HL7 standards for pluggable AI

Congres Architectuur in de Zorg

June 2024, v1.2

Rob Mulders

Introduction

Who am I?

Volunteer at HL7 Netherlands

One of the shareholders in Firely

During 1993 - 2020

Consultant en CEO van Furore

Business Intelligence specialist

UMC's Medical Intelligence chair

Developer in Python / R

Outdoor lover

Guide for skating on natural ice in Sweden

Every winter on natural ice

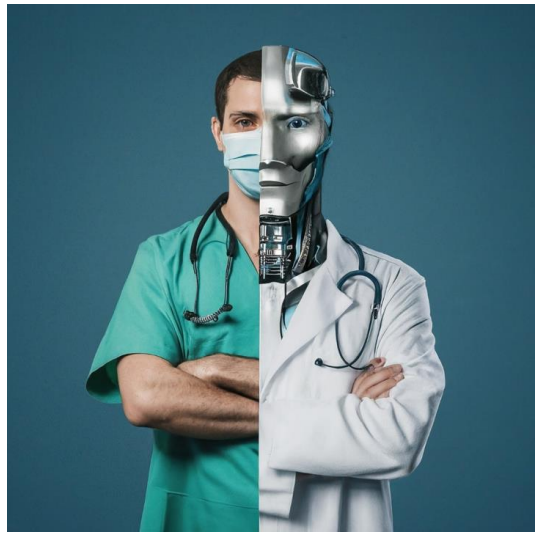
1996
Kasparov won

1997
Deep Blue won

Picture courtesy of Imgur and used under their Fair Use policy

Nowadays, chess apps compete to each other

Doctor versus AI?



My guess is

NO

It will be AI versus AI

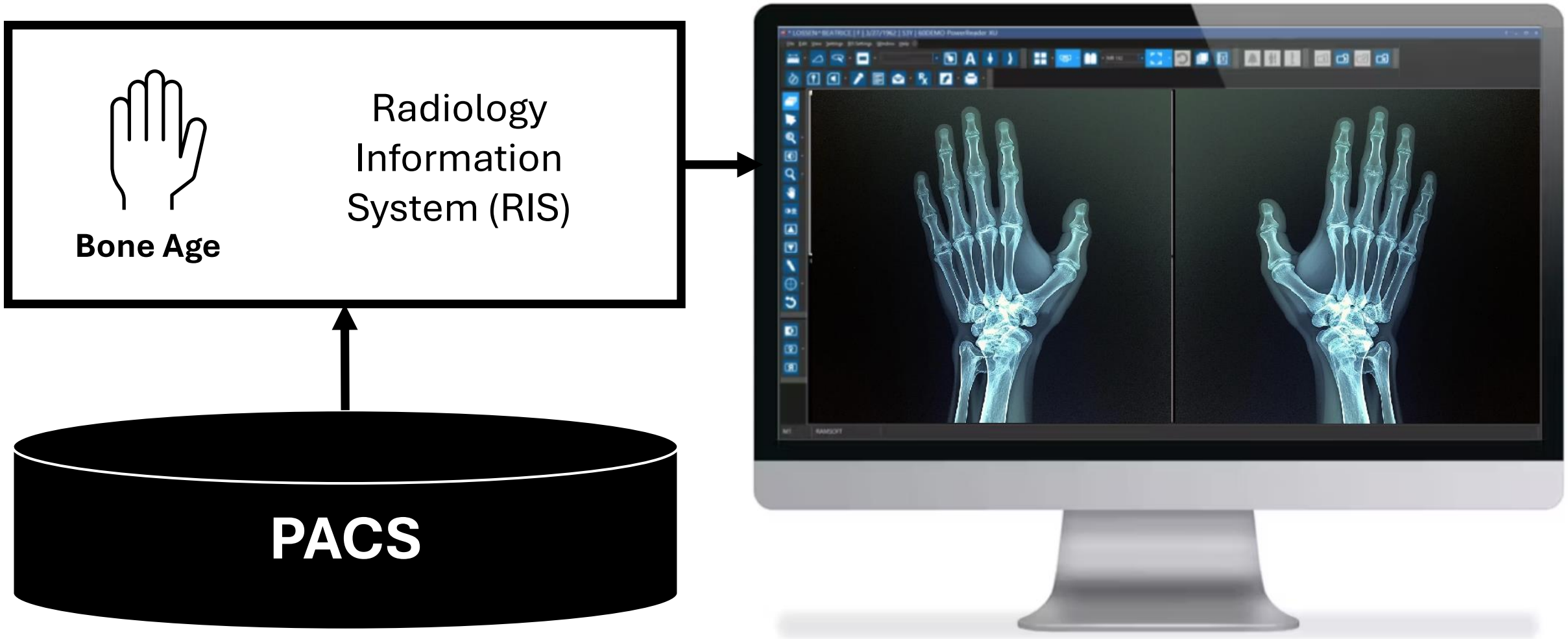
(and doctor with AI)

Don’t put all your eggs in one basket

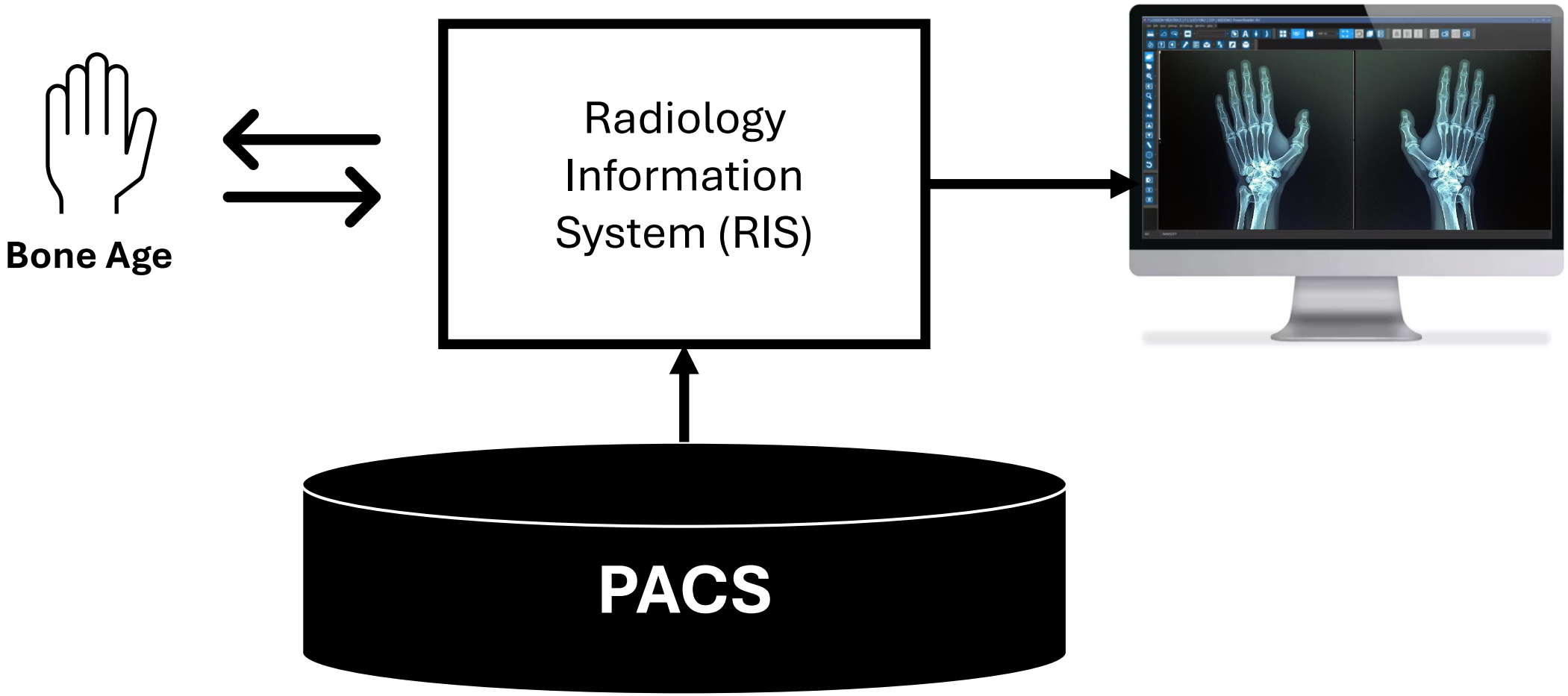
Make your AI’s pluggable!

HL7 Netherlands

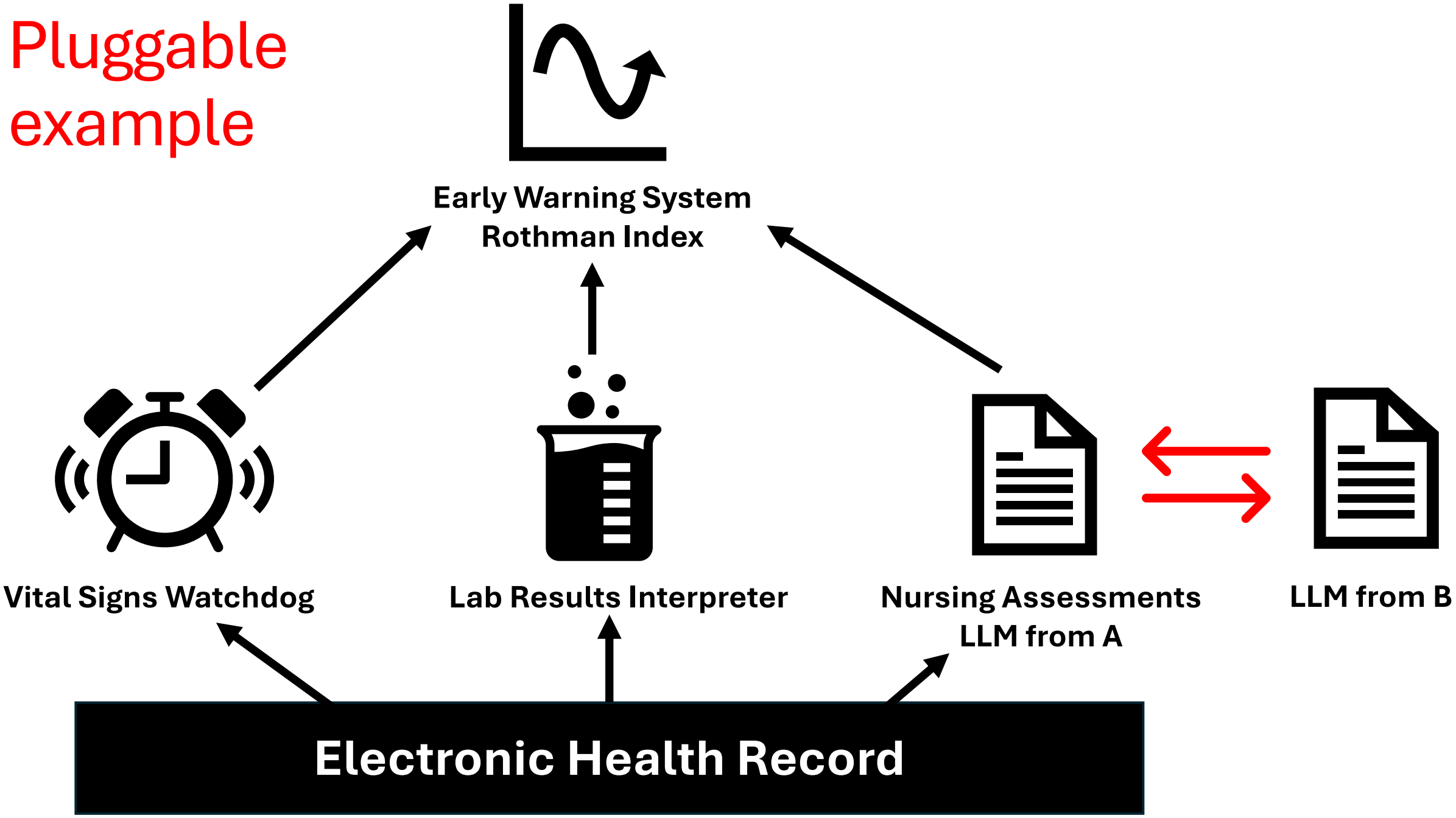
Non-pluggable example

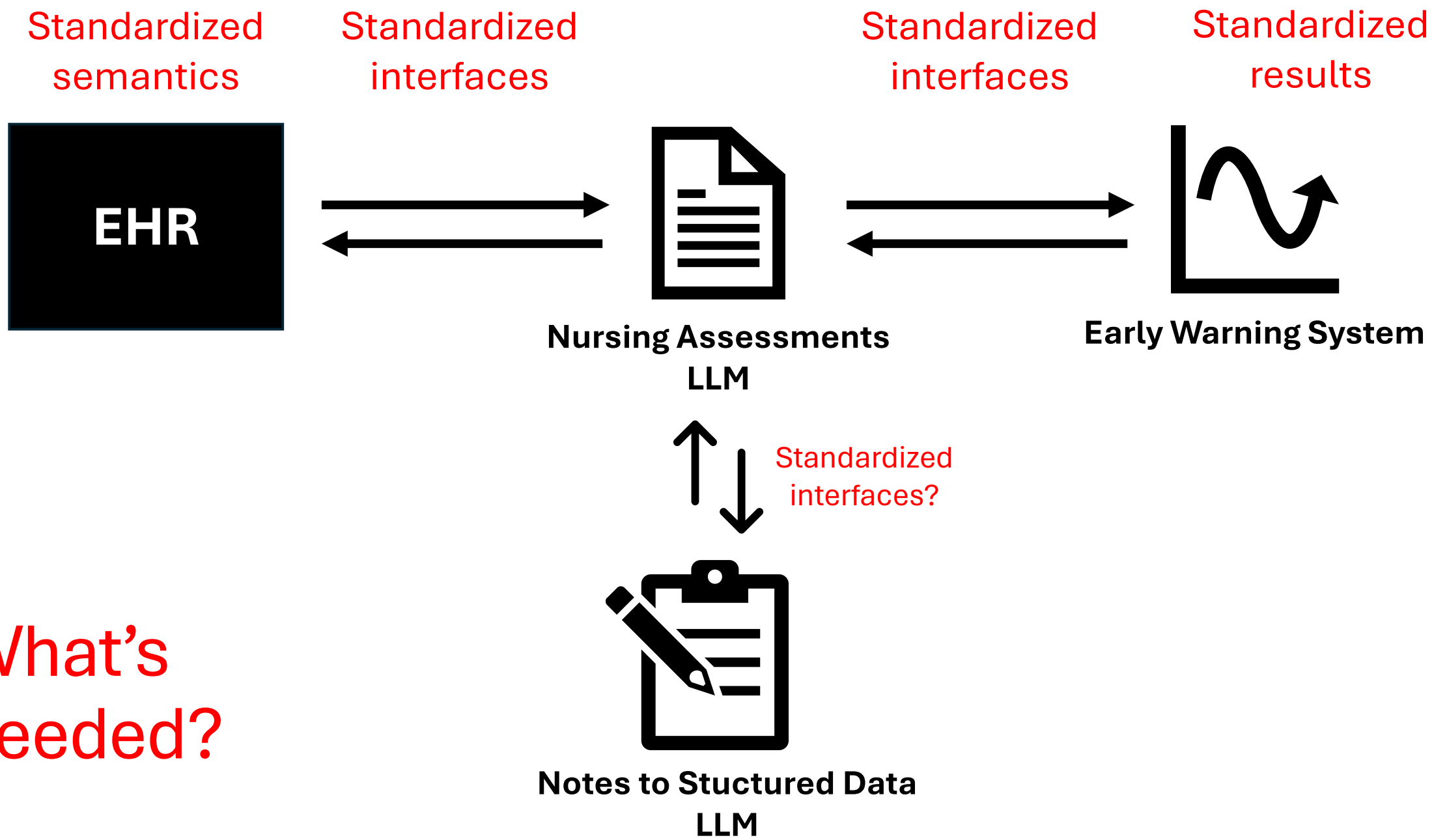


Pluggable example



Pluggable example



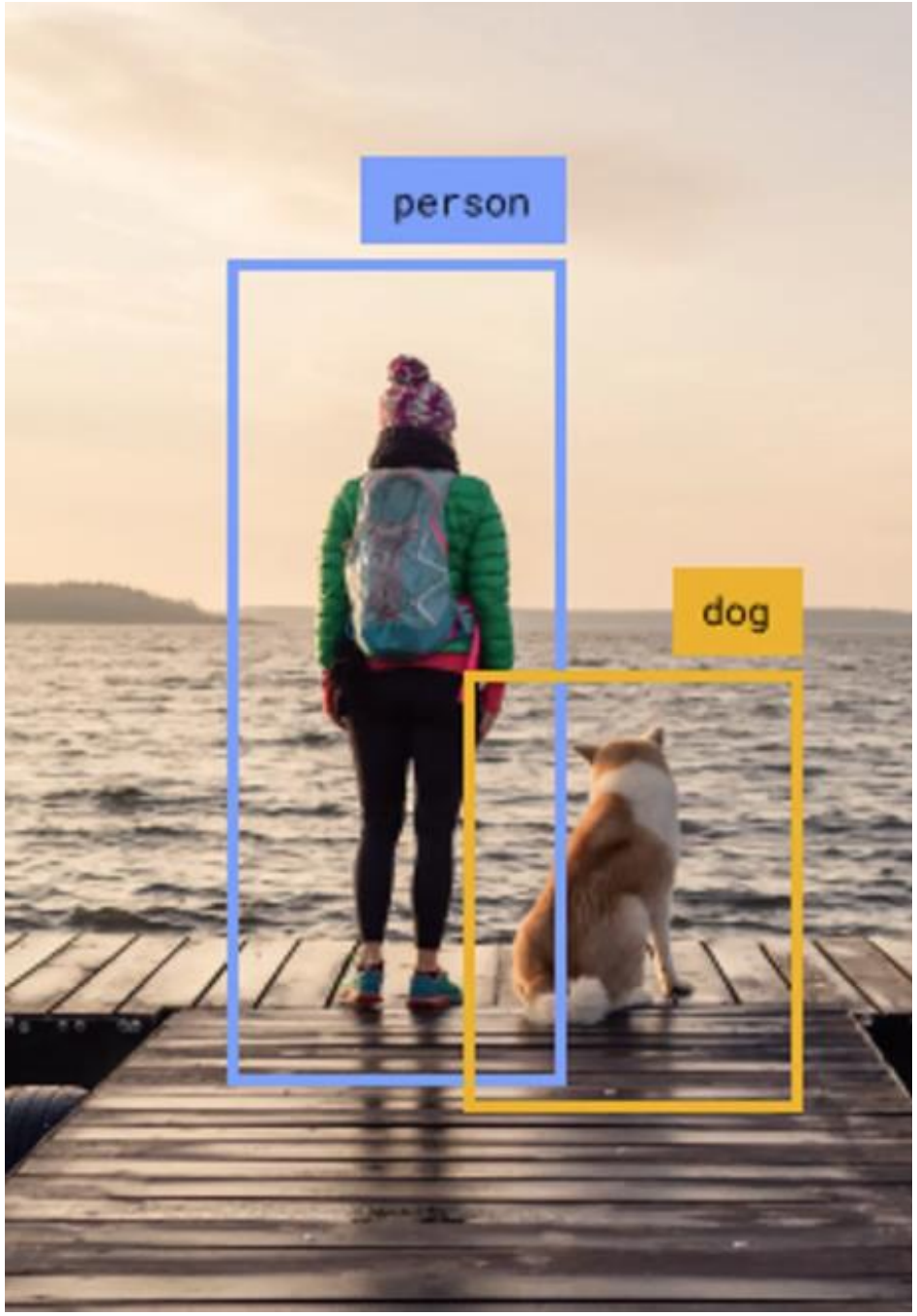


What's needed?

Pluggable AI

According to ChatGPT (3.5)

1. Design modular functionality
2. Standardize input and output parameters of each module
3. Apply API’s to let modules interact with each other
4. Implement a process for (hot) swapping of modules/LLM’s
5. ….



A Long-Standing Relationship to Transform Next Generation Vehicles

The companies will use their expertise to meet the evolving needs of providing best-in-class experiences for consumers

→

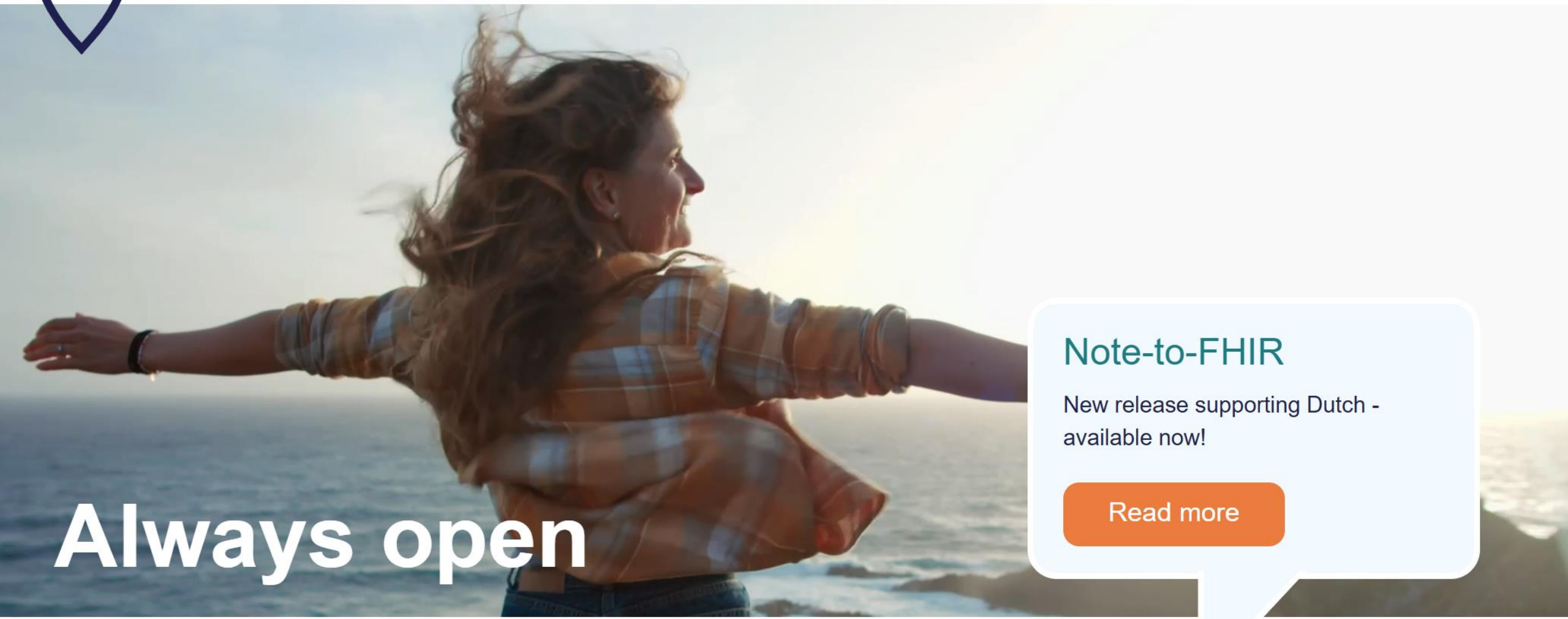
A Strategic Cooperation for Joint Development of Automated Driving Software Solutions

Combining BMW's current AD stack with Arriver's Vision Perception and NCAP Drive Policy products on Qualcomm Technologies' SoC, with the goal of designing best-in-class Automated Driving functions.

→

HealthSageAI

Application | Platform | Developers | Team | Careers | News | Contact



Note-to-FHIR

New release supporting Dutch - available now!

Read more

PLUGIN

Architectuur in de Zorg 6 juni 2024 Ontdek PLUGIN en de kracht van FHIR en Federated Learning

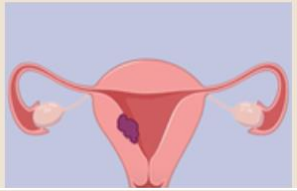
BY EVA • JUNE 3, 2024 • UNCATEGORIZED

pluginml

Clinical Federated Learning

AI-model voorspelt terugkeer van baarmoederkanker met grote nauwkeurigheid

3 juni 2024 Nieuws



Onderzoekers van het Leids Universitair Medisch Centrum (LUMC) hebben een AI-model ontwikkeld dat het risico op de terugkeer van baarmoederkanker nauwkeurig kan voorspellen.

LUMC ontwikkelt AI voor robot-geassisteerde prostaatkankeroperaties

4 maart 2024 Nieuws

Operaties om prostaatkanker te behandelen gebeuren de laatste jaren standaard met behulp van een robot en een 3D-beeldscherm. Het LUMC ontwikkelde kunstmatige intelligentie (AI) die hierbij helpt. De AI helpt chirurgen om effectiever te ...

LUMC eerste ziekenhuis met AI-opnamevoorspeller voor de Acute Opname Afdeling

27 februari 2024 Nieuws

Drukte op de Spoedeisende Hulp is geen betrouwbare indicator voor het aantal patiënten dat naar de Acute Opname Afdeling gaat. Daarom ontwikkelde het Leids Universitair Medisch Centrum een opnamevoorspeller. Deze tool maakt gebruik van ...

Nederlandse Vereniging voor Radiologie

AIFI

AI for imaging - Haalbaarheidsproject in de praktijk van een landelijke infrastructuur voor toepassing van artificiële intelligentie (AI) producten voor radiologie.

Besides AI, “pluggable” has moved forward

1984 – Getting temperature from COM-port	2024 – Getting all KNMI realtime temperatures

```
program IOBtnASM;
{$U+}
 var i: Byte;

procedure InPort(Port: Byte; var Value: Byte);
begin
   inline ($3A/Port/     {    ld a,Port    }
       $4F/              {    ld c,a       }
       $ED/              {    out a,(c)    }
       $3A/Value         {    ld (Value),a  });
end;

begin
  writeln(‘IO Temp using Assembly’);
  writeln('Press Ctrl+C to break');

  while true do
  begin
     InPort(0, i);
     delay(50);
  end;
end.
```

```
import requests

api_url = https://api.dataplatform.knmi.nl/open-data
function_name = "Actuele10minDataKNMIstations“

api_key = “MyApiKey”

get_temps = requests.get(api_url + function_name,
       headers={"Authorization": api_key})

ExcelGraph(get_temps)
```

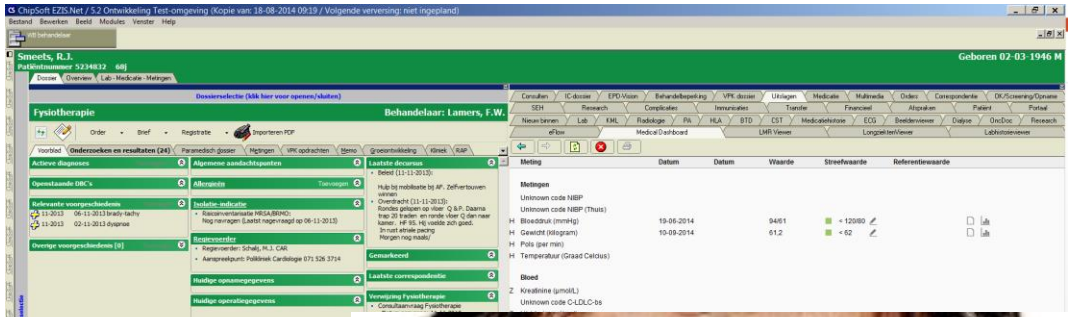
But there is one ‘tiny’ problem!

There is a ‘huge’ gap between progress in

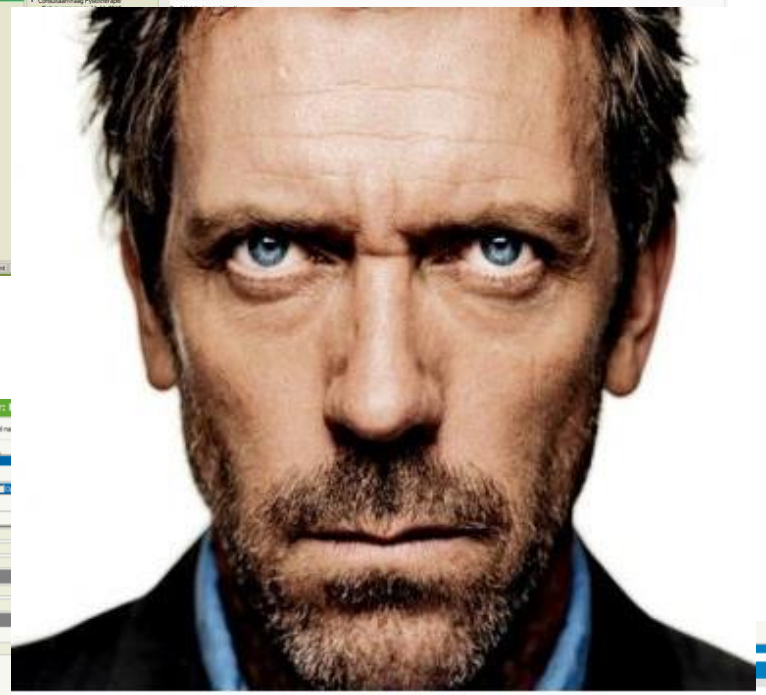
pluggability

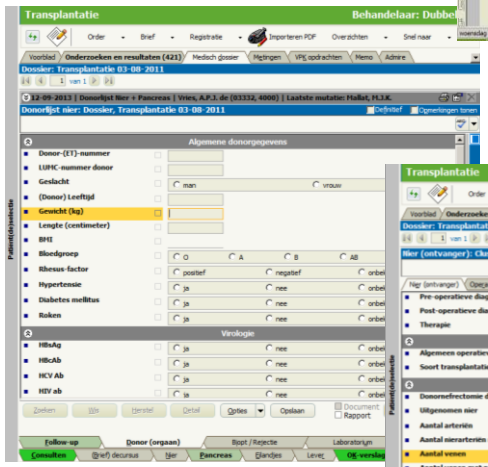
within healthcare versus other industries

NEDERLANDSE TRANSPLANTATIE STICHTING

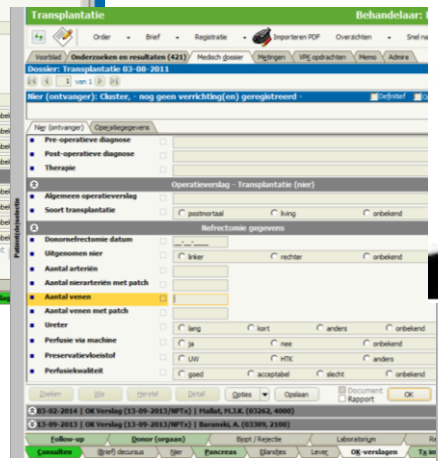


EHR

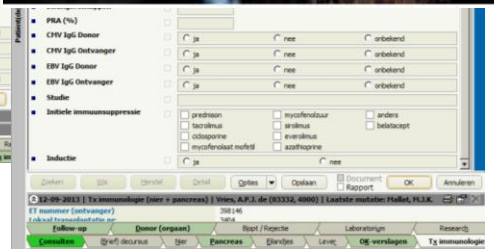




Diagnosis

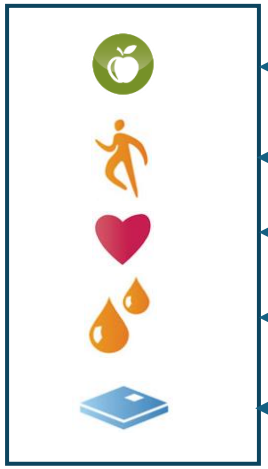


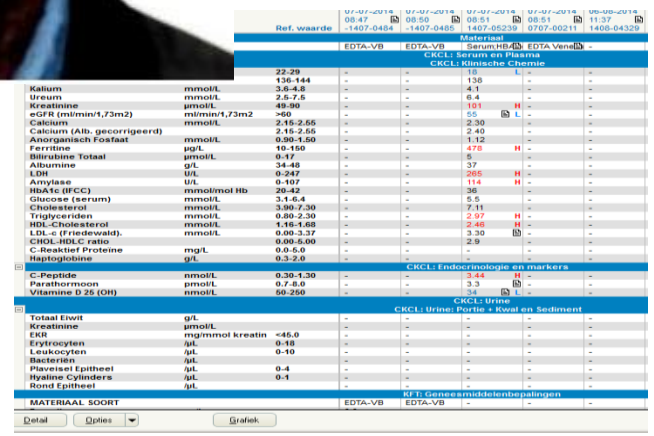
Treatment



Medication

PHR





Laboratory

diet

activities

pressure

weight

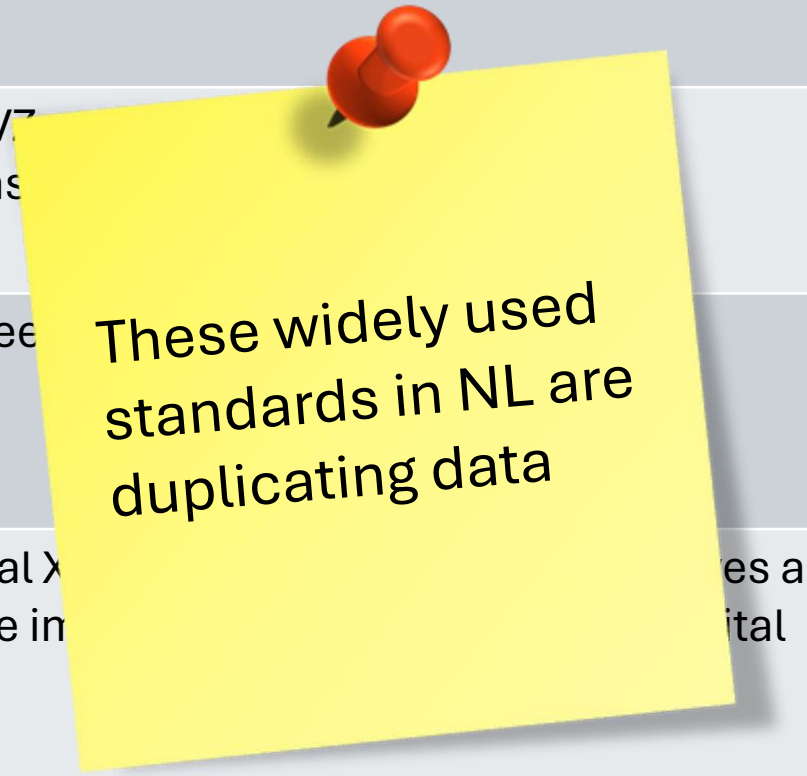
other

Doctor = integrator

Healthcare = copyshop

Interoperability in The Netherlands

Standard	How it works	Examples of use cases
HL7v2	Messaging between applications within a healthcare organization	Hospital Information System sends admission of new patient to various department systems
HL7v3	Messaging between healthcare organizations and (governmental) institutes	LSP at VZV RIVM Breas
HL7 CDA	Structured data of various aspects combined in one document	BGZ betwee
IHE XDS	Exchange of documents between healthcare organizations, like “verwijsbrieven”, “ontslagbrieven”, images	Via regional X copy of the in es a ital
EI-standard	Financial declaration of care delivery	Sending bills via Vecozo to the payer



People also ask

Is duplicate data bad for machine learning?

Duplicate data can have detrimental effects on your machine learning models and outcomes, such as reducing data diversity and representativeness, which can lead to overfitting or biased models. 21 Sept 2023

scaleout

The Copy Problem in Machine Learning

Atlassian Support
https://support.atlassian.com › docs › troubleshoot-issues...

Troubleshoot issues with copying product data

LinkedIn
https://www.linkedin.com › learning › the-dangers-of-co...

The dangers of copying a bad copy

24 Apr 2017 — The danger is that if you have a bad **copy** of your **data** and you simply duplicate that bad **copy**, well, now you have two bad copies. Here's the ...

Miro Community Forum
https://community.miro.com › ask-the-community-45 › i...

Issue with copying data from excel to M

Storage Switzerland, LLC
Home › StorageShort › StorageShort: Why is Copy Data a Problem?

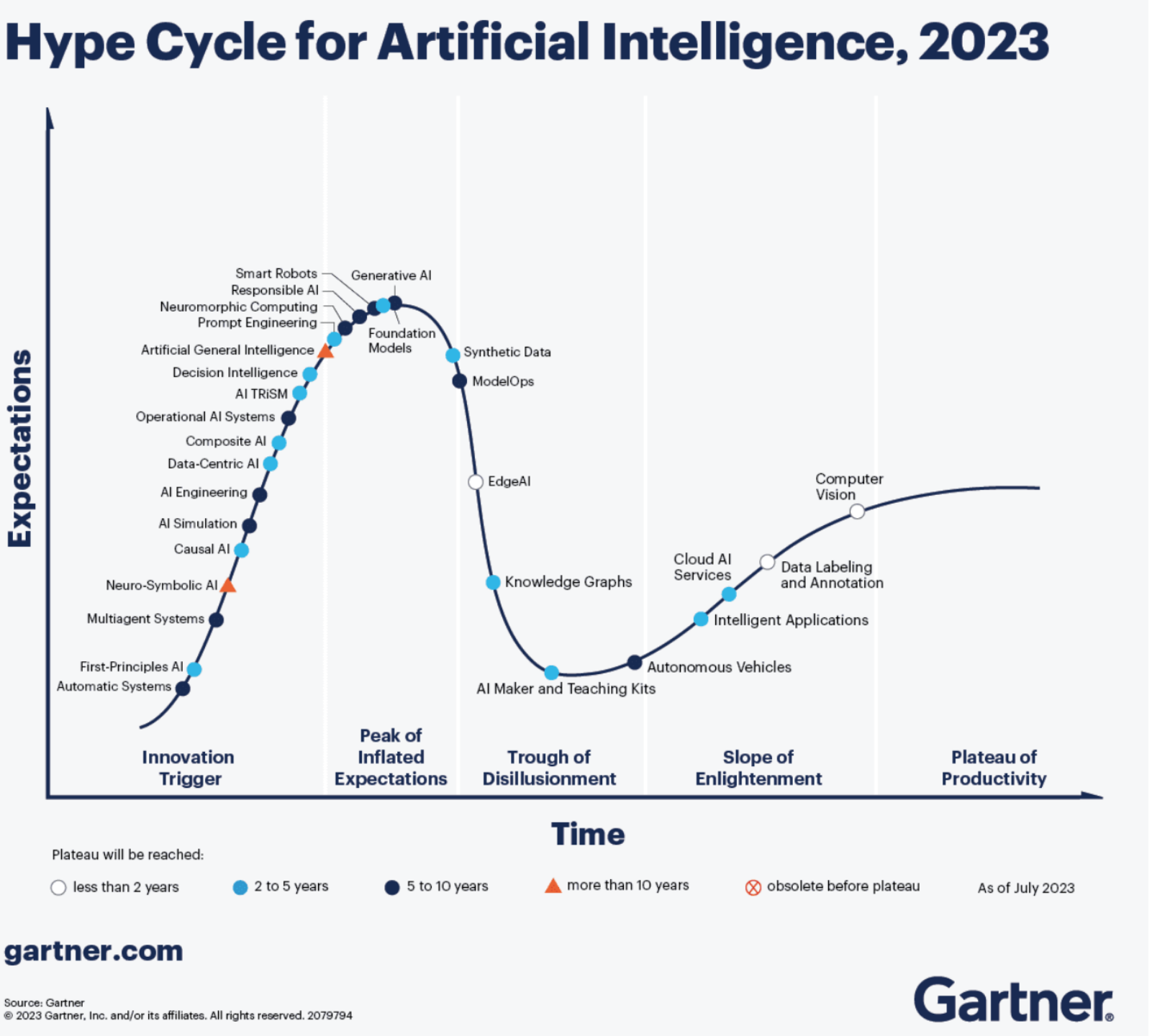
StorageShort: Why is Copy Data a Problem?

Recurring discussions

- “AI will recognize the collection of applications within an organization”
- “AI will know how to handle multiple instances of the same data”
- “AI will learn what to do when multiple data sources contradict each other”
- “AI will become so smart that structured data is no longer needed”

Dream on

The problems AI has with duplicated data is one of the reasons of the Peak of Inflated Expectations



Structured and unstructured data

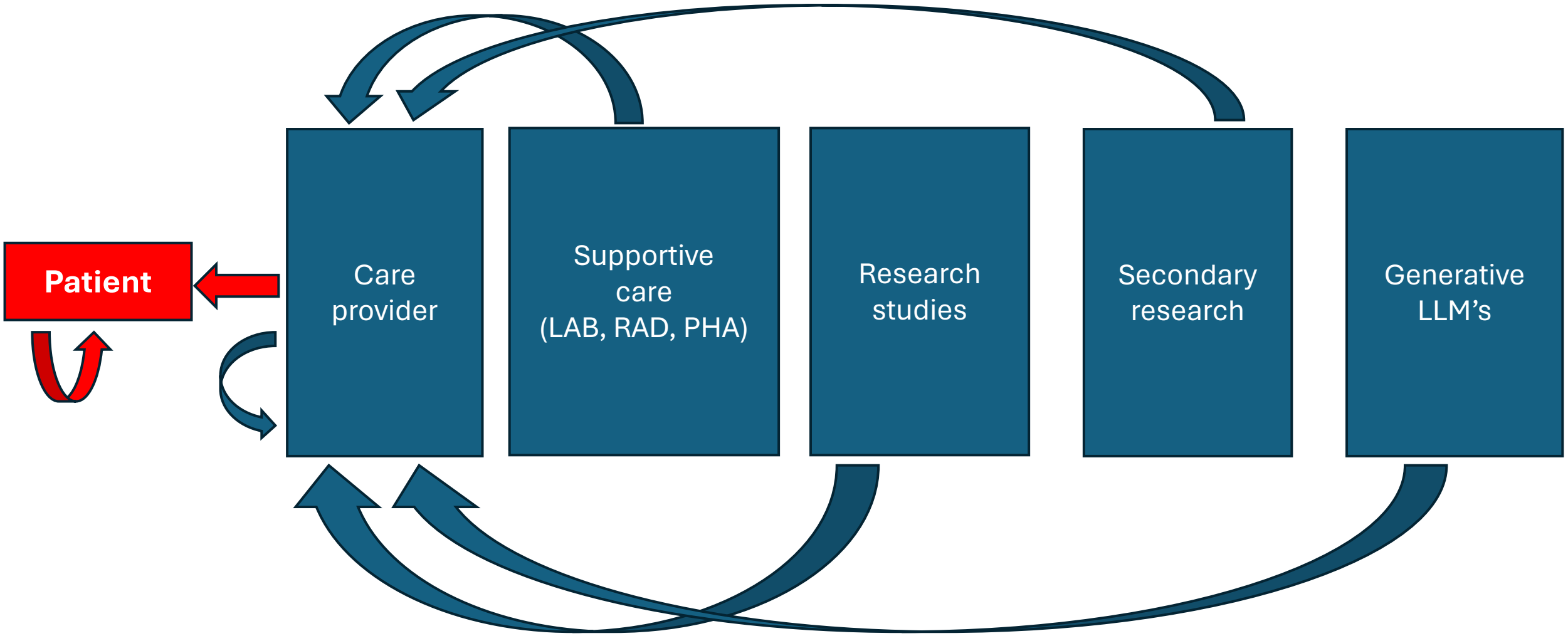
- **Structured data** – AI models trained on structured data can often make precise predictions and perform well on tasks that require clear patterns or rules for an individual entity.

- **Unstructured data** – Examples as text, images and audio, do not have a predefined format and are more challenging for traditional AI models to process. However, RAG can effectively support tasks like answering open-ended questions, generating text, and summarizing information from unstructured text.

RAG – Retrieval Augmented Generation

- RAG is about enhancing the accuracy and reliability of generative AI models with facts fetched from internal/external sources.
- IRL example: judges have learned the law, but with precedents and specific cases they can cite, the verdict of a new case is better.
- In healthcare, RAG probably will consist of online access to the EHR, RIS/PACS, Lab-system, devices, third party software and databases.
- For realtime AI-appliances, access via API's will be key.

AI – Feedback loops and distance to patient



STRUCTURED — **UNSTRUCTURED**

Better results with structured data

Less difference in results

As with many projects in Health IT, the patient will be forgotten. But not at FHIR DevDays.

HL7® FHIR® DevDays

Panel: AI Opportunities for Patients

Join us for a frank and thought-provoking conversation on the future of AI in patient care as we navigate this rapidly evolving field. Our panelists will explore the role of AI in patients' hands, sharing their own experiences using LLMs to better understand their own health. We'll consider how empowered patients can mitigate the challenges of AI "hallucinations" and errors, and we'll touch on the evolving relational dynamics between patients and the healthcare system as patients bring their own tools to the table.

Panel members

Dave deBronkart

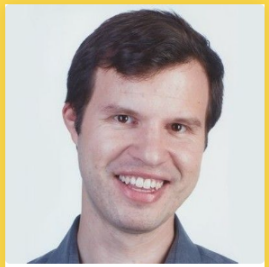
Patient Data Activist, e-Patient Dave

Grace Cordovano

Professional Patient Advocate; HITAC Member

Hugo Campos

Advocate for Health Data Liberation & Patient Autonomy



Josh Mandel

Chief Architect, Microsoft / SMART

Chethan Sarabu

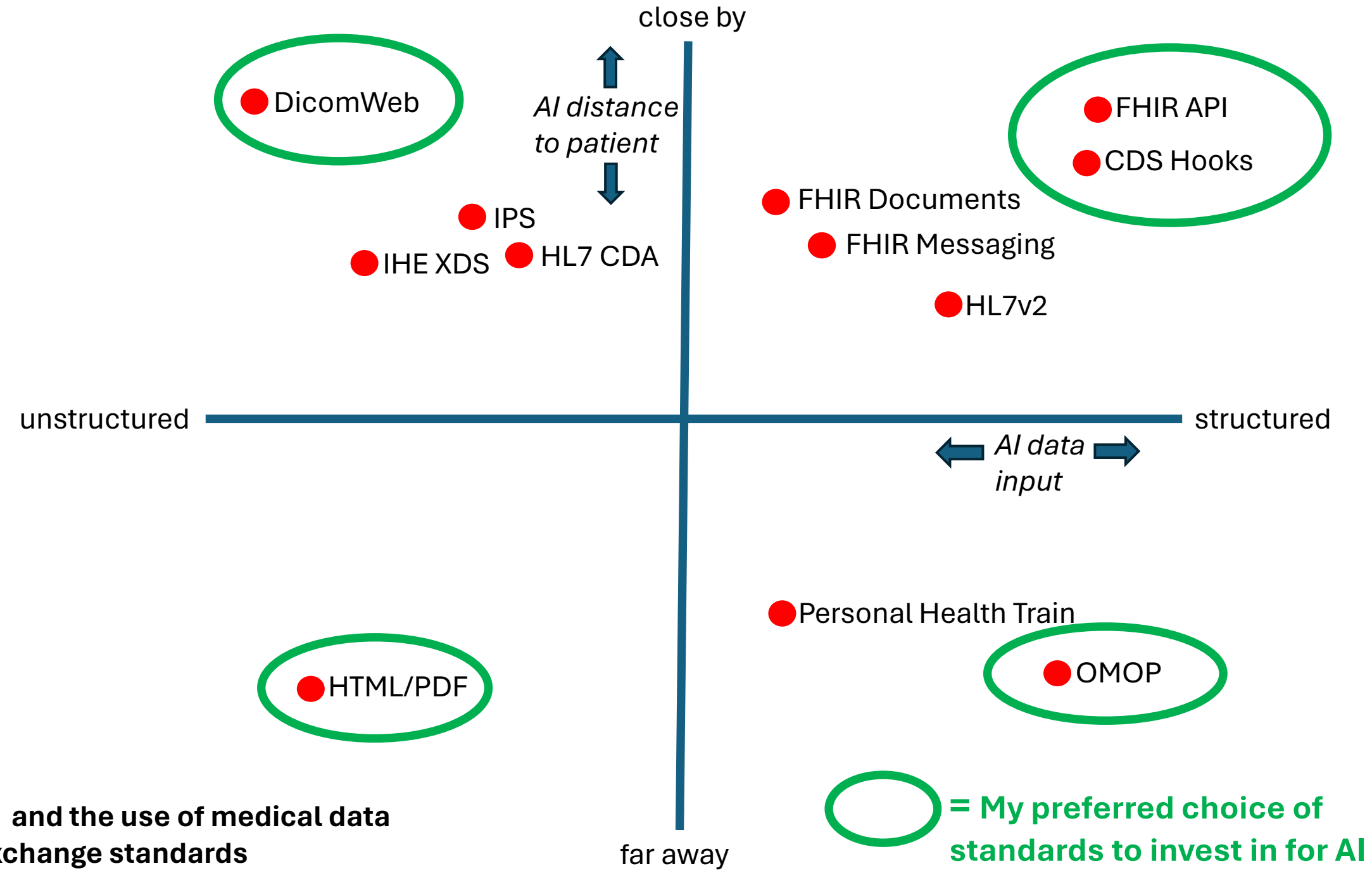
AI & Informatics Strategist, OpenNotes

Come and listen to the panel on Tuesday, June 11 from 1:30-2:15 PM

TODAY

A boy saw 17 doctors over 3 years for chronic pain. ChatGPT found the diagnosis

Alex experienced pain that stopped him from playing with other children but doctors had no answers to why. His frustrated mom asked ChatGPT for help.



AI and the use of medical data exchange standards

Some misunderstandings

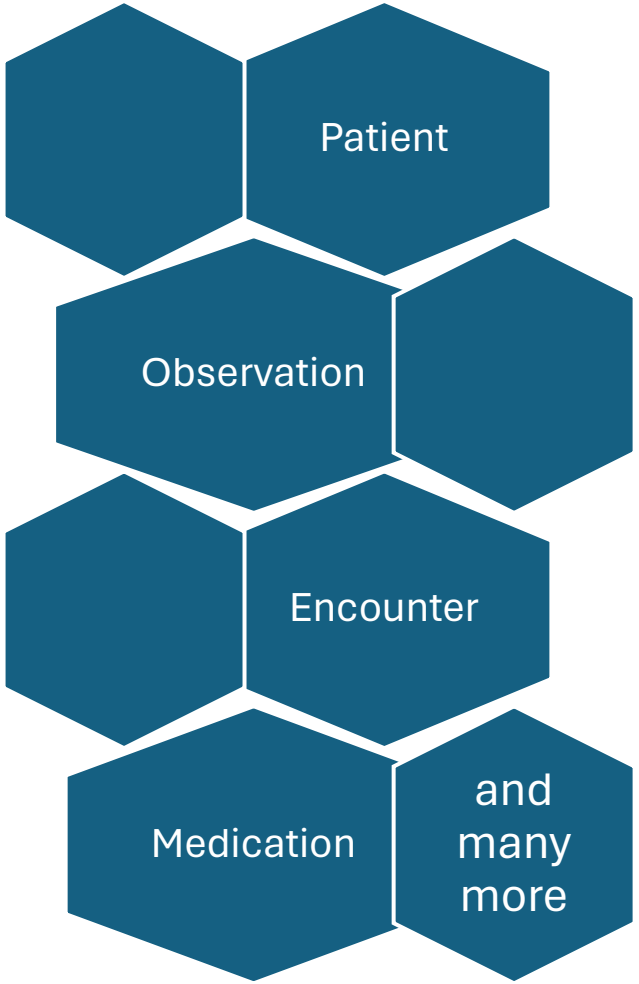
- “We do FHIR” does not necessarily mean “we do FHIR API”.

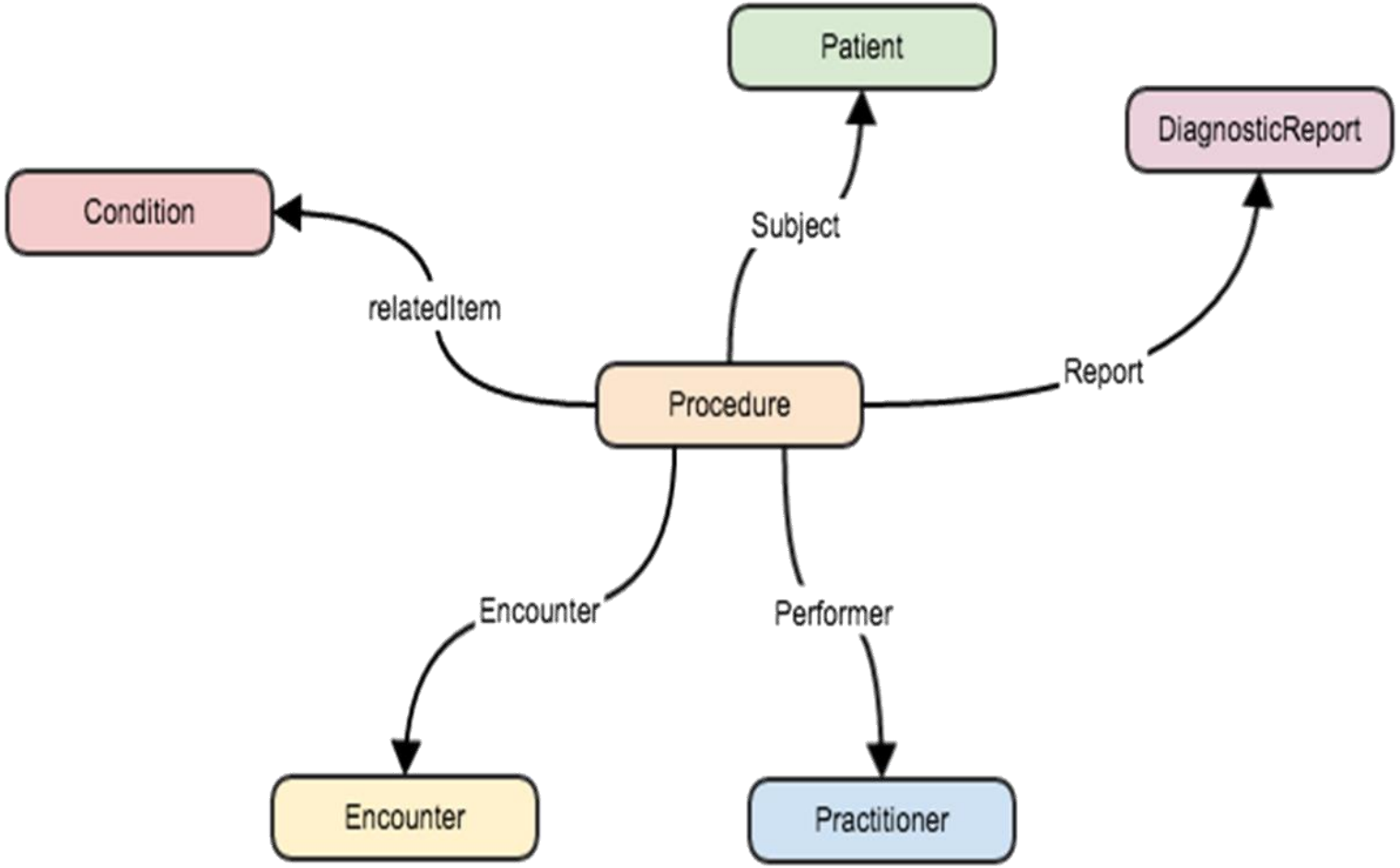
- FHIR Documents is in fact the successor of HL7 CDA and FHIR Messaging is in fact a successor of HL7v2. Both are not an API.

Ewout Kramer, one of the founding fathers of FHIR:

“*We have added a few features just because we had to support older systems where in retrospect we could have said: you will have to migrate or change your ways, otherwise you cannot use FHIR as API.*”

Resources with references





A web of resources that can tell any healthcare story

What is a FHIR Resource?

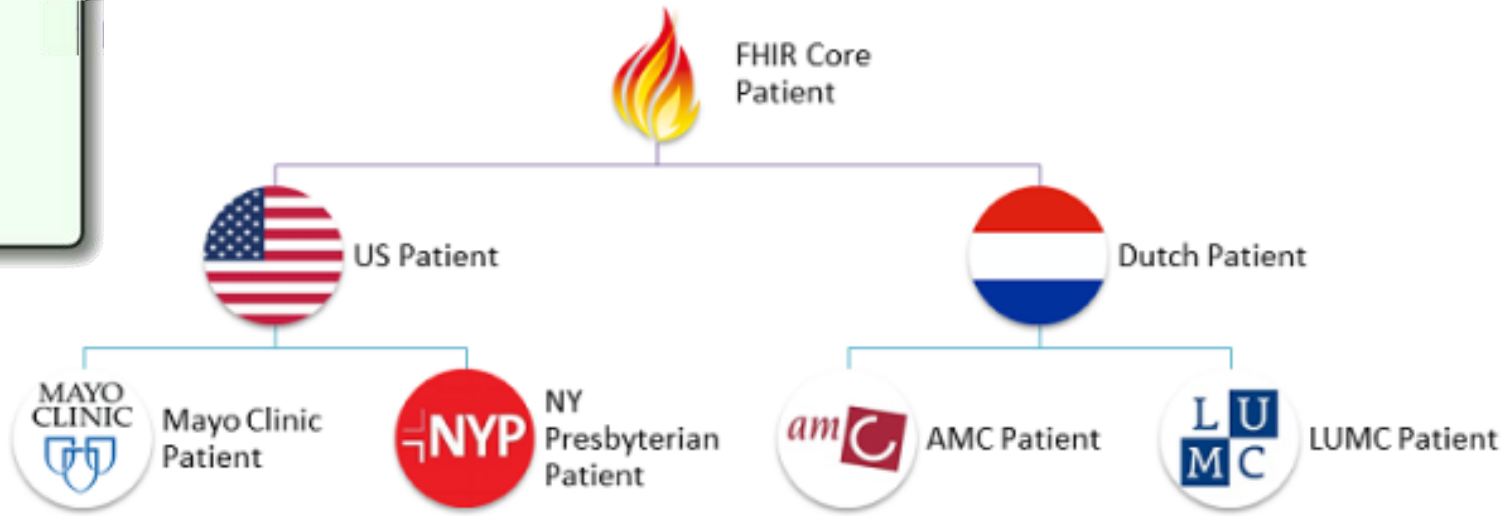
Patient (DomainResource)

identifier : Identifier [0..*]
active : boolean [0..1]
name : HumanName [0..*]
telecom : ContactPoint [0..*]
gender : code [0..1] « AdministrativeGender! »
birthDate : date [0..1]
deceased[x] : Type [0..1] « boolean | dateTime »
address : Address [0..*]
maritalStatus : CodeableConcept [0..1] « Marital Status + »
multipleBirth[x] : Type [0..1] « boolean | integer »
photo : Attachment [0..*]
generalPractitioner : Reference [0..*] « Organization | Practitioner | PractitionerRole »
managingOrganization : Reference [0..1] « Organization »

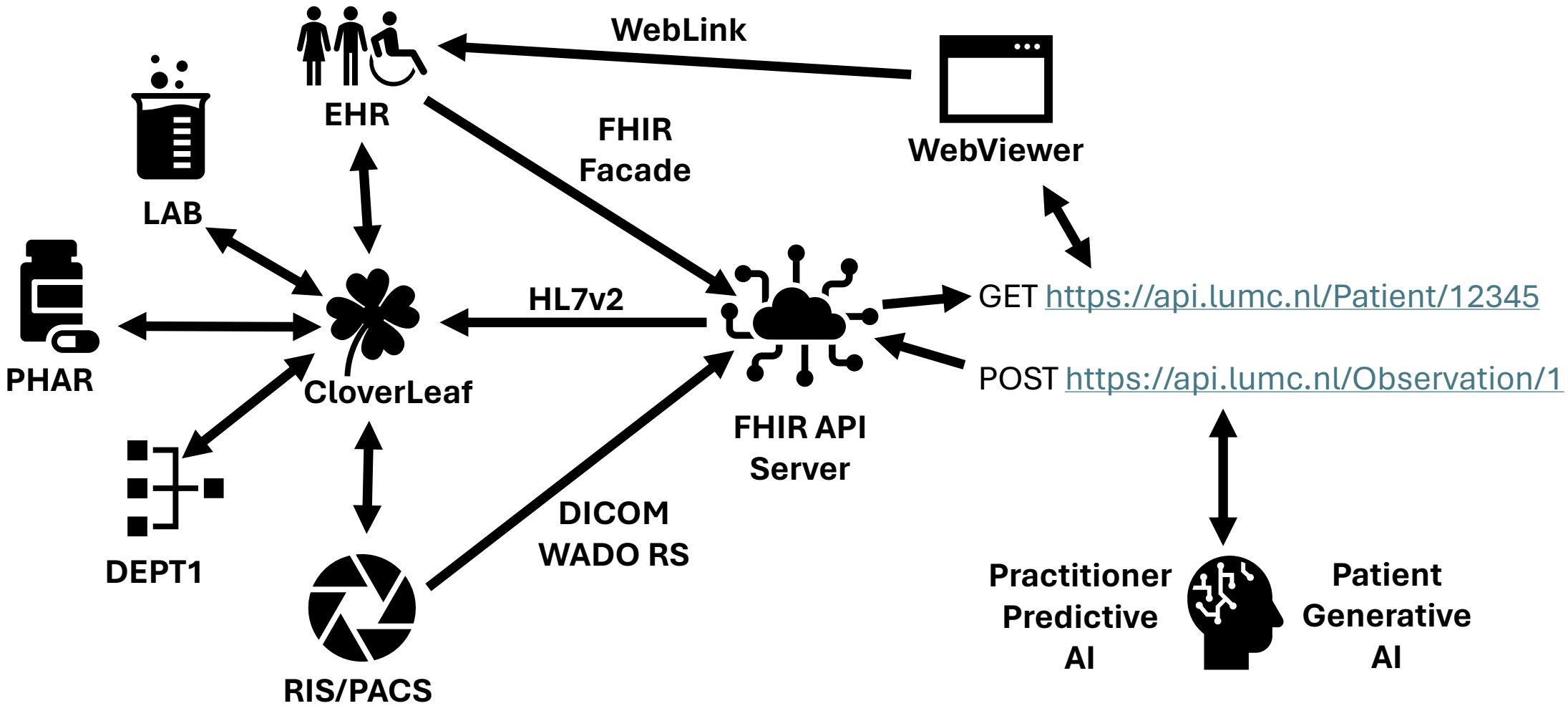
A FHIR resource describes the content of the data involved. FHIR has “core” resources, valid worldwide.

Each country and organization can derive their own resources with extensions.

The global registry simplifier.net keeps track of versions, differences and timestamped packages of resources worldwide.



AI architecture – with FHIR API



What happens in the USA, doesn’t stay in the USA

Each HL7 International WGM has a FHIR connectathon.

CDS Hooks started as a “dream” of a group of young developers.

Before FHIR, such a standard wouldn’t have emerged from HL7.

Personally, I think, next to FHIR, this is the most promising standard from HL7.

EHR Integrated CDS

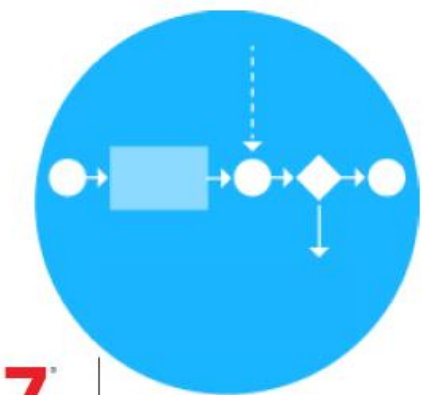
Clinical decision support (CDS) provides the right information, to the right person, at the right time

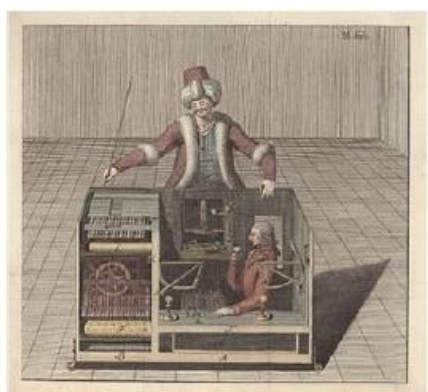
96% of non-Federal acute care hospitals have a certified EHR in 2015 ONC Data Brief 35

Decision support should be integrated with the EHR to provide seamless user-experience

CDS Service

- A service that is:
  - invoked by the EHR via a hook,
  - evaluates its own logic using FHIR data,
  - returns decision support via cards

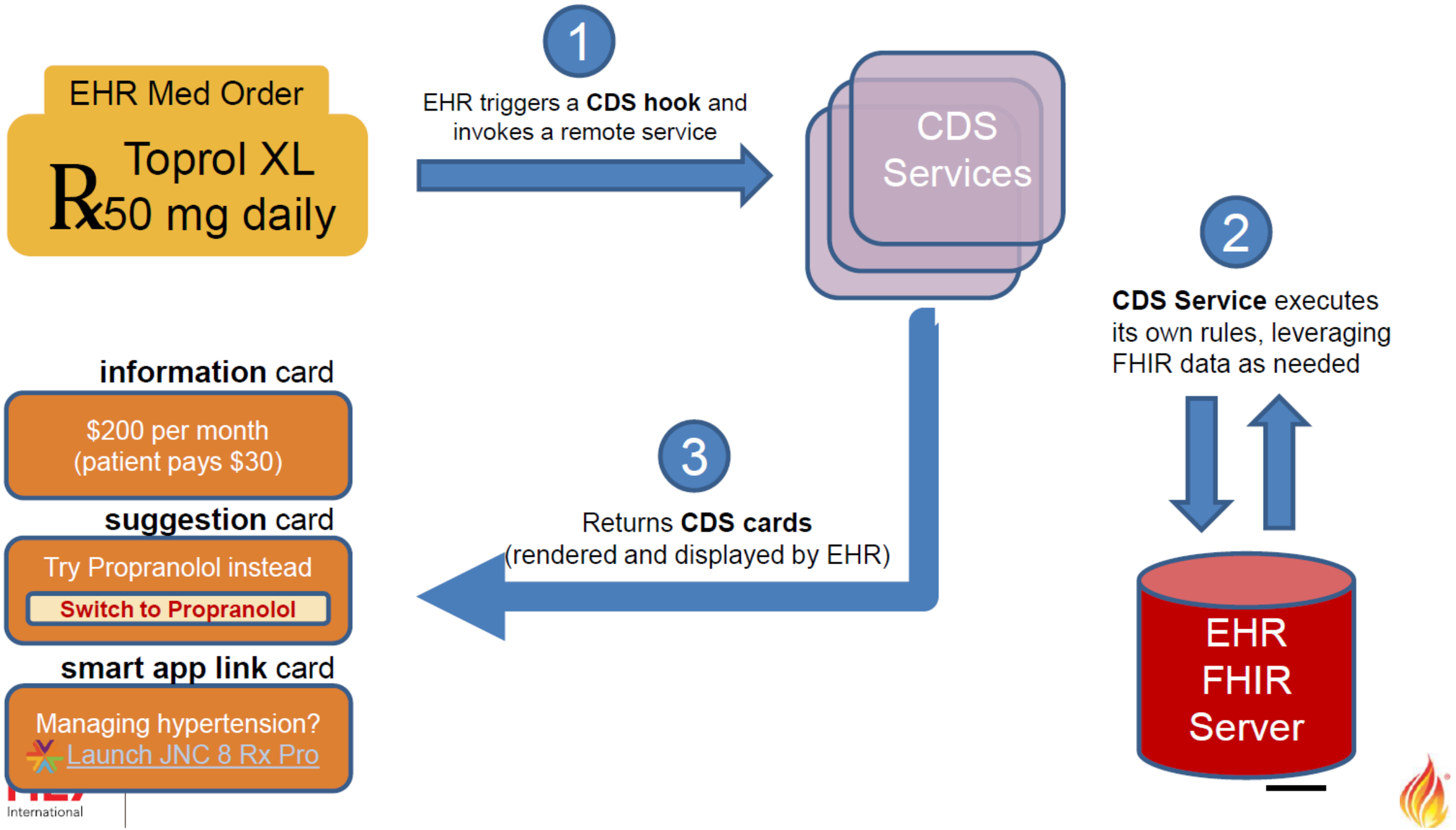




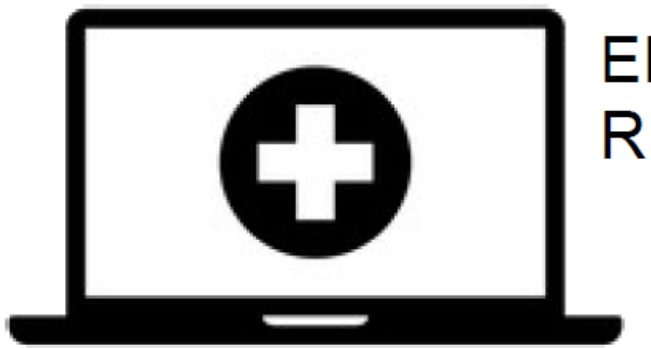
Hook Definitions

https://cds-hooks.org/

- patient-view
  - https://cds-hooks.org/hooks/patient-view/
- order-select
  - https://cds-hooks.org/hooks/order-select/
- order-sign
  - https://cds-hooks.org/hooks/order-sign/


EHR Med Order
Rx Toprol XL
50 mg daily
1
EHR triggers a **CDS hook** and invokes a remote service
CDS Services
2
CDS Service executes its own rules, leveraging FHIR data as needed
EHR FHIR Server
3
Returns **CDS cards** (rendered and displayed by EHR)
information card
$200 per month (patient pays $30)
suggestion card
Try Propranolol instead
Switch to Propranolol
smart app link card
Managing hypertension?
Launch JNC 8 Rx Pro

CDS Hooks Request



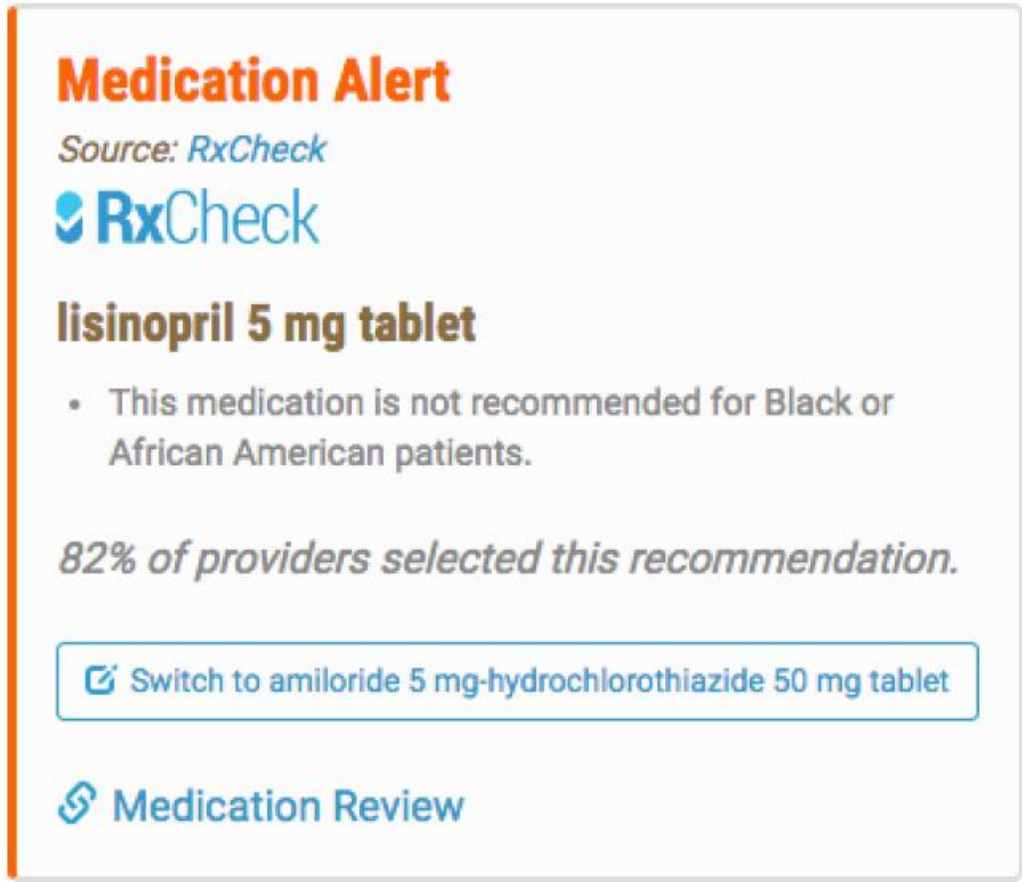
EH
R

CDS
Service

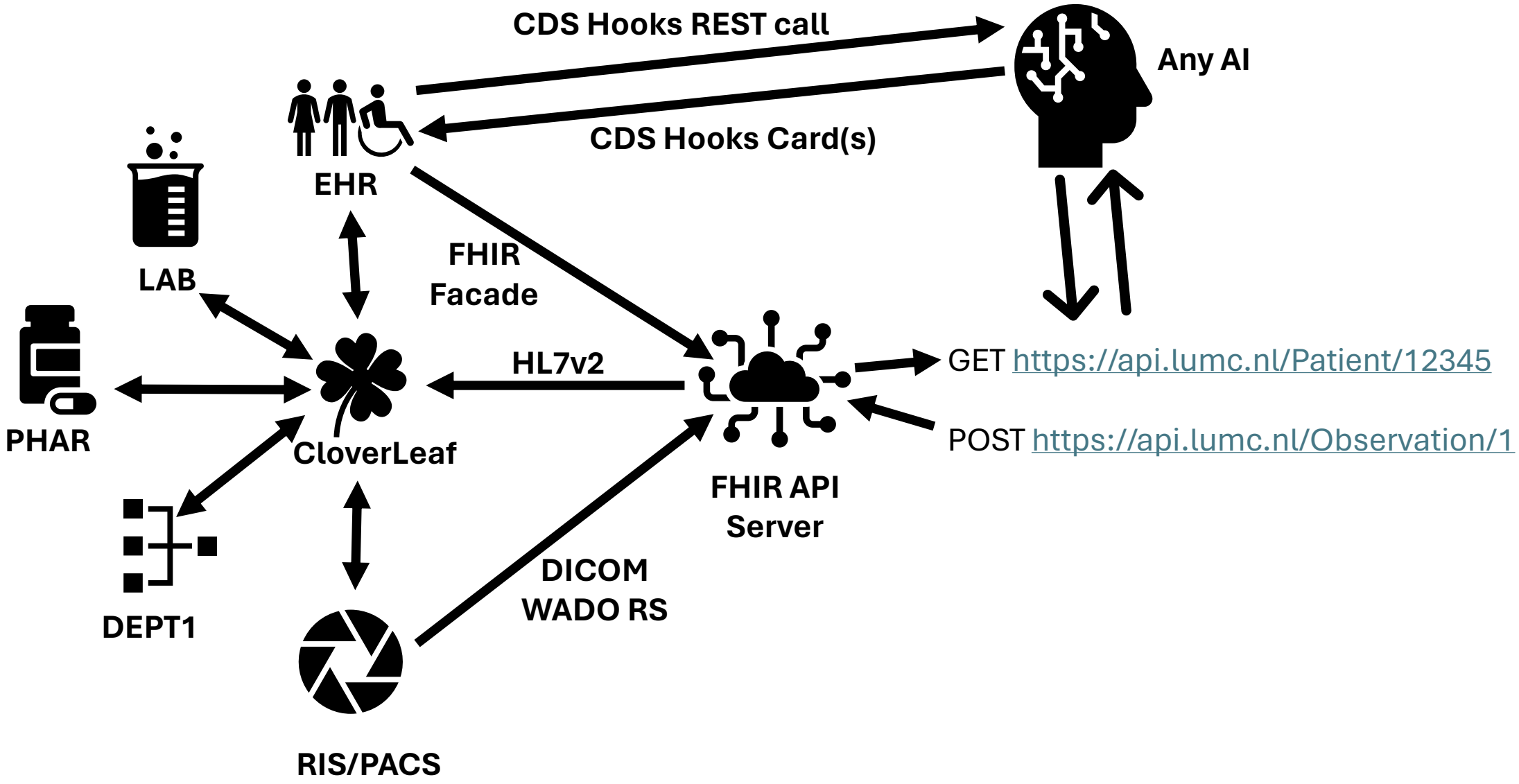
POST https://example.com/cds-services/example-service

```
{
  "hook": "patient-view”,
  "fhirServer": "https://fhir.example.com",
  "context": {
    "user": "Practitioner/789"
    "patientId": "123",
    "encounterId": "456",
  },
  ...
}
```

Cards can contain any combination of information, suggestions, and links

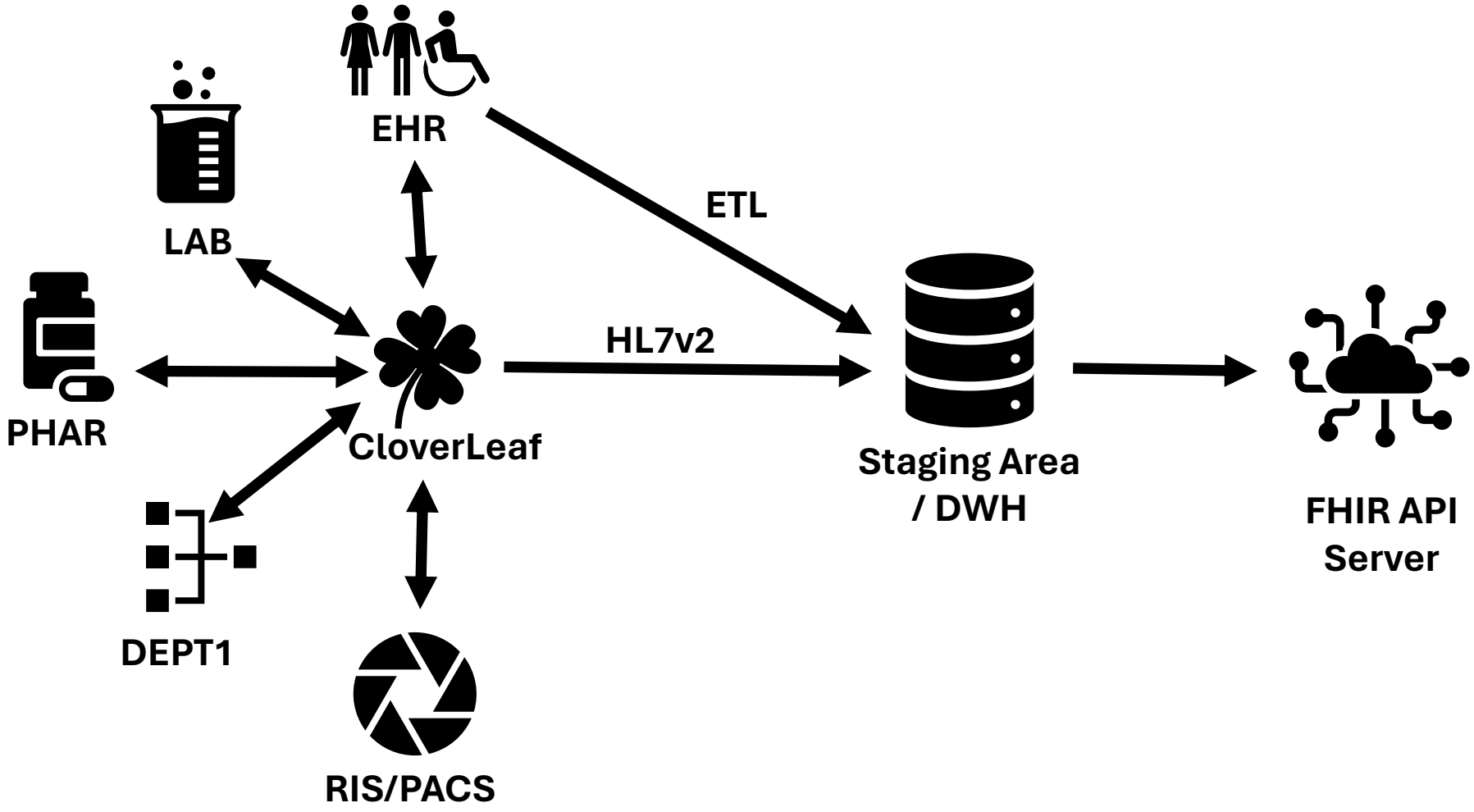


AI architecture – with CDS Hooks

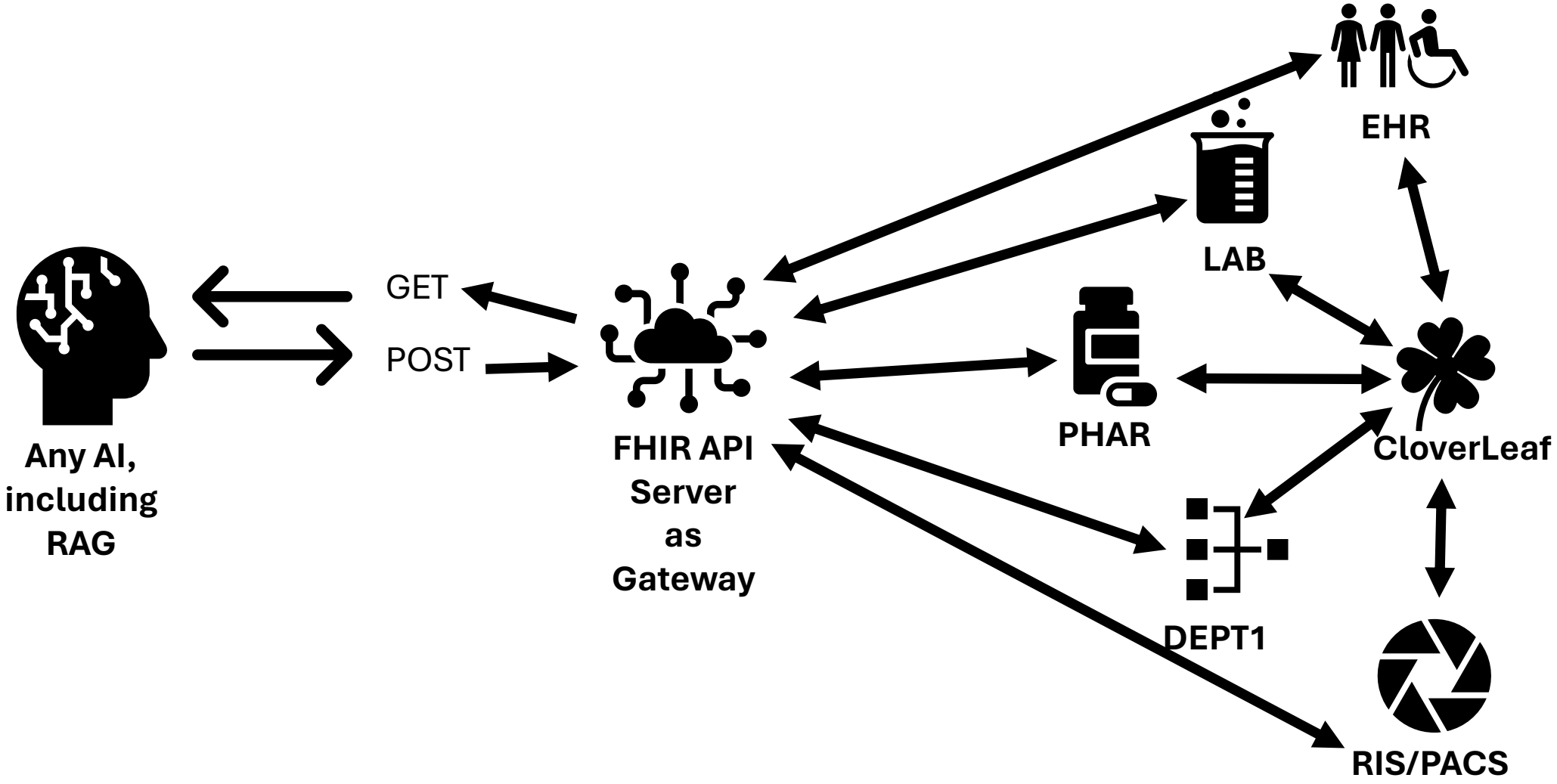


ELSEVIER
covermymeds
fdb
First Databank
HSPC
the healthcare services platform consortium™
hspc.png
MAYO CLINIC
NORTHROP GRUMMAN
UTHealth
The University of Texas Health Science Center at Houston
McKESSON
elimu informatics
flatiron
NANTHEALTH
HARMONIQ
INTEROPION
HLN Consulting LLC
ALCIDION
QVERA
PREMIER
surescripts
visualDx
arpage
PIONETECHS
EBSCO Health
Intermountain Healthcare
Cerner
Oridashi
Epic
healthwise
for every health decision
global strategies
Allscripts
athenahealth
eClinicalWorks
THE SYSTEM
IMO
Intelligent Medical Objects
Lantana
CONSULTING GROUP
mcg
RxREVU
Wolters Kluwer
Health
ENVISION
TECHNOLOGY PARTNERS
fireLy
stanson health
HEALTH SAMURAI
HEALTH
UNIVERSITY OF UTAH
Lush
Group Inc.
PHILIPS
Healthcare
Clinical Cloud Solutions
MITRE
syapse
Cigna
"polyglot"
Health Through Understanding™
medical-objects
CLINICAL APPLICATIONS, MESSAGING AND INTEGRATION

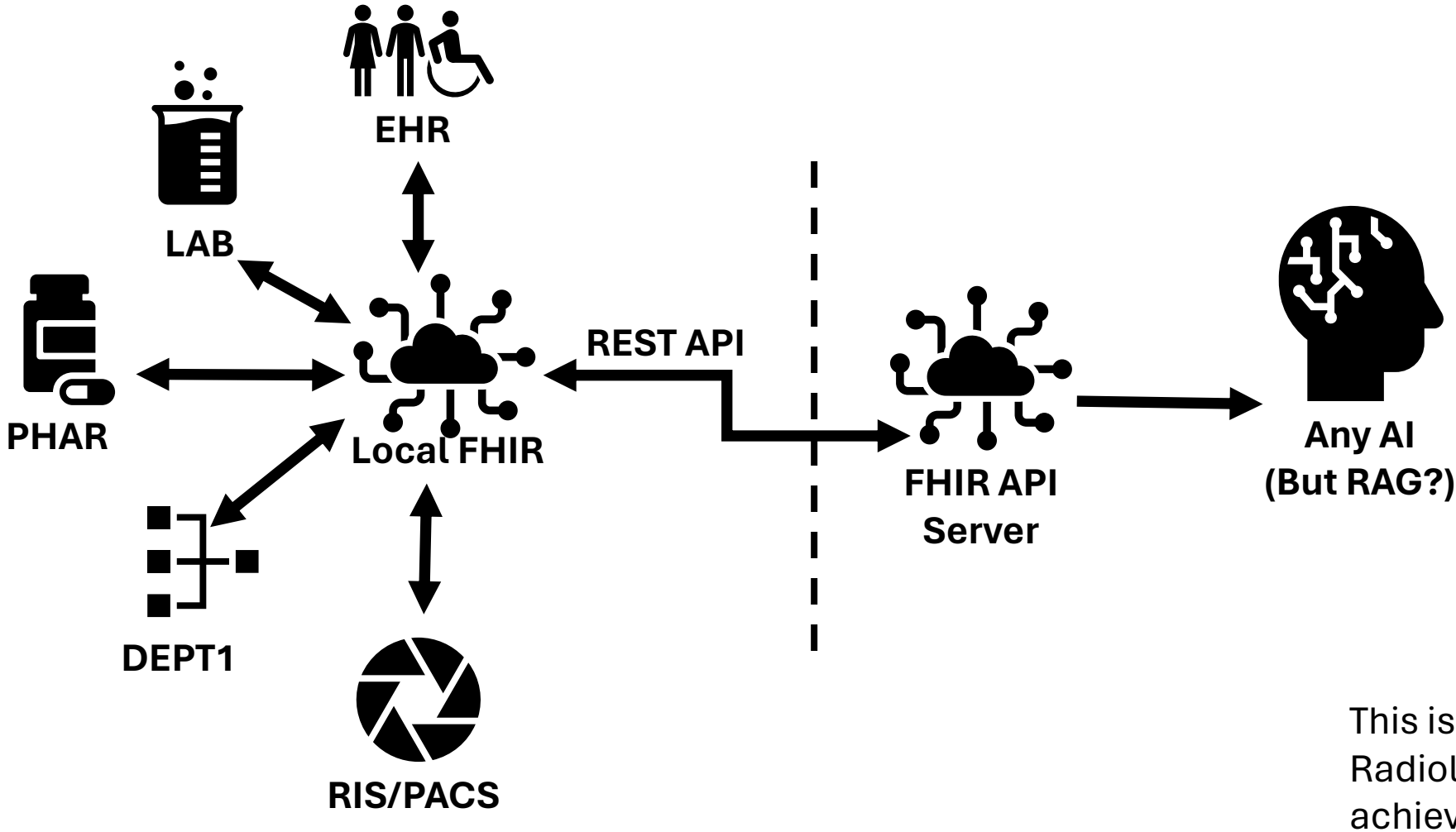
Alternative: via Staging and/or Datawarehouse



Alternative: as a Gateway to direct FHIR API's



Alternative: a dedicated external AI-portal



This is what the Dutch Radiologists want to achieve with project AIFI.

Take care.

It is NOT that simple.

SMART®

Understanding OAuth2

Explaining the concepts, use-cases, and possibilities of t protocol

Albert Starreveld · Follow

Published in The Web Application Security Hub · 9 min read · Aug 2, 2023

FRIDAY, 30 NOVEMBER 2018 BY MARC DE GRAAUW

To ZIB or not to ZIB

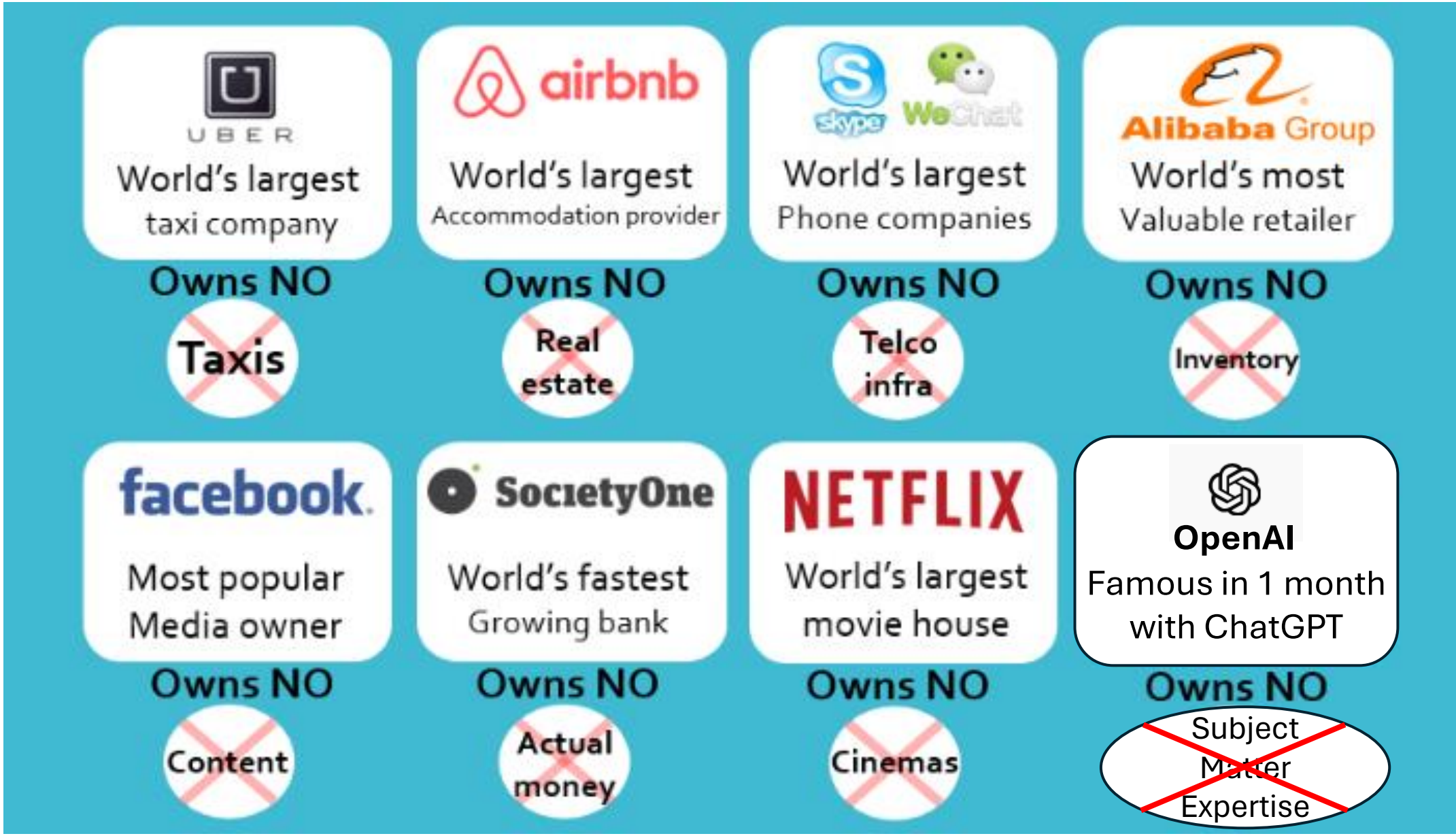
HL7 FHIR Release 5

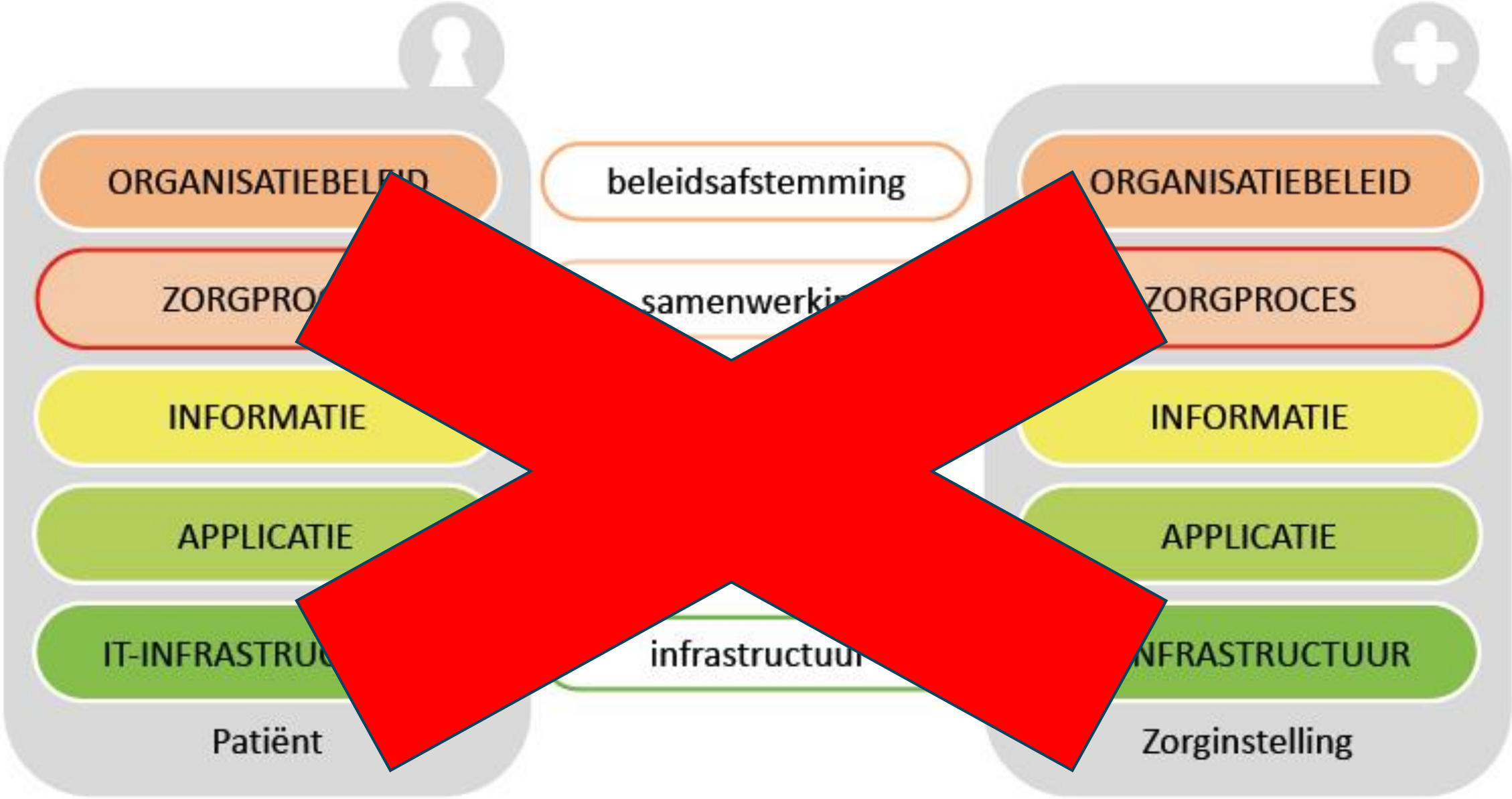
Level 2 Supporting implementation and binding to external specifications

Implementer Support	Security & Privacy	Conformance	Terminology	Exchange
Downloads, Version Mgmt, Use Cases, Testing	Security, Consent, Provenance, AuditEvent	StructureDefinition, CapabilityStatement, ImplementationGuide, Profiling	CodeSystem, ValueSet, ConceptMap, Terminology Svc	REST API + Search Documents Messaging Services Databases Subscriptions

Be prepared to dive in some of the more technical, in-depth, level 2 resources of FHIR

And be aware that AI-companies are like any other internet companies: they are after your knowledge to train their models





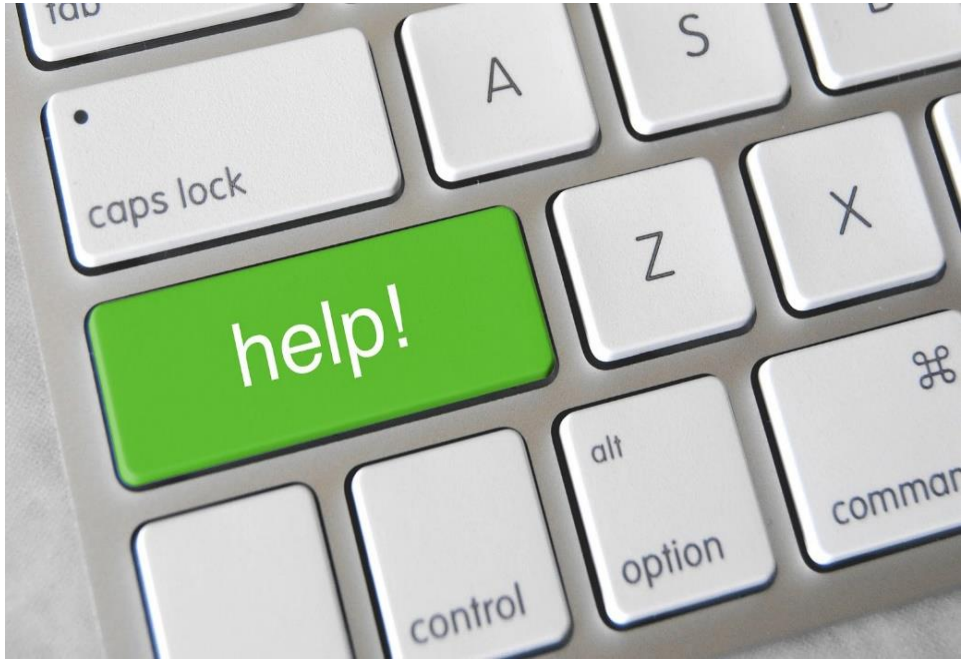
Please note: Disruption seldom starts with a bureaucratic layered model.
The red cross is not from the presenter, but it's the thoughts of tech companies.

Questions?

Now.

or later…

rob@fire.ly



https://hl7.nl/opleidingen