Collaboration FEUP – Ministry of Health

Designing a sustainable Electronic Health Record: from Service Ecosystem to Information Architecture

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FEUP - July, 6th, 2012
A National EHR is:

A patient centered service that carries clinical information and is accessible regardless of location or time of health care delivery.
• A successful development and implementation of an EHR requires addressing several challenges
  – Technological
  – Human
  – Organizational

• Developing a PDS requires a systems approach that integrates technology and human processes.

Service Science Management Engineering and Design (SSMED)
Collaboration FEUP – Ministry of Health

Objectives

- Support the development and implementation of EHR in three areas:
  - **P1 - Service design**: supporting the design of EHR as a service with a focus on the service experience and creating value for the different healthcare stakeholders
  - **P2 - Processes**: contribute to a better implementation of EHR by analyzing and framing the EHR within the operational processes of the different stakeholders, proposing recommendations for process evolution change management
  - **P3 - Information architecture**: contribute to the design of an information architecture that enables an effective implementation of EHR and promotes collaboration among healthcare stakeholders
Integration

P1 – EHR Service Design

P2 – Analysis of operational processes and information needs

P3 – EHR Information Architecture
Activity 1
Project framing

Activity 2
Study / Elicitation

Activity 3
Service Design, Process Modeling and Information Architecture

Activity 4
Support EHR implementation
P1 – Service Design

Designing the Service Offering

Nelson Pinho, Lia Patrício, Raymond Fisk,
EHR Service Design

Stage 1 – Understanding Stakeholders
- Design the stakeholder map with all the entities involved in EHR Service.
- Identify the most relevant entities from both the healthcare professionals and patient perspectives.
- Investigate the type of information exchanged between the different stakeholders.
- Identify the benefits (value) obtained from the interaction between the different stakeholders.

Stage 2 – Designing the Service Offering
- Study and map the experience of different stakeholders.
- Design the service concept of the EHR and its components for the different stakeholders.
- Architecture and navigation of EHR service system.
- Define the service ecosystem borders.
- Design the Service Blueprints for critical PDS processes
## Qualitative Study - Sample

### Qualitative Method
- Interviews and Focus Groups (60 – 180 min)
- Grounded Theory

<table>
<thead>
<tr>
<th>Sample Design</th>
<th>Central Hospital</th>
<th>Private Hospital</th>
<th>Primary Care</th>
<th>Citizens/Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1 – Exploratory Study - Interviews</strong></td>
<td>1 Doctor (CHVNG) 1 Nurse (CHVNG) 1 Pharmacist (CHVNG)</td>
<td></td>
<td></td>
<td>1 Citizen from Porto 1 Member of the Ministry of Health</td>
</tr>
<tr>
<td>Doctors</td>
<td>5 Doctors (CHLO)</td>
<td>2 Doctors (José Mello, Personal Office)</td>
<td>2 Doctors (Health Centers from ARS LVT)</td>
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<tr>
<td>Nurses</td>
<td>7 Nurses (CHLO, CHLN)</td>
<td>3 Nurses (MAC)</td>
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<td></td>
</tr>
<tr>
<td>Pharmacists</td>
<td>4 Pharmacists (CHLO, FX, CHLO - EM, HGH)</td>
<td>2 Pharmacists (CUF - IS, CUF - Descobertas)</td>
<td>1 Pharmacist (Communitarian - Lisbon)</td>
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</tr>
<tr>
<td>Citizens</td>
<td></td>
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<td>8 Citizens from Lisbon</td>
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<tr>
<td><strong>Stage 2 – Focus Group</strong></td>
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<tr>
<td>Doctors</td>
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<tr>
<td>Nurses</td>
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<tr>
<td>Pharmacists</td>
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<tr>
<td>Citizens</td>
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<td></td>
</tr>
<tr>
<td><strong>Stage 2 – Interviews</strong></td>
<td>1 Doctor (CHVNG) 1 Doctor (ML) 1 Nurse (ETG)</td>
<td>1 Pharmacist (Viseu) 1 Nurse (Viseu) 1 Doctor (Viseu)</td>
<td>1 Citizen (Porto)</td>
<td></td>
</tr>
<tr>
<td>Citizen (Porto)</td>
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</tr>
</tbody>
</table>

Citizens: 10  
Doctors: 13  
Pharmacists: 9  
Nurses: 13  
Physiotherapist: 1  
Ministry of Health: 1  
Total: 47
Designing the PDS with the MSD in a Many to Many reality
• Weekly meetings with PDS National Commission (September – December 2011)
  – First versions of Service Concept, Architecture and Service Experience Blueprint

• Workshops (Design & Validation)

<table>
<thead>
<tr>
<th>Sample Design</th>
<th>Doctors</th>
<th>Nurses</th>
<th>Citizens</th>
<th>Total</th>
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<tbody>
<tr>
<td>Workshop 1 – Service Design</td>
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<td>3rd January 2012</td>
<td>6 Porto</td>
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<td>Workshop 2 – Results Validation</td>
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<td>17th January 2012</td>
<td>7 Porto</td>
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<tr>
<td></td>
<td>Santarém</td>
<td>Lisbon</td>
<td>Lisbon</td>
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</tbody>
</table>
Designing the Service Offering

Service Design Workshops Results
January, 3rd and 17th 2011
PSD Service Design Workshop
PDS Detailed Service Concept

Customer Value Constellation

- How?
- What?

Design the Service Offering
PDS Detailed Services Conceptualization for Citizen"
PDS Experience and Service Architecture

Design the Service Offering

Service System Architecture
Doctor Experience

Doctor Daily Experience

- Access daily schedule
- Ask nurses about treatment (Hospital de dia)
- Clinical case discussions
- Collaboration with other physicians
- Emergency support
- Exams planning and execution
- External consult - Ambulatory
- Hospitalization related activities
- Managing patient information
- Primary care activities
- Research and Development
- Read e-mail
- Plan and manage resources
- Surgery related activities
- Write clinical diary
- Write discharge note

Doctor PDS Experience

- Authentication
- Consult and/or Manage Patient Summary (*)
- Consult Patient detailed Information
- Insert or Manage Diagnosis
- Consult and/or Insert Exams Info.
- Manage Patient Medication Info.
- Insert Patient Discharge Note
- Search and Export R&D Information

(*) Only General Practitioners are allowed to Manage the Patient Summary
Doctor PDS Service Architecture

**Customer**
- Introduce patient id and Doctor auth. credentials
- Consult or edit Patient Summary
- Consult details on chronologic or type of episode list
- Create or change Diagnosis
- Consult or create new exam result
- Ask for new Diagnosis
- Manage ChroniMed

**Legacy System**
- Display Login interface and authentication result
- Display Patient Summary
- Display chronologic or type of episode list
- Display exams search list and exam details
- Display diag. search list
- Display prescribed and chronic medicine

**Interface**
- Validate credentials
- Retrieve/update Patient Summary
- Provide search lists and episode details
- Provide stored diagnosis or record new one
- Provide exam search list and exam details or create new record
- Provide prescription and chronic medicine list or update records

**Backstage Support**
- Retrieve anonymised and aggregated data
- Update audit system

**Search and Export R&D Information**
- Search for data
# Doctor PDS Service Architecture

<table>
<thead>
<tr>
<th>Customer</th>
<th>Authentication</th>
<th>Consult and/or Manage Patient Summary</th>
<th>Consult Patient detailed Information</th>
<th>Insert or Manage Diagnosis</th>
<th>Consult and / or Insert Exams Info.</th>
<th>Manage Patient Medication Info.</th>
<th>Insert Patient Discharge Note</th>
<th>Search and Export R&amp;D Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor</td>
<td>Introduce patient id and Doctor auth. credentials</td>
<td>Consult or edit Patient Summary</td>
<td>Consult details on chronologic or type of episode list</td>
<td>Create or Change Diagnosis</td>
<td>Consult or create new exam result</td>
<td>Consult prescribed med. / Manage chronic med.</td>
<td>Create Discharge note</td>
<td>Search for data</td>
</tr>
<tr>
<td>Legacy System</td>
<td>Display Login interface and authentication result</td>
<td>Insert / Manage Alerts and Allergies</td>
<td>Display chronologic or type of episode list</td>
<td>Ask for new Diagnosis</td>
<td>Ask for new exam result</td>
<td>Manage Chronic Medicine</td>
<td>Ask for new Discharge note</td>
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</tr>
<tr>
<td>PDS Interface</td>
<td>Display Login interface and authentication result</td>
<td>Display Patient Summary</td>
<td>Display diag. search list</td>
<td>Display exams search list and exam details</td>
<td>Display prescribed and chronic medicine</td>
<td></td>
<td>Display reporting tool</td>
<td></td>
</tr>
<tr>
<td>Backstage Support</td>
<td>Validate credentials</td>
<td>Retrieve Patient Summary</td>
<td>Provide search lists and episode details</td>
<td>Provide stored diagnosis or record new one</td>
<td>Provide exam search list and exam details or create new record</td>
<td>Provide prescription and chronic medicine list or update records</td>
<td>Record new discharge note</td>
<td>Retrieve anonymised and aggregated data</td>
</tr>
<tr>
<td></td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
<td>Update audit system</td>
</tr>
</tbody>
</table>
Design the Service Offering

PDS Service Experience Blueprint

Doctor

Nurse

Citizen

Use Cases and Data Model

User Interface

xn
Assumptions:
- Authentication on legacy system verified
- In hospitals, the PS consult requires the patient to be in the scope of an active episode
- In Primary Care, the PS consult doesn’t require the patient presence
- Every interaction between an HCP or other system with the PS (RCU2) must be auditable
Service Design Conclusions

• EHR should have customized views for the different groups of stakeholders.

• At the same time we provide an aggregated service concept (Doctor, Nurse and Citizen) providing a holistic vision about what should be the PDS service: globally and for each stakeholder.

• The study also contributes to improving healthcare by designing a robust EHR system that withstands the challenges of a complex service reality.
P2 – Operational Processes

Miguel Oliveira, António Brito, Lia Patricio, Rick Kazman, Hong-Mei Chen
Methodology – Case Study

Research Questions

- How do Information Systems impact the daily routine of health care professionals?
- How do inter-institutional IS affect the institutions functioning?
- How will an EHR system impact current organization processes?
<table>
<thead>
<tr>
<th>Institution type</th>
<th>Type of care</th>
<th>Duration</th>
<th>People involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARS Norte</td>
<td>Public (NHS)</td>
<td>2 days</td>
<td>2</td>
</tr>
<tr>
<td>ACES Gondomar</td>
<td>Public (NHS)</td>
<td>3 days</td>
<td>14</td>
</tr>
<tr>
<td>Hospital da Prelada</td>
<td>Social</td>
<td>6 days</td>
<td>20</td>
</tr>
<tr>
<td>Hospital de Vila Nova de Gaia</td>
<td>Public (NHS) with private administration</td>
<td>15 days</td>
<td>27</td>
</tr>
<tr>
<td>INEM Porto</td>
<td>Public (NHS)</td>
<td>3 days</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Emergency</td>
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</tr>
</tbody>
</table>
Methodology – Data Collection

- Direct observation of the daily routine of health care professionals, taking notes and asking questions whenever necessary

- Direct observation was complemented with in-depth semi-structured interviews with key health care practitioners and administrative staff

- Leverage the interviews to identify and gather documents of interest
• Clinical representatives work group - PDS: Implementation of clinical records

• 40 participants were split into 4 work groups

• Patient summary information

• Reality assessment
Part I: Challenges

- Exercise 1: identification of types of information that shall integrate the patient summary
  - The participants shall select the information that shall be on the patient summary from a list of clinical types of information and being able to add relevant new types of information.

<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Patient Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identificação do internação</td>
<td></td>
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<tr>
<td>2. Contactos do cidadão/familiar responsável</td>
<td></td>
</tr>
<tr>
<td>3. Alergias</td>
<td></td>
</tr>
<tr>
<td>4. Diagnósticos efeitos</td>
<td></td>
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<tr>
<td>5. Antecedentes clínicos</td>
<td></td>
</tr>
<tr>
<td>6. Vacinação</td>
<td></td>
</tr>
<tr>
<td>7. Sumário de consulta externa</td>
<td></td>
</tr>
<tr>
<td>8. Sumário de consulta médica nos CSP</td>
<td></td>
</tr>
<tr>
<td>9. Sumário de consulta e Vigilância nos CSP</td>
<td></td>
</tr>
<tr>
<td>10. Histórico de vigilância (e.g. sinais vitais) do paciente</td>
<td></td>
</tr>
<tr>
<td>11. Diário clínico</td>
<td></td>
</tr>
<tr>
<td>12. Notas de enfermagem</td>
<td></td>
</tr>
<tr>
<td>13. Prescrição de medicamentos</td>
<td></td>
</tr>
<tr>
<td>14. Resultados de MCDTs</td>
<td></td>
</tr>
<tr>
<td>15. Histórico de consultas</td>
<td></td>
</tr>
<tr>
<td>16. Consultas (futuras) marcadas</td>
<td></td>
</tr>
<tr>
<td>17. Procedimentos cirúrgicos realizados</td>
<td></td>
</tr>
<tr>
<td>18. Nota de alta de internamento</td>
<td></td>
</tr>
<tr>
<td>19. Histórico de procedimentos e intervenções (e.g. cirurgias)</td>
<td></td>
</tr>
<tr>
<td>20. Relatório de cirurgia</td>
<td></td>
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<tr>
<td>21. Episódios de urgência</td>
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<tr>
<td>22. Nota de alta de urgência</td>
<td></td>
</tr>
<tr>
<td>23. Pedidos de referência para consulta de especialidade</td>
<td></td>
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<tr>
<td>24. Relatório de avaliação psicológica</td>
<td></td>
</tr>
<tr>
<td>25. Alertas clínicos</td>
<td></td>
</tr>
<tr>
<td>26. Relatório de situação social</td>
<td></td>
</tr>
</tbody>
</table>
Exercise 2: Reality Assessment (setup)

Importance

IS satisfaction
Exercise 2: Reality Assessment - Result
P3 – Information Architecture

Studying relevant architectural models and frameworks

Eduardo Pinto, António Brito, Lia Patrício, Rick Kazman, Hong-Mei Chen
• Support the PDS project for quick-win solutions

• Prevent the adoption of solutions that might preclude future requirements and needs

• Offer a medium/long-term vision to the project

• Promote the finding of solutions that could easily be able to integrate different kind of systems
The Metropolis Model (Rick Kazman and Hong-Mei Chen) identify one of its target as the ‘crowdsourced systems’:

- Community Based Service Systems (CBSSs)
- Value co-creation
- Prosumers (producers who are also consumers of content)
The Metropolis Model

The Architecture
The Metropolis Model – application to PDS

- delimitate the scope of PDS as a platform for sharing data
- split the logical domain from the presentation one
The Metropolis Model – application to PDS

- allow external entities to develop apps to interact with those interfaces:
  - development of mobile applications;
  - PDS data integration in the HIS;
Service-oriented Architectures

- Services are reusable
- Services are loosely coupled
- Services are ‘composable’

Service-oriented architectures promote the development of information systems that enable interoperability and integration with legacy systems.
Service-oriented Architectures – application to PDS

- Examples of services:
  - Data anonymizer: receives some data and returns it without being possible to reveal the patient identity
  - Data Dispatch Manager: receives the data to be transferred to some institution and assures that it arrives at the destination
Process and Architecture Contributions

- RCU2 project
  - Local and central module architecture discussion
  - Information model definition

- epSOS integration

- Professional Portal
  - Discussion and definition of the data sharing and access architecture

- Quality Attribute Workshop
  - Promote the long-term discussion of the project key attributes
FEUP Collaboration contributions

- Embedding a service perspective to create value for all stakeholders
- Involving the most important stakeholders along the different PDS stages
- Providing concrete inputs for the development of the PDS
- Exploring new architecture solutions
- Promoting the alignment between business goals and architecture solutions
Thank you for your attention!

PDS service will change our lives...