Integrating Assisted Living with Primary/Secondary Health Care

Cloud4Health

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Integrated and Secure Cloud-based eHealth for Holistic Care

Industry Age → Information Age

Centralised, Non-integrated, Ad-hoc, Clinician Focused, Reactive, Clinician Control of Records

Distributed Patient Care, Holistic, Patient Focused, Pre-emptive, More Patient Control of Health
Integrated and Secure Cloud-based eHealth for Holistic Care

- Healthcare Professional
- Invited user

- GP
- Invited user

- Care Subject
- 82 years old
- House bound
- COPD (Chronic Obstructive Pulmonary Disease)

- Invited user

- Site Creator
- Primary Carer

Assisted Living (Informal and Trust based)

Primary Health Care (Formal and role-oriented) - GP

Secondary Health Care (Formal and role-oriented) - Hospitals/A&E

Social Care/Health/etc

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Introduction/Context
Integrated and Secure Cloud-based e-Health for Holistic Care

DACAR e-Health Platform

Chelsea and Westminster Hospital NHS Foundation Trust

Edinburgh Napier University

Microsoft

kodit

Imperial College London

Patient Simulator

HoLP

Edinburgh Napier University

CipherLab

Patient Cloud

Technology Strategy Board
Driving Innovation

Research Services

GS1 UK

Patient Capture

EPSRC
Pioneering research and skills
Societal

- Lack of integration between assisted living, primary and secondary care
- Aging population
- Lack of information sharing across the public sector
- Strong demand to consume health care data
- Lack of integration with careers and trusted people

Technical

- Patient records are often static
- Different systems/formatting used for data
- Limited/difficult access methods … typically Government infrastructures … lack of trust
- Poor access control to data
- Data often aggregated and context is often lost
Manager might ask: What's difference in length-of-stay between different age categories for June?

Consultant might ask: How does the Early Warning Score affect the length-of-stay?

Family friend might ask: In which ward is Deirdre?

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- Often localised
- Different systems/formats
- Poor access control
- Poor identity verification
- Cannot be aggregated
- Etc.
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PatientCapture

Data Capture (within the Cloud in buckets)

Capture Agent

PatientCloud

Data Storage

Service B (Infection Tracking)

Service C (Blood)

Service A (EWS)

Interface Delivered From service

ConsumerID (RoleID)

Domain A

Domain B

Patient Simulator

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Security Policy Translation Bridge

Security Policy (including interdomain rights)

Data Storage (within the Cloud in buckets)

Service A (EWS)

Service B (Infection Tracking)

Service C (Blood)

Interface Delivered From service

ConsumerID (RoleID)

Domain A

Domain B

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Service Infrastructure
- Storage service
- Web service
- EWS

Service Provision

Service Consumption

Security Policy (including interdomain rights)

SPoC (Single Point of Contact)

Service Instance creation/invocation

Pointer to service

Organisational Infrastructure

Service Requirement, Ticket

User

Identity credentials

Ticket

Identity Provider (IP)

Federated Identity Management

Windows Live

Google

VeriSign

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Clinical Services
- Service B (Infection Tracking)
- Service C (Blood)
- ConsumerID (RoleID)

Domain A

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Domain B

Expert Analyser
- Event alert
- Risk Factor
- Refinement of rules
- Length of stay
- Assessment

Bayesian Predictor
- Calibration of fuzzy levels

Early Warning Score (EWS) Fuzzifier
- Blood pressure
- Heart rate
- Resp. rate
- Temperature
- SpO2
- Neurology

Blood pressure (Fuzzy)
- Heart rate (Fuzzy)
- Resp. rate (Fuzzy)
- Temperature (Fuzzy)
- SpO2 (Fuzzy)
- Neurology (Fuzzy)
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Patient Simulator

Clinical Services

Service B (Infection Tracking)

Service C (Blood)

Interface Delivered From service

ConsumerID (RoleID)

Domain A

Blood pressure
Heart rate
Resp. rate
Temperature
SpO2
Neurology

Early Warning Score (EWS) Fuzzifier

Blood pressure (Fuzzy)
Heart rate (Fuzzy)
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Expert Analyser

Event alert
Risk Factor

Bayesian Predictor

Refinement of rules
Length of stay
Assessment

Calibration of fuzzy levels

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Domain B
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Assisted Living

Circle-of-Trust
Circle-of-Trust-based Policies

Primary/Secondary Care

Translation Gateway (Security Policy/ID Mapping)

Data Storage (within the Cloud in buckets)

Service A (EWS)

Domain B

Role-based security policies

SPoC

CW.CONSULTANT
CW.NURSE

[permit] [C&W.NURSE] [C | R] [Temp | SpO2 | HR | BP | RR | Pain] of [Patient26078] with [EWS] from [Chelsea & Westminster Hospital] for [*] records in [P2010-12-30T00:00:00] using [Data Protection Act]

[permit | deny] [Requester] [C | R | U | D] [Attribute] of [Object] with [Context] from [Owner] for [N] records in [Time Window] using [Compliance]

Governance Policy

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SPoC Architecture
SPoC Architecture
Policy Syntax

[permit] [Medical Staff] [C | R] [Temp | SpO2 | HR | BP | RR | Pain] of [Patient26078] with [EWS] from [Chelsea & Westminster Hospital] for [*] records in [P2010-12-30T00:00:00] using [Data Protection Act]


A similar syntax is also applied to the request messages:

[Requester] [C | R | U | D] [Attribute] of [Object] with [Context] from [Owner] within [Start] to [End]

- [permit | deny] This is part of the rule syntax which indicates the action of the rule. This defines whether a request meeting the rule criteria will be permitted or denied access.
- [Requester] This identifies a request sender's role, e.g. GP, or pseudonym, e.g. 10420, or a combination of the two, e.g. GP10420.
- [C | R | U | D] This defines detailed permissions for a requester to create, read, update and delete certain information.
- [Attribute] This is a unit of information describing an object. An attribute may be a primitive data type, e.g. the pseudonym of an object as a string, or a complex data type, e.g. a person's ECG record for 45 seconds.
- [Object] This is part of DACAR's system model. It refers to any entities in a healthcare scenario, about which information is held.
- [Context] This identifies the reason why the information is being shared. The context governs the level of access and permissions associated with information exchange, and hence defines the priority accorded to information requests.
- [Owner] This species a role with sufficient privileges to manage all aspects of an information source. The owner has the authority to allow or deny access to an information element, as required by legislation and defines responsibilities.
- [N] records in [Time Window] This defines the number of records permitted over a period of time, where N can be any positive integer.
- [Compliance] This refers to legislative requirements that support the exchange of information, such as the Data Protection Act, the Human Rights Act, the Freedom of Information Act and so on.
- [Start] and [End] These identify the start and end of the date/time period over which information shown.
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The Early Warning Score (EWS) service constantly monitors a patient’s 6 vital signs parameters in real-time, and notifies medical staff when the patient is evaluated to be at risk.

Policy Editor

Purpose:
- Permit
- Denial

Class:
- Role-based
- Individual-based

Available Attributes: Hospital.VITAL.SIGN.Pain, Hospital.VITAL.SIGN.HOD, Hospital.VITAL.SIGN.Temp, Hospital.VITAL.SIGN.Res, Hospital.MEDICAL.INF.

Managed Attributes:
- Hospital.VITAL.SIGN.SpO2

Available Grantees:
- inister Hospital.ROLE.Critical
- inister Hospital.ROLE.Nurse
- inister Hospital.ROLE.Service

Managed Grantees:
- inister Hospital.ROLE.GP

Valid from: 23/03/2012 to: 23/02/2012
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1. Present credentials
2. Issue claims
3. Present claims & request for service/data
4. Analyse policies
5. Locate/initiate service instances
6. Issue service/data ticket
7. Establish secure sessions to consume services/data

Medical Staff

ENU e-Health Cloud

Data Buckets

EWS

Federated ID Providers
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**Step 1:** Present credentials

**Step 2:** Issue claims

**Step 3:** Authenticate using U-Prove

**Step 4a:** Verify identity

**Step 4b:** Verify attributes, e.g., membership in a CoT

**Step 5a:** Issue claims

**Step 5b:** Issue U-Prove token

**Step 6:** Issue U-Prove token

**Step 7:** Issue access token

**Step 8:** Pull data

**Step 9:** Provide data set

**Step 10:** Synchronise with HealthVault

**Data Owners & Their Circle of Trust**

**Web Applications**

**Authorisation Server**

**U-Prove Agent**

**Federated ID Providers**

**ENU e-Health Cloud**

**Data Bridge**

**Data Buckets**

**SPoC**

**Medical Staff**
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Patient Simulator

Deirdre
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