

Fuel Your Digital Health

Innovation with HL7[®] FHIR[®]

HLTH 2024

2024 10 23

Daniel J. Vreeman, PT, DPT, MS, FACMI, FIAHSI, FHL7

Chief Standards Development Officer

HL7 International

HL7[®]
International

Hi, I'm dan@hl7.org



Physiotherapist, biomedical informatician, interoperability aficionado
Unusual, I know.

Chief Standards Development Officer at [HL7 International](#)
President, Board of Directors at [HL7 FHIR Foundation](#)

At [RTI International](#), I led interoperability projects

For 13+ years I led development of [LOINC](#) and other interoperability projects at the [Regenstrief Institute](#)

Conversation starter: *Style with a story*

Game plan for today

1. Lessons learned the hard way with health data
2. Why open standards are essential
3. FHIR basics: what innovators need to know
4. The extended FHIR family
5. Resources and tools for using FHIR
6. Discussion

Lessons learned the hard way with health data

A close-up, grayscale image of a vintage movie camera. The camera's lens and viewfinder are prominent in the foreground, with a textured metal body. A small circular badge on the top of the camera reads "TURN TO CLEAR VISION". In the background, a blurred city skyline is visible, with the Empire State Building being a notable feature. The overall image has a soft, slightly faded appearance.

Lesson 1:

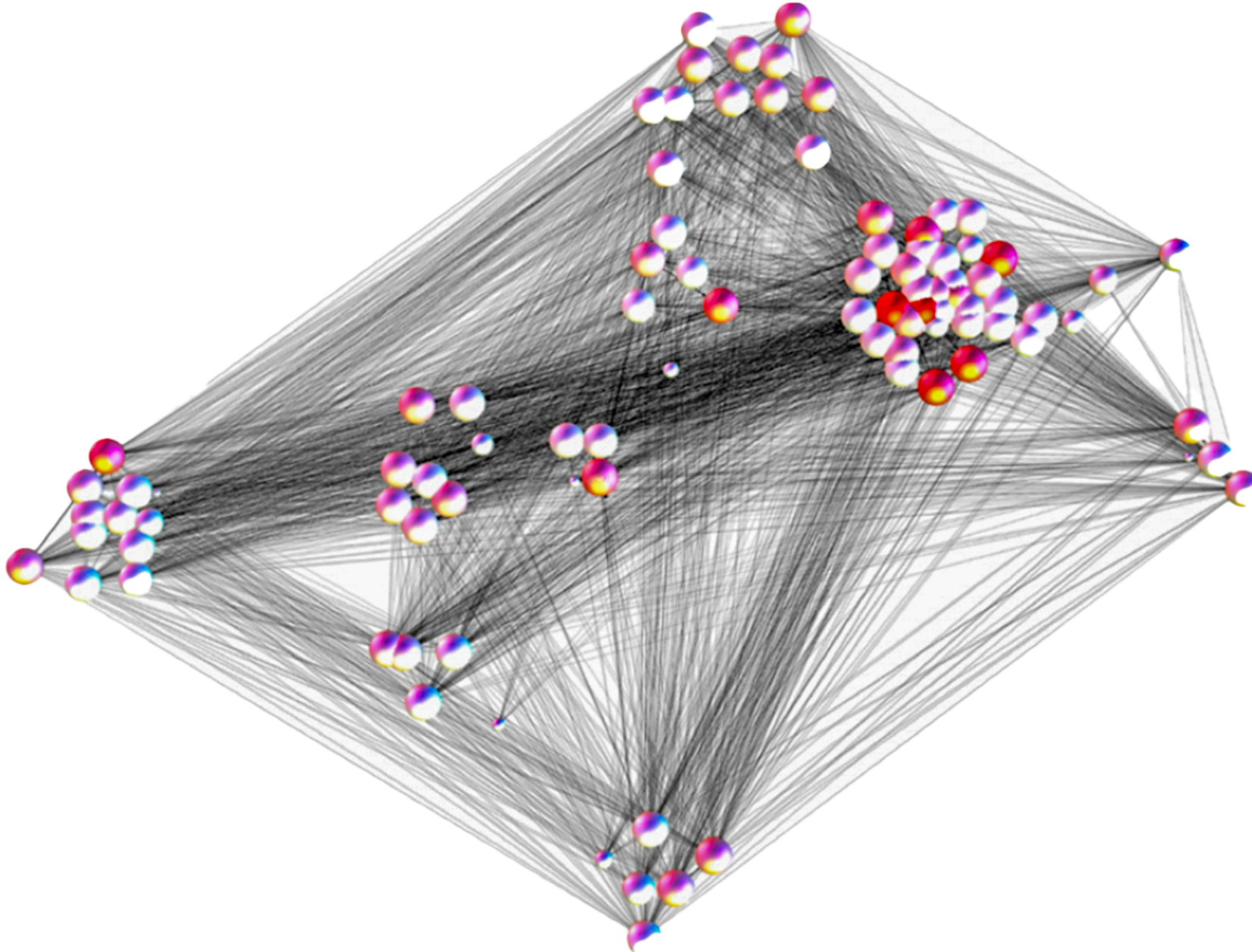
You're almost certainly *not seeing*
the full picture.



41%

of ED visits are for patients ***with data at another institution***

Health care is an ***intricately woven network***



Nearly *every ED* in
Indiana shares
patients with *every
other ED* in the state



Fixed with FHIR




HealthIT.gov > Topics > Laws, Regulation, and Policy > HTI-1 Final Rule


Laws, Regulation,
and Policy


Health Data, Technology, and Interoperability: Certification Program Updates, Algorithm Transparency, and Information Sharing (HTI-1) Final Rule

ONC's HTI-1 final rule implements provisions of the [21st Century Cures Act](#) and makes updates to the [ONC Health IT Certification Program](#) (Certification Program) with new and updated standards, implementation specifications, and certification criteria. Provisions in the HTI-1 final rule advance interoperability, improve transparency, and support the access, exchange, and use of electronic health information.

Current Endpoint Metrics


 ENDPOINTS LAST QUERIED:
2024-10-07 14:07:27


 TOTAL ENDPOINTS
34700

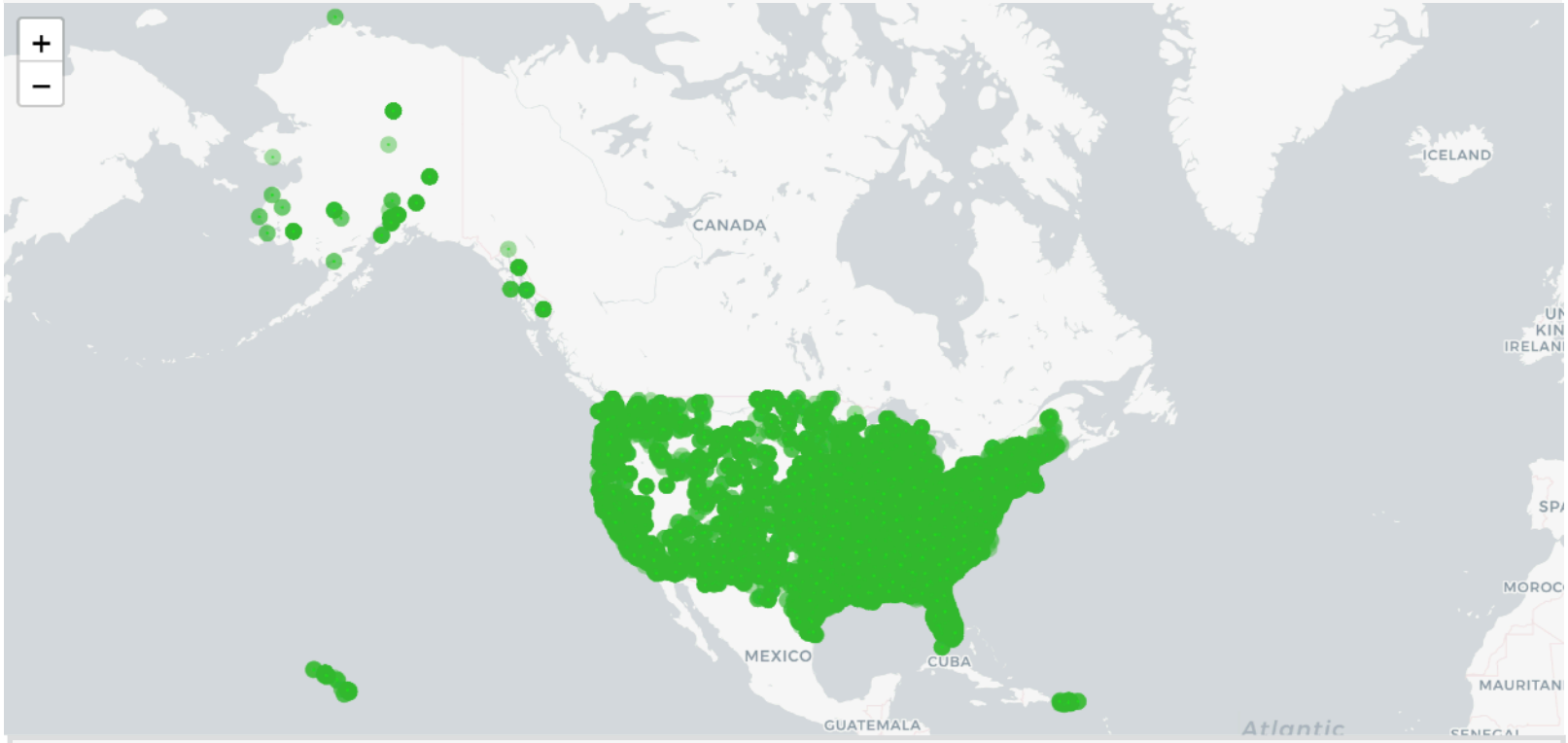
 INDEXED ENDPOINTS*
34700

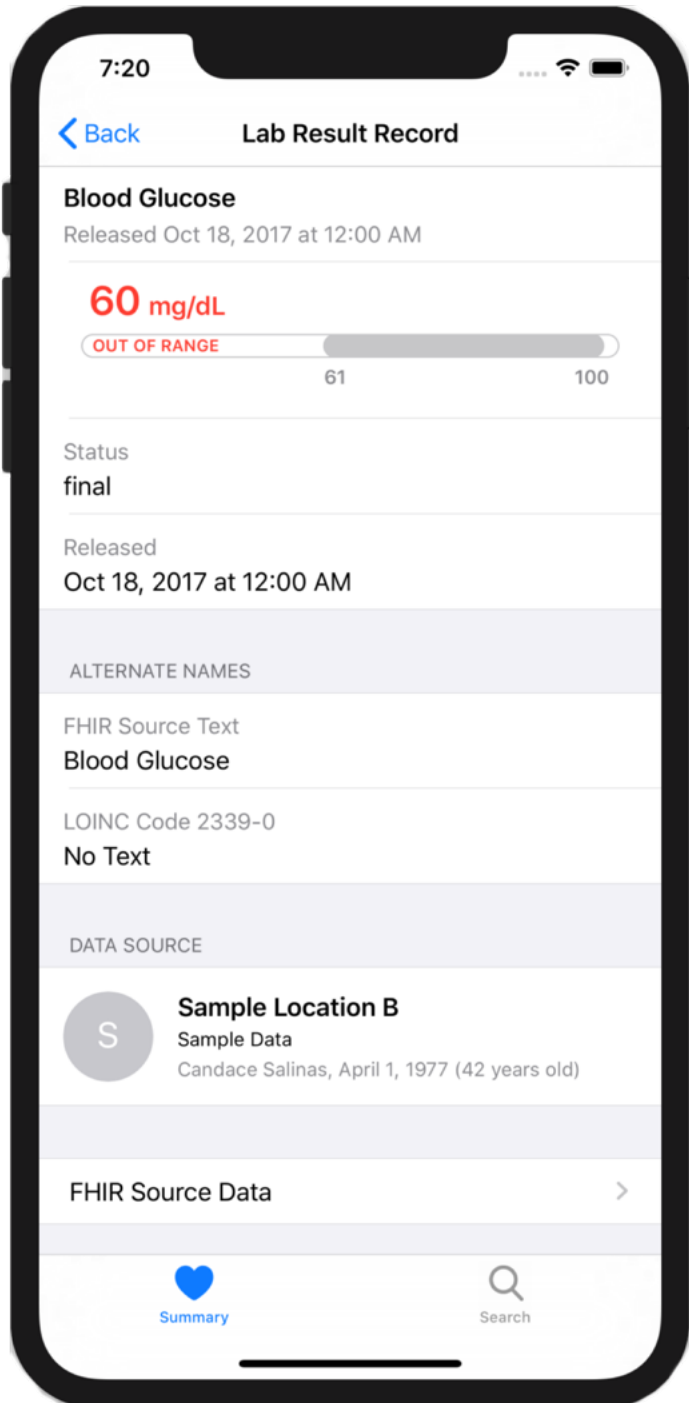
Current endpoint responses:

30743
200 (Success) 

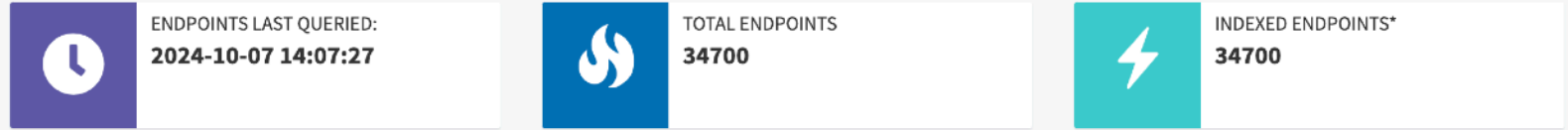
353
404 (Not found) 

168
503 (Unavailable) 

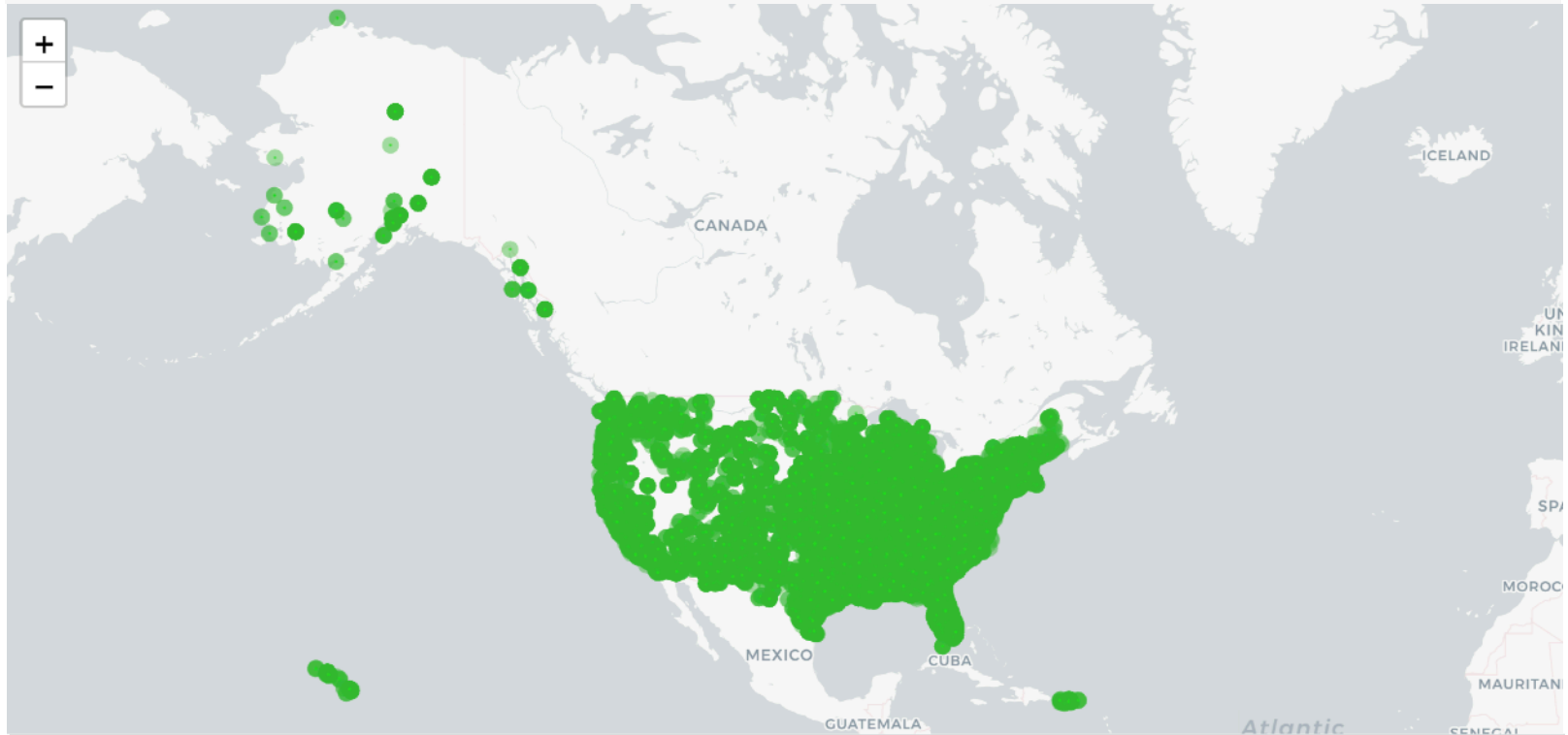
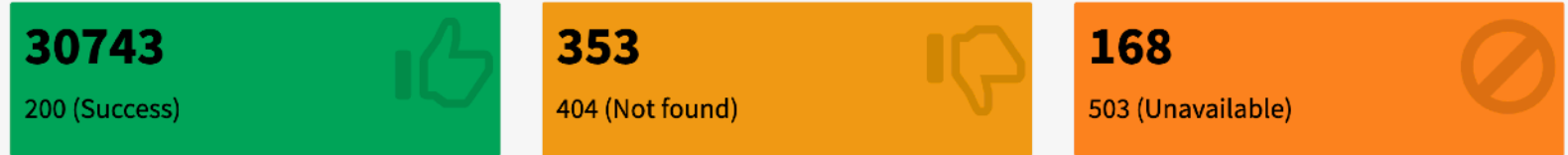




Current Endpoint Metrics



Current endpoint responses:

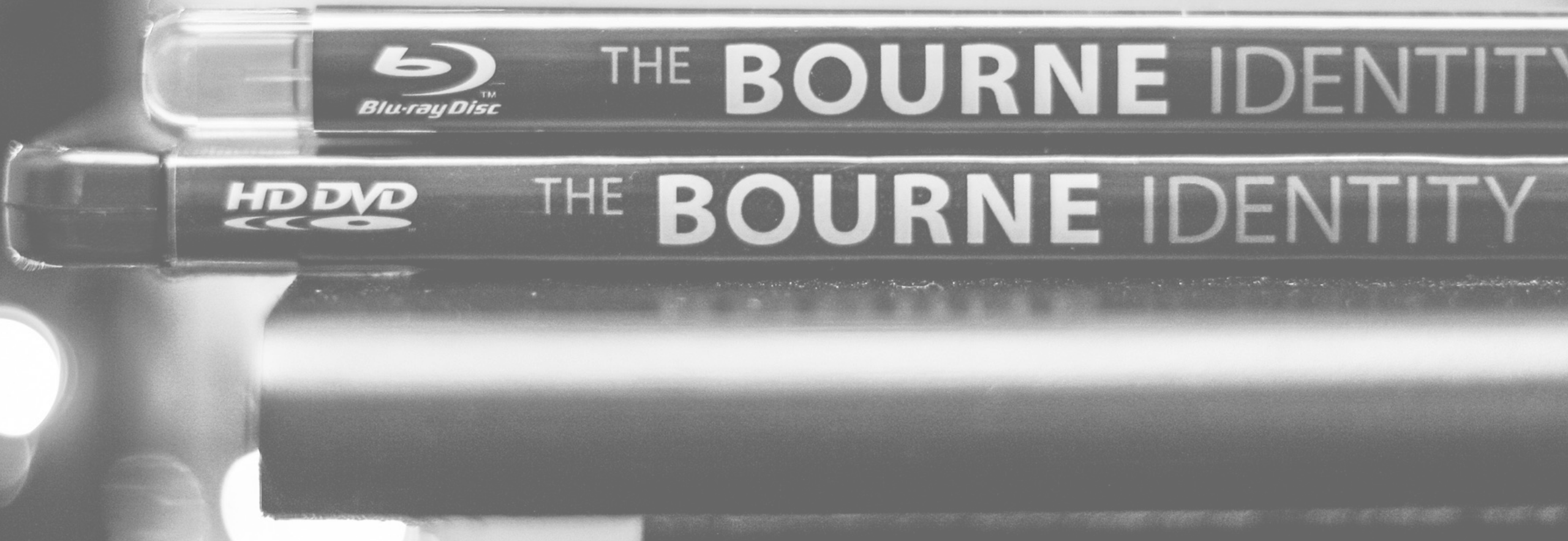


A grayscale photograph of a baby sitting at a table. The baby has a messy face with food smeared on it and is smiling. The baby is wearing a dark shirt with the word "BIRTHDAY" visible. The chair back behind the baby has a pattern of letters and numbers. The table in front of the baby has some food on it.

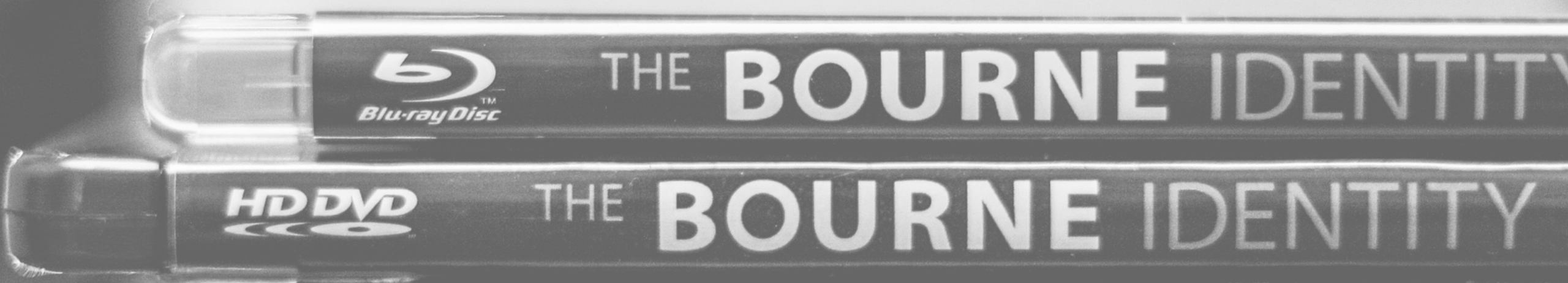
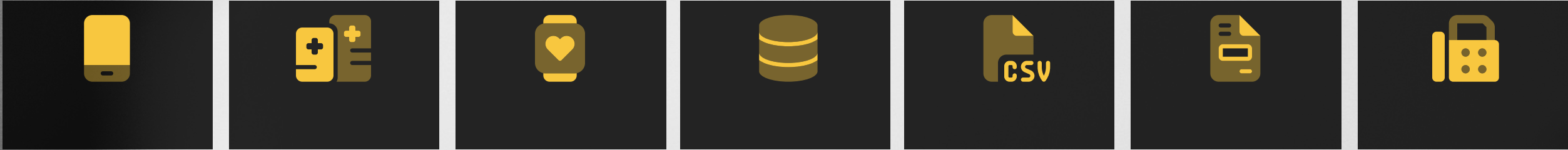
Lesson 2:

If you work with health data, *life will be messy.*

Variation abounds: data formats



Variation abounds: data formats



Variation abounds: data formats



Variation abounds: clinical measures

CODE	NAME
34626D	Arterial BP Diastolic
39312D	ABP Diastolic
ARTDIASBP	Arterial Diastolic BP
nvArtBPS	Arterial Blood Pressure Diastolic
DBP	DBP
25284D	BP (NIBP)
2737317	Diastolic Blood Pressure #1
6881D	BP Diastolic
3800DBP	BP
77934D	BP Manual Diastolic
919109	Diastolic Blood Pressure
DiastBP	DiastolicBP
PBPD	PRE BLOOD PRESSURE DIASTOLIC
POBPD	POST BLOOD PRESSURE DIASTOLIC

Variation abounds: lab tests

CODE	NAME
AGTCE	Angiotensin Converting Enzyme
5523	ACE SerPl Qn
ACE	ACE
22441	AngioTens Conv Enz
99234	ACE (angiotensin)
25284D	Angiotensin-1-Converting Enzyme
2737317	ACE (serum)
6881A	Angiotensin Converting Enzyme, Ser
3800ACE	ANGIOTENSIN CONVERTING ENZYME, S
77934A	Angio Convt Enzym
919109	ACE, SERUM
34ACE	Angiotensin Con. Enz
ANGCE	Angiotensin CE
6621456	Angio. Conv. Enzyme

Variation abounds: units of measure

Blank

%

/100 W

/CMM

CMM

10 3 L

10X3UL

10^3/UL

10*3/uL

10?3/uL

10E3/uL

10e3/uL

10e9/L

E9/L

BIL/L

bil/L

CU MM

FL

K/CMM

k/cmm

K/CU MM

K/CUMM

K/MCL

K/mcL¹⁵

K/UL

k/uL

KU/L

K/MM3

K/mm3

LB

PLATELET CO

T/CMM

TH/MM3

th/mm3

TH/UL

THOU/CMM

thou/cmm

thou/mm3

THOU/UL

THOUS/CU.MM

THOUS/MCL

THOU/mcL

THOUS/UL

Thou/uL

THOUSA

THOUSAND

THOUSAND/UL

U

X 10-3/UL

X 10(3)/UL

X10 3

X10(3)

1000/UL

X10(3)/MCL

X10(3)/UL

X10(6)/MCL

X10*9/L

X10E3/UL

X1000

X10X3

X10^3/UL

x10

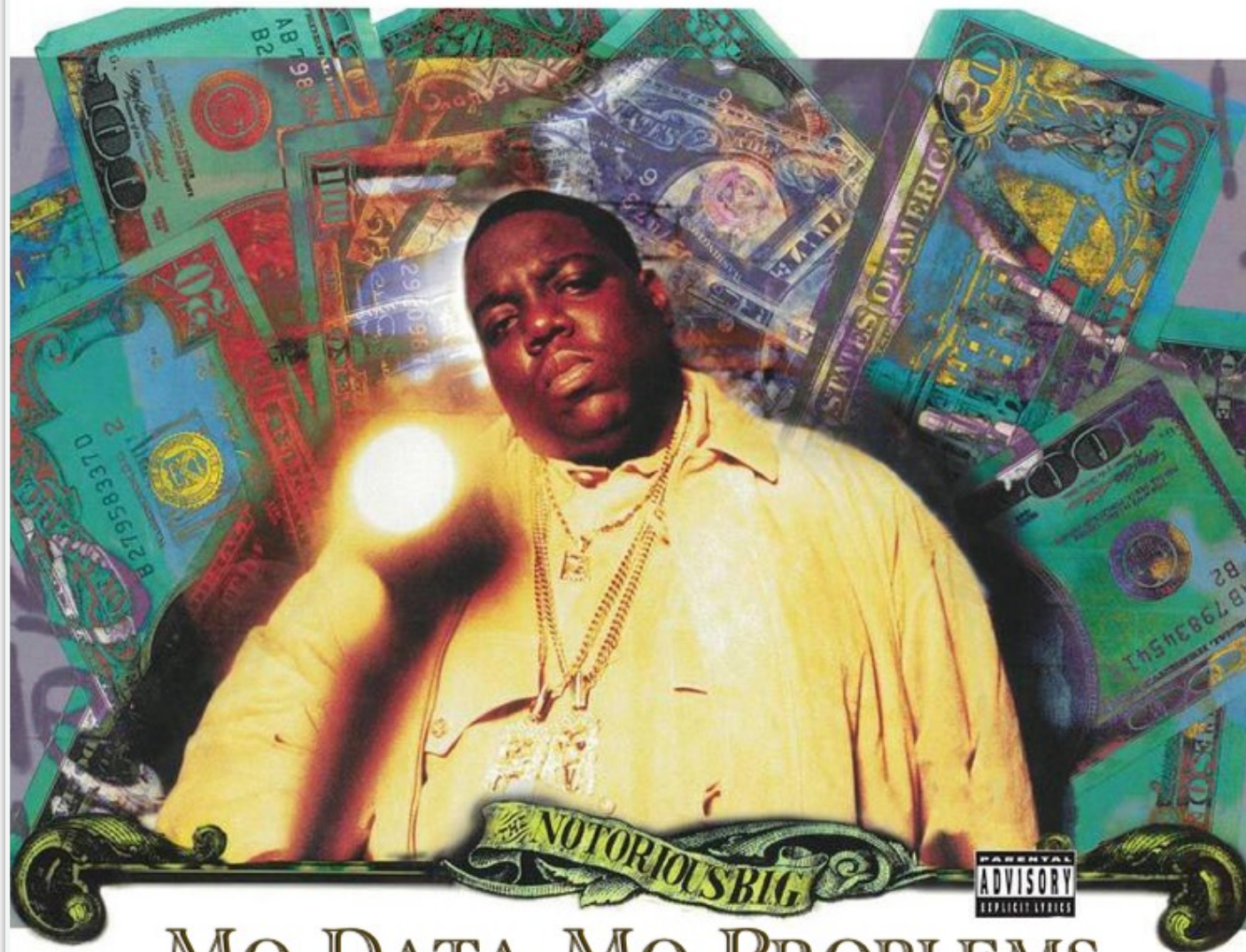
X10?3/uL

X10E3/UL

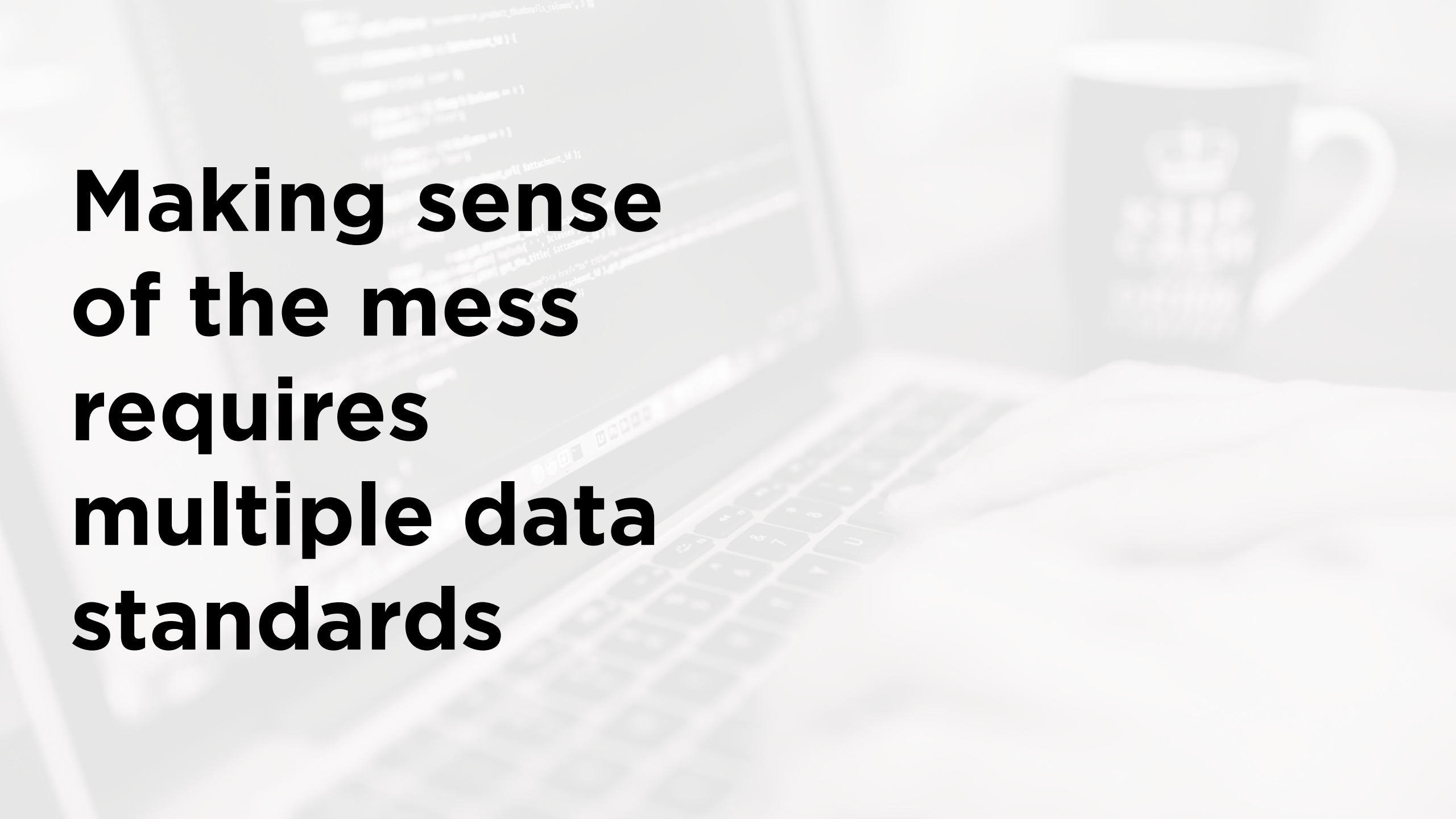
X10E3

K/A?L

K/B5L



MO DATA MO PROBLEMS
FEATURING PUFF DADDY & MASE

The background is a soft-focus photograph of a workspace. On the left, a laptop screen shows lines of code in a dark-themed editor. To the right, a white ceramic coffee cup with a crown logo and the words 'KEEP CALM AND' is visible. The overall scene is dimly lit, creating a professional and focused atmosphere.

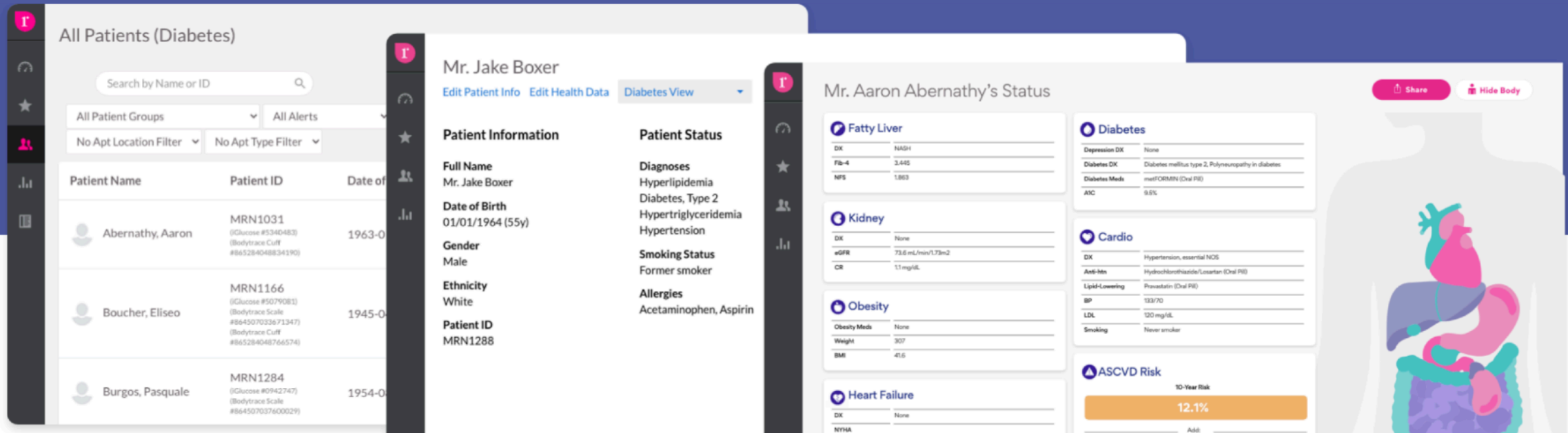
**Making sense
of the mess
requires
multiple data
standards**



Fixed with FHIR

A Holistic & Innovative Approach

As early pioneers of SMART on FHIR, Rimidi's clinical management platform works directly within your EHR - no separate sign in, no workflow disruption, better clinical efficiency. Rimidi combines patient-generated health data from connected devices or patient reported outcomes measures with clinical data to drive patient-specific clinical insights and actions through embedded clinical decision support cards. Current clinical use-cases of the Rimidi platform include chronic, cardiometabolic conditions, epidemic management, and perioperative care.



The screenshot displays the Rimidi interface within an EHR. It features a sidebar with navigation icons and a main content area with several panels:

- All Patients (Diabetes):** A table listing patients with filters for name, ID, and date.

Patient Name	Patient ID	Date of Birth
Abernathy, Aaron	MRN1031 (iGlucose #5340483) (Bodytrace Cuff #865284048834190)	1963-0
Boucher, Eliseo	MRN1166 (iGlucose #5079081) (Bodytrace Scale #864507033671347) (Bodytrace Cuff #865284048766574)	1945-0
Burgos, Pasquale	MRN1284 (iGlucose #0942747) (Bodytrace Scale #864507037600029)	1954-0
- Mr. Jake Boxer (Diabetes View):**
 - Patient Information:** Full Name: Mr. Jake Boxer, Date of Birth: 01/01/1964 (55y), Gender: Male, Ethnicity: White, Patient ID: MRN1288.
 - Patient Status:** Diagnoses: Hyperlipidemia, Diabetes, Type 2, Hypertriglyceridemia, Hypertension; Smoking Status: Former smoker; Allergies: Acetaminophen, Aspirin.
- Mr. Aaron Abernathy's Status:**
 - Fatty Liver:** DX: NAFL, Fib-4: 3.445, NFS: 1.863.
 - Kidney:** DX: None, eGFR: 73.6 mL/min/1.73m2, CR: 1.1 mg/dL.
 - Obesity:** Obesity Meds: None, Weight: 307, BMI: 41.6.
 - Heart Failure:** DX: None, NYHA: II.
 - Diabetes:** Depression DX: None, Diabetes DX: Diabetes mellitus type 2, Polyneuropathy in diabetes, Diabetes Meds: metFORMIN (Oral PI), A1C: 9.6%.
 - Cardio:** DX: Hypertension, essential NOS, Anti-bln: Hydrochlorothiazide/Losartan (Oral PI), Lipid-Lowering: Pravastatin (Oral PI), BP: 133/70, LDL: 120 mg/dL, Smoking: Never smoker.
 - ASCVD Risk:** 10-Year Risk: 12.1%.
- Anatomical Diagram:** A stylized human silhouette with internal organs highlighted in various colors (heart, lungs, liver, stomach, intestines).

A woman with long hair is shown in profile, looking towards the right. She is holding a glowing orb of light in her hands, which is surrounded by a cloud of small, sparkling particles. The background is dark with bokeh light effects, suggesting a magical or futuristic atmosphere.

Lesson 3:

AI's magic can sparkle, but insiders know it's ***data work that powers the glow.***

“Everyone wants to do the model work, not the data work”: Data Cascades in High-Stakes AI

Nithya Sambasivan, Shivani Kapania, Hannah Highfill, Diana Akrong, Praveen Paritosh, Lora Aroyo

[nithyasamba,kapania,hhighfill,dakrong,pkp,loraa]@google.com
Google Research
Mountain View, CA

ABSTRACT

AI models are increasingly applied in high-stakes domains like health and conservation. Data quality carries an elevated significance in high-stakes AI due to its heightened downstream impact, impacting predictions like cancer detection, wildlife poaching, and loan allocations. Paradoxically, data is the most under-valued and de-glamorised aspect of AI. In this paper, we report on data practices in high-stakes AI, from interviews with 53 AI practitioners in India, East and West African countries, and USA. We define, identify, and present empirical evidence on *Data Cascades*—compounding events causing negative, downstream effects from data issues—triggered by conventional AI/ML practices that undervalue data quality. Data cascades are pervasive (92% prevalence), invisible, delayed, but often avoidable. We discuss HCI opportunities in designing and incentivizing data excellence as a first-class citizen of AI, resulting in safer and more robust systems for all.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI.**

lionized work of building novel models and algorithms [46, 125]. Intuitively, AI developers understand that data quality matters, often spending inordinate amounts of time on data tasks [60]. In practice, most organisations fail to create or meet any data quality standards [87], from under-valuing data work vis-a-vis model development.

Under-valuing of data work is common to all of AI development [125]¹. We pay particular attention to undervaluing of data in *high-stakes domains*² that have safety impacts on living beings, due to a few reasons. One, developers are increasingly deploying AI models in complex, humanitarian domains, *e.g.*, in maternal health, road safety, and climate change. Two, poor data quality in high-stakes domains can have outsized effects on vulnerable communities and contexts. As Hiatt *et al.* argue, high-stakes efforts are distinct from serving customers; these projects work with and for populations at risk of a litany of horrors [47]. As an example, poor data practices reduced accuracy in IBM’s cancer treatment AI [115] and led to Google Flu Trends missing the flu peak by 140% [63, 73]). Three, high-stakes AI systems are typically deployed in low-resource contexts with a pronounced lack of readily available, high-quality datasets. Applications span into communities that

“Everyone wants to do the model work, not the data work”:
Data Cascades in High-Stakes AI

Neil S. Davies, Shih-Wei Huang, Hilary J. Dineen, Albert R. Meyer, David J. Foray

Paradoxically, data is the most under-valued and de-glamorised aspect of AI..

An overall lack of recognition for the invisible, arduous, and taken-for-granted data work in AI led to poor data practices, resulting in the data cascades (compounding events causing negative, downstream effects).

CCS CONCEPTS

- **Human-centered computing** → **Empirical studies in HCI.**

[65, 75]). Three, high-stakes AI systems are typically deployed in low-resource contexts with a pronounced lack of readily available, high-quality datasets. Applications span into communities that

Research and Applications

An argument for reporting data standardization procedures in multi-site predictive modeling: case study on the impact of LOINC standardization on model performance

Amie J. Barda,^{1,2} Victor M. Ruiz,^{1,2} Tony Gigliotti³ and Fuchiang (Rich) Tsui^{1,2,4,5,6,7,8,*}

¹Tsui Laboratory, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA, ²Department of Biomedical Informatics, School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania, USA, ³Information Services Division, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA, ⁴Department of Anesthesiology and Critical Care Medicine, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA, ⁵Department of Biomedical and Health Informatics, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, USA, ⁶Institute for Biomedical Informatics, University of Pennsylvania, Philadelphia, Pennsylvania, USA, ⁷School of Computing Information, University of Pittsburgh, Pittsburgh, Pennsylvania, USA and ⁸Department of Bioengineering, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

*Corresponding author: Fuchiang (Rich) Tsui, Ph.D., Tsui Laboratory, Children's Hospital of Philadelphia, 2716 South Street, Philadelphia, PA 19146, USA (tsuif@email.chop.edu)

Received 8 September 2018; Revised 22 November 2018; Editorial Decision 10 December 2018; Accepted 20 December 2018

ABSTRACT

Objectives: We aimed to gain a better understanding of how standardization of laboratory data can impact predictive model performance in multi-site datasets. We hypothesized that standardizing local laboratory codes to logical observation identifiers names and codes (LOINC) would produce predictive models that significantly outperform those learned utilizing local laboratory codes.

Materials and Methods: We predicted 30-day hospital readmission for a set of heart failure-specific visits to 13 hospitals from 2008 to 2012. Laboratory test results were extracted and then manually cleaned and mapped to LOINC. We extracted features to summarize laboratory data for each patient and used a training dataset (2008–2011) to learn models using a variety of feature selection techniques and classifiers. We evaluated our hypothesis by comparing model performance on an independent test dataset (2012).

Results: Models that utilized LOINC performed significantly better than models that utilized local laboratory test codes, regardless of the feature selection technique and classifier approach used.

Discussion and Conclusion: We quantitatively demonstrated the positive impact of standardizing multi-site laboratory data to LOINC prior to use in predictive models. We used our findings to argue for the need for detailed reporting of data standardization procedures in predictive modeling, especially in studies leveraging multi-site datasets extracted from electronic health records.

Key words: hospital readmission, heart failure, logical observation identifiers names and codes, predictive modeling, medical informatics/standards

INTRODUCTION

The growing repository of available healthcare data has motivated the healthcare community to improve medical decision-making by integrating knowledge learned from data-driven analyses.^{1,2} Often,

these analyses are geared toward enhancing clinical decision support (CDS) systems with models that predict events of clinical relevance, such as disease risk or progression.² Laboratory data are particularly valuable information in predictive modeling as they can provide in-

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Research and Applications

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Fixed with FHIR

Microsoft, Amazon, other tech giants forge ahead on healthcare data sharing pledge

by James Thorne on · July 30, 2019 at 10:00 am

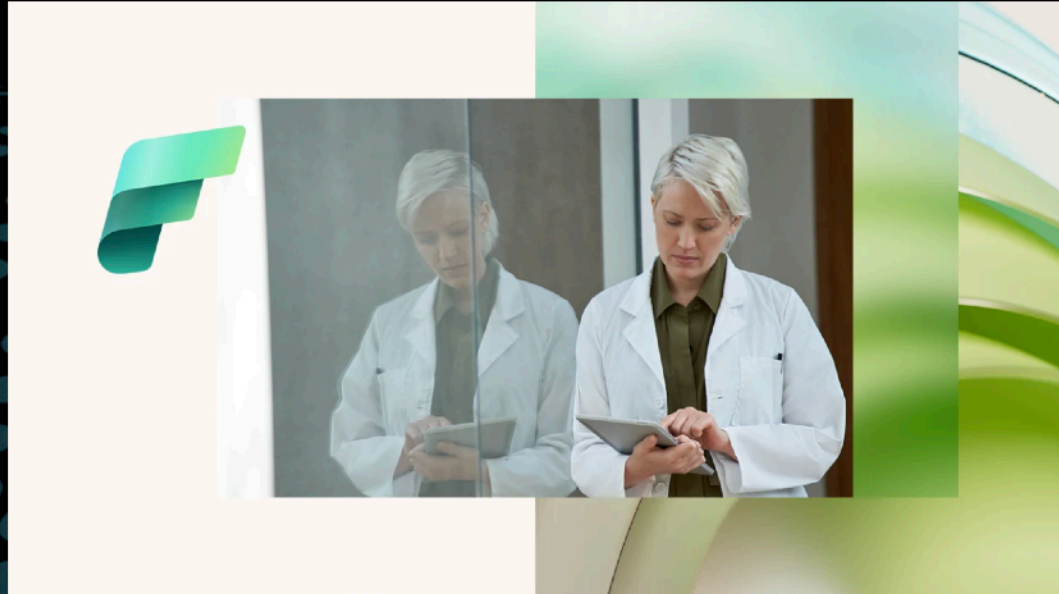


Executives from Amazon, Google, Microsoft and IBM on stage at the CMS Blue Button 2.0 Developer Conference in August 2018. From left: Dean Garfield, Alec Chalmers, Mark Dudman, Peter Lee and Greg Moore. (Microsoft Photo)

This past August, executives from Microsoft, Amazon, Google, IBM, Oracle, and Salesforce **banded together** to promote data sharing in healthcare. Nearly a year later, the world's largest tech companies aren't showing any signs of slowing.

Cloud providers ❤️ FHIR

Big tech vendors were early voluntary adopters and now all have FHIR in their health data solutions



[Healthcare](#) [News and announcements](#) · 7 min read

Power healthcare AI with unified and protected multi-modal healthcare data

By [Umesh Rustogi](#), General Manager, Microsoft Health and Life Sciences Data Platform

October 10, 2024



Announcing general availability of healthcare data solutions in Microsoft Fabric and public preview of healthcare application templates in Microsoft Purview.

Tags



Here are some of the capabilities being released in preview:

Fast Healthcare Interoperability Resources (FHIR) data ingestion. Enables easy ingestion of FHIR data from [Azure Health Data Services](#) in Microsoft Fabric Onelake environment and stores it in the bronze lakehouse as raw newline-delimited JavaScript object notation (NDJSON) files.

Relational FHIR data foundation enables the transformation of FHIR data in bronze to relational FHIR and tabular structure in open data format (delta-parquet) in Silver Lakehouse using highly scalable purpose-built pipelines. This creates a standard-based unified healthcare data model in Silver Data Lake. With support for all FHIR R4 resources, this now enables multiple downstream analytics support for scenarios leveraging the rich clinical, financial (claims and explanation of benefits), and administration data. Healthcare companies and partners can now build analytical scenarios such as quality reporting, population health management, clinical research studies, and operational reporting. It also allows a traditional SQL engine to run on top of the data for a data analyst to conduct ad-hoc exploratory analysis of the healthcare data.

Open data standards:

Fuel for innovation



Open APIs

An idea whose time has come.

After 35 years of developing the standards that powered half of all healthcare data around the globe, HL7 reimagined data sharing the way other industries had successfully done.

choose joy



Organizational Profile

Not-for-profit (501c6)

Standards Development Organization

Founded in 1987

ANSI-accredited

Globally trusted

Product Families





Fast **H**ealthcare **I**nteroperability **R**esources (**FHIR**)

A transformative ***open API specification*** and ***data model*** for health information.

Now a decade+ old and a global phenomenon and public good

FHIR: the Web for health data

Why FHIR is special

Implementation focus

Foundation in modern web standards and API exchange

Open license - literally, public domain ©

Innovations in consensus-building and standards development

But, the biggest reason is that FHIR is also...

Why FHIR is special

Implementation focus

Foundation in modern web standards and API exchange

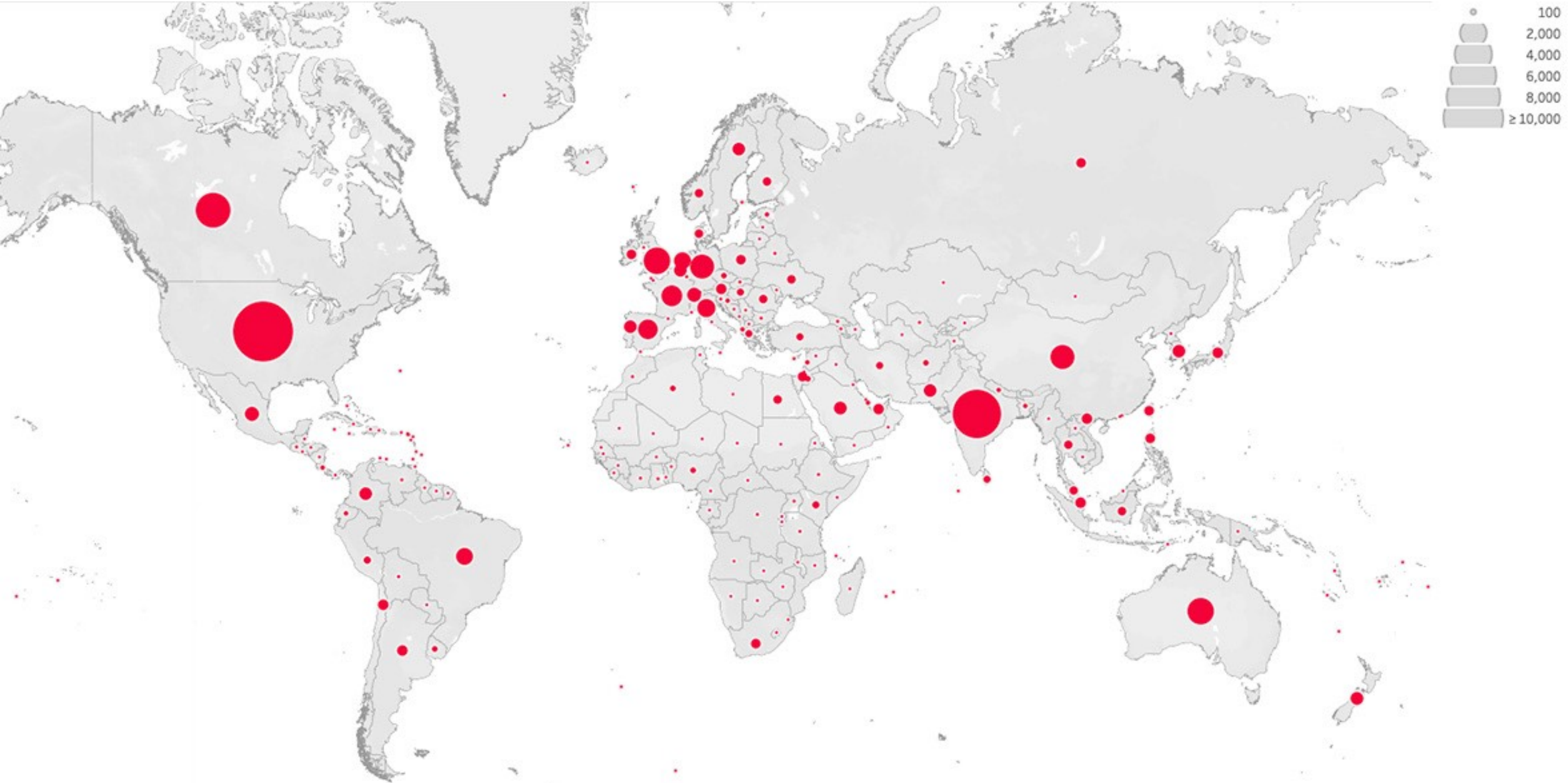
Open license - literally, public domain ©

Innovations in consensus-building and standards development

But, the biggest reason is that FHIR is also...










*A vibrant, open, collaborative, respectful,
and well-orchestrated **community***

Propelled by an Active Community Worldwide



HL7 International Liaisons to (45) other organizations

 Alliance of Community Health Plans (<i>J Skapik</i>)
 America's Health Insurance Plans (<i>L James</i>)
 American College of Physicians (<i>C Jaffe</i>)
 American Dental Association (<i>R Fiehn</i>)
 American Health Information Management Association (<i>V Nguyen</i>)
 American Hospital Association (<i>open</i>)
 American Medical Association (<i>C Jaffe</i>)
 American Medical Informatics Association (<i>C Jaffe</i>)
 American Society for Testing Materials (<i>open</i>)
 Council for Affordable Quality Healthcare (<i>V Nguyen</i>)
 CEN/TC 251 (<i>E Hammond</i>)
 Civitas Networks for Health (<i>C Jaffe</i>)
 Clinical Data Interchange Standards Consortium (<i>open</i>)
 Coalition for Health AI (<i>C Jaffe</i>)
 College of Health Information Management Executives (<i>C Jaffe</i>)
 Designated Standards Maintenance Committee (<i>A Goss</i>)
 Digital Imaging and Communication In Medicine (<i>B Bialecki</i>)
 GS1 (<i>N Piper</i>)
 Global Consortium for eHealth Interoperability (<i>D Vreeman</i>)
 Healthcare Information and Management Systems Society (<i>V Nguyen</i>)
 IEEE (<i>E Hammond</i>)
 Integrating the Healthcare Enterprise International, Inc (<i>D Vreeman</i>)
 Interamerican Development Bank (<i>D Kaminker</i>)

 International Conference on Harmonisation (<i>open</i>)
 International Medical Informatics Association (<i>E Hammond</i>)
 International Organization for Standardization (<i>multiple</i>)
 Joint Initiative Council (<i>D Vreeman</i>)
 National Council for Prescription Drug Programs (<i>F McKinney</i>)
 Object Management Group (<i>K. Rubin</i>)
 Observational Health Data Sciences and Informatics (<i>E Hammond</i>)
 Open Concept Lab, LLC (<i>D Vreeman</i>)
 OpenMRS, Inc. (<i>D Vreeman</i>)
 Pharmaceutical Users Software Exchange (<i>P Guerra</i>)
 Regenstrief Institute, Inc. (<i>D Vreeman</i>)
 The Sequoia Project (<i>A Truscott</i>)
 SHIELD (<i>J Skapik</i>)
 SNOMED International (<i>A Truscott</i>)
 TransCelerate BioPharma, Inc (<i>C Jaffe</i>)
 UDAP.org (<i>D Pyke</i>)
 U.S. Department of Veterans Affairs (<i>K Rubin</i>)
 U.S. Food and Drug Administration (<i>C Jaffe</i>)
 U.S. Office of the National Coordinator for Health IT (<i>C Jaffe, D Vreeman</i>)
 Web3D Consortium (<i>E Hammond</i>)
 Workgroup for Electronic Data Interchange (<i>C Jaffe</i>)
 World Health Organization (<i>D Vreeman</i>)
 X12 (<i>J Keegan</i>)

A Software “Bill of Rights”

Freedom to:

1. Run the program, for any purpose
2. Study how the program works, and change it so it does your computing as you wish
3. Redistribute copies
4. Distribute copies of your modified versions, giving the community opportunity to benefit from your changes

This notion of free is **not about price.**

It is about the freedom to ***create.***



HL7[®] FHIR[®]

Freedom to

Harness global interoperability wisdom

Implement, inspect, and improve the specification

Redistribute refinements, helping others

A grayscale underwater photograph of a diver. The diver is wearing a SCUBAPRO BCD and is making a hand signal with five fingers spread. The background is filled with bubbles and the sandy bottom of the ocean. The text 'Let's dive a little deeper' is overlaid in a large, black, sans-serif font.

Let's dive a little deeper

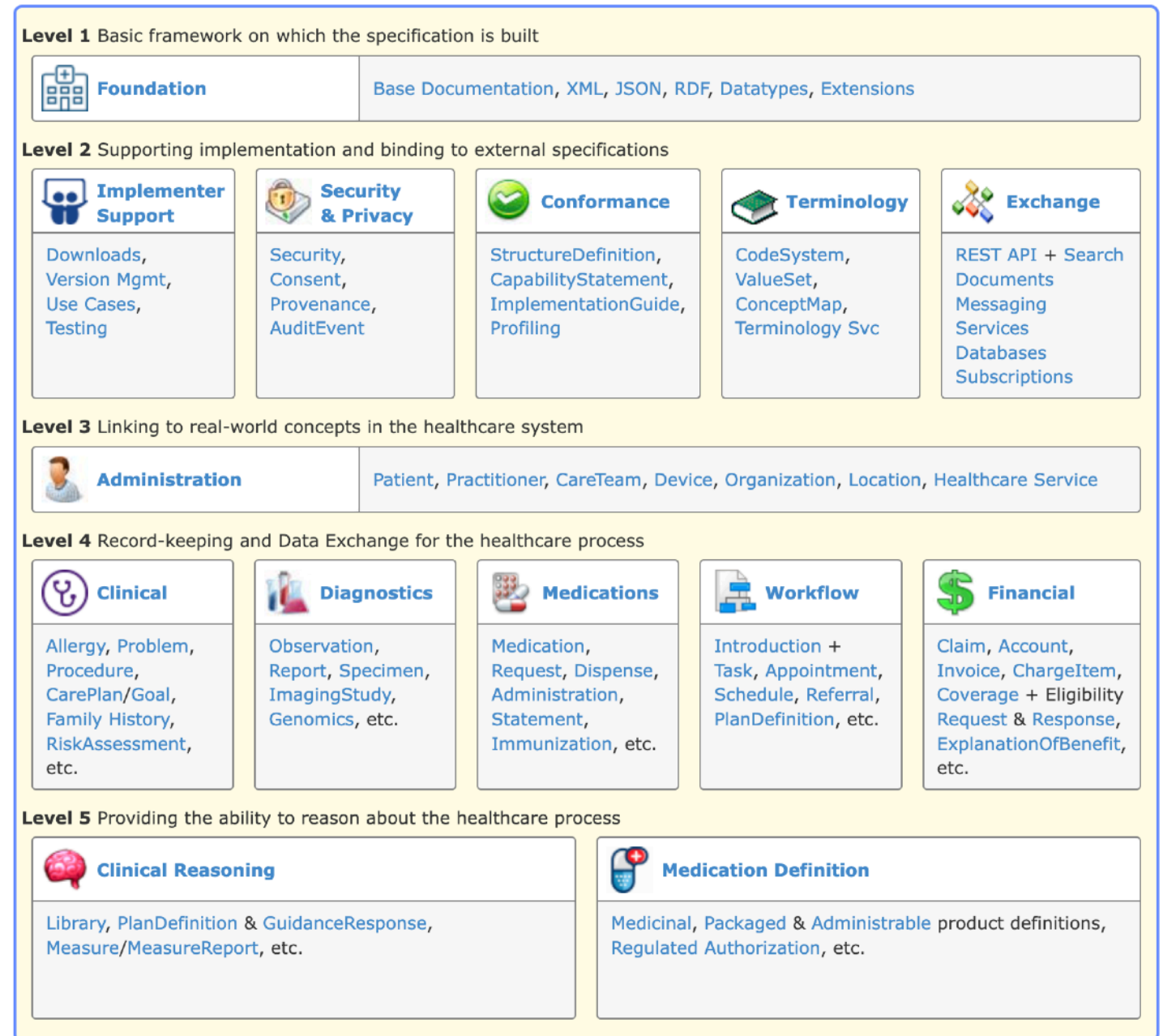
The FHIR spec contains 157 modular data models called **Resources**.

Each defines exchangeable content.

As a base platform standard, FHIR supports many use cases.

Implementer focus:

Will 80% of systems implement this element?



Meet Esperanza Córdova
























Ms. Córdova is not feeling well (fever, body aches, congestion, coughing).

Ugh.

So, she arranges a visit with her primary care provider (Alleen Anderson, MD).

Patient

Individual receiving health services

Name	Flags	Card.	Type	Description & Constraints
 Patient	N		DomainResource	Information about an individual or animal receiving health care services
 identifier		Σ 0..*	Identifier	Elements defined in Ancestors: id , meta , implicitRules , language , text , contained , extension , modifierExtension An identifier for this patient
 active		?! Σ 0..1	boolean	Whether this patient's record is in active use
 name		Σ 0..*	HumanName	A name associated with the patient
 telecom		Σ 0..*	ContactPoint	A contact detail for the individual
 gender		Σ 0..1	code	male female other unknown Binding: AdministrativeGender (Required)
 birthDate		Σ 0..1	date	The date of birth for the individual
 deceased[x]		?! Σ 0..1		Indicates if the individual is deceased or not
 deceasedBoolean			boolean	
 deceasedDateTime			dateTime	
 address		Σ 0..*	Address	An address for the individual
 maritalStatus		0..1	CodeableConcept	Marital (civil) status of a patient Binding: Marital Status Codes (Extensible)
 multipleBirth[x]		0..1		Whether patient is part of a multiple birth
 multipleBirthBoolean			boolean	
 multipleBirthInteger			integer	
 photo		0..*	Attachment	Image of the patient
 contact	C	0..*	BackboneElement	A contact party (e.g. guardian, partner, friend) for the patient <i>+ Rule: SHALL at least contain a contact's details or a reference to an organization</i>
 relationship		0..*	CodeableConcept	The kind of relationship Binding: Patient Contact Relationship (Extensible)
 name	C	0..1	HumanName	A name associated with the contact person
 telecom	C	0..*	ContactPoint	A contact detail for the person
 address	C	0..1	Address	Address for the contact person

Patient

Individual receiving health services

Name	Flags	Card.	Type	Description & Constraints
Patient	N		DomainResource	Information about an individual or animal receiving health care services Elements defined in Ancestors: id , meta , implicitRules , language , text , contained , extension , modifierExtension An identifier for this patient
identifier		Σ 0..*	Identifier	An identifier for this patient
active	?! Σ	0..1	boolean	Whether this patient's record is in active use
name		Σ 0..*	HumanName	A name associated with the patient
telecom		Σ 0..*	ContactPoint	A contact detail for the individual
gender		Σ 0..1	code	male female other unknown Binding: AdministrativeGender (Required)
birthDate		Σ 0..1	date	The date of birth for the individual
deceased[x]	?! Σ	0..1		Indicates if the individual is deceased or not
deceasedBoolean			boolean	
deceasedDateTime			dateTime	
address		Σ 0..*	Address	An address for the individual
maritalStatus		0..1	CodeableConcept	Marital (civil) status of a patient Binding: Marital Status Codes (Extensible)
multipleBirth[x]	?! Σ	0..1		Whether patient is part of a multiple birth
multipleBirthBoolean			boolean	
multipleBirthInteger			integer	
photo		0..*	Attachment	Image of the patient
contact	C	0..*	BackboneElement	A contact party (e.g. guardian, partner, friend) for the patient + Rule: SHALL at least contain a contact's details or a reference to an organization
relationship		0..*	CodeableConcept	The kind of relationship Binding: Patient Contact Relationship (Extensible)
name	C	0..1	HumanName	A name associated with the contact person
telecom	C	0..*	ContactPoint	A contact detail for the person
address	C	0..1	Address	Address for the contact person



Patient

Ms. Esperanza Córdova is a **married female** who prefers to communicate in **Spanish**

```
{
  "resourceType": "Patient",
  "id": "62928",
  "identifier": [...],
  "name": [
    {
      "use": "official",
      "family": "Córdova800",
      "given": [
        "Esperanza675"
      ],
      "prefix": [
        "Ms."
      ]
    }
  ],
  "telecom": [...],
  "gender": "female",
  "birthDate": "1972-05-28",
  "address": [...],
  "maritalStatus": {
    "coding": [
      {
        "system": "http://terminology.hl7.org/CodeSystem/v3-MaritalStatus",
        "code": "M",
        "display": "Married"
      }
    ],
    "text": "Married"
  },
  "communication": [
    {
      "language": {
        "coding": [
          {
            "system": "urn:ietf:bcp:47",
            "code": "es",
            "display": "Spanish"
          }
        ],
        "text": "Spanish"
      },
      "preferred": true
    }
  ]
}
```













Patient

Ms. Esperanza Córdova is a **married female** who prefers to communicate in **Spanish**

```
{
  "resourceType": "Patient",
  "id": "62928",
  "identifier": [...],
  "name": [
    {
      "use": "official",
      "family": "Córdova800",
      "given": [
        "Esperanza675"
      ],
      "prefix": [
        "Ms."
      ]
    }
  ],
  "telecom": [...],
  "gender": "female",
  "birthDate": "1972-05-28",
  "address": [...],
  "maritalStatus": {
    "coding": [
      {
        "system": "http://terminology.hl7.org/CodeSystem/v3-MaritalStatus",
        "code": "M",
        "display": "Married"
      }
    ],
    "text": "Married"
  },
  "communication": [
    {
      "language": {
        "coding": [
          {
            "system": "urn:ietf:bcp:47",
            "code": "es",
            "display": "Spanish"
          }
        ],
        "text": "Spanish"
      },
      "preferred": true
    }
  ]
}
```

Encounter

An interaction during which services are provided for a patient

Name	Flags	Card.	Type	Description & Constraints ?
 Encounter	TU		DomainResource	An interaction during which services are provided to the patient Elements defined in Ancestors: id , meta , implicitRules , language , text , contained , extension , modifierExtension
 identifier	Σ	0..*	Identifier	Identifier(s) by which this encounter is known
 status	?! Σ	1..1	code	planned in-progress on-hold discharged completed cancelled discontinued entered-in-error unknown Binding: Encounter Status (Required)
 class	Σ	0..*	CodeableConcept	Classification of patient encounter context - e.g. Inpatient, outpatient Binding: Encounter class (Preferred)
 priority		0..1	CodeableConcept	Indicates the urgency of the encounter Binding: ActPriority (Example)
 type	Σ	0..*	CodeableConcept	Specific type of encounter (e.g. e-mail consultation, surgical day-care, ...) Binding: Encounter Type (Example)
 serviceType	Σ	0..*	CodeableReference(HealthcareService)	Specific type of service Binding: Service Type (Example)
 subject	Σ	0..1	Reference(Patient Group)	The patient or group related to this encounter
 subjectStatus		0..1	CodeableConcept	The current status of the subject in relation to the Encounter Binding: Encounter Subject Status (Example)
 episodeOfCare	Σ	0..*	Reference(EpisodeOfCare)	Episode(s) of care that this

Encounter

An interaction during which services are provided for a patient

Name	Flags	Card.	Type	Description & Constraints ?
Encounter	TU		DomainResource	An interaction during which services are provided to the patient Elements defined in Ancestors: id , meta , implicitRules , language , text , contained , extension , modifierExtension
identifier		Σ 0..*	Identifier	Identifier(s) by which this encounter is known
status	?! Σ	1..1	code	planned in-progress on-hold discharged completed cancelled discontinued entered-in-error unknown Binding: Encounter Status (Required)
class	Σ	0..*	CodeableConcept	Classification of patient encounter context - e.g. Inpatient, outpatient Binding: Encounter class (Preferred)
priority		0..1	CodeableConcept	Indicates the urgency of the encounter Binding: ActPriority (Example)
type	Σ	0..*	CodeableConcept	Specific type of encounter (e.g. e-mail consultation, surgical day-care, ...) Binding: Encounter Type (Example)
serviceType	Σ	0..*	CodeableReference(HealthcareService)	Specific type of service Binding: Service Type (Example)
subject	Σ	0..1	Reference(Patient Group)	The patient or group related to this encounter
subjectStatus		0..1	CodeableConcept	The current status of the subject in relation to the Encounter Binding: Encounter Subject Status (Example)
episodeOfCare	Σ	0..*	Reference(EpisodeOfCare)	Episode(s) of care that this



Encounter

Ms. Córdova sees Dr. Anderson for an ambulatory visit about her symptoms.

```
{
  "resourceType": "Encounter",
  "id": "62988",
  "status": "finished",
  "class": {
    "system": "http://terminology.hl7.org/CodeSystem/v3-ActCode",
    "code": "AMB"
  },
  "type": [
    {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "185345009",
          "display": "Encounter for symptom (procedure)"
        }
      ]
    }
  ],
  "subject": {
    "reference": "Patient/62928",
    "display": "Ms. Esperanza675 Córdova800"
  },
  "participant": [
    {
      "type": [
        {
          "coding": [
            {
              "system": "http://terminology.hl7.org/CodeSystem/v3-ParticipationType",
              "code": "PPRF",
              "display": "primary performer"
            }
          ],
          "text": "primary performer"
        }
      ],
      "period": {
        "start": "2020-02-29T07:56:34-05:00",
        "end": "2020-02-29T08:57:34-05:00"
      },
      "individual": {
        "reference": "Practitioner/15116",
        "display": "Dr. Alleen813 Anderson154"
      }
    }
  ]
}
```



Encounter

Ms. Córdova sees Dr. Anderson for an ambulatory visit about her symptoms.

```
{  
  "resourceType": "Encounter",  
  "id": "62988",  
  "status": "finished",  
  "class": {  
    "system": "http://terminology.hl7.org/CodeSystem/v3-ActCode",  
    "code": "AMB"  
  },  
  "type": [  
    {  
      "coding": [  
        {  
          "system": "http://snomed.info/sct",  
          "code": "185345009",  
          "display": "Encounter for symptom (procedure)"  
        }  
      ]  
    }  
  ],  
  "subject": {  
    "reference": "Patient/62928",  
    "display": "Ms. Esperanza675 Córdova800"  
  },  
  "participant": [  
    {  
      "type": [  
        {  
          "coding": [  
            {  
              "system": "http://terminology.hl7.org/CodeSystem/v3-ParticipationType",  
              "code": "PPRF",  
              "display": "primary performer"  
            }  
          ],  
          "text": "primary performer"  
        }  
      ],  
      "period": {  
        "start": "2020-02-29T07:56:34-05:00",  
        "end": "2020-02-29T08:57:34-05:00"  
      },  
      "individual": {  
        "reference": "Practitioner/15116",  
        "display": "Dr. Alleen813 Anderson154"  
      }  
    }  
  ]  
}
```



Observation

Because of her symptoms,
Ms. Córdova has a NAAT
for SARS-CoV-2

```
{
  "resourceType": "Observation",
  "id": "63006",
  "status": "final",
  "category": [
    {
      "coding": [
        {
          "system": "http://terminology.hl7.org/CodeSystem/observation-category",
          "code": "laboratory",
          "display": "laboratory"
        }
      ]
    }
  ],
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "94309-2",
        "display": "SARS-CoV-2 (COVID-19) RNA [Presence] in Specimen by NAA with probe detection"
      }
    ],
    "text": "SARS-CoV-2 (COVID-19) RNA [Presence] in Specimen by NAA with probe detection"
  },
  "subject": {
    "reference": "Patient/62928"
  },
  "encounter": {
    "reference": "Encounter/62988"
  },
  "effectiveDateTime": "2020-02-29T08:57:34-05:00",
  "issued": "2020-02-29T08:57:34.125-05:00",
  "valueCodeableConcept": {
    "coding": [
      {
        "system": "http://snomed.info/sct",
        "code": "260373001",
        "display": "Detected (qualifier value)"
      }
    ],
    "text": "Detected (qualifier value)"
  }
}
```



Observation

Because of her symptoms,
Ms. Córdova has a NAAT
for SARS-CoV-2

```
{
  "resourceType": "Observation",
  "id": "63006",
  "status": "final",
  "category": [
    {
      "coding": [
        {
          "system": "http://terminology.hl7.org/CodeSystem/observation-category",
          "code": "laboratory",
          "display": "laboratory"
        }
      ]
    }
  ],
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "94309-2",
        "display": "SARS-CoV-2 (COVID-19) RNA [Presence] in Specimen by NAA with probe detection"
      }
    ],
    "text": "SARS-CoV-2 (COVID-19) RNA [Presence] in Specimen by NAA with probe detection"
  },
  "subject": {
    "reference": "Patient/62928"
  },
  "encounter": {
    "reference": "Encounter/62988"
  },
  "effectiveDateTime": "2020-02-29T08:57:34-05:00",
  "issued": "2020-02-29T08:57:34.125-05:00",
  "valueCodeableConcept": {
    "coding": [
      {
        "system": "http://snomed.info/sct",
        "code": "260373001",
        "display": "Detected (qualifier value)"
      }
    ],
    "text": "Detected (qualifier value)"
  }
}
```


RESTful API

Defines common interactions (read, update, search, etc) performed on a repository of typed Resources

This page is part of the FHIR Specification (v5.0.0: R5 - STU). This is the current published version. For a full list of available versions, see the [Directory of published versions](#). Page versions: **R5** R4B R4 R3 R2

3.2.0 RESTful API

FHIR Infrastructure Work Group Maturity Level: Normative Standards Status: Normative

FHIR is described as a 'RESTful' specification based on common industry level use of the term REST. In practice, FHIR only supports Level 2 of the [REST Maturity model](#) as part of the core specification, though full Level 3 conformance is possible through the use of [extensions](#). Because FHIR is a standard, it relies on the standardization of resource structures and interfaces. This may be considered a violation of REST principles but is key to ensuring consistent interoperability across diverse systems.

For each "resource type" the same set of interactions are defined which can be used to manage the resources in a highly granular fashion. Applications claiming conformance to this framework claim to be conformant to "RESTful FHIR" (see [Conformance](#)).

In addition to a number of [General Considerations](#) this page defines the following interactions:

Instance Level Interactions

read	Read the current state of the resource
vread	Read the state of a specific version of the resource
update	Update an existing resource by its id (or create it if it is new)
patch	Update an existing resource by posting a set of changes to it
delete	Delete a resource
history	Retrieve the change history for a particular resource


Type Level Interactions

create	Create a new resource with a server assigned id
search	Search the resource type based on some filter criteria
delete	Conditional Delete across a particular resource type based on some filter criteria
history	Retrieve the change history for a particular resource type

Whole System Interactions

API Examples:

Return *SARS-CoV-2 RNA NAAT*
Observation for my patient

```
 GET {base}/Observation?patient=62928&code=94309-2
```

Return any **Patients** with a *SARS-CoV-2 RNA NAAT*
Observation

```
 GET {base}/Patient?_has:Observation:patient:code=94309-2
```

FHIR Feature: Flexibility + Adaptation

Health data is inevitably complex; the long tail.

As a platform standard, FHIR's solution: specific techniques for extending and constraining via **profiles**.

FHIR Feature: Flexibility + Adaptation

Health data is inevitably complex; the long tail.

As a platform standard, FHIR's solution: specific techniques for extending and constraining via **profiles**.

FHIR Lingo: *Implementation Guide (IG)*

A specification for how FHIR resources (and APIs) are used for a particular interoperability problem, including computable structures (called **profiles**) representing the adaptations of the base FHIR standard for that use case.

Profile [Observation]

The FHIR specification is designed to be both **extended** and **constrained** for specific purposes

This page is part of the US Core (v7.0.0: STU7) based on FHIR (HL7® FHIR® Standard) R4. This is the current published version. For a full list of available versions, see the [Directory of published versions](#). Page versions: [STU6.1](#) [STU6](#) [STU5](#) [STU4](#) [STU3](#)

Content

Detailed Descriptions

Mappings

XML

JSON

TTL

13.136.1 Resource Profile: US Core Laboratory Result Observation Profile

13.136.1.1 Mandatory and Must Support Data Elements

In addition to the Mandatory and Must Support data elements in the [US Core Observation Clinical Result Profile](#), the following data elements must always be present ([Mandatory](#) definition) or must be supported if the data is present in the sending system ([Must Support](#) definition). They are presented below in a simple human-readable explanation. Profile specific guidance and examples are provided as well. The [Formal Views](#) section below provides the formal summary, definitions, and terminology requirements. Note that the "Differential Table" displays elements unique to this profile and the "Key Elements Table" displays a combined view of elements for this profile and the US Core Observation Clinical Result Profile.

Each Observation Must Have:

1. a category code of 'laboratory'
2. a laboratory [LOINC](#) code, if available, which tells you what is being measured

Each Observation Must Support:

1. a timestamp when the resource last changed*
2. a result value*
 - if the result value is a numeric quantity, a standard [UCUM](#) unit
 - if the result value is a coded quantity, a standard [SNOMED CT](#)
3. result interpretation
 - if the result value is a numeric quantity, a standard [UCUM](#) unit
4. result reference range
5. a specimen type (e.g., blood, serum, urine)

* see guidance below

Profile Specific Implementation Guidance:

Profile [Observation]

The FHIR specification is designed to be both **extended** and **constrained** for specific purposes

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Each Observation Must Have:

1. a category code of 'laboratory'
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Each Observation Must Support:

1. a timestamp when the resource last changed*
2. a result value*
 - if the result value is a numeric quantity, a standard [UCUM](#) unit
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3. result interpretation
 - if the result value is a numeric quantity, a standard [UCUM](#) unit
4. result reference range
5. a specimen type (e.g., blood, serum, urine)

* see guidance below

Profile Specific Implementation Guidance:



Building a foundation for FHIR-based exchange in the United States

- ONC Cures Act Rule (2020)
- CMS Interop and Patient Access Final Rule (2020)
- ONC HTI-1 Final Rule (2023)
- CMS Interop and Prior Authorization Final Rule (2024)
- Common Agreement 2.0 (2024)

Notice of Proposed Rule Making...

- ONC HTI-2 (2024)

U.S. Core Data for Interoperability (V2)

Advancing FHIR U.S. Core to meet industry needs

R#	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
R4	US Core 3.1.1 USCDI v1	US Core 4.0.0 USCDI v1	US Core 5.0.0 USCDI v2	US Core 6.1.0 USCDI v3	US Core 7.0.0 USCDI v4	US Core 8.0.0 USCDI v5	US Core 9 USCDI v6	US Core 10 USCDI v7			
R5 2023											
R6 2026							US Core 9 USCDI v6	US Core 10 USCDI v7	US Core 11 USCDI v8	US Core 12 USCDI v9	US Core 13 USCDI v10
Reg Base	R4_3.1.1	R4_3.1.1	R4_3.1.1	R4_3.1.1	R4_3.1.1	R4_3.1.1	R4_6.1.0	*	*	*	*



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1 Home

Official URL: http://hl7.org/fhir/us/core/ImplementationGuide/hl7.fhir.us.core	Version: 7.0.0
IG Standards status: Trial-use	Maturity Level: 3
Other Identifiers: OID:2.16.840.1.113883.4.642.40.2	Computable Name: USCore
Copyright/Legal: Used by permission of HL7 International, all rights reserved Creative Commons License	

STU Note

Key updates and detailed changes between this and prior versions are available on the US Core [Change Log](#) and [Changes Between Versions](#) pages.

- [Introduction](#)
- [Background](#)
- [How To Read This Guide](#)
- [US Core Actors](#)
- [US Core Profiles](#)
- [US Core FHIR RESTful interactions](#)

1.1 Introduction

This guide and the US Core profiles have become the foundation for US Realm FHIR implementation guides. This annual release reflects changes to [U.S. Core Data for Interoperability \(USCDI\)](#) and comments and requests from the US Realm FHIR community. (The [Future of US Core](#) page outlines this approach to yearly updates.) US Core has benefitted from testing and guidance by the Argonaut Project Team. Their feedback continues to lay the groundwork for documenting the US Core Profile design, interactions, requirements, and guidelines for patient data access and ONC Certification testing. Under the guidance of HL7 and the HL7 US Realm Steering Committee, the content will expand in future versions to meet the needs specific to the US Realm.

The US Core Implementation Guide is based on [FHIR Version R4](#). It defines the minimum constraints on the FHIR resources to create the US Core Profiles. The elements, extensions, vocabularies, and value sets that SHALL be present are identified, and how they are used is defined. It also documents the minimum FHIR RESTful interactions for each US Core Profiles to access patient data. Establishing the "floor" of standards to promote interoperability and adoption through common implementation allows for further standards development evolution for specific use cases. There are two different ways to implement US Core:

1. Profile Only Support: Systems may support *only* the US Core Profiles to represent clinical information.
2. Profile Support + Interaction Support: Systems may support *both* the US Core Profile content structure *and* the RESTful interactions defined for a resource.

For a detailed description of these different usages of US Core, see the [Conformance Requirements](#) page.

1.2 Background

The US Core requirements were initially developed, balloted, and published in FHIR DSTU2 as part of the [Office of the National Coordinator for Health Information Technology \(ONC\)](#) sponsored Data Access Framework (DAF) project. The Argonaut Data Query Implementation Guide superseded DAF and documented security and authorization and the querying of the [2015 Edition Common Clinical Data Set \(CCDS\)](#) and static documents. US Core descended directly from the Argonaut guide to support FHIR Version STU3 and eventually FHIR R4 and The ONC [U.S. Core Data for Interoperability \(USCDI\)](#).

1.3 How To Read This Guide

This Guide is divided into several pages, which are listed at the top of each page in the menu bar.



Corresponds to USCDI V4



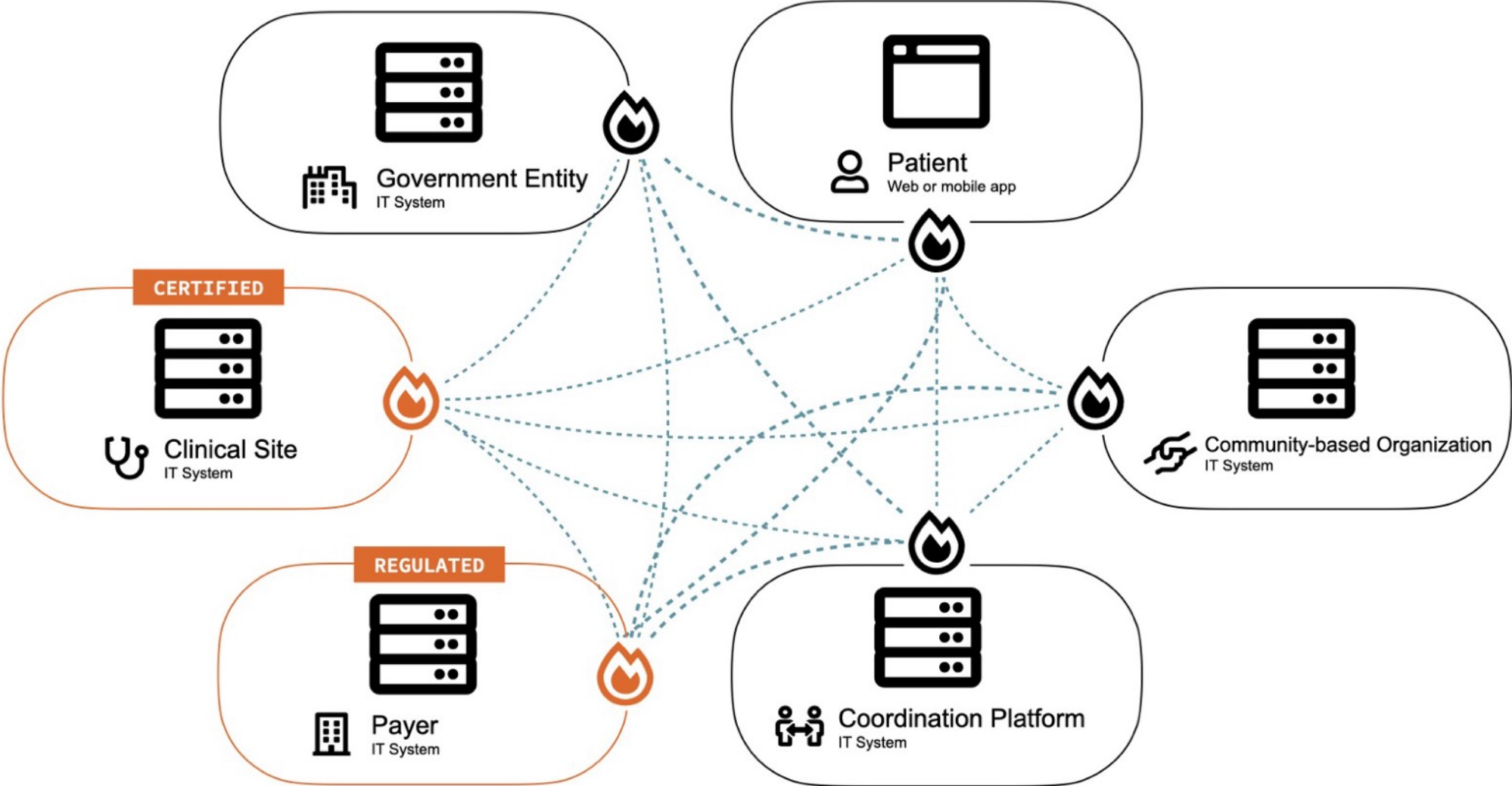
Required API Standards from HL7

	Patient Access API	Provider Access API	Provider Directory API	Payer-to-Payer API	Prior Auth API
FHIR Release 4.0.1	✓	✓	✓	✓	✓
HL7 FHIR US Core IG STU 3.1.1	✓	✓	✓	✓	✓
HL7 SMART App Launch Framework IG 1.0.0	✓	✓	✗	✗	✓
HL7 FHIR Bulk Data Access IG v 1.0.0 STU 1	✗	✓	✗	✓	✗

Recommended IGs from HL7

CARIN for Blue Button IG Version STU 2.0.0	✓	✓	✗	✓	✗
FHIR SMART App Launch IG Release 2.0.0	✗	✓	✗	✓	✗
Da Vinci PDex IG Version STU 2.0.0	✓	✓	✗	✓	✗
Da Vinci PDex U.S. Drug Formulary IG Version STU 2.0.1	✓	✗	✗	✗	✗
Da Vinci PDex Plan Net IG Version STU 1.1.0	✗	✗	✓	✗	✗
Da Vinci Coverage Requirements Discovery (CRD) IG Version STU 2.0.1	✗	✗	✗	✗	✓
Da Vinci Documentation Templates/Rules (DTR) IG Version STU 2.0.0	✗	✗	✗	✗	✓
Da Vinci Prior Authorization Support (PAS) IG Version STU 2.0.1	✗	✗	✗	✗	✓

Growing the FHIR-enabled digital foundation





Fixed with FHIR

MCG, Regence, and MultiCare Connected Care Receive 2023 KLAS Points of Light Award

Leaders in prior auth automation recognized for their innovative work in the HL7[®] Da Vinci Project

SEATTLE, Wash., June 27, 2023 – [MCG Health](#), part of the Hearst Health network and an industry leader in technology-enabled, evidence-based guidance, along with Regence Health Plans and MultiCare Connected Care, were recognized by KLAS with the 2023 Points of Light award. This was the first collaboration between a payer, provider, and clinical decision support vendor to produce a scalable and automated prior authorization (PA) workflow based on the [HL7 Da Vinci Project's](#) implementation guides (IGs). The three organizations were presented with the KLAS Points of Light award during the annual KLAS K2 Summit on May 10, 2023, in Salt Lake City.

KLAS recognized MCG, Regence, and MultiCare Connected Care for utilizing interoperability standards from the HL7 Da Vinci Project to create an end-to-end HL7 FHIR[®] (Fast Healthcare Interoperability Resources) workflow for prior authorizations. This technology automated the submission of prior authorization requests from the provider's electronic health record (EHR) to the





HL7 Product Portfolio

The extended FHIR family unlocks a massive world of opportunity

SMART on FHIR | Bulk FHIR | CQL | CDS Hooks

SMART on FHIR

Plug-and-play apps for seamless interoperability.



Highlight Reel

Dev friendly, OAuth 2.0-based

Patterns for user-facing apps and backend services

Capabilities for limiting access to certain data via scopes

Required in certified Health IT systems by federal regulations (e.g. HTI-1)

Table of Contents > Overview

This page is part of the Smart App Launch Implementation Guide (v2.2.0: STU 2.2) based on FHIR (HL7® FHIR® Standard) R4. This is the current published version. For a full list of available versions, see the [Directory of published versions](#)

1 Overview

Official URL: http://hl7.org/fhir/smart-app-launch/ImplementationGuide/hl7.fhir.uv.smart-app-launch	Version: 2.2.0
Active as of 2023-03-01	Computable Name: SmartAppLaunch

This implementation guide describes a set of foundational patterns based on [OAuth 2.0](#) for client applications to authorize, authenticate, and integrate with FHIR-based data systems. The patterns defined in this specification are introduced in the sections below. For background on SMART Health IT, see smarthealthit.org.

Portions of the specification designated as Experimental are indicated by **EXP** and background shading.

1.1 Discovery of Server Capabilities and Configuration

SMART defines a discovery document, available at [.well-known/smart-configuration](#) relative to a FHIR Server Base URL, allowing clients to learn the authorization endpoint URLs and features a server supports. This information helps client direct authorization requests to the right endpoint, and helps clients construct an authorization request that the server can support.

- [Discovery of Server Capabilities and Configuration](#)
- [SMART Defines Two Patterns For Client Authorization](#)
- [SMART Defines Two Patterns For Client Authentication](#)
- [Scopes for Limiting Access](#)
- [Token Introspection](#)
- [User-Access Brands](#)
- [Persisting App State](#)
- [FHIR Publication Details](#)

1.2 SMART Defines Two Patterns For Client Authorization

1.2.1 Authorization via SMART App Launch

Authorizes a user-facing client application ("App") to connect to a FHIR Server. This pattern allows for "launch context" such as a *currently selected patient* to be shared with the app, based on a user's session inside an EHR or other health data software, or based on a user's selection at launch time. Authorization allows for delegation of a user's permissions to the app itself.

A Blooming App Ecosystem

The SMART App Gallery interface features a top navigation bar with the SMART logo, 'App Gallery' text, and links for 'Add New Listing' and 'Your Listings'. Below this is a search bar with a magnifying glass icon and a 'Login' button. A 'Filters' dropdown menu is located on the left. The main content area is titled 'Featured Apps' with a count of 47 and a 'Sort: Name (A-Z)' dropdown. Two featured app cards are visible: 'Abstractive Health' by Abstractive Health, described as a physician AI assistant, and 'AI-Powered Health Chart App' by Prairie Byte Solutions, described as a pioneering solution for accessing health data. The footer includes a globe icon and the text 'SMART App Gallery'.

The Epic Showroom interface has a yellow header with a search bar containing the text 'FHIR' and a menu icon. The main content area displays a list of FHIR-related applications. Each entry includes a logo, the app name, and a brief description. The visible apps are: 'AppScript on FHIR' (Digital Technology Prescribing), 'EBMcalc FHIR App E4' (Patient Treatment Decision Support), 'PaceMate LIVE - SMART on FHIR EHR Launch' (Ambulatory Cardiac Monitoring Integration), 'Etiometry FHIR API' (ICU Monitor), 'ethizo SMART on FHIR Bulk' (Ambient Voice Recognition), and 'Solo Backend Service - SMART on FHIR'. The footer features a globe icon and the text 'Epic Showroom'.

The Oracle Healthcare Marketplace interface has a dark header with the Oracle logo and 'Cloud Marketplace' text. Below the header is a search bar and a 'Filters' link. The main content area is titled 'Search Results' and lists several applications. Each entry includes a logo, the app name, a star rating, and a 'Free' label. The visible apps are: 'PersonaPay™ for Staff-Assisted and Self-Serve Payments', 'T System SMART App™', 'ActX', 'Fabric: Engagement Suite', 'Wellsheet', 'MedActionPlan PRO', and 'TelemedIQ'. The footer includes a globe icon and the text 'Oracle Healthcare Marketplace'.

Bulk FHIR

Efficient access to large data sets on groups of individuals



Highlight Reel

Uses FHIR asynchronous (single) request pattern

Produces FHIR in compact NDJSON

Uses system:system SMART backend services for security

Required in certified Health IT systems by federal regulations (e.g. HTI-1)

[Table of Contents](#) > [Bulk Data IG Home Page](#)

This page is part of the FHIR Bulk Data Access (Flat FHIR) (v2.0.0: [STU 2](#)) based on [FHIR R4](#). This is the current published version. For a full list of available versions, see the [Directory of published versions](#).

1 Bulk Data IG Home Page

Providers and organizations accountable for managing the health of populations often need to efficiently access large volumes of information on a group of individuals. For example, a health system may want to periodically retrieve updated clinical data from an EHR to a research database, a provider may want to send clinical data on a roster of patients to their ACO to calculate quality measures, or an EHR may want to display claims data to help close gaps in care. The data exchange often involves extracting a specific subset of fields from the source system, mapping the fields into a structured file format like CSV, and persisting the files in a server from which the requester can then download them into the target system. This multi-step process increases the cost of integration projects and can act as a counter-incentive to data liquidity.

- [Conformance](#)
- [Use Cases](#)
- [Additional Documentation](#)

Existing FHIR APIs work well for accessing small amounts of data, but large exports can require hundreds of thousands of requests. This implementation guide defines a standardized, FHIR based approach for exporting bulk data from a FHIR server to a pre-authorized client.

1.1 Conformance

To declare conformance with this IG, a server should include the following URL in its `CapabilityStatement.instantiates`: <http://hl7.org/fhir/uv/bulkdata/CapabilityStatement/bulk-data>

1.2 Use Cases

This implementation guide is designed to support sharing any data that can be represented in FHIR. This means that the IG should be useful for such diverse systems as:

- “Native” FHIR servers that store FHIR resources directly
- EHR systems and population health tools implementing FHIR as an interoperability layer
- Financial systems implementing FHIR as an interoperability layer

1.2.1 US Core Data for Interoperability

Applies to: EHR systems that support the US Core Data for Interoperability.

This use case exports all resources needed for the [US Core Data for Interoperability](#), as profiled by the [HL7 Argonaut FHIR Accelerator](#). For a full list of these resources and profiles, see <http://www.hl7.org/fhir/us/core/>.



Clinical quality language: standardized clinical logic for decision support and quality measures

Highlight Reel


Same logic can be deployed across multiple FHIR-based systems, enhancing efficiency and consistency

Enables clinicians and developers to clearly define clinical criteria and decision logic

Works [hand-in-hand with FHIR](#)

The language used to evaluate eCQMs in CMS quality programs



This page is part of the Clinical Quality Language Specification (v1.5.2: [Normative - Normative](#)) based on [FHIR R4](#). This is the current published version. For a full list of available versions, see the [Directory of published versions](#) 

Clinical Decision Support Work Group	Maturity Level: N	Standards Status: Normative
--------------------------------------	-------------------	-----------------------------

Clinical Quality Language (CQL)

HL7 Standard: Clinical Quality Language Specification, Release 1 Mixed Normative/Trial-Use (CQL 1.5)

HL7 Mixed Normative/STU Specification

Clinical Quality Language (CQL) is a high-level, domain-specific language focused on clinical quality and targeted at measure and decision support artifact authors.

In addition, this specification describes a machine-readable canonical representation called Expression Logical Model (ELM) targeted at implementations and designed to enable sharing of clinical knowledge.



Formal Name:	HL7 Cross-Paradigm Specification: Clinical Quality Language, Release 1
ANSI Designation:	ANSI/HL7 CQLANG, R1-2020
Date of Approval:	2020-12-01

CQL is an ANSI Normative Standard. ANSI has certificated that the portions of this specification marked Normative have met its requirements for development of a formal standard.

This specification is normative, except where identified as informative or trial-use content. For a complete description of the changes to this version, please review the version history linked below.

CDS Hooks

Standardized integration with remote decision support services within a clinician's workflow



Highlight Reel

Synchronous, workflow-triggered CDS calls returning information, suggestions, or App launch

Works perfect with FHIR as patient data

“Hooks” for things like “opening a patient’s record”, “placing an order”

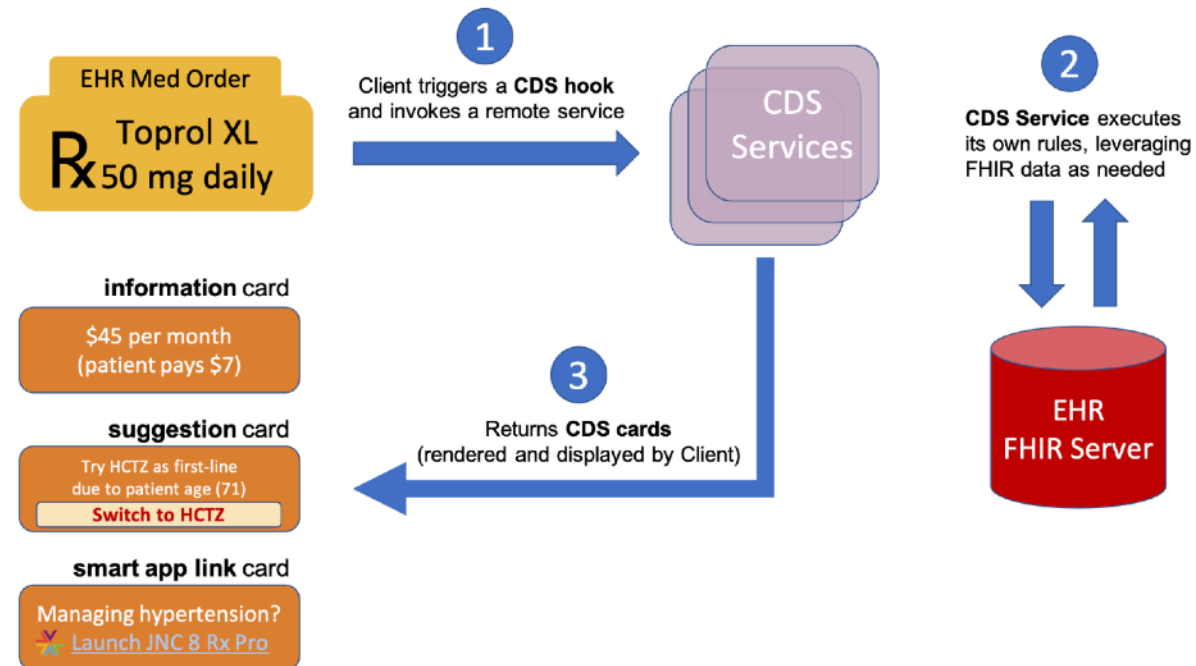
Proposed in draft HTI-2 regulation

How it works

User activity inside the clinician's workflow triggers **CDS hooks** in real-time. For example:

- `patient-view` when opening a new patient record
- `order-select` when selecting one or more orders to place for a patient
- `order-sign` immediately before an order is signed

When a triggering activity occurs, the CDS Client notifies each CDS service registered for the activity. These services must then provide near-real-time feedback about the triggering event. Each service gets basic details about the clinical workflow context (via the `context` parameter of the hook) plus whatever service-specific data are required (via the `pre-fetch-template` parameter).



Support for CDS Hooks is Growing



Cheat Codes for AI Innovation in Health



Semantically interoperable health data at scale



Bulk

Simple export of big FHIR data (e.g. for model training)



CDS Hooks

Workflow-integrated interaction with CDS (including AI)



CQL

Standardized clinical knowledge and metrics



SMART App
Launch

Standard integration for apps interacting with FHIR data

Endless Possibilities

ZERO TO ONE | PETER THIEL | Virgin Business

EGO IS THE ENEMY RYAN HOLIDAY P

RYAN HOLIDAY THE OBSTACLE IS THE WAY
The Timeless Art of Turning Trials into Triumph
PORTFOLIO PENGUIN

EXPONENTIAL ORGANIZATIONS ISMAIL, MALONE & VAN GEEST
DIVERSION BOARDS

Value Proposition Design
WILEY

THE STARTUP
OWNER'S MANUAL

Steve Blank
Bob Dorf
K&S

The corporate startup

Tendayi Viki
Dan Toma
Esther Gons



HL7[®] FHIR[®]

5 Key Resources for Implementers

Connect | Discover | Build on | Test | Learn

Connect: join the FHIR community online

The screenshot shows the chat.fhir.org web interface. At the top, the browser address bar displays 'chat.fhir.org'. The interface features a dark theme with a sidebar on the left containing navigation options: 'Views' (Recent conversations, Combined feed) and 'Channels' (Active, analytics on FHIR, Announcements, argonaut, australia, Belgium, bulk data, C-CDA, canada, Cancer Interoperability, Care Plan/Care Coordination, CARIN BB ExplanationOfBenefit, CARIN IG for Blue Button®, CCDA / FHIR mapping stream, cda to fhir, cds, cds hooks). The main area is titled 'Recent conversations' and includes a search bar and filter buttons (Include DMs, Unread, Participated). Below this is a table of conversations:

Channel	Topic	Participants	Time
committers/notification	ig-build		6 minutes ago
IG creation	unknown NamingSystemIdentifierType code '?'		9 minutes ago
australia	AU eRequest		17 minutes ago
shorthand	pattern auto-population introduces duplicates		40 minutes ago
implementers	Longest Observation	+3	42 minutes ago
cql	function ToString(CodeableConcept)		46 minutes ago
implementers	OperationOutcome code/details for specific use cases		49 minutes ago
V2	ACK handling		56 minutes ago
tooling/Package Crawlers	stream events		An hour ago
Da Vinci	Claim Response service place		An hour ago

Discover: find FHIR specifications



About FHIR

FHIR Packages

Publish a Package

Refine package results

Latest release ?

Only FHIR Versions

- R5
- R4B
- R4
- STU3
- DSTU2

[clear filter](#)

Find matching contents by ?

- Instances
- Profiles

Only in jurisdictions

- Australia
- Belgium

prior authorization



75 results found in 325 ms

POWERED BY SIMPLIFIER.NET

http://hl7.org/fhir/us/davinci-pas • hl7.fhir.us.davinci-pas

R4

Da Vinci Prior Authorization Support (PAS) FHIR IG

2.0.1

December 2023

HL7 International / Financial Management

Guidelines for conveying coverage requirements to clinicians when planning treatment. (built Fri, Dec 1, 2023 20:54+0000+00:00)

Showing first 4 matches:

StructureDefinition AuthorizationNumber

ImplementationGuide DaVinciPriorAuthorizationSupport

Bundle ReferralAuthorizationBundleExample

Bundle HomecareAuthorizationBundleExample

Build on: use open source reference implementations

The screenshot shows the Foundry website (foundry.hl7.org) with a search bar and a sidebar containing filters for Technology, Badges, Function, World Regions, and Domains. The main content area displays four featured open source reference implementations:

- FAST - UDAP Security Server**: A server reference implementation for the FAST Security for Scalable Registration, Authentication, and Authorization Implementation Guide. It integrates UDAP into existing Duende Identity Server references. (https://github.com/JoeShook/udap-devdays-2024)
- SMART Bulk Data CLI Client**: An open-source, NodeJS command line interface for making bulk data requests against FHIR servers implementing the [FHIR Bulk Data API]. (https://www.hl7.org/fhir/uv/bulkdata/)
- Documentation Template and Rules (DTR) Examples CDS Library**: A library of Clinical Decision Support Rules (CDS) to support the CRD, DTR, and PAS use cases. (CMS-0057) The CDS-Library stores common files necessary to make the Coverage Requirements Discovery (CRD), Documentation Templates and Rules (DTR) and Prior
- Genomic Operations Examples and Exercises**: This section provides scenarios that demonstrate various capabilities of the FHIR Genomics Operations. You can also explore these scenarios using the [postman collection] (https://github.com/FHIR/genomics-operations/blob/main/FHIRGenomics-Operations.postman_collection.json).



TECHNOLOGY

- FHIR Servers
- FHIR Clients
- Data & Scripts
- CQL Libraries
- Other

BADGES

HL7 Accelerators

- Argonaut
- CARIN Alliance
- CodeX
- Da Vinci
- FAST
- Helios

Function

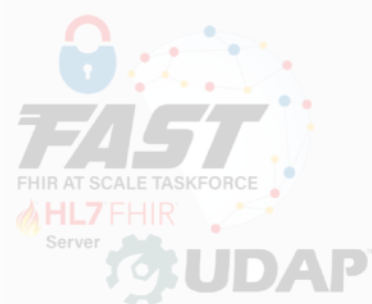
- Directories
- Financial
- Infrastructure

World Regions

- United States

Domains

- Genomics
- Pharmacy



FAST - UDAP Security Server

A server reference implementation for the FAST Security for Scalable Registration, Authentication, and Authorization Implementation Guide. Want to integrate UDAP into your existing Duende Identity Server refer to (<https://github.com/JoeShook/udap-devdays-2024>) for a great informative starting point.



SMART Bulk Data CLI Client

The Bulk Data client is an open-source, NodeJS command line interface for making bulk data requests against FHIR servers implementing the [FHIR Bulk Data API] (<https://www.hl7.org/fhir/uv/bulkdata/>). The client initiates data exports, polls for job status, and downloads files once the export is complete. It



Documentation Template and Rules (DTR) Examples CDS Library

A library of Clinical Decision Support Rules (CDS) to support the CRD, DTR, and PAS use cases. [CMS-0057] The CDS-Library stores common files necessary to make the Coverage Requirements Discovery (CRD), Documentation Templates and Rules (DTR) and Prior



Genomic Operations Examples and Exercises

This section provides scenarios that demonstrate various capabilities of the FHIR Genomics Operations. You can also explore these scenarios using the [postman collection] (https://github.com/FHIR/genomics-operations/blob/main/FHIRGenomicsOperations.postman_collection.json).



HAPI FHIR

Infrastructure

Close

HAPI FHIR is a complete implementation of the HL7 FHIR standard for healthcare interoperability in Java. It is maintained by an open community developing software licensed under the business-friendly Apache Software License 2.0. HAPI FHIR is a product of Smile Digital Health and maintained on GitHub.

These configurations of HAPI will automatically transmit telemetry data if enabled in your platform configuration.

- Try It Now
- Support
- Source Code
- Leave Feedback

Standard

Licensing Options
Apache 2.0 (free)

Server: HAPI Test Server (R4 FHIR) Source Code

KML JSON
On Off

data count

HAPI FHIR

You are accessing the public FHIR server **HAPI Test Server (R4 FHIR)**. This server is hosted elsewhere on the internet and accessed using the HAPI client implementation.

This is not a production server! Do not store any information here that contains personal health information. This server will be regularly purged and reloaded with fixed test data.

Server	HAPI FHIR Test/Demo Server R4 Endpoint
Software	HAPI FHIR Server - 6.11.2-SNAPSHOT/69cd9eb47e/2023-11-29
FHIR Base	http://hapi.fhir.org/baseR4

Server Actions

Retrieve the server's **conformance** statement.

Conformance

Retrieve the update **history** across all resource types on the server.

History Since Limit # (opt)

Multiple FHIR Releases

in a single atomic transaction

- Instructions
- Configuration Wizard
- Bundled Products
- Included With

Now available in FHIR R4 and R5 configuration options!

Running HAPI FHIR on PostgreSQL

If you don't know what to do, you probably want to use the r4 configuration to run HAPI in FHIR R4 mode. For a more real-world experience, HAPI will connect to a PostgreSQL Server



Price Cost Transparency (PCT) Payer Server

Close

Financial United States Da Vinci

This server is based on the HAPI FHIR JPA Starter server with modifications to support Patient Cost Transparency. This version of the reference Implementation supports the [STU1 version of the Da Vinci Patient Cost Transparency Implementation Guide](#)

The primary file for processing the Good Faith Estimate is [GFESubmitProvider.java](#)

A payer server reference implementation for the Da Vinci Patient Cost Transparency (PCT) Implementation Guide. [US-116HR-133][CMS-9908] It provides the means to submit a Good Faith Estimate (GFE) Collection Bundle and retrieve the resulting Advanced Explanation of Benefit (AEOB) Bundle.

- Try It Now
- Support
- Source Code
- Leave Feedback

- Implementation Guide (1.0.0)
- Confluence

Licensing Options

Apache 2.0 (free)

Instructions

No instructions have been provided.

HTTP 200 OK

Response Headers

Narrative

Patient Cost Transparency Implementation Guide Payer Capability Statement

- Implementation Guide Version: 2.0.0-beta1
- FHIR Version: 4.0.1
- Supported Formats: **SMALL** support only. **SHOULD** support only.
- Supported Patch Formats
- Published on: 2023-04-18 14:24:03-0500
- Published by: HL7 International / Financial Management

Note to Implementers: FHIR Capabilities

Any FHIR capability may be "allowed" by the system unless explicitly marked as "SHALL NOT". A few items are marked as "MAY" in the implementation Guide to highlight their potential role.

FHIR RESTful Capabilities

Mode: server

Summary of known capabilities

Capabilities by Resource/Profile

Summary

The summary table lists the resources that are part of this configuration, and for each resource it lists:

- The server's profile(s), if any.
- The interactions supported for each resource (Read, Search, Update, and Create, are always shown, while View, Patch, Delete, History on Instance, or History on Type are only present if the resource is documented in the guide as supporting those interactions).
- The other resources enabled for this resource.
- The operations on the resource (if any).

Resource Type	Profile	R	U	C	U	CR	CR	CR	CR	CR	CR	CR	CR	CR	CR	CR	CR
Bundle	Supported profiles: PCT AEOB Bundle PCT GFE Bundle PCT GFE Collection Bundle																
ExpansionOfBundles	Supported profiles: PCT AEOB Bundle																
Endpoint	Supported profiles: PCT Coverage																
Cost	Supported profiles: PCT Good Faith Estimate Professional PCT Good Faith Estimate Individual																
Organization	Supported profiles: PCT Organization																
Practitioner	Supported profiles: PCT Practitioner																

Revision Conference: SN

License: Apache 2.0

Support Policy

Home

Configuration Wizard

Build on: many other open source tools

Reference Libraries

JAVA

.Net

Delphi

R

Ruby

Python

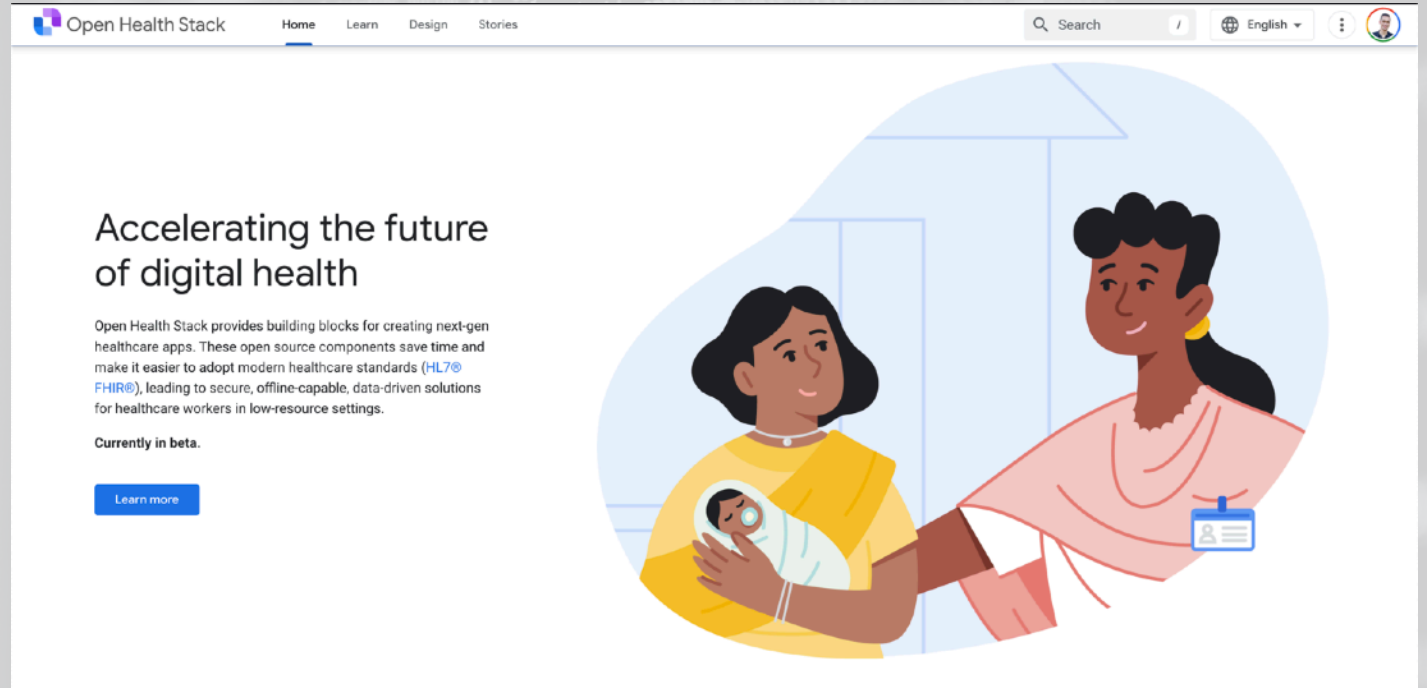
Swift

PHP

Dart/Flutter

Android

Clojure




Example: Open Health Stack

FHIR SDK for Android

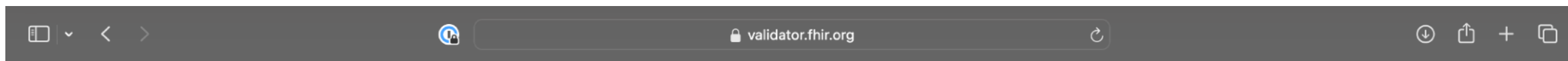
Offline-capable, mobile-first FHIR toolkit (including CQL!) allows developers to create applications helping community health workers in LMICs.

FHIR Analytics

Turn FHIR data into analytics-ready formats for on-prem or cloud processing

 Open Health Stack

Test: validate your FHIR content



Validate Options

Language
English
● tx.fhir.org
● packages2.fhir.org

Validate Resources

Manually enter, or upload resources for validation.

ENTER RESOURCE

UPLOAD RESOURCES

Code

```
{
  "resourceType": "Observation",
  "id": "cbc-hematocrit",
  "meta": {
    "profile": ["http://hl7.org/fhir/us/core/StructureDefinition/us-core-observation-lab"]
  },
  "status": "final",
  "category": [{
    "coding": [{
      "system": "http://terminology.hl7.org/CodeSystem/observation-category",
      "code": "laboratory",
      "display": "Laboratory"
    }],
    "text": "Laboratory"
  }],
  "code": {
    "coding": [{
      "system": "http://terminology.hl7.org/CodeSystem/observation-category",
      "code": "laboratory",
      "display": "Laboratory"
    }],
    "text": "Laboratory"
  }
}
```


| **Learn:** advance *your* FHIR expertise

Education

On Demand

Virtual training events

In person training

Credentialing

Showcase your FHIR knowledge

Helps hirers find qualified people

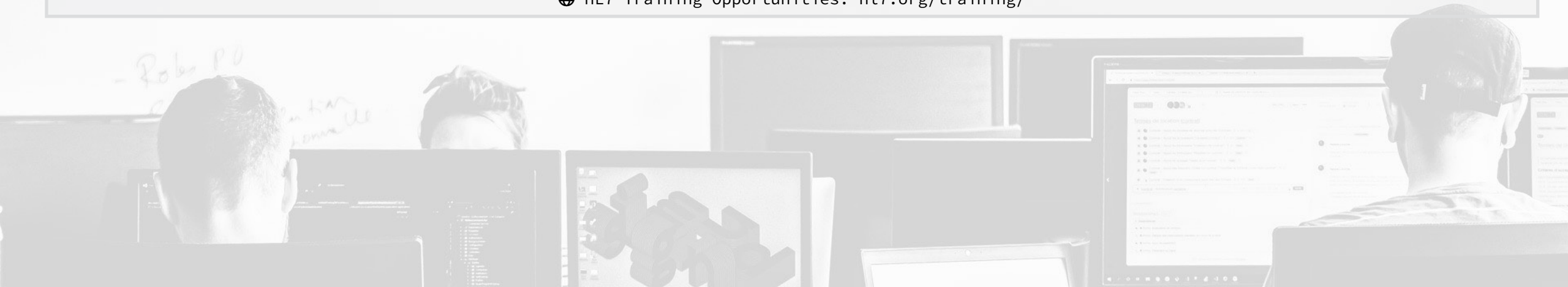
Events

HL7 Work Group Meetings

HL7 FHIR Connectathons

DevDays

🌐 HL7 Training Opportunities: hl7.org/training/



Take Home Messages

Why HL7[®] FHIR[®] ?

Accelerated development

Find top talent

Reduce dev costs

Interoperability + ease of integration

Regulatory compliance

Market access and scalability

Free to focus on innovation

**Let FHIR be the rocket fuel
for your health innovations**





HL7[®] FHIR[®]

Educate. Engage. Enable.