

6.3a Health Information Exchange

10x10 – Introduction to Biomedical Informatics & Artificial Intelligence
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Health information exchange (HIE)

Definitions

Implementations

Implementing HIE

Research results

Trusted exchange

EHR of a single organization is not enough

Patients are “mobile” in many ways – may develop problems away from usual care, need to be referred to other systems, and/or may lose or change insurance

Data bears this out

- In Massachusetts, of 3.69M patients visiting acute care facilities, 31% visited more than one, accounting for 56% of all visits, and 1% visited five or more (Bourgeois, 2010)
- In Indiana, 40% of patients visiting EDs had data at more than one hospital, with network analysis showed all EDs sharing patients (Finnell, 2011)

Also greater need in public health sphere with growing threats of emerging diseases, bioterrorism, and pandemics

Health information exchange (HIE)

“Anytime, anywhere access to clinical information for the care of patients”

- Dr. William Yasnoff, former Sr. Advisor, NHII, 2004

“Data following the patient”

- Dr. Carolyn Clancy, Director, AHRQ, 2007

“Electronic sharing of data among hospitals, physicians, clinical laboratories, radiology centers, pharmacies, health plans (insurers), and public health departments.” (Some may add “patients.”) (GAO, 2010)

Requires that information be interoperable and flow seamlessly across business boundaries (Kuperman, 2011)

Recognized need led to investment under HITECH: \$564 million in grants to states

Tweet from June, 2012

- @Farzad_ONC: HIE is a verb, not a noun

Overview textbook (Dixon, 2022)

Industrywide information sharing and standards are not new

Automated teller machines (ATMs)



Airline reservation systems



Wireless networking and roaming



History and evolution of terminology (Vest, 2010)

Community Health Information Networks (CHINs)

- Conceived in early 1990s, but technology and organizations not ready

National Health Information Infrastructure (NHII) (Detmer, 2003)

- “Set of technologies, standards, applications, systems, values, and laws”

Local Health Information Infrastructures (LHII)s

- “The road to the NHII leads from LHII)s” (Yasnoff, 2004)
- Local governance, national coordination

Regional Health Information Organizations (RHIOs)

- Introduced by Brailer, first ONC Director

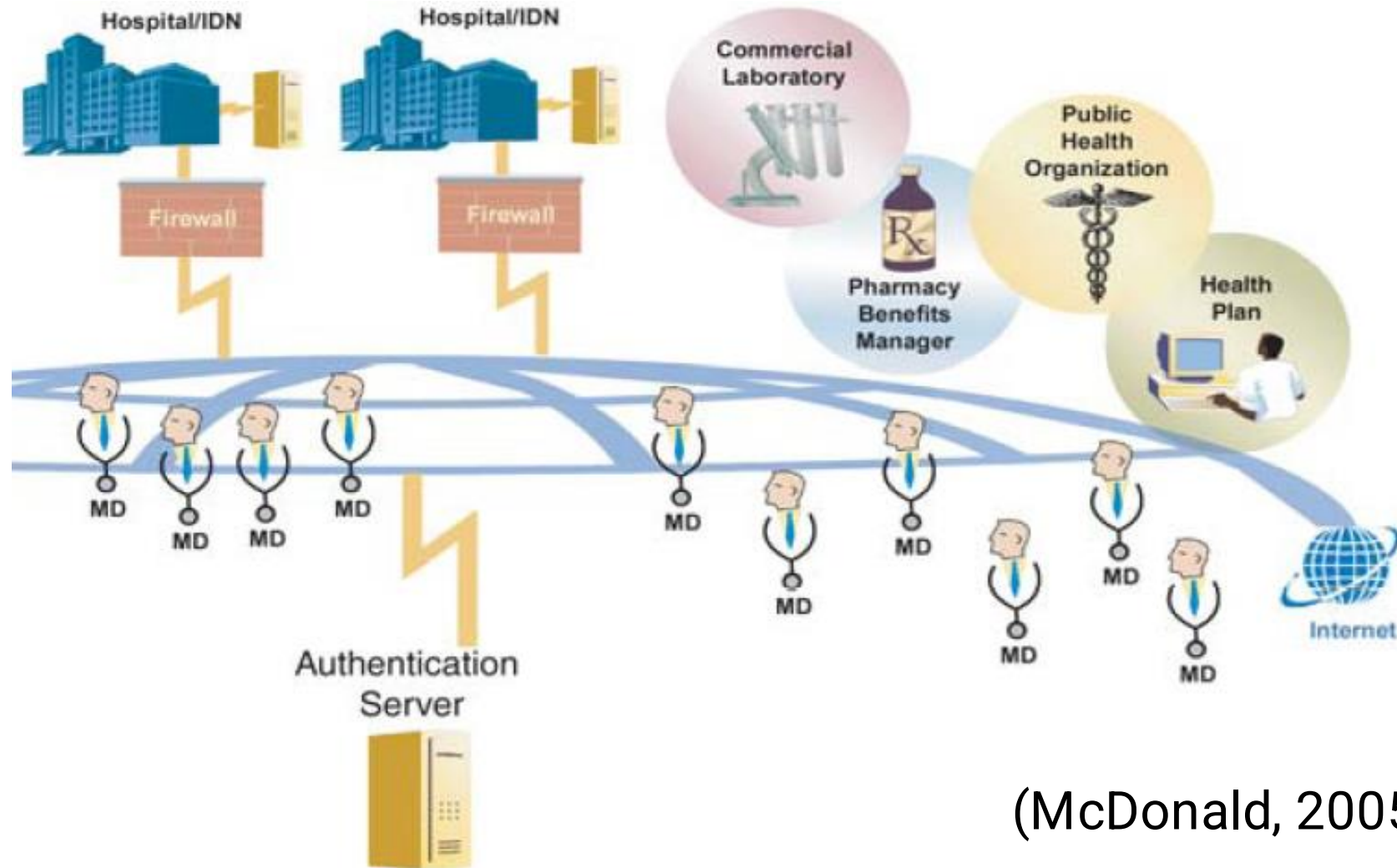
Nationwide Health Information Network (NwHIN, initially NHIN)

- Set of policies, standards, and services that enable the Internet to be used for secure and meaningful exchange of health information
- Name changed to eHealth Exchange, which was joined by non-government members in Healtheway, a non-profit, public-private partnership
- Later subsumed by [Sequoia Project](#), aiming to advance secure, interoperable nationwide HIE

Use cases for HIE (Brailer, 2003)

TO ► FROM ▼	Physicians	Consumers	Hospital	Ancillary Providers	Health Plans	Public Health
Physicians	Referrals and consultations	Findings and treatment advisories	Admission information, reports	Test orders	Authorization, medical necessity, claims	Case reporting
Consumers	Personal health information		Personal health information		Authorization	
Hospital	Reports, results reporting	Personal health records			Authorization, medical necessity, claims	Case reporting
Ancillary Providers	Reports, results reporting	Results reporting	Results reporting			Results reporting
Health Plans	Eligibility, enrollment, formularies		Eligibility, enrollment	Eligibility, enrollment		
Public Plans	Treatment advisories	Treatment advisories	Treatment advisories	Reporting requests		Population reporting

What does/should HIE look like?



(McDonald, 2005)

Types of HIE (Williams, 2012)

Directed – direct sending and receiving of information (“push”)

- e.g., referral, transfer, etc.

Query-based – finding information (“pull”)

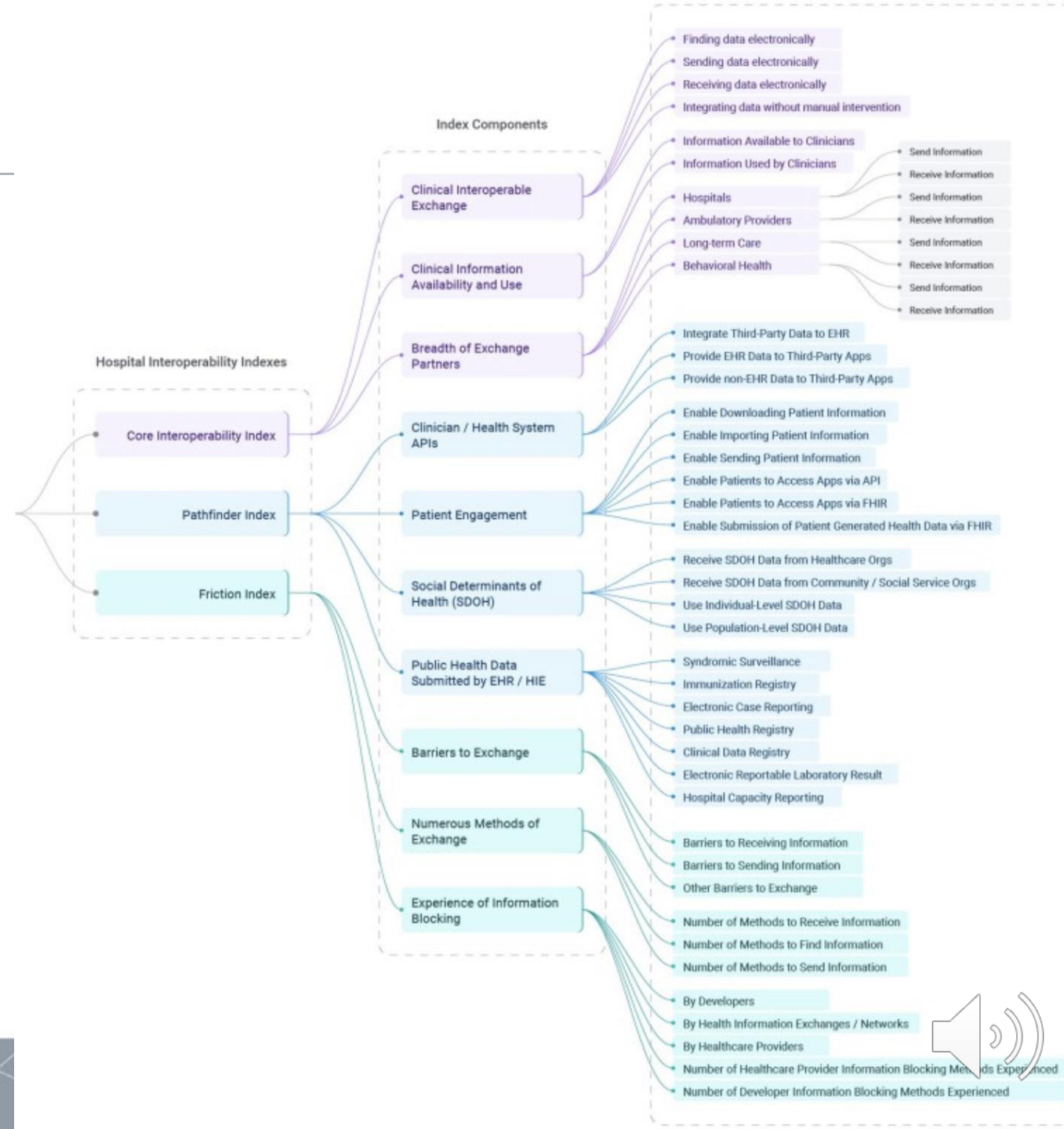
- e.g., emergency care

Consumer-mediated – consumers aggregating and sharing their own information

- e.g., sharing for care

Also classified as public vs. private (Perna, 2014)

Interoperability essential for HIE (Strawley, 2025)



Implementations

Indiana Health Information Exchange (IHIE)

Other US and international

The original HIE: Indiana Health Information Exchange (IHIE)

Launched in mid-1990s (Biondich, 2004; McDonald, 2005)

Originally Indiana Network for Patient Care (INPC); business unit became [IHIE](#)

Consists of

- Central (community) clinical repository with patient-oriented view
- Secure network for delivering clinical data messages to/from repository
- Tools and processes for standardizing the data and using it for different purposes
- Formal agreements among all participants spelling out processes, allowable uses, and HIPAA compliance

Products of IHIE

OneCare

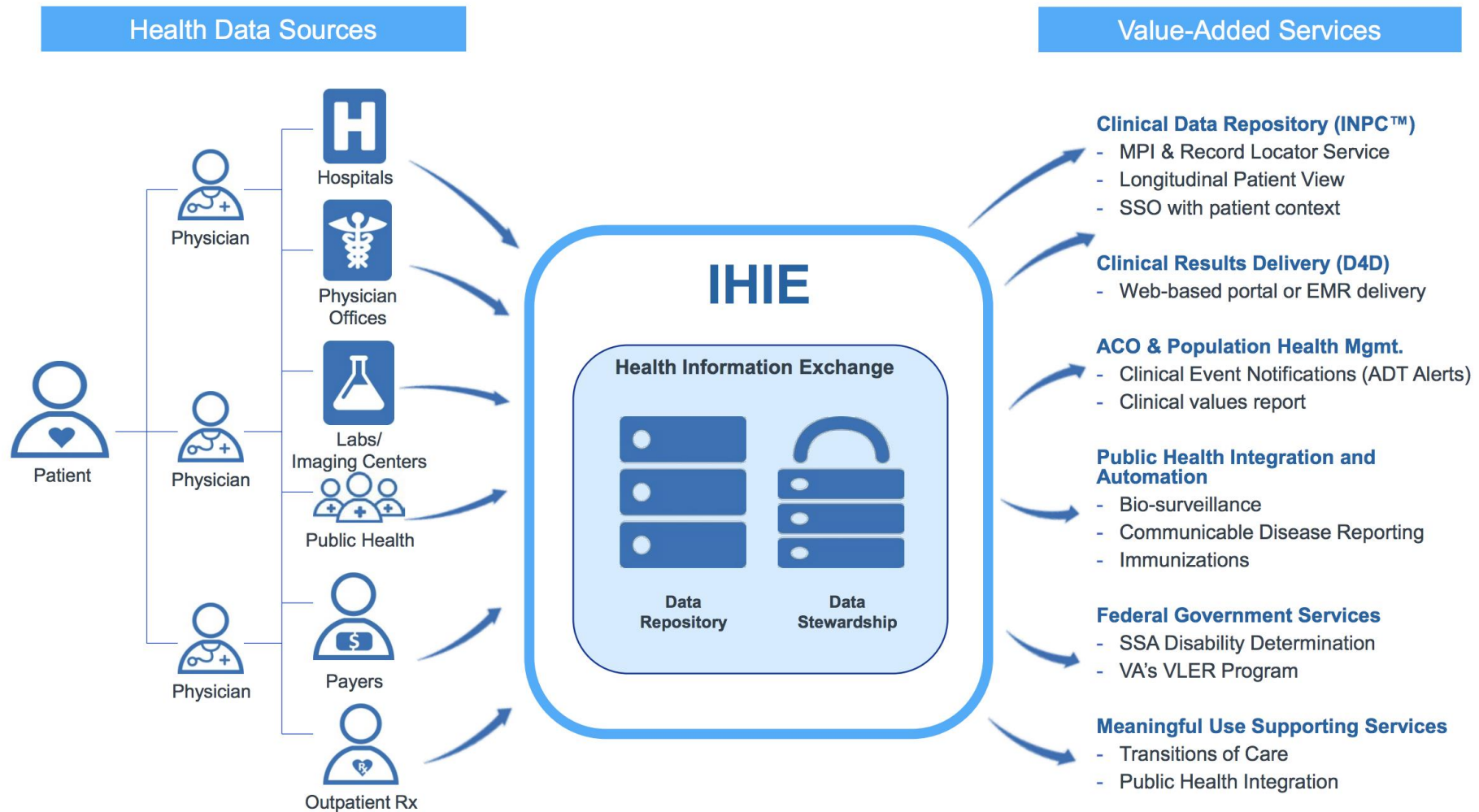
- CCD Connect – summary document of patient's longitudinal health record that can be ingested into EHR
- Health Dart – collaborative service with EHR vendors to execute search of relevant patient information
- Docs4Docs – results delivery service that offers single connection of clinical information
- CareWeb – display of payer and public health data, as well as real-time interfaces to lab, radiology, CCDs, transcriptions, cardiology, and ADT
- Clinical Data Search – find specific patient health information

PopCare

- ADT Alerts – notify patient's provider or Care Manager when their patients admitted or discharged from care facility
- Clinical Value Report – 30+ years of longitudinal data in clinical data repository
- PopDash – analytics dashboard tool that allows drill down into real-time data
- Clinical Data Repository – payer and public health data, with real-time interfaces from providers

GovCare – services to connect data to state and local government services

IHIE sources and services



INPC participants (Overhage, 2016)

Most Indiana hospitals, including the five major hospital systems (99% of non-office care) and community hospitals

National and regional laboratories

Clinics and imaging facilities

Homeless care systems

Public health departments (county and state)

Growing number of physician offices



123+

CONNECTIONS

19k+

PRACTICES

54.5k+

PROVIDERS

20M+

PATIENTS

16B+

DATA POINTS



INPC data (Overhage, 2016)

All ED and outpatient visits

All hospital discharges (diagnosis, procedures)

All inpatient laboratory results

All outpatient laboratory results

Immunizations

All discharge and admission summaries

All operative notes

All radiology reports

All surgical pathology reports

Inpatient medications

Tumor registry data



INPC by the numbers (Williams, 2025)

INPC Data Element	2004 [16, 17]	2023 [12]
Indiana counties	9	92
Total patients	3,554,480	25,449,906
Total Indiana patients in INPC	2,562,836	13,336,671
Clinical data elements	~ 53,055,000	16,000,000,000
Mineable text reports	~ 14,500,000	339,627,290
Encounter records available	~ 50,000,000	1,723,368,077
Patient records	~ 1,300,000	25,456,708
Orders	~ 24,000,000	50,418,515
Coded results	~ 660,000	6,908,843,049
Dictated reports	~ 12,000,000	247,715,536
Radiology reports	~ 8,800,000	91,911,754
Prescriptions	~ 25,000,000	42,396,184
EKG tracings	~ 480,000	7,951,355

INPC database organization and strategy

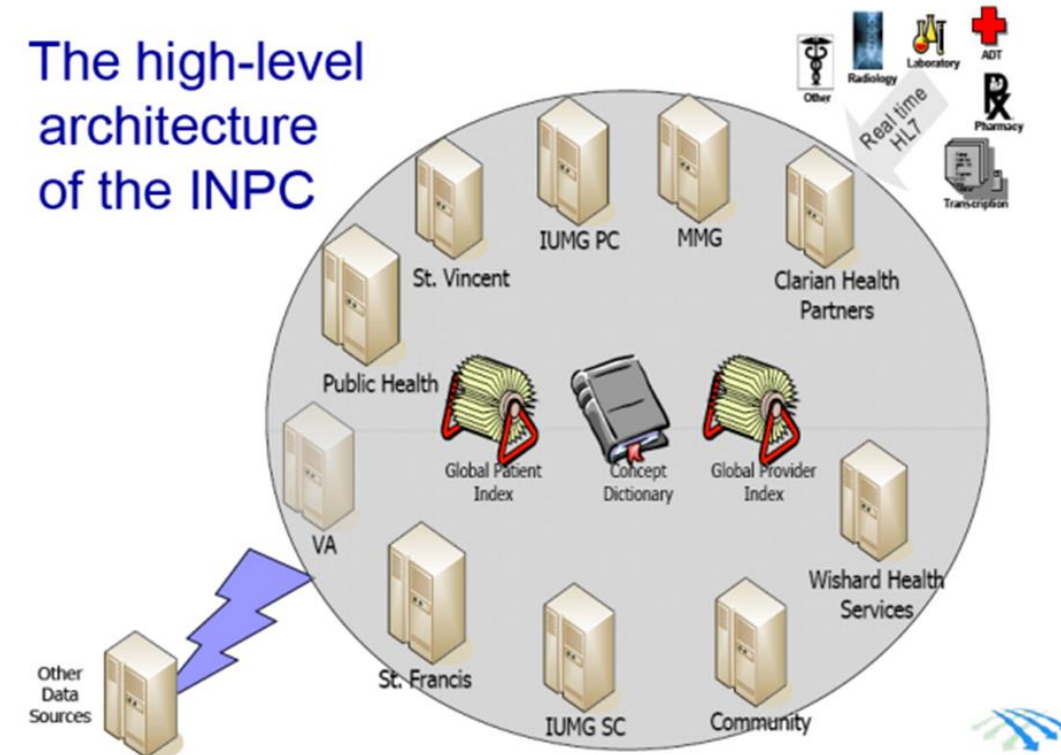
Only “centralized” resources include

- Global patient index
- Concept dictionary
- Global provider index

Data storage strategy

- Central community repository – considered essential
- Separate medical record vault per institution
- Each vault in separate physical files
- Standardized data structure – all use same software and observation codes
- Data combined “on the fly” when needed
- Patient linking

The high-level architecture of the INPC



A big challenge is patient linkage

Originally used matching algorithm of Sideli (1991)

- Matches on name, social security number, gender, and date of birth

Experimented with other linkage algorithms (Grannis, 2003; Grannis, 2004; McFarlane, 2016)

- Aim to minimize false positive linkage even at expenses of false negatives

One global patient index record for each patient

- Linked to patient records, institutional systems (McFarlane, 2016)

How did they accomplish INPC?

Vision – Clement McDonald, to paraphrase

- It's more important to build the highway than the McDonalds
- Always re-use and avoid re-entry of data

Initial grant funding – NLM, AHRQ

- Continued community investment

Community buy-in, augmented by exhaustive legal agreement (Sears, 2005)

Next – develop “patient-centered data home” through [CVITAS](#) (Williams, 2022)