

Discovering connections among 5 billion health data points, starting with two

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Two data points



Hunting
Food
Gardening



Network science?



Pathways to Health,
Disease, and Health
Care



The Indiana Network for Patient Care (INPC)

first and foremost: an operational community wide electronic medical record

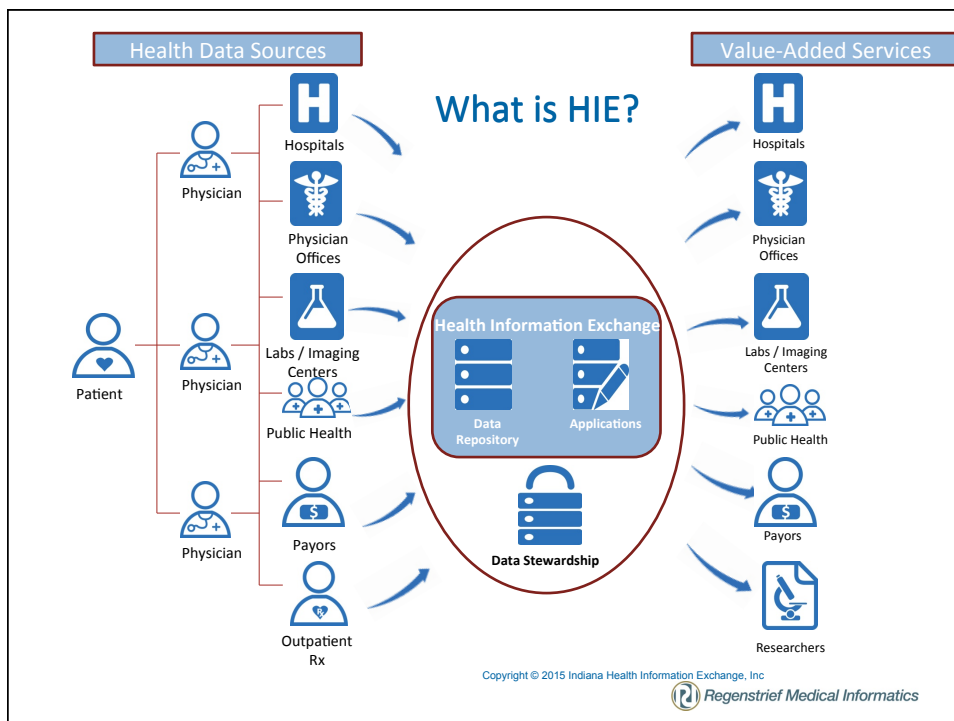
- established in 1988
- developed by Regenstrief, now maintained by the Indiana Health Information Exchange (IHIE)
- clinical data from over 100 hospitals, the state and local public health departments, labs, etc.
- uniquely valuable for observational research

INPC Stakeholders

- >13m patients
- >25,000 clinicians at:
 - Indianapolis med/surg hospitals
 - physician offices
 - community health centers
 - homeless care network
 - public school clinics
- county and state public health departments
- national laboratories
- pharmacies
- Pharmacy benefit managers

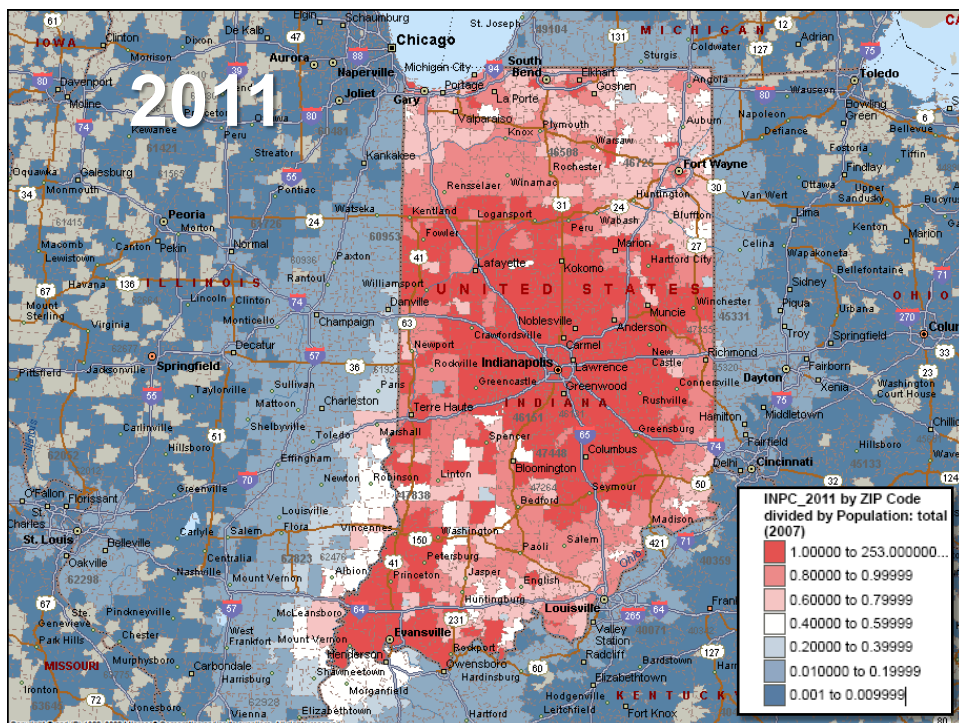
The INPC by the numbers

- > 13m unique patients
- 27.5m registration events
- > 4b discrete results
 - > 1.7b clinical observations
 - > 840m encounter events
 - > 580m claims observations (procedures, prescriptions, etc.)
- 118m text reports
- > 2.5m emergency department visits per year from over 100 Indiana hospitals
- > 2m new transactions processed per day



Classes of data shared by institutions

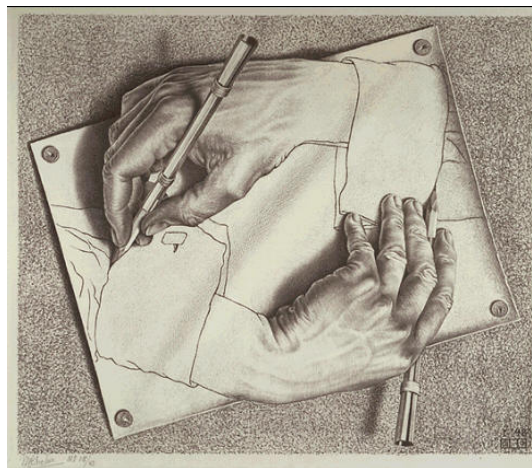
- ED and outpatient visits
- hospital discharges (dx, procedures)
- inpatient laboratory results
- outpatient laboratory results
- Immunizations
- discharge summaries/admissions summaries
- operative notes
- radiology reports
- surgical pathology reports
- Inpatient medications
- tumor registry data



Limitations of INPC and observational data

- Primary purpose is clinical use, NOT research.
- Data is only as good as what is sent; depth of what is sent varies by institution.
- no “enrollment period.”
- Patient matching across institutions is conservative, errs on the side of not matching patient records.

What can we learn from big data in healthcare?



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Can antibiotics kill?

Patients having heart disease or at high risk for it have a slightly higher chance of sudden death when taking azithromycin.

What are the benefits of taking Lasix in patients with chronic heart failure/high BP?

For every 10% increase in medication adherence:

- ED visits ↓ 11%
- hospital admissions ↓ 5%
- length of hospital stay ↓ 1%
- all-cause mortality ↓ 9% (CHF)

Can Vioxx cause heart attacks?

Yes.

It is estimated that Vioxx caused 88,000 and 140,000 episodes of myocardial infarction before its recall.

Can inhaled steroids cause gastrointestinal (GI) problems?

- **Inhaled** steroids are highly effective for treating asthma.
- **Oral** steroids are associated with ulcers and bleeding.
- INPC data (1977-2002) were used to compare 7156 patients taking steroid+albuterol to 12,287 patients on albuterol alone.

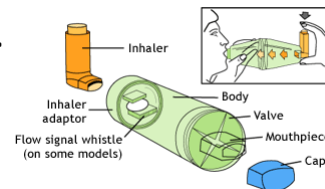
Can inhaled steroids cause GI problems?

Yes:

- Patients on steroids had more gastrointestinal ulcers, perforations or bleeding.
- Risk is increased by 1.26 times after accounting for other factors.

But:

- Use of a spacer in the inhaler greatly reduces the risk.

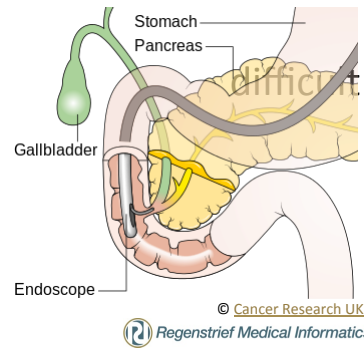


Looking for a doc to perform a procedure?

- For a variety of medical procedures, there is an inverse relationship between provider or facility volume, and good outcomes.
- Minimum volume standards have been established for coronary bypass but not for other high-risk procedures.

Looking for a doc to perform a procedure?

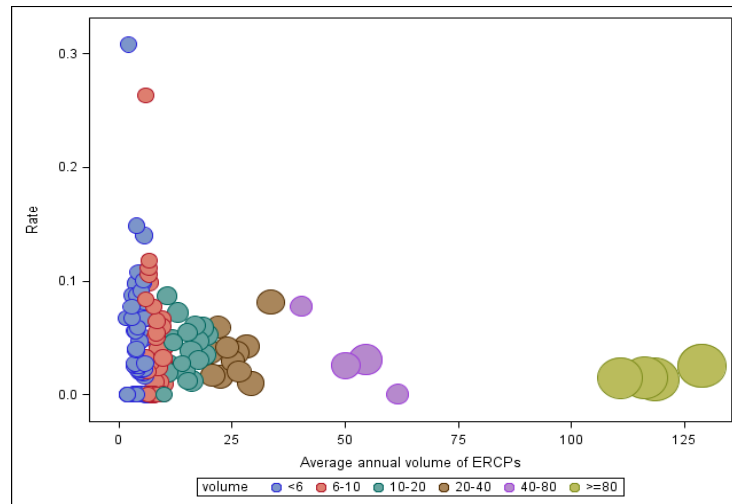
- ERCP (Endoscopic retrograde cholangiopancreatography) combines endoscopy and fluoroscopy to diagnose and treat problems of the bile duct or main pancreatic duct, e.g. gallstones, scars, leaks, cancer.
- ERCP is technically and invasive.



Looking for a doc to perform a procedure?

- data: 15,514 payer claims for ERCP procedures performed by 130 providers in INPC 2001 - 2011
- treatment failure: having a repeat ERCP, PTC or surgery with exploration of the biliary tree, within 7 days

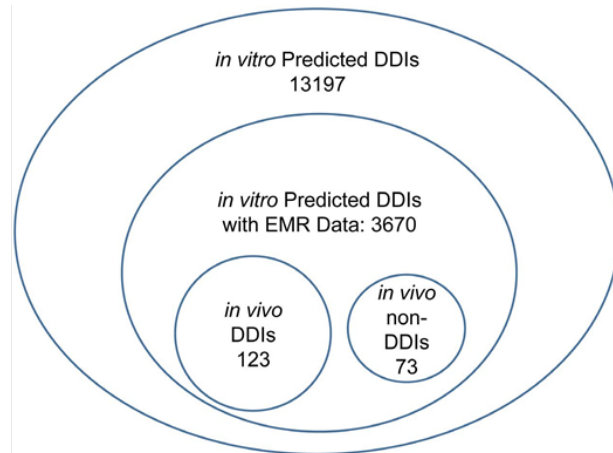
ERCP failure rate vs. provider volume



Discovering novel drug-drug interactions

- DDIs are a common cause of adverse drug events.
- Study identified pairs of drugs that, when taken together, led to *myopathy* (muscle disorder).
- started with literature mining for all FDA-approved drugs with known CYP substrates/inhibitors to identify drug pairs
- looked for such pairs in INPC

Discovering novel drug-drug interactions

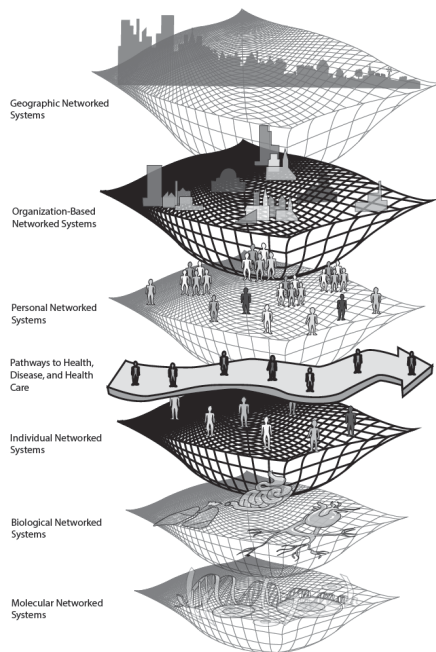


Discovering novel drug-drug interactions

- For each of 123 drug pairs in CDM, we examined whether the risk of myopathy was higher in patients taking the drug pair than the additive risk of two single drugs.
- DDI was identified in 5 drug pairs, 4 of which involved loratadine (Claritin, Alavert).

Three additional useful INPC tools/features

- Common Data Model (CDM)
- Natural Language Processing pipeline
- geocoding



The opportunity:

We have one of
the largest
collections of
rich clinical data
in the US.





What can
network analysis
learn from it?

Thank you for your attention!



Indiana Health Information Exchange



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-  titusschleyer.wordpress.com
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This talk:

