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openEHR

An introduction

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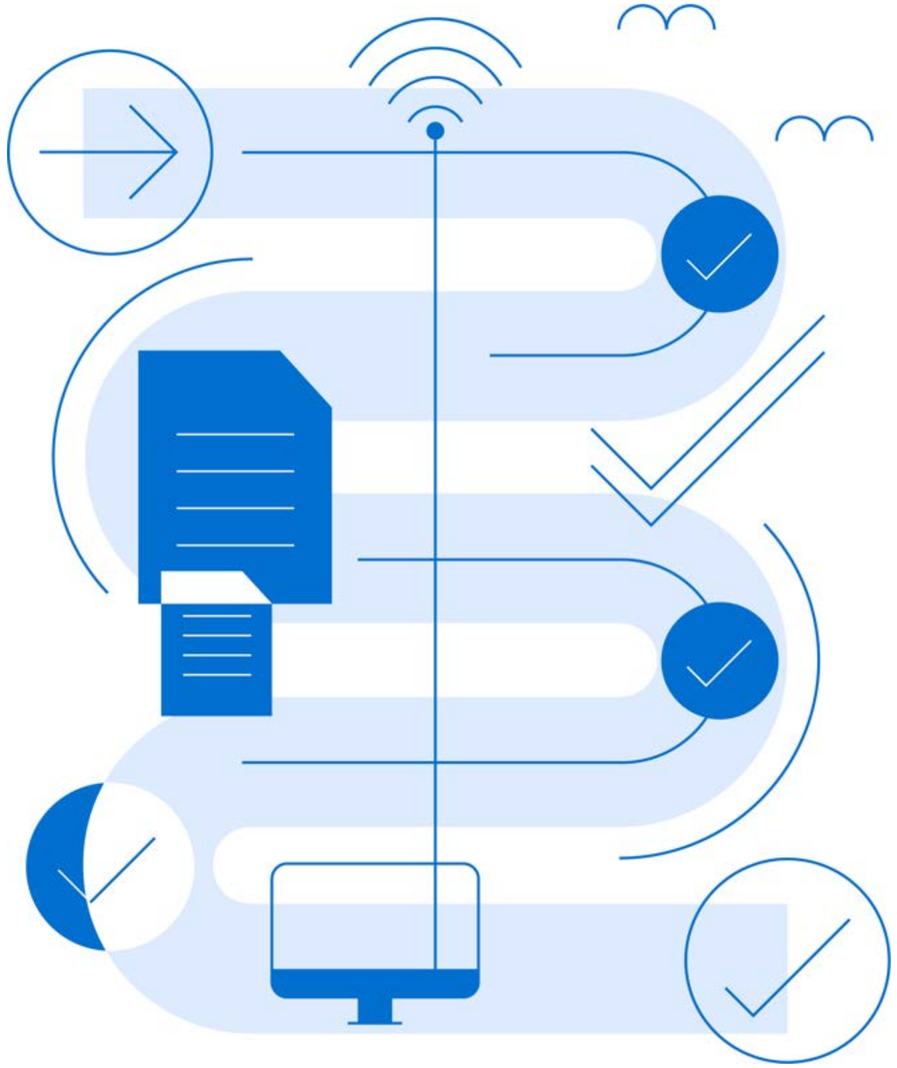
About Me



Richard Kavanagh

- Healthcare Standards advocate
- 19 Years Standards Experience
  NHS Digital / Graphnet / Kainos / Better
- Board Member
  openEHR UK / HL7 UK / INTEROPen

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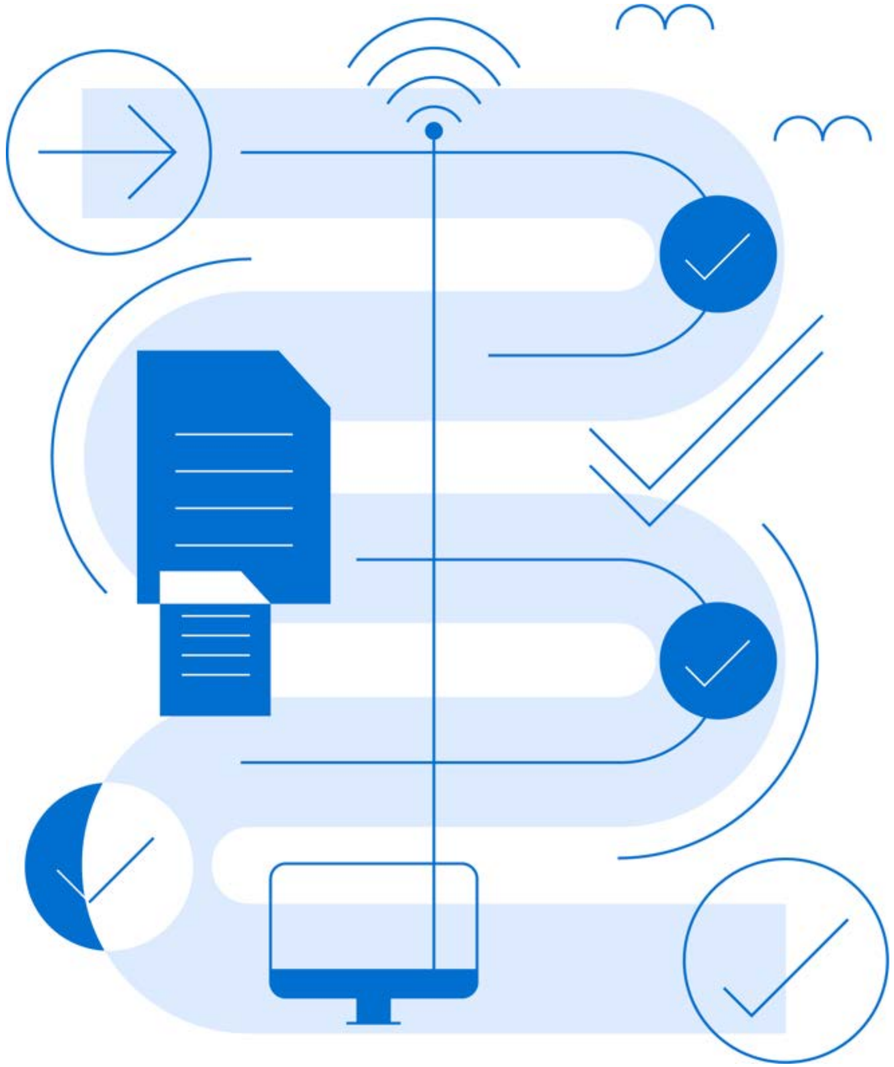
Agenda



- openEHR what is it ?
- Modelling approach
- Tools
- Clinical Data Repositories
- Querying Data
- APIs
- openEHR & FHIR

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openEHR ?

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openEHR

- An **open specification** for a health information model.
  - defines clinical data models
  - how to store and manage them
  - governance processes

- A collaboration between **clinicians**, **industry** & **health organisations** to store data and share clinical data
  - **vendor neutral**
  - **technology neutral**

- Creates the infrastructure for an **Open Platform Ecosystem**

- Significant deployments across the UK
  - London UCP
  - Christies PROMs
  - Wales ePMA
  - etc.

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openEHR

- A **specification** for healthcare systems not a **software product**
- A set of **modular components** that are evolving, whist **maintaining stability** for implementation.

  https://specifications.openehr.org/release_baseline

- Allows **implementation feedback** to shape and improve **openEHR** standards components.

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openEHR

QUERY (Query Languages) PRs | CRs	**AQL** S Archetype Query Language **AQL Examples** D AQL Examples	**1.1.0** (14-May-2021) 1.0.1 (26-Jul-2020) 1.0.0 (15-Nov-2017)
AM (Archetype Model) PRs | CRs AOM2 UML AOM1.4 UML	**Archetype Technology** S Business case for archetyping; overview of archetype specifications **ADL 2** S Archetype Definition Language 2 **AOM 2** S ADL 2 Object Model (enhanced AST) **OPT 2** D Operational Template 2 **Identification** S Archetype / template identifiers & versioning rules **ADL 1.4** S Archetype Definition Language 1.4 **AOM 1.4** S ADL 1.4 Object Model (enhanced AST) **OPT 1.4** S Operational Template 1.4	**2.3.0** (20-Mar-2024) 2.2.0 (18-Jun-2019) 2.1.0 (24-Aug-2018) 2.0.6 (07-Jan-2017) 1.4 (31-Dec-2008)
LANG (Generic Languages) PRs | CRs LANG UML	**ODIN** S Object Data Instance Notation **BMM** T Basic Meta-Model of models & expressions **P_BMM** S BMM human-readable serial format **Expression Language** D A syntax for formal expressions	**1.0.0** (11-May-2020)

Legend: D - Development | T - Trial | S - Stable | R - Retired

https://specifications.openehr.org/release_baseline

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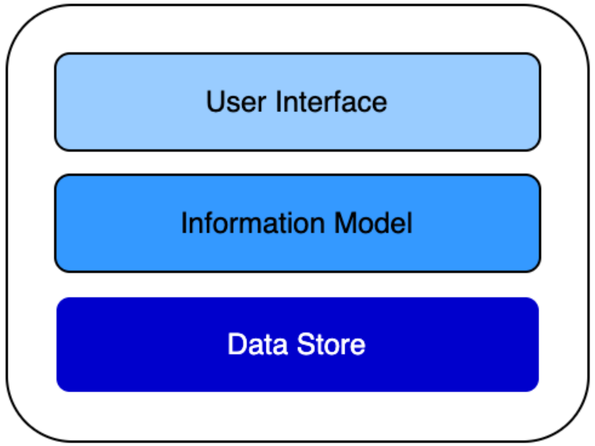
Architecture

A view of a typical healthcare system …

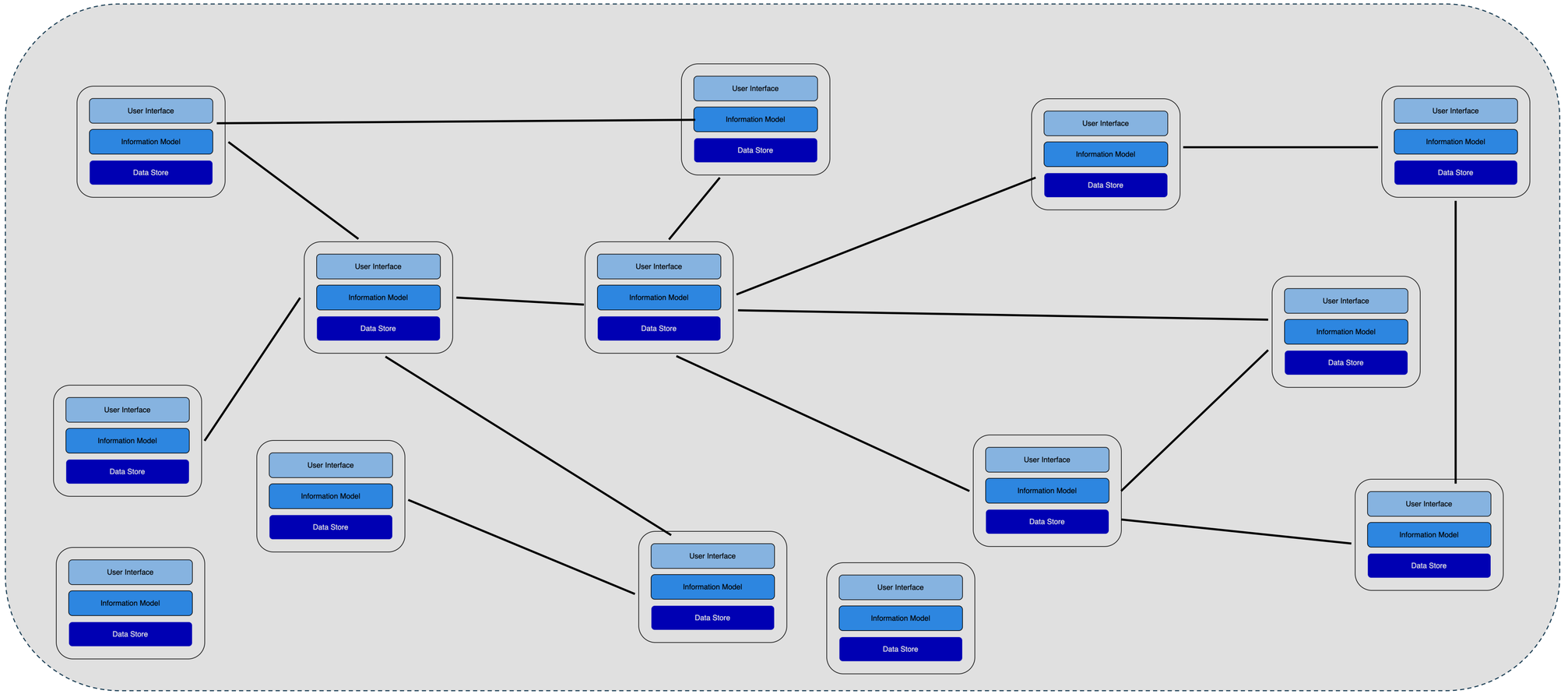


Different between vendors, specialties, countries, etc.

Proprietary and semantically unaligned

Different technologies with different schema

A healthcare organisation…



A web of interfaces

HL7v2
HL7v3
FHIR

Interoperability challenges

Data migration challenges

Data liquidity challenges

A healthcare organisation – using an open data platform

A shared data platform

- **Common open data models**
- **Common data APIs**
- **Technology neutrality**

A healthcare organisation – the components of the data platform

OpenEHR CDR

- **Clinical data models**

FHIR Data Store

- **Demographics**
- **Transactional Data**
- **Organisational Data**

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Data Models

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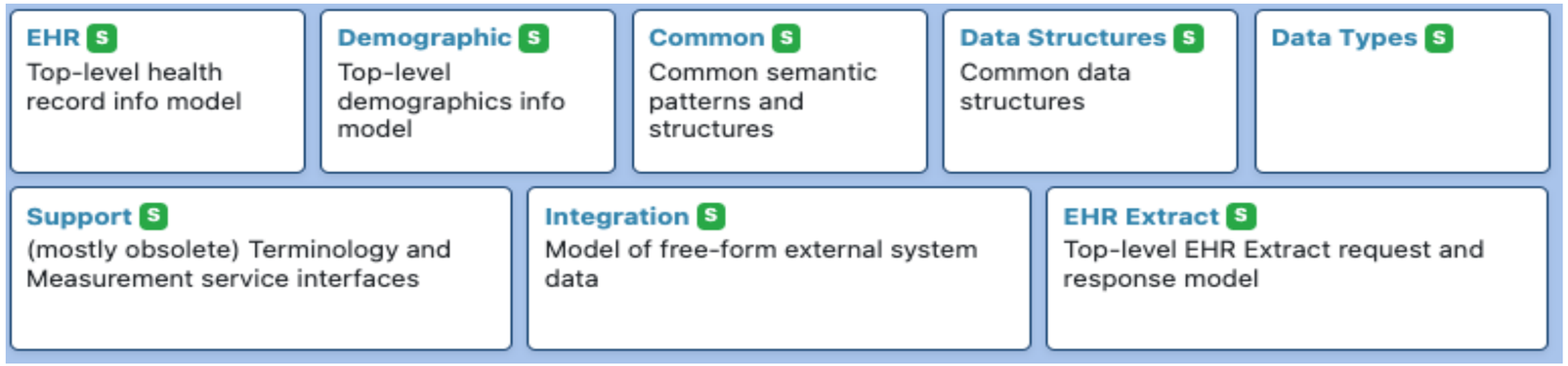
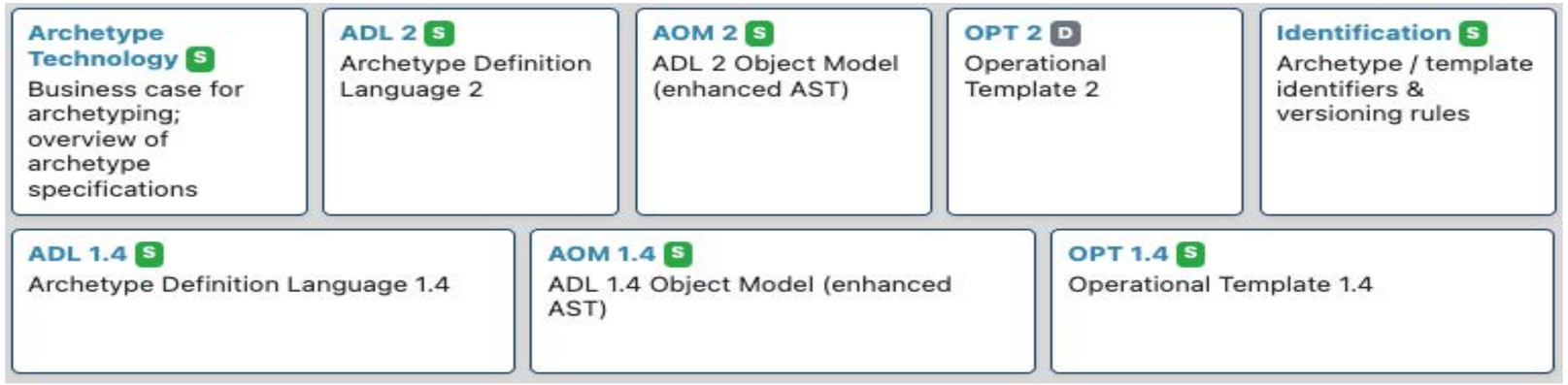
Data Models

openEHR makes use of a **two level** data modelling approach which provides both **flexibility** and **stability**

Level 1 – Reference Model



Level 2- Archetypes & Templates



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Level-1

Reference Model

The **Reference Model** is the overarching model for **openEHR**

The model is **implemented in software** using the vendor's **technology choice**.

It consists of :

- The EHR information model, defining the class models to be used
- Data types & data structures
- EHR extract information model for extracting data

The **Reference Model** is extremely stable and consistent between implementations, ensuring **data portability** and **interoperability** between openEHR data stores.

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Level-2

Archetypes & Templates

Archetype Models are **knowledge artefacts** using the **reference model** to describe a single clinical concept.

- Blood pressure
- Medication supply
- Diagnosis
- Allergy
- Laboratory Test Result
- Medical Device
- Apgar Score
- Body Temperature

The models are described using a **maximal data** set, attempting to cater for all clinical viewpoints.

A rigorous **governance** process is used to ensure the **quality** of models being created and any ongoing **maintenance.**

Although not optimal, **local archetypes** can be created to address gaps and ensure delivery timelines.

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Level-2

Archetypes & Templates

Template Models are used to create use-case specific models.

They typically consist of **multiple archetypes** and allow the archetypes to be **constrained** to meet the requirements of the use-case.

Template Models still conform to the **reference model** and as such any **template** and any **archetype** is valid on any openEHR data store.

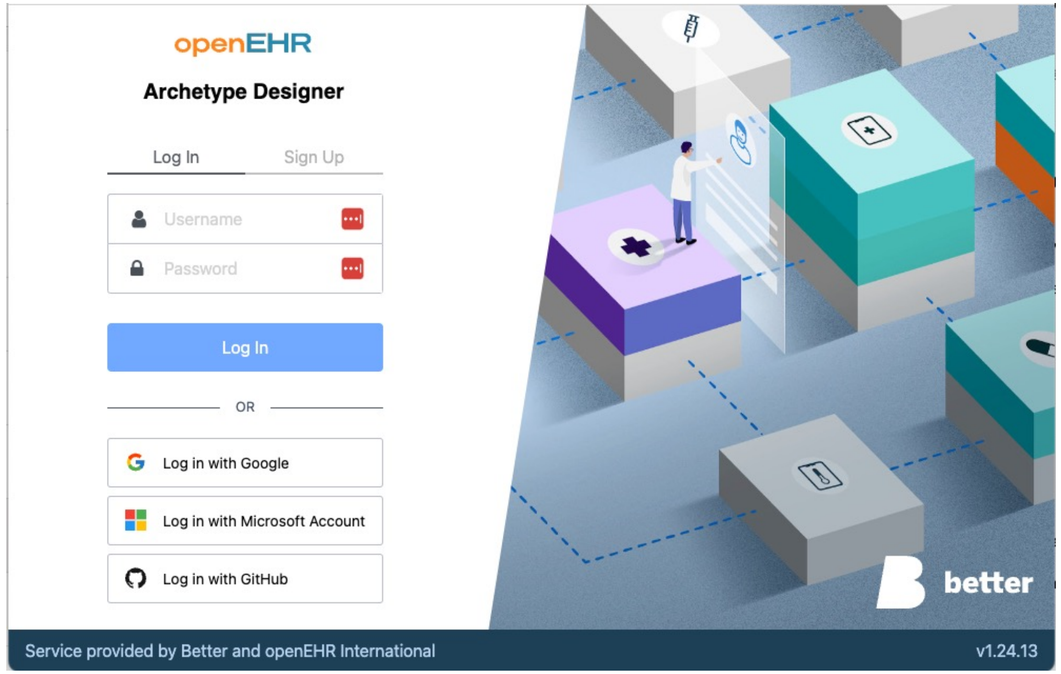
Both **archetypes** and **templates** have a formal modelling approach and constrain language to computably describe them.

openEHR tooling ensures that data modellers can focus on the models not the underlying technical mechanisms.

Data Modelling Tools

Specialised tooling exists for creating both **archetypes** and **templates**.

Free **web-based** tools are available to the community to author, maintain and share models.



https://tools.openehr.org/designer/#/

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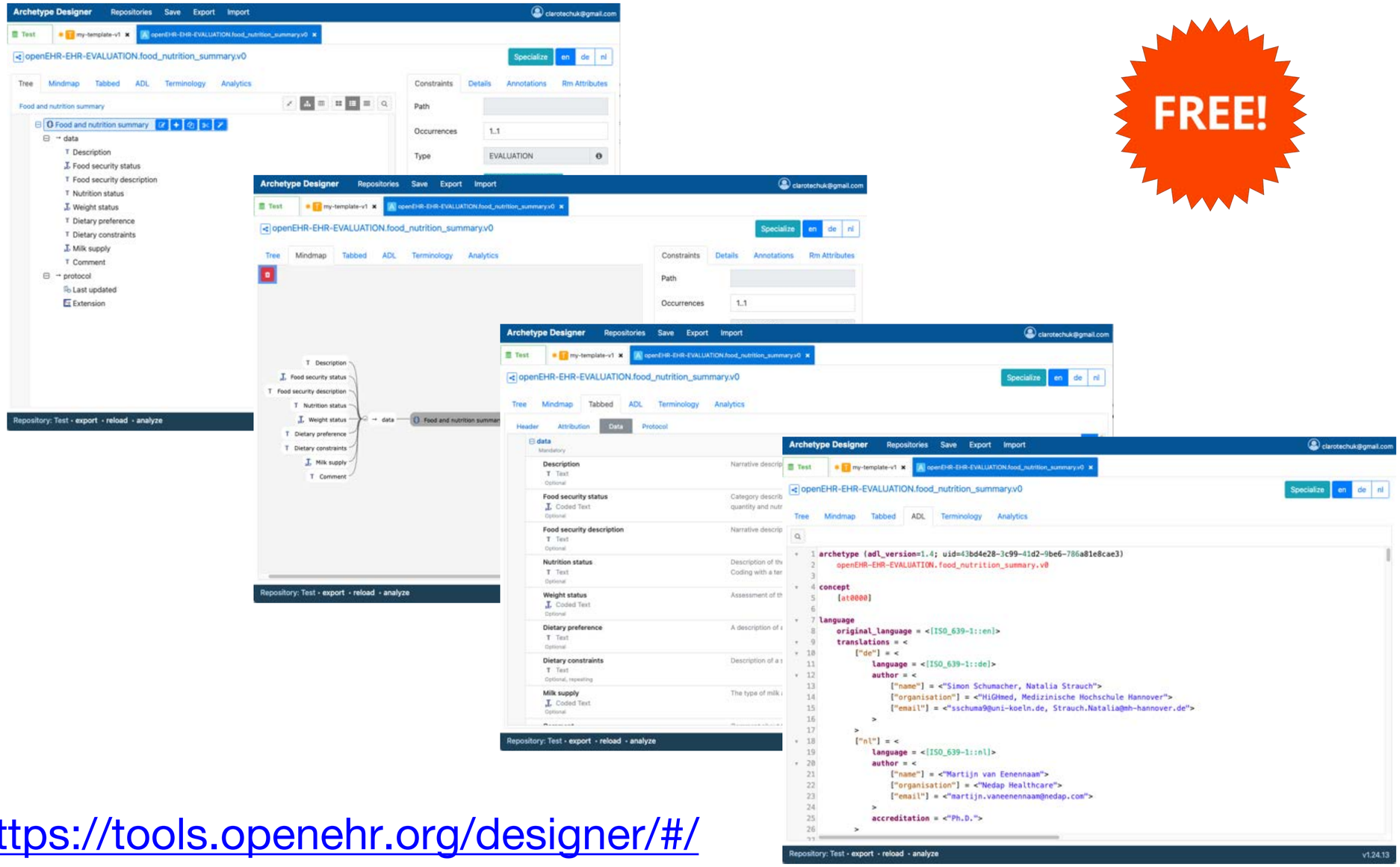
Data Modelling

Tools



FREE!

https://tools.openehr.org/designer/#/

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Data Modelling

Tools

- The **openEHR community** makes use of the **CKM (Clinical Knowledge Manager)** platform as the governance platform for **archetypes** and **templates**.

- Several CKM instances exist in a federated manner across different jurisdictions.

https://ckm.openehr.org/ckm/ the international CKM
https://ckm.apperta.org/ckm/ the CKM used for UK projects

- CKM is used to both catalogue the models and facilitate the model review process.

- The value of the data models within CKM is fundamental to the openEHR value proposition .

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Clinical Data Repositories

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CDRs

Clinical Data Repositories are the data stores for **openEHR** content.

The unit of data storage is a **Composition** a data structure from the **reference model.**

These consist of three key components:

- content – the data as represented by a template/archetype
- context – the context around the composition (archetyped)
- composer – who authored the composition

Clinical Data Repositories standards define not just the model of the composition but also how they are managed, stored, located and organised within a **CDR.**

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CDRs

There are a variety of options when considering the use of a **CDR**. They are complicated components and require expertise to develop.

- Create your own by following the **specifications** (not recommended)
- Use an **open-source** version on manage it yourself.
- Use a cloud hosted offering.
- Use a **managed service** where it is delivered as part of an overall platform offering.

A **CDR** is not a clinical system, it still requires other components to operate as a data platform.

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Data Queries

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Archetype Query Language

The ability to discover and **efficiently query data** within a **CDR** is essential for the functionality of health applications.

AQL (Archetype Query Language) is a declarative language designed specifically for querying data based on the **openEHR reference model**.

There are many similarities with **SQL** as seen in **relational databases** and **AQL** offers comparable power and functionality.

AQL has the following clauses:

- The **SELECT** clause specifies the data elements to be returned.
- The **FROM** clause specifies the result source and the corresponding containment criteria.
- The **WHERE** clause specifies data value criteria within the result source.
- The **ORDER** BY clause indicates the data items used to order the returned result set.
- The **LIMIT** clause indicates which portion of the result set will be returned.

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Archetype Query Language

An example **AQL** query to illustrate the syntax

```
SELECT                                                          -- Select clause
   o/data[at0001]/.../items[at0004]/value AS systolic,          -- Identified path with alias
   o/data[at0001]/.../items[at0005]/value AS diastolic,
   c/context/start_time AS date_time
FROM                                                            -- From clause
   EHR[ehr_id/value=$ehrUid]                                    -- RM class expression
      CONTAINS                                                  -- containment
         COMPOSITION c                                          -- RM class expression
            [openEHR-EHR-COMPOSITION.encounter.v1]              -- archetype predicate
         CONTAINS
            OBSERVATION o [openEHR-EHR-OBSERVATION.blood_pressure.v1]
WHERE                                                           -- Where clause
   o/data[at0001]/.../items[at0004]/value/value >= 140 OR       -- value comparison
   o/data[at0001]/.../items[at0005]/value/value >= 90
ORDER BY                                                        -- order by datetime, latest first
   c/context/start_time DESC
```

https://specifications.openehr.org/releases/QUERY/Release-1.1.0/AQL.html

https://specifications.openehr.org/releases/QUERY/Release-1.1.0/AQL_examples.html

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Archetype Query Language

Scenario: ***Get all blood glucose values and their corresponding subject ids, where blood glucose > 11 mmol/L or blood glucose >= 200 mg/dL***

```
SELECT
    e/ehr_status/subject/external_ref/id/value,
    o/data[at0001]/events[at0002 and name/value='Any event']/data[at0003]/items[at0013.1]/value
FROM EHR e CONTAINS COMPOSITION c
    CONTAINS OBSERVATION o [openEHR-EHR-OBSERVATION.laboratory-glucose.v1]
WHERE
    o/data[at0001]/events[at0002 and name/value='Any event']/data[at0003]/items[at0013.1]/value
matches {
        C_DV_QUANTITY<
            list = <
               ["1"] = <
                   units = <"mmol/L">
                   magnitude = <|>=11|>
               >
               ["2"] = <
                   units=<"mg/dL">
                   magnitude=<|>=200|>
               >
            >
        >
    }
```

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APIs (x3)

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openEHR APIs

As would be expected the interaction with the **CDR** is via **RESTful APIs**

There are three different sets of APIs within **openEHR**.

EHR APIs https://specifications.openehr.org/releases/ITS-REST/Release-1.0.2/ehr.html

- Used to create/update/delete and retrieve compositions from the CDR
- Used to manage the internal configuration of the CDR

Query APIs https://specifications.openehr.org/releases/ITS-REST/Release-1.0.2/query.html

- Used to execute adhoc AQL queries against the CDR
- Used to execute stored AQL queries against the CDR

Definition APIs https://specifications.openehr.org/releases/ITS-REST/Release-1.0.2/definitions.html

- Used to add/retrieve templates used within the CDR
- Used to manage stored queries (AQL) within the CDR

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(openEHR + FHIR) = ?

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openEHR + FHIR

- There is now growing recognition that **openEHR** and **FHIR** would benefit from closer alignment.
- Statements by **Grahame Grieve (FHIR**) and **Rachel Dunscombe (openEHR)** in **May 2024** have met (mostly) positivity in the standards communities.
- So, what happens, next ?
- My thoughts…

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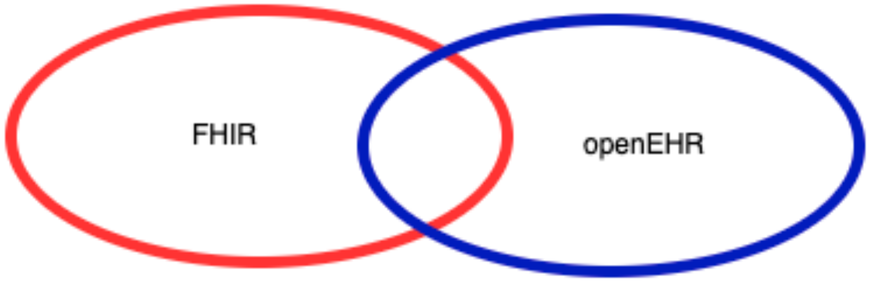
openEHR + FHIR

- **FHIR** and **openEHR** serve different purposes for different communities.
- There is overlap and hence some of the historic tensions



- Will the standards merge in to one – **No**
- Will change be quick – **No**
- Does everyone in each community agree/care – **No**
- Both standards are built by volunteer communities – **change will be slow**.

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openEHR
+
FHIR

- **Stream 1 – Organisational**
  - Organisationally there will be efforts to align and signpost areas of interest
  - Governance will be a challenge; there is not a unified desire to achieve this
  - Standards development is slow and is volunteer led

- **Stream 2 – Technical**
  - Both communities have excellent tool smiths mainly volunteers
  - Focus will tend to be on the interesting rather than the useful
  - Without focus, there could will be inefficiencies and duplication
  - Commercial stimulation on tools is historically poor

- **Stream 3 – User Centric**
  - Community driven to address real life use-cases, evidence driven.
  - Voices in the overlap areas to articulate the need on priorities

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openEHR + FHIR

- Progress will be made (it already is), the pace and extent of alignment is unknown.
- Areas of potential focus:
  - FHIR Terminology Usage
  - Model <> Model transforms
  - Package Management
  - Smart-On-FHIR vs Smart-On-OpenEHR
  - Implementation Guide development
  - Modelling tools
  - Semantic Alignment
  - Governance processes

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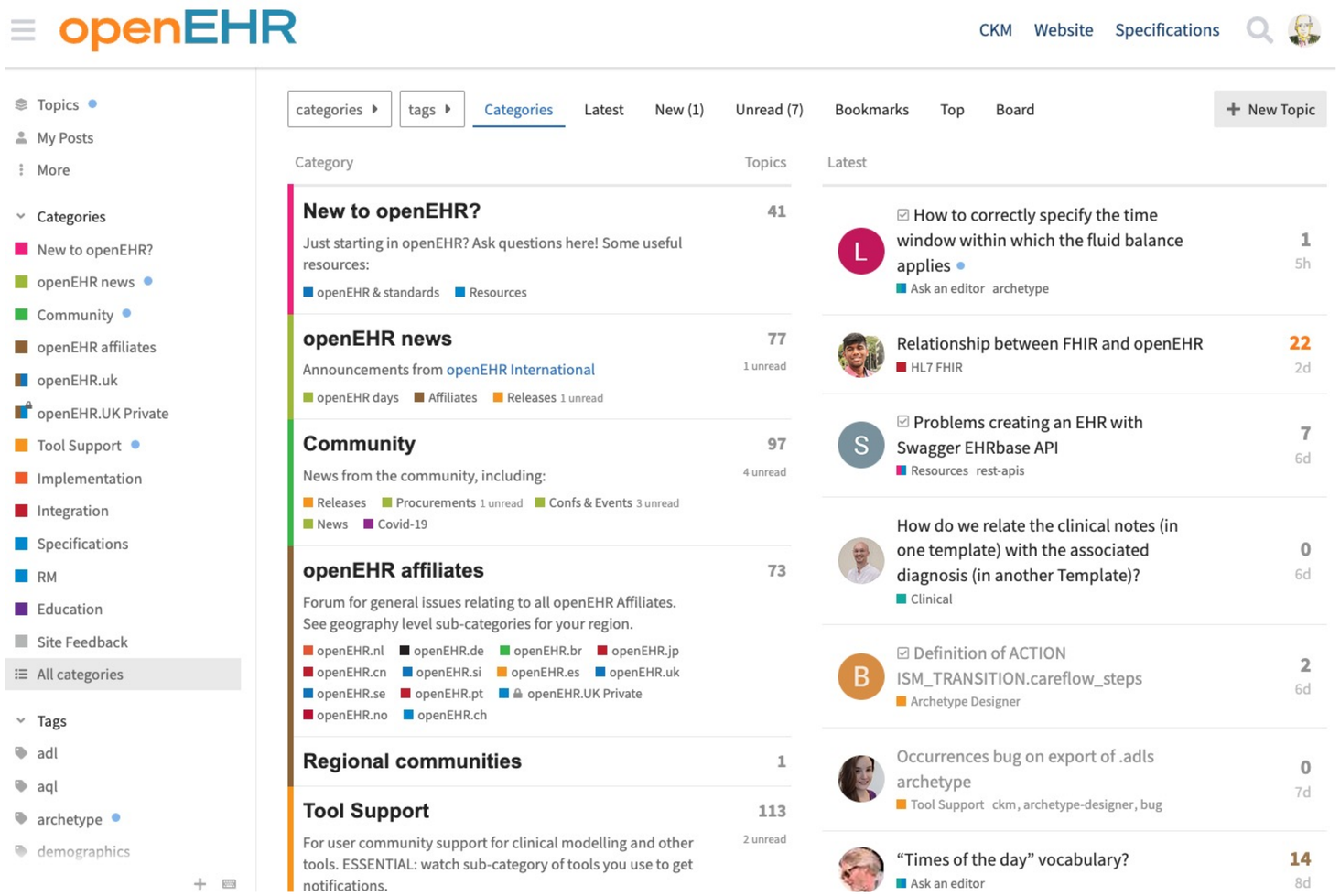
Curious ... ?

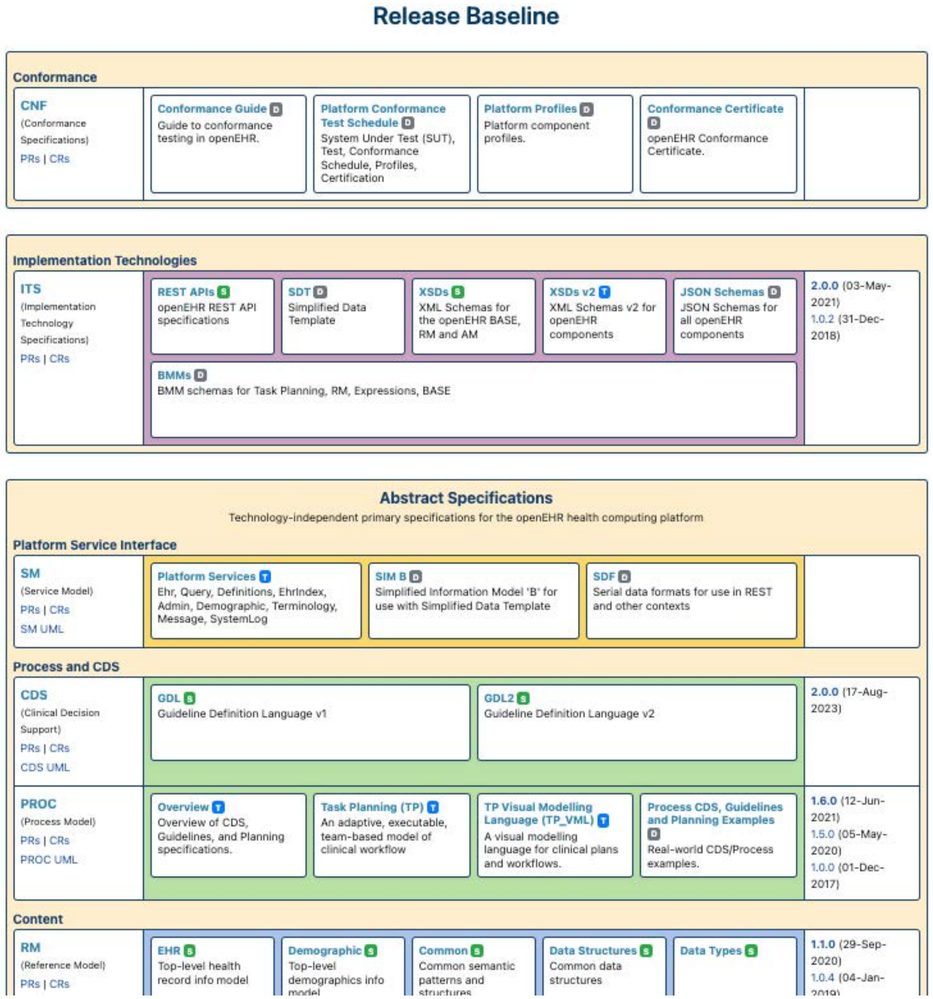
Useful Links

openEHR has a friendly, supportive online community at https://discourse.openehr.org/ - register for free.



Useful Links

openEHR specifications are freely available online. The community will help with any questions. https://specifications.openehr.org/release_baseline



Useful Links

openEHR's first Internation conference is in the UK in November
https://openehrfoundation26.wildapricot.org/Conference-2024

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Q&A

https://www.linkedin.com/in/richardkavanagh/

https://x.com/RKavanagh


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