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Discharge and referral data exchange using global standards – The SCIPHOX project in Germany

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Abstract. The goal of the German project "Standardization of Communication between Information Systems in Physician Offices and Hospitals using XML" (aka SCIPHOX) is to provide an XML based information exchange between Hospital Information Systems (HIS) and Physician Office Systems (POS). HL7's Clinical Document Architecture (CDA) was chosen to serve as the "backbone" specification. The CDA is an ANSI approved document architecture for exchange of clinical information using XML. The SCIPHOX proposal specifies the use of the CDA in the context of discharge and referral letters in Germany, taking local needs (insurance information etc.) into account.

1. Introduction

Electronic data interchange in healthcare meanwhile covers not only the hospital area, but also the non-hospital environment, for example the communication between Physician Offices / General Practitioners (GPs). While the first is often done using the message standards of HL7 (Health Level Seven, [1]), support of information exchange between applications in the non-hospital arena is achieved utilizing a variety of other protocols like EDIFACT or even proprietary exchange formats.

In Germany the use of HL7 is widespread for communication of applications within and between hospitals. In the outpatient sector a local proprietary protocol suite has been established, called "*DT". This set of protocols was endorsed by the German physicians statutory association in 1988 and was intended for storing and also exchange of data in the outpatient area only. It primarily supports the reimbursement process (ADT), the storage and communication of lab results (LDT) and other medical findings (BDT), among others.

Although it is a pragmatic approach without an underlying data model, a valuable repository of tags for data fields along with their semantics, type and constraints has been created over the years. The repository also represents a valuable knowledge about requirements of amount and content of electronic data exchange in this area.

In Germany, both protocols mentioned were used (and developed) in parallel in both domains and without any point of contacts. Over time the old pragmatic "*DT" approach became more and more insufficient and efforts has been undertaken to replace it by newer specifications concerning both, the semantical and the exchange format aspects and to start electronic communications between the two domains.

2. Extensible Markup Language as a "mediator" between worlds

The Extensible Markup Language (XML) plays a key role in various economical and scientific domains for both as an interchange format for messages and as a document standard. XML is a set of recommendations of the World Wide Web industry consortium (W3C) covering the meta language itself [2], the definition of schemas [3] to constrain structure and semantics of instance documents, and the processing of XML documents concerning presentation, transformation [4], navigation [5] etc.

Healthcare applications uses XML more and more: for clinical documentation and electronic patient records, for communication tasks between institutions and organisations, for clinical practice guidelines as well as for remote data entry in clinical studies – just to mention some of the use cases. The initial euphoria about XML and its flexibility was accompanied by some misunderstandings, including the declaration of other "older" healthcare communication standards being superfluous. Interoperable data interchange and data maintenance in healthcare however requires more than a solid confession to a single flexible and extensible exchange format. Assumptions concerning semantics or relations between information, i.e. implicit or explicit data models, are needed: the knowledge of interoperable use of data is inherent to the data models and the vocabulary and not to a specific syntax.

It must be mentioned, that in Germany XML encouraged the domain experts of hospital communication on the one hand and the outpatient area on the other, to overcome the years of parallel development and to think about a common and shared way of exchanging information, that clearly uses XML but is build on a more standardised way of thinking. Furthermore the requirements for a document oriented approach, i.e. human-readable and persistent "information objects", rather than exchanging messages on demand including extracting their payload into database applications and drop them afterwards, spurred the ignition of a project to deal with these issues.

3. The SCIPHOX project

The goal of the German project "Standardisation of Communication between Information Systems in Physician Offices and Hospitals using XML" (also called SCIPHOX) in its phase I is to close the gap of electronic communication between hospital systems and applications for the outpatient sector, such as referral or discharge letters, by providing an XML based method of communication between the two parts. The project started at the beginning of the year 2000 with a pilot study aiming on content definitions and the implementation of a prototype demonstrator. Partners for this first phase came from both arenas described above, namely the Physicians Statutory Organisation and associated institutes, physician office system and hospital information system vendors, various vendors associations, the HL7 user group Germany (the German international affiliate of the HL7 US organisation) and some universities.

Phase I is aimed at the definition of discharge letters and the exchange of referral documents. In this context, discharge letters are intended as instant short reports to the corresponding/referring general practitioner as an end-of-treatment summary document containing major aspects of the treatment episode including diagnoses, procedures, findings and further medications. Ideally it's directly derived from clinical documentation in the hospital information system. Content definition is done in the project using the experiences made creating the HL7 and the *DT information models or repositories respectively.

As a "backbone", HL7's Clinical Document Architecture CDA ([6]) was chosen. The CDA is an ANSI approved XML based document architecture for exchange of clinical

information. The CDA specification provides a header and a body, the header part contains information about

- the document itself including version handling,
- the event that caused the creation of the document,
- service providers such as physicians, and
- service "targets" such as patients.

Three architectural levels of CDA are defined. In the so called level 1 of the CDA architecture, the header is distinctly defined whereas the body part is largely structural markup in the sense of sections, paragraphs, lists and tables etc. It is used to convey the most important information like diagnoses, procedures, further steps (medication etc.), scheduling information or even free text (with or without further markup). The repository created for clinical data exchange in the outpatient area contributed important input to the project. Experiences made with HL7 provided the complimentary part of input for the content definitions, intensive document analyses of the forms used for "normal" paper based information exchange played a third role. Level 2 and 3 of the CDA architecture are still under development.

Because the CDA specification is completely build on XML different needs in today's clinical reporting can be covered:

- narrative reporting as usually used in paper based correspondence with or without additional markup
- coded entries such as diagnoses or procedures that can be (and must be by legal requirements) encoded in specific coding systems such as ICD (international classification of diseases) or ICPM (international classification of procedures in medicine)
- anything in between these two extremes of narration and highly structured documentation.

This fact can be seen as a possibility for a "smooth" migration process for healthcare applications. Relying on the standard CDA approach also ensures a high degree of "shared semantics" (especially in the header part) and thus tries to find a compromise between local specialisation and global generalisation.

An overview about CDA as a standard specification is also given in [7].

4. Results of Phase I

The SCIPHOX proposal specifies the use of the CDA header, taking local needs (insurance information etc.) into account. The preceding independent efforts on alternative XML based encoding for both, the *DT and the HL7 protocols were found being helpful. Furthermore coded items make use of a defined vocabulary, for instance to express clinical locations. In order to achieve this, part of the original standard has been translated and adopted to the local requirements.

To make use of newer XML-related techniques and their advantages, a XML schema for the CDA specification was derived from the DTDs that were provided in the original CDA standard (see [2]). One key point is here the use of namespace necessary to allow "escaped markup" for the localised information such as insurance data. Furthermore definitions drawn from tables or narrative of the specification were included into the CDA/SCIPHOX schema directly as <annotation> / <documentation> elements. All table values, for example for insurance types, lab result status etc, are integral part of the underlying schema and could be used for validation of corresponding XML instances.

```
<section>
  <caption>
    <caption cd V="11502-2" S="LOINC-OID"/>Laborwerte
  </caption>
  <paragraph>
    <content>
      Die Laborwerte waren unauffällig.
      Die angeforderten Werte sind im Folgenden zusammengestellt.
    </content>
  </paragraph>
  <local markup ignore="all" descriptor="sciphox">
    <sciphox:sciphox-ssu type="labresults" country="de" version="v1">
      <sciphox:Laborwerte>
        ... (SSU lab results)
      </sciphox:Laborwerte>
    </sciphox:sciphox-ssu>
  </local markup>
</section>
```

Figure 1: Fragment of a CDA/SCIPHOX document with interspersed local markup in its own namespace showing a lab result paragraph.

Betr.: Udo Gefas, männlich, geb. 09. August 1936, wohnhaft Martinstr. 1, 50931 Köln

Kurzmitteilung

Sehr geehrter Herr Kollege,

wir berichten Ihnen über o.g. Patienten, der sich vom 15.1. bis zum 29.1.2001 in unserer stationären Behandlung befand. Ein ausführlicher Arztbrief folgt.

Diagnosen

Diagnose	Code	Codesystem	Lok./Zusatz	Datum
Prostataadenom (BPH)	N40	ICD 10		17.01.2001
Leistenhernie links	K40.9	ICD 10	L	17.01.2001

Therapie

- Suprapubische Adenomektomie *[ICPM 5-603.0]* und
- Leistenhernienverschluss nach Shouldice links *[ICPM 5-530]* (konsiliarisch-chirurgisch) am 16.1.2001

Histologie

- Benigne Prostatahyperplasie (E-Nr.:123456, Patholog. Institut Dr. Weller)

Abschlusslabor

Das Abschlusslabor war, bis auf den Hb von 13 mmol/l, unauffällig. *[LOINC 14134-1]*

Letzte Medikation

Handelsname	PZN	Dosis	Verabreichung	Status	Dauer	Datum
Ferro Sanol Duodenal Kps.		100 mg	1-0-0		2 Wochen	17.01.2001
Tanameric	12345678	50 mg	morgens eine halbe Tablette (=25 mg), die andere Hälfte abends vor dem Schlafengehen	empfohlen	4m	17.01.2001

Weiteres Vorgehen

Wir empfehlen bzgl. der Adenomeklomie die üblichen fachurologischen Kontrollen.

Bzgl. der Leistenhernien-OP wurde dem Patienten von Seiten der chirurgischen Klinik unseres Hauses ein Merkblatt mit Verhaltensmaßregeln mitgegeben.

Hier wurde ein poststationärer Termin in der chirurgischen Ambulanz unseres Hauses für den 7.2.2001 vereinbart.

Mit freundlichen Grüßen

Dr. med. P. Schmidt
Chefarzt
19. Januar 2001

Dr. med. K. Bäumer
Stationsärztin
19. Januar 2001

Figure 2: SCIPHOX document fragment (part of a discharge letter), visually rendered using a style sheet for the original SCIPHOX markup

Small information units, so called small semantic units SSUs were added to the original specification to match local needs. The approach is similar to the already standardized <local_markup> or <local_header> definition of CDA, but in order to have better methods to constrain the additional local information, the use of an own SCIPHOX-namespace was preferred.

In an XML instance document, the SCIPHOX namespace is thus used to distinguish between original CDA document markup (default namespace) and the SCIPHOX additions (refer to figure 1). SSUs defined so far, cover insurance information for the patient, which is always highly proprietary, but also lab results, diagnoses, medication, and form information for referral. Figure 2 shows a visually rendered SCIPHOX document.

Development requirements in terms of constraints were identified and addressed. As an example, developers cannot easily implement a worldwide unique "patient id" or "document id" (as specified in the original standard) without knowing precisely what this means in their specific environment or without regarding local legal aspects.

Tools were developed, for example a (generic) schema browser ([8], see also [9]) to support developers and implementers to step in to the CDA / SCIPHOX specification.

5. Future aspects of SCIPHOX

Phase II of the SCIPHOX project began in 2002 and aims on the extension of the communication scope, for example the electronic prescription, on runtime implementations including security issues, and on highly domain specific documentation (diabetes, outpatient treatment/operational notes quality assurance etc.). A web site was created to publish all project related information.

6. Conclusion

Making a global standard as the ANSI-CDA specification feasible for the use in a local environment by "enriching" the already existing definitions and identifying the issues that make the difference between what exists and what is still locally required can be seen as a opportunity to a "smooth" migration process rather than enforce superfluousness of existing (and successfully running) approaches in healthcare application communication and data storage. Relying on the standard approach also ensures a high degree of "shared semantics" and thus tries to find a compromise between local specialisation and global generalisation.

Because of (legal) requirements in healthcare in Germany and many other countries, several efforts were ignited to create clinical reports such as discharge letters, message specifications or even electronic patient record systems. They are based on various but sometimes not standardised work. The outcome from these activities for example is a variety of XML based specification that each uses different tag names for the same semantic content and – which is even more fatal – different underlying data models. The flexibility of XML not only allows this effect, it "encourages" diversity and thus could elicit lack of interoperability.

Our findings show that projects in healthcare using XML should be build on already available standardisation efforts as much as possible. They should participate in or contribute to the healthcare standardisation. Data repositories along with controlled vocabulary will surely play an important role. We encourage seeing XML as a vehicle for interoperability rather than for individuality.

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