The REUSE project: EHR as single datasource for biomedical research

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Senior Director, Data Privacy & Healthcare Interoperability Standards at Sanofi-Aventis R&D and Member, CDISC Board of Directors,
at the International HL7 Interoperability Conference in Kyoto, May 9, 2009
Most important French University Hospital Organization with

- 38 hospitals: 1,000,000 hospitalized patients, 23,000 beds, 1500 day care and 850 home care capacity
- 69,000 employees including 15,300 physicians

G.Pompidou university hospital (HEGP = Hôpital Européen Georges Pompidou) (853 beds)
- EHR: DxCare® (Medasys©)
First research center about human beings in Europe
- 354 active research projects and 35,000 enrolled patients
- Sponsors: AP-HP, pharma industry, public institutions
- Research structures
  - 18 federated research institutes, 7 Clinical Investigation Centers, 12 bio-medical research centers, 8 Clinical Research Unit
  - 112 INSERM (French National Institute for Health and Medical Research) teams, 30 CNRS (French National Institute for Scientific Research)

HEGP, Necker, Cochin (GHU Ouest): half of the institutional research conducted at AP-HP
- HEGP: pilot studies of eCRF using MARVIN® (XClinical ©)

http://www.aphp.fr/site/recherche_innovations/presentation1.htm
http://www.aphp.fr/site/connaitre/chiffres_recherche.htm
One patient, how many records?

Landen Bain. How the CDISC Standard can be used to Integrate Healthcare and Therapeutic Product Safety
Integrating Patient Care & Biomedical Research

- **Improve patient recruitment**
  - Only 7% of eligible patients enroll in a clinical trial
  - 86% of all trials fail to enroll on time
  - Women, minorities, children and special populations are underrepresented

- **Improve data capture and submission to regulatory agencies**
  - EHR contains 30% to 50% of items of research forms

- **Improve reporting of drug adverse events**
  - Only few % of Adverse Events are spontaneously reported

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*The eClinical Forum and PhRMA EDC. The Future Vision of Electronic Health Records as eSource for Clinical Research. Draft version 0.1, March 3, 2006*

*Kush, R.D., Helton E. Electronic Health Records, Medical Research and the Tower of Babel. The new england journal of medicine. 1738-40. april 2008*
Why is it so difficult?

<table>
<thead>
<tr>
<th>Different business processes and information systems</th>
<th>Electronic Healthcare Record (EHR)</th>
<th>Clinical Data Management System (CDMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HL7 EHR-S Functional Model, Release 1 (HL7)</td>
<td>BRIDG business models FDA guideline (« Computerized Systems Used in Clinical Investigations »(CSUCI))</td>
</tr>
<tr>
<td>Different data standards</td>
<td>HL7, CDA</td>
<td>CDISC, ODM</td>
</tr>
</tbody>
</table>
Objectives

- To conceive, implement and assess an integrated solution for both clinicians and researchers
  - using EHR and CDMS
  - taking into consideration recent standardization and integration efforts by IHE (Integrating Healthcare Enterprise)
- To evaluate this solution in real settings of AP-HP
Methods

- Modelization
  - Business models of biomedical research
  - UML models and architecture of the REUSE project
    - Derived from the IHE integration profile RFD (Retrieve Form for Data Capture)
- Implementation et experiment in real settings
  - Biomedical study « Dyspnea »
Results:
High Level Interaction Diagram
Results:
12 2nd Level Interaction Diagrams

- The steps that must be integrated into the EHR (n=5)
- The steps that could be integrated into the EHR (n=7)
Results

The steps that must be integrated into the EHR (n=5)
- Designing eCRF
- Designing the data management program
- Pre-populating eCRF with clinical data
- Updating administrative or clinical data during the study
- Data monitoring
Results: Database Management

- Develop the list of variables
- Model the relational schema of data (paper)
- Develop the database with the selected software
  - Valid database (referential integrity - normal form)
- Design a 'form'
- Develop the form
  - Programming statements
  - Presence of statements
  - Test data input for minimum 2 patients
  - Secure, Put Into service

The data manager should be different from that developed for other databases.

Formatting:
- Cycle management variables
- Exports data
- Number of patients to enter
Results: RE-USE architecture (1/2)

- Clinical Research Unit
- Marvin (XClinical©)
- CDISC
- eCRF
- CDMS
- Form Manager
- Retrieve Forms (Metadata)
- Import & integration
- EHR
- Form Mapper/Filler
- Patient care
  - DxCare (Medasys ©)
  - HL7
Results: REUSE experiment
Clinical study “Dyspnea”

CDMS
MARVIN
(XClinical)

EHR
DxCare® (Medasys)

ODM (MetaData + Data)
Results: REUSE architecture
On going development

Retrieve & Integrate Forms
Transaction based on an HL7 CDA template
(Metadata)

Submit Form
HL7 CDA/ ODM mediator
(Metadata + Data)

Form Manager
SGDC
Clinical research
Marvin (XClinical©)
CDISC
Form Receiver
eCRF
HL7
DPI
Form Mapper/Filler

Patient care
DxCare (Medasys©)
HL7

Template

DxCare (Medasys©)
Clinical Research Data Capture Data Elements

<table>
<thead>
<tr>
<th>CDASH Domains</th>
<th>CCD Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demography</td>
<td>CCD Header Information</td>
</tr>
<tr>
<td>Medical History</td>
<td>Active Problems, Past Medical History, and Procedures and Interventions</td>
</tr>
<tr>
<td>Concomitant Medication</td>
<td>Current Medications</td>
</tr>
<tr>
<td>Substance Use</td>
<td>Social History</td>
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<tr>
<td>Vital Signs</td>
<td>Vital Signs</td>
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<tr>
<td>Physical Exam</td>
<td>Physical Exam</td>
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<tr>
<td>Adverse Events</td>
<td>Allergies</td>
</tr>
<tr>
<td>Lab Test Results</td>
<td>Coded Results</td>
</tr>
<tr>
<td>ECG Test Results</td>
<td>Coded Results</td>
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</tbody>
</table>

Source: http://www.ihe.net
### HL7 CDA/CDISC ODM mediator
Based on alignment between CCD content modules and CDASH domains

<table>
<thead>
<tr>
<th>CR: CDASH Domains</th>
<th>EHR: CCD Référence</th>
<th>Template CDA</th>
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</thead>
<tbody>
<tr>
<td>Exposure</td>
<td></td>
<td><strong>New content module</strong></td>
</tr>
<tr>
<td>Concomitant Medication</td>
<td>Current Medications</td>
<td>Medications. Medications Administered</td>
</tr>
</tbody>
</table>
| Substance Use     | Social History     | History of Tobacco Use  
|                   |                    | Current Alcohol/Substance Abuse |
| Adverse Event     | Allergies          | Allergies and Other Adverse Reactions |
| Disposition       |                    | **New content module** |
| Medical History   | Active Problems, Procedures and Interventions, Past Medical History | Active Problems. History of Present Illness  
|                   |                    | Family Medical History. |
| Deviations        |                    | **New content module** |
| Lab Test Results  | Coded Results      | Coded Results |
| ECG Test Results  | Coded Results      | Coded Results |
| Vital Signs       | Vital Signs        | Vital Signs |
| Physical Examination | Physical Exam     | Physical Exam |
| Inclusion / Exclusion Criteria | | **New content module** |
| Subject Characteristics | | **New content module** |
| Drug Accountability | | **New content module** |
| Demographics      | CCD Header Information | CDA Header templates (Patient Contacts, Spouse,..) |
| Comments          |                    | Comments |
Discussion - Conclusion

- **REUSE project**
  - Integrated solution for both clinicians and researchers between EHR and CDMS
  - Differs from IHE RFD integration profile since EHR is the single source of data

- **Benefits**
  - For healthcare providers: avoiding double data entry
  - For patients: in our approach, considering the EHR as the single source of data may improve patient safety as ALL data collected in a biomedical research setting is kept in the EHR, which is currently not the case for most research studies

- **Limits**
  - Ongoing implementation of the transaction « Retrieve and integrate form »
  - Current transaction « Submit form » is specific to the HEGP DPI; a new version will be implemented (HL7 CDA/CDISC ODM mediator)