

# Implementation of an IHE XDS-MS Based Electronic Emergency Referral Document System

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**Abstract-** The emergency department (ED) represents an important transition of care for patients, where understanding the patient health condition is critical to forming an appropriate plan of care. Because many emergency referral visits are unplanned and urgent, this information may not be conveyed in advance to ED physicians. Loss of this data can lead to costly over-testing in the ED referral, or worse, an inappropriate disposition for the patient.

In this study, we use the XDS-MS (Cross-Enterprise Sharing of Medical Summaries) profile to implement the prototype of Emergency department system for referral document to solve the problem of patient's health information losing and sharing crossing the different hospital emergency departments.

## I. INTRODUCTION

Emergency departments (EDs) in the United States are in crisis. Between 1992 and 2003, the number of ED visits in the United States increased more than 26% from 90.3 million to 113.9 million visits annually, whereas during the same period the number of hospital EDs decreased by 425 or 12.3% and the number of hospital beds decreased by 198,000 [1]. Because many emergency department visits are unplanned and urgent, this information may not be conveyed in advance to ED physicians. Even such information may be available to physicians, many of the problems with safety and quality in EDs are due to a lack of provider access to vital patient data at the point of care due to information gaps [2].

The emergency referral is critical component of quality clinical care. It has become increasingly scrutinized in managed care era. Nearly 5000 EDs in United States on the average of a year [3]. It is very significant percentage of ED visits are referrals.

Whenever a patient is transferred to referral hospital without the patient's health or clinical information, it will lead the information gaps. These information gaps are likely caused to a large extent by patient migration among providers, institutions, and health plans and decentralization and fragmentation of the overall healthcare system. So, it is very important to improve communication of intended patient care plans to ED providers and ensure that no pertinent data is lost to solve the information gaps in emergency referral. The complete health information of patients and all conditions can help doctors make the patient the best of medical treatment and related health care, and timely rescue of patients.

Even when full patient's health information may be

available to physicians, time constraints can restrict their availability to pursue it, so the ED physicians should need vital information in emergency referral. The discharge summary is a critical source of information for treating emergency room patients. It also presents vital information in the medical records. It is abstracted from a set of patient care records is in fact somewhat arbitrary. It can be a full or minimum set of the patient care records.

The discharge summary usually includes the information of the referral's chief complaints, allergy, diagnosis, a care plan, the Glasgow Coma Scale (GCS) and the recommendations for accepting physicians. The chief complaint represents how a patient describes the symptoms. The care plan describes what will be performed or what has been performed during the care of a patient and usually includes the laboratory tests, radiology (X-ray, endoscopy, sonograph, etc.) examinations and the treatment. The Glasgow Coma Scale (GCS) is used for evaluating the trauma of a patient's nervous system. It is extremely important in dealing with emergency transported patients.

A discharge summary can be represented by a hierarchical tree in which each information element is represented by a node and the part-of relationship between nodes can be represented by a link [4].

There are three kinds of nodes in the hierarchy. A root node has no parent node. It represents the starting entry point of the discharge summary. There is one and only one root node in a hierarchy. A branch node must have children nodes that can be leaf nodes or branch nodes. A leaf node has no children. It is usually associated with a value or the raw data (such as strings, numbers, etc.).

In the hierarchical tree, the chief complaints, allergy, diagnosis and the recommendations to accepting physicians are represented as leaf nodes. However, the GCS and the care plan are represented as branch nodes. This is because they contain structural elements. The GCS consists of the scale of eye-movement (E), the clearance of voice (V) and the response of motor mechanism (M). The care plan can usually be divided into laboratory test, radiology examination and treatment. Each part may contain several items [4].

The tree is a graphical representation of a discharge summary and can easily be understood. It is a basic unit for sharing or exchanging patient care records among the hospitals in this study.

However, the discharge summary must contain the essential information required for continual medical care for the

emergency transported or referred patients. In our approach, the discharge summary is a basic unit that can be accessed or shared.

IHE (Integrating the Healthcare Enterprise) is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. In 1997, a consortium of radiologists and information technology experts formed IHE, or "Integrating the Healthcare Enterprise." IHE aims to create a process through which interoperability can be implemented. The group gathers case requirements, identifies available standards, and develops technical guidelines that manufacturers can implement. IHE also stages "connectathons" and "interoperability showcases" in which many vendors assemble to demonstrate the interoperability of their products. [5].

IHE Integration Profiles describe a clinical information need or workflow scenario and document how to use established standards (e.g. HL7, DICOM, LOINC...) to accomplish it. A group of systems that implement the same Integration Profile address the need/scenario in a mutually compatible way.

XDS-MS (Cross-Enterprise Sharing of Medical Summaries) profile provides a mechanism to automate the sharing process between care providers of Medical Summaries, a class of clinical documents that contain the most relevant portions of information about the patient intended for a specific provider or a broad range of potential providers in different settings. Patient transfers and, therefore, the summary documents that accompany these transfers can be categorized into 3 primary types: Episodic, Collaborative, or Permanent. [6]

XDS-MS profile is based on XDS (Cross-Enterprise Document Sharing profile). The XDS profile not only facilitates the registration, distribution and access across health enterprises of patients' electronic health records, but also provides a standards-based specification for sharing clinical record between healthcare enterprises in the form of documents. The XDS profile uses the registry (document registry) and repository (document repository) architecture (see Fig.1). The registry will point out where the queried healthcare data is. The repository assigns the uniform resource identifier (URI) to documents for subsequent retrieval by a Document Consumer. CDAs are stored in the repository [7]. (see Fig.1)

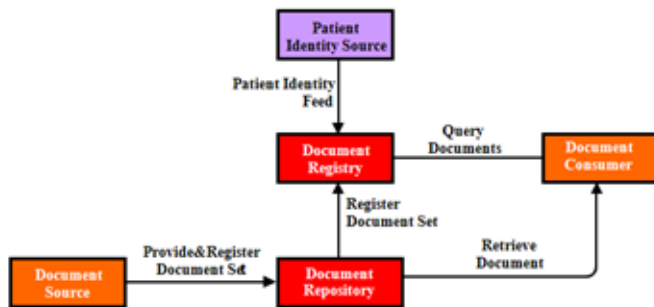


Figure 1. Cross-Enterprise Document Sharing Diagram

Medical Summaries are commonly created and consumed by electronic medical record systems at points in time of one of these types of transfers of care. For example, a referral note is a medical summary used for a collaborative transfer of care whereby a discharge summary is a medical summary reflecting an episodic transfer. XDS-MS profile uses HL7 Clinical Document Architecture (CDA) Release 2 and Care Record Summary as its base standard and constrains this to level 3 encoding for medications, allergies and problem lists.

The aim of the study is to build the prototype of Emergency department system for referral documents realizable in cross-enterprise document sharing. The system will reduce the "information gap" problems occur, when a patient referral to other hospital emergency room, so that ED physicians can get the most complete, real-time, the most accurate patient health information, such as past history, relevant medical history summary, physical examination reports.

In the second section of the paper will provide some related concepts, then present the methods used in the study. The third section will describe the expected results, and discuss the study in the conclusions.

## II. MATERIALS AND METHODS

### A. The Care2x Hospital Information system

We install the free Hospital Information system-Care2x Hospital Information system, Care2x is a generic multi-language open-source project that implements a modern Hospital Information System.

The project was started in May 2002 with the release of the first beta version of Care2x by a nurse who was dissatisfied with the HIS in the hospital where he was working. Until today the development team has grown to over 100 members from over 20 countries [8].

Care2x is a web-based HIS that is built upon other open-source projects: the Apache web server, the script language PHP and the relational database management system MySQL. There exist several source code branches that try to integrate the option to choose from other RDBMS like Oracle.

Care2x is a very feature rich HIS, that is fully configurable for any clinical structure. It is built upon different modules which include e.g. in-and out-patient administration, admission, pharmacy, radiology (including DICOM image uploads), laboratories, ambulatories, nursing, medocs, DRG, etc. Online help is available for some clinical paths.

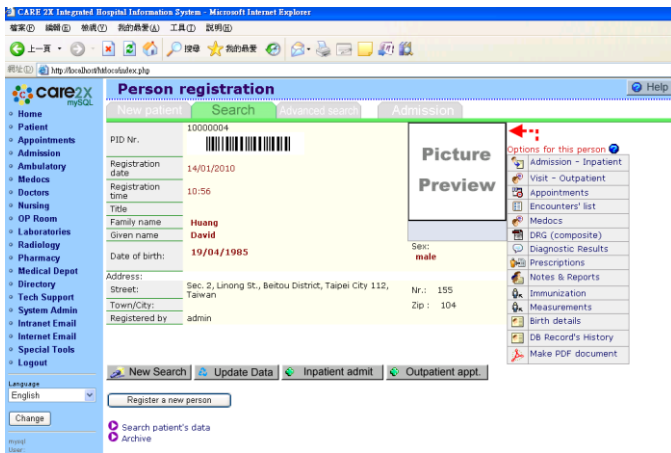


Figure 2. Care2x Hospital Information System

```
<ClinicalDocument xmlns='urn:hl7-org:v3'>
<typeId extension='POCD_HD000040' root='2.16.840.1.113883.1.3' />
<templateId root='1.3.6.1.4.1.19376.1.5.3.1.1.2' />
<templateId root='1.3.6.1.4.1.19376.1.5.3.1.1.4' />
<id root='1' extension='1' />
<code code='1' displayName='1'
codeSystem='2.16.840.1.113883.6.1' codeSystemName='LOINC' />
<title>Discharge Summary</title>
<effectiveTime value='20091226012005' />
<confidentialityCode code='N' displayName='Normal'
codeSystem='2.16.840.1.113883.5.25' codeSystemName='Confidentiality' />
<languageCode code='en-US' />
:
<component><structuredBody>
<component>
<section>
<templateId root='1.3.6.1.4.1.19376.1.5.3.1.3.6' />
<!-- Required Active Problems Section content -->
</section>
</component>
<component>
<section>
<templateId root='1.3.6.1.4.1.19376.1.5.3.1.3.8' />
<!-- Required Resolved Problems Section content -->
</section>
</component>
<component>
<section>
<templateId root='1.3.6.1.4.1.19376.1.5.3.1.3.7' />
<!-- Required Discharge Diagnosis Section content -->
</section>
</component>
</structuredBody>
</component>
</ClinicalDocument>
```

Figure 4. Simple Clinical Document Architecture document in XDS-MS

**B. Discharge Summary Specification of XDS-MS**

This use case is described fully in the XDS-MS profile. It involves an episodic transfer of care in the form of a patient discharge from a hospital to home. The important data elements identified by physicians and nurses for this use case are listed in the table below under the column "Data Elements". These are mapped to the categories given HL7 Care Record Summary Implementation Guide, and HL7 CDA Release 2.0 in the next two columns

A discharge summary is a type of medical summary, and incorporates the constraints defined for Medical Summaries. This section defines additional constraints for Medical Summary Content used in a Discharge Summary. These tables present the data elements described above, along with their optionality, and references to the section and template where these sections or header data elements are further defined..

Date of Discharge	Participate Providers and Roles	Discharge Disposition	Admitting Diagnosis	History of Present Illness	Hospital Course
Discharge Diagnosis	Selected Medicine Administered during Hospitalization	Discharge Medications	Allergies and adverse reactions	Discharge Diet	Review of Systems
Vital Signs	Functional Status	Relevant Procedures and Reports	Relevant Diagnostic Tests and Reports	Plan of Care	Administrative Identifiers

Figure 3. Data elements in XDS-MS profile

**C. System architecture**

In this study, we design and implement the prototype of Emergency department system for referral document, system scope and architecture as show below:

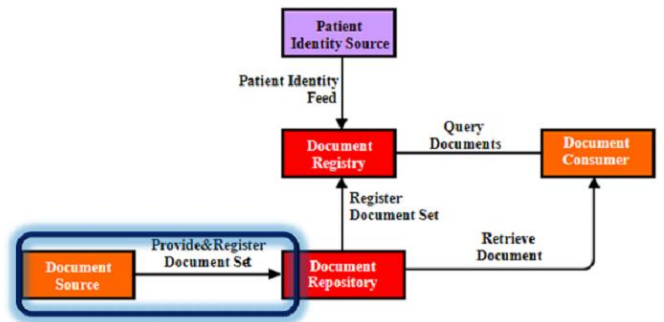


Figure 5. System Scope

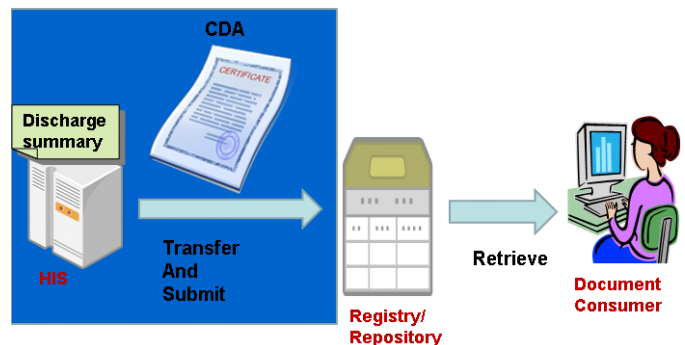


Figure 6. System Architecture

### III. EXPECTED RESULTS

When the patient was referred to another hospital, the referral emergency doctor or nurse will use this emergency department referral document system to search this patient. Because this emergency department referral document system is based on Cross-Enterprise Document Sharing architecture, these patients CDA for discharge summary will store in document repository. So the referral hospital emergency doctor or nurse can retrieve these patients CDA for discharge summary immediately from the hospital repository. The related medical information in this CDA will help not only to resolve in the emergency referral and sharing of data losing, can also help emergency physicians make the appropriate medical decision-making and medical care, real-time to save patient lives and greatly enhance the quality of medical care.

```

<tr><td>Gabapentin 300 mg</td><td>1 tablet twice a day</td></tr>
<tr><td>Simvastatin (Zocor) 10 mg</td><td>1 tablet once a day at bedtime</td></tr>
</tbody>
</table>
</tr>
<paragraph>The patient has just completed a 4 week course of Vanco and
Rifampin for a MRSA UTI.</paragraph>
<paragraph>I note that this patient has been on Prednisone for adrenal
insufficiency in the past.</paragraph>
</text>
<entry>
<substanceAdministration classCode="SBADM" moodCode="EVN">
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<consumable>
<manufacturedProduct>
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<code codeSystem="2.16.840.1.113883.6.88"
codeSystemName="RxNorm" code="203644"
displayName="LISINAPRIL (PRINIVIL)-PO 5MG TAB">
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</originalText>
</code>
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</manufacturedProduct>
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</substanceAdministration>
</entry>
</section>
</component>

```

Figure 7.Expected CDA R2 documents

### IV. CONCLUSION AND DISCUSSION

The IHE profile is a great solution to the healthcare environment. There are many profiles to provide the guides to build a complete healthcare environment for data exchange. The IHE XDS-MS profiles are applied in this study. When developing the IHE data exchange environment by the IHE profiles, the researcher realized the advantage when using

standard. The Health Level 7(HL7) v3 Clinical Document Architecture (CDA) Release 2 is used as the format of health data in this study. Both HL7 CDA R2 and IHE profiles provide the great solutions for the researchers to do the study..

The work of the study is still working. We have mapped the data elements of discharge summary between the Care 2x and XDS-MS successfully. Next, we will transfer a discharge summary to Clinical Document Architecture Release 2 entry level for Cross-Enterprise Document Sharing. But it is difficult, because in Clinical Document Architecture Release 2 entry level, because in Clinical Document Architecture Release 2 entry level, there is no uniform coding system and coding method to complete.

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