Development of Prototype for Exchang Discharge Summary Information between two University Hospitals using HL7

Ki Sung Um, Yun Sik Kwak, Hune Cho, Hee-Seung Bom[a], Il Kon Kim, Bockgyun Lee

Department of Medical Informatics, Kyungpook National University School of Medicine
[a]Department of Biomedical Informatics, Chonnam National University Medical School

Abstract

This study is carried out to develop a pilot system and test the applicability of a Health Level Seven(HL7) interface engine for sharing discharge summary(DS) information between two university hospitals.

The following steps have been used for the pilot study: 1) development of a new interface engine based on the HL7 V2.4 with a new algorithm; 2) construction of a HL7 message format suitable for the DS sharing; 3) development of a system for the DS interchange; and 4) live testing of the DS interchange and the database storing. Two tertiary-care teaching hospitals and a physician's clinic have participated in this pilot project.

We developed the HL7 Interface Engine with a 'Message Structure Table' that contains the HL7 message composition for the DS and a parsing mechanism. Also developed is a DS sharing system consisting of three sub systems - 1) data entry and message generation, 2) message transfer and parsing, and 3) DS information retrieval and downloading - that was applied to the interface engine. The results of the live system-test have revealed the DS interchange system to be functional and useful. However, the performance of the real-time transmission requires improvements in the future. The system had no problem during the off-peak hours of DS interchange.

Keywords :

Discharge Summary, HL7, Java, Interface Engine

Introduction

The discharge summary(DS) is a summarized report of individual inpatient care with a discharge care plan, and it is the most commonly shared information among health care providers for the patient's continuous care. However, sharing of the individual patient care information among health care organizations in Korea has been dependent upon the traditional manual systems (as fax or hand copies) even places where hospital information systems are already in operation.

When a patient is transferred between two large medical organizations such as university hospitals, various medical records may be needed because university hospitals are usually the last medical delivery point to most patients with severe medical problems. Therefore the DS may have the first priority among various parts of the medical information. According to the van Walraven's study, the risk of rehospitalization may decrease when patients are assessed following discharge by physicians who have received the DS information[1].

Paterson and his colleagues tried to exchange DS information using Clinical Document Architecture(CDA)[2]. This study is another style of the DS information exchange. The goal of this study is sharing the DS information between two university hospitals using the HL7 messages.

Materials and Methods

Development Environment:

For the DS information exchange, we needed some medical organizations to participate in this research. The participant institutes are Kyungpook National University Hospital (KNUH) in Daegu city and Chonnam National University Hospital(CNUH) in Kwangju city. Both hospitals are one of the largest hospitals in their provinces, and they are the subject of the HL7 message generation and exchange. Additionally, Sunsa Internal Medicine Clinic(SIMC) in Ulsan city has participated in this research as a DS information simulated demander.

The Development tools which are used in this research are visual basic 6.0 and Java 1.3.1 programming languages, MS-Access and Oracle 9i as the DBMS, Java servlet as the web programming tool, and Resin 2.0.0 server as web hosting server[3][4][5]. The implemented HL7 version is the 2.4[6].

The hardware and network environments are one DBMS server with Linux OS in a pentium Ⅳ PC, one HL7 message server and web server using Resin 2.0.0 server in a pentium Ⅲ PC, and three pentium Ⅳ PCs as application development computers and message clients.

Table 1. ADT^A03 message segment structure

ADT^A03^ADT_A03	ADT Message
MSH	Message Header

EVN	Event Type
PID	Patient Identification
[PD1]	Additional Demographics
[ROL]	Role
PV1	Patient Visit
[PV2]	Patient Visit-Additional Info
[ROL]	Role
[DB1]	Disability Information
[DG1]	Diagnosis Information
[DRG]	Diagnosis Related Group
[	
PR1	Procedures
[ROL]	Role
]	
[OBX]	Observation/Result
[PDA]	Patient Death and Autopsy

HL7 Message Specification for DS:

The message type which is chosen for delivering DS information is ADT^A03 designed for patient discharge or end visit. Table 1 is the segment structure of this message type[6].

Before designing message specifications for the DS, it is needed to choose data items which will be incorporated into a HL7 message. Table 2 explains the items of the message data and mapping with its assigned segments which will be placed in a HL7 message[7]. Figure 1 is a sample message which is applied to these specifications.

Development of HL7 interface Engine:

Originally, the use of a commercial HL7 interface tool kit was planned in this study as the HL7 programming tool. But, there were many problems in licensing it early in the study period. Since the study schedules could not be delayed, we decided to develop it ourselves.

Most of the commercial HL7 interface engines are programmed using object oriented methods[8][9], but our engine has an applied 'Message Structure Table' which is a new algorithm from us for the HL7 engine programming[10].

Table 2. Mapping with Segment and DS Content

Content		Assigned Segment	Data Type
Patient's basic information (Demographic)		PID	
Patient's admission information		PV1	
Final Diagnosis		DG1	CE
Operation and Special Procedure		PR1	CE
Test Report	Laboratory Test Report	OBX	CE
	Radiology Test Report	OBX	CE
Narrativ e	Chief Complain (CC)	OBX	FT
	History Present Illness (HPI)	OBX	FT
	Past Medical History (PMH)	OBX	FT
	Family History (FH)	OBX	FT
	Physical Examination (PE)	OBX	FT
	Mental Status Examination (MSE)	OBX	FT
	Hospital Course Management	OBX	FT
	Home Medication	OBX	FT
	Discharge Plan	OBX	FT

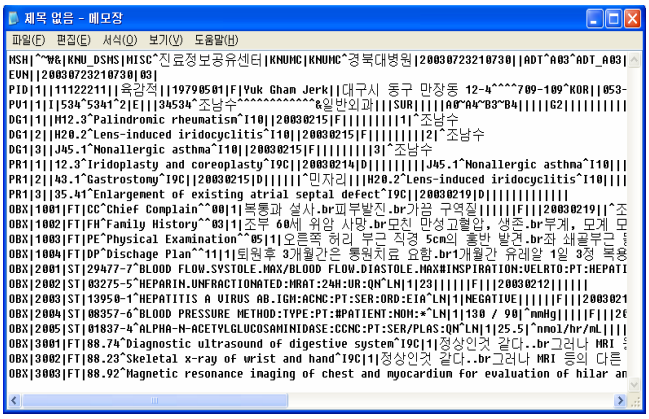

Figure 1. Sample ADT^A03 Message (Part)

System Design:

The system can be classified in two operation stages. First is the client side which represents two hospitals(KNUH and CNUH) and a clinic(SIMC). Second is the server side which works as the 'DS Information Sharing Center(DSISC)' as an imaginary organization for this research. Figure 2 illustrates the outline of this operational concept. The KNUH and the CNUH generate HL7 messages and send it to the DSISC server, and the server parses and saves these messages into its own database. The DS information which is stored in the DSISC database can be retrieved through a web browser by the SIMC which is a simulated demander of the DS information. The SIMC can download the HL7 messages and parse them into their database for the DS information within their information system.

This system is composed of three sub-systems. First is the basic DS data-entry system for the purposes of data collection, which is needed for the HL7 DS messages through the way of direct input or transform from other databases, and the HL7 message generation using those collected data. Second is the HL7 message transfer/receiving system used for HL7 message queuing, sending through TCP socket, receiving, parsing into data, and saving the data in the database. Last is the DS information retrieval system which can inquire the DS information through a web browser. Table 3 provides a more detailed explanation and figure 3 illustrates the interaction among these sub-systems.

Table 3. Details and Attributes of Sub-Systems

Name of Sub-System (Abbreviation)	Purpose	Development Tools	Remarks	Operating Stage
Basic DS Data Entry System (DSDES)	- data collection - HL7 message generating	Visual Basic 6.0	-DBMS: MS-Access	Client (Hospital, Clinic)
HL7 Message Transferring System (MTS)	HL7 Message - queueing - sending - receiving - parsing - saving into DB	Java 1.3.1	TCP Socket applied	Both Side (Interfacing between client and server)
DS Information Retrieval System (DSRS)	inquiring DS information through web browser	Java Servlet 2.0	-DBMS : Oracle 9i	Server (DS Information Sharing Center)

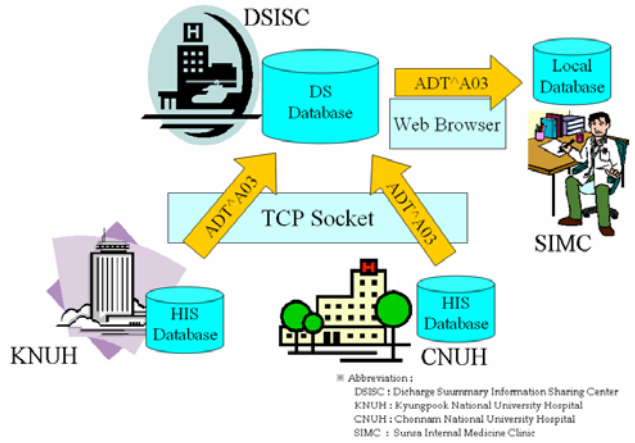

Figure 2. the Operation Concept

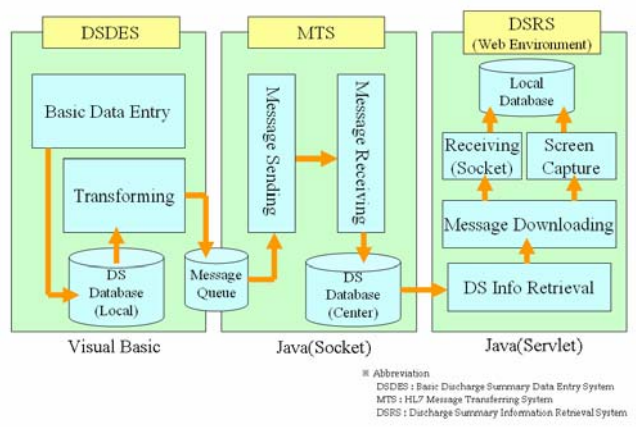

Figure 3. The Interaction of Sub-Systems

System Implementation:

This system was developed by two programmers over five months with 12,000 Lines of Codes(LOC) in Visual Basic 6.0 and 15,000 LOC in Java. The databases are consisted of 26 tables which included the HL7 message information for generating and parsing within the new interface engine, which was developed by ourselves. The logging information for message sending and receiving is also included. Figure 4 is a part of the table schemas as 'create table' statements of SQL (Standard Query Language) format.

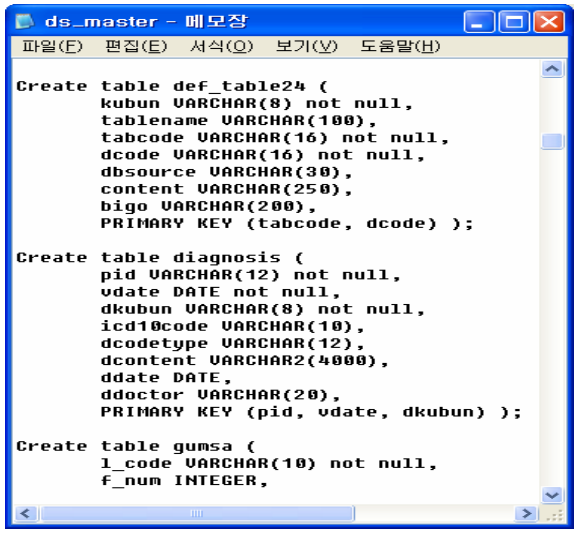

Figure 4. A Part of Table Schema

Testing:

The system was tested for three months. The methods of testing were the single message transfer with direct data input method and the batch transfer method where message groups are sent and received. The first method is designed for an imaginary case for testing only, and the other is for real DS information derived from a real database.

All message communications are recorded into a log table and the timestamp of every communication step - generating, queuing, sending, receiving, parsing, and replying - is also recorded in the log table.

Results

Of the 323 ADT^A03 messages - 121 are from the CNUH, 202 are from the KNUH - were sent to the DSISC server during the testing period. There was no lost or damaged data among them. All of the DS information can be queried through a web page by the SIMC.

The SIMC can download up to 60 messages, parse the source data and store them in its databases without error, and these stored DS information can be used within the simulated SIMC information system.

Figure 5 is a screen which is captured during the HL7 message generation in the basic DS data entry system, figure 6 is a screen which is captured during message parsing in the HL7 message server, and figure 7 shows a captured web browser screen during an inquiry of the DS information by the SIMC.

The average time spent from a message generation to a reply after parsing is 5.2 seconds for each message. This includes the waiting time in the message queue before sending.

Figure 5. A Screen of Message Generating (DSDES)

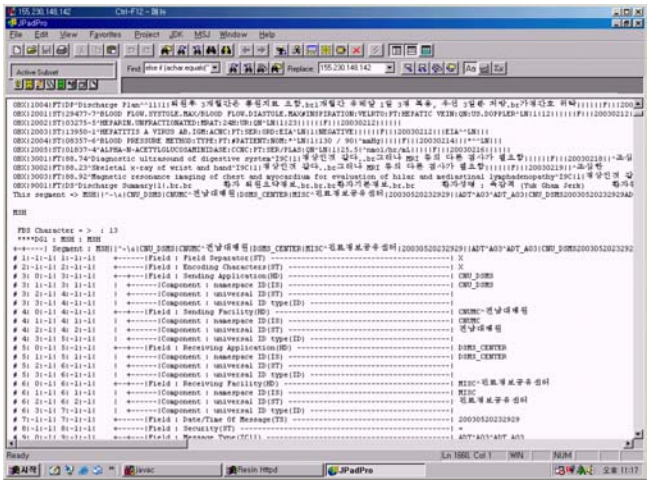

Figure 6. A Screen of Message Parsing (MTS)

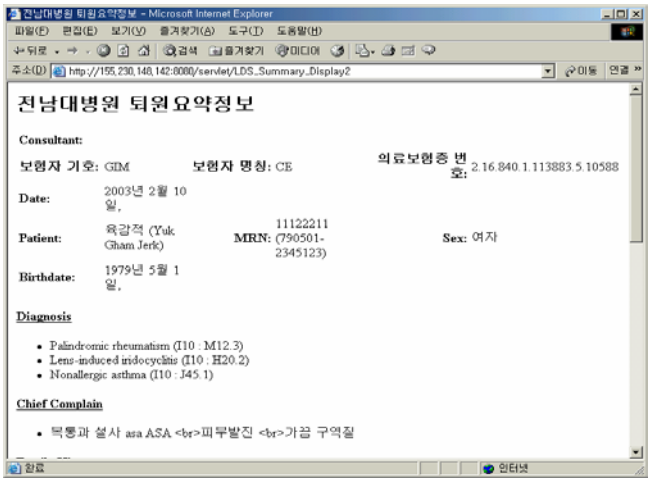

Figure 7. A Web Browser Screen of a DS Information -CDA XSLT Format (DSRS)

Discussion

Overall, the result of the test was sufficient to satisfy the purpose of this study. There were a few more problems than our initial estimate. Some of these problems may be thought of as serious if this system is used in a real situation. The most serious is the slow performance of the system. The total processing time for each message is 5.2 seconds on average. This slow response time may present a major hurdle in a real world situation. The next problem is the weakness in security functions. As we are all aware, medical records can be very sensitive information for a person. So, all medical information needs to be protected through strict security measures. As a result, the test system may not be efficient enough to be used in a real world situation unless greater security is developed as part of the application.

However, in spite of these problems, the purpose of this study was satisfied in the area of exchanging and sharing DS information between hospitals by HL7 messages.

Conclusion

In general, medical records are too complex to exchange between medical organizations through electrical methods[11]. It was very difficult but not impossible. Through this study, we found many possibilities to share patient care information with the HL7 technique. Designing the HL7 message specifications for the DS information was most troublesome during the study period, because the DS format of each hospital is distinct. So, we had to 1) find commonalities; 2) scrutinize all forms; and 3) Standardize them into a new form agreeable to both hospitals and transform it into the HL7 format. However, the subsequent steps were less difficult than our presuppositions.

This product is only a prototype for the research to prove the possibility to exchange patient care information between hospitals. So, there are many elements which are needed in a real service; improvements in performance, upgrades of user interface, transforming into class package, and supplement for security functions, etc. However, this study is not yet finished. With the above listed goals, a subsequent study has been already initiated, and it is our hope to have this product restrictively implemented in actual service within one or two years.

Acknowledgement

This study was supported by the research project of Health Technology Planning and Evaluation Board in Korea Health Industry Development Institute (KHIDI). (01-PJ1-PG3-51300-0019)

References

[1] van Walraven C, Seth R, Austin PC, Laupacis A, Effect of discharge summary availability during post-discharge visits on hospital readmission, Journal of general internal medicine, 2002 Mar, 17(3):186-92

[2] Paterson GI, Shepherd M, Wang X, Watters C, Zitner D, Using the XML-based Clinical Document Architecture for Exchange of Structured Discharge Summaries, Proceedings of the 35th Hawaii International Conference on System Science, IEEE Computer Society, 2002.

[3] Joo KM, Park SW, Kim MH, Visual Basic Programming Bible, Youngjin.com, 2000.

[4] Jung EH, Kim SJ, Clicking JAVA2, Daerim Pub., 2000.

[5] Patel P, Moss K, JAVA Database Progrmming with JDBC, Coriolis Group books, 1997.

[6] Health Level Seven Standard version 2.4, Health Level Seven, 2000

[7] Kwak YS, Um KS, Park SH, Cho H, Bum HS, HL7 Message Specification for Interchange Discharge Summaries Between University Hospitals, Journal of Korean Society of Medical Informatics, Volume 8, Supplement 1, 2002

[8] Gong JK, Jwa YG, Kim, YE, Lim CS, Um KS, Health Level Seven and Development Tools, Korea Health Industry Development Institute, Dec. 2002

[9] Lim CS, Toolkits for HL7 messages and System design, Proceeding of the 1st HL7 Korea Workshop, 2001.2, pp60-80.

[10] Um KS, Cho H, Kim IK, Kwak YS, Algorithm Development for HL7 Message Generating and Parsing Based on Message Structure Table, Journal of Korean Society of Medical Informatics, Volume 9, Supplement 1, 2003

[11] Shortliffe EH, Perreault LE, Wiederhold G, Fagan LM, Wiederhold G, Medical Informatics - Computer Applications in Health Care and Biomedicine, Springer-Verlag, 2000.

[12] Lee TS, Cha EJ, Chae SI, Kim YT, Kim WJ, Multimedia database for discharge summary information, The Journal of Chungbuk National University College of medicine, 8(1), 2002

[13] Okuhara Y, Kitazoe Y, Narita Y, Kurihara Y, Matsuura K, Saibara T, Onishi S, Kagiyama A, Inaoka N, New approach to the medical information system for quality management in patient care: development of Problem Mapping System, Journal of medical systems, 1999 Oct, 23(5):377-87

[14] Um KS, Kwak YS, Cho H, Kim IK, Development of HL7 Message Browser Based on Web Environment, Proceedings of the 4th China-Japan-Korea Joint Symposium on Medical Informatics, 2002

[15] Introduction to Health Level Seven, Korea Health Industry Development Institute, 2000.

Address for Correspondence

Kisung Um is a Ph.D candidate of the Department of Medical Informatics, School of Medicine, Kyungpook National University. He was born in Korea and Graduated from the Korea Airforce Academy(Bachelor) and Yonsei Graduate School of Health Science and Management(MPH). His major research interests are development of hospital database system and HL7 communication. E-mail : altturbo@hanmail.net