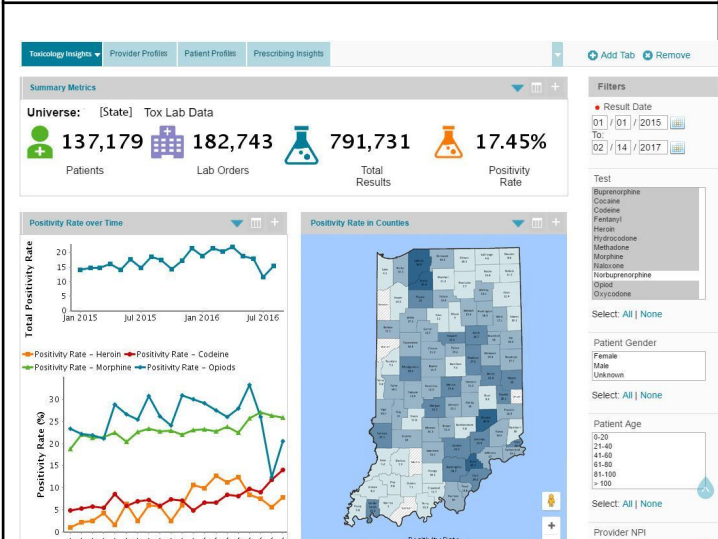
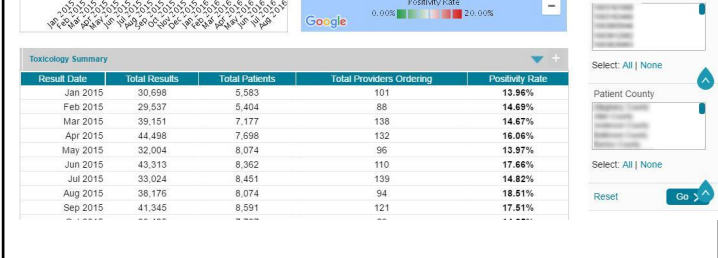
Provider NPI: [Input field]

Patient County: [Input field]

Reset Go >

Toxicology Summary

Result Date	Total Results	Total Patients	Total Providers Ordering	Positivity Rate
Jan 2015	30,698	5,583	101	13.96%
Feb 2015	29,537	5,404	88	14.69%
Mar 2015	39,151	7,177	138	14.67%
Apr 2015	44,498	7,698	132	16.06%
May 2015	32,004	8,074	96	13.97%
Jun 2015	43,313	8,362	110	17.66%
Jul 2015	33,024	8,451	139	14.82%
Aug 2015	38,176	8,074	94	18.51%
Sep 2015	41,345	8,591	121	17.51%

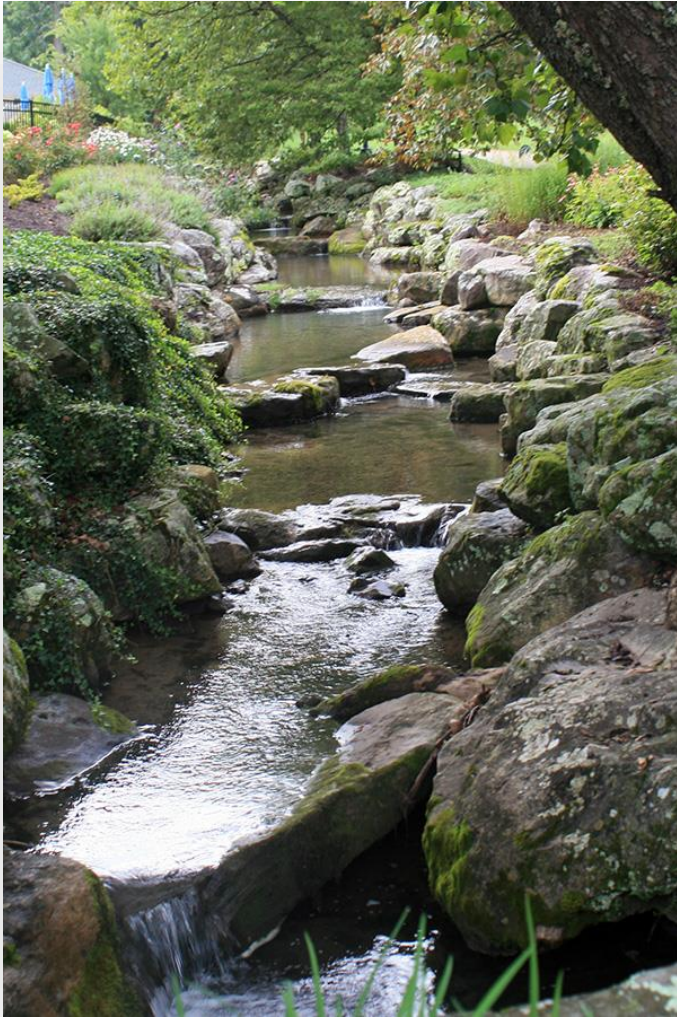
Dashboard	Report	Question	Limitation																																																		
<p>Toxicology Insights</p> <p>Universe: hc1 Tox Lab data for [state]</p>		<p>What are the key toxicology highlights by drug, geography, test volume and positivity rate?</p>	<p>Tested population composition is different from the overall composition of the population, so positivity rate should be viewed as a baseline not an absolute number.</p>																																																		
 <p>The dashboard displays the following summary metrics:</p> <ul style="list-style-type: none"> Universe: [State] Tox Lab Data Patients: 137,179 Lab Orders: 182,743 Total Results: 791,731 Positivity Rate: 17.45% <p>Key features include:</p> <ul style="list-style-type: none"> Filters: Result Date (01/01/2015 to 02/14/2017), Test (Buprenorphine, Cocaine, Codeine, Fentanyl, Heroin, Hydrocodone, Methadone, Morphine, Naloxone, Nalbuphine, Oxycodone, Zolpidem), Patient Gender (Female, Male, Unknown), Patient Age (0-20, 21-40, 41-60, 61-80, 81-100, >100), Provider NPI, Patient County. Charts: <ul style="list-style-type: none"> Positivity Rate over Time: Line chart showing trends from Jan 2015 to Jul 2016. Positivity Rate by Key Drug: Line chart showing rates for Heroin, Codeine, Morphine, and Opioids. Positivity Rate in Counties: Map of the state showing regional distribution. Toxicology Summary Table: <table border="1" data-bbox="79 1082 629 1249"> <thead> <tr> <th>Result Date</th> <th>Total Results</th> <th>Total Patients</th> <th>Total Providers Ordering</th> <th>Positivity Rate</th> </tr> </thead> <tbody> <tr><td>Jan 2015</td><td>30,698</td><td>5,593</td><td>101</td><td>13.96%</td></tr> <tr><td>Feb 2015</td><td>29,537</td><td>5,404</td><td>88</td><td>14.69%</td></tr> <tr><td>Mar 2015</td><td>39,151</td><td>7,177</td><td>138</td><td>14.67%</td></tr> <tr><td>Apr 2015</td><td>44,498</td><td>7,698</td><td>132</td><td>16.06%</td></tr> <tr><td>May 2015</td><td>32,004</td><td>8,074</td><td>96</td><td>13.97%</td></tr> <tr><td>Jun 2015</td><td>43,313</td><td>8,362</td><td>110</td><td>17.66%</td></tr> <tr><td>Jul 2015</td><td>33,024</td><td>8,451</td><td>139</td><td>14.82%</td></tr> <tr><td>Aug 2015</td><td>38,176</td><td>8,074</td><td>94</td><td>18.51%</td></tr> <tr><td>Sep 2015</td><td>41,345</td><td>8,591</td><td>121</td><td>17.51%</td></tr> </tbody> </table> 	Result Date	Total Results	Total Patients	Total Providers Ordering	Positivity Rate	Jan 2015	30,698	5,593	101	13.96%	Feb 2015	29,537	5,404	88	14.69%	Mar 2015	39,151	7,177	138	14.67%	Apr 2015	44,498	7,698	132	16.06%	May 2015	32,004	8,074	96	13.97%	Jun 2015	43,313	8,362	110	17.66%	Jul 2015	33,024	8,451	139	14.82%	Aug 2015	38,176	8,074	94	18.51%	Sep 2015	41,345	8,591	121	17.51%	<p>Patients, Lab Orders, Total Results, Positivity Rate</p>	<p>What is the composition of the test population?</p>	
Result Date	Total Results	Total Patients	Total Providers Ordering	Positivity Rate																																																	
Jan 2015	30,698	5,593	101	13.96%																																																	
Feb 2015	29,537	5,404	88	14.69%																																																	
Mar 2015	39,151	7,177	138	14.67%																																																	
Apr 2015	44,498	7,698	132	16.06%																																																	
May 2015	32,004	8,074	96	13.97%																																																	
Jun 2015	43,313	8,362	110	17.66%																																																	
Jul 2015	33,024	8,451	139	14.82%																																																	
Aug 2015	38,176	8,074	94	18.51%																																																	
Sep 2015	41,345	8,591	121	17.51%																																																	
	<p>Positivity Rate by Key Drug</p>	<p>What changes if any have there been in positivity rate overtime by top abused drugs?</p>																																																			
	<p>Total Positivity Rate</p>	<p>What changes if any have there been in total positivity rate overtime for drugs of abuse?</p>																																																			
	<p>Positivity Rate by County</p>	<p>Is there a different in positivity rate distribution across counties?</p>																																																			
 <p>The Toxicology Summary table provides a detailed view of the data over time, including result dates, total results, total patients, total providers ordering, and the corresponding positivity rate.</p>	<p>Toxicology Summary Table (results, patients, providers ordering, positivity rate)</p>	<p>What is the volume in terms of patients, tests and results?</p>																																																			

- “You can’t manage what you can’t measure.”
- analytics dashboards a useful tool to generate insights
- Can intervene at several levels:
 - geographic
 - pharmacy benefit plan
 - physician
 - patient
- Tool for interventions: *Healthcare Relationship Management Platform*

Integrating data across health IT systems: Patient-facing medication reconciliation



The why



Omni Homestead, VA, © T. Schleyer, 2016

Health information
should flow like water ...
... fast, slow, around
obstacles ...
... but, ultimately,
unimpeded.

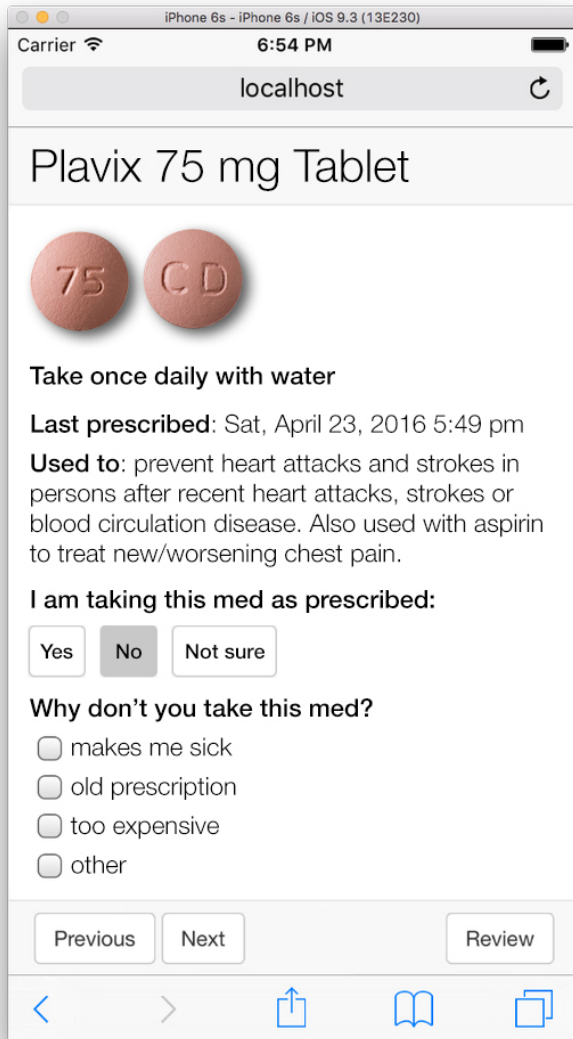
Where does information not flow like water?



© Wade Tregaskis, Flickr, 2016

- between healthcare systems
- within healthcare systems
- between care settings (eg ED ↔ primary care)
- ... pretty much everywhere ☹️

Our use case

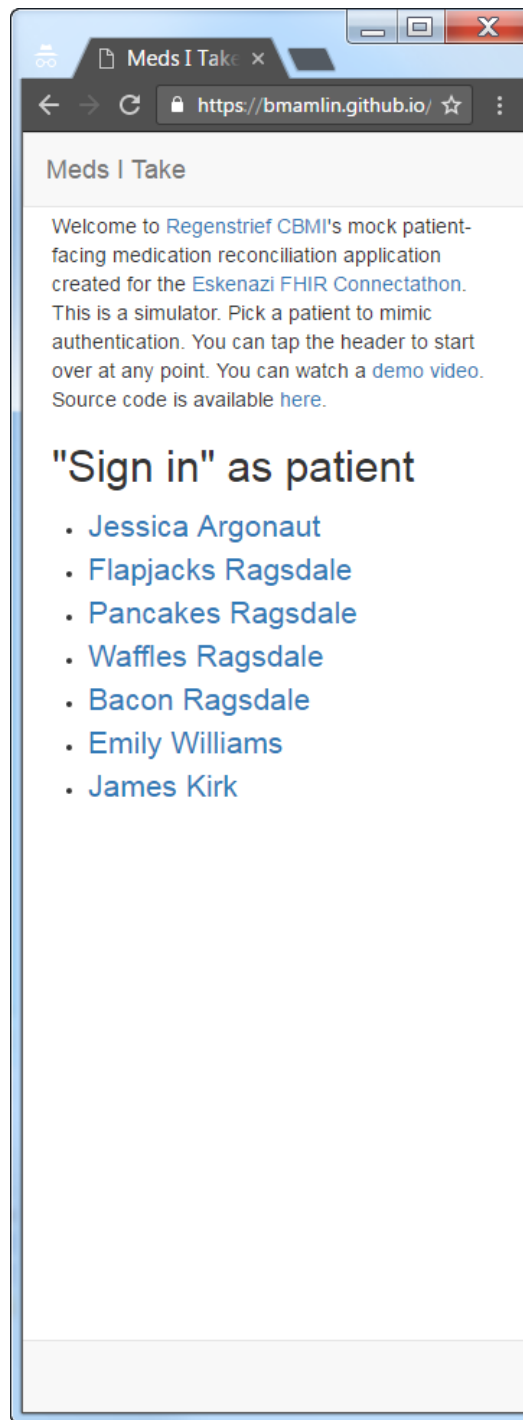


help patients create a unified, current medication list from multiple lists spread across several health IT systems

Demo time!



<https://github.com/bmamlin/org.regenstrief.fhirmedlistweb>



Meds I Take

Welcome to Regenstrief CBMI's mock patient-facing medication reconciliation application created for the [Eskenazi FHIR Connectathon](#). This is a simulator. Pick a patient to mimic authentication. You can tap the header to start over at any point. You can watch a [demo video](#). Source code is available [here](#).

"Sign in" as patient

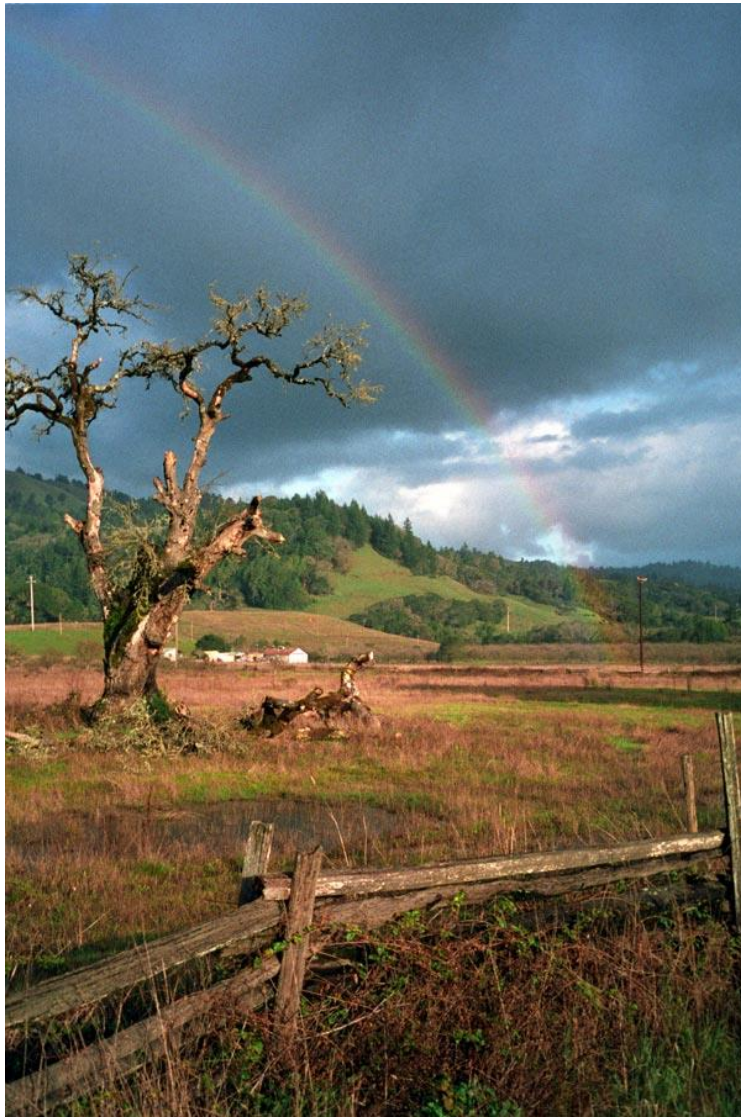
- [Jessica Argonaut](#)
- [Flapjacks Ragsdale](#)
- [Pancakes Ragsdale](#)
- [Waffles Ragsdale](#)
- [Bacon Ragsdale](#)
- [Emily Williams](#)
- [James Kirk](#)

What is the magic here?

- medications: 2  FHIR[®] instances
 - Epic (at Eskenazi Health)
 - INPC (at Regenstrief)
- medication images: 
- indications: 

FHIR on the INPC

- FHIR access layer on top of IHE data repository
- permits
 - standardized way to request and receive clinical data
 - fine-grained data access (ask for only what you need)
- accessible to any FHIR-based application



Anderson Valley, California, © T. Schleyer, 2016

FHIR-on-INPC: The vision

- seamless interoperability among health IT systems (within limits)
- use cases:
 - individual patient
 - quality measures
 - population health analytics
- increased innovative capacity
- “innovation ecology”

A sunset over a body of water. The sun is low on the horizon, partially obscured by a layer of clouds. The sky is filled with soft, golden light, and the water reflects the sun's glow. In the foreground, a dark, silhouetted landmass or island is visible, extending into the water. The overall mood is peaceful and serene.

Thank you! Questions, comments?



Regenstrief Institute



@titusschleyer, @RCBMI



schleyer@regenstrief.org

This talk:

