creative commons
COMMONS DEED

저작자표시-비영리-변경금지 2.0 대한민국

이용자는 아래의 조건을 따르는 경우에 한하여 자유롭게

- 이 저작물을 복제, 배포, 전송, 전시, 공연 및 방송할 수 있습니다.

다음과 같은 조건을 따라야 합니다:

저작자표시. 귀하는 원저작자를 표시하여야 합니다.

비영리. 귀하는 이 저작물을 영리 목적으로 이용할 수 없습니다.

변경금지. 귀하는 이 저작물을 개작, 변형 또는 가공할 수 없습니다.

- 귀하는, 이 저작물의 재이용이나 배포의 경우, 이 저작물에 적용된 이용허락조건을 명확하게 나타내어야 합니다.
- 저작권자로부터 별도의 허가를 받으면 이러한 조건들은 적용되지 않습니다.

저작권법에 따른 이용자의 권리는 위의 내용에 의하여 영향을 받지 않습니다.

이것은 이용허락규약(Legal Code)을 이해하기 쉽게 요약한 것입니다.

Disclaimer

dCollection

연세대학교
YONSEI UNIVERSITY

HL7 V2 Model of behavioral health depression specific Digital Therapeutics

Min, Hwapyung

Department of Integrative Medicine
Graduate School
Yonsei University

연세대학교
YONSEI UNIVERSITY

HL7 V2 Model of behavioral health depression specific Digital Therapeutics

Advisor Seok, Jeong-Ho

A Master's Thesis Submitted
to the Department of Integrative Medicine
and the Committee on Graduate School
of Yonsei University in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

Min, Hwapyung

June 2025

연세대학교
YONSEI UNIVERSITY

HL7 V2 Model of behavioral health depression specific Digital Therapeutics

This certifies that the Master's Thesis of Min, Hwapyung is approved.

Committee Chair	**Seok, Jeong-Ho**
Committee Member	**Kim, So Yun**
Committee Member	**Oh, Jooyoung**

Department of Integrative Medicine
Graduate School
Yonsei University
June 2025

연세대학교
YONSEI UNIVERSITY

TABLE OF CONTENTS

LIST OF FIGURES ii

LIST OF TABLES iii

ABSTRACT IN ENGLISH iv

1. INTRODUCTION 1

2.MATERIALS AND METHOD 3

2.1. Materials 3

2.2. Communication Method 8

2.3. Verification Method 10

3. RESULT 13

3.1. New HL7 model 13

3.2. Hardware recommendation 19

4. DISCUSSION 20

5. CONCLUSION 22

REFERENCES 23

ABSTRACT IN KOREAN 24

연세대학교
YONSEI UNIVERSITY

LIST OF FIGURES

<Figiure 1> Example of OBR segment uses in HL7 protocol 7
<Figiure 2> Basic HL7 interaction table 8
<Figure 3> Diagram HL7 communication table between LIS-SPH-CDC 10

연세대학교
YONSEI UNIVERSITY

LIST OF TABLES

<Table 1> Content of ADT Message 3
<Table 2> Content of ORM Message 4
<Table 3> Content of ORU Message 5
<Table 4> Behavioral categories examples 6
<Table 5> MSH example 10
<Table 6> ORC example 11
<Table 7> OBR example 12
<Table 8> OBX example 13

연세대학교
YONSEI UNIVERSITY

ABSTRACT

Effect of HL7 V2 Model of behavioral health depression specific Digital Therapeutics

Secure sensitivity data transmission via HL7 protocol with reduced development time on HL7 V2 Model of behavioral health depression specific Digital Therapeutics. HL7 version of 2.4 and or 2.5 can be used for the model. And it is mandatory to use ADT, ORM, ORU Messages to communicate with EMR. Within the HL7 Messages, also defined a field to use what data will be contained in the message via collecting data from behavioral health depression specific Digital Therapeutics “CHEEU. Forest N”.

Key words : EMR, HL7, ADT, ORM, ORU, CHEEU. Forest N, Digital Therapeutics

연세대학교
YONSEI UNIVERSITY

1. Introduction

1.1. Research background

Many electronic machines and devices are improving in many areas. Especially, healthcare is one of the most important industries where electronic machines are used today. Currently, hospitals use many electronic devices such as MRI, CT, analyzer etc.. And from the devices the EMR(Electronic Medical Records) is integrated via Health Level 7 (HL7). HL7 is the most interoperable protocol that the world widely uses. Most of the hospitals, especially in Western Laboratory Information System and Radiology Information System conduct HL7 messages. As technology improves, HL7 protocol in behavioral health also needs to be defined but currently there are lack of behavioral HL7 protocol. From this thesis, I suggest the HL7 protocol Model of behavioral health depression specific Digital Therapeutics.

About HL7, HL7 organization defines “Founded in 1987, Health Level Seven International (HL7) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. HL7 is supported by more than 1,600 members from over 50 countries, including 500+ corporate members representing healthcare providers, government stakeholders, payers, pharmaceutical companies, vendors/suppliers, and consulting firms.”[1]

And 95% of US healthcare organizations use HL7 V2.x, more than 35 countries have HL7 V2.x implementations.

As behavioral healthcare organizations, conducting many sensitive data therefore it is mandatory to secure data within the hospital and other healthcare organizations. In order to transmit data, from this thesis, I suggest HL7 protocol for behavioral healthcare use.

연세대학교
YONSEI UNIVERSITY

HL7 V2 is the most widely used healthcare messaging standard for exchanging clinical and patient information between systems. The goal of HL7 v2 was to provide enterprise-wide interoperability between health information systems using standardized messages representing clinical event information. This includes patient administrative activities, demographics, medical orders, results and financial.

연세대학교
YONSEI UNIVERSITY

2. Materials and Method

2.1. Materials

For materials Health Level 7(HL7) is the most used in the healthcare industry. In order to provide the model, it is recommended to use HL7. Table below are models of behavioral specific HL7 ADT, ORM, ORU messages.

<Table 1> Content of ADT Message [1]

Event Type	HL7 Event	Trigger event
A01	Admit/visit notification	- Patient visit - Patients cancel visit
A02	Transfer a patient	- Bed Transfer In
A03	Discharge/end visit	- Visit Discharge
A04	Register a patient	- Visit Activation - Visit Cancellation/ (For non-IP visit types only)
A06	Change an outpatient to an inpatient	- Visit Conversion (non-IP visit type -> IP)
A07	Change an inpatient to an outpatient	- Visit Conversion (IP -> non-IP visit type)
A08	Update patient information	- Visit Update - Visit Update From Patient Update - Patient Update/Patient Transport - Physician/Medical Service Update - Visit Discharge Update - Change Visit/Conversion Time Interface - Result Filling (For Allergies Height/Weight)
A11	Cancel admit/visit notification	- Visit Cancellation/No Show (for active visit)
A13	Cancel discharge/end visit	- Visit Discharge Cancellation

연세대학교
YONSEI UNIVERSITY

A34	Merge patient information – patient ID only	- Patient Collapse
A45	Move visit information - visit number	- Visit Move
A54	Change attending doctor	- Physician/Service Change

ADT messages are basic messages in HL7 V2 and it widely used and one of the most important HL7 message types. It contains many trigger events, especially in patient's admissions, register, cancel, updates, discharges, and others
The general process in the hospital involves collecting many data in Electronic Medical Record (EMR). And from the ADT message, it indicates many patient's status related data in the hospital. Therefore, ADT has the most different message types compared to other messages

<Table 2> Content of ORM Message [1]

Event Type	HL7 Event	Triggering Condition
O01	Order message	- issued, scheduled, checked-in, performed, canceled

"HL7 ORM" refers to the Order Entry message type within the HL7. It initiates the transfer of order information and contains actions like placing new orders, modifying, and canceling existing ones. Within the ORM messages ORM-001 is one of basic event type and world widely used, the message events support the transmission of order details and significantly impact healthcare communication by ensuring seamless information flow.

The HL7 ORM message acts as a request for services or materials, linking multiple healthcare providers through order details. Mainly, it is utilized in laboratory or radiology departments but also can be used for other ancillary systems.

연세대학교
YONSEI UNIVERSITY

<Table 3> Content of ORU Message [1]

Event Type	HL7 Event	Triggering Condition
R01	Result message	Observation Result (scheduled)

ORU messages are most used where medical results come from the medical equipment. They have also been used to communicate order and results information for the purpose of clinical trials. It is important to note that ORU messages do not natively contain images, but use a combination of text, codes and numbers to communicate results.

Behavioral health Digital Therapeutics “CHEEU. Forest N” uses Patient’s previous result and patient’s demographic data. In HL7 protocol. ADT(Admit, Discharge, and Transfer), ORM, ORU can be used for HL7 messages. In “CHEEU. Forest N”, View patient training results and history, View patient usage information, View patient depression symptom test (DS) and suicidal ideation test (SR) results, View statistics on number of patients, number of subscribers, number of uses, etc.

To contain the following, Example of “CHEEU. Forest N” questions. (Over the past week) I felt depressed for most of the day. (Over the past week) I experienced less interest or pleasure in daily activities compared to before. (Over the past week) My appetite or weight decreased more than usual. (Over the past week) My appetite or weight increased more than usual. (Over the past week) I had difficulty falling asleep or woke up frequently. (Over the past week) I slept more than usual. All these questions are used for every patient and it needs to be in the HL7 message.

According to “Physicians’ Perspectives on HL7 Information Policy Sensitive Value Set: A Validation Study through Health Concept Categorization” suggest HL7 information sensitive policy as table below.

연세대학교
YONSEI UNIVERSITY

<Table 4> Behavioral categories examples [2]

Proposed Categories for the First Survey	Modified Categories for the Second Survey
Behavioral health information • Danger to self or others • Emotional disturbance information • Mental health information • Psychiatry disorder information • Psychotherapy notes information • Substance use disorder information • Alcohol use disorder information • Opioid use disorder information	**Behavioral health** • Danger to self or others • Mental health • Psychiatry • Psychotherapy notes • Substance use • Alcohol use • Opioid use

These categories are also helpful to contain behavioral health data as well as material. As it indicates Behavioral health data should be very carefully treat.

Currently, there is no behavioral health depression for HL7 specification. Example as below, this is a HL7 specification for Laboratory, but it cannot be use in behavioral health depression.

연세대학교
YONSEI UNIVERSITY

OBR segment—Order

The OBR segment is required and repeating. Each OBR segment represents one panel of tests requested.

Example:

```
OBR|1|LabPasId|SpecId|P1^Description^LabPas|||20110120143112+0100|||||||||||||
||||||||||||||||||||||
```

OBR field	Name	Data
0	Segment ID	OBR
1	Set ID	Contains a sequential number.
2	Placer Order Number	Contains the LabPas Sample Id (barcode). This is the same value as ORC field 2.
3	Filler Order Number	Contains the Lab system Specimen Id. **Note:** This is provided only if tubes are relabeled in LabPas.
4	Universal Service Identifier	Contains a coded element in the following format: Panel Id^Description^LabPas where: • Panel Id maps to a LabPas Panel Code, which is required by the LabPas application. It maps to the Panel Code 2 field for the panel on the Test Panels screen. • LabPas denotes the coding system. Example: P1^Description^LabPas
5	Priority	N/A
6	Requested Date/Time	N/A
7	Observation Date/Time	Contains the LabPas Sample Date/Time, formatted as YYYYMMDDhhmmss + or – hhmm offset from UTC.
8	Observation End Date/Time	N/A
9	Collection Volume	N/A
10	Collector Identifier	N/A
11	Specimen Action Code	N/A
12	Danger Code	N/A
13	Relevant Clinical Info.	N/A
14	Specimen Received Date/Time	N/A
15	Specimen Source	N/A

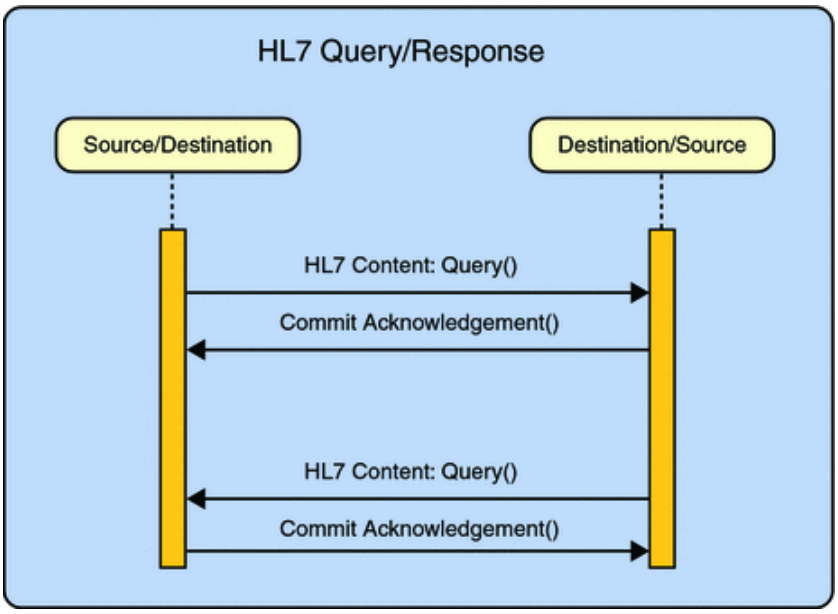
<Figure 1> Example of OBR segment uses in HL7 protocol [3]

연세대학교
YONSEI UNIVERSITY

For example, as Figure 1, example of OBR segment use in HL7 protocol indicates, OBR-2 mentioning about Specimen ID. Which is not use in behavioral health. This HL7 protocol cannot be used in behavioral health depression specific digital therapeutics. Therefore, new types of HL7 protocols needed.

2.2. Communication Method

HL7 Query and response table below is what behavioral health HL7 is used equally. This protocol of behavioral health HL7 should be the same as the HL7 standard.



<Figure 2> Basic HL7 interaction table [4]

As figure1 indicates, HL7 interacts as send query and response ACK(Acknowledgement). This is a basic communication of HL7 protocol, if there is no ACK message from the Destination then the Source should not be sending next message to Destination. And the HL7 message should look like message as below.

연세대학교
YONSEI UNIVERSITY

Example of HL7 communication sample ADT Message

MSH|^~\&|EMRCompany name |Behavioral Digital || |||ADT^A04|100000|P|2.4||||||||

PID|||1234||DOE^JANE||19990101|M||1000-1|123 MAIN
STREET^^GREENSBORO^NC^27401-1020| |(02)123-1234

PV1||O|||||0001^Jonny^Appleseed |||||||||| ||||||||||||||||||||||200007010800||||||||

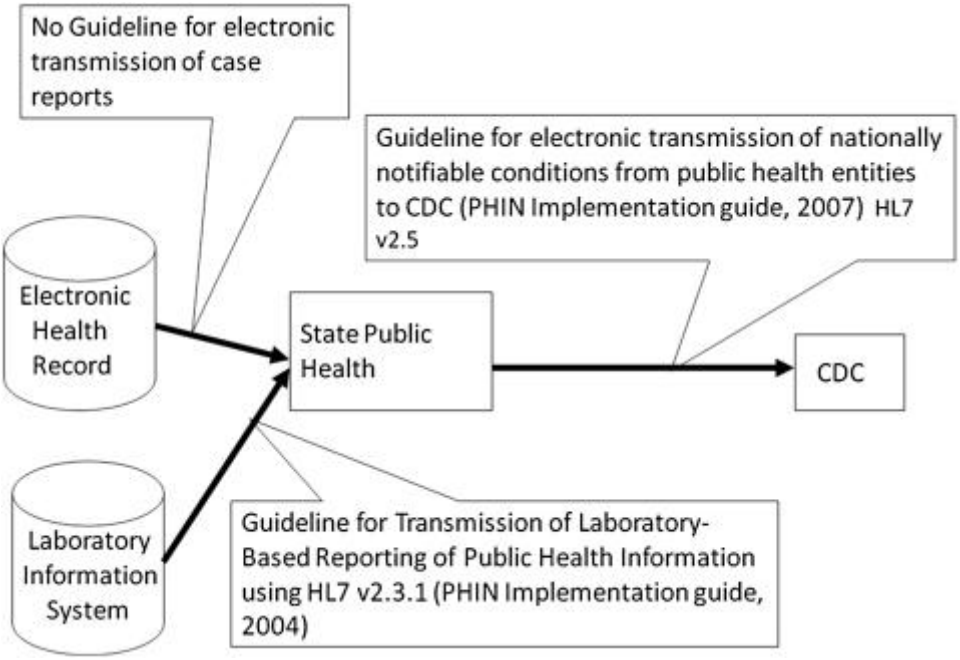
OBX|1|ST||35|||||F||||||

AL1|1||Amphetamine

Also, conducting security is very important for the communication process. EMR sever and the digital therapeutics servers need to be inside of its hospital to secure communication which only communicate within its intranet. Within the hospital's network, it is secure from the other cyberattacks. It is not a good idea to have a digital therapeutics server outside of hospital due to lack of protection from hackers. Without the intranet there is a high possibility that hackers can be approached easily on digital therapeutics server. Even though it's not 100-percent of secure since hospital's network also can be bleached by hackers. However, currently it is the best way to protect patients' data and use HL7 communication. To be more secure, recommend that setting up the firewall for the digital therapeutics server can be help. Firewall activation can block from the virus.

Moreover, outside of the hospital's network. Reimbursement behavioral health in digital therapeutics can be communicated with HL7.

연세대학교
YONSEI UNIVERSITY



<Figure 3> Diagram HL7 communication table between LIS-SPH-CDC [5]

Example of national integration (Development of an electronic public health case report using HL7 v2.5 to meet public health needs)
The table above indicates how CDC (Centers for Disease Control and Prevention) obtain the LIS (Laboratory Information System) data from the hospital. As CDC obtains the LIS data from HL7 V2 behavioral information able to use.

2.3. Verification Method

To verify HL7 format, used “HL7 soup”, which is HL7 Message generation program that commercially use.
Structure wise, tested ADT, ORM, ORU message shown as the message below.

ADT message
MSH|^~**&**|EMR|01|CHEEU. FOREST
N||20250502210000||ADT^A04|ADT20250502210000|P|2.4

연세대학교
YONSEI UNIVERSITY

PID|||11125755^^||Jonny^Appleseed^^||19991121|M|||50 Yonsei-ro^^Seoul^^03722||02-2123-2114
PV1|1|O|||||77283^Hwapyung^Min|

And was able to successfully, Send ACK (Response Message) message as below.

ADT ACK message
MSH|^~**&**|CHEEU. FOREST
N||EMR|01|20250502210000||ACK^A04|ADT20250502210000|P|2.4
MSA|AA|ADT20250502210000

Next message is ORM message
MSH|^~**&**|EMR|01|CHEEU. FOREST
N|01|20250502230000||ORM^O01|ORM202301011220300001|P|2.4
PID|||11125755^^||Jonny^Appleseed^^||19991121|M|||50 Yonsei-ro^^Seoul^^03722||02-2123-2114
PV1|1|O|||||77283^Hwapyung^Min|
ORC|NW|EMR1234567|Forest123456||||202301011210 ||20230101121030|Andy Park|Hwapyung Min||||20230101121030|||Digital Therapeutics|
OBR|1|EMR1234567|Forest123456||||202301011210|202301011210|||||||||||||||||||||1112575 5|||I felt depressed for most of the day|Over the past week||||||

And was able to successfully, Send ACK (Response Message) message as below.

ORM ACK message
MSH|^~**&**|CHEEU. FOREST
N|01|EMR|01|20250502230000||ACK^O01|ORM202301011220300001|P|2.4
MSA|AA|ORM202301011220300001

Next message is ORU message
MSH|^~**&**|CHEEU. FOREST

연세대학교
YONSEI UNIVERSITY

N|01|EMR|01|20250502233000||ORU^O01|ORU20250502233000|P|2.4
PID|||11125755^^||Jonny^Appleseed^^||19991121|M|||50 Yonsei-ro^^Seoul^^03722||02-2123-2114
PV1|1|O|||||77283^Hwapyung^Min|
ORC|NW|EMR1234567|Forest123456||||202301011210 ||20230101121030|Andy Park|Hwapyung Min||||20230101121030|||Digital Therapeutics|
OBR|1|EMR1234567|Forest123456||||202301011210|202301011210||||||||||||||||||||1112575 5|||I felt depressed for most of the day|Over the past week|||||||
OBX|1|ST|||45||0 ~ 48|H|||||||VR|

ORU ACK message

MSH|^~**&**|EMR|01|CHEEU. FOREST
N|01|20250502233000||ACK^O01|ORU20250502233000|P|2.4
MSA|AA|ORU20250502233000
As ACK message sent “AA” in MSA segment, which means “accept message” from this it shows that example of ORM message was correctly formalized and ACK also was correctly formalized.

연세대학교
YONSEI UNIVERSITY

3. Result

3.1. New HL7 model.

The table below is HL7 model of behavioral health depression specific Digital Therapeutics. This model mainly follows data from “CHEEU. Forest N”. Inside of ADT, ORM, ORU messages, there are “Segments” which indicates MSH, ORC, OBR, OBX etc.. And these Segments are very important because it contains data. In HL7, every individual data called “field”. Field can be defined as below for the behavior health specific Digital Therapeutics.

<Table 5> “CHEEU. Forest N” MSH example

Seq. No.	Max Len.	Data Type	R/O	HL7 Name	Description	Example
1	1	ST	R	Field Separator		|
2	4	ST	R	Encoding Characters	HL7 delimiters	^~\&
3	180	HD	R	Sending Application	Sending application name	CHEEU. Forest N
4	180	HD	O	Sending Facility	Sending facility code	01
5	180	HD	R	Receiving Application	Receiving application name	EMR
6	180	HD	O	Receiving Facility	Receiving facility code	01
7	26	TS	R	Date/Time of Message	Message generation date/time	20230101121030
8	40	ST	O	Security	<not used>	
9	13	CM	R	Message Type	Message type and event type	ADT^A01

연세대학교
YONSEI UNIVERSITY

10	20	ST	R	Message Control ID	Unique ID of HL7 message	ADT202301011210300001
11	3	PT	R	Processing ID	Processing environment	P
12	60	VID	R	Version ID	Version of HL7 message	2.4
13	15	NM	O	Sequence Number	<not used>	
14	180	ST	O	Continuation Pointer	<not used>	
15	2	ID	O	Accept Acknowledgment type	<not used>	
16	2	ID	O	Application Acknowledgment Type	<not used>	
17	3	ID	O	Country Code	Country Code	KOR

This MSH segment mainly shows information on the message. This is a general format compared to other hospital departments. Most importantly, this segment indicates when the message arrived to Digital Therapeutics.

<Table 6> “CHEEU. Forest N” ORC example

Seq. No.	Max Len.	Data Type	R/O	HL7 Name	Description	Example
1	2	ID	R	Order Control	Order Control	NW
2	22	EI	C	Placer Order Number	EMR Order ID	EMR1234567
3	22	EI	C	Filler Order Number	Filler Order ID	Forest123456
4	22	EI	O	Placer Group Number	<not used>	
5	2	ID	O	Order Status	<not used>	
6	1	ID	O	Response Flag	<not used>	

연세대학교
YONSEI UNIVERSITY

7	200	TQ	B	Quantity/Timing	Order issue Datetime	202301011210
8	200	CM	O	Parent	<not used>	
9	26	TS	O	Date/Time of Transaction	current date/time (date and time hook called)	20230101121030
10	250	XCN	O	Entered By	Primary Physician	
11	250	XCN	O	Verified By	Attending doctor	
12	250	XCN	R	Ordering Provider	Ordered By Physician	
13	80	PL	O	Enterer's Location	<not used>	
14	250	XTN	O	Call Back Phone Number	<not used>	
15	26	TS	O	Order Effective Date/Time	Scheduled Date/Time	
16	250	CE	O	Order Control Code Reason	<not used>	
17	250	CE	O	Entering Organization	<not used>	
18	250	CE	O	Entering Device	Device description	Digital Therapeutics

This ORC segment mainly shows Order information from EMR. And from this segment Digital Therapeutics can be determined what order given to its system. Physicians can give orders to determine to use Digital Therapeutics during the patient's stay or visit.

<Table 7> "CHEEU. Forest N" OBR example

Seq. No.	Max Len.	Data Type	R/O	HL7 Name	Description	Example
1	4	SI	O	Set ID-Observation Request	Set ID	1

연세대학교
YONSEI UNIVERSITY

2	22	EI	C	Placer Order Number	EMR Order ID (Same as ORC.2)	EMR1234567
3	22	EI	C	Filler Order Number	Accession Number	forest123456
4	250	CE	R	Universal Service ID	<not used>	
5	2	ID	B	Priority - OBR	<not used>	
6	26	TS	B	Requested Date/Time	<not used>	
7	26	TS	C	Observation Date/Time	YYYYMMDDhhmmss	202301011210
8	26	TS	O	Observation End Date/Time	YYYYMMDDhhmmss	202301011210
9	20	CQ	O	Collection Volume	<not used>	
10	250	XCN	O	Collector Identifier	<not used>	
11	1	ID	O	Specimen Action Code	<not used>	
12	250	CE	O	Danger Code	<not used>	
13	300	ST	O	Relevant Clinical Info.	Order/Label Comment	
14	26	TS	C	Specimen Received Date/Time	<not used>	
15	300	SPS	O	Specimen Source	<not used>	
16	250	XCN	O	Ordering Provider	Order Author	
17	250	XTN	O	Order Callback Phone Number	<not used>	
18	60	ST	O	Placer Field 1	<not used>	
19	60	ST	O	Placer Field 2	<not used>	
20	60	ST	O	Filler Field 1	<not used>	
21	60	ST	O	Filler Field 2	<not used>	
22	26	TS	C	Results Rpt/Status Change Date/Time	YYYYMMDDhhmmss	
23	40	CM	O	Charge to Practice	<not used>	
24	10	CE	O	Diagnostic Serv. Sect. ID	<not used>	
25	1	ID	C	Result Status	<not used>	
26	400	CM	O	Parent Result	Parent Result	

연세대학교
YONSEI UNIVERSITY

27	200	TQ	O	Quantity/Timing	<not used>	
28	250	XCN	O	Result Copies To	<not used>	
29	200	CM	O	Parent Number	MRN	
30	20	ID	O	Transportation Mode	<not used>	
31	250	CE	O	Reason For Study	<not used>	
32	200	CM	O	Principal Result Interpreter	Test questions	I felt depressed for most of the day
33	200	CM	O	Assistant Result Interpreter	Test sub questions	Over the past week
34	200	CM	O	Technician	<not used>	
35	200	CM	O	Transcriptionist	<not used>	
36	26	TS	O	Scheduled Date/Time	Scheduled Date/Time	
37	4	NM	O	Number of Sample Containers	<not used>	
38	250	CE	O	Transport Logistics of Collected Sample	<not used>	
39	250	CE	O	Collector's Comment	Comment	

This OBR segment mainly shows Order information from EMR. This is the most important segment for Digital Therapeutics as this OBR segment contains what questions have been asked to patients. This segment information can be shown in the EMR. Without opening the other application physician might understandable which questions have been asked to the patient.

<Table 8> "CHEEU. Forest N" OBX example

Seq. No.	Max Len.	Data Type	R/O	HL7 Name	Description	Example

연세대학교
YONSEI UNIVERSITY

1	4	SI	O	Set ID - OBX	Set ID	
2	2	ID	C	Value Type	Data Type	ST
3	250	CE	R	Observation Identifier	Observation Identifier	
4	20	ST	C	Observation Sub-ID	<not used>	
5	65536	*	C	Observation Value	Score	45
6	60	CE	O	Units	<not used>	
7	60	ST	O	Reference Range	Reference Range	0 ~ 48
8	5	IS	O	Abnormal Flags	Abnormal Flags	H
9	5	NM	O	Probability	<not used>	
10	2	ID	O	Nature of Abnormal Test	<not used>	
11	1	ID	R	Observ Result Status	<not used>	
12	26	TS	O	Date Last Obs Normal Values	<not used>	
13	20	ST	O	User Defined Access Checks	<not used>	
14	26	TS	O	Date/Time of the Observation	Date/Time of the Observation	
15	250	CE	O	Producer's ID	<not used>	
16	250	XCN	O	Responsible Observer	<not used>	
17	250	CE	O	Observation Method	Interpretation	VR

This OBX conducts patient's test results via Digital Therapeutics. This segment can be sent to EMR which means it can be also seen from other medical doctors whom may need to be known.

3.2. Hardware recommendation

연세대학교
YONSEI UNIVERSITY

Specification of server is also a huge part in communication between EMR and Digital Therapeutics. Since Digital Therapeutics operates by videos or animation it might need a decent quality of server but currently there is a web server to collect the data from the virtual reality operation PC. Therefore, there is not a high-quality server for communication between EMR- Behavioral health servers. According to hardware server specifications for “CHEEU. Forest N”, Operating Environment: OS: Microsoft Windows 10 64bit, CPU: Intel Core i3-7xxx or higher or AMD Ryzen 3-1xxx or higher, RAM: 2GB or higher, Storage Free Space: 2GB or higher.

연세대학교
YONSEI UNIVERSITY

4. Discussion

HL7 V2 Model of behavioral health depression specific Digital Therapeutics tested via SoupHL7 program, and the HL7 message worked properly without any error. It means that the HL7 message structure can be able to use in behavioral health depression specific Digital Therapeutics. It interprets that HL7 V2 can integrate behavioral health depression specific Digital Therapeutics with EMR. Currently, there is no standardization for the area. But now it can be integrated. As behavioral health depression specific Digital Therapeutics expand themselves. This model can be useful. Other HL7 V2 models cannot adopt the behavioral health depression specific Digital Therapeutics; the previous HL7 model cannot be used.

During the making of this HL7 V2 model, found that the HL7 V2 standards has lack of covers in text information. Normally, HL7 V2 ORM and ORU messages are based on laboratory data, and usually laboratory results are expressed and indicated in numbers. There are some text-based results in the laboratory field, but not much text information as in behavioral health. In the behavioral health department, there are many text-based questions and answers, and the department needs long text-based. During the validation of the HL7 V2 model, found no issue regarding the limitation on text result, but this is something that would not be aware of. The HL7 V2 model in theory and technically, there is no issue or error. But it appears that the actual HL7 model should be integrated with EMR. And from this paper, it was not the scope of integrating with a real EMR. After this, a recommendation of research is needed in the follow-up to ensure that from it needs to be secure interoperability. In addition, later research can be more focused on the cloud-based EMR. As cloud-based EMR is expanding worldwide. Currently, most of the EMR companies install their server on-premises, but soon, more cloud-based EMR install.

HL7 communication can be different depending on hospitals policy. Currently, many EMR companies provide cloud service to hospitals. Which is this behavioral health depression specific HL7 communication need to be modified from on-premise version.

연세대학교
YONSEI UNIVERSITY

Recommendation of HL7 version 2.4 and 2.5 used for the model. As version 2.6 or higher can be used but as 2.6 or higher model is not world-widely use. Most of the HL7 communication is transmitted via HL7 version 2.4 or 2.5

연세대학교
YONSEI UNIVERSITY

5.Conclusion

As HL7 is an international standard. The HL7 V2 Model of behavioral health depression specific Digital Therapeutics can be used internationally. From this thesis, behavioral health companies can use the model to develop their own system. Also, behavioral health information is very confidential, so it needs to be secure via HL7 communication.

연세대학교
YONSEI UNIVERSITY

References

[1] About Health Level Seven International | HL7 International. (n.d.). Retrieved June 12, 2025, from https://www.hl7.org/about/index.cfm?ref=nav

[2] Eluru, M., Mendoza, D. H., Wong, A., Jafari, M., Todd, M., Bayless, P., Chern, D., Eldredge, C., Fonseca, R., Franco-Fuquen, P., Garcia-Robledo, J. E., Gifford, B. G., Hans, R., Moreno-Cortes, E. F., Perumbeti, A., Vargas-Cely, F. S., Zhao, L., & Grando, M. A. (2023). Physicians' Perspectives on HL7 Information Policy Sensitive Value Set: A Validation Study through Health Concept Categorization. Healthcare, 11(21), 2845. https://doi.org/10.3390/healthcare11212845

[3] Specification for the HL7 Lab Data Interface Oracle ® Health Sciences LabPas Release 3.1. (n.d.). Retrieved June 2, 2025, from https://docs.oracle.com/cd/E62060_01/doc.314/E48677.pdf

[4] MLLP V2 Content Exchange Model (Working with TCP/IP HL7 Collaborations). (n.d.). Retrieved June 2, 2025, from https://docs.oracle.com/cd/E19509-01/820-5508/ggywd/index.html

[5] Rajeev, D., Staes, C. J., Evans, R. S., Mottice, S., Rolfs, R., Samore, M. H., Whitney, J., Kurzban, R., & Huff, S. M. (2010). Development of an electronic public health case report using HL7 v2.5 to meet public health needs. Journal of the American Medical Informatics Association, 17(1), 34–41. https://doi.org/10.1197/jamia.M3299

연세대학교
YONSEI UNIVERSITY

Abstract in Korean

정신건강의학과 특화 우울증 디지털 치료제 HL7 V2 표준 제안 모델

본 논문은 HL7 프로토콜을 통하여 의료 데이터 전송을 EMR (Elctronic Medical Record) 와 디지털 치료제 사이에서 상호운용성 및 안전하게 전송하는 방법을 서술하고 있습니다. 이를 위해 HL7 V2을 사용하며 해당 모델 개발 시간을 단축한 표준을 제공합니다. HL7 버전 2.4 또는 2.5 모델에 사용할 수 있습니다. 해당 HL7 모델중 EMR과 통신하려면 ADT, ORM, ORU 메시지를 사용하는 것이 필수입니다. HL7 메시지내의 내용은 정신건강의학과 특화 디지털 치료제 인 "CHEEU. Forest N"에서 데이터를 수집하여 메시지에 어떤 데이터를 포함할지 정의하는 필드를 정의하였습니다.

핵심되는 말 : EMR, HL7, ADT, ORM, ORU, CHEEU. Forest N, 디지털 치료제, 상호운용성