

Success factors for guideline and clinical decision support in task planning and EHRs

Thomas Beale

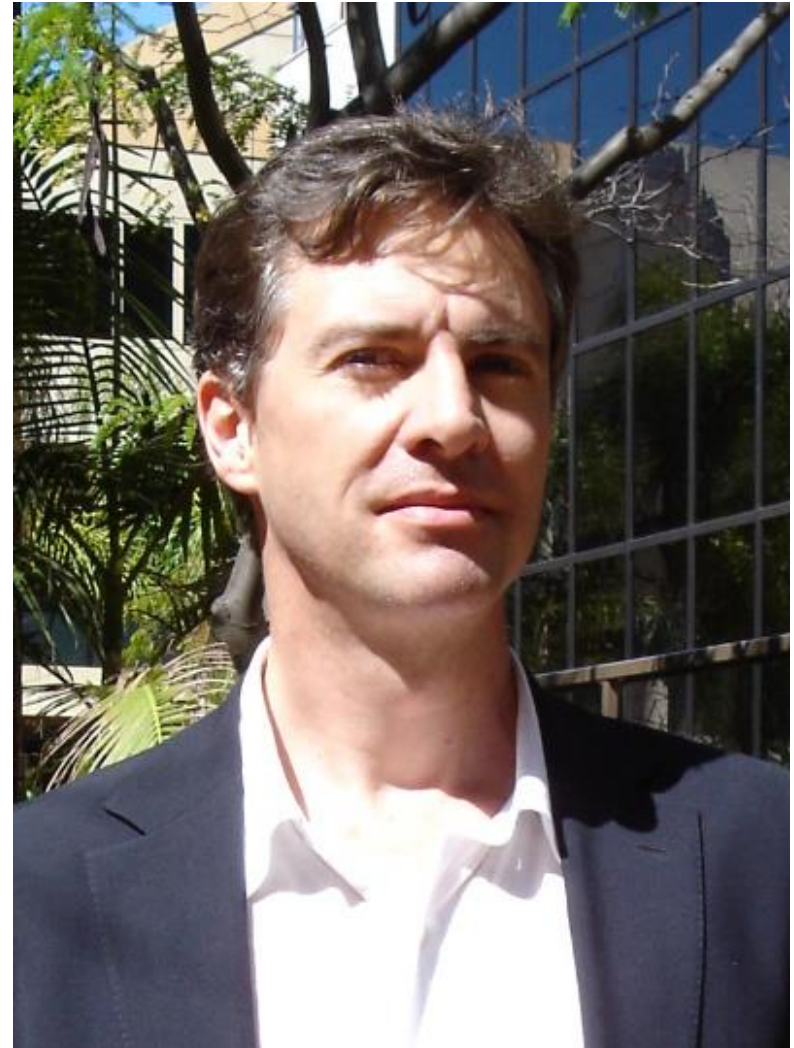
openEHR Management Board

Joint lead, openEHR Specification Program

Principal, Ars Semantica

Introduction

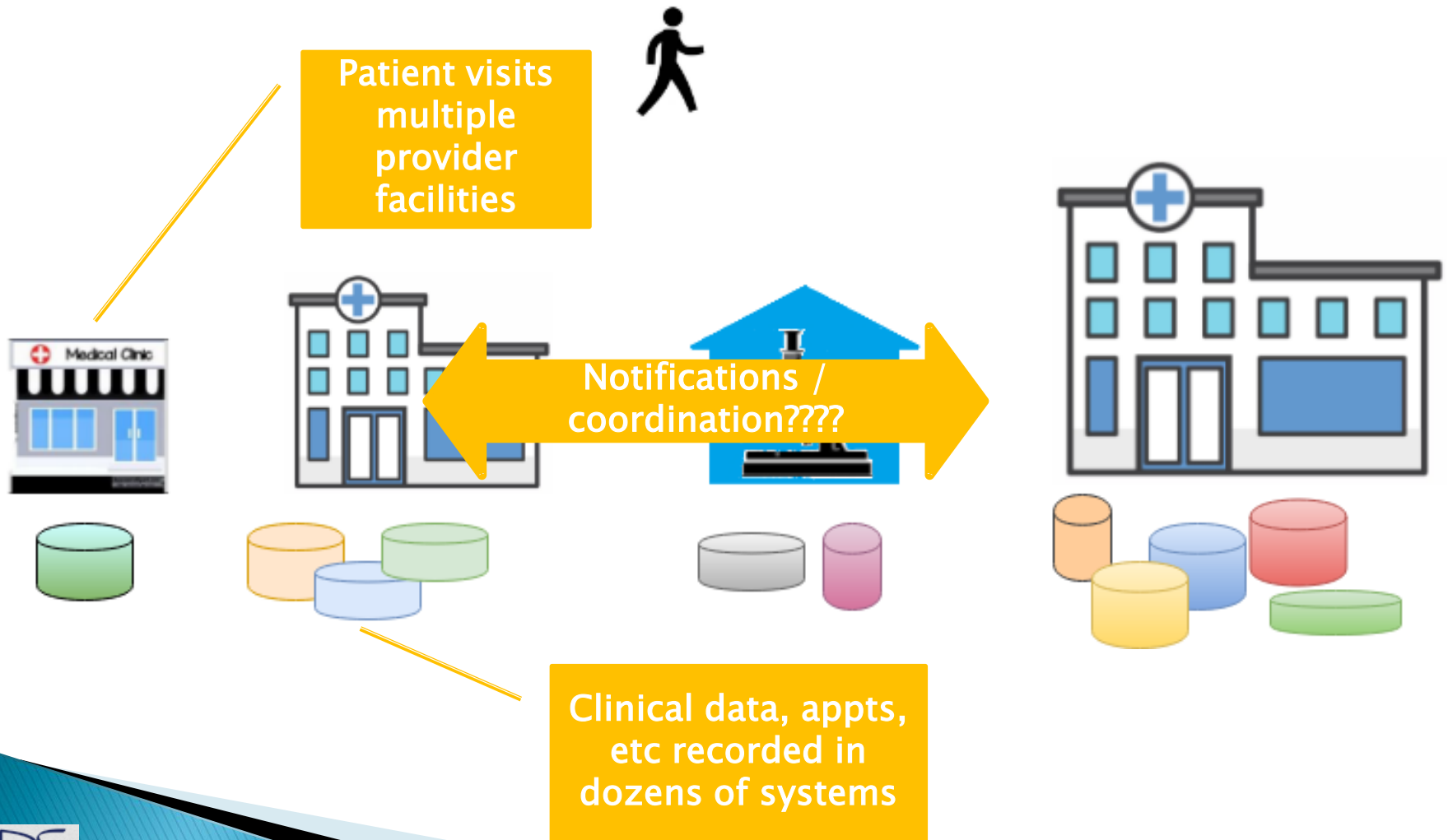
- ▶ Currently
 - Co-lead of Specifications openEHR
 - openEHR Management Board
 - Principal, Ars Semantica
 - US VA consultant
- ▶ Background
 - Elec Eng + Comp Sci
 - 6y real-time systems
 - 5y finance
 - 23y in e-health
- ▶ Interested in
 - Realist philosophy
 - Reality, unreality, and modern politics
 - Wine, beer and other coping mechanisms



Interesting Questions



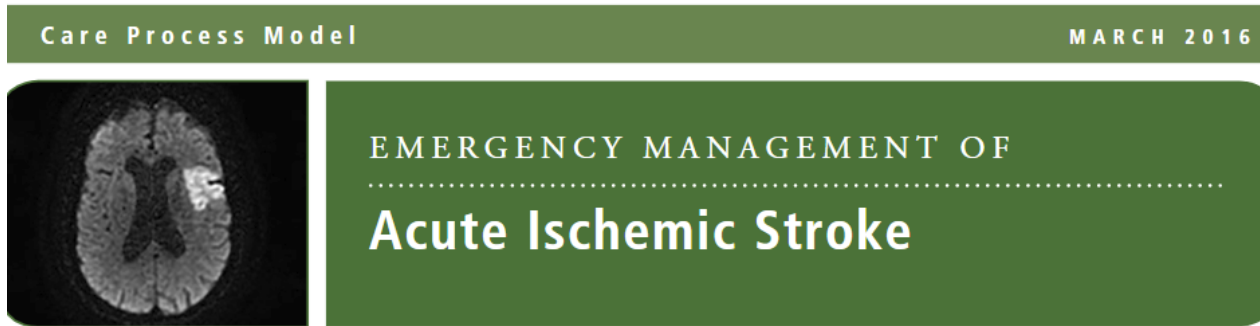
Q1: what's going on with my patient?



Q1: What's going on with my patient?

- ▶ The situation
 - Increasing team-based / distributed care
 - Long-term routine monitoring e.g. diabetes
 - Multi-day/week procedures e.g. chemo
- ▶ ➔ constant shift and personnel changes
- ▶ Q: Who knows what's happening with the patient?
- ▶ A: Noone (i.e. no person).
- ▶ A: the EHR (passive); plan system (active)

Q2: how to get from Care Pathway PDFs to CPGs?



This care process model (CPM) was created by the Neurosciences, Intensive Medicine, and Cardiovascular Clinical Programs at Intermountain Healthcare. These groups include multidisciplinary representation from neurovascular medicine, interventional radiology, cardiology, anesthesia, hospitalists, and others. The CPM provides expert advice for the emergency management of acute ischemic stroke and summarizes current medical literature and national practice guidelines. (See guideline references on page 8.)

Intermountain's care management system for stroke also includes:

- **Education materials and programs** for providers and patients.
- **Data systems** that help providers and facilities track stroke management success.
- **Multidisciplinary coordination** of stroke care.

► Why Focus ON ISCHEMIC STROKE?

► What's new IN THIS UPDATE?

- **Updated treatment algorithms** for diagnosis and classification, emergency management of acute ischemic stroke, and endovascular therapy (see pages 2–7)
- **Telestroke process details** (see page 2)
- **New ED Acute Stroke Process Checklist** (see page 6)
- **Concentrated focus on emergency management**

► WHAT'S INSIDE?

ALGORITHMS:

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Emergency Management of Acute Ischemic Stroke	4
Assessment for Endovascular Therapy	7

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indicates an Intermountain measure.



Intermountain[®]
Healthcare

ALGORITHM 1: DIAGNOSIS AND CLASSIFICATION

Patient/family

SIGNS AND SYMPTOMS (a)

In-hospital

ALGORITHM 2: EMERGENCY MANAGEMENT OF ACUTE ISCHEMIC STROKE

Acute Ischemic Stroke

(a) Intravenous (IV) tPA relative exclusion criteria for < 3 hours since symptom onset[†]BER, BRU, GOY, JOV, SAV

Contraindications (risk of bleeding is greater than the potential benefit)

- Thrombolytic therapy initiated by another hospital prior to arrival
- CT findings (ICH, SAH, or major infarct signs)
- SBP > 185 or DBP > 110 mmHg despite maximal treatment
- Plts < 100,000
- Confirmed active bleeding

BTW: this keeps changing!

apixiban (Xarelto®), apixaban (Xarelto®), apixaban (Xarelto®)

Warnings and Precautions (use clinical judgment)

- Blood glucose concentration ≤ 50 mg/dL greater than or equal to 400 mg/dL
- Seizure at onset
- Recent surgery/major trauma (< 15 days)
- Active internal bleeding (< 22 days)
- Significant stroke or head trauma (< 3 mo)
- Intracranial or spinal surgery (< 3 mo)
- Myocardial infarction (MI) (< 3 mo)
- Non-disabling stroke symptoms
- Life expectancy < 1 year or severe co-morbid illness
- History of vascular malformation
- History of intracranial hemorrhage
- History of brain aneurysm or brain tumor
- Pregnant or lactating

(b) Additional criteria for IV tPA at 3–4.5 hours

- Age > 80
- Imaging finding of infarction with hypodensity involving >33% of the cerebral hemisphere



≤ 10 min
from ED
arrival to
seen by MD



≤ 15 min
from ED
arrival to
telestroke
activation



CONDUCT stat imaging (c)	
CT Tech	<ul style="list-style-type: none"> Performs non-contrast CT of brain Performs CTA and CT perfusion if requested by neurologist and available at facility (if requested but not available, see Telestroke info at right). Alerts radiologist to read STAT CT scan
Radiologist	<ul style="list-style-type: none"> Reads scan and reports to neurologist the "bleed/no bleed" and ASPECTS score. IF Telestroke facility, radiologist contacts neurologist through the Transfer Center. (See Telestroke info at right.)

The challenge of team work – Coordination and hand-offs

TABLE 1. ED Acute Stroke Process Checklist

Role	Action (for patient presenting with stroke-like symptoms)	Tips
RN	<input type="checkbox"/> Determines acuity: RN determines if patient is possible stroke alert (remains symptomatic <u>AND</u> LSN <6 hrs.) <input type="checkbox"/> Notifies HUC of stroke alert	Example scripting: 'room XX.'
HUC	<input type="checkbox"/> Notifies Stroke Alert to ED staff and stroke team, if available, using standard communication methods	Example scripting: 'room XX.'
Stroke Alert		
MD	<input type="checkbox"/> Assesses for stroke immediately <input type="checkbox"/> Notifies HUC to activate Telestroke if applicable <input type="checkbox"/> Conducts NIHSS-PE (page 3) / Reviews tPA contraindications (page 5) and eligibility for endovascular therapy (page 7)	For BP treatment, cc • Labetalol (10–20 mg repeat 1 time) • Nicardipine (5 mg, repeat 1 time)
Pharmacist*	<input type="checkbox"/> Responds to patient room ASAP <input type="checkbox"/> Obtains brief medication history <input type="checkbox"/> Reviews tPA eligibility criteria, as needed <input type="checkbox"/> Prepares for possible tPA administration/pharmacy protocol	
ECG/RT Tech*	<input type="checkbox"/> Performs 12-lead ECG	

*Note: If these services are unavailable, RN/provider may delegate tasks as appropriate.

The Formalism challenge

- ▶ Guidelines today have hundreds of steps / decisions
- ▶ They keep changing
 - E.g. SCAD, Lp(a) not on NHS Dx GL for chest pain
 - Costs and radiation of CT falling; MRIs improving
- ▶ Need formalism(s) to:
 - Represent tasks, events, timing, conditionality
 - But also connection with EMR data sets, app forms
 - Decision logic –
 - high-level, abstract, clinical programming
 - Subject variables used in logic

Q3: How can we integrate CDS into the EMR?

VC Halsan Health Center, System administrator*, Anna Fiorillo - COMMON -CDS- R8.2.03

Menu 19 640912-3475, Filip Filipsson, 55 years

Stroke Prevention 19 640912-3475 Filip Filipsson


Diagnosöversikt

DIAGNOS

- Förmaksflimmer
- Hjärtsvikt/VK-dysfunktion
- Hypertoni
- Diabetes
- Stroke/TIA/Tromboembolism
- Vaskulär sjukdom

CHA₂DS₂-VASc poäng

	RISIKFAKTORER
C	Hjärtsvikt/VK-dysfunktion:
H	Hypertoni:
A ₂	Ålder ≥ 75:
D	Diabetes:
S ₂	Stroke/TIA/Tromboembolism:
V	Vaskulär sjukdom:
A	Ålder 65-74:
Sc	Kön kvinna:
	Totalpoäng:



as enligt riktlinjer från Socialstyrelsen

CHA₂DS₂-VASc: NOAK eller VKA

[Riktlinjer för hjärtsjukvård 2018 – Vetenskapligt underlag.](#)

Y. Evaluation of risk stratification schemes for ischaemic stroke and bleeding in 182 678 patients with atrial fibrillation: a cohort study. Eur Heart J. 2012 Jun;33(12):1500-10.

as NOAK högre än Waran.

atrialisstenos eller mekanisk hjärtklaff ska ej NOAK ges.

ords

CAMBIO

CLINICAL DECISION SUPPORT

SIGNERA

NOLLSTÄLL

NOLLSTÄLL

Detta är en utvecklingsversion och skall ej än användas för att vägleda medicinska beslut

Q3: How can we integrate CDS into the EMR?



Q3: integrating CDS

The difficulty of the EMR integration problem has made people think it's just a data access problem, to be solved by standards.

A better understanding of the subject data problem: *lifting* epistemic data from back-end systems, devices etc to populate ontic subject variables e.g. *is_diabetic*, *neutrophils*, *SpO2*...

Q3: integrating CDS

- ▶ Also: how to choose right guideline?
 - Event-driven approach, match pre-conditions
- ▶ And: prevent useless alerts
 - Need to track history of previous alerts ... other tricks

Alert overload / appropriateness problem



Q4: the problem of cognitive integration



Q4: the cognitive problem

- ▶ A question of attention and focus:
 - The system competes with the focus of the work (the patient)
- ▶ Patient work is substantial and hands
- ▶ Why not *talk* to the system?
 - Real-time voice interaction
 - Maintain the sterile field
 - Record notes as you go



Hey Alexa,
patient haemorrhage
switch to caesarean
protocol

Some solutions

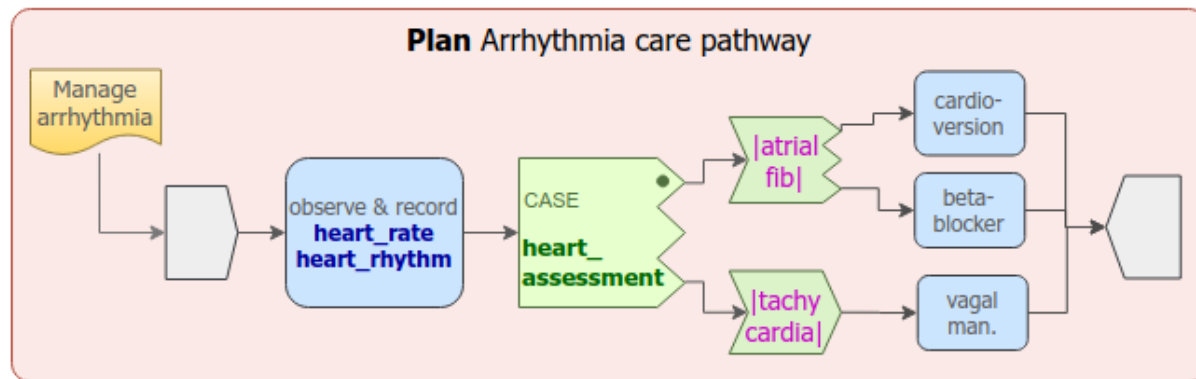


General Need

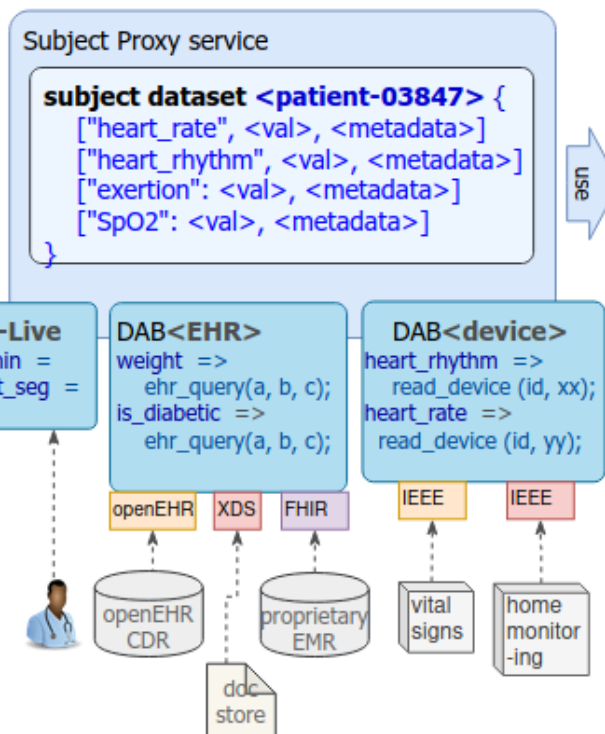
- ▶ Adaptive process / plan based system
 - ▶ With 'plans' formally derived from care pathway guidelines
 - ▶ And integrated analytic guidelines (Dx, risk analysis, medication etc)
 - ▶ Semantic EHR backbone
 - ▶ Solution for subject variables
- ▶ → A new category of system

- Separation of concerns
- Push data problem to separate component
- Guidelines mostly use small datasets

Plan definition:
structured plans based on guidelines, care pathways



Subject proxy:
variables & events of subject
- currency
- simplified types
- caching
(ontic view)



DLM openEHR.cardiology_basic.v1.0.4

input
heart_rate: Quantity
heart_rhythm: Terminology_term
exertion: Terminology_term

reference
Afib_heart_rate: Quantity= 120 /min
High_heart_rate: Quantity = 100 /min

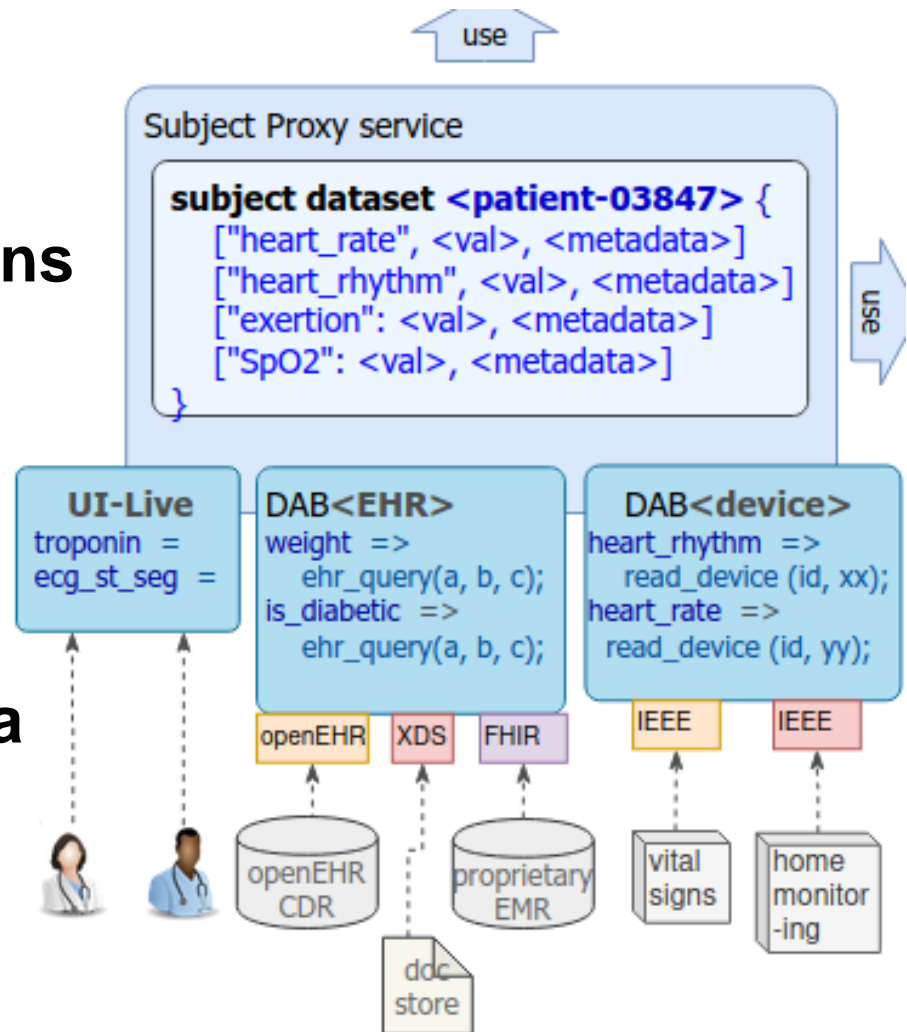
conditions
has_atrial_fibrillation:
 heart_rhythm = |erratic|286761003 and
 heart_rate >= Afib_heart_rate
has_tachycardia:
 heart_rate >= High_heart_rate and
 exertion = |at rest|263678003

rules
heart_assessment: Terminology_term
 if has_atrial_fibrillation
 Result <- |atrial fibrillation|49436004
 elseif has_tachycardia
 Result <- |tachycardia|11092001
 else
 Result <- |normal|76863003

Decision logic module:
conditions & rules, guideline logic

The problem that keeps on giving

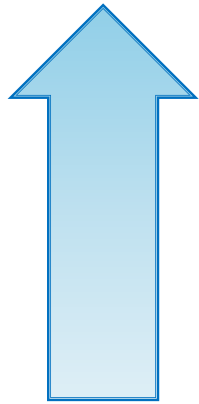
- Different standards
- Different data-set definitions
- Different APIs
- Different query models
- Different terminology
- Absent data
- Get data from user
- Duplicated/competing data
- Formal type & naming



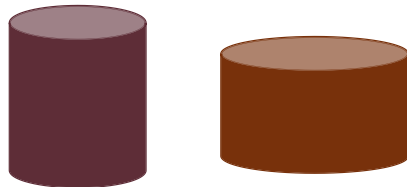
A theory of 'lifting' subject data

ontic subject
variables

has_coronary_artery_disease: Boolean



epistemic subject
data



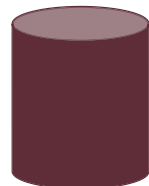
get_dx (sct::194828000|angina| or
sct::22298006|MI| or ...): List <Evaluation>



Fhir_rest_api (...):
List<Condition>



Exec_query ('<select text>',
'<from text>, ...): ResultSet



Oops...
ICD10
here



Missing
data

openEHR projects

- ▶ GDL (7y)
 - Cambio / Rong Chen
- ▶ Task Planning (4y)
 - Example:
 - https://specifications-test.openehr.org/releases/PROC/latest/tp_examples.html#_multi_drug_chemotherapy

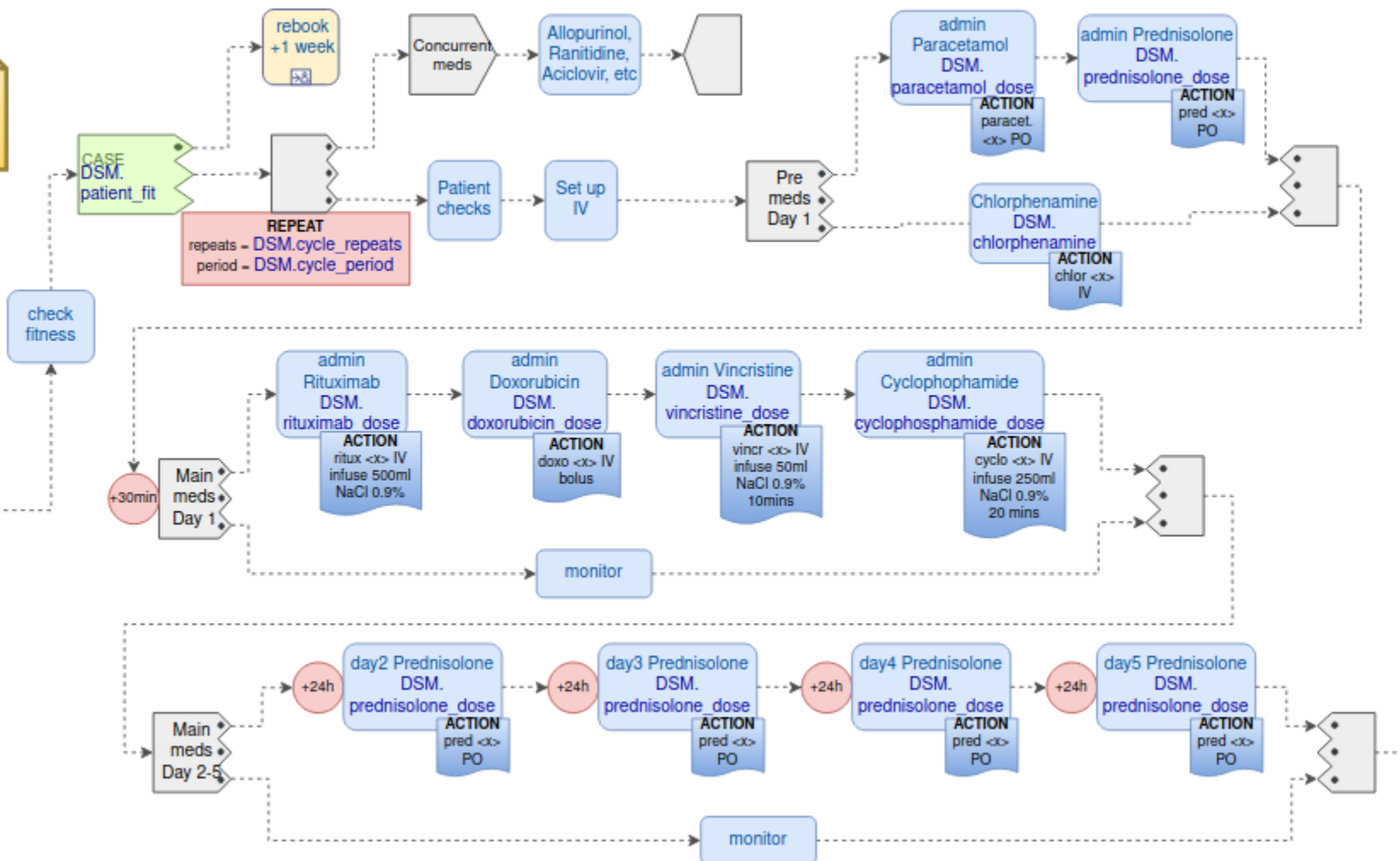
openEHR Task Plan

NHS RCHOPS-21

name = RCHOPS-21 plan
purpose = Lymphoma GL
care_pathway = NSSG Oxford
indications = Lymphoma
context =
proxy = Lymphoma_patient
dsm = RCHOPS21

Pre-assessment
function = chemo mgr
role = oncologist

Main Administration



name	type	description
high_ipi	Resu	International Prognostic Index
Ref	Resu	ref: https://en.wikipedia.org/wiki/International_Prognostic_Index
One point is assigned for each of the following risk factors:		
Age greater than 60 years		
Stage III or IV disease		
Elevated serum LDH		
ECOG/Zubrod performance status of 2, 3, or 4		
More than 1 extranodal site		
The sum of the points allotted correlates with the following risk groups:		
Low risk (0-1 points) - 5-year survival of 73%		
Low-intermediate risk (2 points) - 5-year survival of 51%		
High-intermediate risk (3 points) - 5-year survival of 43%		
High risk (4-5 points) - 5-year survival of 26%		
ipi_raw_score: Integer		
if age > 60		
Result <- Result + 1		
if staging ∈ { stage III , stage IV }		
Result <- Result + 1		
if ldh.in_range ([normal])		
Result <- Result + 1		
if ecog > 1		
Result <- Result + 1		
if extranodal_sites > 1		
Result <- Result + 1		
ipi_risk: Terminology_code		
Result <-		
map ipi_raw_score {		
0..1 : [ipi_low_risk],		
2 : [ipi_intermediate_low_risk],		
3 : [ipi_intermediate_high_risk],		
4..5 : [ipi_high_risk]		
}		

Standards activities

- ▶ BPM+
 - BPMN + CMMN + DMN (decisions)
 - SDMN (subject variables) + KPMN (packages) + PMMN (provenance)
- ▶ HL7
 - FHIR PlanDefinition, Careplan resources;
 - Clinical Quality Framework (CQF);
 - Clinical Quality Language (CQL);
- ▶ CDS-hooks
 - Generic model of notification to/from CDS
- ▶ Logica (was HSPC)
 - BPM+ / Fhir approach

Resources



- ▶ <https://specifications-test.openehr.org/releases/PROC/latest>



- ▶ <https://www.bpm-plus.org/>



- ▶ <https://build.fhir.org/ig/HL7/cqf-recommendations/>
- ▶ <https://cql.hl7.org/>



- ▶ <https://cds-hooks.org/>