openEHR for NHS Wales

16-02-2021
## Agenda and Speakers

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<th>Topic/Details</th>
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<td>Why is openEHR different and who else is using it?</td>
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<td>Why openEHR can work for clinicians</td>
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Welcome!
How did we get here?

John Meredith
Technical Architect, NHS Wales Informatics Service
What is openEHR?
The openEHR Journey

New requirements:
• Data storage
• Data re-use

New projects:
• WISDM
• Cancer replacement
• Nursing documentation
• Cardiology
Single Source of Truth?
Structured Data Once for Wales
NWIS openEHR Review

18 Month project covering 4 key areas;

1. Legacy data to ease burden on documents stored in WCRS i.e. proxy data repositories

2. End-to-end platform development; a single source of truth for structured clinical data,

3. Service layer analysis to support interoperability, data migration and data query,

4. Clinical data standards; modelling and governance tools
Building blocks

Photo by Glen Carrie on Unsplash
What is openEHR?

A specification comprising of; clinical models the rules that govern them.
Why is openEHR different and who else is using it?

Ian McNicoll
Director, FreshEHR, OpenEHR Foundation
What is openEHR and why is it different?

Ian McNicoll
openEHR International
What is openEHR?

- open specification for patient-centric, healthcare information
  - data **is stored separately** from apps
  - vendor /technology/ license neutral

- openEHR International
  - Non-profit collaborative
  - industry / clinical/ health organisations
  - openehr.org
A patient-centred coherent information system?
Complexity of healthcare data
‘open Platform’ architecture

Apps

Vendor-neutral Information model

openEHR

Technology-neutral datastore (CDR)
openEHR tooling

https://tools.openehr.org/

https://openehr.org/ckm
Archetypes and templates

Template underpinning application

Archetypes used in template

Issue: Tingling feet, feeling tired
Weight: 76kg
Blood Pressure: 124/92
HbA1c: 7.5%
Assessment: Excellent control

Cardiology Clinic

- Issue: High Blood Pressure
- Weight: 66kg
- Blood Pressure: 192/114 mmHg
- Pulse Pressure: 78 mmHg
- spO2: 92%
- Assessment: NAD, see 4/52
Covid-19

https://www.youtube.com/watch?v=oAzjHdiioDY&feature=youtu.be
openEHR CDR - Clinical data repository

- Smart datastore which natively stores, retrieves, queries openEHR data via a standard API
- All data completely available
- AQL - Vendor-neutral querying
- ‘No-code’ deployment of new clinical content definitions
EY - connected Health ecosystem

https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/health/ey-global-health-tech.pdf
openEHR applications - at scale
openEHR in UK

- Plymouth FT
- Somerset FT
- Wye Valley FT
- Dartford and Gravesham FT
- South London and Maudsley mental health Trust
- Oxford Mental Health Trust
- South Tees hospital FT
- Salford FT
- West Midlands Cancer Alliance
- North Thames and West midlands NHS genomics medicine centres

- NHS Wales
- NHS Scotland National Digital platform
- Digital Health and Care Institute Scotland - sandbox environment
- OCEANIC N. Ireland Genomics platform
- English Shared Care Record projects - coming!!
NHS Scotland: National Digital Platform

194. It is no longer acceptable in this age that our health service is still using multiple incompatible systems and various platforms. In all our work we have heard

*It is no longer acceptable in this age that our health service is still using multiple incompatible systems...*

167. We agree the best way forward for data sharing is through a single platform, or脊, for data that other systems connect into and we note witnesses and the Scottish Government are in agreement. Can the Scottish Government advise whether it has had discussions with other countries regarding the use of a single platform?

*...the best way forward for data sharing is through a single platform...*
openEHR International: [openehr.org]
Introduction to Archetypes and Templates

Ian McNicoll
Director, Fresh EHR, OpenEHR Foundation
Introduction to archetypes and templates

I want to record ‘pulse rate’
Traditional modelling: the data dictionary
UML: Clinically unfriendly
Clinically-accessible?

<table>
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<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Fields</strong></td>
<td></td>
</tr>
<tr>
<td>TypeId</td>
<td>Retrieves the unique identifier for the item type.</td>
</tr>
<tr>
<td><strong>Properties</strong></td>
<td></td>
</tr>
<tr>
<td>AllergenCode</td>
<td>Gets or sets the code for the allergen that causes an allergic reaction.</td>
</tr>
<tr>
<td>AllergenType</td>
<td>Gets or sets the type of allergen that causes an allergic reaction.</td>
</tr>
<tr>
<td>CommonData</td>
<td>Gets the common data for the HealthRecordItem. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>Created</td>
<td>Gets the audit information associated with the creation of this health record item. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>EffectiveDate</td>
<td>Gets the date and time that the health record item data was taken. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>EffectivePermissions</td>
<td>Gets the effective permissions on the item granted to the person retrieving the HealthRecordItem. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>FirstObserved</td>
<td>Gets or sets the approximate date of the first occurrence of the allergy.</td>
</tr>
<tr>
<td>Flags</td>
<td>Gets the HealthRecordItem flags. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>HealthRecordItemSignatures</td>
<td>Gets the signatures for the HealthRecordItem. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>IsDownVersioned</td>
<td>Gets the value indicating if the HealthRecordItem is down-versioned. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>IsImmutable</td>
<td>Gets a value indicating whether the HealthRecordItem is immutable. (Inherited from HealthRecordItem.)</td>
</tr>
<tr>
<td>IsNegated</td>
<td>Gets or sets a value indicating whether the allergic reaction is negated with treatment.</td>
</tr>
<tr>
<td>IsPersonal</td>
<td>Gets or sets the value indicating if the HealthRecordItem is private. (Inherited from HealthRecordItem.)</td>
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openEHR: Multi-level modelling
openEHR Health Record structure

- **EHR**: Electronic health record for one person
- **Folders**: High level organisation of the EHR, e.g. by episode or by specialty
- **Compositions**: Set of entries comprising a clinical care session or document, e.g. encounter, result
- **Sections**: Clinical headings reflecting workflow or consultation process
- **Entries**: Clinical statements about observations, evaluations, instructions, actions
- **Clusters**: Entry subcomponents, e.g. device details or inspired oxygen information
- **Elements**: Leaf nodes of name-value pair and datatype, e.g. body weight = 60kg (Quantity)
openEHR Reference Model (RM)

- Generic technical artefacts for representing health information
  - Data structures and types
  - Overall health record structure
  - Security, Versioning
  - People, Dates, Times etc.
- Deliberately hidden in the clinical modelling tools

https://specifications.openehr.org/releases/UML/latest/index.html
openEHR Archetypes

• Computable models of discrete clinical concepts
• Familiar components of a health record
  • Blood pressure, Body weight, Symptom
  • Medication order, Family history
• ‘Maximal dataset’ philosophy
• Capture as many clinical perspectives as possible
COMPOSITION archetypes

- ‘Top level document’ container
  - All clinical data saved inside a Composition
- Generic document types
  - Encounter, Report, Lab Report
  - Problem List, Discharge Summary, End of Life Care plan
- Simple - do not define detailed content.
ENTRY archetypes

The Clinical Process

1. Observation
   Previous results
   Current observations

2. Evaluation
   Domain Experts
   Domain Knowledge

3. Instruction
   Orders

4. Action
OBSERVATION archetypes

• Gathering of evidence

• Measurable / observable data
  • Patient history, physical examination
  • Lab tests, imaging
  • Scores and scales
EVALUATION archetypes

• Outcomes of a clinical assessment or decision
  • “I think the problem is …”
  • “I think there is a risk of …”
  • “The treatment goal is …”

• Diagnosis, synthesis

• Risk of Adverse reaction

• CPR Decision
INSTRUCTION archetypes

• Orders that arise from clinical assessment
• Initiation of workflow process
  • “I will order some blood tests”
  • “I would like you to start this medication”
  • “I would like to refer you to a specialist”
• Lab test request, referral
• Medication order
• Nursing task
ACTION archetypes

- Activities that result from an Instruction
  - “Lab test performed”
  - “Medication prescribed, administered, deferred”
  - “Procedure performed”
  - “Referral scheduled”
openEHR Templates

- Computable models bringing together component archetypes
- create a dataset for a particular clinical context or purpose
- adjust component archetypes to make them ‘fit for purpose’
  - make items mandatory
  - remove unwanted items
Use-case dataset
Templates vs Forms

Template = Dataset

Form = User Interface

Vital Signs Encounter (Composition), Draft Template [Internet]. UK Clinical Models, UK Clinical Models Clinical Knowledge Manager [cited: 2016-03-09]. Available from: http://clinicalmodels.org.uk/ckm/#showTemplate_1051.57.23

https://www.ehrscape.com/forms-demo.html
Templates - the openEHR ‘workhorse’?

• Archetypes get the glory, templates deliver the datasets

• Key clinical endpoint and starting point for generation of technical artefacts

• Class libraries, GUI skeletons, Message schema

• Most demand for archetyped content will originate as requests for datasets
Building Digital with openEHR

Ian McNicoll
Director, Fresh EHR, OpenEHR Foundation
Build an app in 30 minutes
AD: Archetype Designer

- https://tools.openehr.org/designer/#/
- For creating Archetypes and Templates
- Can store locally / cloud
- Github
- Download from CKM, import to AD
- Export from AD, upload to CKM
- Marand (Better) tool – free to use
CKM: Clinical Knowledge Manager

- Repository
- Collaboration for Reviews
- Two main CKMS
  - International:
    - https://ckm.openehr.org/ckm/
    - UK & 5 Nations / Apperta
      - https://ckm.apperta.org/ckm/
- Searching
- Sharing
- Reviewing
Better Studio

- CDR utility
- Form-builder
- AQL Builder
The FOXS Stack: FHIR, openEHR, XDS, SNOMED CT

John Meredith
Technical Architect, NHS Wales Informatics Service
openEHR has been shown to support;

- Data fully exchangeable with legacy and big data platforms
- Portability of data between CDR vendors
- Not an “all-in” approach;
  - platform components are stable and self-contained
- Extensible to support the evolving digital health and social care record
openEHR has been shown to support;

• Interoperability via shared, clinically driven and validated open models,

• Standards complaint data input/output via modern mobile-first web services

• Rapid application innovation supported by a core data standard
Interoperawhat?

Interoperability; OpenEHR provides a platform component to enable both technical and semantic interoperability.

• Adoption of openEHR can support an open standards-based approach in conjunction with the use of HL7 FHIR,
• Supports software development with appropriate and necessary constraints at the data persistence layer,
• Supports recommendations by the NHS Wales Architecture Review,
• Provide a foundation component for a national Clinical Data Repository.
noun: interoperababble

The confused sound of a group of people talking simultaneously...

...about the subject of interoperability without describing the full meaning and sub-categorisation within the specialist domain such as health.

“It was exceptionally difficult to understand how I could connect to my data, above the din of interoperababble”
WORLD HEAVYWEIGHT INTEROP BOUT!!

NDR PRESENTS

THE HUBBUB @ THE HWB!

openEHR VS FHIR

THE BATTLE OF CHAMPIONS
different
Resource ↔ Archetype
Profile ↔ Template
I shamelessly steal this from @ianmcnicoll to share this on Twitter: automatically generating FHIR Logical Model from an openEHR Template thanks to @yampeku's work in LinkEHR. 🙌🏼🙌🏼🙌🏼🙌🏼
The Technological Fit for Health Interoperability

- **Technical**
- **Process (Clinical)**
- **Semantic**

Related Technologies:
- **IHE** (Integrating the Healthcare Enterprise)
- **XDS**
- **FHIR** (Fast Healthcare Interoperability Resources)
- **SNOMED CT**
- **openEHR**
The FOXS Stack: Open Architecture
The Open Platform

Review highlighted the complementary nature of openEHR, HL7 FHIR and SNOMED CT;

• Standard, published APIs e.g. native, openEHR or FHIR depending on use case,
• Support a persistent data model that outlives the application,
• Technology neutral,
• Data stored and managed in a secure, auditable way at scale,
• Reusable; release design and development resource over time.
Separation of apps and data

3rd Party Consumers (Apps and Services)

NHS Applications and Services

Application Layer

Platform APIs

Routing | API Management | Transforms | Authentication | Terminologies

Open Architecture

Systems APIs

Data Layer

Legacy Repositories | Results | Docs | Structured Data
Recommendation

OpenEHR meets the architectural requirements for standardised, clinical data persistence.

Recommendations:

1. Adopt openEHR modelling approach to help define the emerging digital record for Wales.
2. Adopt openEHR as a clinical data repository component of the Welsh Digital Record/Platform.
3. Develop live exemplar project, supporting key deliverables (e.g. Shared Medication Record, Accelerating Cancer programme).
Semantic Coherence and Governing Open Clinical Data Standards

Ian McNicoll
Director, Fresh EHR, OpenEHR Foundation
Semantic coherence and governing clinical model standards
Why is digital healthcare standardisation so hard?

• The ‘usual suspects’
  • Clinical ego, technophobia, vendor lock-in
• Innovation, research
  • The consultant’s MS-Access database
• Information granularity
  • ‘Family history of breast cancer’
    • GP, Breast Cancer unit, Research Genetics Unit
• Organisational constraints
  • Financial, Legal, Project timescales
Healthcare Information Standards Process

- Clinical stakeholders engage through top-down governance
- Committee-based
- Late vendor engagement
- Fixed review cycles
- Unclear / unresponsive change request mechanism
The maximum dataset: e-Cardiology record
Building consensus

**eCARDIOLOGY TEMPLATE**

- Diagnosis
- Date of Diagnosis
- Date Recorded
- BP
  - Systolic
  - Diastolic
  - Position
  - Cuff Size
- ECG
  - Automated report
  - Heart rate
  - PR interval
  - QRS interval

**Regional Hospital A**

**Regional Hospital B**

**Tertiary Centre**

**eCardiology Record**
Evolutionary standardisation
‘distributed Governance’
Clinical Knowledge Manager

ckm.openehr.org
Archetype versioning
Distributed software development

Working copies
- Ian
- John
- Hildi

Authoring repositories
- commit
- update
- comment, review, request, endorse

Software development repository

Operational repositories

openEHR Archetype Designer

Apperta CKM

GIT

Operational repositories
• Too much information is locked inside apps
• Even when these apps share information too much is locked into forms
• Even when locked into forms too much information is locked into pathway or condition-based
• This is bad for patients and a major burden for the service
Patient Core - Pathway - Events

- Patient core information
  - global patient-centric information
  - Meds, allergies
  - Living situation, Preferences, About me
  - Legal situation, Advance directives
  - Pathway / condition information
- Breast Cancer pathway
- End of life care plan
- Events
  - Investigation results
  - MDT meetings
Governance challenges of a coherent record?

• End of silos?
  • by vendor, technology, organisation or form
  • should allow widespread read-only access
  • time for a ‘coProduced PHR’?
• but will we need to introduce silos ‘by-design’ to protect data quality for pathways or organisations?
  i.e. who is ‘trusted’ to write/update?

https://apperta.org/coPHR/
Modelling NHS Wales Requirements

John Meredith
Technical Architect, NHS Wales Informatics Service
The Hepatitis C Form

**APPOINTMENT DETAILS**

- **PATIENT DETAILS**
  - Date of Referral: 01-May-2019
  - Referral Source: Primary Care
  - Type of Appointment: New
  - Record of Attendance: Attended

- **APPOINTMENT DETAILS**
  - Date of Appointment: 19-May-2019
  - Consultant: Dr A H El-Shaboury
  - Location: GGH Adult Critical Care

Hospital: Clongwill General Hospital
# The Hepatitis C Form

## Treatment Details

**Start Date**
- 29-May-2019
- Today

**Stop Date**
- Today

**Reason for Stopping**
- Please select:

**Biological Outcome**
- SVR 24
- SVR 12
- Relapse independent of reason for stopping

**Treatment Regimen**
- Sofosbuvir + Darlatavir
Why model Hep C?

Supports Objective 4: Clinical Modelling
Process validation

Also...

- Objective 1: Legacy Data mapping/migration
- Objective 2: demonstrator apps with low-code e-forms
- Objective 3: AQL queries, API testing
“When I discovered 84% of the needed archetypes were already available...”

NHS Wales Hep C form

Photo by Ben White on Unsplash
Has the modelling already been done in openEHR?

- 84% of the model was already available
- Of which, 1 Child archetype was needed
- 3 genuinely new archetypes
- *1 in draft...with 2 modelling patterns
Modelling Problems...

When to specialise?
When to build archetypes from scratch?

Modelling patterns: Consideration required at
• Archetype level
• Template level
Query CDR for Adverse Reactions data

List Present in CDR? No

Initialise EHR Record

Yes

Does the patient have a history of adverse reactions? Yes

Record Clinical Data

No

Record "No Known Adverse Reactions"

Commit Clinical List as a Composition

This data element ensures that a record of the review of this data has been committed.
KNOW THE RULES!!
When is a “standard” a standard?

Blood pressure archetype
62 contributors
Published May 2014

Problem/diagnosis archetype
5 review rounds
34 reviewers
71 reviews
Published June 2015
How Standards Proliferate:
(See: A/C chargers, character encodings, instant messaging, etc.)

Situation: There are 14 competing standards.

14?! Ridiculous! We need to develop one universal standard that covers everyone’s use cases. Yeah!

Soon:

Situation: There are 15 competing standards.
Wales Cardiac Network Project

Could openEHR tools and techniques help clinical system development?
- Clinical time is £XPEN$IV€
- 6 week rule
- Physical meetings & workshops
- Danger of repeating work done elsewhere

Consideration:
- Finding a partner
- Engagement - perception of time/value i.e. “what’s in it for us?”
- Learning curve & initial training
- “Hand holding” approach
Modelling Audit Data

Query to the CDR/Problem List for absence of data

Treatment regimen

Date first diagnosed
Pop Quiz: Which is the least useful?

1. Diabetes = YES

2. Problem/Diagnosis = Diabetes mellitus type 2 (SCTID: 44054006)

3. Problem/Diagnosis = Chronic kidney disease due to type 2 diabetes mellitus (SCTID: 771000119108)

4. Problem/Diagnosis = Ketoacidosis due to type 1 diabetes mellitus (SCTID: 420270002)
Outcome

- ACS pathway modelled;
  - 2 templates
    - ACS Pathway Outcome Assessment
    - ACS Referral
  - 2 new archetypes
    - Crusade Bleeding Risk
    - GRACE Risk Score
  - Out for review on UK CKM
  [https://ckm.apperta.org/](https://ckm.apperta.org/)
Continued Work

- WCN sees value in continuing
- Planning to re-launch as a Way of Working following governance review
- Plan to model 3 remaining pathways
- Option to develop ACS into an app
Clinical Standards Interoperability