

Concept Matching between OpenEHR and SONHO

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Abstract. SONHO is the dominant Information System (IS) in hospitals in Portugal. Currently it is seriously compromised due to its outdated infrastructure, and hospitals seek a solution enabled data migration to new ISs. OpenEHR is an open standard that describes the management and storage, retrieval and exchange of health data in electronic health records. The aim of this work is to study how to create an application interface to SONHO implemented according to the openEHR standard. The first phase of this work was to extract the demographic concepts existing on SONHO. The second phase was to select the proper openEHR structure holding the patient demographic information. The third phase was to match both concepts aiming to identify omissions in openEHR archetypes. 41 concepts were found in SONHO, and 12 in openEHR person demographics archetype. From the 41 different SONHO concepts, 14 concepts were mapped to a openEHR concept and 27 are missing. From the 12 concepts found in the openEHR person demographics 3 are missing in SONHO. We claim that many important SONHO concepts are still missing in the openEHR person demographics archetype (e.g. patient identification numbers). To build a useful interface the used archetype must include the missing concepts, which leads to the need of creating a new demographics archetype.

1 Introduction

Currently there is a growing number of Health Information Systems (HIS) operating on Hospitals. Communication among these HIS aiming at semantic operability is a hot topic [1]. The main driver behind current standardization efforts is the goal of consistency and predictability across our data and our system processes, with the added goal of saving effort through re-use, and more controversially, raising quality [2]. Different standards, namely CEN 13606 [3], HL7 [4] and openEHR [5], have emerged aiming to solve interoperability questions. These standards are maintained by organisations that are very different in their origin. CEN is the European Normalization Committee; HL7 is a all-volunteer, not-for-profit organisation involved in development of international healthcare standards; and openEHR foundation is a not-for-profit foundation supporting the open research, development, and implementation of openEHR open standard (i.e. publicly available). OpenEHR is an open standard that describes the management and storage, retrieval and exchange of health data in

electronic health records (EHRs) [6]. The openEHR endeavour is about creating specifications, open source software and tools in the technical space for such a platform [5].

1.1 The Portuguese Scenario

At the end of the 80s the Health Portuguese Ministry was faced with a major disorganization in the administrative departments of different hospitals. So the idea emerged to create an Information System (IS) that standardized and organized the information management. This IS, called “Sistema Integrado de Informação Hospitalar” (SONHO), was developed by a national agency called “Instituto de Gestão Informática e Financeira da Saúde” (IGIF). SONHO is an administrative management system of patient’s data that apparently met the existing organizational needs. It has proved to be useful in the management of patients, particularly in administrative and financial areas. It was a pioneering application in Portugal, with no competitors at that time [7].

SONHO is now a dominant system in hospitals in Portugal and is installed in about 90% of the 86 Portuguese public hospitals. This IS currently assumes a fundamental role in the registration and management of the administrative information of the patient.

The overall objective of the SONHO was controlling the flow of patients in the hospital, namely to know who is in, who leaves, what he/she does and if possible, with what resources aiming to ensure the standardization of statistical data and billing. SONHO also aims at facilitating the organization and management of the Health Ministry by initially considering three patient encounter modules: outpatient, inpatient, and emergency, which represented the three main entry points of patients in a hospital. Subsequently, new modules were added for surgery operation room and the day care.

This application allows for the possibility of registration of clinical data (including history of an inpatient encounter, summary report of emergency, referral letters, list of diagnosis and procedures).

SONHO is seriously compromised due to its outdated infrastructure, because it depends on currently discontinued Oracle Database and Oracle Forms versions. Many hospitals using SONHO are seeking alternatives to it, and thereby facing migration problems.

1.2 The OpenEHR Initiative

OpenEHR is about creating high-quality, re-usable clinical models of content and process – known as archetypes – along with formal interfaces to terminology [5]. The innovation of two-level modelling of Electronic Health Records (EHRs) and archetypes [8] pioneered by openEHR [9] and standardized by CEN/ISO [3] brings us one step further towards semantic interoperability of EHRs [10]. Instead of being hard-coded into proprietary software by software developers, clinical content models are expressed in the Archetype Definition Language (ADL) [11] and authored by the clinical professionals themselves. Archetypes are used at runtime by EHR systems to

validate user data entry and query fine-grained data in the EHR. Archetype-based EHR systems are highly adaptive and can evolve when clinical requirements change over time since volatile clinical requirements are captured in archetypes while software systems are built using only the stable openEHR information model and archetype language. Archetypes are expressed in a standardized formal language so they are machine-interpretable and can be shared between systems. This makes the semantics of EHR data available not only to other EHR systems but also to surrounding systems [12].

An openEHR archetype is “a computable expression of a domain content model in the form of structured constraint statements, based on some reference model”. Archetypes are seen as a means of defining clinical knowledge in an explicit way, separating it out from the system software that uses it. This has dual benefits of enhancing clinical ownership and making system development and maintenance easier. An openEHR template is “a directly, locally usable definition which composes archetypes into a larger structure logically corresponding to a screen form”. Templates have an important role in grouping and refining archetypes for specific local applications [13].

1.3 Aim

The aim of this work is to study how to create an application interface to SONHO implemented according to the openEHR standard.

2 Methods

The first phase of this work was to extract the demographic concepts existing on SONHO. The second phase was to select the proper openEHR structure holding the patient demographic information. The third phase was to match both concepts aiming to identify omissions in openEHR archetypes.

2.1 Existing Concepts in SONHO

The demographic concepts present in SONHO were retrieved by analyzing the user interface. Unfortunately, there is no database documentation made available for us. A SONHO expert user was used to confirm the list of concepts retrieved. The patient demographic data of SONHO is mainly presented in three forms (Figure 1 to 3). A description of the concepts can be found in the results section.

2.2 Existing Concepts in OpenEHR

The search of the proper openEHR structures holding the person demographic information lead to the selection of the person demographics archetype (openehr-demographic-PERSON.person.v1) created by Thomas Beale in 2003 [14]. It is still a draft aimed to be used in a demographic service. Its purpose is to be a general model

of a PARTY with legal name, other identities, and contact details. The existing information concepts were extracted considering the term definitions on the ontology section of the archetype (e.g. legal name, home address).

HSJ IDENTIFICAÇÃO IGIF

PROCESSO N° 20011160
 Última actualização: 03/03/2008 Registrado em: 27/05/1995

N° Utente do S.N.S.: 167732233 N° Antigo Processo:

Nome: CARLA ISABEL MONTEIRO JESUS AVILA

Sexo: 2 Feminino Data Nascimento: 17/03/1970 Idade: 38 Anos

Nacionalidade: 620 PORTUGAL País Or.: 620 PORTUGAL

Doc. Identificação: 8 Bilhete Identidade N° Documento: 9005565

Naturalidade: Distrito : 13 PORTO
 Concelho : 08 MATOSINHOS
 Freguesia : 10 SENHORA DA HORA

Observações:

[Ver Dados Cartao] [Pág. Seguinte] [Gravar] [Sair] [Mostrar Teclas]
 Count: *1 <Replace>

Fig. 1. First demographic information form from SONHO.

HSJ IDENTIFICAÇÃO IGIF

MORADA

Rua: R GUERQUEIRO 93

Localidade: S MAMEDE DE INFESTA Telefone: ()

Distrito : 13 PORTO
 Concelho : 08 MATOSINHOS
 Freguesia : 09 S MAMEDE DE INFESTA 4465 SAO MAMEDE DE INFESTA

CONTACTOS

Tipo Contacto	Nome Contacto	Corresp.

[Pág. Anterior] [Pág. Seguinte] [Copiar] [Gravar] [Sair] [Mostrar Teclas]
 Count: *1 <Replace>

Fig. 2. Second demographic information form from SONHO.

2.3 Matching Concepts from SONHO and OpenEHR

The process of matching of concepts was accomplished by searching for the nearest concept in meaning in both SONHO and openEHR. When the concepts of SONHO

were non-existent not similar enough to the ones on openEHR, new concepts are proposed.

Código	Designação	Nº Beneficiário	Válido até
910005	A.D.S.E. - ASSIST. DOENCA SERVID. E	0077345140A	17/03/2008
935601	SERVICO NACIONAL SAUDE	167732233	

Fig. 3. Third demographic information form from SONHO.

3 Results

3.1 Concepts Found in SONHO

The concepts found ($N_{\text{SONHO}}=41$) in the three SONHO demographic forms are presented in Table 1. The terms in *italics* are not considered as concepts per-se and work as group labels.

3.2 Concepts Found in openEHR Person Demographic Archetype

The concepts founding the openEHR person demographic archetype ($N_{\text{openEHR}}=12$) are here presented organised in a tree to improve readability. The term identification between parentheses is the original identification found in the person demographics archetype.

Person demographics

Identities

Legal name (at0001)

Other name (at0002)

Contacts

Home address (at0003)

Postal address (at0004)

Home contact (at0005)

Phone number (at0006)

Table 1. Concepts existing in SONHO demographics forms ($N_{\text{SONHO}}=41$). The concepts are divided by the first, second and third forms.

Concept	Form label in Portuguese
First form	
Hospital patient identification number	PROCESSO N°
Date of last update	Última actualização
Date of record creation	Registado em
National patient number	N° Utente do S.N.S
Old hospital patient identification number	N° Antigo Processo
Complete name	Nome
Gender code and description	Sexo (Feminino, Masculino, Hibrido)
Date of birth	Data Nascimento
Age in years	Idade ... Anos
Nationality code and description	Nacionalidade
Country	País Or. (Portugal, França, Espanha, etc...)
Identification card - e.g. Passport of National	Doc. Identificação (Bilhete Identidade, Passaporte, Cedula, Numero Fiscal)
Identification card	N° Documento
Number of identification card	Naturalidade, Distrito, Concelho and Freguesia (Porto, Matosinhos, São Mamede Infesta)
Place of birth	Observações
Observations	
Second form	
<i>Address</i>	<i>Morada</i>
Street	Rua
Local	Localidade
Phone number	Telefone
District	Distrito (Porto, Lisboa, Aveiro, etc...)
County	Concelho (Porto, Matosinhos, Maia, etc...)
Parish	Freguesia (Aldoar, Bonfim, Campanhã, etc...)
Postal code	no label (4464-159 São Mamede Infesta, etc...)
<i>Contacts</i>	<i>Contactos</i>
Type of contact	Tipo Contacto (Pai, Mãe, etc...)
Name for contact	Nome Contacto
Third form	
<i>Parents</i>	<i>Filiação</i>
Father name	Pai
Mother name	Mãe
<i>Reimbursement systems</i>	<i>Subsistemas</i>
Code	Código (910005, 935601, etc...)
Description	Designação (A.D.S.E. - ASSIST. DOENÇA SERVID., SERVICO NACIONAL DE SAUDE, etc...)
Number of Reimbursment System	N° Beneficiário
Valid until	Válido até
<i>Other data</i>	<i>Outros Dados</i>
Primary care code and description	Centro Saúde
General practitioner name	Médico Família
Civil state code and description	Est. Civil (Solteiro, Divorciado, Casado, Viuvo, Outro)
Professional status code and description	Sit. Face Prof.
Migrant	Migrante
Profession code and description	Profissão (Apicultor, Jardineiro, Engenheiro Textil, etc...)
Habilitations	Habilitações (MENOS DE 4 ANOS ESCOLARIDADE, BACHARELATO, etc...)
Chronic patient	Doente Crónico
Exemption of payment	Isenção
Special medication	Medicação Especial

Fax number (at0007)
Email address (at0008)
Work contact (at0009)
Details
Date of birth (at0011)
Place of birth (at0012)
Sex (at0013)

3.3 Concept Matching

Table 2 presents the matching of concepts between SONHO and openEHR person demographics. From the 41 different SONHO concepts, 14 concepts were mapped to an openEHR concept and 27 are missing. From the 12 concepts found in the openEHR person demographics 3 are missing in SONHO.

4 Discussion

The authors feel that the methods used to collect the SONHO concepts, namely by using the user forms, allowed a correct description of the concepts. Also, some of the concepts found on SONHO's demographic forms are not really demographics (e.g. "Is this a chronic patient", "Special medication"). Nevertheless, these concepts were all considered, as they should be part of the data interface to SONHO.

The openEHR person demographics archetype is very simple regarding its concepts. This is probably the main reason that leads to other efforts to create new demographics archetypes which are much more complete (e.g. demographics archetype used in Brazilian project [15], and used by children cancer treatment system project [16]).

From the process of matching the concepts, the authors claim that many important SONHO concepts are still missing in the openEHR person demographics archetype (e.g. patient identification numbers). For a useful interface to be built, the used archetype must include the missing concepts, which leads to the need of creating new demographics archetypes and specialized local archetypes.

Despite SONHO and openEHR present different approaches, it seems feasible to create an interface that meets the standard for openEHR and the demographics data of SONHO.

5 Future Work

Further work is required to explore the possibility to auto-generate the application interface based on openEHR templates composed with publicly available archetypes and the locally tailored archetypes.

Currently the authors are planning the implementation of the interface to SONHO, and also a change of the considered concepts aiming to extend from patient demo-

graphics to patient summary following one of the key actions items of the European Community in the field of eHealth [17].

Table 2. Concept matching between SONHO and openEHR person demographics concepts.

SONHO concepts	Existing openEHR concepts	
	Description	Term
Hospital patient identification number	Missing	
Date of last update	Missing	
Date of record creation	Missing	
National patient number	Missing	
Old hospital patient identification number	Missing	
Complete name	Name of person as legally recognized by the state	at0001
Missing	Other name	at0002
Gender code and description	Gender of person	at0013
Date of birth	Date of birth of person	at0011
Age in years	Missing	
Nationality code and description	Missing	
Country of birth	Missing	
Identification card - e.g. Passport of National Identification card	Missing	
Number of identification card	Missing	
Place of birth	Place of birth of person	at0012
Notes	Missing	
<i>Address</i>		
Street	Person's usual home address	at0003
Local	Person's usual home address	at0003
Phone number	Person's phone number	at0006
Missing	Person's fax number	at0007
Missing	Person's email address	at0008
District	Person's usual home address	at0003
County	Person's usual home address	at0003
Parish	Person's usual home address	at0003
Postal code	person's postal address	at0004
<i>Contacts</i>		
Type of contact	Person's home contact details	at0005
Name for contact	Person's home contact details	at0005
	Person's work contact details	at0009
<i>Parents</i>		
Father name	Missing	
Mother name	Missing	
<i>Reimbursement systems</i>		
Code	Missing	
Description	Missing	
Number	Missing	
Valid until	Missing	
<i>Other data</i>		
Primary care code and description	Missing	
General practitioner name	Missing	
Civil state code and description	Missing	
Professional status code and description	Missing	
Migrant	Missing	
Profession code and description	Missing	
Academic graduation	Missing	
Chronic patient	Missing	
Exemption of payment	Missing	
Special medication	Missing	

References

1. Cruz-Correia, R.J., et al., *Reviewing the integration of patient data: how systems are evolving in practice to meet patient needs*. BMC Medical Informatics and Decision Making, 2007. 7(1): p. 14.
2. Hoya, D., et al., *Collaborative development of clinical templates as a national resource* International Journal of Medical Informatics, 2008. Epub ahead of print.
3. CEN/TC 251, *EN 13606:2007, Electronic Health Record Communication*. 2007, CEN - European Committee for Standardization: <http://www.cen251.org/>.
4. Health Level Seven Inc. *What is HL7*. [Web site] 2005 [cited 2005 Dec]; Available from: <http://www.hl7.org>.
5. openEHR. *Introducing openEHR*. 2004 [cited].
6. *openEHR*, in *Wikipedia*. 2008.
7. Teixeira, A. and A. Brochado, *Quando o S.O.N.H.O. se torna realidade ... Avaliação estatística do impacto das Tecnologias de Informação nos serviços de consulta externa hospitalar*. Revista Portuguesa de Saúde Pública, 2005(1).
8. Beale, T. and S. Heard, *Archetype Principles in The openEHR Foundation Release 0.95*, T. Beale and S. Heard, Editors. 2005, The openEHR foundation.
9. Kalra, D. and T. Beale, *The openEHR Foundation*. Studies in Health Technology and Informatics, 2005. 115: p. 153-173.
10. Garde, S., et al., *Towards Semantic Interoperability for Electronic Health Records: Domain Knowledge Governance for openEHR Archetypes*. Methods of Information in Medicine, 2007. 46(3): p. 332-343.
11. Beale, T. and S. Heard, *Archetype Object Model*. 2006, The openEHR Foundation.
12. Rong, C., et al., *An archetype-based testing framework*. Studies in Health Technology and Informatics, 2008. 136: p. 401-406.
13. Beale, T. and S. Heard, *Archetype Definitions and Principles, revision 0.6*, The openEHR Foundation: London.
14. Beale, T., *openehr-demographic-PERSON.person.v1*. 2003, Ocean Informatics: <http://www.openehr.org/svn/knowledge/archetypes/dev/adl/openehr/demographic/openehr-demographic-PERSON.person.v1.adl>.
15. Freire, S.M. and R. Dutra, *Representação dos dados de uma pessoa - br-demographic-PERSON.pessoa.v1*. 2007, Universidade do Estado do Rio de Janeiro - UERJ.
16. Chen, R., *openehr-demographic-PERSON.child_patient.v1*. 2004, Acode HB.
17. Committee of the European Communities, *An action plan for a European e-Health*. 2004. p. 356

