Model-Driven EHR

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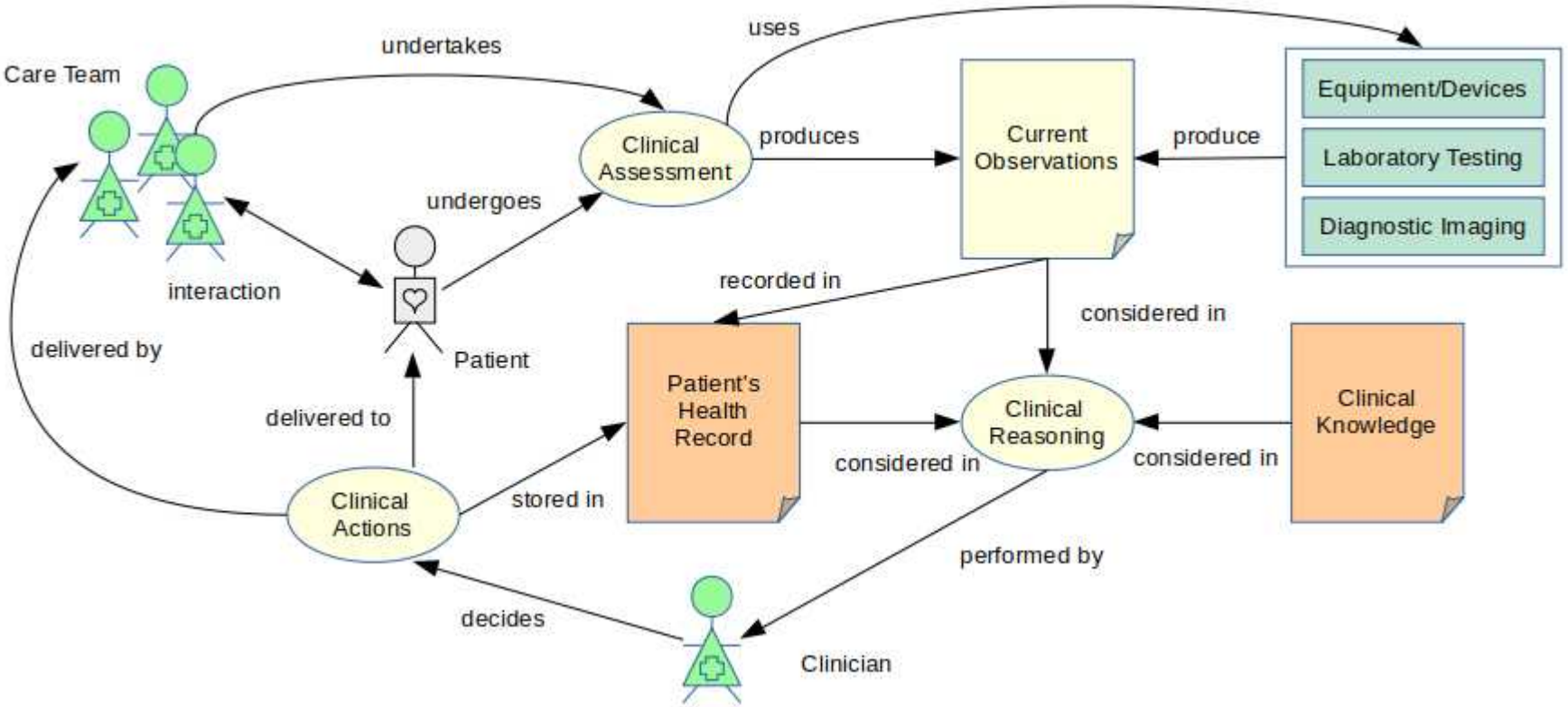
Clinical Decision Making



Clinical decision making is supported by information and knowledge that is managed in Clinical Information Systems

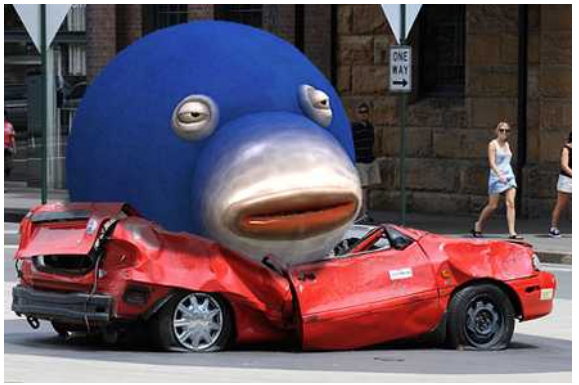
National Agencies - Top Down

National agencies tend to favour top-down approaches to clinical systems implementation.

Particularly where these agencies provide the funding for healthcare and technology.

Top down approaches can crush the life out of the grass roots of healthcare and health information systems suppliers

- No match with requirements
- No stakeholder buy-in
- No innovation



But top down directives could also be made to give freedom to do things locally that match exactly what is required.

Bottom-Up Can Be a Car Wreck

Allowing local decision makers complete freedom to develop and deploy clinical information systems can lead to chaos.

Complete freedom may mean

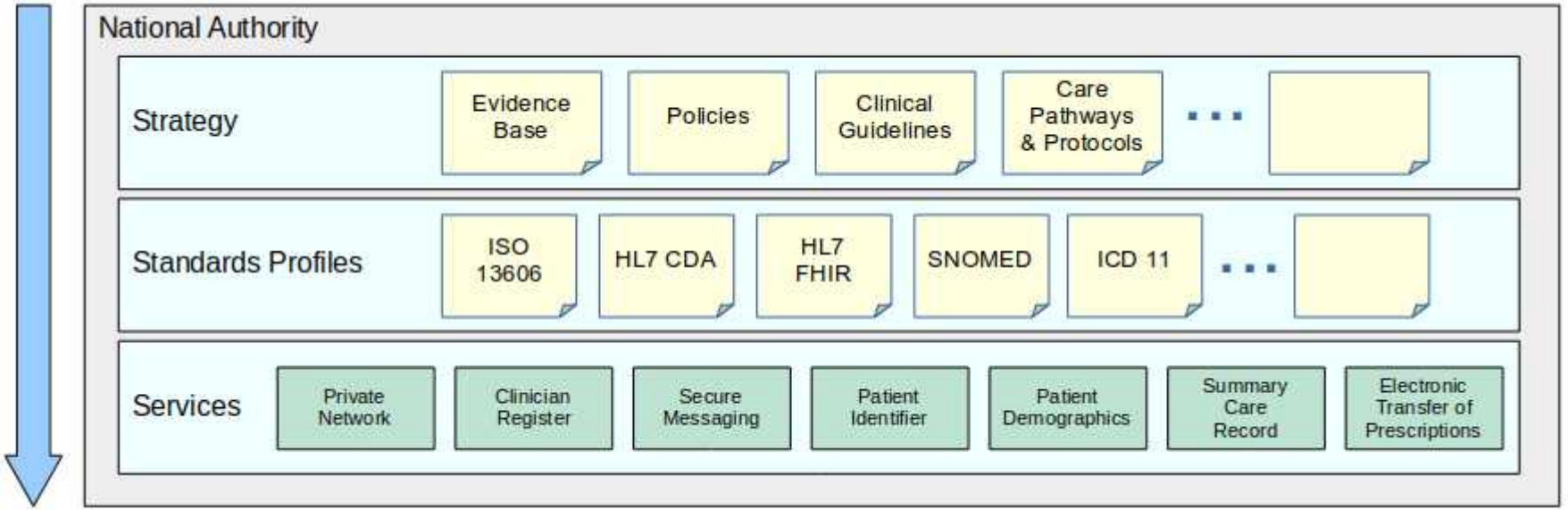
- ignoring guidelines for best practice
- missing out on economies of scale
- creating systems that cannot interoperate
- hindering the exchange of clinical information

Open standards are key to balancing top-down and bottom-up approaches, but care is needed....

Open standards can be used to force everything to be done in the same way.

Open standards can also mean giving freedom to do things locally in a way which will allow data exchange and functional interoperability with others.

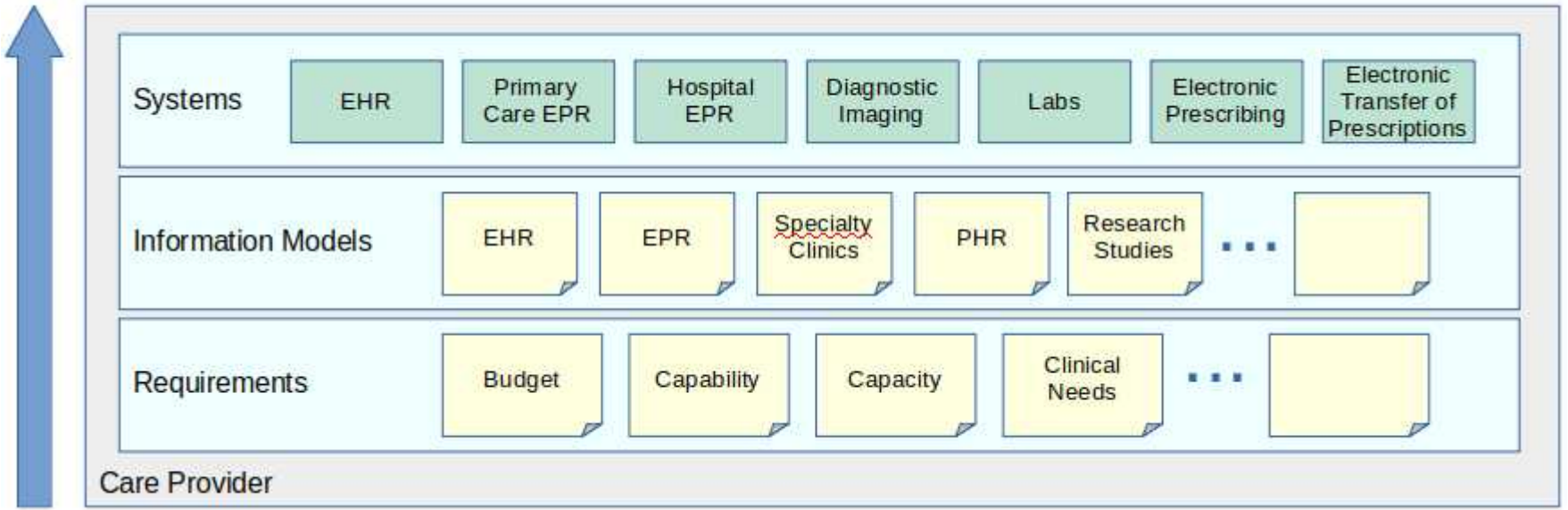
Open Standards Deliver Top-Down



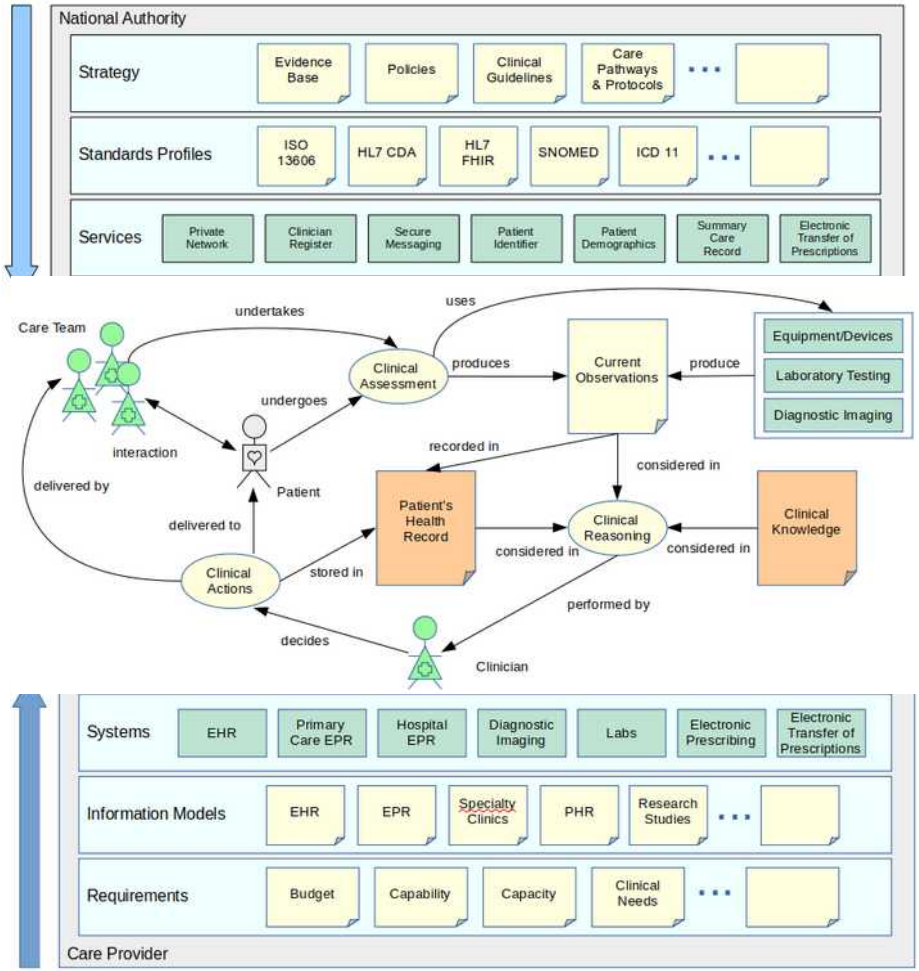
National Strategy determines the Open Standards Profiles used to define shared Clinical Information Services

Open Standards Deliver Bottom-Up

Local Requirements drive the development of local Information Models that configure the Clinical Information Systems.



Top-Down Meets Bottom-Up



The best top-down approach from National Agencies can meet the bottom-up implementations from Care Providers.

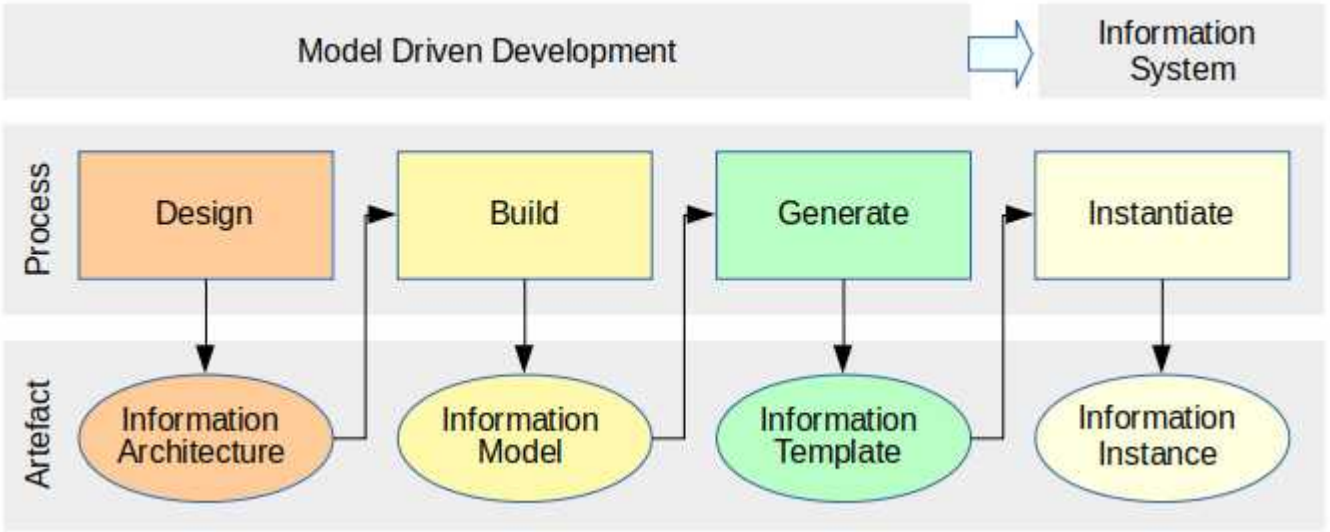
A robust framework of open standards guides the bottom-up implementation.

Evidence shows that it is difficult to 'police' adherence to those standards.

Better the carrot than the stick:

- public sector procurement and funding can require adherence to the standards
- a Government Catalogue of approved products can be maintained
- connection to national level services can mandate the use of standards
- 'payment by results' can require reporting through the national services

Architecture and Models



Agreement (national) on the Design of a Clinical Information Architecture allows for...

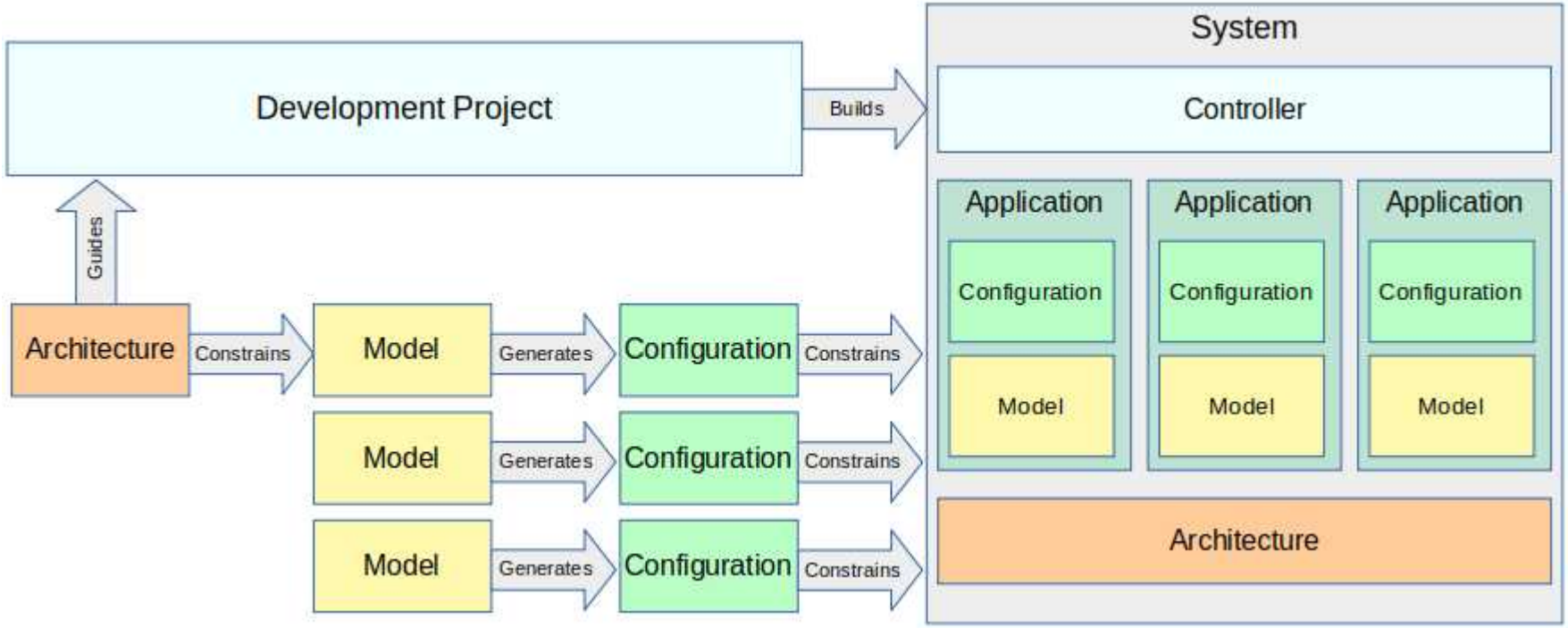
Information Models to be developed locally, which then generate the templates used to...

instantiate the Clinical Information gathered and used for clinical care and research

Model-Driven Clinical Systems

Using the EHR framework, clinicians can develop their own clinical information models.

Then deploy them as enterprise-scale EHR, conforming to the architectural standards



ISO 13606 Reference Model

EHR_EXTRACT - The electronic health record for one person

FOLDER - High-level organisation of the EHR e.g. per episode, per clinical specialty

COMPOSITION - A clinical care session, encounter or document e.g. test result, letter

SECTION - Clinical headings reflecting the workflow and consultation process

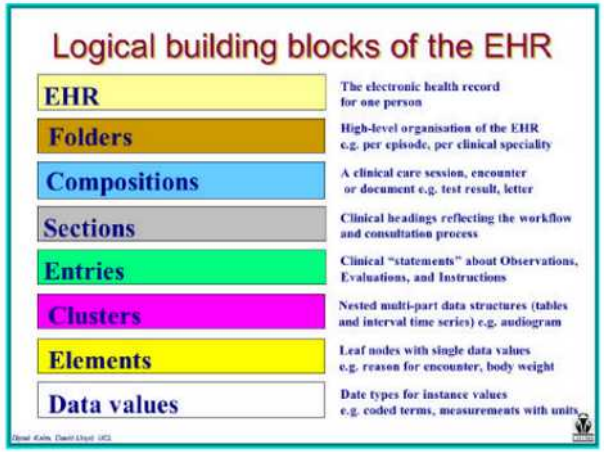
ENTRY - Clinical statements about Observations, Evaluations and Instructions

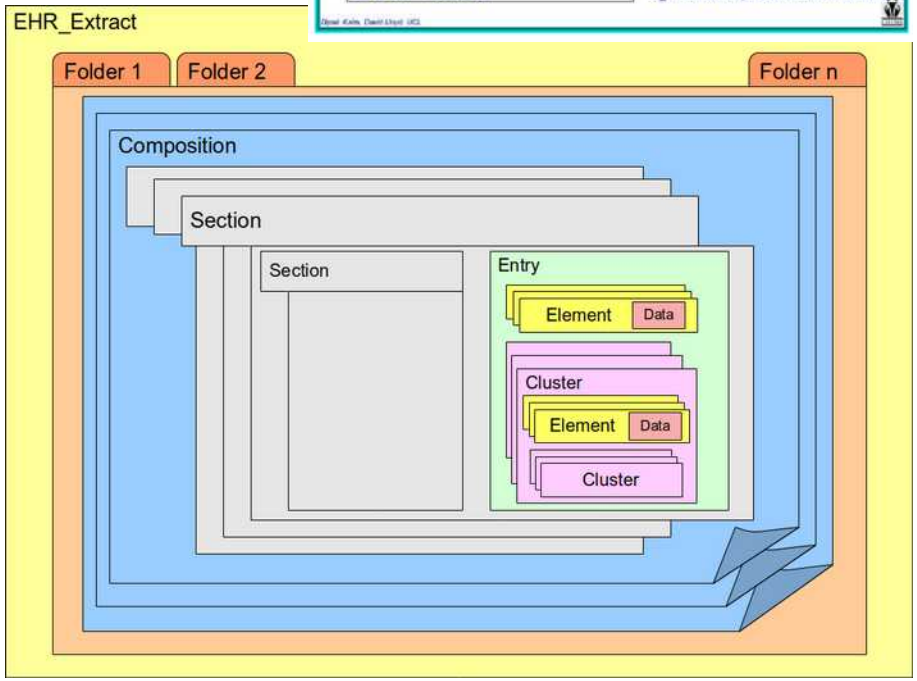
CLUSTER - Nested multi-part data structures (tables and interval time series) e.g. audiogram

ELEMENT - nodes with single data values e.g. reason for encounter, body weight

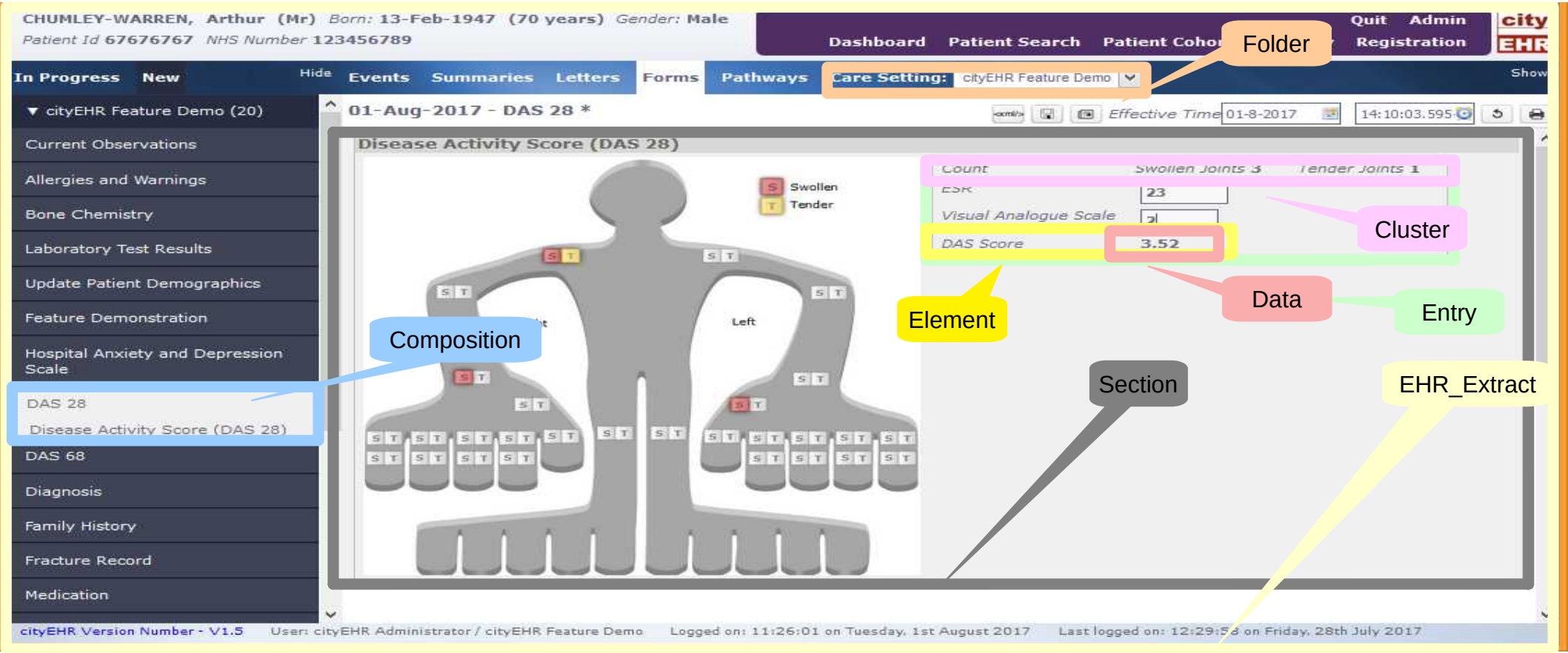
DATA - Data types for instance values e.g. coded terms, measurements with units

Kalra, D., 2006. Electronic health record standards. Yearbook of medical informatics, 15(01), pp.136-144.

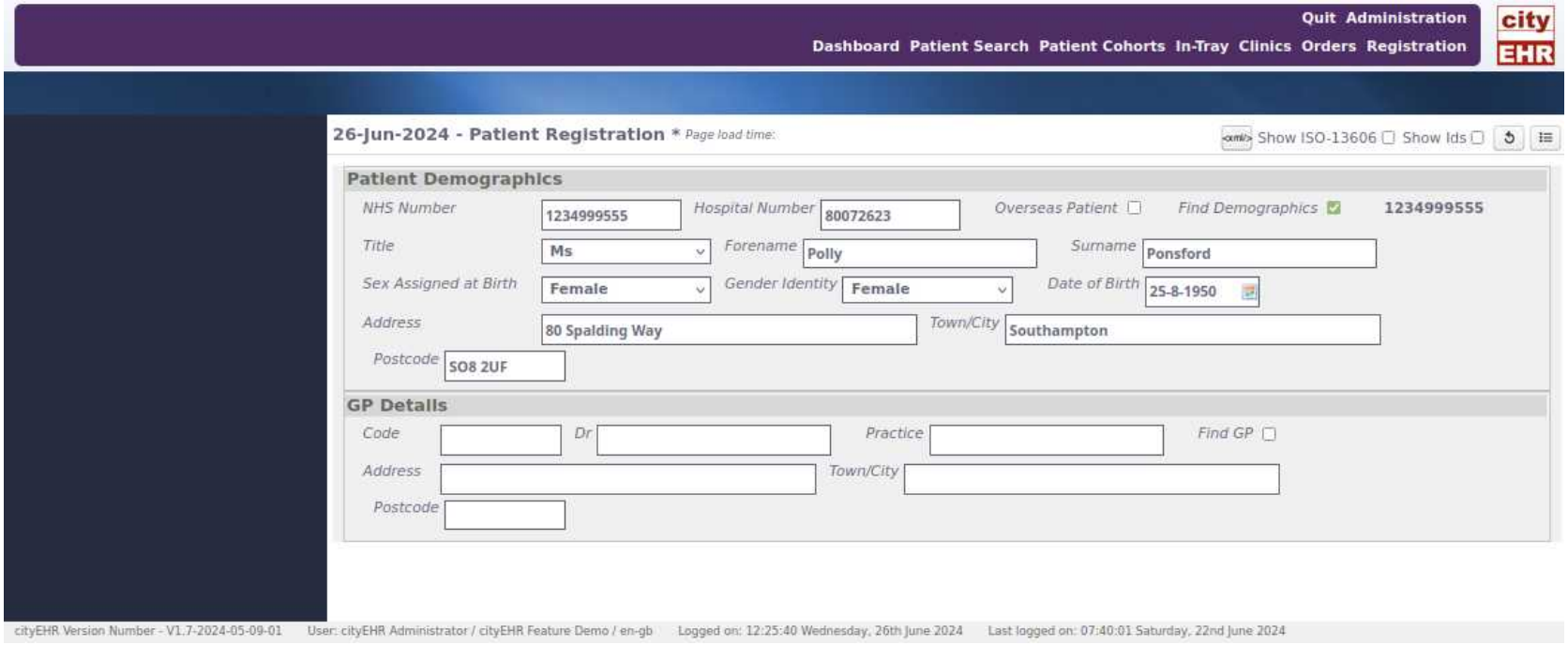




The Reference Model in Practice



Model-Driven cityEHR



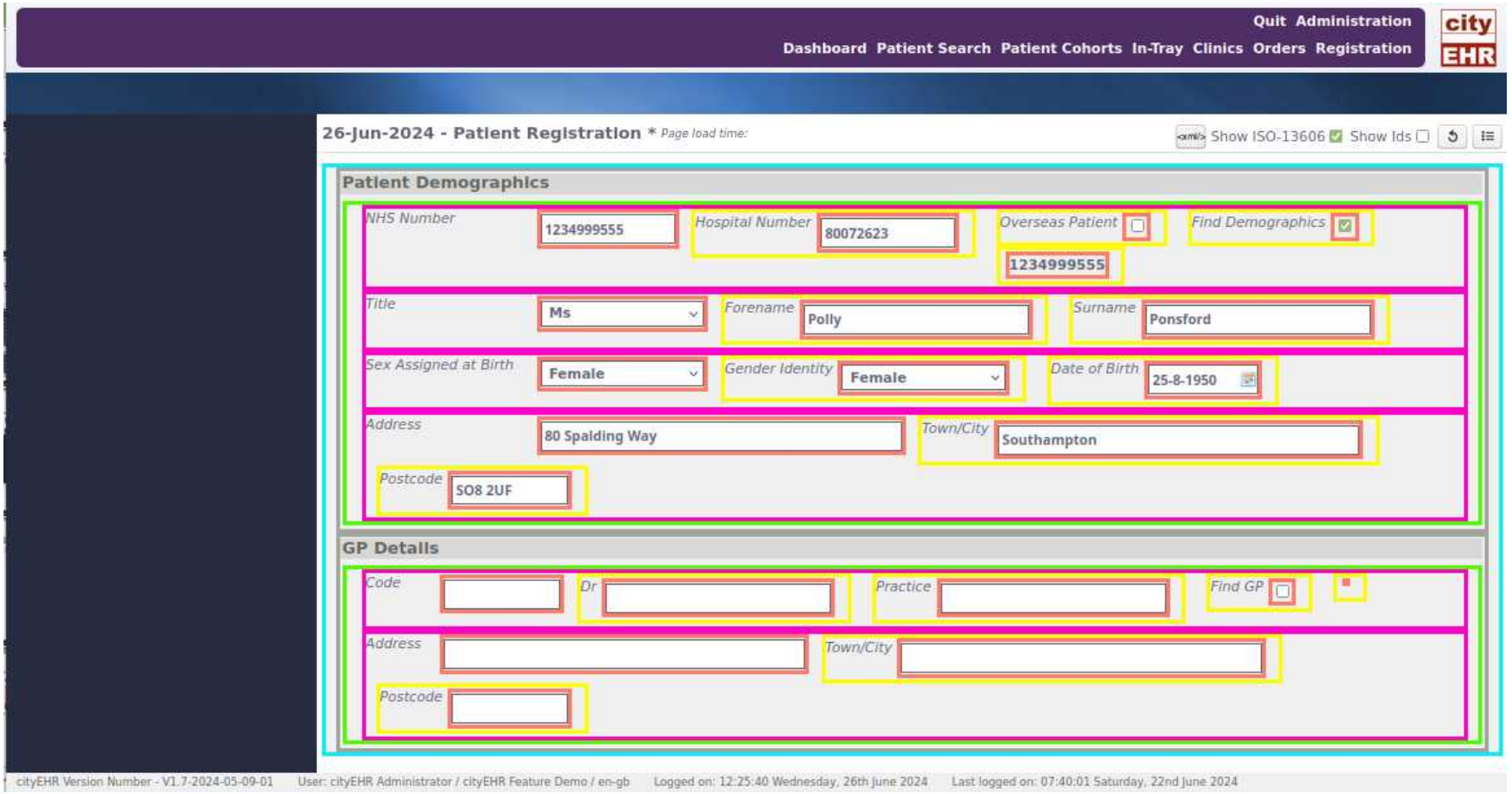
Here is a patient registration screen in the EHR

Compositions, with their Sections, Entries and Elements are defined in the Information Model

The Composition to gather the data is chosen in the configuration

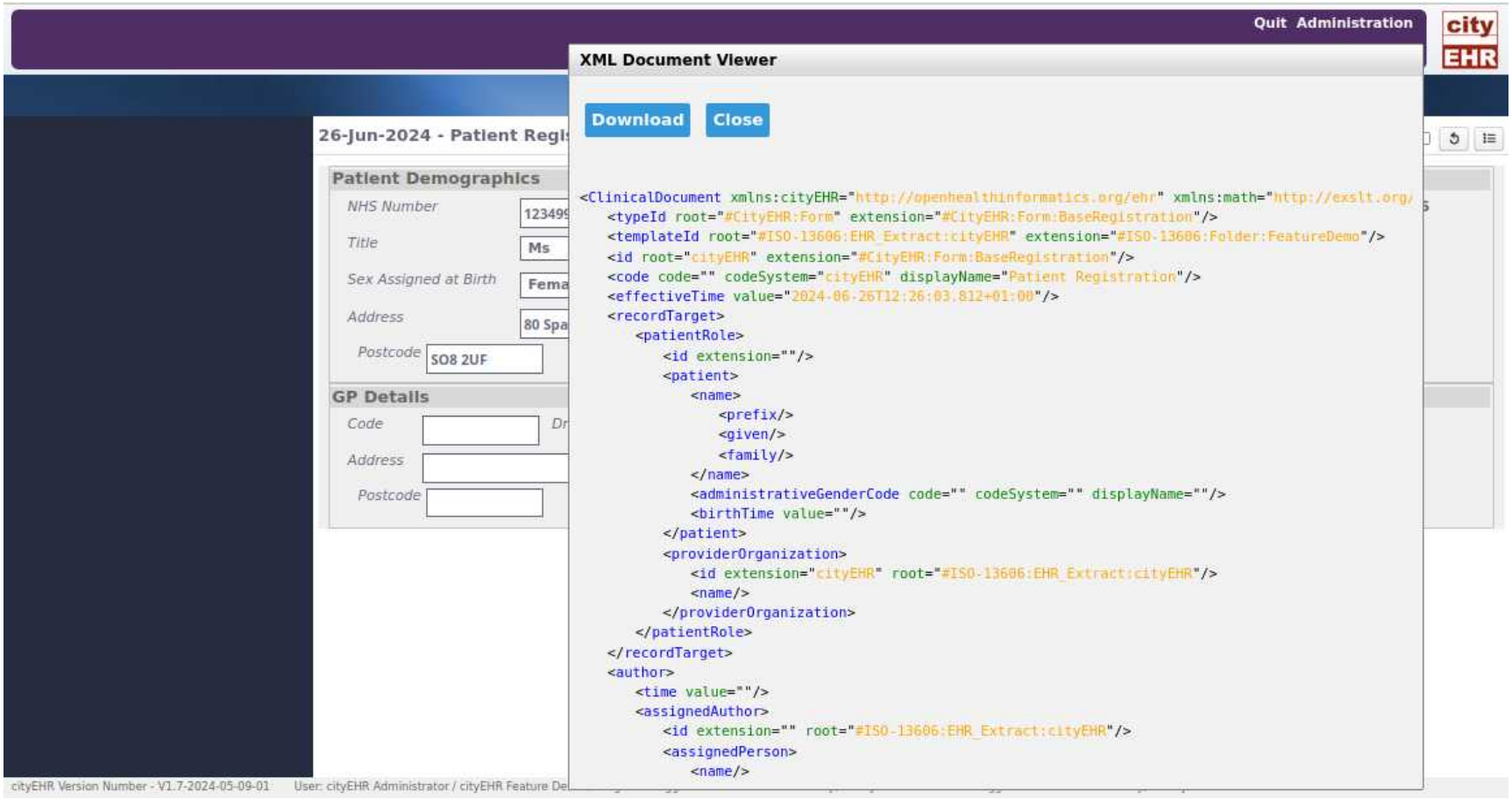
Supporting ISO 13606

Running cityEHR in debug mode allows viewing of the ISO 13606 structure.

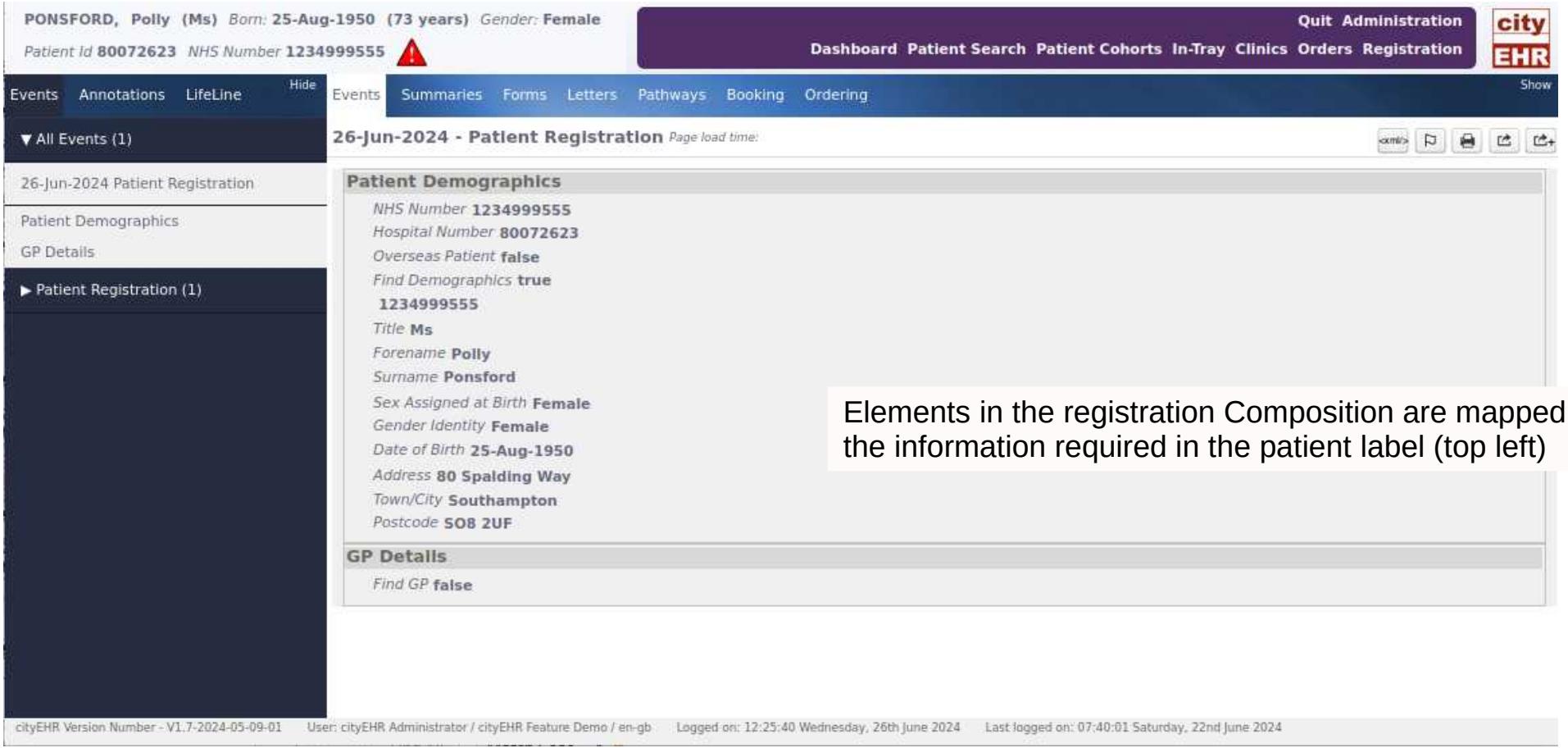


Supporting HL7 CDA

Running cityEHR in debug mode allows viewing of the HL7 CDA structure.

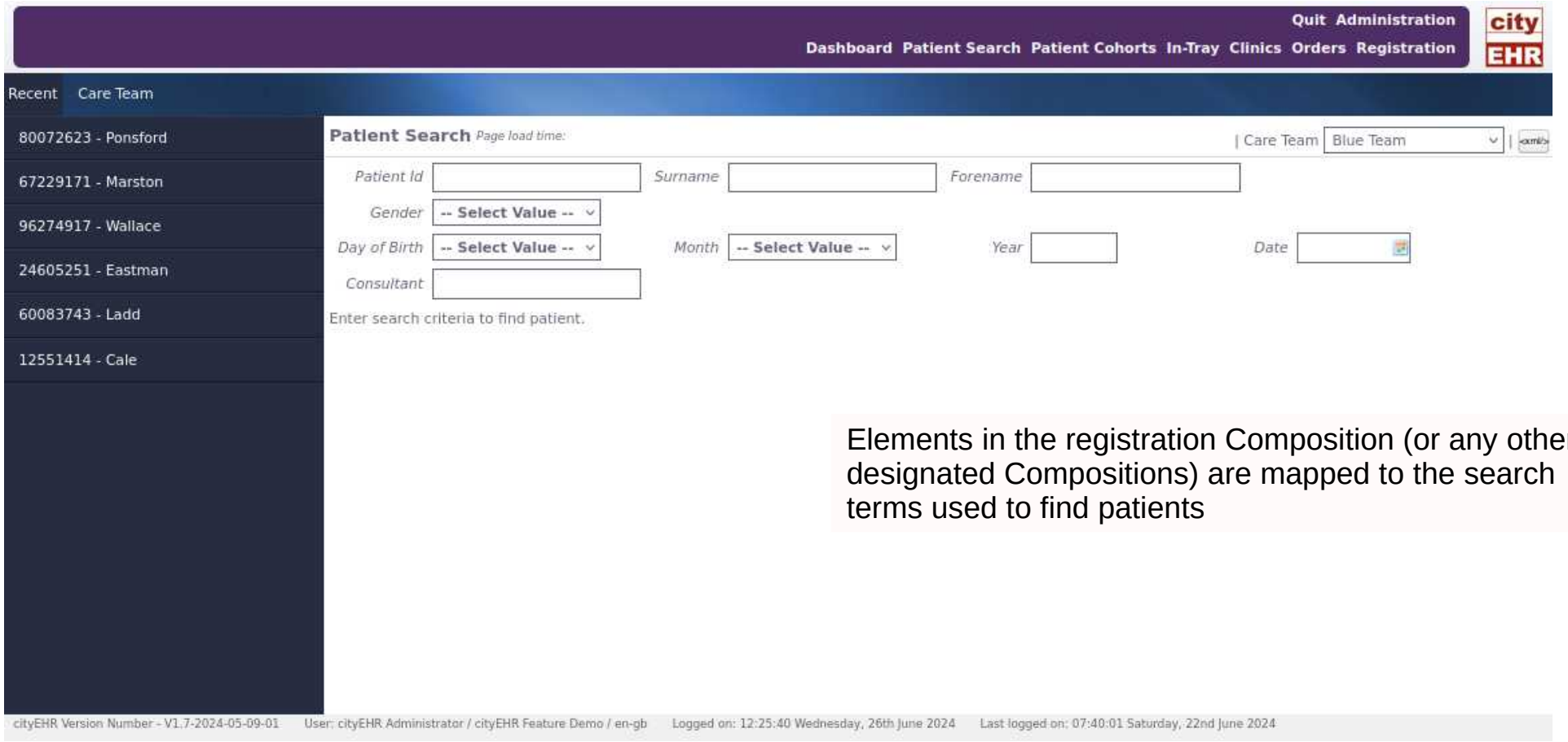


Patient Record - Based on the Model



Elements in the registration Composition are mapped to the information required in the patient label (top left)

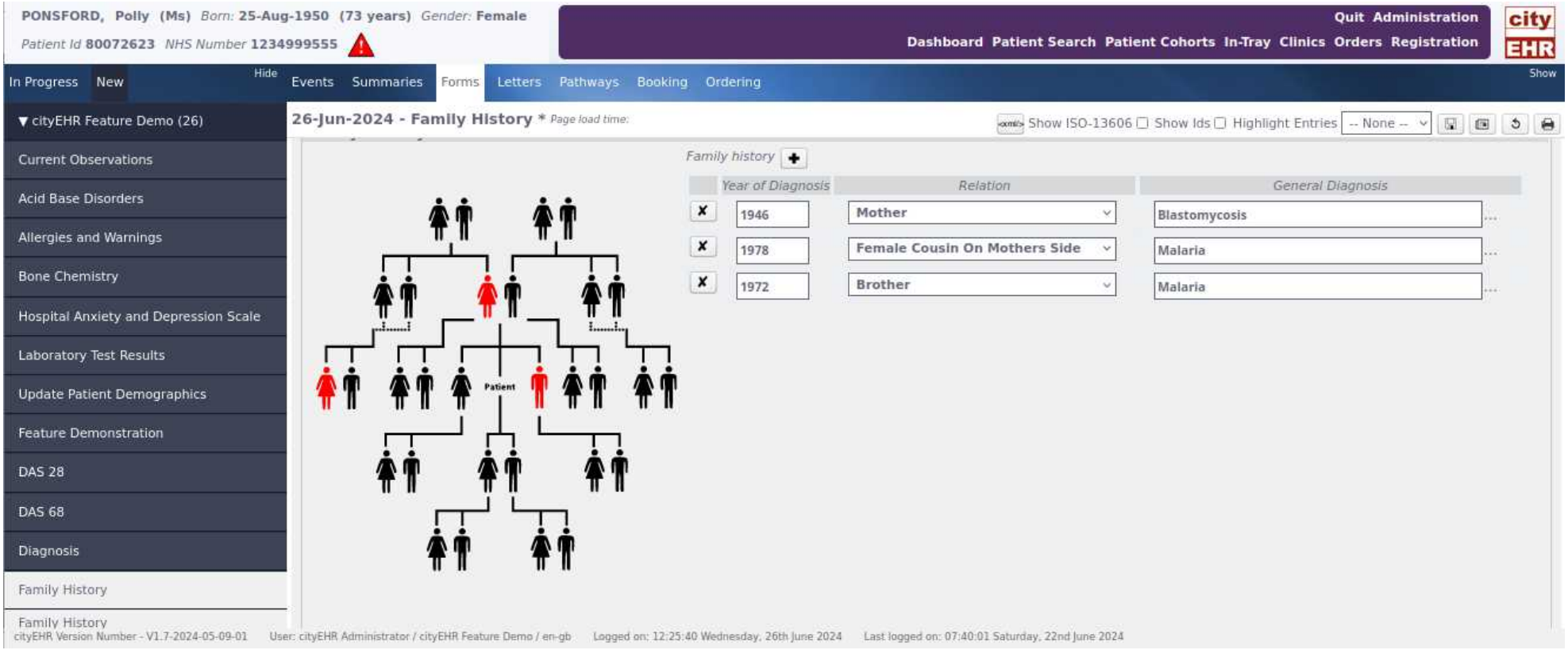
Patient Search



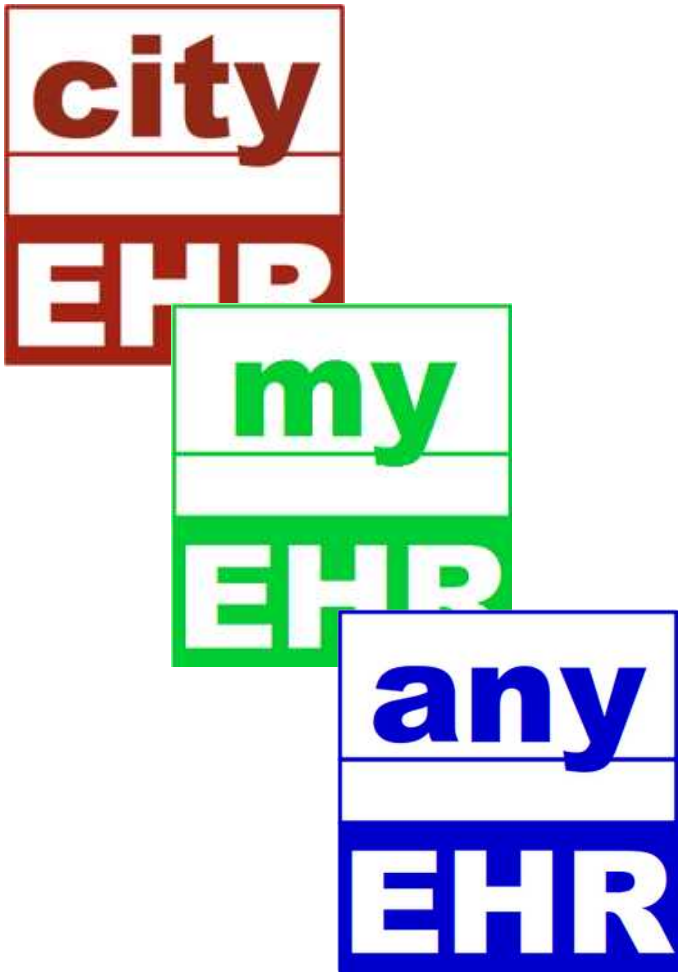
Elements in the registration Composition (or any other designated Compositions) are mapped to the search terms used to find patients

Enter Patient Data

Using any of the Compositions defined in the Information Model



cityEHR



cityEHR is an **open source** Electronic Health Records system

Implemented as an **Enterprise Java** application, accessed through a **web browser**.

Managing clinical information for patient care and research studies, using the HL7 **Clinical Document Architecture** (CDA)

Based on over ten years of **academic research**

Using **open standards** throughout - ISO 13606. HL7 CDA, ICD 11, SNOMED CT, UML, XML, OWL/XML, XForms

Entirely **model-driven** (using Ontology models, following the ISO 13606 standard)

Clinician-led - using Clinical Information Models tailored for each deployment, developed by clinicians using standard desktop tools

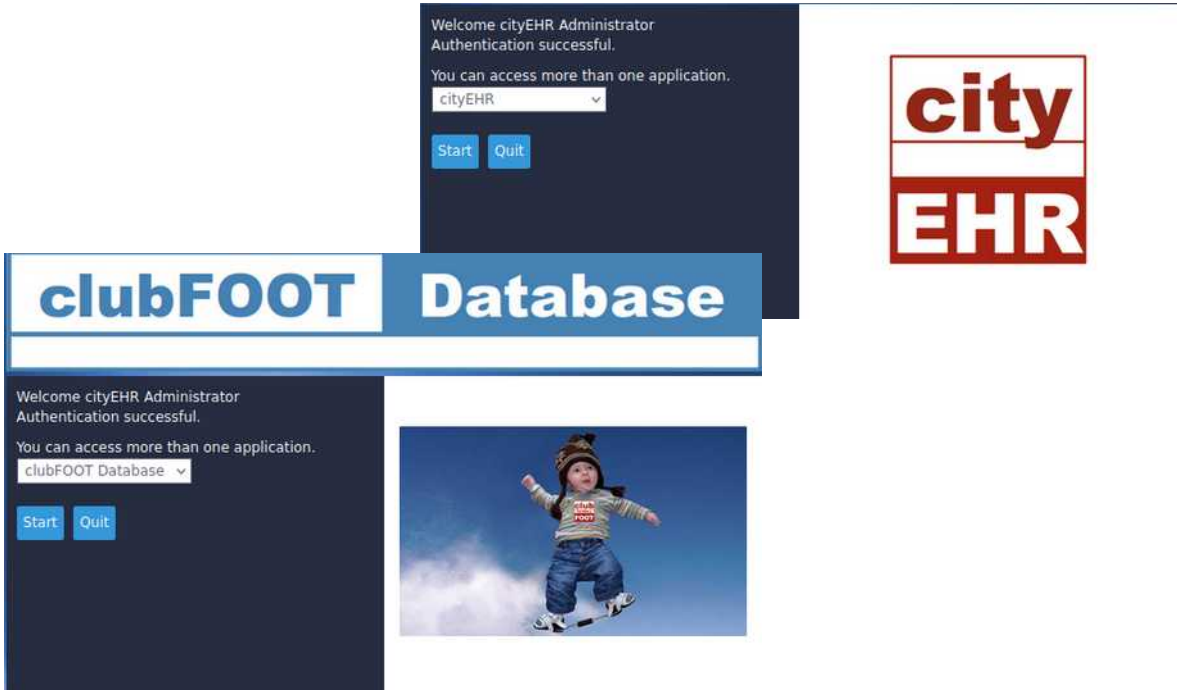
Seven Informatics and cityEHR

Founded in 2013 to support the development and deployment of cityEHR

Now also delivers Fordham University's Applied Health Informatics masters program

seven informatics

nottingham orchid



city EHR

Global Open Source Electronic Health Records

GOSEHR was launched the with financial support of Seven Informatics and the support for Academic Research and Education Programs from Fordham University.

Partners include leading universities in the UK, Canada and Norway, together with the African Digital Health Research Institute.

Global Open Source Electronic Health Records

FORDHAM UNIVERSITY

THE JESUIT UNIVERSITY OF NEW YORK

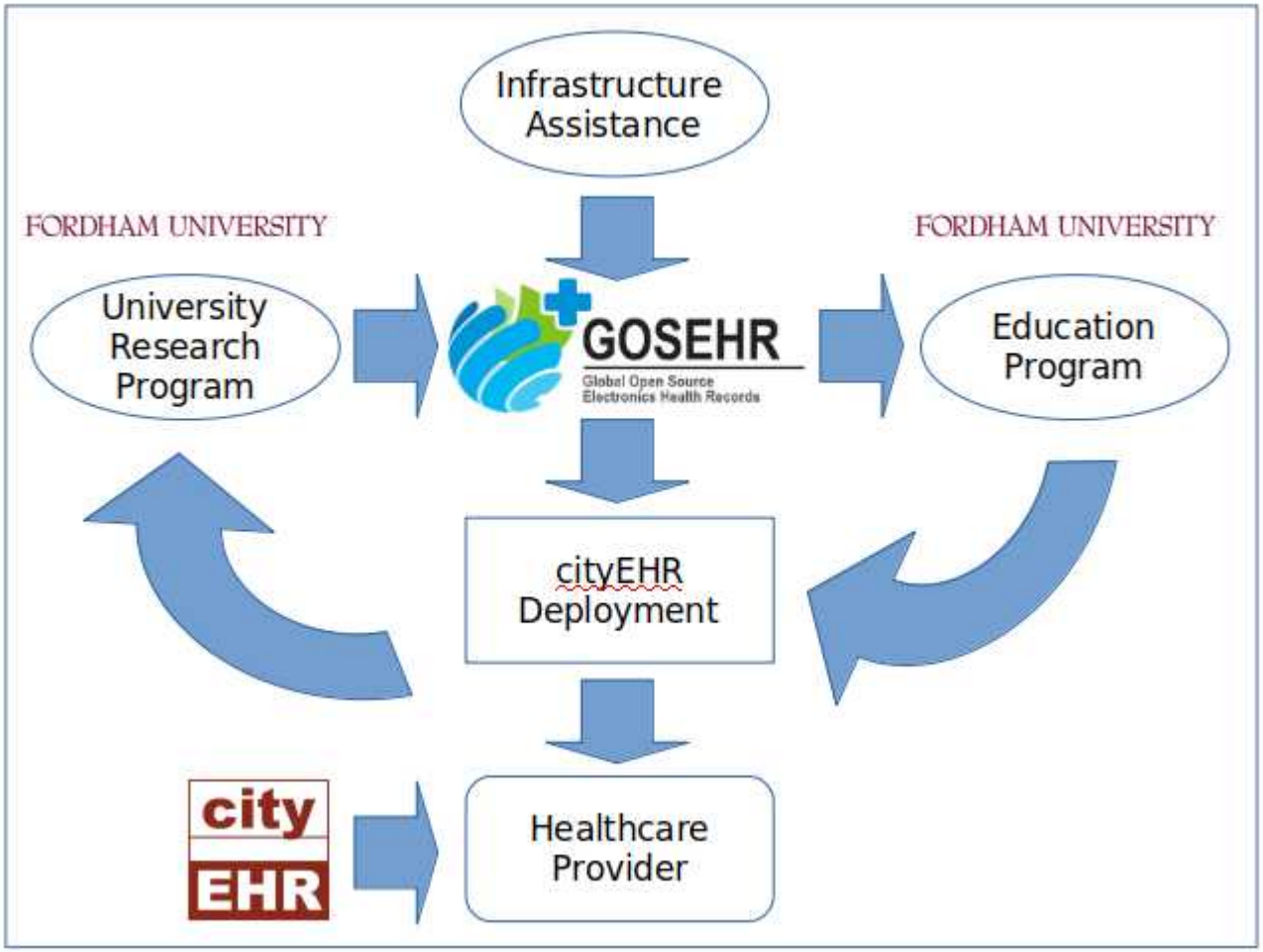
The objective of the Global Open Source Electronic Health Records initiative is to create a sustainable program for the deployment of open source EHR in participating countries, with the ultimate aims of improving patient outcomes and delivering better healthcare, within existing budget constraints.

The Initiative is bringing the benefits of open source, structured EHR systems to low-income countries, through engagement, education and research with local communities.

Partners include leading universities, healthcare providers, open source software developers, NGOs and local community companies.

https://gosehr.org

GOSEHR Dimensions



Global Open Source EHR

University Research

Education and training

Deployment of EHR

Infrastructure Assistance

GOSEHR Engagement Model

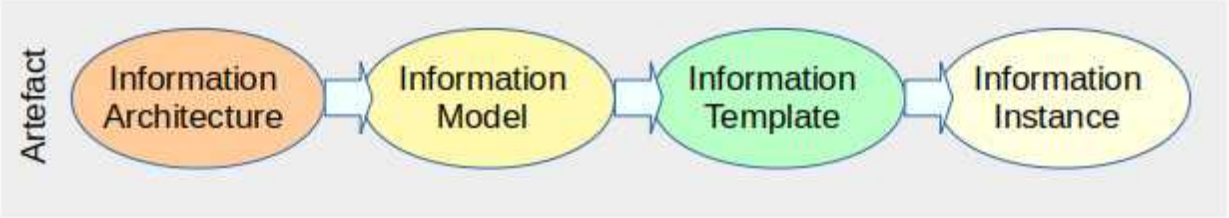
The GOSEHR Engagement Model brings together local research, systems integrators and care providers to deploy open source EHR, supported by the GOSEHR partners.

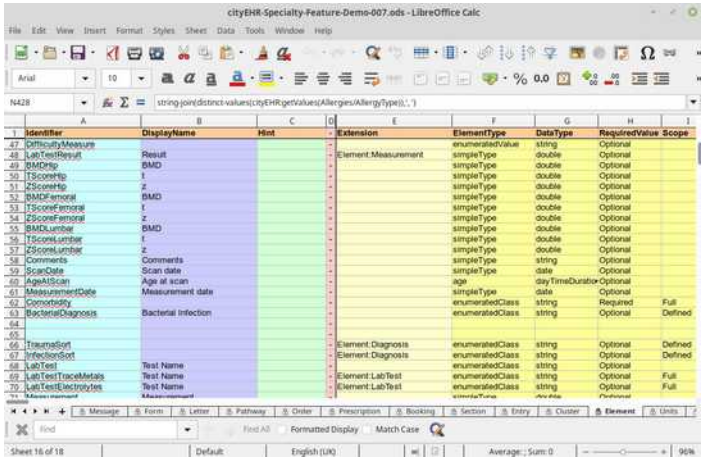
Model-Driven EHR

cityEHR

Open Health Informatics for Electronic Health Records

Model-Driven Platform





myEHR

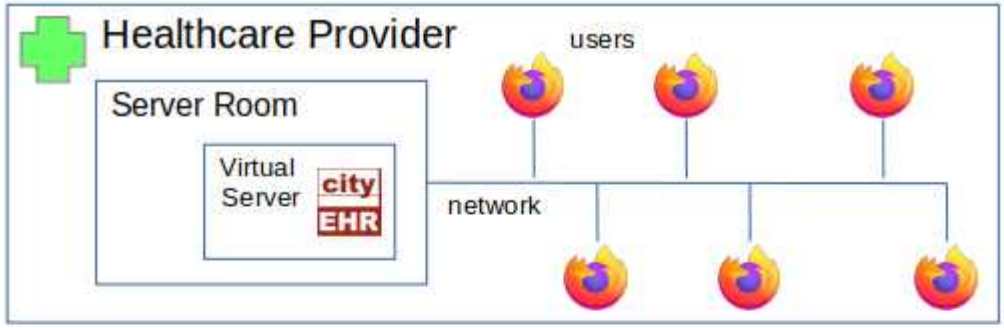
cityEHR is a model-driven platform for the development and deployment of Electronic Health Record applications.

The underlying Information Architecture is an ontology that follows the ISO 13606 and HL7 CDA standards.

Clinicians create Clinical Information Models using familiar tools. such as a spreadsheet.

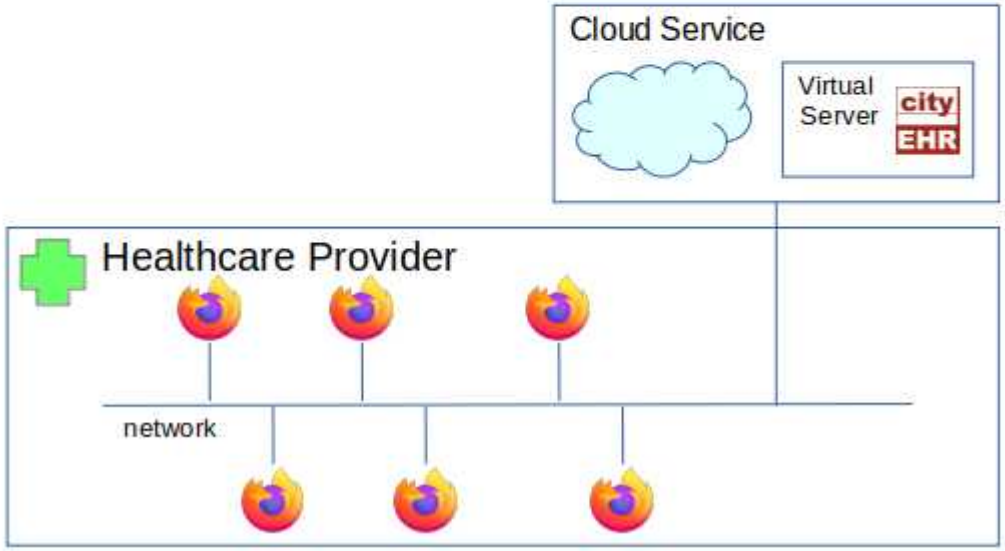
The models are imported to cityEHR and then drive the features of the EHR that are made available to clinical users.

Deployment of cityEHR



cityEHR can be deployed within the Healthcare Provider, ideally in a secure server room using a virtual server infrastructure.

Users access the EHR using the Firefox web browser on devices connected to the network within the Healthcare Provider.



Alternatively, cityEHR can be deployed on secure private Cloud Service, accessible through the Healthcare Provider network.

The most secure way to achieve this is to set up a Virtual Private Network (VPN) between the Cloud Service and the Healthcare Provider.

cityEHR Scalability

Stand-alone Deployment

Built-in database
1 to 10 users
Up to 10,000 patients

Deploy with External Database

External database, single instance
1 to 100 users
Up to 50,000 patients

Deploy with Database Cluster

External database, multiple instances
1 to 10,000 users
Up to 1,000,000 patients

cityEHR is deployed on the open source eXist Native XML Database

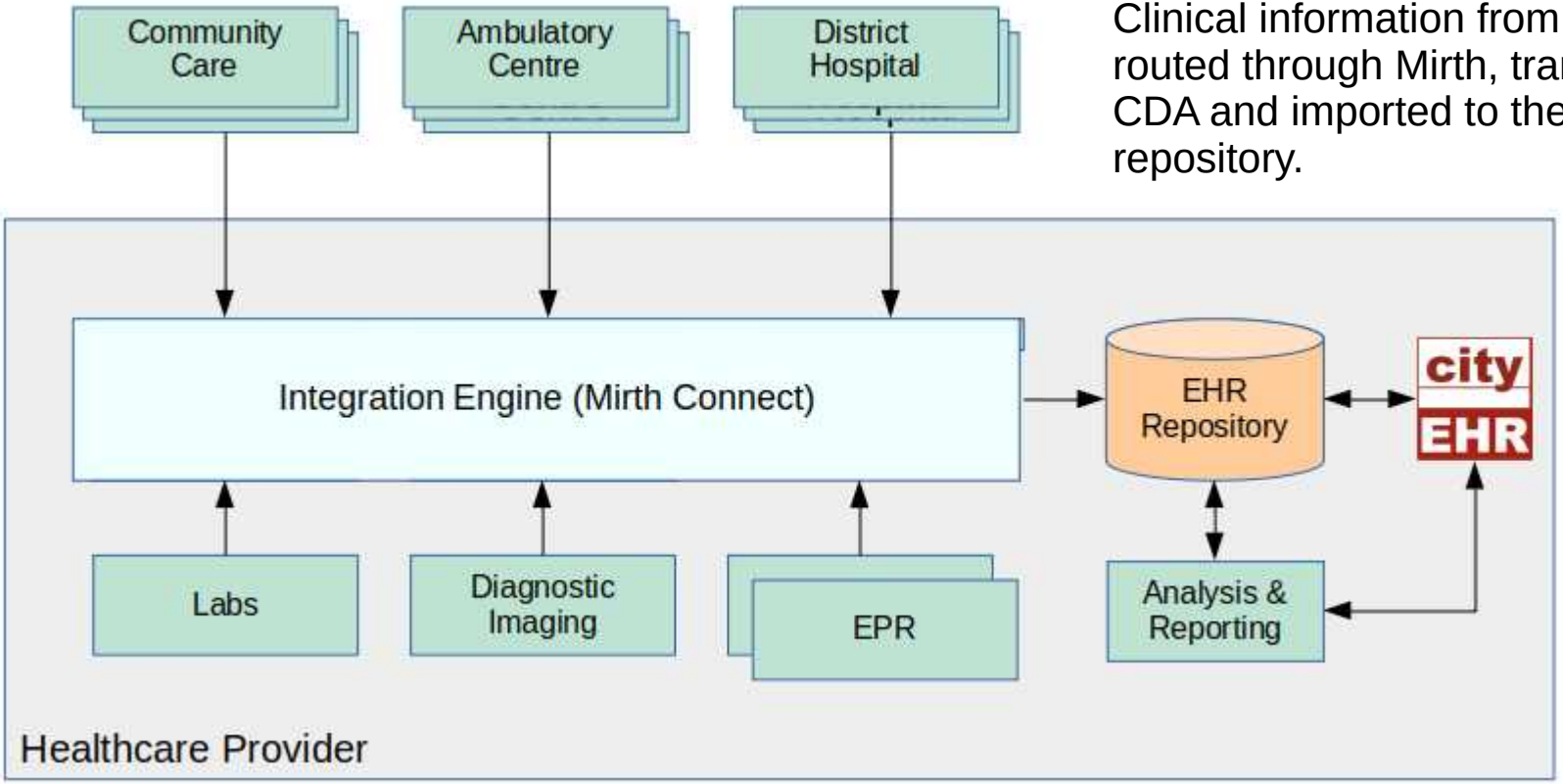
The database is built in to the cityEHR system and can be used for small scale deployments.

For larger deployments, the database can be installed on its own server, either as a single instance or as a database cluster on multiple servers.

Integration with cityEHR

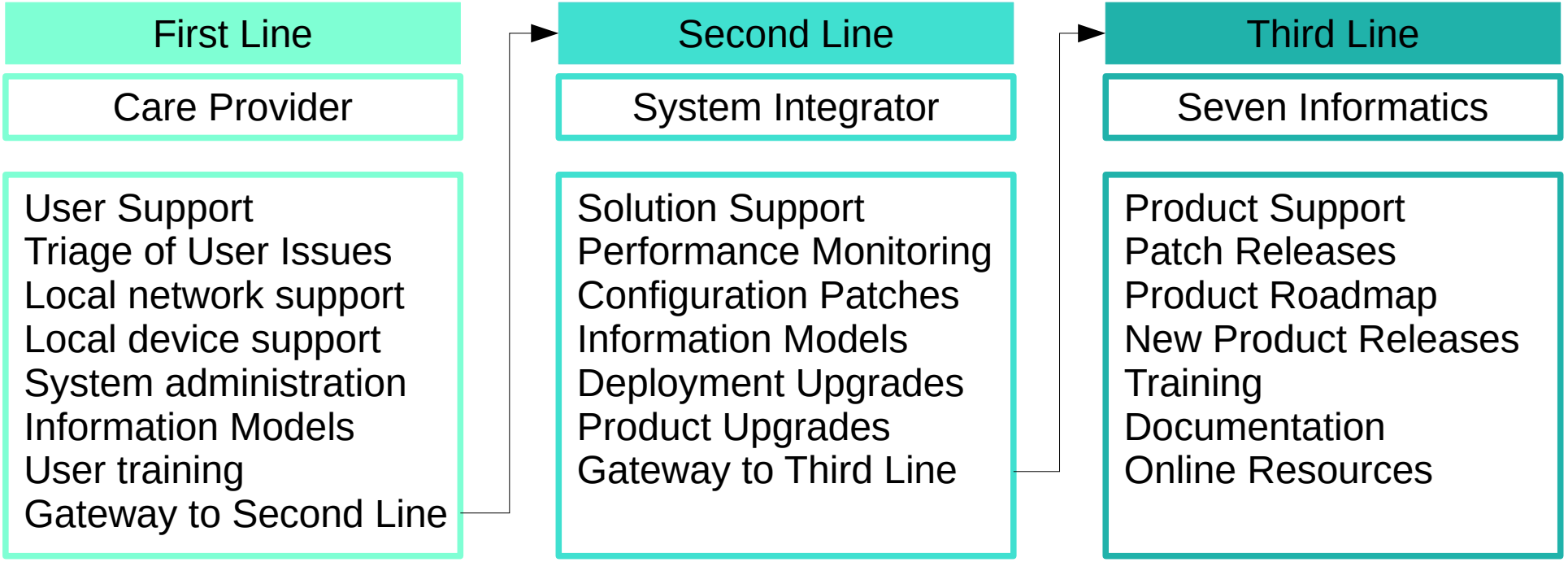
cityEHR can be deployed with the open source Mirth Connect integration engine,

Clinical information from multiple sources is routed through Mirth, transformed to HL7 CDA and imported to the cityEHR repository.



Support and Maintenance

Blueprints for system Support and Maintenance, involving the Care Provider, Local System Integrator and Seven Informatics.



Agile Deployment Plan

Blueprints for deployment in three phases, of three or six months, with monthly iterations, using the agile Scrum methodology.

Phase One	Phase Two	Phase Three
Foundation	Integration	Electronic Health Record
Local Engagement Project Teams Regulatory Approval Education and Training Deployment Plan Information Models Feasibility Prototypes	Network Server Installation End-User Devices Deploy Mirth Connect Information Models Connect End Points Connect EHR Database Pilot with live data	Education and Training Mirth Connect go-live Deploy cityEHR Pilot cityEHR as Viewer Information Models Pilot cityEHR Refine models cityEHR go-live

Open Health Informatics

openhealthinformatics.org

Open Standards
Open Source Software
Open Systems Interfaces
Open Development Processes

Get Involved

Register **8th – 13th September 2024, St Edmund Hall, Oxford.**

Presented by: FORDHAM UNIVERSITY

This one-week residential workshop will bring together participants from around the world, to learn how to configure and deploy an open source, model-driven, health electronic records system. We will use the open source cityEHR system, initially configured with example ontology models for a range of clinical services, which have been created by students at Fordham University, the University of Oxford and the University of Victoria, Canada.

GOSEHR Summit

An annual summit, bringing together academics, healthcare professionals, engineers and investors from around the world, presented in association with Fordham University.

Next Date: Saturday 5th April 2025, St Edmund Hall, Oxford.

Register FORDHAM UNIVERSITY