

Integrated Care & Digital Records - A Maturity Model explained

For those folk working to move healthcare into the 21st Century, they/we are all on a change journey, made up of people + process + technology elements, which is particularly challenging when we aim towards integrated care. I've looked at the key patterns we see across technical elements in the past, in the form of options explained elsewhere in fairly simple A/B/C terms.

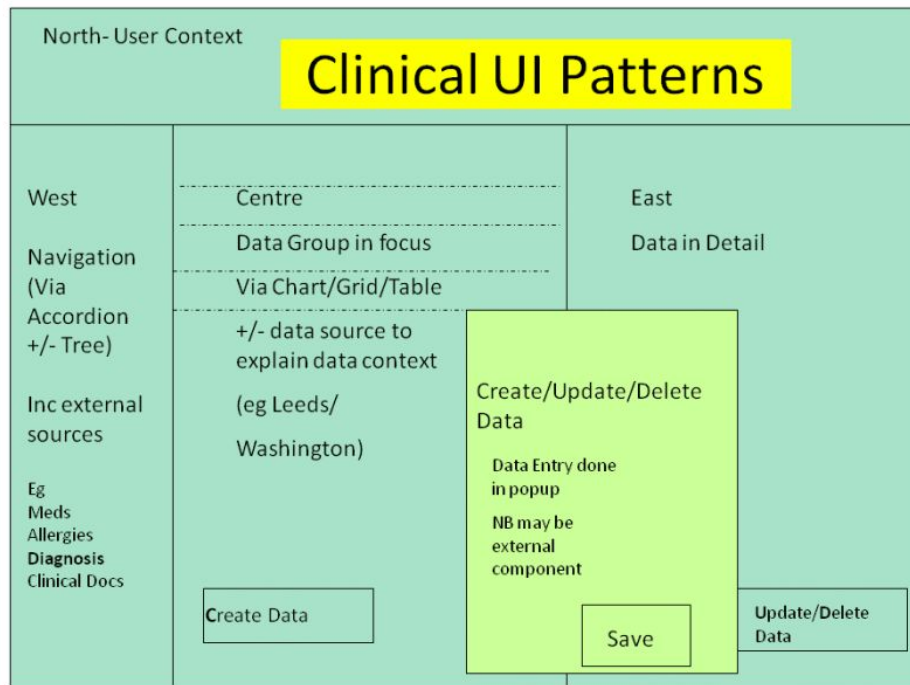
Most folk are not starting from a blank technical slate, rather their patch is often littered with (A) Myriad of Siloes. Some have already gone on a (B)est of Breed 1.0 Journey and others have gone down/are facing towards the (C)orporate/Conglomerate choice of proprietary monolithic technology systems.

Beyond these current constraints, the market is slowly but steadily shifting towards "Healthcare Best of Breed 2.0, the platform that will transform 21st Century Healthcare". I've described this platform elsewhere, made up of 5 key elements ;

- 1) Usability
- 2) Integration
- 3) Clinical Kernel
- 4) Community & Code
- 5) Leadership & Governance

Here and now I'd like to explain the approach that we offer to the effective union of these elements (1) clean and simple user interface design, (2) integration with existing/other systems and the path to the (3) clinical kernel oriented platform approach.

As part of the the Ripple Open Source Initiative towards this platform I've outlined the key aspects of the UI/UX framework elsewhere - which follow key patterns in clinical process and information management, from business/clinical intelligence to multi-patient view to single patient view - all based on a few key UI patterns.



Clinical UI Pattern from ClinUiP.wordpress.com

We re-introduce our user interface with its north, south, east and west panels, plus a modal approach to data entry. We offer this open sourced UI framework not as a perfect solution but one we find to be good enough for most/all the challenges we throw at it .. while we look forward to others offering improved alternatives.

Within this framework we can offer an approach that is akin to a bridge.. both to access to a wide range of existing/other systems as well as access to the open platform of the future. To emphasise, the essence of the approach here is to enable access to both legacy data in its varied formats and to more future proof architectural elements (e.g. openEHR for structured data and VNA for unstructured data) in a single User Interface framework. (See screenshots 3 & 4 below to illustrate this further).

We explain this framework along a stepwise progression or maturing of healthcare integration, towards integrated digital care records that are centred around the patient.

Level 0 No Sharing

We start the baseline here, with no patient information sharing between healthcare providers as for many folk sharing of data between systems is a real problem. It is worth noting that the challenges of interoperability in healthcare are increasingly acknowledged as a real barrier to improved healthcare.

Ripple Care Record Joe Bloggs, Leeds 1, DOB 1950		
Maturity Level 1		
	Acute Filtered View	Primary Care Filtered View
Welcome to the RCR Viewer text This is the first phase.. More info here..	<p>You have selected the Primary Care view so you will see a filtered view of the patients Primary Care record</p> <p>Inc Problem Medications Allergies</p>	

Level 1 Sharing Via HTML (Presentation Only)

This first level of integrated care within an Integrated Digital Care Record (IDCR) is a very simple level of access to data in today's information age. Here the user is logged into the patient's record and hoping to see information from more than 1 healthcare organisation. (e.g. professional based in Primary Care/GP, wanting access to patient information from the hospital... and/or vice versa).

Here we show the usual patient record, with the patient banner and a "tab" allows us to show data incoming from an outside source. The tab view access is analogous to accessing a regular website today, where the website provider chooses what information they want to share and how they want to present it. With this level of information sharing we accept whatever view we can from the information provider who shares it (eg Primary Care organisation as selected here).

Of course access to such data is a breakthrough for many of us, though further processing of that data for purposes such as decision support, clinical/business intelligence etc is not possible. So it is a first , albeit limited step, better than no data, but certainly not adequate to support truly integrated care (eg cross organisational pathways support etc).

Ripple Care Record			Joe Bloggs, Leeds 1, DOB 1950	
Maturity Level 2				
RCP Headings	Medications		Detail	
			You are pulling a view of the patients record but Not Persisting it	
	Medication 1	GP		
	Medication 2	Hospital		
	Medication 3	Hospital		
Medications				

Level 2 Sharing via Structured Data + Presentation Transformation

This next level involves the sharing of structured data. For some time messaging between systems has been at the frontier of healthcare integration, be that referral messages (e.g. Primary Care to Hospital) and/or discharge messages (e.g. Hospitals back to Primary Care) etc.

Data Messages (in data formats such as HL7v2, XML, JSON etc) allow for the “transformation” of that data such that it can be presented in a variety of ways, esp to align with the receiving system. Here our centre pane displays the source/provenance of that incoming data (e.g. GP, Hospital) etc and we may apply stylesheet or other technology to align the data, so that it can be viewed under common record headings (eg Medications).

This data may be incoming as the result of a “pull” mechanism, e.g. calling out to another system and getting that information back over an Application Programming Interface (API). Note that at this level we explain that we are presenting this data momentarily (“on the fly”) i.e. without persisting the information in a local Clinical Data Repository.

Ripple Care Record			Joe Bloggs, Leeds 1, DOB 1950	
Maturity Level 3				
RCP Headings These help to structure the views of the patient record	Medications		Detail	
	Medication 1	GP	You are pulling a view of the patients record + Persisting it	
	Medication 2	Hospital		
	Medication 3	Hospital		
	Medications			

Level 3 Sharing of Data + Presentation + Persistence

To the end user this next level may look identical but under the hood there are further changes.

The data sharing is made available either as a result of the pull mechanism/API call mentioned earlier, or the result of a “push” mechanism whereby the originating system sends the information as an update to some form of trigger to the integrated digital care record.

The significant additional step here is that the data is now persisted in a local IDCR Repository.

Ripple Care Record			Joe Bloggs, Leeds 1, DOB 1950
Maturity Level 4			
RCP Headings	Medications		Detail
	Medication 1 Eg Aspirin 300 mg od	GP	You are pulling a view of the patients record + Persisting it + Modelling it BUT Not reconciling it
	Medication 2 Eg Aspirin 300 mg od	Hospital	
	Medication 3 Eg Warfarin	Hospital	
Medications			

Level 4 Sharing of Data + Present + Persist + Model

After some time, if tackling decision support/business intelligence within an IDCR setting, the issue of data/information models invariably comes up. For these more sophisticated purposes though we may be digesting similar data from multiple source systems, we need to agree on a common data model to run computerised rules over the data etc.

Whether we want to support clinical decision support/business intelligence over patient information that is distributed (aka federated) or centralised, a common information model is key. All our experience in this field points to the openEHR specification, methodology and tooling as world leading in this regard.

This clinical information modelling effort may be at “design time” rather than “run time” but it gives us a common semantic target which is necessary if we ever want to run local Clinical Decision Support over the combined data/information... be that distributed or centralised. Here our information modelling work on medications highlights that Medications have a name (eg Aspirin), numeric dose (eg 300), unit dose (eg mg) and frequency (e.g. once a day).

Ripple Care Record			Joe Bloggs, Leeds 1, DOB 1950	
Maturity Level 5				
RCP Headings	Medications		Detail	
	Medication A	Eg Aspirin 300 mg od	You are pulling a view of the patients record + Persisting it + Modelling it + Reconciling it	
	Medication B	Eg Warfarin		
Medications				

Level 5 Sharing of Data + Present + Persist + Model + Reconcile

The fifth step on this journey, is a reconciliation step whereby, after discussion between the people involved and a process is agreed, a decision to reconcile towards one entry may be possible.

e.g. the Aspirin prescription from both the GP and the Hospital in this case. Having been modelled we note that they are representing the same medication, so a decision is made to reconcile this to one medication instance.

In reaching this point we draw attention to the fact that a patient-centred view of medication information has required the sharing of information from multiple organisational sources, the modelling of that information and the reconciliation of duplicate information. It should be noted that such an endpoint requires not only a solid information & technical architecture to make this possible, but requires people and process to collaborate beyond traditional boundaries.... in the patient's best interest.

An IDCR Maturity Model

We include a summary slide to explain the steps along this integration journey/IDCR maturity model.

IDCR Maturity Levels 0-5

	Shared	View	Persisted	Modelled	Reconciled	
Maturity Level						Tech Comments
0	Not Shared	No View	-	-	-	
1	Shared	Diverse View	-	-	-	e.g. Tabbed View; Filtered LTH View + MIG v1 View
2	Shared	Aligned View	-	-	-	(eg Melded View) Via MIG v2 Structured Data + Stylesheets
3	Shared	Aligned View	Persisted	-	-	e.g. Documents store
4	Shared	Aligned View	Persisted	Archetyped	-	e.g. Medication Records from GP, Community, Hospital etc
5	Shared	Aligned View	Persisted	Archetyped	Reconciled	e.g. City Wide Medication Record for city

We now include a couple of screenshots to illustrate this model in practice

Single Patient View

Actions		Home		X	
View Patient Details				Born	
View Audit Log				Gender Male NHS No.	
Clinical Record Types		Address		Phone	GP Details
		PAS No.		Allergies not recorded	
		Hospital		GP	
All		Summary			
Alerts					
Allergies		Current Problems 09-May-2012 Pain in joint - arthralgia 01-Oct-1996 Essential hypertension 19-May-1996 Ischaemic heart disease 04-Mar-1937 Infectious dis:prevent/control			
Audits/Tracking					
Clinical Documents					
Eprescription					
Health View					
Encounters/Events		Current Medication Acute Medication There is no Acute Medication in the patient's record Repeat Medication Aspirin 75mg dispersible tablets Losartan 50mg tablets Simvastatin 20mg tablets			
Medications					
Observations					
Orders					
ICE Request					
Plans		Allergies and Adverse Reactions 11-May-2012 Adverse Reaction to ibuprofen tablets 400mg (Synergy code: j282.)			
Problems/Issues/Diagnoses					
Procedures		Recent Tests There are no Recent Test items in the patient's record			
Results					
Clinical Photography					
ICE Result					
Scheduling					
Tasks					
Trials/Studies					

ScreenShot 1

**Leeds Care Record Single Patient View- IDCR Maturity Level 1
Tabbed View- Primary Care - Information Sharing (View Only)**

ppm+ Single Patient View

PPM2
Electronic Patient Record

Patient:

The Leeds Teaching Hospitals NHS Trust

Menu

Actions Home TEST, Test (Sir) x

TEST, Test (Sir)

Address Temple Bank Lodge, Bra... Phone GP Details BEST, Alison Clare (Dr) PAS No. Allergies not recorded

Latest Clinical Records (Max 20)

Date	Record
04-Feb-2014	ORTHO-VEYVT17 (Mr Veyal) 14:35 - Provider Cancellation
23-Jan-2014	To: Al-Ghazal S, From: Best A
23-Jan-2014	To: Ackroyd S, From: Addla S
15-Jan-2014	Discharged 17/01/2014, Guy S.
15-Jan-2014	128 (Bradford Royal Infirmary), Guy S. 15/01/2014 to 17/01/2014
14-Jan-2014	ORTHO-BREC17 (Dr Brew) 09:45
06-Jan-2014	ORTHOASS-NURLED74 (Mrs Gray) 10:10 - Patient Attended
01-Jan-2014	To: Addla S, From: Best A
01-Jan-2014	To: Abraham A, From: Best A
13-Dec-2013	To: Brew C, From: Best A
09-Dec-2013	ORTHO-GUYSP17 (Dr Guy) 09:50 - Patient Attended
21-Nov-2013	ORTHO-GUYSP17 (Dr Guy) 09:10 - Patient Attended
13-Nov-2013	FRACTURE-VEYVT17 (Mr Veyal) 09:40 - Provider Cancellation
12-Nov-2013	To: Wilson B, From: Unknown, Unknown
05-Nov-2013	To: Guy S, From: Best A
29-Aug-2013	To: Veyal V, From: Veyal V
20-May-2013	Bem C.
20-May-2013	407 (Bradford Royal Infirmary), Bem C. 20/05/2013 to 20/05/2013

Referral Details Actions for Office Outcome Discharge Documents Care Episode

Date of Decision to Refer 23-Jan-2014

Referred by BEST, Alison Clare (Dr) : Unknown (GP)

Referral Received Date 23-Jan-2014

Referral Reason

Referral Source GP

Location Before Referral

Ward (if LTH Ref)

Referral Priority Routine

Urgent Referral Cancer Type

Disease Status

Referred to AL-GHAZAL, Sharif Kaf (Mr) : Department of Plastic Surgery, Bradford Royal Infir

ScreenShot 2
PPM+ Single Patient View- IDCR Maturity Level 3
Sharing of Data (from PAS) + Presentation + Persistence

IDCR POC Search... Demonstration

Back Patients Details

Ivor Cox Gender: Male Born: 05-Jun-1944 NHS No: 999999000

Address: 6948 Et St., Halesowen, Worcestershire, VX27 5DV Phone: (011981) 32362 GP Details: Goff, Carolyn D. PAS No: 352541

Problems / Diagnoses

Filter...

Problems / Diagnoses	Date	Source
Lactose Intolerance	29-Nov-2015	openehr
Fever	15-Feb-2016	openehr
COPD	02-Feb-2016	openehr
Vascular dementia	03-Mar-2016	openehr
ex-smoker	24-Mar-2016	openehr
HYPERTENSION NOS	01-Jan-1970	vista
PRIM CARDIOMYOPATHY NEC	01-Jan-1970	vista

Problem and Diagnosis

Problem / Diagnosis: HYPERTENSION NOS

Description: Hypertensive disorder (SCT 38341003)

Date of Onset: 01-Jan-1970

Terminology: HYPERTENSION NOS

Code: um.icd.401.9

Author: ALEXANDER,ROBERT

Date Created: 1970-01-01

Source: vista

ScreenShot 3
RippleOSI Single Patient View
IDCR Maturity Level 2 - Sharing via Structured Data + Presentation Transformation

IDCR POC Search... Q Search Demonstration

← Back **Patients Details**

Patient Summary

Ivor Cox Gender: **Male** Born: **06-Jun-1944** NHS No.: **9999999000**

Address: **6948 Et St., Halesowen, Worcestershire, VX27 5DV** Phone: **(011981) 32362** GP Details: **Goff, Carolyn D.** PAS No.: **352541**

Problems / Diagnoses

Filter...

Problems / Diagnoses	Date	Source
Lactose Intolerance	29-Nov-2015	openehr
Fever	15-Feb-2016	openehr
COPD	02-Feb-2016	openehr
Vascular dementia	03-Mar-2016	openehr
ex-smoker	24-Mar-2016	openehr
HYPERTENSION NOS	01-Jan-1970	vista
PRIM CARDIOMYOPATHY NEC	01-Jan-1970	vista

Problem and Diagnosis

Problem / Diagnosis: Lactose Intolerance

Description: loss of appetite nausea and vomiting diarrhea abdominal pains and cramps blood in your stools high fever

Date of Onset: 29-Nov-2015

Terminology: terminology

Code: 12393890

Author: Dr Tony Shannon

Date Created: 2016-02-24

Source: openehr

1 2 + Create Edit

Screenshot 4

RippleOSI Single Patient View

IDCR Level 4 Sharing of Data + Present + Persist + Model

Of note in Screenshots 3 & 4, the Ripple OSI framework allows us to blend the IDCR maturity model in one approach..

.. with access to Level 2 existing/legacy data (e.g. Problem/Diagnosis: Hypertension - from VistA service in example here) which in this case is read-only,

...while also allowing access to the Level 4 robust information models (e.g.

Problem/Diagnosis: Lactose Intolerance - from openEHR service in example here) which we make editable.

Adding new data via the Create Button, launches a new modal which enters data against the Level 4 approach (i.e. openEHR service).

Acknowledgements

The model explained here is based on a simple yet effective model to information sharing that evolved during work on the Leeds Care Record. Thanks to Geoff Hall for his help and support on the User Interface framework and to Richard Pugmire on the maturity model that underpins this approach.

We believe the principles here are widely applicable across healthcare which is why we are openly sharing this for wider discussion/learning.