HL7 Conformance Profile Development for National Messaging Standards

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university.

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Summary

Communication between the multitudes of heterogeneous proprietary information systems used in the delivery of healthcare is crucial to delivering quality of care and efficacy of treatments. Achieving seamless communication between these proprietary Information and Communication Technology (ICT) systems in the health sector presents a serious challenge and a standardised approach is essential. Standards on their own however are not enough and it is critical that communicated information conforms to the standard so that conformant systems can understand the information. However measuring conformance to the HL7 version 2 set of standards, the most widely implemented standard used for healthcare communication, has historically been impossible.

To address the shortcomings with the standard the HL7 organisation developed the concept of Conformance Message Profiles which provides the ability to measure conformance to the standard. The HL7 standard provides the specific rules for the creation of the message profiles but does not provide a complete process on how to build and test these profiles or a process for conformance testing.

The aim of this research project is to utilise the conformance profile approach to provide the ability to measure conformance to national messaging standards that are based on the HL7 version 2 standard. To achieve this, a process for the creation of conformance message profiles for use with national messaging standards was developed in conjunction with a message validation and reporting framework. These were then evaluated by applying these processes to a national messaging standard called the General Practice Messaging Standard (GPMS).

The main findings of this research demonstrate that a viable process has been developed for the building and testing of conformance message profiles. This process is capable of producing the required and varied range of profiles defined within a national messaging standard. It is robust, scalable and includes sufficient safeguards to deal with any inaccuracies that may have been introduced. This research has also shown that the profiles allow for message validation to take place. The message validation and testing framework has demonstrated that the profiles provide reliable and accurate violations against the standard.

By streamlining the development of conformance message profiles and providing the capabilities to perform message validation against a national standard, the process of implementing that standard at a national level can be begin.

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Abbreviations

ADT	- Admission, Discharge, Transfer
AHML	- Australian Healthcare Messaging Laboratory
AIRA	– American Immunization Registry Association
ANSI	– American National Standards Institute
CDA	– Clinical Document Architecture
CDC	– Centers for Disease Control and Prevention, United States
EDIFACT	– Electronic Data Interchange for Administration, Commerce and Transport
EHR	– Electronic Health Record
GP	– General Practitioner
GPMS	– General Practice Messaging Standard
GUI	- Graphical User Interface
HAPI	– HL7 Application Programming Interface
HeBE	– Health Board Executive
HIMSS	– Healthcare Information Management Systems Society
HIQA	– Health Information and Quality Authority
HITSP	– Health Information Technology Standards Panel
HL7	– Health Level 7
HSE	– Health Service Executive
ICT	– Information and Communication Technology
IHE	– Integrating the Healthcare Enterprise
ISO	– International Organisation for Standardisation
MWB	– Messaging Workbench
NAACCR	– North American Association of Central Cancer Registries
NHS	– National Health Service, UK
NIST	– National Institute of Standards and Technology, United States
NPCR	– National Programme for Cancer Registries, United States
NPfIT	– National Programme for IT, UK

OSI – Open Systems Interconnect

PCRS – Primary Care Reimbursement Scheme

RIM – Reference Information Model

SIG – Special Interest Group

UML – Unified Modelling Language

W3C – World Wide Web Consortium

XML – Extensible Markup Language

Chapter 1. Introduction

1.1 Overview

Healthcare is an information-intensive and extremely complex environment [1]. Often healthcare delivery can comprise of many healthcare institutions, usually independent of each other, equipped with multiple proprietary systems from separate vendors. These systems are used to deal with the widely varying information needs depending on the healthcare services provided by the institutions [2], information which can typically be in varying formats. Communication between these varying systems is key to delivering quality of care and efficacy of treatments at the point of care [3]. However, this communication or interoperability of ICT systems in the health sector is a serious challenge [4].

The electronic communication of patient and clinical information between systems is referred to as electronic health messaging. Messages can vary from admitting a patient to requesting laboratory results for blood tests. To enable the safe, secure and reliable exchange of messages a standardized approach is essential. Standards provide the specifications which are necessary for systems to communicate meaningfully with each other [4]. The most widely implemented messaging standard in the world is the Health Level 7 (HL7) version 2 standard [5] and is used in over 90% of all US hospitals [6]. There are no official figures for HL7 version use in Ireland. However a recent review of Health Messaging Standards in Primary Care carried out by the Health Information Standards Committee shows that the HL7 version 2 of the standard is the predominant version used nationally [7].

Standards on their own however are not enough, it is essential that messages conform to the standard so that they can interoperate between conformant

systems [8]. Message validation increases the possibility of effective interoperability between applications sharing the same messages [9]. Until now it has been historically impossible to define or measure conformance to the HL7 v2.x standard in any meaningful way [10]. This is due to a number of reasons i.e. too much optionality and a lack of a common methodology within the standard. HL7 recognised these shortcomings from an early stage and developed the concept of Conformance Message Profiles. Conformance profiles define a set of precise constraints on standard HL7 messages and thus provide an unambiguous description of those messages. They specifically state what data will be allowed pass in a message and also the format of that data, both of which are measureable quantities [10]. This together with the XML representation of the profiles allows for message validation against the specific profiles [11]. The HL7 standard provides the specific rules for the creation of the message profiles yet does not provide a complete process on how to build and test these profiles, the tools to use or a process for message validation.

Therefore this dissertation seeks to contribute to the area of conformance testing by documenting the process of developing conformance message profiles and providing a framework for message validation. Evaluation of this work is achieved by applying these processes to a National Messaging Standard, developed by the Health Information and Quality Authority (HIQA), called the General Practice Messaging Standard. By streamlining the development of conformance message profiles and providing the capabilities to perform message validation against a national standard, the initial steps in the adoption of that standard at a national level can be achieved.

1.2 Research Objectives

The main purpose of this research project is to tackle the difficulties involved with measuring compliance to the HL7 version 2 messaging standards. From this perspective the objectives of this study are to:

- Provide an overview of Health Messaging, the HL7 v2.x standard and its associated issues, and the Conformance profile approach
- Develop a process for creating Conformance message profiles for application to national messaging standards and evaluate this process
- Develop a Message Validation and Reporting Framework and evaluate this process
- Explore the possibilities of adapting this framework to an online tool for Message Validation & Reporting

1.3 Methods

To address the objectives set out for this research project the following methods were used:

- The first objective was achieved by completing a thorough literature review concentrating on the HL7 v2.x standard, the main issues associated with the standard and the conformance profile approach which can be used to address some of these issues.
- To address the next two objectives a process was developed which allowed for the specification, creation and testing of conformance profiles that could be applied to national messaging standards and that would also allow message validation against these profiles.

- The development of the conformance message profile creation process and the message validation and reporting framework were both evaluated by applying these processes to a National Messaging Standard called the General Practice Messaging Standard (GPMS). The principal evaluation criteria will be that the process yields valid conformance message profiles. Message validation will be evaluated against the criteria specified in the GPMS for message conformance [12].
- Finally the possibilities for adopting these processes for use as an online tool were explored. While it was never envisaged that this research project would produce such a tool it was the intention to see if this was possible. However time constraints for finishing this dissertation meant that this final objective was not fully achieved.

1.4 Dissertation Structure

In order to communicate a full account of this research dissertation it was decided to structure the dissertation in the following way.

Chapter 2 introduces the topic of Health Messaging, the standards involved and the associated issues, some specifics of health messaging relating to Ireland, the conformance message profile approach and some state of the art applications of this approach worldwide.

Chapter 3 describes a process for the creation of conformance message profiles, the tools used and also a framework for the validation and reporting of message conformance.

Chapter 4, by way of evaluation, applies the processes developed in chapter 3 to a national messaging standard called the General Practice

Messaging Standard. This chapter also describes some of the issues raised by this application to a national standard and the limitations of the process.

Chapter 5 begins to explore the possibility of adapting this process for use as an online tool for message validation. Time constraints for completion of this dissertation meant that this final objective was not fully met. However this chapter reports on what the author was able to uncover in the time frame given.

Finally Chapter 6 contains conclusions, limitations and suggested future work resulting from this research process.

Chapter 2. Health Messaging

2.1 Introduction

The first objective of this research dissertation, specified in section 1.2, is to provide the reader with an overview of the topic of health messaging. This chapter aims to provide this with particular focus on what health messaging is, the requirement for standards in this field and an overview of the current messaging standards that are available. This chapter will also provide a detailed description of the messaging standard central to this dissertation, the HL7 version 2 messaging standard, its associated limitations and also its relevance to Ireland. Finally it provides a review of the Conformance Profile approach, a solution which helps alleviate some of the limitations of the HL7 version 2 standard and references some of the current international projects utilising this approach.

2.2 Health Messaging Overview

Healthcare is an information-intensive and extremely complex environment [1]. Often healthcare delivery can comprise of many healthcare institutions, usually independent of each other, equipped with multiple proprietary systems from separate vendors. These systems are used to deal with the widely varying information needs depending on the healthcare services provided by the institutions [2], information which can typically be in varying formats. Communication between these varying systems is key to delivering quality of care and efficacy of treatments at the point of care [3]. However, this communication or interoperability of ICT systems in the health sector is a serious challenge [4]. The electronic communication of patient and clinical information between systems is referred to as electronic health messaging. A message in this context is defined as "the atomic unit of data transferred between two

systems" [13]. Messages can vary from admitting a patient to requesting laboratory results for blood tests.

Considering the differences in data structure and storage that may exist between any two systems it is important that the structure and meaning of the data being exchanged is agreed upon and understood by both parties prior to the electronic exchange of that data. "Without a consistent way to denote messages, communication, interpretation and translation of that message would be time-consuming at best and totally erroneous at worst" [14]. In order to enable the safe, secure and reliable exchange of information between these systems a standardized approach is essential.

2.2.1 The need for Health Messaging Standards

Effective transfer of information between two systems is critical for ensuring that healthcare systems are reliable and standards based systems are essential to achieve this [15]. According to HIMSS (Healthcare Information and Management Systems Society) the definition of a standard is "a document established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context."[16]

2.2.2 The benefits of Standards

Figure 2-1 depicts 6 separate systems interconnecting within a healthcare environment. The star on the right hand side indicates one standard used to link the 6 systems instead of the 15 separate links required when no standard interface is agreed. To calculate the number of separate interfaces required to

link N number of systems, the formula $(N^2-N)/2$ is used [6,17].

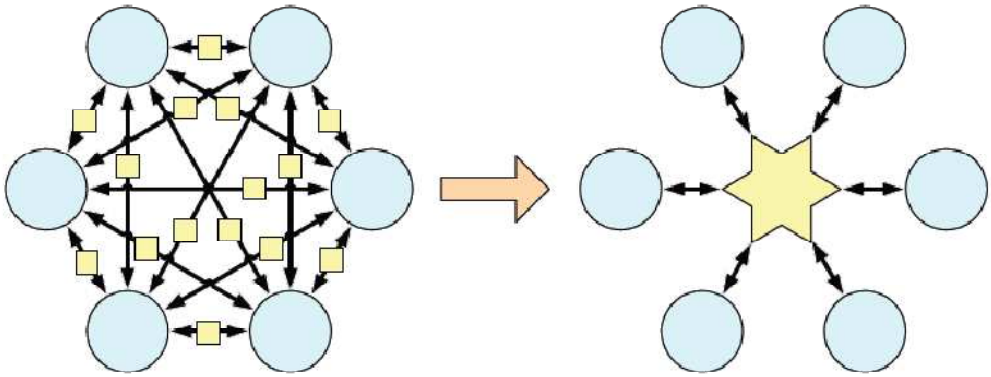

Figure 2-1 The benefits of one Standard [6]

The benefits become more apparent the more systems are involved. So for instance if there are 50 systems in one institution using non-standardized communication, then 1225 separate interfaces between these systems would be required. Not all of these systems will necessarily require separate interfaces but if we consider that large healthcare organizations may have many more systems than the number mentioned, interface management can still use considerable resources.

Pan et al. 2003[18] in their study "The Value of Health Care Information Exchange and Interoperability" found that the savings from implementing fully standardized interoperability measures could potentially generate savings of $77.8 billion annually. They also believed that these financial benefits, derived from avoided redundancies and saved administrative time, would be dwarfed by the improved patient safety, the reduction in medical errors and the better quality and continuity of care that standardized implementations bring.

2.3 Current Health Messaging Standards

2.3.1 Summary of Current Messaging Standards

There are a number of international standards for health messaging that have been developed and are in use today. The most common are HL7 V2.x, HL7 V3, CDA, EDIFACT and XML [7].

- **HL7 Version 2.x:** The HL7 v2.x messaging standard is the most widely used standard for the transfer of electronic data between healthcare applications. It is used in over 90% of all US hospitals [6] and the most widely implemented standard for healthcare information in the world [5]. There have been seven releases of the Version 2.x Standard to date. The HL7 Standard covers messages that exchange information in the general areas of:
  - Patient Demographics
  - Patient Charges and Accounting
  - Patient Insurance and Guarantor
  - Clinical Observations
  - Encounters including Registration, Admission, Discharge and Transfer
  - Orders for Clinical Service (Tests, Procedures, Pharmacy, Dietary and Supplies)
  - Observation Reporting including Test Results
  - The synchronization of Master Files between systems
  - Medical Records Document Management
  - Scheduling of Patient Appointments and Resources
  - Patient Referrals—Specifically messages for primary care referral

- Patient Care and problem-oriented records.

- **HL7 Version 3:** HL7 Version 3 was developed to compensate for the limitations of version 2, namely too much optionality, ambiguity and complicated encoding rules. Version 3 is not a replacement for version 2, it is an alternative specification with enhanced features [19]. Version 3 is a model-driven methodology based on Unified Modelling Language (UML) and uses the Reference Information Model (RIM), Data Type Specifications and Vocabulary Specifications to derive the information component of V3 message specifications. The model-based methodology ensures consistency in HL7 message specifications and enables mapping to and convergence with other healthcare standards [19].

- **HL7 Clinical Document Architecture (CDA):** The Clinical Document Architecture (CDA) provides an exchange model for clinical documents, where clinical documents are defined as historical, human readable healthcare records [7]. Examples would include discharge summaries and progress notes and brings the healthcare industry closer to the realisation of an electronic health record [5]. CDA combines the use of XML (Extensible Markup Language), the HL7 RIM and coded vocabularies which allow for documents to be both machine-readable and human-readable [5,7]. HL7 CDA is the most widely used application of HL7 version 3 [7]. Some countries are now adopting the HL7 version 3 standards for use with national projects. All new messages developed by the Canadian Health Infoway for their pan-Canadian

electronic health information systems will use HL7 V3 or CDA release 2 [28]. The National Programme for IT (NPfIT) currently being rolled out in the UK's National Health Service (NHS) have also adopted HL7 Version 3 as the standard used for messaging. The NHS is currently the global leader in the implementation of HL7 V3 messaging [29].

- **EDIFACT:** EDIFACT is the International standard for the *Electronic Data Interchange for Administration, Commerce, and Transport* developed under the United Nations. It is a set of internationally agreed standards, directories and guidelines for the electronic interchange of structured data, and in particular that related to trade in goods and services between independent, computerized information systems [25]. A number of countries have adopted EDIFACT standards for health messaging. These include Denmark, who adopted EDIFACT in 1994 as part of their national messaging programme, and the UK's National Health Service (NHS) use EDIFACT for the transfer of electronic pathology results between laboratories and GP systems [7].

- **XML:** XML stands for Extensible Markup Language and is a simple text based format for representing structured information. It is developed by the World Wide Web Consortium (W3C), an international community who work together to develop web standards [26]. XML is one of the most widely-used formats for sharing structured information either between programs, between people, between computers and people, both locally and across networks [27]. HL7 have utilised the XML standard in their latest Version 3 and CDA standards. HL7 have also

developed encoding rules to allow for HL7 version 2.x messages to be translated into XML [5].

2.3.2 Detailed Review of HL7 Version 2.x Messaging Standard

This dissertation will primarily focus on the HL7 V2.x messaging standard therefore a detailed overview of the features of this standard are presented here.

2.3.2.1 History and Background

The HL7 v2.x messaging standard is the most widely used standard for the transfer of electronic data between healthcare applications. It is used in over 90% of all US hospitals [6] and the most widely implemented standard for healthcare information in the world [5]. HL7 stands for Health Level 7, the 7 refers to the seventh level of the International Organisation for Standardisation's (ISO) seven-layer communications model for Open System Interconnection (OSI). The seventh level of the OSI model is labelled the Application layer and this layer interfaces directly to and performs common application services for the application process.

HL7 was founded in 1987, with a common goal of simplifying the implementation of interfaces between computer applications from different vendors. It sets out to achieve this by providing standards for the exchange of data among healthcare applications. It is a non-profit organisation and an American National Standards Institute (ANSI) accredited standards developing organisation. HL7 currently has over 2,300 members, 500 of which represent 90% of the information systems vendors serving healthcare [5].

2.3.2.2 HL7 V2.x Definitions

- **Message**: A message is defined as the atomic unit of data transferred between systems. Each message is comprised of segments that are in a defined sequence and all messages have a message type that defines its purpose. For example, ADT (Admission/Discharge/Transfer) type messages cover patient administration messages. HL7 describes an abstract message syntax which defines the structure and content of each message.
- **Trigger Event:** The cause of a message is a real healthcare event which necessitates the movement of data between two systems e.g. admitting a patient or requesting a laboratory test. This real world event is called a Trigger Event. The HL7 standard is written from the point of view that an event in healthcare requires the need for data to be transferred between systems. Trigger events are identified by a unique three letter code known as an event type and are specific to a message type.
- **Segment:** A segment is defined as a logical group of fields in a defined sequence. Message segments may be required or optional. They can also occur only once in a message or they may repeat. Each segment is given a name, known as the Segment ID, and is identified by a unique three letter code. Segments can also be grouped together to form segment groups.
- **Field:** A field is defined as a string of characters. When fields are transmitted they are sent as character strings. Fields have specific attributes which the standard lists in a segment attribute table e.g. Table 2-2. These attributes include:

- *Position* (i.e. sequence within the segment)

Defined as the ordinal position of the data field within the segment. This information is provided in the segment attribute table in the column labelled **SEQ.**

- *Maximum Length*

Defined as the maximum number of characters that one occurrence of the data field may occupy. Listed in the column labelled **LEN** in the segment attribute table.

- *Data Type*

Provides restrictions on the content of the data field. Information is provided in the column labelled **DT**. In the HL7 version 2.4 of the standard there are 54 data types defined (section 2.9 of the standard) ranging from primitive data types (e.g. string) to complex data types (e.g. Extended Person Name XPN).

- *Optionality*

Defines whether the field is required, optional, or conditional in a segment. Information is provided in the column labelled **OPT**. The designations are:

R – Required, O – Optional, C – Conditional, X – Not Used, B – Backward Compatible.

- *Repetition*

Defines whether the field repeats or not. Information is provided in the column labelled **RP**/#. The designations are:

N or Blank – No Repetition, Y – Field may repeat, (integer) – field may repeat up to the integer number of times.

- *Table*

  The table attribute specifies the HL7 identifier for a set of coded values. Information is provided in the column labelled **TBL**#. HL7 defines table values in 3 ways:

  User-defined Tables: A set of values that are locally or site defined.

  HL7 Tables: A set of values defined and published by HL7.

  External Tables: A set of coded values defined and published by another standards organisation.

- *ID number*

  This is a small integer that uniquely identifies the data item throughout the Standard. Information is provided in the column labelled **ITEM #**.

- *Name*

  This is the descriptive name for the data item. Information is provided in the column labelled **ELEMENT NAME**. When the same name is used in more than one segment, it must have the same data type and semantic meaning in each segment as well as the same ID number.

- **Message Delimiters:** Message delimiters are special characters used when constructing a message. They denote the boundary between elements of the messages. The term element here refers to segments, fields, components and sub-components. The delimiters are the segment terminator, the field separator, the component separator, subcomponent separator, repetition separator and escape character. HL7 recommends the values shown in Table 2-1 for delimiters.

Table 2-1 HL7 Delimiter Values [13]

Delimiter	Suggested Value	Usage
Segment Terminator	<cr> (hex 0D)	Terminates a segment record. This value cannot be changed by implementers.
Field Separator	|	Separates two adjacent data fields within a segment. It also separates the segment ID from the first data field in each segment.
Component Separator	^	Separates adjacent components of data fields where allowed.
Subcomponent Separator	&	Separates adjacent subcomponents of data fields where allowed. If there are no subcomponents, this character may be omitted.
Repetition Separator	~	Separates multiple occurrences of a field where allowed.
Escape Character	\	Escape character for use with any field represented by an ST, TX or FT data type, or for use with the data (fourth) component of the ED data type. If no escape characters are used in a message, this character may be omitted. However, it must be present if subcomponents are used in the message.

2.3.2.3 Example Message Structure

The following example is used to illustrate the previous discussion. Consider the event, a patient has arrived at a hospital but is not assigned a bed. This event is described by the HL7 v2.4 standard as trigger event A04 – register a patient. The associated abstract message syntax (or structure) for this ADT_A04 message is defined as follows:

ADT^A04^ADT_A01	**ADT Message**	**HL7 Chapter**
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
[PD1]	Additional Demographics	3
[{ ROL }]	Role	12
[{ NK1 }]	Next of Kin / Associated Parties	3
PV1	Patient Visit	3
[PV2]	Patient Visit - Additional Info.	3
[{ ROL }]	Role	12
[{ DB1 }]	Disability Information	3
[{ OBX }]	Observation/Result	7
[{ AL1 }]	Allergy Information	3
[{ DG1 }]	Diagnosis Information	6
[DRG]	Diagnosis Related Group	6
[{		
PR1	Procedures	6
[{ ROL }]	Role	12
}]		
[{ GT1 }]	Guarantor	6
[{		
IN1	Insurance	6
[IN2]	Insurance Additional Info.	6
[{ IN3 }]	Insurance Additional Info - Cert.	6
[{ ROL }]	Role	12
}]		
[ACC]	Accident Information	6
[UB1]	Universal Bill Information	6
[UB2]	Universal Bill 92 Information	6
[PDA]	Patient Death and Autopsy	3

Figure 2-2 Abstract Message Syntax for HL7 ADT_A04 [13]

All HL7 v2.4 messages begin with the Message Header (MSH) segment. This segment defines the intent, source, destination and some of the specifics of the syntax of the message such as which delimiters are to be used throughout the message.

To further understand the message structure it is necessary to take a look at one of the segments, for example the PID or Patient Identification segment. This segment contains permanent patient identifying and demographic information that generally does not change. In version 2.4 this segment alone has 38 fields, only 2 of which are required fields. The HL7 Segment attribute table for this segment contains the following:

Table 2-2 HL7 Attribute Table – PID – Patient identification [13]

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O			00104	Set ID – PID
2	20	CX	B			00105	Patient ID
3	250	CX	R	Y		00106	Patient Identifier List
4	20	CX	B	Y		00107	Alternate Patient ID – PID
5	250	XPN	R	Y		00108	Patient Name
6	250	XPN	O	Y		00109	Mother's Maiden Name
7	26	TS	O			00110	Date/Time of Birth
8	1	IS	O		0001	00111	Administrative Sex
9	250	XPN	B	Y		00112	Patient Alias
10	250	CE	O	Y	0005	00113	Race
11	250	XAD	O	Y		00114	Patient Address
12	4	IS	B		0289	00115	County Code
13	250	XTN	O	Y		00116	Phone Number – Home
14	250	XTN	O	Y		00117	Phone Number – Business
15	250	CE	O		0296	00118	Primary Language
16	250	CE	O		0002	00119	Marital Status
17	250	CE	O		0006	00120	Religion
18	250	CX	O			00121	Patient Account Number
19	16	ST	B			00122	SSN Number – Patient
20	25	DLN	O			00123	Driver's License Number - Patient
21	250	CX	O	Y		00124	Mother's Identifier
22	250	CE	O	Y	0189	00125	Ethnic Group
23	250	ST	O			00126	Birth Place
24	1	ID	O		0136	00127	Multiple Birth Indicator
25	2	NM	O			00128	Birth Order
26	250	CE	O	Y	0171	00129	Citizenship
27	250	CE	O		0172	00130	Veterans Military Status
28	250	CE	B		0212	00739	Nationality
29	26	TS	O			00740	Patient Death Date and Time
30	1	ID	O		0136	00741	Patient Death Indicator

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
31	1	ID	O		0136	01535	Identity Unknown Indicator
32	20	IS	O	Y	0445	01536	Identity Reliability Code
33	26	TS	O			01537	Last Update Date/Time
34	40	HD	O			01538	Last Update Facility
35	250	CE	C		0446	01539	Species Code
36	250	CE	C		0447	01540	Breed Code
37	80	ST	O			01541	Strain
38	250	CE	O	2	0429	01542	Production Class Code

A closer investigation of one of these fields e.g. SEQ #5 – Patient Name, shows that this field has Data Type (DT) XPN. XPN stands for Extended Patient Name and is a complex data type as defined by the HL7 standard. This complex field is further broken down into its component parts and for those components that are also of a complex data type, their sub-components are also defined by the standard. The component/sub-component structure for this field is as follows:

PID-5 Patient name (XPN) 00108

Components:

<family name (FN)> ^ <given name (ST)> ^ <second and further given names or initials thereof (ST)> ^ <suffix (e.g., JR or III) (ST)> ^ <prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (IS)> ^ <name type code (ID) > ^ <name representation code (ID)> ^ <name context (CE)> ^ <name validity range (DR)> ^ <name assembly order (ID)>

Subcomponents of family name:

<family name (ST)> & <own family name prefix (ST)> & <own family name (ST)> & <family name prefix from partner/spouse (ST)> & <family name from partner/spouse (ST)>

This level of detail is required to capture the patient's name in one segment of one type of trigger event, showing just how detailed and extensive the HL7 standard is.

2.3.2.4 Example Message

An example of a message for the event A04 – register a patient, would look like this:

MSH|^~\&|HIS||WARD|||20091127141030||ADT^A04|MSG000001|P|2.4<CR>
EVN|A04|20091127135525<CR>
PID|||H000123||LYNCH^RAY^||19501026|M|||LB04^^TCD^DUBLIN2<CR>
PV1|1|O|O/R|||0010^TEST^^DR|||SUR||||ADM|A0|<CR>
OBX||ST|1010.1^BODY WEIGHT||62|kg|||||F|<CR>
OBX||ST|1010.1^HEIGHT||190|cm|||||F|<CR>

This can be translated as:

Patient Ray Lynch, Hospital ID H000123, date of birth 06 October 1950, was admitted for his first visit by Dr. Test (#0010) on 27th November 2009 at 14:10 for Surgery. The message was sent from the HIS system to the O/R system, on the same day as the registration took place but 15 minutes after the registration. The Patient was also weighed and measured.

2.3.3 Limitations of the HL7 v2.x standard

The HL7 standard, as it recognises itself, is not a complete systems integration solution. It was never intended, or indeed possible to be a "Plug and Play" system [13]. There exist a number of reasons for this.

- **Optionality:** Due to the complexity of healthcare delivery, ICT systems need to be able to deal with the large and varied array of business processes that exist within this environment. In an attempt to address this varied array of processes the HL7 standard tries to accommodate all

of them within the standard. This was essential to gain wide industry support but has lead to an enormously large standard with very many optional components [9].

- **No common methodology:** The HL7 version 2 Standard, by its own admission and also recognised by others, was developed in an ad hoc way [6, 30]. It provides no common methodology for developing messages or for establishing HL7 implementation requirements. There is a common saying which summarises these issues in relation to HL7 version 2 implementations i.e. "when you have seen one implementation of V2, you have seen one implementation; every one is different" [6].
- **Z Segments:** The HL7 standard provides the capability to add messages or portions of messages that are local to an institution. These local extensions are labelled Z Segments. The standard does not define these segments. Z-Segments can be placed anywhere in a message, with some message designers placing all Z-segments at the end of the message, while others place them adjacent to relevant information. There is no clearly defined structure for writing these Z segments but they can add another layer of complexity to an already complex setup, further hampering interoperability.
- **Multiple versions**: HL7 2.X is designed to be backward compatible. As new segments and fields are added they are marked as optional, so that older systems communicating with newer systems do not need to contain those elements. In theory, the version of HL7 2.X does not matter. However some occasions can arise where different versions cause problems. This is most often caused by one system requiring a message

element that did not exist in a previous version, even though HL7 defines it as optional.

- **Interoperability:** Although the HL7 standard is very specific about the message definitions there are still many ways to specify a given HL7 transaction. This can cause interoperability issues. Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged [6]. For example two systems could both be HL7 compliant but not interoperable due to the fact that the sending system supports 10 repetitions of a field while the receiving application might only support 5 [11].

2.4 National Messaging Standards

The requirement for the adoption of international messaging standards is clear. However it is usually necessary to customize these international standards for use at a national level [3]. This is important as an agreement can be reached in relation to any of the optional elements defined by the standard, thus minimizing local variations and reducing the likelihood of communication errors. It is also an important way to improve the use of messaging technology, thus leading to more effective exchange of information benefiting the quality and safety of patient care. There have been two main bodies involved in the development of national messaging standards for Ireland. The first project was coordinated by the Health Boards Executive (HeBE) messaging group which was founded in 2002 [7]. The latest project, the "General Practice Messaging Standard" was released by the Health Information and Quality Authority (HIQA) in March 2010 [20].

2.4.1 HeBE Messaging Group

The Health Board Executive (HeBE) was formed in 2002 as part of the government's eHealth initiative [12]. One of the long term aims of the HeBE messaging group was to create a single national messaging service [3]. To this end the group developed a number of standards using the HL7 V2.4 messaging standard and XML (Extensible Markup Language). Some examples of these standards are listed below.

- **HL7 Message Standards for Laboratory Results and Radiology Reports in Ireland**

  The final version (v1.5) of this standard was developed over a 10 month period in 2002/2003 and was released in August 2003. The main focus of this standard was the HL7 ORU_R01 Observational Report message used to transmit laboratory reports and also radiology results. The standard defined in detail the following message segments which were the minimum segments to be included in the ORU_R01 message, MSH (Message Header), PID (Patient Identification), PV1 (Patient Visit), OBR (Observation Request), OBX (Observation Result) and NTE (Notes and Comments). [21]

- **HL7 Message Standard for Out of Hours Coop Messages and Hospital Discharge Summary Messages in Ireland**

  This was the second in the series of standards developed by the HeBE messaging group and was released in December 2003. This standard focused on the HL7 REF_I12 Discharge Referral Message and its use in relation to hospital discharge summary messages i.e. when a patient is discharged from hospital, and out of hours coop messages i.e. when a patient is seen by a GP out of hours cooperative. Although both scenarios

use the same REF_I12 message syntax they use different segments of the message. This standard specified in detail the MSH, PRD (Provider Data), PID, DG1 (Diagnosis), PV1 and NTE segments for the hospital discharge summary, and the MSH, PRD, PID, OBR and OBX segments for the out of hours coop messages. [22]

- **HL7 Message Standard for Admission and Discharge Notification Messages in Ireland**

Released in January 2004 this was the third standard released by the group and focused on the Admission, Discharge and Transfer type messages (known as ADT) of the HL7 v2.4 standard. These types of messages provide for the transmission of new or updated patient demographic and visit information about patients. In particular this standard specified in detail two specific event types, the ADT_A01 and the ADT_A03.

The ADT_A01 event type, defined by HL7 for admitting patients, is used by HeBE for the Notification of Accident and Emergency department attendance. The standard defined in detail the segments MSH, EVN (Event), PID, PV1 and PV2 (Patient Visit – additional information). The ADT_A03 event is used to signal the end of a patients stay in a healthcare facility, so their status has changed to "discharged" and a discharge date is in place. It is different to the hospital discharge summary message REF_I12 already mentioned in that it contains no clinical information relating to the patients diagnosis or treatment, it only contains demographic information and admission and discharge details. The standard defines in detail the following segments MSH, EVN, PID and PV1.

The ADT_A03 message is also used to transmit the death notification message as this is also effectively a discharge notification. Within the death notification message, as well as containing the other segments already stated, the standard further defines the PID segment and includes the PDA (Patient Death and Autopsy) segment. [23]

- **Health Service Executive (HSE) Laboratory Order Message in HL7 XML (Health Level Seven Extensible Markup Language)**

This was one of the last in the series of standards to be released by the HeBE messaging group and was released in December 2005. At this time the HeBE messaging group became the HSE messaging group. The standard deals with the Laboratory Order Message OML_O21 and the acknowledgement of that Order, the ORL_O22 message. The standard specified in some detail the ORC (Common Order), OBR (Observation Request) and OBX (Observation Result) segments. The group recognized a couple of obstacles in the implementation of the Lab order message. The first issue was matching the patient who was the subject of the request with patients which may have already been registered on the laboratory information system or the hospital patient administration system. The second was agreeing test and test group codes and names, so that all parties recognised what tests are being ordered and reported. In the standard early adopters were asked to seek early peer review of their project with a view to adopting best practice and reducing project risks. [24]

The messaging group was dissolved in 2005 due to the reform of the health service. With this the development of messaging standards for Ireland also finished [3].

2.4.2 General Practice Messaging Standard

The Health Information and Quality Authority of Ireland (HIQA), recognized that the adoption of standards, particularly for General Practice, are critically important in "promoting the effective and consistent recording and sharing of information between GPs and third parties such as laboratories, radiology services, emergency departments and hospital consultants".[12]

HIQA, in keeping with its mandate under section 8 (1) (k) of the Health Act 2007, began developing this standard for messaging in General Practice in 2009. In creating the General Practice Messaging Standard (GPMS), HIQA convened a multidisciplinary working group consisting of clinical practice management experts, acute-care information specialists and message experts. The terms of reference for the group were:

- agree to adopt, adapt or develop a general practice messaging standard
- make recommendations on a mechanism for testing conformance to the standard
- make recommendations on a mechanism for amendments, version control, and timescale when the standard should be formally reviewed [20]

The aim of the GPMS is to prevent any misinterpretation of information and enable the adoption of a standardised system for messages to and from GP services in Ireland. The GPMS focuses on the structure and content of the electronic messages exchanged between GP, out-of-hour and secondary care systems. As we have seen in section 2.2, it is essential that both sender and

receiver agree on the structure and content of the electronic messages before effective exchange can take place.

The GPMS is based on the HL7 V2.4 standard and specifies detailed Message Segments, 20 in total, used to construct messages for 12 clinical scenarios. The segments defined are:

- The MSH segment (Message Header)
- The PID segment (Patient Identification)
- The EVN segment (Event)
- The PV1 segment (Event type / Patient visit)
- The PV2 segment (Event type additional information)
- The PRD segment (Provider Data)
- The DG1 segment (Diagnosis)
- The NTE segment (Notes and Comments)
- The OBR segment (Observation Request)
- The OBX segment (Observation Result)
- The PDA segment (Patient death and autopsy)
- The RGS segment (Resource group)
- The AIP segment (Appointment information – Personnel resources)
- The SCH segment (Scheduling activity information)
- The AIL segment (Appointment information – location resource)
- The ORC segment (Common Order)
- The RF1 segment (Referral information)
- The SAC segment (Specimen container detail)
- The MSA segment (Message Acknowledgement)
- The ERR segment (Message Error)

The clinical scenarios covered by the standard are as follows:

- Emergency department attendance
- Admission notification
- Administrative discharge
- Clinical discharge summary
- Death notification
- Cooperative discharge summary
- Outpatient department summary
- Waiting list notification
- Online referral and response
- Laboratory order
- Unsolicited laboratory result
- Unsolicited radiology result

An example of one of those clinical scenarios, the emergency department attendance message flow as specified in the GPMS [20], is outlined below.

- Emergency Department Attendance

  A person attends an emergency department and the attendance is recorded on the local hospital system. An electronic notification of the attendance may be sent to other systems. The message type used to capture this is the ADT_A01 message type. For the purpose of the GPMS standard the minimum emergency department attendance notification message must contain the following segments:

  MSH Message Header

  PID Patient Identification

ENV Event Segment

PV1 Event Type / Patient Visit - PV1.14 (Admit Source) & PV1.44 (Admit Date/Time) are the extra required elements necessary for this scenario.

PV2 Event Type/Additional information

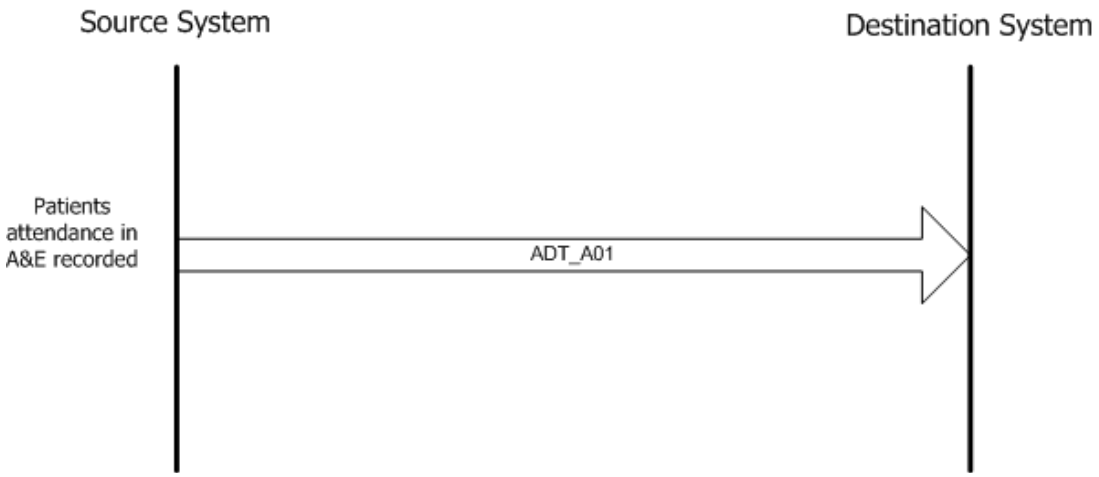

Figure 2-3 Interaction model for Emergency Department attendance

HIQA recognise that benefits of such a standard form of GP Messaging exist for both patient and GP alike. Some of the benefits for the patient include more efficient delivery of care, earlier diagnosis and reductions in adverse events. While the benefits for the GP include faster, more efficient and accurate transfer of information between acute services and GPs, reduced transcription errors and increased efficiencies [12].

HIQA understands that vendors will need time to implement the GPMS into their current systems. However, they foresee a situation where any new procurement of systems will have the standard incorporated into the requirements specifications for such systems [12].

2.5 Current Level of Health Messaging in Ireland

In a recent review of Standards in GP Messaging, carried out by the Health Information Standards Committee Feb 2009[7] it was found that current healthcare messaging in Ireland can be categorised into two distinct regions: Healthlink and non-Healthlink regions.

2.5.1 Healthlink

Healthlink is an electronic communications project, initiated in the Mater Hospital Dublin in 1995 and made a national project in 2003 [31]. This was due to the introduction of Healthlink Online which allows for the secure transfer of clinical information between hospitals and GPs (General Practitioners). The objective of the project is to implement a prototype healthcare communications network which focuses primarily on GP, acute hospital and agency relationships and the corresponding data exchange [31].

The current participant statistics as of 16th August 2010 show that 25 hospitals and 1,916 GPs in 865 practices with 1,491 practice staff currently avail of the Healthlink services [31].

Healthlink messages can be both Inbound i.e. from GP system to secondary care system and Outbound i.e. from the secondary care system to the GP system. Inbound messages are either a) referral type messages or b) laboratory orders. Outbound messages range from laboratory results to death notifications. All current message types from Healthlink are based on the HL7 2.4/XML representation of messages.

2.5.2 Non Healthlink Regions

2.5.2.1 Health Services Executive Regions

Four former health boards independently developed their own regional messaging services. These regions are outlined here:

- HSE North West Region: There are currently 2 hospitals providing 92 GPs with messaging services in this region. 2 message types are available, laboratory results and radiology reports. These messages are based on the HL7 v2.3.1 version of the standard [7].
- HSE North East Region: There are currently 2 hospitals providing 39 GP practices with messaging services. They provide laboratory results and GP out of hours Co-op reports. (The out of hours Co-op message is generated when a patient attends an out of hours clinic). These messages are based on the HL7 2.4 XML encoding format [7].
- HSE South East Region: There are currently 4 hospitals in this region providing 73 GP practices with only laboratory results messages. In addition to this, the Carlow Emergency Doctors on Call Ltd (CAREDOC) provide out of hours Co-op reports and acknowledgement messages to 51 GP practices in the region. All of these messages are based on the HL7 2.4 XML encoding format [7].
- HSE South Region: There are currently 3 hospitals in this region providing 150 GP practices with laboratory and radiology results messages. These messages are based on the HL7 2.4 XML encoding format [7].

2.5.2.2 Primary Care Reimbursement Scheme (PCRS)

Formerly known as the General Medical Services Payment Board, the role of this scheme is to process payments to GP's, dentists and other self-employed medical professional who provide free or reduced cost healthcare services to the public [7, 32]. Part of this scheme involves the Pharmacy Project which allows the electronic submission of claims for re-imbursement. This system uses a bespoke messaging standard based on the HL7 Clinical Document Architecture (CDA) Release 1. Figures from 2008 suggest that approximately 450 pharmacies avail of this messaging service [3].

2.6 Conformance

2.6.1 Introduction

Standards, no matter how detailed and comprehensive they are, are on their own not enough to ensure that information sharing between systems will take place. Conformance and interoperability testing will also be required [15]. Conformance has been defined as the fulfilment of a product, process, or service of specified requirements [15]. Conformance testing then evaluates an implementation's adherence to a particular standard [15]. For HL7 systems it is essential that messages conform to the standard so that they can interoperate between conformant systems [8]. Message validation increases the possibility of effective interoperability between applications sharing the same messages [9]. However it has been historically impossible to define or measure conformance to the HL7 v2.x standard in any meaningful way [10]. This is due to the shortcomings of the standard as highlighted in section 2.3.3, namely too much

optionality, no common methodology, multiple versions of the standard and the interoperability issues which can also exist.

An example of the difficulties experienced in measuring conformance is highlighted by the work of the HeBE messaging group. The group carried out comparison work on sites which had implemented some of their standards, specifically the "HL7 Messages Standards for Laboratory Results and Radiology Reports in Ireland". For the laboratory aspect of the standard, messages from 5 separate sites were compared against the standard and for the radiology reports section, messages from 3 sites which had implemented the standard were compared [33, 34]. These files were first checked using an XML editor to make sure they were valid and well formed according to XML encoding rules. Validation of the messages was carried out against the HL7 Message Schemas of March 2003, another form of XML validation. Comparison to the standard however was a completely manual process. Each field of each message was compared against those specified in the standard and any discrepancies from the standard were recorded in a specific Excel file. These discrepancies were then reported back to the relevant sites so the messages could be updated [33, 34]. No indication was given in either report as to how long this process took, however it demonstrates just how difficult a task it is to measure conformance to the HL7 version 2 standard.

2.6.2 Conformance Profile Approach

To address the shortcomings with HL7 V2.x, discussed in section 2.3.3, the HL7 organisation through the work of the HL7 Conformance Special Interest Group (SIG) developed the concept of Conformance Message Profiles [9]. This approach was formally introduced into version 2.5 of the HL7 Standard [10]. Conformance

Message Profiles, more commonly known as Message profiles, define processing rules and provide an unambiguous description of HL7 messages. This is achieved by defining exactly what data will be sent in a message (therefore removing any ambiguity), and also the format in which this data will be sent [10].

An HL7 message profile is defined as "an unambiguous specification of one or more standard HL7 messages that have been analysed for a particular use case. It prescribes a set of precise constraints upon one or more standard HL7 messages [10]". The profile defines the static content and structure of the message and also the dynamic interaction, which covers the communication of the message between the sender system and the receiver system.

Each profile must consist of the following components [10]:

- ***Use Case Analysis:*** This documents the scope and requirements for an HL7 message profile or set of message profiles.
- ***Dynamic Definition:*** This is an interaction specification for a conversation between two or more systems. It is used to illustrate the sequence of trigger events, the resulting message flows and the required acknowledgements between the systems.
- ***Static Definition:*** This is as an exhaustive specification for a single message. It is based on the HL7 standard for message structure and provides definition at the message, segment and field level. The static definition also only identifies those specific elements of a standard HL7 message that will be used in the message exchange.

A detailed description of conformance message profiles is provided in section 2.12 HL7 version 2.5 standard [10].

2.6.3 Benefits of Conformance Profiles

The conformance profile approach provides a number of benefits. The most important of which provides a standard way to document message specifications. This consistent documentation eliminates the potential ambiguities allowed by the standard, it enforces agreement between trading partners and provides a better way to conduct and document interface negotiations. Another consequence of the consistency of documentation is that it allows for profiles to be registered, thus encouraging reusability and comparisons of specifications.

The fact that message profiles now specify what data will be passed in a message, the format in which this data will be passed and also the acknowledgement responsibilities of the sender and the receiver, provides for measurable quantities within the specification. This together with the XML representation of the profiles allows for message validation against the specific profiles [11]. The added value of message validation increases the possibility of effective interoperability between applications sharing the same messages [9].

2.6.4 International Applications of Conformance Profiles

There have been a few applications of the HL7 conformance profile approach worldwide and below is an introduction to some of them.

2.6.4.1 Australian Healthcare Messaging Laboratory (AHML) [35]

The Australian Healthcare Messaging Laboratory (AHML) is a testing service for HL7 messages to ensure conformance with existing and newly emerging local and international messaging standards. It is operated by the Collaborative Centre for eHealth (CCeH), University of Ballarat in Victoria. It is a not-for-profit

organisation whose mission is to promote and facilitate the adoption of international messaging standards. AHML's testing system uses profiles for the testing of messages against both Australian and International messaging standards. Testing of HL7 messages is carried out against the International HL7 V2.3.1 Standard, the Australian AS4700.2 (Pathology Orders and Results), AS4700.6 (Referral and Discharge Summary) and AS4700.7 (Diagnostic Imaging Orders & Results) standards. AHML also provides a Compliance and Certification service which provides assurance that an organisation's messages are conformant to the required standards.

2.6.4.2 Integrating the Healthcare Enterprise (IHE) [36]

Integrating the Healthcare Enterprise is an initiative by industry and healthcare professionals with the aim of improving the way healthcare information is shared between computer systems. IHE International has over 370 member organisations ranging from Healthcare Professional Associations, Healthcare Provider organisations and Healthcare IT companies. IHE provide Profiles which offer precise definitions on how standards, particularly HL7 and DICOM, can be implemented to meet specific clinical needs. Profiles are published for the following clinical domains:

- Anatomic Pathology
- Cardiology
- Eye Care
- IT Infrastructure
- Laboratory
- Patient Care Coordination
- Patient Care Devices

- Radiation Oncology
- Radiology

IHE Profiles define the actors, the transactions and detailed specifications required to address the clinical use case with reference to established standards like HL7. The HL7 content of these IHE profiles are conformance profiles. The profiles are then compiled into IHE Technical Framework documents, which are the detailed technical guides and act as the implementation guides for vendors. Vendors claiming compliance to IHE profiles are then rigorously tested by IHE experts at regular events called Connectathons, where the aim is to promote the adoption of standards-based interoperability by vendors and users. At the 11th Annual IHE North America Connectathon, held in January 2010 in Chicago 3,500 successful tests of IHE Integration profiles were carried out on more than 150 systems from over 100 participating organizations [36].

2.6.4.3 United States

- **HL7 Version 2.5.1 Implementation Guide: Immunization Messaging [37]**

  This implementation guide is a collaborative effort between the American Immunization Registry Association (AIRA) and the Centers for Disease Control and Prevention (CDC). The aim is to improve inter-system communication of immunization records in the US. The guide specifies the use cases, message transactions, data types, message segments and message details required to deal with immunisation records.

- **HL7 Version 2.5.1 Implementation Guide: Orders and Observations; Interoperable Laboratory Result Reporting to EHR (US REALM) Release 1** [38]

This specification developed as a response by HL7 to a request from the U.S. Health Information Technology Standards Panel (HITSP) for a standard laboratory message to meet the requirements of its use case. The guide contains the necessary specifications for reporting laboratory results, via the HL7 ORU_RO1 message, to Electronic Health Record (EHR) systems in the U.S.

- **The HL7 Version 2.5.1 Implementation Guide: Electronic Laboratory Reporting to Public Health (US Realm), Release 1** [39]

This guide is the public health version of the "Interoperable Laboratory Result Reporting to EHR" implementation guide just mentioned. It contains the necessary specification for reporting laboratory results, also using the ORU_R01 message, to local, state, territorial and federal health agencies in the US.

- **Standards for Cancer Registries Volume V - Pathology Laboratory Electronic Reporting** [40]

This document was developed by the Pathology Data Work Group of the North American Association of Central Cancer Registries (NAACCR), to provide standards and guidelines on the transmission of cancer information from pathology laboratories to cancer registries. In particular it contains specifications for sending reportable cancers and benign/borderline intracranial and CNS tumours to appropriate hospital, state, and territorial

cancer registries using HL7 v2.5.1 messages. It focuses on the HL7 ORU_R01 message and specifies each data field required in the ORU message, examples of complete messages, and recommended table values.

2.7 Summary

This chapter has provided an introduction to the topic of health messaging. It has demonstrated that there is a clear requirement for standards in relation to health messaging and has provided an overview of some of the standards currently in use internationally. In particular it has concentrated on the most widely used version of these standards, namely the HL7 version 2 standard and its application in an Irish context.

The HL7 v2 standard is an extensive and comprehensive standard however it does have major drawbacks which have also been highlighted. HL7 recognised these shortcomings from an early stage and developed the concept of Conformance Message Profiles in an effort to deal with some of these issues. In doing so they have provided the specific rules for the creation of these message profiles. However they do not provide a complete process on how to build and test these profiles, the tools to use or a process for message validation. The aim of this research project is to contribute to the area of conformance testing by a) developing conformance message profiles for use with national messaging standards, and providing a framework for message validation and b) evaluating this work with the application of these processes to the General Practice Messaging Standard, as an example of a national messaging standard.

Chapter 3. Developing Conformance Profiles for National Messaging Standards

3.1 Introduction

To address the objectives set out in section 1.2 this chapter details a process developed to specify, create and test conformance profiles that could be applied to national messaging standards and that would also allow message validation against these profiles.

In developing a process for the creation of conformance message profiles, a full review of the available literature on this subject was undertaken. The aim was to identify a) previous attempts at producing a conformance profile development approach to implement national messaging standards and b) relevant steps that may need to be included in any such process. A number of observations became apparent from an early stage in the literature review.

Firstly no fully documented procedure on profile creation from specification through to Implementation could be found. The HL7 Standard provides documentation which specifies the complete content and structure that profiles should take [10]. However the standard does not provide a complete guide on how to build message profiles, the tools required for their creation or any facilities for profile testing [10]. The closest approach found came from the National Program for Cancer Registries (NPCR) in the US, in conjunction with the Centres for Disease Control and Prevention (CDC). They are funding a Messaging Workbench project for Conformance Testing [41]. The aim of the project is to develop a conformance testing tool that cancer registries and laboratories can use to ensure their anatomical pathology reports conform to the message specification contained within the (North American Association of Central Cancer Registries) *NAACCR Volume V Standard for Pathology Laboratory Electronic*

Reporting Guide [40]. Phase 2 of this project hopes to develop a how to guide for using their profile for validation testing. To date this has not been completed.

Secondly, although the Conformance profile approach was originally introduced with HL7 v2.5 version of the protocol in July 2003 [10] there is still very limited published material available on this subject. For example, a simple search in both the PubMed and IEEE Electronic Library for "HL7 Conformance Profile" revealed zero articles in PubMed [42] and 1 article in the IEEE library [43]. The article returned in the IEEE library search relates to the HL7 Version 3 standard [8] not version 2.x which was required for this research project. Another indicator of the lack of published material is the limited number of published HL7 version 2.x conformance profiles. Part of the goal of the conformance profile approach was that profiles could be shared and reused [10]. To this end HL7 provide the facility to register profiles for this purpose called the HL7 v2 Global Message Profile Library [44]. However, only 8 profiles are currently registered on this site, 3 of which were published by the HL7 Conformance SIG for the purpose of providing profile examples.

Due to the lack of information available which details how to create message conformance profiles and perform message validation this chapter concentrates on a) sourcing the required tools for developing conformance profiles, b) using these tools to develop a process that will streamline the creation of conformance message profiles for specific application to national messaging standards and c) developing a Message Validation and Reporting Framework. This is in keeping with the research objectives that were set out in section 1.2 of this dissertation.

3.2 Conformance Profile Tools

A fundamental element in developing a process to build conformance profiles was to source the tools that could be used to build and test the required conformance profiles. The primary tool available, which was apparent from the literature, was the Messaging Workbench [9, 10, 45]. It is a Windows based Graphical User Interface (GUI) tool which can be used for profile construction, reporting, validation and test message generation [9], ideal for this research project. There are commercial tools available, such as HL7 Connect [53], which will provide profile validation and message validation but they do not provide the ability to create conformance profiles.

3.2.1 Messaging WorkBench (MWB)

Messaging Workbench is a freeware tool developed by Peter Rontey of the Veterans Hospital Association's Office of Information Messaging and Interface Services in the US, in coordination with the HL7 Conformance Special Interest Group [45].

There are a number of versions of this tool available on the HL7 Conformance SIG namely version 1.6.7.1 and 1.6.8. It was decided to use version 1.6.7.1 for this research project for a number of reasons. Firstly, problems installing and getting version 1.6.8 of the tool to work without errors were encountered. Secondly, there are a number of international projects which use version 1.6.7.1 for their respective projects. HL7 Canada promotes this version of the tool on their HL7 Version 2 Software tools section [46]. The North American Association of Cancer Registries (NAACCR) has also used this version to develop their profile to

aid in the implementation of their electronic pathology reporting specifications [41].

MWB version 1.6.7.1 incorporates all the HL7 v2.x versions up to and including v2.5.1. It holds these standards in the form of version specific libraries. This stems from the fact that each different version of the HL7 standard may contain new or revised segments, table elements and data types. Those library files that MWB employ are:

- Segment Library: This file contains the complete set of segment definitions that apply to the loaded HL7 standard
- Data Type Library: Contains the full set of data types as specified for the loaded HL7 standard
- Table Library: Contains the complete set of HL7 tables and any elements that may be specified for the loaded HL7 standard

These library files can be used to build message profiles for each of the abstract message types available within each specific version of the standard e.g. ADT_A01 or OML_O21 etc.

3.2.2 Using MWB for Creating Conformance Profiles

Essential to any message profile is the requirement that a full static definition of the required messages are in place prior to creating a message profile. The static definition will explicitly define [10]:

a) Segments, segment groups, fields and components usage rules

b) Cardinalities - minimum and maximum number of repetitions

c) Value sets and coding systems

Once this static definition is in place, MWB can then be used to create the required profiles. MWB allows the user to create message profiles from already preloaded HL7 v2.x version libraries. This involves the following:

1. Specifying the version of the standard you want to use (File -> Change Structure list). This will load the correct library files required for the chosen HL7 standard including the relevant Segment library, Table Reference library and the Data Type library.
2. Load the specific abstract message required for your needs (File -> Load Msg Structure). MWB will then load the complete abstract message structure, as defined by the standard, within its GUI allowing for customisation to a predefined static definition. Figure 3-1 shows these choices within MWB.

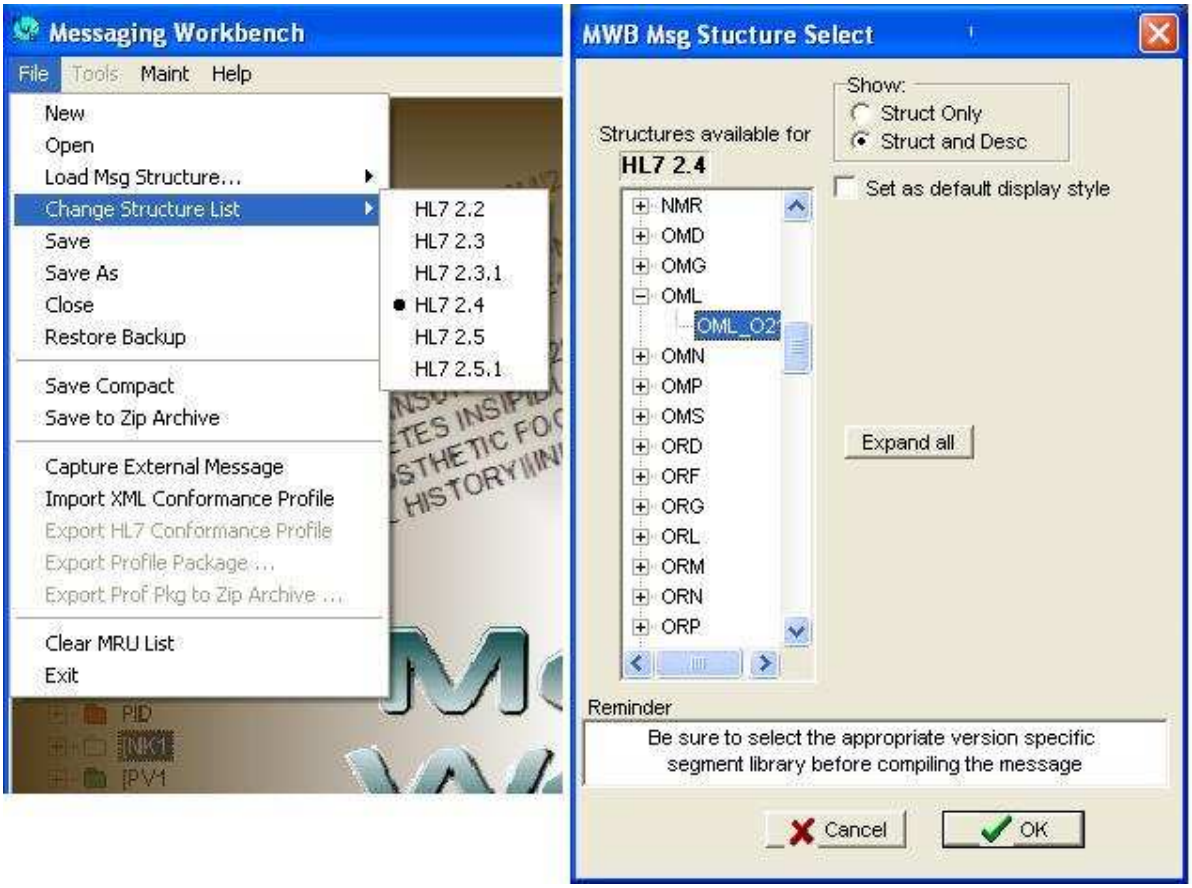

Figure 3-1 Creating Message Profiles from preloaded HL7 libraries in MWB

Customisation to a predefined static definition now becomes a manual process of going through each segment and using the GUI to edit the optionality, cardinality and data lengths to match the static definition.

3.3 Conformance Profile Creation Process for National Messaging Standards.

The process, outlined in section 3.2.2, is adequate if the requirement is only for one message profile to be created. However, the application of this process for the creation of message profiles for use with national messaging standards is not viable. Within any national messaging standard, it is possible to have defined multiple message profiles which cover many different aspects of the HL7 standard i.e. ADT, Order, and Referral. For example, the GPMS (discussed in section 2.4.2) defines a total of 20 segments, covering 12 clinical scenarios which will require a total of 22 message profiles to cover the abstract messages defined within the standard [20].

To manually create each profile using this process would be an exceedingly time consuming operation. It would also most likely lead to multiple input errors when specifying each of the profiles. A different approach was required to achieve the goal of developing a process for creating message profiles for use with National Messaging Standards.

MWB provides the capability to allow for the addition of customised library files. Therefore for any given message specification you can define one or more associated libraries e.g. segment libraries, table libraries or data type libraries. The main purpose of this feature as described by MWB is to allow developers to keep custom library definitions separate from standard libraries, but to bring

them together as needed [47]. The utilisation of this feature became the primary focus of this research into the development of a process for creating conformance profiles suitable for application to national messaging standards. What follows is a description of the process that was developed utilising the library function within MWB and the rationale behind each step of that process. Figure 3-2 provides a high level overview of the developed process.

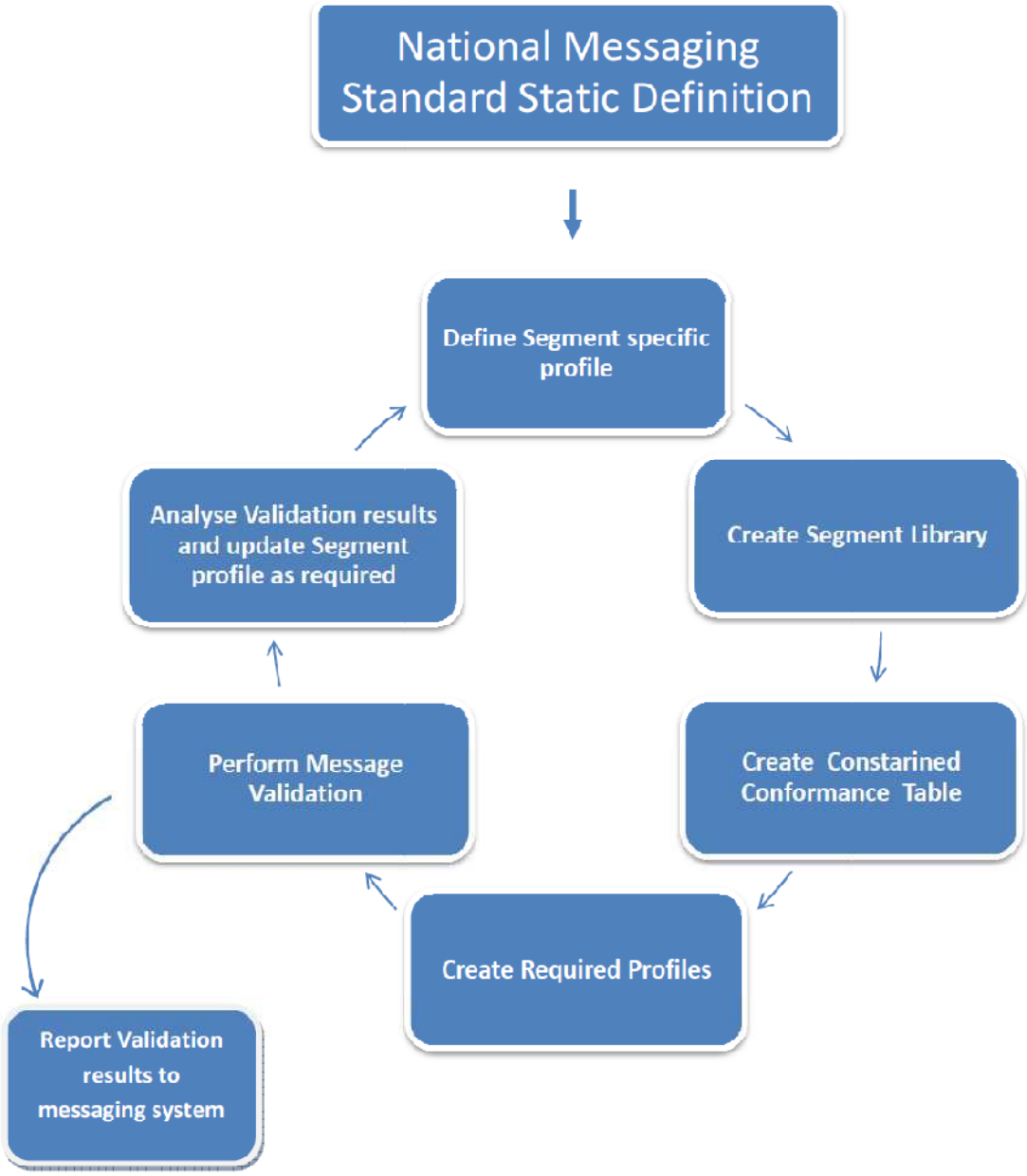

Figure 3-2 Message Profile Development Process

3.3.1 Define Segment Specific Profile

Rationale:

To facilitate the creation of a segment library specific to the desired static definition, the required segments first need to be defined in MWB. To achieve this it is necessary to specify the full set of required segments in one specific profile. Using this method all segments are located in a single profile file. Any updates or changes that need to be made to the segments can be done centrally to the segment profile and then recompiled to update the segment library. This allows for one central repository for all segments, making the tracking of updates and changes more manageable and keeping errors to a minimum. It also provides scalability; new segments can be added and configured to the profile as required. For instance if a national standard is to be expanded, the specific libraries can be updated from this single profile file. This segment profile is the most important file in the process.

Method:

- Create a new message specification in MWB paying particular attention to the following:
    - *Specification:* It is best to implement a naming convention for any of the profiles created. The Specification section should always include what the profile is for and a reference to the static definition or national standard that is being worked on. In this instance the profile is defining the Master segments used to create the segment library.
    - *Msg & Evt Type:* Normally these sections would contain one of the specific HL7 defined messages and event types e.g. ADT and A03

respectively. Since the Master segment message profile does not follow any specific HL7 defined abstract message structure, ZZZ designations should be used, referring to local variations.

- *HL7 Version:* Important for profile validation to include the correct HL7 version being used.
- *Structure:* This section will include all the segments that were found to be required by the static definition. By listing these segments in the "structure" section, it allows the compiler within MWB to create the profile with only these segments.
- *Spec Version:* In keeping with a system of version control, start with version v1.0. This should then be incremented for any subsequent changes.
- *Conformance Type:* Choose the conformance type that suits the requirements. Each conformance type places certain constraints on the optionality choices available for the profile.

- Compile the profile to populate the message tree view in MWB. This allows for the detailed specification of each of the segments defined. Depending on the number of segments and the level of detail that each segment is given, the level of manual input required can be vast. It is therefore important to ensure that the profile itself is accurate and follows your specification faithfully. There is a facility within MWB, under the Displays/Report Tab, which displays the message profile in a web page format. This allows for better comparison to your static definition to check for input errors that may have arisen when populating the profile.

Figure 3-3 shows how to define the required segment profile within MWB.

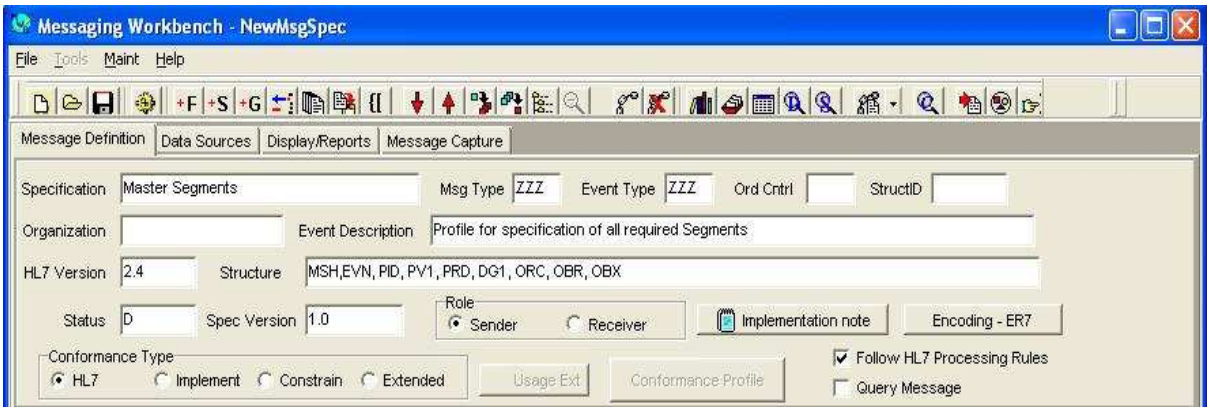

Figure 3-3 Segment Profile definitions within MWB

3.3.2 Create Segment Library

Rationale:

From the segment profile the segment library can now be created. This segment library will then become the main library file for building the required message profiles necessary for the static definition contained within the national messaging standard. This will ensure the required segments for the static definition will automatically be populated, no matter which abstract message syntax is used for the profile.

Method:

- Create a new library file by choosing the Maint -> Libraries -> New Library file from the menu bar paying attention to the following:
    - Specify which HL7 Standard version is used.
    - The Source specification should refer to the segment profile just created.
    - Specify the "Attached datatype file". Unless the static definition has specified new Data Types it is best to choose the default HL7

datatype library file that corresponds to the HL7 Standard version chosen.

- Compile the library to populate the "Constituent Segments" and save the library file. Again a clear naming convention should be followed ensuring that version control can be implemented.

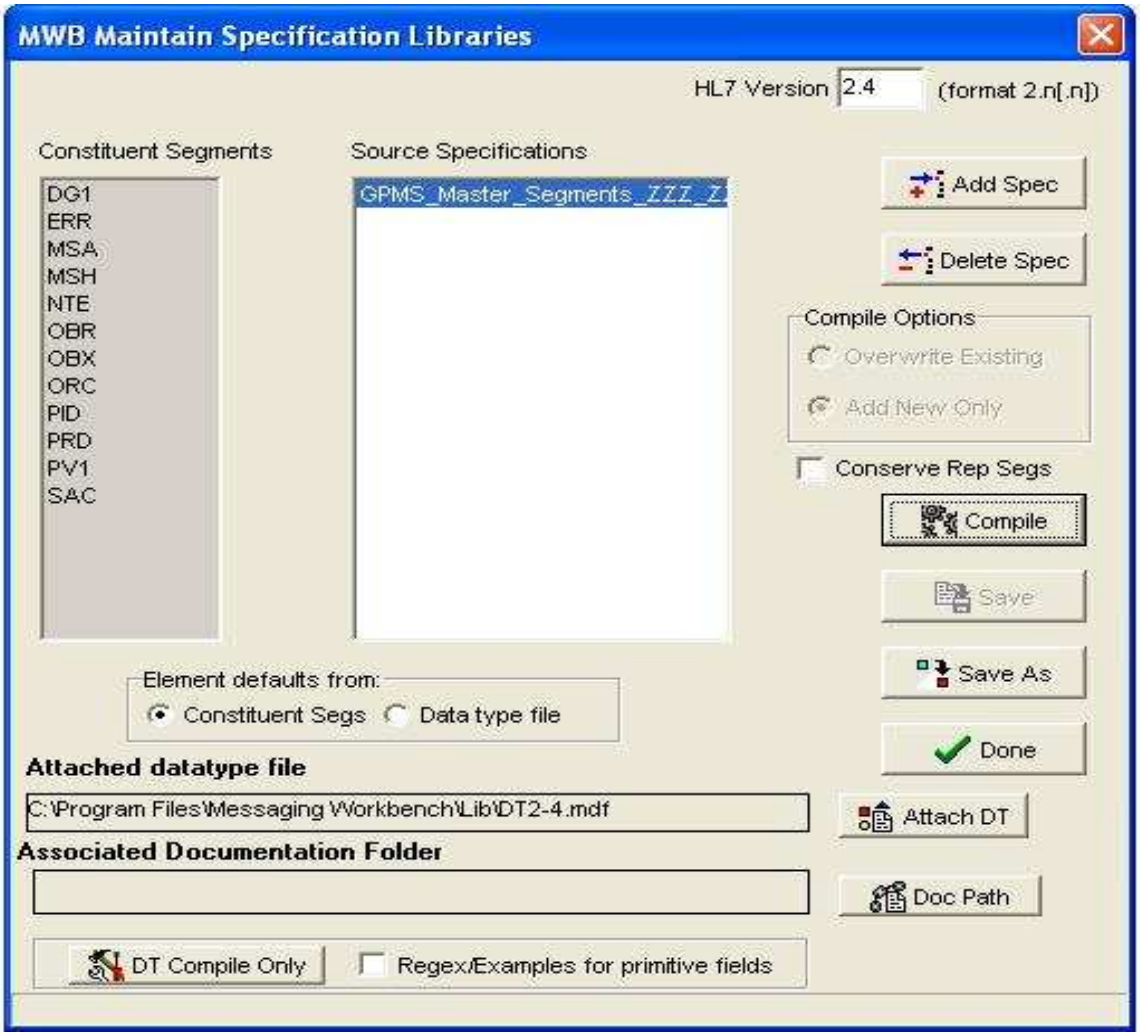

Figure 3-4 Creating a new library file within MWB

3.3.3 Create Conformance Table Library

Rationale:

The next step in the process involves creating a conformance table library. This is an important step as it allows only those tables and their associated elements that are relevant to your specific needs, to be populated in this table. Thus making the testing process easier as validation against all HL7 tables and table entries is no longer required.

The conformance table library allows for the following:

- The definition of Local table definitions and their associated values. These are specific only to the needs of the static definition and not defined by the HL7 standard. An example of Local table definitions is used in HIQA's GPMS [20]. HIQA use the HL7 User-defined Table 0362 – Sending facility, to define the coded values for all of the facilities in Ireland that could potentially send HL7 messages. These values are only relevant to the HIQA GPMS and no other messaging standard.
- The definition of a subset of HL7 defined tables. An example of this is the HL7 Table 0003. This table provides the coding values for all event types as defined by v2.4 of the standard. Section 2.17.2 of the v2.4 standard [13] displays the values of this table which extend over 8 pages. No project would ever require the use of all of these event types, so a much smaller sub set can be defined. This makes it easier in the testing process as validation is now against a discrete subset of values and not against all 8 pages of table entries for this table.

Method:

- Create the constrained table library using "Tools ->Create/edit Constrained Table Lib" function from the menu bar.
    - This function becomes available when the required segment profile is loaded. MWB will only populate the General Table Library section based on the tables that are referenced in the loaded profile, which for this section is the Master Segment profile.
    - Update the Localised Profile Table Library file (left hand side of Figure 3-5), using the General Table Library file (right hand side of Figure 3-5). New elements can also be added manually or in batch format.

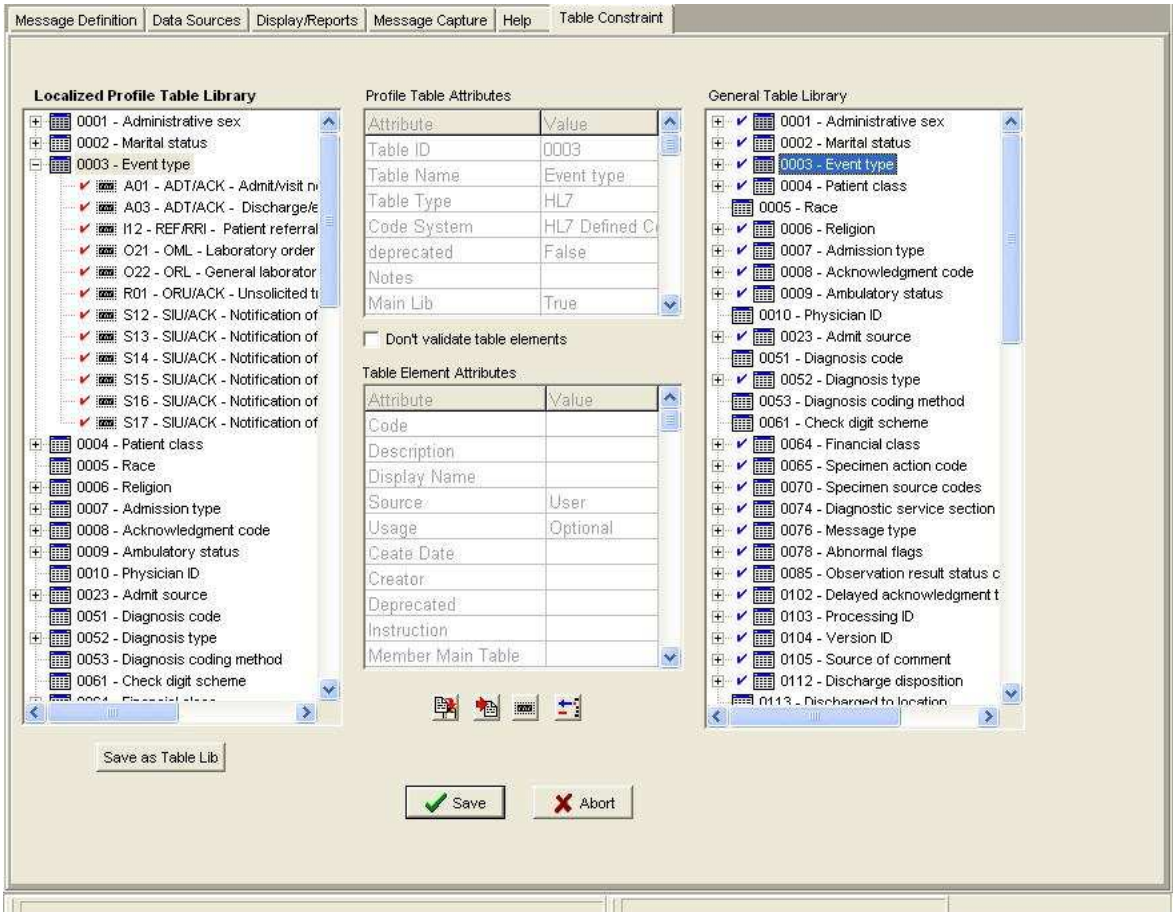

Figure 3-5 Constrained Table library creation.

- Save as Table library file, following a clear naming convention to ensure that version control can be implemented. The constrained table now becomes an integral part of the profile, and the main table library for all table library functions including table lookup.

3.3.4 Set Default Library Specifications

Rationale:

It is important once the specific library files (segment and table libraries) have been created that MWB uses these files for the creation of the required message profiles. Otherwise MWB will build profiles using the default standard HL7 libraries. All reference values that may be used in the created message profiles will be populated from the constrained table library, so they will only contain values that are explicitly required.

Method:

- Select the "Maint -> Options" menu in MWB. Under the General tab specify the libraries to be used by default e.g. Figure 3-6.

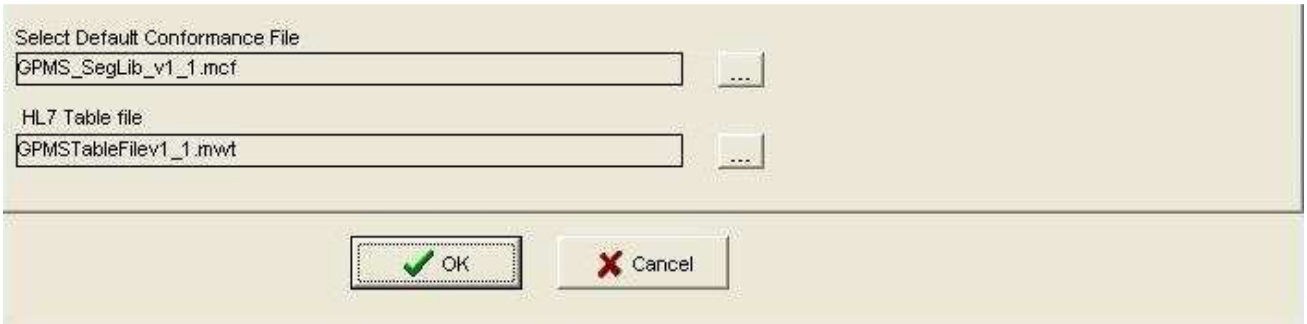

Figure 3-6 Setting Default libraries within MWB

3.3.5 Create Required Profiles

Rationale:

The final step of the creation process involves creating the required message profiles.

Method:

- Load any of the message structures defined by the particular HL7 standard using the File -> Load Msg Structure (Figure 3-1). However the following should be noted:
    - Before the profile is complied the Conformance Specifications must be chosen using "Maint -> Libraries -> Select Conformance Files" (Figure 3-7).

      This will ensure that any new message profiles will have the following characteristics:

      a) If the abstract message type chosen for the required profile has segments that are specified in the new segment library, this library will be used to define these segments.

      b) All other segments will be created from the default HL7 standard segment library.

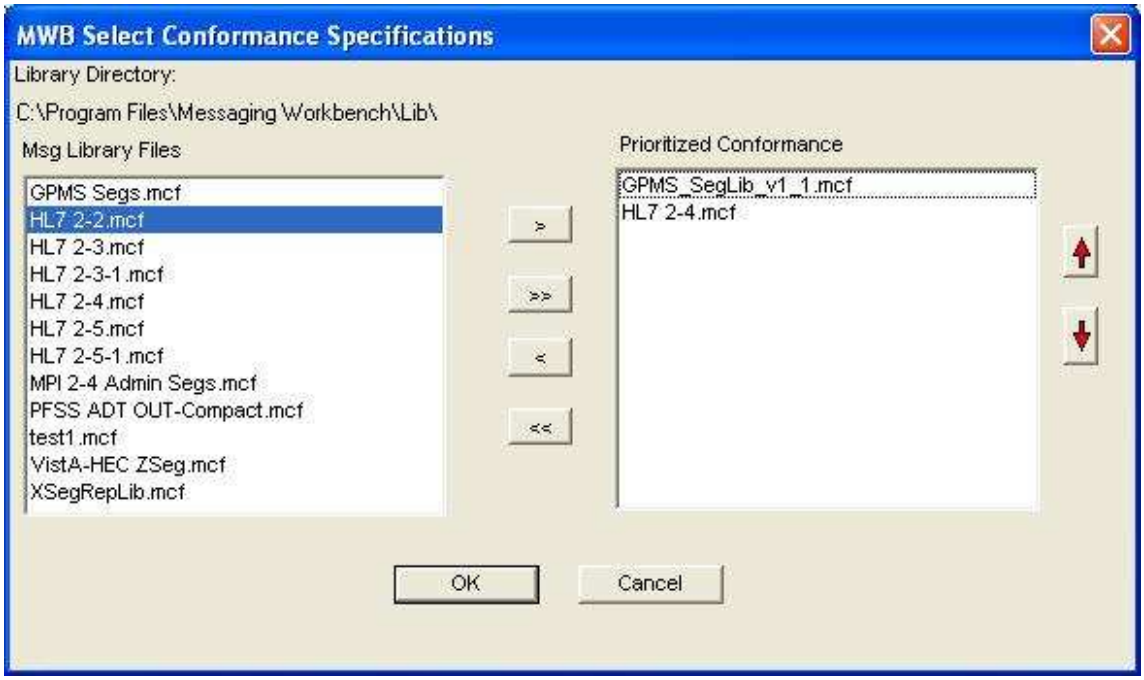

Figure 3-7 Selecting Conformance libraries

3.3.6 Validate Profiles

Rationale:

According to the HL7 standard a message profile will only be a valid HL7 message profile if it conforms to the constraints expressed in the Message Profile Schema [10]. It is therefore important to ensure that the profiles created are validated against the HL7 Message Profile Schema.

Method:

- Select the Display/Report Tab and choose "Spec XML" from the drop down list. This converts the message profile to its XML representation.
- Once completed click the "HL7" button. This transforms the Spec XML report into a HL7 registerable profile.

- Apply the HL7 Message profile document schema to the report listed in MWB as HL7RegistrationSchema.xsd, using "File -> Apply DTD/Schema to report".
- Validate the profile with "File -> Validate XML doc "

3.3.7 Implement Version Control

Rationale:

It is important to note that any profile creation process inevitably involves manual input of conditions and variables. Manual entry always allows the possibility of mistakes to be introduced into the profiles. While every effort is made to ensure no such errors arise, there is no 100% guarantee that this will be the case. In order to manage this possibility it is important to introduce a system of version control into the process. Version control provides the ability to track errors, apply changes and also allows a roll back operation if a serious issue is encountered with any changes.

Method:

- For each of the files created; Segment Profile, Segment Library, Table Library and subsequent message profiles, a consistent naming scheme should be applied.
- A simple Version Log template was developed to track any required changes to any of the files listed and is included in Figure 3-8.

Version History

File Repository Location:

Filename:	Date:
Description:	
Author	

Figure 3-8 Template for version control

3.3.8 Message Validation and Reporting Framework

Rationale:

Message Validation is essential to ensure that any messages which may be sent conform to the required standard. It is also important to report any violations that are found to the relevant messaging system. This allows for updates to be made, where required, until conformance to the standard is reached. Another aspect of the validation process involves analysing the validation reports to ensure that no validation errors are caused by the conformance profile development process. For example a field which was given an incorrect length definition or an optionality code which was mistakenly entered as "optional" when it should have being set to "required". Any such issues that may exist within the profiles need be reported so that changes can be made to the Master Segment profile.

Message Validation & Reporting

Method:

- Load an existing message profile and click on the "Message Capture" tab.
- Choose "Get Message File" to navigate to the message under test. The message can also be pasted into the message text field. MWB allows for messages that are HL7 encoded or XML encoded.
- Parse the message, once in place, to populate the parse tree.
- "Validate to Spec" to validate the message against the message profile loaded. An example is shown in Figure 3-9.

MWB produces a report listing the discrepancies between the loaded message and the specific message profile. However, this report is specific to the MWB application. In order to report validation issues to the corresponding messaging sites, a "Message Validation Report" template was created. This can be used to report validation issues in a much clearer format to the message site. The template is shown in Figure 3-10.

Analysis of Validation Results

Method:

- A full analysis of each of the message validation reports should be completed to check for possible validation errors that may arise from the definitions in each of the library files. Any errors uncovered should be corrected and the corrections applied to the relevant library file. The

version control protocol should also be implemented to track these changes.

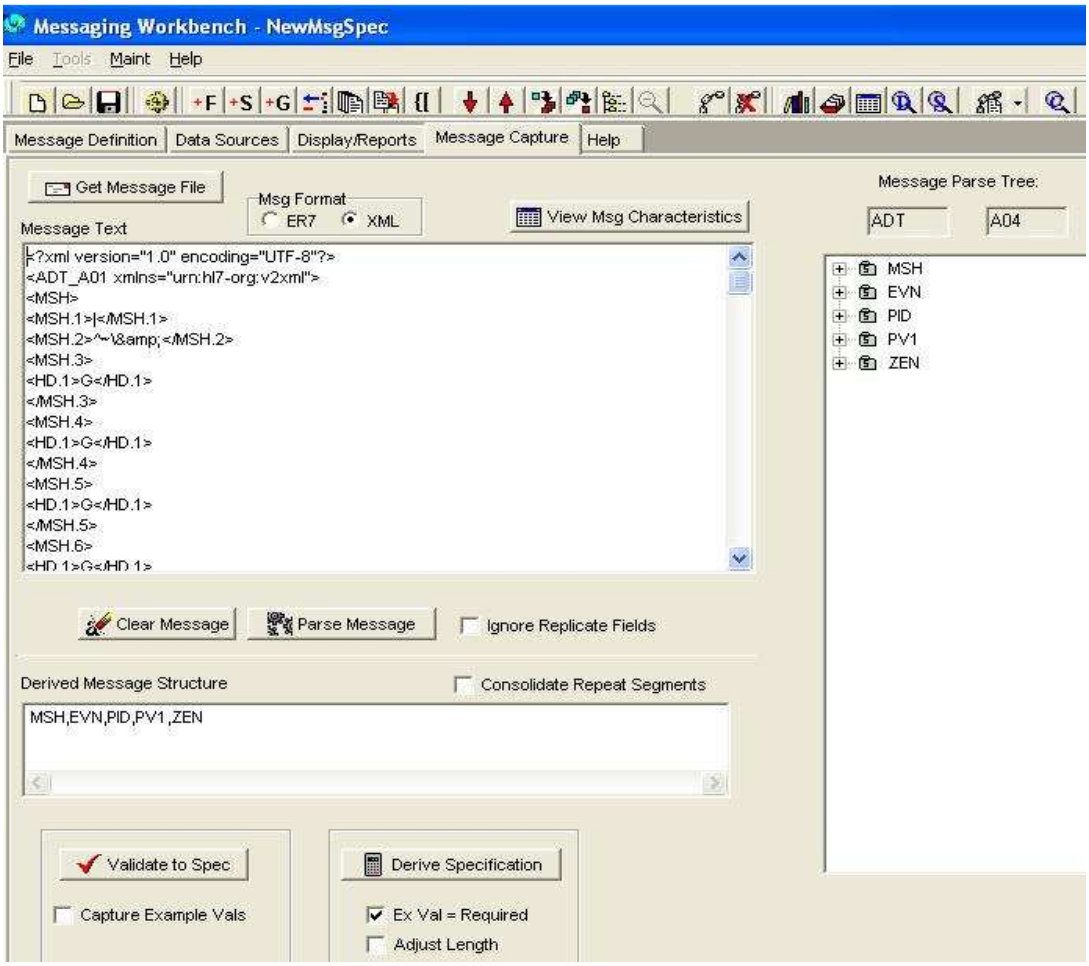

Figure 3-9 Message Capture and Validation in MWB

Message Validation Report			
Profile used for Validation:		**Version:**	
Date of Validation:			

Site :	
System under Validation:	

Message Encoding:	
Original Message:	

Summary of Message Validation	
Segment:	
Validation Details:	

Segment:	
Validation Details:	

Segment:	
Validation Details:	

Figure 3-10 Message Validation Report Template

Chapter 4. Evaluation: Application of Profile Creation Process to a National Messaging Standard

4.1 Introduction

Two of the main objectives of this dissertation, outlined in section 1.2, are to develop a process for the creation of conformance message profiles for use with national messaging standards and develop a message validation and reporting framework. These processes on their own are of limited value if they have no practical application to a national messaging standard. With this in mind it is of upmost importance to evaluate these processes by their application to a national messaging standard. The national messaging standard chosen for evaluating these processes is the General Practice Messaging Standard (GPMS) [12]. This standard was developed by HIQA, the Health Information and Quality Authority, and focuses on the structure and content of the electronic messages exchanged between General Practitioners (GPs), out of hours and acute care systems, with the aim of preventing any misinterpretation of information between them. A more detailed description of the standard is included in section 2.4.2.

When evaluating the application of these processes to the GPMS, it was important to have a set of criteria which the project could be measured against. These criteria should be as objective as possible in their definition. With this in mind the following evaluation criteria were chosen:

1. The principal evaluation criteria is that the process yields valid conformance message profiles, required by the static definition contained within GPMS, and that message validation can be performed to check for conformance to the messaging standard.
2. In the GPMS, HIQA have stated that messages will be assessed against the following criteria to ensure they are consistent with the messaging standard [12]:

- Well formed and valid
- Cardinality – defines the minimum and maximum number of repetitions
- Usage – whether an element must be present or present on certain circumstances
- Length – the length column defines the maximum length of a sub element.
- Code sets and constant values – coded entry fields (CE, CF, CWE, CNE) are specified as being populated based on coding systems or tables.

These criteria, set out in the GPMS, were then used as the evaluation criteria for the message validation and reporting framework.

The remainder of this chapter describes the experience of applying these processes to the GPMS, it highlights some of the lessons learned and also describes some of the main limitations experienced.

4.2 Profile Selection

As this research focused on developing a process to facilitate conformance testing it was decided that a subset of the clinical scenarios detailed in the GPMS should be used for evaluation purposes. In particular the Laboratory Order and the Emergency Department attendance message flows were chosen from the GPMS [12]. According to the National Audit of Health Messaging standards in GP Practice [7] the highest uptake of messages between acute care and GP systems is the Laboratory results message type. The audit showed that 78% of hospitals

which use Healthlink implemented this message type. This made this the obvious choice for inclusion.

The Emergency Department attendance message type was also chosen. This is an example of the ADT (Admission Discharge Transfer) type of message. Four of the 12 message flows in the GPMS are based on the ADT message type so it was important to also cover this message type in the research.

4.3 Application of message profile creation process

4.3.1 Segment Profile Definition and creation

In order to create the GPMS segment library, the required segment profile needed to be defined. As described in section 4.2, for the purposes of this research it was decided to build the profiles for the Laboratory Order scenario and the Emergency Department Attendance scenario. The Laboratory Order scenario has three messages associated with it, namely the OML_O21 laboratory order message, the ORL_O22 laboratory order acknowledgement messages and the ORU_R01 laboratory result message [12]. The Emergency Department attendance message only consists of the ADT_A01 message [12]. An analysis of the segments contained in the abstract message structures of these messages was undertaken and compared with those defined by the GPMS. This necessitated for the following Segments to be initially included in the GPMS segment library:

- MSH (Message Header) Segment
- PID (Patient Identification) Segment
- EVN (Event Type) Segment

- PV1 (Patient Visit) Segment
- PV2 (Event Type additional information) Segment
- PRD (Provider Data) Segment
- DG1 (Diagnosis) Segment
- NTE (Notes & Comments) Segment
- OBR (Observation Request) Segment
- OBX (Observation Result) Segment
- ORC (Common Order) Segment
- SAC (Specimen and Container Detail) Segment
- MSA (Message Acknowledgement) Segment
- ERR (Error) Segment

A detailed itemisation of these segments as specified by the GPMS is included in Appendix 1.

In was also important to choose which type of message profile to use for the Segment profile definition. The HL7 standard [10] specifies 3 types of message profile which can be used for documenting standard conformance, all of which are included in Messaging Workbench. These are

a) HL7 Standard profile: this represents a specific HL7 published standard

b) Constrainable profile: Allows "Optional" elements. Two types of constrainable profile also exist, Vendor constrainable and Realm constrainable profiles.

c) Implementation profile: No optional elements are allowed.

The GPMS redefines some elements of the HL7 standard but still allows for the existence of optional units. Therefore the type of profile used for this research was determined to be the Realm constrainable profile. Realm constrainable

profiles apply localisations and restrictions on a standard at a national level. Examples of their use in other regions include:

- AS4700.1-2001 Implementation of HL7 v2.3.1 Part 1: Patient Administration (constrainable profile for Australian Standards, constrains HL7 2.3.1, Chapter 3) [10].
- AS/NZS 4700.3-1999 Implementation of HL7 v2.3 Part 3: Electronic messages for exchange of information on Drug Prescription (constrainable profile for Australian Standards, constrains HL7 2.3, various Chapters) [10].

This choice of profile type had implications for the GPMS segment profile as within this standard some elements have been listed with the optionality code of "Backward". Examples include Patient Alias; sequence number 9 in the PID (Patient Identification) segment and Event Type Code; sequence number 1 in the EVN (Event) segment [12]. This option is not allowed for constrainable profiles so the GPMS had to be redefined to set these to "Optional".

The Segment profile was then created following the process outlined in section 3.3.1. Figure 4-1 shows how this looked in MWB. A simple naming convention was used when creating the segment profile e.g. GPMS_Mater_Segments_March2010 which refers to a) the national standard used i.e. GPMS, b) what this profile was for i.e. the Master Segment profile and c) the version of the standard used i.e. the final version published in March 2010.

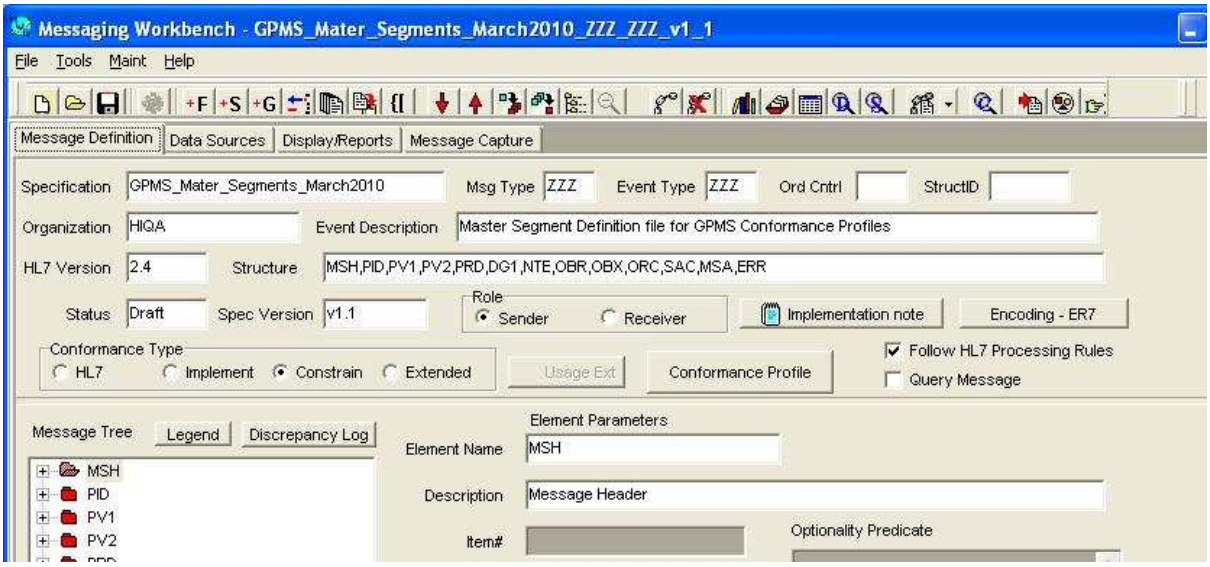

Figure 4-1 Master Segment Profile

4.3.2 GPMS Segment Library

The Segment Library was now generated following the process as described in section 3.3.2. Again a straight forward naming convention was used when saving this library file i.e. GPMS_Seglib_V1_0, which specified what the file was for and which version of the file it was.

4.3.3 GPMS Constrained Table Library file

Next step in the process was to create the constrained table library file as described in section 3.3.3. Complete lists of the tables and their elements, as specified by the GPMS have been included in Appendix 2.

4.3.4 Creating GPMS specific Profiles

Following the process of defining the Segment library and the constrained table library from the subset of segments described, we are now in a position to

create complete message profiles for the following clinical scenarios described within the GPMS:

- Emergency Department Attendance
- Admission
- Administrative Discharge
- Clinical Discharge Summary
- Cooperative Discharge Summary
- Laboratory Order
- Unsolicited Radiology Report
- Unsolicited Lab Result

The creation of all these profiles can now be accomplished with a few clicks of the mouse within the MWB application showing the extent to which this process that has been developed can streamline the creation of conformance profiles required for national messaging standards.

4.3.4.1 Example GPMS Message Profile

For the purposes of this dissertation and to give the reader a full and clear example of the process through to message validation it is important that one of these profiles be shown as an example. In their review of standards in GP messaging the Health Information Standards Committee [7] found that the most widely implemented message by Healthlink affiliated hospitals was the Laboratory Results message and so makes it the ideal candidate for our purposes. The HL7 message type that is used to transmit the Laboratory Results information is the ORU_R01 abstract message type [13]. Table 4-1 shows the abstract message structure for the ORU_R01 laboratory result abstract message type. The table also shows how, by using the process just described, MWB will

compile the profile. Where segments were defined within the GPMS segment library they will be used in the profile. Any segments not defined will be taken from the standard HL7 version specific library. Also where coded elements are used, the tables that will be referenced will be those tables that have been defined within the GPMS Table Library file.

ORU_R01 Unsolicited Observation Abstract Message Structure

Segment	Description	Segment Library compiled from
MSH	Message Header	GPMS
{		
[		
PID	Patient Identification	GPMS
[PD1]	Additional Demographics	HL7
[{NK1}]	Next of Kin/Associated Parties	HL7
[{NTE}]	Notes and Comments	GPMS
[		
PV1	Patient Visit	GPMS
[PV2]	Patient Visit - Additional Info	GPMS
]		
]		
{		
[ORC]	Order common	GPMS
OBR	Observations Report ID	GPMS
{[NTE]}	Notes and comments	GPMS
[CTD]	Contact Data	HL7
{		
[OBX]	Observation/Result	GPMS
{[NTE]}	Notes and comments	GPMS
}		
[{FT1}]	Financial Transaction	HL7
{[CTI]}	Clinical Trial Identification	HL7
}		
}		
[DSC]	Continuation Pointer	HL7

Table 4-1 Abstract message Syntax for ORU_R01 showing which segment library was used for each specified segment

To create this profile the steps outlined in section 3.3.4 and section 3.3.5 were followed. It was important to remember that for each of the message profiles required by the GPMS, the GPMS adds further specifications to some of the segments for particular clinical scenarios. The GPMS applies the following conditions when generating the laboratory results message ORU_R01 [12]:

- OBR.2 (Placer Order Number). This element is required
- OBR.7 (Observation Date/Time). This element is required
- OBR.14 (Specimen received Date/Time). This element is required
- OBR.24 (Diagnostic Serv Sect ID). This element is required.

These specifications could not initially be included in the GPMS Master Segment Profile as these conditions do not apply to every profile e.g. OBR.14 and OBR.24 are not required in the Laboratory Order Message Profile OML_O21[12].

4.3.5 Profile Validation

Profile validation is an important feature and ensures that any profiles created will be valid HL7 profiles and may also be considered for publication on the HL7 Profile database. The process as described in section 3.3.6 was followed in order to make sure that the ORU_R01 Laboratory results profile just created was also valid against the rules described by HL7. However the author found multiple errors were reported when the validation of this profile was carried out against the HL7 Registration Schema included within MWB. An example of one of these errors is:

Invalid XML file
Reason: Element content is invalid according to the DTD/Schema.
Expecting: ImpNote, Use Case.
Line #: 4

Character: 14

Source Text <Encodings>

Error Code: -1072898028

A full analysis of the Message Profile Schema [10] would need to be undertaken and compared to the message profiles that are created. For example this error is the result of the fact that within the profile that was created no Implementation note or Use Case were described as required by the Profile Schema.

</xs:annotation>
</xs:element>
<xs:element name="ImpNote" type="ImpNoteType" minOccurs="0">
<xs:annotation>
<xs:documentation>Implementation Notes provide a general description about how the profile is intended to be used, as well as hints on using or interpreting the profile.</xs:documentation>
</xs:annotation>
</xs:element>
<xs:element name="UseCase">
<xs:annotation>
<xs:documentation>A use case model documents the scope and requirements for an HL7 message profile or set of message profiles.</xs:documentation>

Figure 4-2 Extract from HL7 Message Profile Schema [10] highlighting cause of initial error

Further work would be required to resolve all of these errors if ever the profiles were going to be published. However the initial focus of these profiles was to allow for message validation to the GPMS and further work to resolve these errors was not carried out.

4.3.6 Version Control

When creating any of the required message profiles it was an important consideration to include a method of version control. Version control provides the ability to track errors, apply changes and also allows a roll back operation if a serious issue is encountered with any changes. The process as outlined in section 3.3.7 for implementing version control was followed and applied to the GPMS Master Segment Profile, GPMS Constrained Table file and also the GPMS Laboratory Result ORU_R01 message profile. The version logs for each of these have been included here as examples.

4.3.6.1 GPMS Master Segment Profile

Master Segment Profile File Version History

File Repository Location:

C:\Program Files\Messaging Workbench\Projects

Filename: GPMS_Master_Segments_ZZZ_ZZZ.mwb	**Date:** 30-03-2010
Description: Created initial Master Segment file. From this profile the Segment Library file is created, from which all the relevant conformance profiles for the project will be created. GPMS Version used was Draft 13-01-2010. Segments Defined: MSH, PID, PV1, PRD, DG1, NTE, OBR, OBX, ORC, SAC, MSA, ERR	
Author	Ray Lynch

Filename: GPMS_Mater_Segments_March2010_ZZZ_ZZZ_v1_1.mwb	**Date:**19-06-2010
Description: 1. Improved filename version. Now includes which version of the GPMS is used e.g. March 2010 published version. Also includes a version ending which should now be incremented when the file is revised or updated. 2. Master Segment file now faithfully follows the GPMS standard as written, specifically in relation to Data Field lengths. There were initial concerns that HL7 v2.4 Maximum Field length rules had been broken within the GPMS standard. Have received correspondence that this is normal in real world environments which HL7 recognise themselves since further version of the v2.x standard have already increased these data fields. For example: Data Type XPN. HL7 v2.4 length =250. HL7 v2.5 Length = 1103 3. Added EVN and PV2 segments to Master Segment file	
Author	Ray Lynch

Table 4-2 Master Segment File Version History

4.3.6.2 GPMS Constrained Table file

GPMS Constrained Table File Version History

File Repository Location:

C:\Program Files\Messaging Workbench\Lib

Filename: GPMSTableFilev1_0.mwt	**Date:** 31-05-2010
Description: Initial GPMS Constrained Table file created. Created from GPMS_Master_Segment_ZZZ_ZZZ.mwb, initial Master Segment profile file. Used "Tools -> Create/Edit Constrained Table Lib" within MWB program. User defined elements manually added.	
Author	Ray Lynch

Filename: GPMSTableFilev1_1.mwt	**Date:** 20-06-2010
Description: Revised GPMS table file using updated GPMS_Master_Segments_March2010_ZZZ_ZZZ_v1_1.mwb file.	
Author	Ray Lynch

Table 4-3 GPMS Constrained Table File Version History

4.3.6.3 GPMS Lab Results (ORU_R01) Profile

GPMS Lab Order Response (ORU_R01) Profile Version History

File Repository Location:

C:\Program Files\Messaging Workbench\Projects\GPMS Profiles

Filename: GPMS-ORU_R01_v1_0.mwb	**Date:** 20-06-2010

Description:

Conformance Library files used to create this profile were:

- Segment Library: 1. GPMS_SegLib_v1_1.mcf 2. HL7 2-4.mcf

Note: GPMS_SegLib_v1_1.mcf was created from the GPMS_Master_Segments_March2010_ZZZ_ZZZ_v1_1.mwb file. The segment library will need to be updated if there are any revisions to the Master Segment file.

- Constrained Table Library file:GPMSTableFilev1_1.mwt

Note: Also created using the GPMS_Master_Segments_March2010_ZZZ_ZZZ_v1_1.mwb file. If further segments are defined which require new tables this file will also need to be updated.

As per Laboratory Order message workflow in the GP Messaging Standard March 2010 have further changed the optionality of the following components to "**Required"**.

OBR.2 – Placer Order Number

OBR.7 – Observation Date/Time

OBR.14 – Specimen Received Date/Time

OBR.24 - Diagnostic Serv Sect ID

Author	Ray Lynch

Table 4-4 GPMS Lab Order Response (ORU_R01) Profile Version History

4.3.7 Message Validation against GPMS Profile ORU_R01

Message Validation is an integral part of this process and is an essential requirement in testing conformance. It is used to verify to what extent messaging systems adhere to the GPMS standard. In order to check for message validation the author required some valid HL7 message examples. To avoid any ethical issues in relation to accessing patient information, test message examples were used. However it was important to use messages that were as close to a real life scenario as possible. To this extent, the author received a limited number of test messages as processed by Heathlink.

The process of validation as described in section 3.3.3 was carried out on the test messages that were received. The message validation report, produced by MWB, is shown here for one of the test messages that was validated against the GPMS Lab Order response ORU_R01 message profile. The complete message is shown in the Message Validation Report on page 84.

Message Validation Report for GPMS Lab Order response ORU_R01 message profile as produced by MWB.

Error: MSH.3.1 [Sending Application.namespace ID][1.3.1] - CODE value (Beaumont.Healthlink.10) not an element of table 0361 - Sending/receiving application (USER table type)

Error: MSH.3.2 [Sending Application.universal ID] - Captured Msg missing required element - truncated

Error: MSH.3.3 [Sending Application.universal ID type] - Captured Msg missing required element - truncated

Error: MSH.4.1 [Sending Facility.namespace ID][1.4.1] - CODE value (Beaumont) not an element of table 0362 - Sending/receiving facility (USER table type)

Error: MSH.6.1 [Receiving Facility.namespace ID][1.6.1] - CODE value (SAMPLE PRACTICE) not an element of table 0362 - Sending/receiving facility (USER table type)

Error: MSH.10 [Message Control ID][1.10] - specified value LENGTH (20) exceeded - "923BEA_090727_132005502_0015" (28)

Error: PATIENT_RESULT.ORDER_OBSERVATION [ORDER_OBSERVATION][4] - MISSING SegGroup

Error:PATIENT_RESULT.ORDER_OBSERVATION.OBR.3.1 [ORDER_OBSERVATION.OBR.Filler Order Number.entity identifier][4.3.1] - CODE value (E090065962) not an element of table 0363 - Assigning authority (USER table type)

Error:PATIENT_RESULT.ORDER_OBSERVATION.OBR.4.3 [ORDER_OBSERVATION.OBR.Universal Service Identifier.name of coding system][4.4.3] - CODE value (L) not an element of table 0396 - Coding System (USER table type)

Error:PATIENT_RESULT.ORDER_OBSERVATION.OBR.16.2.1 [ORDER_OBSERVATION.OBR.Ordering Provider.family name.surname][4.16.2.1] - specified value LENGTH (3) exceeded - "PRACTICE" (8)

Error:PATIENT_RESULT.ORDER_OBSERVATION.OBR.16.3 [ORDER_OBSERVATION.OBR.Ordering Provider.given name][4.16.3] - specified value LENGTH (3) exceeded - "SAMPLE" (6)

4.3.8 Analysis and Reporting of message validation

Analysis of each message validation report is also necessary to ensure a) the accuracy of the errors reported and that b) none of the reported errors are caused due to inaccuracies introduced by the manual entry of conditions at the Master Segment profile development stage. By analysing each Segment in turn a

clear understanding of the accuracy of the results can be established and an overall assessment of the segment profile accuracy can be achieved.

Message Header (MSH) Segment

- *Error: MSH.3.1 [Sending Application.namespace ID][1.3.1] - CODE value (Beaumont.Healthlink.10) not an element of table 0361 - Sending/receiving application (USER table type).*

  Table 0361 of the GPMS does not include the entry "Beaumont.Healthlink.10" [12] showing that the process is producing valid error instances in relation to coded entries. It also shows that this error was not related to any inaccuracies within the process itself.

- *Error: MSH.3.2 [Sending Application.universal ID] - Captured Msg missing required element – truncated*

  Error: MSH.3.3 [Sending Application.universal ID type] - Captured Msg missing required element – truncated

  According to the GPMS MSH 3.2 and MSH 3.3 are specified as required elements [12]. The example message shown only populates the MSH 3.1 field. This demonstrates that the process can return valid errors relating to required elements defined by the GPMS that must be included in all messages.

- *Error: MSH.4.1 [Sending Facility.namespace ID][1.4.1] - CODE value (Beaumont) not an element of table 0362 - Sending/receiving facility (USER table type)*

  Error: MSH.6.1 [Receiving Facility.namespace ID][1.6.1] - CODE value (SAMPLE PRACTICE) not an element of table 0362 - Sending/receiving facility (USER table type)

Similar to the first reported error in this series, the entries in this sample message for these particular fields do not match the coded entries available in the GPMS user defined table 0362. The errors may be due to the fact that this is a sample message; nonetheless it is still demonstrating that the process is yielding valid results in relation to coded values within messages.

- *Error: MSH.10 [Message Control ID][1.10] - specified value LENGTH (20) exceeded - "923BEA_090727_132005502_0015" (28)*

  The GPMS defines the MSH.10 field as being a "required" field with a maximum length of 20 characters [12]. Again this error shows that the process is producing valid error instances in relation to maximum field length violations against the GPMS.

Observation Request (OBR) Segment

- *Error:PATIENT_RESULT.ORDER_OBSERVATION[ORDER_OBSERVATION][4] - MISSING SegGroup*

  The author is unsure of the origin of this error. It is unclear as to whether the issue is caused by the profile or the test message that is used. Further investigation will be required to determine the root cause of the error.

- *Error:OBR.3.1[ORDER_OBSERVATION.OBR.FillerOrderNumber.entityidentifier][4.3.1] - CODE value (E090065962) not an element of table 0363 - Assigning authority (USER table type)*

  This error is similar to the errors that have appeared already relating to coded entries in the GPMS User defined tables. However in this case, table 0363 has no values defined by the GPMS [12]. Since there are no values defined in the table, ideally no value can be incorrect. Therefore in this

case and with any other tables that have no values defined it may be better to remove the reference to the specific empty table in the GPMS Master Segment profile. This will remove the extra burden of reporting on errors that don't need to be reported on.

- *Error:OBR.4.3[ORDER_OBSERVATION.OBR.UniversalServiceIdentifier.name of coding system][4.4.3] - CODE value (L) not an element of table 0396 - Coding System (USER table type)*

  The GPMS defines that the OBR.4.3 field should use the User defined table 0396. However in Appendix 3 of the released standard March 2010 [12] there is no reference to this table. Unlike the previous error which related to a table with no defined values, this table is not listed at all in the Appendix. This is an error relating to the GPMS and should be reported back to HIQA as feedback in relation to the standard. If it is decided that this table should have no values defined, similar to table 0393, then it may be best to leave this table reference out of the GPMS Master Segment profile.

- *Error:OBR.16.2.1[ORDER_OBSERVATION.OBR.OrderingProvider.familyname.surname][4.16.2.1] – specified value LENGTH (3) exceeded – "PRACTICE" (8)*

  Error:OBR.16.3[ORDER_OBSERVATION.OBR.OrderingProvider.given name][4.16.3] – specified value LENGTH (3) exceeded – "SAMPLE" (5)

  The GPMS does not make any reference to either of these fields in the OBR segment. However it does define OBR.16.1, OBR 16.6 and OBR 16.16. Given that this is the case it was necessary to leave all other elements of the OBR.16 field as "optional" in MWB, which also meant that

the default lengths of these optional fields, as defaulted by MWB were used. In this example the default length of both OBR.16.2.1 and OBR.16.3 are by default 3 characters. Further investigation would be required to see if these elements, which are not defined by the GPMS but which can legitimately be sent in a message, can be removed from the validation process within MWB. This would remove the load on validating messages and also on the reporting of violations.

It becomes clear from the analysis that not all errors that appear in the MWB are of relevance to the site where the message originated. It then becomes important that only those issues that the message validation process highlighted as specifically related to site specific messaging issues need to be reported. For this test message example the Message Validation Report would consist of the following:

Table 4-5 Message Validation Report for Sample Message

Message Validation Report			
Profile used for Validation:	GPMS-ORU_R01_v1_0	**Version:**	1.0
Date of Validation:	10-08-2010		

Site :	HealthLink
System under Validation:	Test System

Message Encoding:	XML
Original Message:	
Message: 923BEA_090727_132005502_0015 <?xml version="1.0" encoding="UTF-8"?> <ORU_R01> <MSH>	

```
<MSH.1>|</MSH.1>
<MSH.2>^~\&amp;amp;</MSH.2>
<MSH.3>
<HD.1>Beaumont.Healthlink.10</HD.1>
</MSH.3>
<MSH.4>
<HD.1>Beaumont</HD.1>
<HD.2>923</HD.2>
<HD.3>HIPEHOS</HD.3>
</MSH.4>
<MSH.6>
<HD.1>SAMPLE PRACTICE</HD.1>
<HD.2>12201</HD.2>
<HD.3>L</HD.3>
</MSH.6>
<MSH.7>
<TS.1>200907271320</TS.1>
</MSH.7>
<MSH.9>
<MSG.1>ORU</MSG.1>
<MSG.2>R01</MSG.2>
</MSH.9>
<MSH.10>923BEA_090727_132005502_0015</MSH.10>
<MSH.11>
<PT.1>P</PT.1>
</MSH.11>
<MSH.12>
<VID.1>2.4</VID.1>
</MSH.12>
</MSH>
<ORU_R01.PATIENT_RESULT>
<ORU_R01.PATIENT>
<PID>
<PID.3>
<CX.1>761409</CX.1>
<CX.4>
<HD.1>Beaumont</HD.1>
</CX.4>
<CX.5>MRN</CX.5>
</PID.3>
<PID.5>
<XPN.1>
<FN.1>Test</FN.1>
</XPN.1>
<XPN.2>SEAN</XPN.2>
</PID.5>
<PID.7>
<TS.1>19570727</TS.1>
</PID.7>
<PID.8>M</PID.8>
<PID.11>
<XAD.1>
```

<SAD.1>44 Test Rd.</SAD.1>
</XAD.1>
<XAD.2>PORTMARNOCK</XAD.2>
<XAD.3/>
<XAD.4/>
</PID.11>
</PID>
<ORU_R01.PATIENT_VISIT>
<PV1>
<PV1.2>O</PV1.2>
<PV1.3>
<PL.9/>
</PV1.3>
<PV1.7>
<XCN.1/>
<XCN.2>
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<FN.1/>
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<XCN.6/>
</PV1.9>
<PV1.14/>
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<CX.1>9900434947</CX.1>
</PV1.19>
<PV1.51>V</PV1.51>
</PV1>
</ORU_R01.PATIENT_VISIT>
</ORU_R01.PATIENT>
<ORU_R01.ORDER_OBSERVATION>
<OBR>
<OBR.1>1</OBR.1>
<OBR.2>
<EI.1/>
</OBR.2>
<OBR.3>
<EI.1>E090065962</EI.1>
<EI.3/>
</OBR.3>
<OBR.4>

<CE.1>B12F</CE.1>
<CE.2>VIT.B12 / FOLIC ACID</CE.2>
<CE.3>L</CE.3>
<CE.4/>
<CE.5/>
<CE.6/>
</OBR.4>
<OBR.7>
<TS.1>200907231539</TS.1>
</OBR.7>
<OBR.13/>
<OBR.14>
<TS.1>200907240935</TS.1>
</OBR.14>
<OBR.15>
<SPS.1>
<CE.1/>
<CE.2/>
<CE.3/>
<CE.4/>
<CE.5/>
<CE.6/>
</SPS.1>
<SPS.2/>
<SPS.3/>
<SPS.4>
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</SPS.4>
<SPS.5>
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<CE.4/>
<CE.5/>
<CE.6/>
</SPS.5>
<SPS.6>
<CE.1/>
<CE.2/>
<CE.3/>
<CE.4/>
<CE.5/>
<CE.6/>
</SPS.6>
</OBR.15>
<OBR.16>
<XCN.1>12201</XCN.1>

```
<XCN.2>
<FN.1>PRACTICE</FN.1>
</XCN.2>
<XCN.3>SAMPLE</XCN.3>
<XCN.4/>
<XCN.5/>
<XCN.6>Dr</XCN.6>
</OBR.16>
<OBR.24>CH</OBR.24>
<OBR.25>F</OBR.25>
</OBR>
<ORU_R01.OBSERVATION>
<OBX>
<OBX.1>1</OBX.1>
<OBX.2>NM</OBX.2>
<OBX.3>
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<CE.2>VITAMIN B12</CE.2>
<CE.3>L</CE.3>
<CE.4/>
<CE.5/>
<CE.6/>
</OBX.3>
<OBX.5>152</OBX.5>
<OBX.6>
<CE.1>ng/l</CE.1>
<CE.2>ng/l</CE.2>
<CE.3/>
<CE.4/>
<CE.5/>
<CE.6/>
</OBX.6>
<OBX.7>180.-914.</OBX.7>
<OBX.8>L</OBX.8>
<OBX.11>F</OBX.11>
</OBX>
</ORU_R01.OBSERVATION>
<ORU_R01.OBSERVATION>
<OBX>
<OBX.1>2</OBX.1>
<OBX.2>NM</OBX.2>
<OBX.3>
<CE.1>FOL</CE.1>
<CE.2>FOLIC ACID</CE.2>
<CE.3>L</CE.3>
<CE.4/>
<CE.5/>
<CE.6/>
</OBX.3>
<OBX.5>9.4</OBX.5>
<OBX.6>
<CE.1>ug/L</CE.1>
```

<CE.2>ug/L</CE.2>
<CE.3/>
<CE.4/>
<CE.5/>
<CE.6/>
</OBX.6>
<OBX.7/>
<OBX.8/>
<OBX.11>F</OBX.11>
</OBX>
</ORU_R01.OBSERVATION>
</ORU_R01.ORDER_OBSERVATION>
</ORU_R01.PATIENT_RESULT>
</ORU_R01>

Summary of Message Validation	
Segment:	MSH – Message Header
Validation Details:	Error: *MSH.3.1 [Sending Application.namespace ID][1.3.1] - CODE value (Beaumont.Healthlink.10) not an element of table 0361 - Sending/receiving application (USER table type)* Coded Value "Beaumont.Healthlink.10" not a valid entry according to GPMS standard. Error: *MSH.3.2 [Sending Application.universal ID] - Captured Msg missing required element - truncated* Error: *MSH.3.3 [Sending Application.universal ID type] - Captured Msg missing required element - truncated* Error: *MSH.4.1 [Sending Facility.namespace ID][1.4.1] - CODE value (Beaumont) not an element of table 0362 - Sending/receiving facility (USER table type)* Coded Value "Beaumont" not a valid entry according to GPMS standard. Error: *MSH.6.1 [Receiving Facility.namespace ID][1.6.1] - CODE value (SAMPLE PRACTICE) not an element of table 0362 - Sending/receiving facility (USER table type)* Coded Value "DAVID MADDEN" not a valid entry according to GPMS standard. Error: *MSH.10 [Message Control ID][1.10] - specified value LENGTH (20) exceeded - "923BEA_090727_132005502_0015" (28)* Maximum Length as defined by the GPMS for this field is 20 characters.

4.4 Summary of Findings, Lessons Learned, Limitations and Further Work

4.4.1 Summary of Findings

This chapter evaluates the conformance message profile creation process and the message validation and reporting framework developed in chapter 3. The evaluation was carried out by applying these processes to a suitable national messaging standard, in this case the General Practice Messaging Standard. Evaluation criteria were defined by which these processes should be measured. Presented here is the summary of those findings.

4.4.1.1 Conformance Message Profile Creation Process

- The principal evaluation criteria was that the process would yield valid conformance message profiles, required by the static definition contained within the GPMS, and that message validation could be performed to check for conformance to the messaging standard. The criteria have been achieved and the process has been shown to provide valid conformance message profiles that allow for message validation to take place.
- By focusing the conformance profile development process around the creation of a central master segment profile, an element of scalability has been introduced into the process. For example, HIQA hope to build on and further develop the GPMS for use in other clinical areas by the addition of more clinical scenarios and their relevant message segments [12]. The master segment profile approach allows for the introduction (and removal if necessary) of new segments as required. Once these have been

compiled within the profile, the segment library and table library files can easily be updated to reflect the new changes. The process of creating the new conformance profiles, required by the updated standard, becomes an operation of a few mouse clicks in MWB.

- Adequate fail safes have also been introduced into the process in the form of the version control protocol. Version control allows for the tracking of mistakes that may have been introduced during the development phase of the Master Segment Profile. It also becomes valuable in the context of the previous point on scalability as it can be used to track changes and modifications for future revisions. In their final report, the Diabetes Messaging Project in New South Wales Australia [54], (who developed HL7 messaging standards for communication between general practitioner, clinical management software and Division register/recall systems) noted that not having a version control system in place at the early stages of their project was a problem. They found that any modifications to their specifications were lost, adding weight to the value of version control for this project.

4.4.1.2 Message Validation and Reporting Framework

- The GPMS itself specified the criteria by which messages will be checked to ensure they are consistent with the messaging standard. They are:
  - *Valid and well formed*: In the message validation phase of the process MWB performs a parsing operation on the message. The parsing function checks the specific message and ensures that it is both valid and well formed. MWB will report errors if the message is not well formed and valid and will not parse completely.
  - *Cardinality – defines minimum and maximum number of repetitions*:

Cardinality specifies the minimum and maximum number of repetitions for a particular element. The message example used for validation demonstrated that the process explicitly identifies situations where an element must appear i.e. is required. However, the process was not able to identify situations where maximum repetition instances have been violated. The GPMS applies specific maximum cardinality rules to only four fields in the whole standard. These are OBR.17 (Order Call Back Phone Number) and OBR.28 (Repeat Copies to) which are allowed repeat twice and five times respectively, OBX.8 (Abnormal Flags) which can repeat a maximum of 5 times and ORC.14 (Call Back Phone Number) specified to repeat twice [12]. To test for these maximum cardinality rules, sample or live messages would need to specifically break these rules. Unfortunately there were no such messages available at the time of writing to explicitly demonstrate that such violations would be captured by the message validation process. It may have been possible to manually create test messages that break the maximum cardinality rules but this was not undertaken as the author could not ensure further unknown message violations would not be introduced due to limited expertise in this area. However it is the author's firm belief that such maximum cardinality violations would be caught by MWB.

- *Usage – whether an element must be present or present on certain circumstances:*
- *Length – the length column defines the maximum length of a sub element:*

- *Code sets* – Compliant messages are required to use specific coding systems but may use alternative coding systems as supported by the data type.

  As demonstrated by the violation errors generated from the sample message used and the subsequent analysis that has been discussed in section 4.3.8 all of the evaluation criteria have been met by the message validation process.

- The ability to provide reliable and valid message validation reports for all the required profiles specified in the GPMS will now provide the basis on which the implementation of the GPMS can be rolled out nationally. Compare this message validation process to the comparison work carried out by the HeBE messaging subgroup described in section 2.6.1. Message validation for the HeBE standards consisted of a manual process of comparing each field of each message to be validated, against the specified standard. This approach has now automated this part of the process highlighting its value.

  The ability to perform message validation could also be extended to include checking Vendor products e.g. Laboratory systems, to make sure they conform to the GPMS, particularly when procurement of new systems at a national level is required. This is an area that HIQA intend the GPMS to be implemented.

From the findings achieved in respect of the evaluation criteria set out, the author believes that the processes developed are effective in creating valid message profiles and provide the ability to perform message validation against a national messaging standard. These findings are in keeping with the research objectives that were set out initially for this project.

4.4.2 Lessons Learned

One key lesson was learned when compiling the Master Segment profile for the General Practice Messaging Standard. This concerned the maximum length definition of some fields defined within the GPMS.

The HL7 v2.4 standard specifies maximum field lengths for certain data types. The maximum field length is defined as the maximum number of characters that one occurrence of the data field may occupy [13]. An example of this is the data type XPN (Extended Person Name) which the HL7 v2.4 standard specifies a maximum length of 250 characters. This XPN data type is used throughout the standard to capture people's names; one specific occurrence of this data type is sequence 5 of the PID (Patient Identification) segment, used to capture the patient's name. The GPMS defines seven subcomponents for this field, each with a length of 50 characters, thus breaking the maximum length for this field as specified in the HL7 v2.4 standard. There are numerous other occurrences within the GPMS where the maximum length specified violates the maximum lengths as specified by the HL7 standard. By their definition "an HL7 message profile is compliant, in all aspects, with the HL7 defined message(s) used in the profile" [10] so this presented a problem.

The author could find no reference or material which could explain and/or solve this issue. The answer came from correspondence between the author and Mr. Pete Rontey, developer of the Messaging Workbench tool. According to Mr. Rontey the length dilemma has plagued message developers since the beginning of HL7 and in his experience is the most frequently violated aspect of the standard. However these violations are necessary in virtually all cases in order to realise the real world information requirements of HL7 implementations. HL7

recognise the length limitations and has addressed them in subsequent versions of the standard [52]. In the HL7 v2.5 of the standard for example, the maximum length of the XPN data type has already been increased to 1103 characters [10]. Therefore these length deviations from the standard should always be considered and applied very judiciously and only as the need dictates. Following this correspondence and consultation with Dr. Kevin O'Carroll, Standards and Technology Manager with HIQA it was decided to stick faithfully to the GPMS standard and use the lengths as defined in the GPMS.

4.4.3 Limitations

The application of the processes has demonstrated that they do work, however the evaluation itself has highlighted some limitations that need to be mentioned.

- **Evaluation Message Sample Size:**

  The limited availability of test messages has implications for the validation process. The sample size available is very small hence a complete evaluation of the process is not possible. A full testing suite may need to be developed or further work in the field needs to be carried out to cover the majority of possible violations that can be produced. For example the "Missing SegGroup" error reported for the OBR Segment discussed in section 4.3.8, would need to be explored further.

- **Message Validation Reporting**:

  The message validation process works well for highlighting violations against the profiles. A thorough analysis of the error report from MWB can also reveal possible issues with the initial setup. However, the reporting of these errors is still cumbersome. At the moment it is a copy and paste

exercise for inserting violations reported by MWB. This is adequate for one small sample message however Laboratory results messages could possibly be larger and more complex than the message shown. Further investigation into automating the reporting of message violations produced by MWB would need to be undertaken.

Also the inclusion of original messages in the message validation reports may need to be reconsidered especially when the messages are in XML format. In example Table 4-5 the message was quite small, yet in XML format filled roughly 5 pages of the validation report.

- **Profile Validation:**

  The validation of the profiles against the HL7 profile Schema was not completed. Further work is required to overcome the errors experienced when profile validation was carried out. This work would be beneficial especially if there is a requirement to register the profiles with the HL7 organisation.

4.4.4 Further Work

The limitations that exist within the profile development and subsequent validation process highlight the requirement for further work to address these issues. This should include:

- Completion of the master segment profile to include all 20 segments defined by the GPMS. This will facilitate the creation of the complete segment and table library files required to create the entire range of message profiles specified in the GPMS.

- Message validation should be carried out on a full range of relevant messages to further validate that the developed profiles are correct and that the violations reported are also valid.
- Investigation into streamlining the reporting of message violations back to the messaging sites is required, specifically to address the limitations mentioned for the message validation reporting.

In this respect the author has passed on the relevant segment libraries, created profiles and version control logs developed in this dissertation for the GPMS, to the Standards and Technology project team in HIQA. The project team have updated the master segment profile to include all 20 of the message segments defined within the GPMS. The segment and constrained table libraries have also been updated from the new segment profile. At the time of writing preliminary testing to check compliance to the GPMS had taken place but progress had been described as slow. The primary reason relates to data confidentiality and establishing the necessary confidentiality contracts required for accessing patient data [55].

In relation to message validation some issues have arisen which the project team are investigating further. Some of the problems relate to difficulty in parsing messages from specific sites, while errors relating to missing and unexpected segments similar to those described in section 4.3.8 for the OBR segment have also been observed. The team will continue the work on message validation across all sites concerned. The ability to conduct automated testing of messages however greatly increases the likelihood that a wide-ranging implementation of the standard can be achieved. The eventual results and

recommendations that the team identify during the validation process will be compiled and released in a report.

Chapter 5. Online Message Validation Tool

5.1 Introduction

One of the initial objectives for this research project was to explore the potential to develop a web-based online tool to support the message validation process developed for this research. An online message validation tool would have the added benefit of allowing message sites to test and validate their own applicable messages against the profiles. While the intention was never to produce a viable online message validation tool, the purpose was really to see how possible or not that this may be. Time constraints for completion of this research project unfortunately meant that this final objective was not fully realised however this chapter summarises some of the current online message validation projects and some data security considerations necessary for any online tool like this.

5.2 Current Online Message Validation Projects

5.2.1 Australian Health Messaging Laboratory (AHML)

This project has already been discussed in section 2.6.4.1, and is a testing service for HL7 messages to ensure conformance with existing and newly emerging local and international messaging standards. The AHML uses an automated server based test engine that is designed to run 24 hours a day 7 days a week unattended [35]. The message test engine currently supports HL7 version 2.3.1 messages and XML encoded messages with plans for version 2.4 and version 2.5.1 to be included. The testing process can check messages for a number of issues:

- Messages are well formed.
- Validation can be checked against lookup table or databases.

- Messages can also be tested against business rules to make sure they adhere to them.

A graphical display of the AHML testing process is shown here.

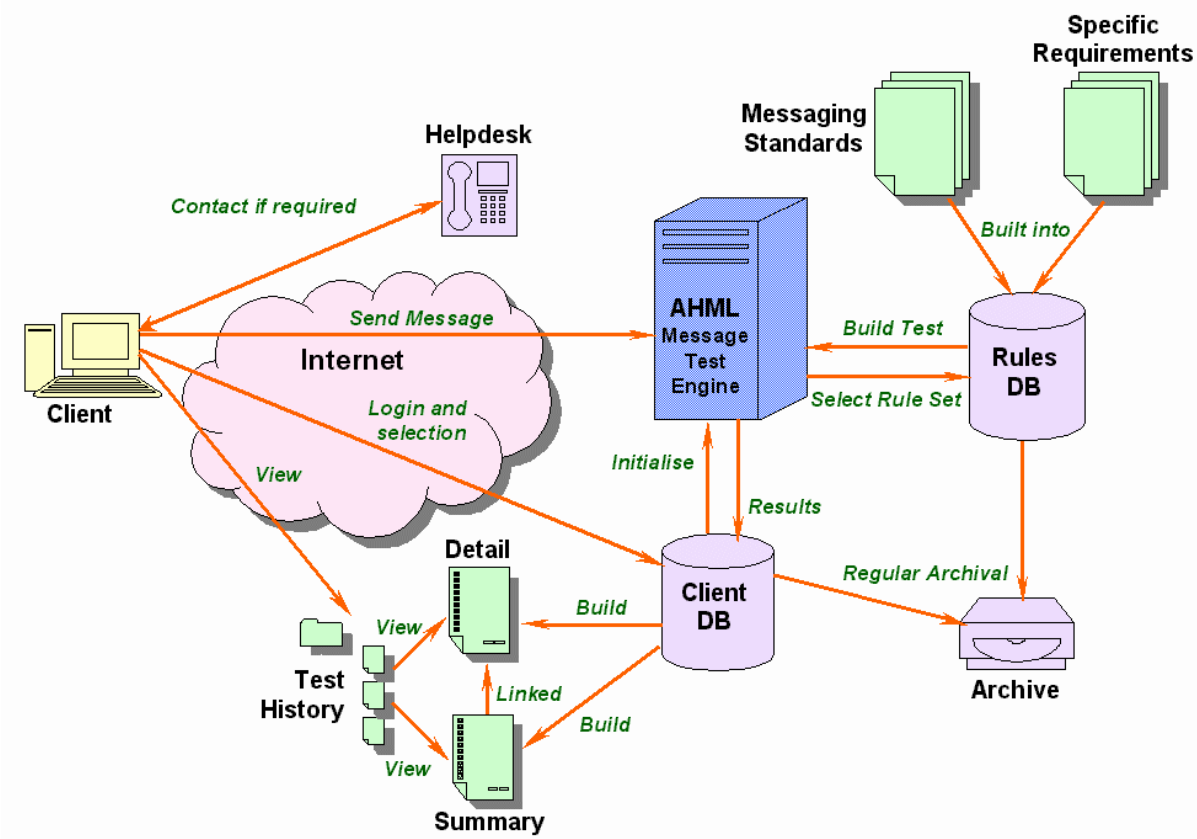

Figure 5-1 Overview of AHML testing process [35]

Test reports are also generated by the application in a number of different formats and also at a number of different levels i.e. summary reports, detailed reports or test history.

5.2.2 National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology is an agency of the US Department of Commerce which was founded in 1901 as the United States first federal physical science research laboratory [48]. One of the areas that NIST are

involved in is enabling Health IT Conformance and Interoperability. As part of this NIST have built and continue to develop a set of tools for testing HL7 version 2 messages and interfaces using the Conformance profile approach. One of these tools is an online tool for message and profile validation [49]. The services on this site include message validation, profile validation and message generation. The tools are based around a set of Java Application Programming Interfaces (APIs). NIST also make these web services available to developers as remote APIs that can be integrated into test environments. The available services are MessageGeneration, MessageValidation and ProfileValidation [50]. An overview of the NIST HL7 testing toolkit is included below.

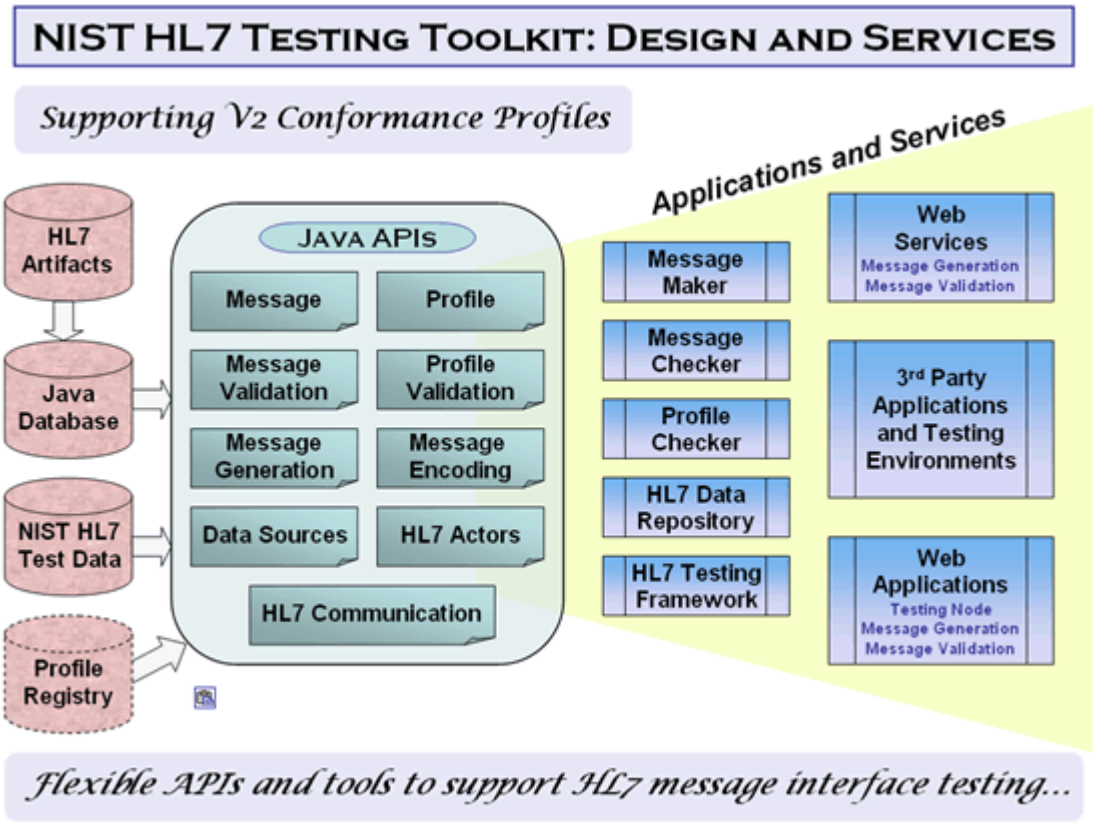

Figure 5-2 Overview of the NIST HL7 testing toolkit [49]

5.2.3 HL7 Application Programming Interface (HAPI)

The HL7 application programming interface is an open source, object orientated HL7 version 2 library for Java [51] that was first initiated by the University Health Network in Toronto. The HAPI object model defines Java classes for every HL7 version 2.x data type, segment and message. The idea being that developers can add HAPI to their applications as required.

In version 0.4 of HAPI (current version 1.0.1) a number of features were introduced relating to HL7 Conformance based on the conformance profile approach. These included:

- *Message Validator*: Part of the HAPI framework this checks messages against profiles and produces a list of conformance violations. These violations can be written to a log or report, or they can trigger an email to an interface engine administrator.
- *Profile Compiler*: This tool translates a static conformance profile into an API which includes all the constraints of that profile. Using this API HL7 messages can be created that conform directly to the profile that created them.

5.2.4 Messaging Workbench (MWB)

Central to this dissertation was the use of Messaging Workbench to create the required message profiles and also provide the capabilities to perform message validation. It may also be worth investigating if the MWB application could be transformed into a web based application.

Messaging Workbench does provide the capabilities to act as a Validation Server [47]. The Validation Service can be configured to receive HL7 framed messages

either as default HL7 format or HL7 XML encoded from external sources. As demonstrated earlier it can perform message validation of each message received against the currently loaded message profile and produce its own validation report. It also allows the option to automatically save all messages and validation reports received during a validation session for later analysis.

5.3 Data Security Considerations

Any online validation tool automatically implies that patient information will be transferred from an institution to be validated. Health messages by their nature contain patient identifiable information and also clinical information relating to that patient i.e. Laboratory results, radiology results etc. Security of this information has to be the paramount priority of any system that would be put in place.

Some lessons on how to deal with this can be learned from the Heathlink [31] project already in place in Ireland. As mentioned in section 2.5.1 Healthlink Online allows for the secure transfer of clinical information between hospitals and GPs. Healthlink employs the following safety features to deal with the issue of data security:

- Data Protection Registration: Healthlink requires that any GP Practice involved in the Healthlink project must be registered with the Data Protection Commissioner.
- HTTPS: Healthlink uses 'Hypertext Transfer Protocol Secure' communications protocol, which is designed to transfer encrypted information over the Web. By using this protocol it also enforces users of

the system to login using a combination of Username, Password and PIN Code.

- Browser Certificates: Once registered Healthlink will create a browser certificate for each site. This browser certificate protects the users identity over the internet and is also used to sign and encrypt any messages that are sent.
- Session Management: Each time Healthlink is accessed unique session Ids are generated. After a period of 25 minutes inactivity the session is closed.
- Infrastructure: Healthlink also employ infrastructural security measures for example internet firewalls.

5.4 Future Work

Even from this limited review it is clear that the ability of an online tool to provide automated message validation results of a product against national messaging standards holds huge benefits in realising the adoption and implementation of national messaging standards. The ideal scenario would be to extend this functionality to include a compliance and certification service similar to that offered by AHML. This service provides independent assurance to healthcare organisations that their electronic messaging conforms to required standards and specifications. This could also be extended to include certification of Vendor products e.g. Laboratory systems, when procurement of new systems at a national level is required.

Further work into the development of such an online tool particularly in an Irish context the author believes would be a very worthwhile project.

Chapter 6. Conclusion, Limitations and Future Work

6.1 Conclusion

The aim of this research project is to provide the ability to measure conformance to national messaging standards based on the HL7 version 2 standard which has historically been very difficult to achieve. To accomplish this, a process for the creation of conformance message profiles for use with national messaging standards was developed in conjunction with a message validation and reporting framework. These processes were then evaluated by their application to a national messaging standard called the General Practice Messaging Standard (GPMS). The evaluation criteria were that the processes should yield valid conformance message profiles and that message validation can be performed to check for conformance to the messaging standard. Message validation checked that messages are well formed and valid and that they obey the rules set out in the GPMS for cardinality, usage, length and coded values.

The evaluation of these processes has shown the following:

- The conformance profile creation process has yielded valid conformance profiles required by the specifications set out in the General Practice Messaging Standard. The process also provides scalability in that it is capable of evolving as and when the standard evolves. Adequate fail safes in the form of a version control protocol have been included which can deal with any mistakes that may be introduced during the development phase. This can also be used to track changes and modifications introduced with future revisions.
- Message validation has been shown to provide reliable and accurate violations against the standard for the criteria specified i.e. cardinality, usage, length and coded values.

These findings are in keeping with the research objectives that were set out initially for this project.

6.2 Limitations

The evaluation process also highlighted some of the limitations of this research project. In particular the message sample size used in the evaluation process was very small and a comprehensive evaluation of the process was not possible. The reporting of message violations was also found to be cumbersome. Further work to address these issues is being carried out by the Standards and Technology project team in HIQA. The team have conducted preliminary testing to assess messaging systems conformance to the GPMS and will expand this work on message validation across all sites concerned. The practical application of these processes will address the limitations experienced during this research project. The eventual results and recommendations that the project team identify during the validation process will be compiled and released in a report.

6.3 Future Work

The ability to provide online automated message validation and certification of compliance would hold huge benefits in introducing and deploying messaging standards at a national level. Further work into the development of such an online tool particularly in an Irish context, based on the conformance profile approach, the author believes would be a very valuable project.

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Appendices:

Appendix 1: Detailed description of the GPMS defined Segments

This appendix provides a complete description of the GPMS Segments were defined in the GPMS Master Segment file GPMS_Master_Segments_March2010_ZZZ_ZZZ_v1_1.mwb namely:

- MSH (Message Header) Segment
- PID (Patient Identification) Segment
- EVN (Event) Segment
- PV1 (Patient Visit) Segment
- PV2 (Additional Information) Segment
- PRD (Provider Data) Segment
- DG1 (Diagnosis) Segment
- NTE (Notes & Comments) Segment
- OBR (Observation Request) Segment
- OBX (Observation Result) Segment
- ORC (Common Order) Segment

- SAC (Specimen Container) Segment
- MSA (Message Acknowledgment) Segment
- ERR (Error) Segment

MSH (Message Header) Segment-

The MSH segment defines the intent, source, destination, and some specifics of the syntax of a message.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	MSH.1 - Field Separator	1	ST	R			00001	This field contains the separator between the segment ID and the first real field, MSH-2-encoding characters. As such it serves as the separator and defines the character to be used as a separator for the rest of the message. Recommended value is |, (ASCII 124).
2	MSH.2 - Encoding Characters	4	ST	R			00002	This field contains the four characters in the following order: the component separator, repetition separator, escape character, and subcomponent separator. Recommended values are ^~\& (ASCII 94, 126, 92, and 38, respectively).

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
3	MSH.3 - Sending Application	180	HD	R			00003	This field uniquely identifies the sending application among all other applications within the network enterprise. The network enterprise consists of all those applications that participate in the exchange of HL7 messages within the enterprise. This field further describes the sending application, MSH-3-sending application. The field structure is System or System.Middleware or System.Middleware.Message Number. The optionality of this field is further constrained than the HL7 standard optionality of (O).

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
3	MSH.3/HD.1	50	IS	R		0361		The name of the sending application. This field further describes the sending application, MSH-3-sending application. The field structure is System or System.Middleware or System.Middleware.Message Number.
3	MSH.3/HD.2	50	ST	R				The code associated with the sending application.
3	MSH.3/HD.3	50	ID	R				The coding system used to identify the sending application.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
4	MSH.4 - Sending Facility	180	HD	R			00004	The field is used to define the health agency where the message originated. In the acute setting this may be the department or clinic, in the general practice setting this will be the general practice. This field further describes the sending application, MSH-3-sending application. The optionality of this field is further constrained than the HL7 standard optionality of (O).
4	MSH.4/HD.1	50	IS	O		0362		The name of the sending facility.
4	MSH.4/HD.2	50	ST	R				The code associated with the sending facility.
4	MSH.4/HD.3	50	ID	O				The coding system used to identify the sending facility.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
5	MSH.5 -Receiving Application	180	HD	O			00005	This field uniquely identifies the receiving application among all other applications within the network enterprise.
5	MSH.5/HD.1	50	IS	O		0361		The name of the receiving application.
5	MSH.5/HD.2	50	ST	O				The code associated with the receiving application.
5	MSH.5/HD.3	50	ID	O				The coding system used to identify the receiving application.
6	MSH.6 - Receiving Facility	180	HD	R			00006	The field is used to define the health agency where the message is destined. In the acute setting this may be the department or clinic, in the general practice setting this will be the general practice. The optionality of this field is further constrained than the HL7 standard optionality of (O).
6	MSH.6/HD.1	50	IS	O		0362		The name of the receiving facility.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
6	MSH.6/HD.2	50	ST	R				The code associated with the receiving facility.
6	MSH.6/HD.3	50	ID	O				The coding system used to identify the receiving facility.
7	MSH.7 – Date / Time Of Message	26	TS	R			00007	This field contains the date/time that the sending system created the message.
8	MSH.8 – Security	40	ST	X			00008	Not Currently Used.
9	MSH.9 - Message Type	13	CM	R			00009	The first component is the message type code defined by HL7 Table 0076 - Message type. This table contains values such as ACK, ADT, ORM, ORU etc.. The second component is the trigger event code defined by HL7 Table 0003 - Event type. This table contains values like A01, O01, R01 etc..
9	MSH.9/MSG.1	3	ID	R		0076		This field is the message type code defined by HL7 Table 0076 - Message type. This table contains values such as ACK, ADT, ORM, ORU etc..

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
	MSH.9/MSG.2	3	ID	R		0003		This field is the trigger event code defined by HL7 Table 0003 - Event type. This table contains values like A01, O01, R01 etc..
10	MSH.10 - Message Control ID	20	ST	R			00010	This field contains a number or other identifier that uniquely identifies the message. The receiving system echoes this ID back to the sending system in the Message acknowledgment segment (MSA) where applicable.
11	MSH.11- Processing ID	3	PT	R		0103/0207	00011	This field is used to decide whether to process the message as defined in HL7 Application (level 7) Processing rules.
11	MSH.11/PT.1	3	ID	R				This should be set to P for live messages, T for training messages and D for debugging messages.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
12	MSH.12 - Version ID	60	VID	R		0104	00012	The version id. This should be 2.4.
13	MSH.13- Sequence Number	15	NM	X			00013	Not Currently Used.
14	MSH.14-Continuation Pointer	180	ST	X			00014	Not Currently Used.
15	MSH.15 - Accept Acknowledgment Type	2	ID	O		0155	00015	This field identifies the conditions under which accept acknowledgments are required to be returned in response to this message. Required for enhanced acknowledgment mode.
16	MSH.16 - Application Acknowledgment Type	2	ID	X		0155	00016	Not Currently Used.
17	MSH.17 - Country Code	3	ID	O		0399	00017	This field contains the country of origin for the message. HL7 recommends using ISO table 3166 as the suggested values.
18	MSH.18 - Character Set	16	ID	X		0211	00018	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
19	MSH.19 - Principal Language Of Message	250	CE	O			00019	This field contains the principal language of the message. HL7 recommends using ISO table 639 as the suggested values.
20	MSH.20 - Alternate Character Set Handling Scheme	20	ID	X		0356	00020	Not Currently Used.
21	MSH.21 - Conformance Statement ID	10	ID	X	Y	0449	00021	Not Currently Used.

EVN (Event) Segment

The EVN segment is used to communicate necessary trigger event information to receiving applications.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	ENV.1 - Event Type Code	3	ID	B		0003	00099	**This field has been retained for backward compatibility only.** HL7 recommend using the second component (trigger event) of *MSH-9 - Message Type* to transmit event type code information. This field contains the events corresponding to the trigger events described in this section, e.g., admission, transfer, or registration.
2	ENV.2 Recorded Date/Time	26	TS	R			00100	The date time that the event was recorded on the source system.
2	ENV.2/TS.1	26	TS	R				The date time that the event was recorded on the source system.
3	ENV.3 - Date/Time Planned Event	26	TS	X			00101	Not Currently Used.
4	ENV.4 - Event Reason Code	3	IS	X			00102	Not Currently Used.
5	ENV.5 - Operator ID	250	XCN	X			00103	Not Currently Used.
6	ENV.6 - Event Occurred	26	TS	X			01278	Not Currently Used.
7	ENV.7 Event Facility	180	HD	X			01534	Not Currently Used.

PID (Patient Identification) Segment

The PID segment is used by all applications as the primary means of communicating patient identification information. This segment contains permanent patient identifying and demographic information that, for the most part, is not likely to change frequently.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	PID.1 - Set ID – PID	4	SI	O			000104	This field contains the number that identifies this transaction. For the first occurrence of the segment, the sequence number shall be one, for the second occurrence, the sequence number shall be two, etc..
2	PID.2 - Patient ID	20	CX	X			00105	Not Currently Used.
3	PID.3 - Patient Identifier List	250	CX	R	Y		00106	This field contains the list of identifiers (one or more) used by the healthcare facility to uniquely identify a patient (e.g., medical record number, billing number, national unique individual identifier, etc.).
3	PID.3/CX.1	50	ST	R				The patient identifier.
3	PID.3/CX.4/HD.1	50	ST	R				The name of the authority that assigned the patient identifier.
3	PID.3/CX.4/HD.2	50	IS	O				The code of the assigning authority.
3	PID.3/CX.4/HD.3	50	ID	O		0203		The coding system used to identify the assigning authority.
3	PID.3/CX.5	50	ID	O		0203		The type of identifier in PID.3/CX.1.
4	PID.4 – Alternate Patient ID – PID	20	CX	X	Y		00107	Not Currently Used.
5	PID.5 -Patient Name	250	XPN	R	Y		00108	This field contains the names of the patient.
5	PID.5/XPN.1/FN.1	50	ST	R				Patient's Family Name.
5	PID.5/XPN.2	50	ST	R				Patient's First Name.
5	PID.5/XPN.3	50	ST	O				Middle Names/and or initials.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
5	PID.5/XPN.4	50	ST	O				A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
5	PID.5/XPN.5	50	ST	O				A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
5	PID.5/XPN.6	50	IS	O		0360		Qualifications.
5	PID.5/XPN.7	50	ID	O		0200		Name type code.
6	PID.6 -Mother's Maiden Name	250	XPN	O	Y		00109	This field contains the family name under which the mother was born (i.e., before marriage).
7	PID.7 -Date/Time of Birth	26	TS	C			00110	This field contains the patient's date and time of birth. This field should be populated if known. The structure of the field is YYYYMMDD. Thus, YYYY is used to specify a precision of "year" YYYYMM specifies a precision of "month" YYYYMMDD specifies a precision of "day". The optionality of this field is further constrained than the HL7 standard optionality of (O). If the date of birth is known then it is strongly recommended that is supplied. If the date of birth is unknown a default Date of birth may be supplied and it is recommended that this is indicated using the PID.32 field.
8	PID.8 -Administrative Sex	1	IS	R		0001	00111	This field contains the patient's sex. The optionality of this field is further constrained than the HL7 standard optionality of (O).
9	PID.9 -Patient Alias	250	XPN	B	Y		00112	**This field has been retained for backward compatibility only.** It is recommended to use PID-5 - patient name for all patient names. This field contained the name(s) by which the patient has been known at some time.
10	PID.10 –Race	250	CE	O	Y	0005	00113	This field refers to the patient's race.
11	PID.11 -Patient Address	250	XAD	O	Y		00114	This field contains the mailing address of the patient.
11	PID.11/XAD.1/SAD.1	100	ST	O				Street Address.
11	PID.11/XAD.2	50	ST	O				Address line 2.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
11	PID.11/XAD.3	50	ST	O				Address line 3.
11	PID.11/XAD.4	50	ST	O				Address line 4.
11	PID.11/XAD.5	50	ST	O				Postal code.
12	PID.12 -County Code	4	IS	B		0289	00115	**This field has been retained for backward compatibility only.** This field contains the patient's county code.
13	PID.13 -Phone Number – Home	250	XTN	O	Y		00116	This field contains the patient's personal phone numbers.
13	PID.13/XTN.2	50	ID	O		0201		A code that represents a specific use of a telecommunication number.
13	PID.13/XTN.3	50	ID	O		0202		A code that represents the type of telecommunication equipment.
13	PID.13/XTN.4	50	ST	O				Email address.
13	PID.13/XTN.7	50	NM	O				Phone number.
14	PID.14 -Phone Number – Business	250	XTN	O	Y		00117	This field contains the patient's business telephone numbers.
15	PID.15 -Primary Language	250	CE	O		0296	00118	This field contains the patient's primary language. HL7 recommends using ISO table 639 as the suggested values.
15	PID.15/CE.1	20	ST	O				Primary language code.
15	PID.15/CE.2	50	ST	O				Description of coded language.
15	PID.15/CE.3	20	IS	O				Name of coding system used.
16	PID.16 -Marital Status	250	CE	O		0002	00119	This field contains the patient's marital status.
17	PID.17 –Religion	250	CE	O		0006	00120	This field contains the patient's religion.
18	PID.18 -Patient Account Number	250	CX	O			00121	This field contains the patient account number assigned by accounting to which all charges, payments, etc., are recorded.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
19	PID.19 -SSN Number – Patient	16	ST	B			00122	**This field has been retained for backward compatibility only.** It is recommended to use *PID-3 - Patient Identifier List* for all patient identifiers. However, in order to maintain backward compatibility, this field should also be populated. When used for backward compatibility, this field contains the patient's social security number.
20	PID.20 - Driver's License Number – Patient	25	DLN	X			00123	Not Currently Used.
21	PID.21 -Mother's Identifier	250	CX	O	Y		00124	This field is used, for example, as a link field for newborns. Typically a patient ID or account number may be used.
22	PID.22 -Ethnic Group	250	CE	O	Y	0189	00125	This field further defines the patient's ancestry.
23	PID.23 -Birth Place	250	ST	O			00126	This field indicates the location of the patient's birth.
24	PID.24 -Multiple Birth Indicator	1	ID	O		0136	00127	This field indicates whether the patient was part of a multiple birth.
25	PID.25 -Birth Order	2	NM	O			00128	When a patient was part of a multiple birth, a value (number) indicating the patient's birth order is entered in this field.
26	PID.26 –Citizenship	250	CE	O	Y	0171	00129	This field contains the patient's country of citizenship.
27	PID.27 -Veterans Military Status	250	CE	O		0172	00130	This field contains the military status assigned to a veteran.
28	PID.28 -Nationality	250	CE	B		0212	00739	**This field has been retained for backward compatibility only.** This field contains a code that identifies the nation or national grouping to which the person belongs. This information may be different from a person's citizenship in countries in which multiple nationalities are recognised (for example, Spain: Basque, Catalan, etc.).
29	PID.29 -Patient Death Date and Time	26	TS	C			00740	This field contains the date and time at which the patient death occurred. Please refer to the Death Notification message flow for specific usage of this field.
29	PID.29/TS.1	26	TS	C				The date and time of the patient's death.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
30	PID.30 -Patient Death Indicator	1	ID	C		0136	00741	This field indicates whether the patient is deceased. Please refer to the Death Notification message flow for specific usage of this field.
31	PID.31 Identity Unknown Indicator	1	ID	O		0136	01535	This field indicates whether or not the patient's/person's identity is known.
32	PID.32 -Identity Reliability Code	20	IS	O	Y	0445	01536	This field contains a coded value used to communicate information regarding the reliability of patient/person identifying data transmitted via a transaction. Values could indicate that certain fields on a PID segment for a given patient/person are known to be false (e.g., use of default or system-generated values for Date of Birth)
33	PID.33 -Last Update Date/Time	26	TS	X			01537	Not Currently Used.
34	PID.34 -Last Update Facility	40	HD	X			01538	Not Currently Used.
35	PID.35 -Species Code	250	CE	X		0446	01539	Not Currently Used.
36	PID.36 -Breed Code	250	CE	X		0447	01540	Not Currently Used.
37	PID.37 –Strain	80	ST	X			01541	Not Currently Used.
38	PID.38 - Production Class Code	250	CE	X		0429	01542	Not Currently Used.

PV1 (Patient Visit) Segment

The PV1 segment is used by registration/patient administration applications to communicate information on an account or visit-specific basis.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	PV1.1 - Set ID	4	SI	O			00131	This field contains the number that identifies this transaction. For the first occurrence of the segment, the sequence number shall be one, for the second occurrence, the sequence number shall be two, etc..
2	PV1.2 - Patient Class	1	IS	R		0004	00132	This field identifies the class of the patient in terms of Inpatient, Outpatient, Emergency, Unknown etc..
3	PV1.3 - Assigned Patient Location	80	PL	O			00133	This field contains the patient's initial assigned location or the location to which the patient is being moved e.g. Radiology Department. The first component may be the nursing station for inpatient locations, or clinic or department, for locations other than inpatient.
3	PV1.3/PL.4/HD.1	40	IS	O				The name of the assigned patient location.
3	PV1.3/PL.4/HD.2	10	ST	O				The code associated with the assigned patient location.
3	PV1.3/PL.4/HD.3	10	ID	O				The coding system used to identify the assigned patient location.
3	PV1.3/PL.9	80	ST	O				The location of the patient as plain text.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
4	PV1.4 - Admission Type	2	IS	O		0007	00134	This field indicates the circumstances under which the patient was or will be admitted.
5	PV1.5 - Preadmit Number	250	CX	X			00135	Not Currently Used.
6	PV1.6 - Prior Patient Location	80	PL	X			00136	Not Currently Used.
7	PV1.7 - Attending Doctor	250	XCN	O	Y	0010	00137	This field identifies the healthcare practitioner responsible for care of the patient. It is recommended that the doctors' name and professional identifier are supplied.
7	PV1.7/XCN.1	50	ST	O				The identifier for the attending doctor.
7	PV1.7/XCN.2/FN.1	50	ST	O				The family name of the attending doctor.
7	PV1.7/XCN.3	50	ST	O				The first name of the attending doctor.
7	PV1.7/XCN.4	50	ST	O				Middle names/and or initials.
7	PV1.7/XCN.5	50	ST	O				The name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
7	PV1.7/XCN.6	50	ST	O				A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
8	PV1.8 - Referring Doctor	250	XCN	O	Y	0010	00138	This field identifies the healthcare practitioner responsible for referring the patient. It is recommended that the doctors' name and professional identifier is supplied.
8	PV1.8/XCN.1	50	ST	O				The identifier for the doctor.
8	PV1.8/XCN.2/FN.1	50	ST	O				The family name of the referring doctor.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
8	PV1.8/XCN.3	50	ST	O				The first name of the referring doctor.
8	PV1.8/XCN.4	50	ST	O				Middle names/and or initials.
8	PV1.8/XCN.5	50	ST	O				The name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
8	PV1.8/XCN.6	50	ST	O				The name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
9	PV1.9 - Consulting Doctor	250	XCN	B	Y	0010	00139	**This field has been retained for backward compatibility only**. This field contains the consulting physician information. Some hospital use this field to identify other healthcare professionals involved in this episode of care.
9	PV1.9/XCN.1	50	ST	O				The identifier for the consulting doctor.
9	PV1.9/XCN.2/FN.1	50	ST	O				The family name of the consulting doctor.
9	PV1.9/XCN.3	50	ST	O				The first name of the consulting doctor.
9	PV1.9/XCN.4	50	ST	O				The middle names/and or initials of the consulting doctor.
9	PV1.9/XCN.5	50	ST	O				The name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
9	PV1.9/XCN.6	50	ST	O				The name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
10	PV1.10 - Hospital Service	3	IS	X		0069	00140	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
11	PV1.11- Temporary Location	80	PL	X			00141	Not Currently Used.
12	PV1.12- Preadmit Test Indicator	2	IS	X		0087	00142	Not Currently Used.
13	PV1.13 - Re-admission Indicator	2	IS	X		0092	00143	Not Currently Used.
14	PV1.14 - Admit Source	6	IS	C		0023	00144	This field indicates where the patient was admitted. Please refer to the A&E Notification and Admission Notification workflows for specific usage of this field.
15	PV1.15 - Ambulatory Status	2	IS	O	Y	0009	00145	This field indicates any permanent or transient disability.
16	PV1.16 - VIP Indicator	2	IS	X		0099	00146	Not Currently Used.
17	PV1.17 - Admitting Doctor	250	XCN	X	Y	0010	00147	Not Currently Used.
18	PV1.18 - Patient Type	2	IS	X		0018	00148	Not Currently Used.
19	PV1.19 - Visit Number	250	CX	O			00149	This field contains the unique number assigned to each patient visit.
19	PV1.19/CX.1	20	ST	O				The hospitals episode number.
20	PV1.20 - Financial Class	50	FC	O	Y	0064	00150	This field contains the financial class(es) assigned to the patient for the purpose of identifying sources of reimbursement.
20	PV1.20/FC.1	20	IS	O				Financial class code of the patient, as per the user defined table.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
20	PV1.20/FC.2	26	TS	O				Effective date.
21	PV1.21 - Charge Price Indicator	2	IS	X		0032	00151	Not Currently Used.
22	PV1.22 - Courtesy Code	2	IS	X		0045	00152	Not Currently Used.
23	PV1.23- Credit Rating	2	IS	X		0046	00153	Not Currently Used.
24	PV1.24 - Contract Code	2	IS	X	Y	0044	00154	Not Currently Used.
25	PV1.25 - Contract Effective Date	8	DT	X	Y		00155	Not Currently Used.
26	PV1.26 - Contract Amount	12	NM	X	Y		00156	Not Currently Used.
27	PV1.27- Contract Period	3	NM	X	Y		00157	Not Currently Used.
28	PV1.28 - Interest Code	2	IS	X		0073	00158	Not Currently Used.
29	PV1.29 - Transfer to Bad Debt Code	1	IS	X		0110	00159	Not Currently Used.
30	PV1.30- Transfer to Bad Debt Date	8	DT	X			00160	Not Currently Used.
31	PV1.31 - Bad Debt Agency Code	10	IS	X		0021	00161	Not Currently Used.
32	PV1.32- Bad Debt Transfer Amount	12	NM	X			00162	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
33	PV1.33- Bad Debt Recovery Amount	12	NM	X			00163	Not Currently Used.
34	PV1.34- Delete Account Indicator	1	IS	X		0111	00164	Not Currently Used.
35	PV1.35 - Delete Account Date	8	DT	X			00165	Not Currently Used.
36	PV1.36 - Discharge Disposition	3	IS	C		0112	00166	This field contains the disposition of the patient at time of discharge (i.e., discharged to home, expired, etc.). The optionality of this field is further constrained than the HL7 standard optionality of (O). Please refer to message flow Discharge Summary message flow for specific usage of this field.
37	PV1.37 - Discharged to Location	25	CM	C		0113	00167	This field indicates the healthcare facility to which the patient was discharged. The optionality of this field is further constrained than the HL7 standard optionality of (O). Please refer to Discharge Summary message flow for specific usage of this field.
37	PV1.37/DLD.1	25	IS	O				If the patient is discharged to another coded location it should be indicated here.
38	PV1.38 - Diet Type	250	CE	X		0114	00168	Not Currently Used.
39	PV1.39 - Servicing Facility	2	IS	X		0115	00169	Not Currently Used.
40	PV1.40 - Bed Status	1	IS	X		0116	00170	Not Currently Used.
41	PV1.41 - Account Status	2	IS	X		0117	00171	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
42	PV1.42- Pending Location	80	PL	X			00172	Not Currently Used.
43	PV1.43- Prior Temporary Location	80	PL	X			00173	Not Currently Used.
44	PV1.44- Admit Date/Time	26	TS	C			00174	The date/time the patient was admitted. The optionality of this field is further constrained than the HL7 standard optionality of (O). Please refer to the A&E Notification and Admission Notification workflow for specific usage of this field.
45	PV1.45- Discharge Date/Time	26	TS	C	Y		00175	The date/time the patient was discharged. The optionality of this field is further constrained than the HL7 standard optionality of (O). Please refer to message flow Please refer to Discharge Notification and Discharge summary message flow
46	PV1.46 - Current Patient Balance	12	NM	X			00176	Not Currently Used.
47	PV1.47- Total Charges	12	NM	X			00177	Not Currently Used.
48	PV1.48- Total Adjustments	12	NM	X			00178	Not Currently Used.
49	PV1.49- Total Payments	12	NM	X			00179	Not Currently Used.
50	PV1.50 - Alternate Visit ID	250	CX	X		0203	00180	Not Currently Used.
51	PV1.51- Visit Indicator	1	IS	O		0326	01226	This field specifies the level on which data are being sent.
52	PV1.52- Other Healthcare Provider	250	XCN	X	Y	0010	01274	Not Currently Used.

PV2 (Event Type additional Information) Segment

The PV2 segment is a continuation of information contained on the PV1 segment.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	PV2.1 - Prior Pending Location	80	PL	X			00181	Not Currently Used.
2	PV2.2 - Accommodation Code	250	CE	X		0129	00182	Not Currently Used.
3	PV2.3 - Admit Reason	250	CE	X			00183	Not Currently Used.
4	PV2.4 - Transfer Reason	250	CE	X			00184	Not Currently Used.
5	PV2.5 - Patient Valuables	25	ST	X	Y		00185	Not Currently Used.
6	PV2.6 - Patient Valuables Location	25	ST	X			00186	Not Currently Used.
7	PV2-7 - Visit User Code	2	IS	X	Y	0130	00187	Not Currently Used.
8	PV2.8 - Expected Admit Date/Time	26	TS	X			00188	Not Currently Used.
9	PV2.9 - Expected Discharge Date/Time	26	TS	X			00189	Not Currently Used.
10	PV2.10 - Estimated Length of Inpatient Stay	3	NM	X			00711	Not Currently Used.
11	PV2.11 - Actual Length of Inpatient Stay	3	NM	X			00712	Not Currently Used.
12	PV2.12 - Visit Description	50	ST	X			00713	Not Currently Used.
13	PV2.13 - Referral Source Code	250	XCN	X	Y		00714	Not Currently Used.
14	PV2.14 - Previous Service Date	8	DT	X			00715	Not Currently Used.
15	PV2.15 - Employment Illness Related Indicator	1	ID	X		0136	00716	Not Currently Used.
16	PV2.16 - Purge Status Code	1	IS	X		0213	00717	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
17	PV2.17 - Purge Status Date	8	DT	X			00718	Not Currently Used.
18	PV2.18 - Special Program Code	2	IS	X		0214	00719	Not Currently Used.
19	PV2.19 - Retention Indicator	1	ID	X		0136	00720	Not Currently Used.
20	PV2.20 - Expected Number of Insurance Plans	1	NM	X			00721	Not Currently Used.
21	PV2.21 - Visit Publicity Code	1	IS	X		0215	00722	Not Currently Used.
22	PV2.22 - Visit Protection Indicator	1	ID	X		0136	00723	Not Currently Used.
23	PV2.23 - Clinic Organization Name	250	XON	X	Y		00724	Not Currently Used.
24	PV2.24 - Patient Status Code	2	IS	X		0216	00725	Not Currently Used.
25	PV2.25 - Visit Priority Code	1	IS	X		0217	00726	Not Currently Used.
26	PV2.26 - Previous Treatment Date	8	DT	X			00727	Not Currently Used.
27	PV2.27 - Expected Discharge Disposition	2	IS	X		0112	00728	Not Currently Used.
28	PV2.28 - Signature on File Date	8	DT	X			00729	Not Currently Used.
29	PV2.29 - First Similar Illness Date	8	DT	X			00730	Not Currently Used.
30	PV2.30 - Patient Charge Adjustment Code	250	CE	X		0218	00731	Not Currently Used.
31	PV2.31 - Recurring Service Code	2	IS	X		0219	00732	Not Currently Used.
32	PV2.32 - Billing Media Code	1	ID	X		0136	00733	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
33	PV2.33 - Expected Surgery Date and Time	26	TS	X			00734	Not Currently Used.
34	PV2.34 - Military Partnership Code	1	ID	X		0136	00735	Not Currently Used.
35	PV2.35 - Military Non-Availability Code	1	ID	X		0136	00736	Not Currently Used.
36	PV2.36 - Newborn Baby Indicator	1	ID	X		0136	00737	Not Currently Used.
37	PV2.37 - Baby Detained Indicator	1	ID	X		0136	00738	Not Currently Used.
38	PV2.38 - Mode of Arrival Code	250	CE	O		0430	01543	Identifies how the patient was brought to the healthcare facility.
38	PV2.38/CE.1	20	ST	O				The code indicating how the patient arrived at the healthcare facility.
38	PV2.38/CE.2	50	ST	O				The accompanying text for the code in PV2.38/CE.1.
38	PV2.38/CE.3	20	IS	O		0396		The coding system used in PV2.38/CE.1.
39	PV2.39 - Recreational Drug Use Code	250	CE	X	Y	0431	01544	Not Currently Used.
40	PV2.40 - Admission Level of Care Code	250	CE	X		0432	01545	Not Currently Used.
41	PV2.41 - Precaution Code	250	CE	X	Y	0433	01546	Not Currently Used.
42	PV2.42 - Patient Condition Code	250	CE	X		0434	01547	Not Currently Used.
43	PV2.43 - Living Will Code	2	IS	X		0315	00759	Not Currently Used.
44	PV2.44 - Organ Donor Code	2	IS	X		0316	00760	Not Currently Used.
45	PV2.45 - Advance Directive Code	250	CE	X	Y	0435	01548	Not Currently Used.
46	PV2.46 - Patient Status Effective Date	8	DT	X			01549	Not Currently Used.
47	PV2.47 - Expected LOA Return Date/Time	26	TS	X			01550	Not Currently Used.

PRD (Provider Data) Segment

This segment will be employed as part of a patient referral message and its related transactions.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	PRD.1 - Provider Role	250	CE	R	Y		01155	This field contains the contact role that defines the relationship of the person described in this segment to the patient being referred.
1	PRD.1/CE.1	20	ST	R		0286		The provider role. This field contains the contact role that defines the relationship of the person described in this segment to the patient being referred.
2	PRD.2 Provider Name	250	XPN	C	Y		01156	This field contains the name of the provider. Please refer to the Online Referral work flow for specific usage of this field.
2	PRD.2/XPN.1/FN.1	194	ST	O				The provider's family name.
2	PRD.2/XPN.2	30	ST	O				The provider's first name.
2	PRD.2/XPN.3	30	ST	O				Middle names and/or initials
2	PRD.2/XPN.4	20	ST	O				Name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
2	PRD.2/XPN.5	20	ST	O				Name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
3	PRD.3 Provider Address	250	XAD	C	Y		01157	This field contains the mailing address of the provider identified in this segment. Please refer to the Online Referral work flow for specific usage of this field.
3	PRD.3/XAD.1/SAD.1	100	ST	O				Street Address.
3	PRD.3/XAD.2	50	ST	O				Address Line 2.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
3	PRD.3/XAD.3	50	ST	O				Address Line 3.
3	PRD.3/XAD.4	50	ST	O				Address Line 4.
4	PRD.4 Provider Location	60	PL	C			01158	This field contains the location of the provider as needed when a provider that may be external to a given enterprise must be referenced. Please refer to the Online Referral work flow for specific usage of this field.
4	PRD.4/PL.1	50	IS	O				Point of Care.
4	PRD.4/PL.6	50	IS	O				Person Location Type.
4	PRD.4/PL.9	50	ST	O				Location Description.
5	PRD.5 Provider Communication Information	250	XTN	C	Y		01159	This field contains information, such as the phone number or electronic mail address, used to communicate with the provider or organization. Please refer to the Online Referral work flow for specific usage of this field.
5	PRD.5/XTN.1	20	C	O				Phone Number.
6	PRD.6 Preferred Method of Contact - Provider	250	CE	X		0185	00684	Not Currently Used.
7	PRD.7 Provider Identifiers	100	CM	C	Y		01162	Provider identifiers. Please refer to the Online Referral work flow for specific usage of this field.
7	PRD.7/PI.1	20	ID	O				This repeating field contains the provider's unique identifiers.
7	PRD.7/PI.2	20	IS	O				Type of ID Number (IS).
7	PRD.7/PI.3	20	ST	O				Other qualifying information.
8	PRD.8 Effective Start Date of Provider Role	26	TS	X			01163	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
9	PRD.9 Effective End Date of Provider Role	26	TS	X			01164	Not Currently Used.

DG1 (Diagnosis) Segment

The DG1 segment contains patient diagnosis information of various types, for example, admitting, primary, etc. The DG1 segment is used to send multiple diagnoses (for example, for medical records encoding).

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	DG1.1 - Set ID - DG1	4	SI	R			00375	This field contains the number that identifies this transaction. For the first occurrence of the segment the sequence number shall be 1, for the second occurrence it shall be 2, etc..
2	Dg1.2 - Diagnosis Coding Method	2	ID	(B) R		0053	00376	**This field has been retained for backward compatibility only.** Use the components of *DG1.3* instead of this field.
3	DG1.3 - Diagnosis Code - DG1	250	CE	O		0051	00377	This field contains the diagnosis code. Use this field instead of *DG1.2* and *DG1.4.*
3	DG1.3/CE.1	20	ST	O		0051		Local Code for the diagnosis.
3	DG1.3/CE.2	199	ST	O				The diagnosis text associated with the code in DG1.3/CE.1.
3	DG1.3/CE.3	20	IS	O				The coding system used in DG1.3/CE.1. They should contain 'L' if used.
4	DG1.4 - Diagnosis Description	40	ST	B			00378	**This field has been retained for backward compatibility only.** It is recommended to use the components of *DG1-3 - diagnosis code-DG1* field instead of this field.
5	DG1.5 - Diagnosis Date/Time	26	TS	O			00379	This field contains the date/time that the diagnosis was determined.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
6	DG1.6 - Diagnosis Type	2	IS	R		0052	00380	This field contains a code that identifies the type of diagnosis being sent.
7	DG1.7 - Major Diagnostic Category	250	CE	X		0118	00381	Not Currently Used.
8	DG1.8 - Diagnostic Related Group	250	CE	X		0055	00382	Not Currently Used.
9	DG1.9 - DRG Approval Indicator	1	ID	X		0136	00383	Not Currently Used.
10	DG1.10 - DRG Grouper Review Code	2	IS	X		0056	00384	Not Currently Used.
11	DG1.11 - Outlier Type	250	CE	X		0083	00385	Not Currently Used.
12	DG1.12 - Outlier Days	3	NM	X			00386	Not Currently Used.
13	DG1.13 - Outlier Cost	12	CP	X			00387	Not Currently Used.
14	DG1.14 - Grouper Version And Type	4	ST	X			00388	Not Currently Used.
15	DG1.15 - Diagnosis Priority	2	ID	X		0359	00389	Not Currently Used.
16	DG1.16 - Diagnosing Clinician	250	XCN	O	Y		00390	This field contains the individual responsible for generating the diagnosis information.
16	DG1.16/XCN.1	50	ST	O				The individual responsible for the diagnosis.
16	DG1.16/XCN.2/FN.1	50	ST	O				The family name of the diagnosing clinician.
16	DG1.16/XCN.3	50	ST	O				The first name of the Diagnosing clinician.
16	DG1.16/XCN.4	50	ST	O				Middle Names and/or Initials.
16	DG1.16/XCN.5	50	ST	O				The name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
16	DG1.16/XCN.6	50	ST	O				The name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
17	DG1.17 - Diagnosis Classification	3	IS	X		0228	00766	Not Currently Used.
18	DG1.18 - Confidential Indicator	1	ID	X		0136	00767	Not Currently Used.
19	DG1.19 - Attestation Date/Time	26	TS	X			00768	Not Currently Used.

NTE (Notes & Comments) Segment

The NTE segment is commonly used for sending notes and comments.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	NTE.1 - Set ID - NTE	4	SI	O			00096	This field may be used where multiple NTE segments are included in a message. Their numbering must be described in the application message definition.
2	NTE.2 - Source of Comment	8	ID	O		0105	00097	This field is used when source of comment must be identified.
3	NTE.3 - Comment	65536	FT	O	Y		00098	This field contains the comment contained in the segment.
4	NTE.4 - Comment Type	250	CE	X		0364	01318	Not Currently Used.

OBR (Observation Request) Segment

The observation request segment is used to transmit information specific to an order for a diagnostic study or observation, physical exam, or assessment.In the reporting of clinical data, the OBR serves as the report header. It includes the relevant ordering information when that applies. It contains many of the fields that usually apply to all of the included observations. When a set of observations is ordered, the order message contains an OBR segment. However, observations can be collected and reported without an antecedent order. When observations are reported, the report message also includes one or more OBR segments.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	OBR.1 - Set ID	4	SI	R			00237	For the first order transmitted, the sequence number shall be 1; for the second order, it shall be 2; and so on. The optionality of this field is further constrained than the HL7 standard optionality of (O).
2	OBR.2 - Placer Order Number	22	EI	C			00216	This field is a case of the Entity Identifier data type. Please refer to message flow Laboratory Order and Referral work flows for specific usage of this field.
2	OBR.2/EI.1	22	ST	C				If the system that placed the order provided a reference to the filler, then it should be entered here.
3	OBR.3 - Filler Order Number	22	EI	C			00217	This field is the order number associated with the filling application. Please refer to message flow Laboratory and Radiology Results work flows for specific usage of this field. The optionality of this field is further constrained than

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
								the HL7 standard optionality of (O). It is strongly recommended that one of OBR.3/EI.1, OBR.3/EI.2 or OBR.3/EI.3 is populated.
3	OBR.3/EI.1	22	ST	C		0363		The order number of the system that received the order.
3	OBR.3/EI.2	50	IS	C				The numeric identifier of the system that received the order.
3	OBR.3/EI.3	50	ST	C				The name of the system that received the order.
3	OBR.3/EI.4	50	ID	C		0301		The universal id of the system that received the order.
4	OBR.4 - Universal Service Identifier	250	CE	R			00238	This field is the identifier code for the requested observation/test/battery.
4	OBR.4/CE.1	20	ST	O				The code for observation/test.
4	OBR.4/CE.2	50	ST	R				Meaningful description of the test being ordered or a meaningful description of the overall set of OBX's included under each OBR. For example: Hemoglobin, Urea & Electrolytes.
4	OBR.4/CE.3	20	IS	O		0396		The coding system used in OBR.4/CE.1.
4	OBR.4/CE.4	20	ST	O				Code for the observation/test. Reserved for adoption of national coding system.
4	OBR.4/CE.5	50	ST	O				Meaningful description of the Lab/Radiology Test. Reserved for adoption of national coding system.
4	OBR.4/CE.6	20	IS	O		0396		Coding system used in OBR.4/CE.4. Reserved for adoption of national coding system.
5	OBR.5 - Priority - OBR	2	ID	X			00239	Not Currently Used.
6	OBR.6 - Requested Date/Time	26	TS	X			00240	Not Currently Used.
7	OBR.7 - Observation Date/Time	26	TS	C			00241	This field is the clinically relevant date/time of the observation. When the OBR is transmitted as part of a report message, the field **must** be filled in. If it is

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
								transmitted as part of a request **and** a sample has been sent along as part of the request, this field must be filled in because this specimen time is the physiologically relevant date/time of the observation. Please refer to Laboratory Results and Radiology Results message flows for specific usage of this field.
7	OBR.7/TS.1	26	TS	C				The date and time the specimen was collected or obtained.
8	OBR.8 - Observation End Date/Time	26	TS	O			00242	This field contains the end date and time of a study or timed specimen collection.
9	OBR.9 - Collection Volume	20	CQ	O			00243	For laboratory tests, the collection volume is the volume of a specimen.
10	OBR.10 - Collector Identifier	250	XCN	O	Y		00244	When a specimen is required for the study, this field will identify the person, department, or facility that collected the specimen.
11	OBR.11 - Specimen Action Code	1	ID	O		0065	00245	This field identifies the action to be taken with respect to the specimens that accompany or precede this order.
12	OBR.12 - Danger Code	250	CE	O			00246	This field contains the code and/or text indicating any known or suspected patient or specimen hazards, e.g., patient with active tuberculosis or blood from a

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
								hepatitis patient.
13	OBR.13 - Relevant Clinical Info.	300	ST	O			00247	This field contains any additional clinical information about the patient or specimen. It is strongly recommended that this field is populated where clinically appropriate.
14	OBR.14 - Specimen Received Date/Time	26	TS	C			00248	The time that the specimen was received at dispatch. Please refer to message flow Laboratory Order and Laboratory Results work flow for specific usage of this field.
15	OBR.15 – Specimen Source	300	CM	O		0070	00249	This field identifies the site where the specimen should be obtained or where the service should be performed.
15	OBR.15/SPS.1/CE.1	20	ST	O				The specimen source code.
15	OBR.15/SPS.1/CE.2	50	ST	O		0070		Meaningful specimen source code description.
15	OBR.15/SPS.1/CE.3	20	IS	O				Coding system used in CE.1
15	OBR.15/SPS.1/CE.4	20	ST	O				Alternate specimen source code.
15	OBR.15/SPS.1/CE.5	50	ST	O				Alternate specimen description.
15	OBR.15/SPS.1/CE.6	20	IS	O				Alternate coding system used in CE.4

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
15	OBR.15/SPS.2	50	ST	O				Text describing additives.
15	OBR.15/SPS.3	50	ST	O				Simple Free Text.
15	OBR.15/SPS.4/CE.2	50	ST	O				Text description of body site.
15	OBR.15/SPS.5/CE.2	50	ST	O				Text description of site modifier.
15	OBR.15/SPS.6/CE.2	50	ST	O				Text description of collection method.
16	OBR.16 - Ordering Provider	250	XCN	O	Y		00226	This field identifies the provider who ordered the test. Either the identifier code or the name, or both, may be present. This is the same as ORC-12-Ordering provider.
16	OBR.16/XCN.1	50	ST	O				Identifier of the person ordering.
16	OBR.16/XCN.6	50	ST	O				Name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
16	OBR.16/XCN.16	50	CE	O		0448		<Copy To> Indicator Prefix.
17	OBR.17 - Order Callback Phone Number	250	XTN	O	Y/2		00250	This field is the telephone number to call when reporting a status or a result.
17	OBR.17/XTN.1	199	TN	O				Telephone Number.
17	OBR.17/XTN.2	3	ID	O		0201		Telecommunications Use Code.
17	OBR.17/XTN.3	8	ID	O		0202		Telecommunications Equipment Type.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
18	OBR.18 - Placer Field 1	60	ST	X			00251	Not Currently Used.
19	OBR.19 - Placer Field 2	60	ST	X			00252	Not Currently Used.
20	OBR.20 - Filler Field 1	60	ST	X			00253	Not Currently Used.
21	OBR.21 - Filler Field 2	60	ST	X			00254	Not Currently Used.
22	OBR.22 - Results Rpt/Status Chng - Date/Time	26	TS	C			00255	This field specifies the date/time when the results were reported or status changed.
23	OBR.23 - Charge to Practice	40	CM	X			00256	Not Currently Used.
24	OBR.24 - Diagnostic Serv Sect ID	10	ID	C		0074	00257	This field is the section of the diagnostic service where the observation was performed. If the study was performed by an outside service, the identification of that service should be recorded here. Please refer to message flow Laboratory Results, Radiology Results for specific usage of this field.
25	OBR.25 - Result Status	1	ID	C		0123	00258	This field is the status of results for this order. Please refer to Laboratory Results and Radiology Results work flows for specific usage of this field.
26	OBR.26 – Parent Result	400	CM	O			00259	This field is defined to make it available for other types of linkages (e.g., toxicology). This important information, together with the information in *OBR-29-parent,* uniquely identifies the parent result's OBX segment related to this order. The value of this OBX segment in the parent result is the organism or chemical species about which this battery reports.
27	OBR.27 - Quantity/Timing	200	TQ	O	Y		00221	This field contains information about how many services to perform at one service time and how

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
								often the service times are repeated, and to fix duration of the request.
27	OBR.27/TQ.1	200	CQ	O				Quantity.
28	OBR.28 - Result Copies To	250	XCN	O	Y/5		00260	This field is the people who are to receive copies of the results. By local convention, either the identifier number or the name may be absent.
28	OBR.28/XCN.1	50	ST	O				Identifier of the person being copied (e.g. GP's GP code).
28	OBR.28/XCN.2/FN.1	50	ST	O				Family Name.
28	OBR.28/XCN.3	50	ST	O				First Name.
28	OBR.28/XCN.4	50	ST	O				Middle/ Other Names.
28	OBR.28/XCN.5	50	ST	O				Name suffix. A name suffix follows a person's full name and provides additional information about the person, for example M.A, M.F.A, MBA, Ph.D.
28	OBR.28/XCN.6	50	ST	O				Name prefix. A name prefix precedes a person's full name and provides additional information about the person, for example Dr, Mr.
28	OBR.28/XCN.16	50	CE	O		0448		<Copy To> indicator string.
29	OBR.29 - Parent	200	CM	O			00261	This field is identical to *ORC-8-parent*. This field relates a child to its parent when a parent/child relationship exists.
30	OBR.30 - Transportation Mode	20	ID	X		0124	00262	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
31	OBR.31 - Reason for Study	250	CE	X	Y		00263	Not Currently Used.
32	OBR.32 - Principal Result Interpreter	200	CM	O			00264	This field identifies the physician or other clinician who interpreted the observation and is responsible for the report content.
33	OBR.33 - Assistant Result Interpreter	200	CM	X	Y		00265	Not Currently Used.
34	OBR.34 - Technician	200	CM	X	Y		00266	Not Currently Used.
35	OBR.35 - Transcriptionist	200	CM	X	Y		00267	Not Currently Used.
36	OBR.36 - Scheduled Date/Time	26	TS	X			00268	Not Currently Used.
37	OBR.37 - Number of Sample Containers	4	NM	X			01028	Not Currently Used.
38	OBR.38 - Transport Logistics of Collected Sample	250	CE	X	Y		01029	Not Currently Used.
39	OBR.39 - Collector's Comment	250	CE	X	Y		01030	Not Currently Used.
40	OBR.40 - Transport Arrangement Responsibility	250	CE	X			01031	Not Currently Used.
41	OBR.41 - Transport Arranged	30	ID	X		0224	01032	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
42	OBR.42 - Escort Required	1	ID	X		0225	01033	Not Currently Used.
43	OBR.43 - Planned Patient Transport Comment	250	CE	X	Y		01034	Not Currently Used.
44	OBR.44 - Procedure Code	250	CE	X		0088	00393	Not Currently Used.
45	OBR.45 - Procedure Code Modifier	250	CE	X	Y	0340	01316	Not Currently Used.
46	OBR.46 - Placer Supplemental Service Information	250	CE	X	Y	0411	01474	Not Currently Used.
47	OBR.47 - Filler Supplemental Service Information	250	CE	X	Y	0411	01475	Not Currently Used.

OBX (Observation Result) Segment

The OBX segment is used to transmit a single observation or observation fragment. It represents the smallest indivisible unit of a report.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	OBX.1 - Set ID	4	SI	R			00569	This field contains the sequence number. For compatibility with ASTM. The optionality of this field is further constrained than the HL7 standard optionality of (O).
2	OBX.2- Value Type	2	ID	C		0125	00570	This field contains the format of the observation value in OBX. It must be valued if OBX-11-Observ result status is not valued with an 'X" meaning the result cannot be obtained or this observation.
3	OBX.3 - Observation Identifier	250	CE	R			00571	This field should contain a unique identifier for the observation.
3	OBX.3/CE.1	20	ST	R				The code for the OBX.3/CE.2 description.
3	OBX.3/CE.2	50	ST	R				A description of the test or observation.
3	OBX.3/CE.3	20	IS	R				The coding system used in CE.1.
3	OBX.3/CE.4	20	ST	O				Alternate code for the test or observation.
3	OBX.3/CE.5	50	ST	O				Alternate description of the radiology test.
3	OBX.3/CE.6	20	IS	O				The alternate coding system used in CE.4.
4	OBX.4 - Observation Sub-ID	20	ST	O			00572	This field is used to distinguish between multiple OBX segments with the same observation ID organised under one OBR.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
5	OBX.5 - Observation Value	65536	*	C	Y		00573	This field contains the value observed by the observation producer. OBX-2-value type contains the data type for this field according to which observation value is formatted. It is not a required field because some systems will report only the normalcy/abnormalcy (OBX-8), especially in product experience reporting.
6	OBX.6 - Units	250	CE	O			00574	When an observation's value is measured on a continuous scale, one must report the measurement units within the units field of the OBX segment.
6	OBX.6/CE.1	20	ST	O				The code for the units used.
6	OBX.6/CE.2	50	ST	O				The actual units used as text (not a code).
6	OBX.6/CE.3	50	IS	O				The coding system used for the units.
7	OBX.7 - References Range	60	ST	O			00575	This field contains the reference range for this particular test.
8	OBX.8 - Abnormal Flags	5	IS	O	Y/5	0078	00576	This field contains a table lookup indicating the normalcy status of the result. This field may not be valued for certain laboratory results e.g. Microbiology Results.
9	OBX.9 - Probability	5	NM	X			00577	Not Currently Used.
10	OBX.10 - Nature of Abnormal Test	2	ID	X	Y	0080	00578	Not Currently Used.
11	OBX.11 - Observation Result Status	1	ID	R		0085	00579	This field contains the observation result status. This field reflects the current completion status of the results for one Observation Identifier.
12	OBX.12 - Date Last Observation Normal Value	26	TS	X			00580	Not Currently Used.
13	OBX.13 - User Defined Access Checks	20	ST	X			00581	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
14	OBX.14 - Date/Time of the Observation	26	TS	O			00582	In the case of tests performed on specimens, the relevant date-time is the specimen's collection date-time. In the case of observations taken directly on the patient (e.g., X-ray images, history and physical), the observation date-time is the date-time that the observation was performed.
15	OBX.15 - Producer's ID	250	CE	O			00583	This field contains a unique identifier of the responsible producing service. It should be reported explicitly when the test results are produced at outside laboratories.
16	OBX.16 - Responsible Observer	250	XCN	O	Y		00584	When required, this field contains the identifier of the individual directly responsible for the observation (i.e., the person who either performed or verified it).
17	OBX.17 - Observation Method	250	CE	X	Y		00936	Not Currently Used.
18	OBX.18 - Equipment Instance Identifier	22	EI	X	Y		01479	Not Currently Used.
19	OBX.19 - Date/Time of the Analysis	26	TS	X			01480	Not Currently Used.

ORC (Common Order) Segment

The common order segment is used to transmit fields that are common to all orders (all types of services that are requested).

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	ORC.1 - Order Control	2	ID	R	N	0119	00215	Determines the function of the order segment.
2	ORC.2 - Placer Order Number						00216	Not Currently Used.
3	ORC.3 - Filler Order Number	22	EI	X			00217	Not Currently Used.
4	ORC.4 - Placer Group Number	22	EI	X			00218	Not Currently Used.
5	ORC.5 - Order Status	2	ID	X	N	0038	00219	Not Currently Used.
6	ORC.6 - Response Flag	1	ID	X		0121	00220	Not Currently Used.
7	ORC.7 - Quantity/Timing	200	TQ	X	Y		00221	Not Currently Used.
8	ORC.8 - Parent	200	CM	X			00222	Not Currently Used.
9	ORC.9 - Date/Time of Transaction	26	TS	X			00223	Not Currently Used.
10	ORC.10 - Entered By	250	XCN	X	Y		00224	Not Currently Used.
11	ORC.11 - Verified By	250	XCN	X	Y		00225	Not Currently Used.
12	ORC.12 - Ordering Provider	250	XCN	X	Y		00226	Not Currently Used.
13	ORC.13 - Enterer's Location	80	PL	X			00227	Not Currently Used.
14	ORC.14 - Call Back Phone Number	250	XTN	O	Y/2		00228	This field contains the telephone number to call for clarification of a request or other information regarding the order.
14	ORC.14/XTN.1	250	C any Text	O				Displayed as an emergency number.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
15	ORC.15 - Order Effective Date/Time	26	TS	X			00229	Not Currently Used.
	ORC.16 - Order Control Code Reason	250	CE	X			00230	Not Currently Used.
17	ORC.17 - Entering Organization	250	CE	X			00231	Not Currently Used.
18	ORC.18 - Entering Device	250	CE	X			00232	Not Currently Used.
19	ORC.19 - Action By	250	XCN	X	Y		00233	Not Currently Used.
20	ORC.20 - Advanced Beneficiary Notice Code	250	CE	X		0339	01310	Not Currently Used.
21	ORC.21 - Ordering Facility Name	250	XON	X	Y		01311	Not Currently Used.
22	ORC.22 - Ordering Facility Address	250	XAD	X	Y		01312	Not Currently Used.
23	ORC.23 - Ordering Facility Phone Number	250	XTN	X	Y		01313	Not Currently Used.
24	ORC.24 - Ordering Provider Address	250	XAD	X	Y		01314	Not Currently Used.
25	ORC.25 - Order Status Modifier	250	CWE	X	N		01473	Not Currently Used.

SAC (Specimen Container) Segment

The container detail segment is the data necessary to maintain the containers that are being used throughout the laboratory automation system.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
1	SAC.1 - External Accession Identifier	80	EI	O			01329	This field identifies the laboratory accession (see section *Glossary*). This identifier is assigned by the external laboratory information system. Example: If laboratory A sends a specimen to laboratory B, then within laboratory B this field contains accession identifier of lab A.
2	SAC.2 - Accession Identifier	80	EI	X			01330	Not Currently Used.
3	SAC.3 - Container Identifier	80	EI	X			01331	Not Currently Used.
4	SAC.4 - Primary (parent) Container Identifier	80	EI	X			01332	Not Currently Used.
5	SAC.5 - Equipment Container Identifier	80	EI	X			01333	Not Currently Used.
6	SAC.6 - Specimen Source	300	CM	X		0070/ 0369	00249	Not Currently Used.
7	SAC.7 - Registration Date/Time	26	TS	X			01334	Not Currently Used.
8	SAC.8 - Container Status	250	CE	X		0370	01335	Not Currently Used.
9	SAC.9 - Carrier Type	250	CE	X		0378	01336	Not Currently Used.
10	SAC.10 - Carrier Identifier	80	EI	X			01337	Not Currently Used.
11	SAC.11 - Position in Carrier	80	NA	X			01338	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
12	SAC.12 - Tray Type - SAC	250	CE	X		0379	01339	Not Currently Used.
13	SAC.13 - Tray Identifier	80	EI	X			01340	Not Currently Used.
14	SAC.14 - Position in Tray	80	NA	X			01341	Not Currently Used.
15	SAC.15 - Location	250	CE	X	Y		01342	Not Currently Used.
16	SAC.16 - Container Height	20	NM	X			01343	Not Currently Used.
17	SAC.17 - Container Diameter	20	NM	X			01344	Not Currently Used.
18	SAC.18 - Barrier Delta	20	NM	X			01345	Not Currently Used.
19	SAC.19 - Bottom Delta	20	NM	X			01346	Not Currently Used.
20	SAC.20 - Container Height/Diameter/Delta Units	250	CE	X			01347	Not Currently Used.
21	SAC.21 - Container Volume	20	NM	X			00644	Not Currently Used.
22	SAC.22 - Available Volume	20	NM	X			01349	Not Currently Used.
23	SAC.23 - Initial Specimen Volume	20	NM	X			01350	Not Currently Used.
24	SAC.24 - Volume Units	250	CE	X			01351	Not Currently Used.
25	SAC.25 - Separator Type	250	CE	X		0380	01352	Not Currently Used.
26	SAC.26 - Cap Type	250	CE	X		0381	01353	Not Currently Used.
27	SAC.27 - Additive	250	CE	X	Y	0371	00647	Not Currently Used.
28	SAC.28 - Specimen Component	250	CE	X			01355	Not Currently Used.
29	SAC.29 - Dilution Factor	20	SN	X			01356	Not Currently Used.

HL7 Seq	HL7 Element Name	Max Len	HL7 Data Type	Opt	Repeat	Table	Item #	Description
30	SAC.30 - Treatment	250	CE	X		0373	01357	Not Currently Used.
31	SAC.31 - Temperature	20	SN	X			01358	Not Currently Used.
32	SAC.32 - Hemolysis Index	20	NM	X			01359	Not Currently Used.
33	SAC.33 - Hemolysis Index Units	250	CE	X			01360	Not Currently Used.
34	SAC.34 - Lipemia Index	20	NM	X			01361	Not Currently Used.
35	SAC.35 - Lipemia Index Units	250	CE	X			01362	Not Currently Used.
36	SAC.36 - Icterus Index	20	NM	X			01363	Not Currently Used.
37	SAC.37 - Icterus Index Units	250	CE	X			01364	Not Currently Used.
38	SAC.38 - Fibrin Index	20	NM	X			01365	Not Currently Used.
39	SAC.39 - Fibrin Index Units	250	CE	X			01366	Not Currently Used.
40	SAC.40 - System Induced Contaminants	250	CE	X	Y	0374	01367	Not Currently Used.
41	SAC.41 - Drug Interference	250	CE	X	Y	0382	01368	Not Currently Used.
42	SAC.42 - Artificial Blood	250	CE	X		0375	01369	Not Currently Used.
43	SAC.43 - Special Handling Considerations	250	CE	X	Y	0376	01370	Not Currently Used.
44	SAC.44 - Other Environmental Factors	250	CE	X	Y	0377	01371	Not Currently Used.

MSA (Message Acknowledgment) Segment

The MSA segment contains information sent while acknowledging another message.

HL7 SEQ	HL7 ELEMENT NAME	MAX LEN	HL7 Data Type	OPT	Repeat	Table	Item #	Description
1	MSA.1 Acknowledgment Code	2	ID	R		0008	00018	This field contains an acknowledgment code.
2	MSA.2 Message Control ID	20	ST	R			00010	This field contains the message control ID of the message sent by the sending system. It allows the sending system to associate this response with the message for which it is intended.
3	MSA.3 Text Message	80	ST	O			00020	This optional field further describes an error condition. This text may be printed in error logs or presented to an end user. Use the ERR Segment rather than MSA.3 or MSA.6 for descriptions of error conditions.
4	MSA.4 Expected Sequence Number	15	NM	O			00021	This optional numeric field is used in the sequence number protocol.
5	MSA.5 Delayed Acknowledgment Type	1	ID	B		0102	00022	
6	MSA.6 Error Condition	250	CE	O		0357	00023	This field allows the acknowledging system to use a user-defined error code to further specify AR or AE type acknowledgments. This field is a generalised replacement for *MSA-3-text message*.

ERR (Error) Segment

The ERR segment is used to add error comments to acknowledgment messages.

HL7 SEQ	HL7 ELEMENT NAME	MAX LEN	HL7 Data Type	OPT	Repeat	Table	Item #	Description
1	ERR.1 Error Code and Location	80	CM	R	Y			This field identifies an erroneous segment in another message. The second component is an index if there is more than one segment of type <segment ID>. For systems that do not use the HL7 Encoding Rules, the data item number may be used for the third component. The fourth component (which references HL7 Table 0357 - Message error condition codes, is restricted from having any subcomponents as the subcomponent separator is now the CE's component separator.

Appendix 2: Reference Tables defined by the GPMS

This appendix provides the reference tables defined by the GPMS.

Table 1 - HL7 User-defined Table 0001 – Administrative sex

Value	Description
F	Female
M	Male
O	Other
U	Unknown
A	Ambiguous
N	Not applicable
S	Unspecific

Table 2 - HL7 User-defined Table 0002 – Marital status

Value	Description
A	Separated
D	Divorced
M	Married
S	Single
W	Widowed
C	Common law
G	Living together
P	Domestic partner
R	Registered domestic partner
E	Legally Separated
N	Annulled
I	Interlocutory
B	Unmarried
U	Unknown
O	Other
T	Unreported

Table 3 - HL7 Table 0003 - Event type

Value	Description
A01	ADT/ACK - Admit/visit notification
A03	ADT/ACK - Discharge/end visit
I12	REF/RRI - Patient referral
O21	OML - Laboratory order
022	ORL - General laboratory order response message to any OML
R01	ORU/ACK - Unsolicited transmission of an observation message
S12	SIU/ACK - Notification of new appointment booking
S13	SIU/ACK - Notification of appointment rescheduling
S14	SIU/ACK - Notification of appointment modification
S15	SIU/ACK - Notification of appointment cancellation
S16	SIU/ACK - Notification of appointment discontinuation
S17	SIU/ACK - Notification of appointment deletion

Table 4 HL7 User-defined Table 0004 – Patient class

Value	Description
E	Emergency
I	Inpatient
O	Outpatient
P	Preadmit
R	Recurring patient
B	Obstetrics
C	Commercial Account
N	Not Applicable
U	Unknown

Table 5 HL7 User-defined Table 0005 – Race

Value	Description
	No suggested values defined

Table 6 - HL7 User-defined Table 0006 – Religion

Value	Description
AGN	Agnostic
ATH	Atheist
BAH	Baha'i
BUD	Buddhist
BMA	Buddhist: Mahayana
BTH	Buddhist: Theravada
BTA	Buddhist: Tantrayana
BOT	Buddhist: Other
CFR	Chinese Folk Religionist
CHR	Christian
ABC	Christian: American Baptist Church
AMT	Christian: African Methodist Episcopal
AME	Christian: African Methodist Episcopal Zion
ANG	Christian: Anglican
AOG	Christian: Assembly of God
BAP	Christian: Baptist
CAT	Christian: Roman Catholic
CRR	Christian: Christian Reformed
CHS	Christian: Christian Science
CMA	Christian: Christian Missionary Alliance
COC	Christian: Church of Christ
COG	Christian: Church of God
COI	Christian: Church of God in Christ
COM	Christian: Community
COL	Christian: Congregational
EOT	Christian: Eastern Orthodox
EVC	Christian: Evangelical Church
EPI	Christian: Episcopalian
FWB	Christian: Free Will Baptist
FRQ	Christian: Friends
GRE	Christian: Greek Orthodox
JWN	Christian: Jehovah's Witness
LUT	Christian: Lutheran
LMS	Christian: Lutheran Missouri Synod
MEN	Christian: Mennonite
MET	Christian: Methodist
MOM	Christian: Latter-day Saints
NAZ	Christian: Church of the Nazarene
ORT	Christian: Orthodox
COT	Christian: Other
PRC	Christian: Other Protestant
PEN	Christian: Pentecostal
COP	Christian: Other Pentecostal
PRE	Christian: Presbyterian
PRO	Christian: Protestant
QUA	Christian: Friends
REC	Christian: Reformed Church
REO	Christian: Reorganized Church of Jesus Christ-LDS
SAA	Christian: Salvation Army
SEV	Christian: Seventh Day Adventist
SOU	Christian: Southern Baptist
UCC	Christian: United Church of Christ
UMD	Christian: United Methodist
UNI	Christian: Unitarian
UNU	Christian: Unitarian Universalist
WES	Christian: Wesleyan

Value	Description
WMC	Christian: Wesleyan Methodist
CNF	Confucian
ERL	Ethnic Religionist
HIN	Hindu
HVA	Hindu: Vaishnavites
HSH	Hindu: Shaivites
HOT	Hindu: Other
JAI	Jain
JEW	Jewish
JCO	Jewish: Conservative
JOR	Jewish: Orthodox
JOT	Jewish: Other
JRC	Jewish: Reconstructionist
JRF	Jewish: Reform
JRN	Jewish: Renewal
MOS	Muslim
MSU	Muslim: Sunni
MSH	Muslim: Shiite
MOT	Muslim: Other
NAM	Native American
NRL	New Religionist
NOE	Nonreligious
OTH	Other
SHN	Shintoist
SIK	Sikh
SPI	Spiritist
VAR	Unknown

Table 7 - HL7 User-defined Table 0007 – Admission type

Value	Description
A	Accident
E	Emergency
L	Labor and Delivery
R	Routine
N	Newborn (Birth in healthcare facility)
U	Urgent
C	Elective

Table 8 - HL7 Table 0008 - Acknowledgment code

Value	Description
AA	Original mode: Application Accept - Enhanced mode: Application acknowledgment: Accept
AE	Original mode: Application Error - Enhanced mode: Application acknowledgment: Error
AR	Original mode: Application Reject - Enhanced mode: Application acknowledgment: Reject
CA	Enhanced mode: Accept acknowledgment: Commit Accept
CE	Enhanced mode: Accept acknowledgment: Commit Error
CR	Enhanced mode: Accept acknowledgment: Commit Reject

Table 9 - HL7 User-defined Table 0009 – Ambulatory status

Value	Description
A0	No functional limitations
A1	Ambulates with assistive device
A2	Wheelchair/stretcher bound
A3	Comatose; non-responsive
A4	Disoriented
A5	Vision impaired
A6	Hearing impaired
A7	Speech impaired

Value	Description
A8	Non-English speaking
A9	Functional level unknown
B1	Oxygen therapy
B2	Special equipment (tubes, IVs, catheters)
B3	Amputee
B4	Mastectomy
B5	Paraplegic
B6	Pregnant
B7	Not Pregnant
B8	Pregnancy Unknown

Table 10 - HL7 User-defined Table 0010 – Physician ID

Value	Description
	No suggested values defined

Table 11 - HL7 User-defined Table 0023 – Admit source

Value	Description
1	Physician referral
2	Clinic referral
3	HMO referral
4	Transfer from a hospital
5	Transfer from a skilled nursing facility
6	Transfer from another healthcare facility
7	Emergency room
8	Court/law enforcement
9	Information not available

Table 12 – HL7 User-defined Table 0051 - Diagnosis code

Value	Description
	No suggested values defined

Table 13 - HL7 User-defined Table 0052 – Diagnosis type

Value	Description
A	Admitting
W	Working
F	Final

Table 14 - HL7 User-defined Table 0053 - Diagnosis coding method

Value	Description
	No suggested values defined

Table 15 - HL7 User-defined Table 0064 – Financial class

Value	Description
01	Medical Card
02	Public Patient
03	Semi Private Patient
04	Private Patient

Table 16 - HL7 Table 0065 – Specimen action code

Value	Description
A	Add ordered tests to the existing specimen
G	Generated order; reflex order
L	Lab to obtain specimen from patient
O	Specimen obtained by service other than Lab

Value	Description
P	Pending specimen; Order sent prior to delivery
R	Revised order
S	Schedule the tests specified below

Table 17 - HL7 Table 0070 – Specimen source code

Value	Description
ABS	Abscess
AMN	Amniotic fluid
ASP	Aspirate
BPH	Basophils
BIFL	Bile fluid
BLDA	Blood arterial
BBL	Blood bag
BLDC	Blood capillary
BPU	Blood product unit
BLDV	Blood venous
BON	Bone
BRTH	Breath (use EXHLD)
BRO	Bronchial
BRN	Burn
CALC	Calculus (=Stone)
CDM	Cardiac muscle
CNL	Cannula

Value	Description
CTP	Catheter tip
CSF	Cerebral spinal fluid
CVM	Cervical mucus
CVX	Cervix
COL	Colostrum
CBLD	Cord blood
CNJT	Conjunctiva
CUR	Curettage
CYST	Cyst
DIAF	Dialysis fluid
DOSE	Dose med or substance
DRN	Drain
DUFL	Duodenal fluid
EAR	Ear
EARW	Ear wax (cerumen)
ELT	Electrode
ENDC	Endocardium
ENDM	Endometrium
EOS	Eosinophils
RBC	Erythrocytes
EYE	Eye

Value	Description
EXHLD	Exhaled gas (=breath)
FIB	Fibroblasts
FLT	Filter
FIST	Fistula
FLU	Body fluid, unsp
GAS	Gas
GAST	Gastric fluid/contents
GEN	Genital
GENC	Genital cervix
GENL	Genital lochia
GENV	Genital vaginal
HAR	Hair
IHG	Inhaled Gas
IT	Intubation tube
ISLT	Isolate
LAM	Lamella
WBC	Leukocytes
LN	Line
LNA	Line arterial
LNV	Line venous
LIQ	Liquid NOS

Value	Description
LYM	Lymphocytes
MAC	Macrophages
MAR	Marrow
MEC	Meconium
MBLD	Menstrual blood
MLK	Milk
MILK	Breast milk
NAIL	Nail
NOS	Nose (nasal passage)
ORH	Other
PAFL	Pancreatic fluid
PAT	Patient
PRT	Peritoneal fluid /ascites
PLC	Placenta
PLAS	Plasma
PLB	Plasma bag
PLR	Pleural fluid (thoracentesis fld)
PMN	Polymorphonuclear neutrophils
PPP	Platelet poor plasma
PRP	Platelet rich plasma
PUS	Pus

Value	Description
RT	Route of medicine
SAL	Saliva
SEM	Seminal fluid
SER	Serum
SKN	Skin
SKM	Skeletal muscle
SPRM	Spermatozoa
SPT	Sputum
SPTC	Sputum - coughed
SPTT	Sputum - tracheal aspirate
STON	Stone (use CALC)
STL	Stool = Fecal
SWT	Sweat
SNV	Synovial fluid (Joint fluid)
TEAR	Tears
THRT	Throat
THRB	Thrombocyte (platelet)
TISS	Tissue
TISG	Tissue gall bladder
TLGI	Tissue large intestine
TLNG	Tissue lung

Value	Description
TISPL	Tissue placenta
TSMI	Tissue small intestine
TISU	Tissue ulcer
TUB	Tube NOS
ULC	Ulcer
UMB	Umbilical blood
UMED	Unknown medicine
URTH	Urethra
UR	Urine
URC	Urine clean catch
URT	Urine catheter
URNS	Urine sediment
USUB	Unknown substance
VOM	Vomitus
BLD	Whole blood
BDY	Whole body
WAT	Water
WICK	Wick
WND	Wound
WNDA	Wound abscess
WNDE	Wound exudate

Value	Description
WNDD	Wound drainage
XXX	To be specified in another part of the message

Table 18 - HL7 Table 0074 – Diagnostic service section ID

Message	Description
AU	Audiology
BG	Blood Gases
BLB	Blood Bank
CUS	Cardiac Ultrasound
CTH	Cardiac Catheterization
CT	CAT Scan
CH	Chemistry
CP	Cytopathology
EC	Electrocardiac (e.g., EKG, EEC, Holter)
EN	Electroneuro (EEG, EMG,EP,PSG)
HM	Hematology
ICU	Bedside ICU Monitoring
IMM	Immunology
LAB	Laboratory
MB	Microbiology
MCB	Mycobacteriology
MYC	Mycology
NMS	Nuclear Medicine Scan

Message	Description
NMR	Nuclear Magnetic Resonance
NRS	Nursing Service Measures
OUS	OB Ultrasound
OT	Occupational Therapy
OTH	Other
OSL	Outside Lab
PHR	Pharmacy
PT	Physical Therapy
PHY	Physician (Hx. Dx, admission note, etc.)
PF	Pulmonary Function
RAD	Radiology
RX	Radiograph
RUS	Radiology Ultrasound
RC	Respiratory Care (therapy)
RT	Radiation Therapy
SR	Serology
SP	Surgical Pathology
TX	Toxicology
VUS	Vascular Ultrasound
VR	Virology
XRC	Cineradiograph

Message	Description
HIS	Histopathology
CAR	Cardiology

Table 19 - HL7 Table 0076 – Message Type

Message	Description	Chapter
ACK	General acknowledgment message	2
ADT	ADT message	3
OML	Laboratory order message	4
ORL	Laboratory acknowledgment message (unsolicited)	7
ORU	Unsolicited transmission of an observation message	7
REF	Patient referral	11
RRD	Pharmacy/treatment dispense acknowledgment message	4
RRE	Pharmacy/treatment encoded order acknowledgment message	4
RRG	Pharmacy/treatment give acknowledgment message	4
RRI	Return referral information	11
SIU	Schedule information unsolicited	10

Table 20 - HL7 User-defined Table 0078 - Abnormal flags

Message	Description
L	Below low normal
H	Above high normal
LL	Below lower panic limits
HH	Above upper panic limits
<	Below absolute low-off instrument scale

Message	Description
>	Above absolute high-off instrument scale
N	Normal (applies to non-numeric results)
A	Abnormal (applies to non-numeric results)
AA	Very abnormal (applies to non-numeric units, analogous to panic limits for numeric units)
null	No range defined, or normal ranges don't apply
U	Significant change up
D	Significant change down
B	Better--use when direction not relevant
W	Worse--use when direction not relevant
S	Susceptible. Indicates for microbiology susceptibilities only.
R	Resistant. Indicates for microbiology susceptibilities only.
I	Intermediate. Indicates for microbiology susceptibilities only.
MS	Moderately susceptible. Indicates for microbiology susceptibilities only.
VS	Very susceptible. Indicates for microbiology susceptibilities only.

Table 21 - HL7 Table 0085 – Observation results status codes interpretation

Value	Description
C	Record coming over is a correction and thus replaces a final result
D	Deletes the OBX record
F	Final results; Can only be changed with a corrected result.
I	Specimen in lab; results pending
N	Not asked; used to affirmatively document that the observation identified in the OBX was not sought when the universal service ID in OBR-4 implies that it would

Value	Description
	be sought.
O	Order detail description only (no result)
P	Preliminary results
R	Results entered -- not verified
S	Partial results
X	Results cannot be obtained for this observation
U	Results status change to final without retransmitting results already sent as 'preliminary.' E.g., radiology changes status from preliminary to final
W	Post original as wrong, e.g., transmitted for wrong patient

Table 22 - HL7 Table 0102 – Delayed acknowledgment type

Value	Description
D	Message received, stored for later processing
F	Acknowledgment after processing

Table 23 - HL7 Table 0103 – Processing ID

Value	Description
D	Debugging
P	Production
T	Training

Table 24 - HL7 Table 0104 – HL7 version identifier

Value	Description	Date
2.0	Release 2.0	September 1988
2.0D	Demo 2.0	October 1988
2.1	Release 2. 1	March 1990
2.2	Release 2.2	December 1994

Value	Description	Date
2.3	Release 2.3	March 1997
2.3.1	Release 2.3.1	May 1999
2.4	Release 2.4	November 2000

Table 25 - HL7 Table 0105 – Source of comment

Value	Description
L	Ancillary (filler) department is source of comment
P	Orderer (placer) is source of comment
O	Other system is source of comment

Table 26 - HL7 User-defined Table 0112 – Discharge disposition

Value	Description
01	Discharged to home or self care (routine discharge)
02	Discharged/transferred to another short term general hospital for inpatient care
03	Discharged/transferred to skilled nursing facility (SNF)
04	Discharged/transferred to an intermediate care facility (ICF)
05	Discharged/transferred to another type of institution for inpatient care or referred for outpatient services to another institution
06	Discharged/transferred to home under care of organised home health service organization
07	Left against medical advice or discontinued care
08	Discharged/transferred to home under care of Home IV provider
09	Admitted as an inpatient to this hospital
10 …19	Discharge to be defined at state level, if necessary
20	Expired (i.e. dead)
21 ... 29	Expired to be defined at state level, if necessary

Value	Description
30	Still patient or expected to return for outpatient services (i.e. still a patient)
31 … 39	Still patient to be defined at state level, if necessary (i.e. still a patient)
40	Expired (i.e. died) at home
41	Expired (i.e. died) in a medical facility; e.g., hospital, SNF, ICF, or free standing hospice
42	Expired (i.e. died) - place unknown

Table 27 - HL7 User-defined Table 0113 – Discharged to location

Value	Description
	No suggested values defined

Table 28 - HL7 Table 0123 – Result status

Value	Description
O	Order received; specimen not yet received
I	No results available; specimen received, procedure incomplete
S	No results available; procedure scheduled, but not done
A	Some, but not all, results available
P	Preliminary: A verified early result is available, final results not yet obtained
C	Correction to results
R	Results stored; not yet verified
F	Final results; results stored and verified. Can only be changed with a corrected result.
X	No results available; Order canceled.
Y	No order on record for this test. (Used only on queries)
Z	No record of this patient. (Used only on queries)

Table 29 - HL7 Table 0125 – Value type

Value	Description
AD	Address
CE	Coded Entry
CF	Coded Element With Formatted Values
CK	Composite ID With Check Digit
CN	Composite ID And Name
CP	Composite Price
CX	Extended Composite ID With Check Digit
DT	Date
ED	Encapsulated Data
FT	Formatted Text (Display)
MO	Money
NM	Numeric
PN	Person Name
RP	Reference Pointer
SN	Structured Numeric
ST	String Data.
TM	Time
TN	Telephone Number
TS	Time Stamp (Date & Time)
TX	Text Data (Display)

Value	Description
XAD	Extended Address
XCN	Extended Composite Name And Number For Persons
XON	Extended Composite Name And Number For Organizations
XPN	Extended Person Name
XTN	Extended Telecommunications Number

Table 30 - HL7 Table 0136 – Yes/no indicator

Value	Description
Y	Yes
N	No

Table 31 - HL7 Table 0155 – Acknowledgement type

Value	Description
AL	Always
NE	Never
ER	Error/reject conditions only
SU	Successful completion only

Table 32 - HL7 User-defined Table 0171 – Citizenship

Value	Description
	No suggested values defined

Table 33 - HL7 User-defined Table 0172 – Veterans military status

Value	Description
	No suggested values defined

Table 34 - HL7 User-defined Table 0189 – Ethnic group

Value	Description
	No suggested values defined

Table 35 - HL7 Table 0200 – Name type

Value	Description
A	Alias Name
B	Name at Birth

Value	Description
C	Adopted Name
D	Display Name
I	Licensing Name
L	Legal Name
M	Maiden Name
N	Nickname /"Call me" Name/Street Name
P	Name of Partner/Spouse (retained for backward compatibility only)
R	Registered Name (animals only)
S	Coded Pseudo-Name to ensure anonymity
T	Indigenous/Tribal/Community Name
U	Unspecified

Table 36 - HL7 Table 0201 - Telecommunication use code

Value	Description
PRN	Primary Residence Number
ORN	Other Residence Number
WPN	Work Number
VHN	Vacation Home Number
ASN	Answering Service Number
EMR	Emergency Number
NET	Network (email) Address
BPN	Beeper Number

Table 37 - HL7 Table 0202 - Telecommunication equipment type

Value	Description
PH	Telephone
FX	Fax
MD	Modem
CP	Cellular Phone
BP	Beeper
Internet	Internet Address: Use Only If Telecommunication Use Code Is NET
X.400	X.400 email address: Use Only If Telecommunication Use Code Is NET

Table 38 - HL7 User-defined Table 203 – Identifier type

Value	Description
GMS	General Medical Services Number
GPN	GP Electronic Patient Record Number
MRN	Medical Record Number
PPSN	Personal Social Services Number
CCEI	Central Client Eligibility Index
VHI	Voluntary Health Insurance Number
BUPA	BUPA Number
RAD	Radiology Chart Number
LAB	Laboratory Number
OTH	Other
UNK	Unknown
COOP	Out of Hours Number

Value	Description
RIS	Radiology Information System
CN	Chart Number
PASPID	Patient Admin System Patient ID No

Table 39 - HL7 Table 0206 – Segment action code

Value	Description
A	Add/Insert
D	Delete
U	Update

Table 40 - HL7 Table 0207 – Processing mode

Value	Description
A	Archive
R	Restore from archive
I	Initial load
T	Current processing, transmitted at intervals (scheduled or on demand)
Not present	Not present (the default, meaning current processing)

Table 41 - HL7 User-defined Table 0278 – Filler status codes

Value	Description
Pending	Appointment has not yet been confirmed
Waitlist	Appointment has been placed on a waiting list for a particular slot, or set of slots
Booked	The indicated appointment is booked
Started	The indicated appointment has begun and is currently in progress
Complete	The indicated appointment has completed normally (was not discontinued, canceled, or deleted)
Cancelled	The indicated appointment was stopped from occurring (canceled prior to starting)
Dc	The indicated appointment was discontinued (DC'ed while in progress, discontinued parent appointment, or discontinued child appointment)
Deleted	The indicated appointment was deleted from the filler application
Blocked	The indicated time slot(s) is(are) blocked
Overbook	The appointment has been confirmed; however it is confirmed in an overbooked state

Table 42 - HL7 User-defined Table 0280 – Referral priority

Value	Description
S	STAT/ With Highest Priority
A	ASAP/ As soon as possible (after S)
R	Routine

Table 43 - HL7 User-defined Table 0281 – Referral type

Value	Description
Lab	Laboratory
Rad	Radiology
Med	Medical
Skn	Skilled Nursing
Psy	Psychiatric
Hom	Home Care
Prostate	Prostate
Breast	Breast
Lung	Lung

Table 44 - HL7 User-defined Table 0282 – Referral disposition

Value	Description
WR	Send Written Report
RP	Return Patient After Evaluation
AM	Assume Management
SO	Second Opinion

Table 45 - HL7 User-defined Table 0283 – Referral status

Value	Description
A	Accepted
P	Pending
R	Rejected

Value	Description
E	Expired

Table 46 - HL7 User-defined Table 0284 – Referral category

Value	Description
I	Inpatient
O	Outpatient
A	Ambulatory
E	Emergency

Table 47 - HL7 User-defined table 0286 – Provider role

Value	Description
RP	Referring Provider
PP	Primary Care Provider
CP	Consulting Provider
RT	Referred to Provider

Table 48 - HL7 User-defined Table 0289 – County code

Value	Description
	No values Defined

Table 49 - HL7 User-defined Table 0296 – Primary language

Value	Description
	No suggested values defined

Table 50 HL7 User-defined Table 0302 - Point of care

Value	Description
MED	Medical
SUR	Surgical
PSY	Psychiatric
MAT	Maternity
PAE	Paediatric
EME	Emergency
OTH	Other

Table 51 - HL7 User-defined Table 0326 – Visit indicator

Value	Description
A	Account level (default)
V	Visit level

Table 52 - HL7 User-defined Table 0336 – Referral reason

Value	Description
S	Second Opinion
P	Patient Preference
O	Provider Ordered
W	Work Load

Table 53 - HL7 Table 0357 - Message error condition codes

Error Condition Code	Error Condition Text	Description/Comment
Success		
0	Message accepted	Success. Optional, as the AA conveys success. Used for systems that must always return a status code.
Errors		
100	Segment sequence error	The message segments were not in the proper order, or required segments are missing.
101	Required field missing	A required field is missing from a segment
102	Data type error	The field contained data of the wrong data type, e.g. an NM field contained "FOO".

Error Condition Code	Error Condition Text	Description/Comment
103	Table value not found	A field of data type ID or IS was compared against the corresponding table, and no match was found.
Rejection		
200	Unsupported message type	The Message Type is not supported.
201	Unsupported event code	The Event Code is not supported.
202	Unsupported processing id	The Processing ID is not supported.
203	Unsupported version id	The Version ID is not supported.
204	Unknown key identifier	The ID of the patient, order, etc., was not found. Used for transactions other than additions, e.g. transfer of a non-existent patient.
205	Duplicate key identifier	The ID of the patient, order, etc., already exists. Used in response to addition transactions (Admit, New Order, etc.).
206	Application record locked	The transaction could not be performed at the application storage level, e.g. database locked.
207	Application internal error	A catchall for internal errors not explicitly covered by other codes.

Table 54 - HL7 User-defined Table 0360 - Degree

Value	Description
	No values Defined

Table 55 - HL7 User-defined Table 0361 – Sending application

Value	Description
TOREX.HEALTHLINK.12	Torex, Healthlink Bridge Middleware, Discharge Notification Message
PAS.HEALTHLINK.12	Patient Administration System, Healthlink Bridge Middleware, Discharge Notification Message
IPMISOFT.HEALTHLINK.12	iPMiSoft, Healthlink Bridge Middleware, Discharge Notification Message
TOREX.HEALTHLINK.10	Torex, Healthlink Bridge Middleware, Message ID Lab Result
WOODARD.HEALTHLINK.10	Woodard, Healthlink Bridge Middleware, Message ID Lab Result
APEX.HEALTHLINK.10	Apex, Healthlink Bridge Middleware, Message ID Lab Result
MCKESSAN.HEALTHLINK.10	McKessan, Healthlink Bridge Middleware, Message ID Lab Result
TELEPATH.HEALTHLINK.10	Telepath, Healthlink Bridge Middleware, Message ID Lab Result Message
TOREX.HEALTHLINK.9	Torex, Healthlink Bridge, Healthlink Bridge Middleware, Waiting List Message
PAS.HEALTHLINK.9	Patient Administration System, Healthlink Bridge, Healthlink Bridge Middleware, Waiting List Message
TOREX.HEALTHLINK.8	Torex, Healthlink Bridge, Healthlink Bridge Middleware, OPD Appointment Message
PAS.HEALTHLINK.8	Patient Administration System, Healthlink Bridge Middleware, OPD Appointment Message

Value	Description
IPMISOFT.HEALTHLINK.8	iPMiSoft, Healthlink Bridge Middleware, OPD Appointment Message
IMS.HEALTHLINK.7	IMS, Healthlink Bridge Middleware, Radiology Message
KEOGHRIS.HEALTHLINK.7	Keogh Radiology System, Healthlink Bridge Middleware, Radiology Message
MCKESSAN.HEALTHLINK.7	KcKessan Radiology System, Healthlink Bridge Middleware, Radiology Message
PAS.HEALTHLINK.7	Patient Administration System, Healthlink Bridge Middleware, Radiology Message
IPMISOFT.HEALTHLINK.7	iPMiSoft, Healthlink Bridge Middleware, Radiology Message
TOREX.HEALTHLINK.6	Torex, Healthlink Bridge Middleware, Death Notification Message
PAS.HEALTHLINK.6	Patient Administration System, Healthlink Bridge Middleware, Death Notification Message
IPMISOFT.HEALTHLINK.6	iPMiSoft, Healthlink Bridge Middleware, Death Notification Message
TOREX.HEALTHLINK.5	Torex, Healthlink Bridge Middleware, Discharge Summary Message
PAS.HEALTHLINK.5	Torex, Healthlink Bridge Middleware, Discharge Summary Message
AE.HEALTHLINK.4	A&E Information System, Healthlink Bridge Middleware, A&E Notification Message
TOREX.HEALTHLINK.4	Torex, Healthlink Bridge Middleware, A&E Notification Message
IMS.HEALTHLINK.4	IMS A&E System, Healthlink Bridge Middleware, A&E Notification Message
HLONLINE.HEALTHLINK.1	Healthlink Online, Healthlink Bridge Middleware, Lab Order Message
HLONLINE.HEALTHLINK.14	Healthlink Online, Healthlink Bridge Middleware, Neurology Referral Message
HLONLINE.HEALTHLINK.15	Healthlink Online, Healthlink Bridge Middleware, Neurology Response Message
TOREX.HEALTHLINK.11	Torex, Healthlink Bridge, Healthlink Bridge Middleware, Laboratory Order NACK
IPMISOFT.HEALTHLINK.17	iPMiSoft, Healthlink Bridge Middleware, Cardiology Message
SUNQUEST	HSE NW Laboratory Information System
WINPATH HL7	HSE NE Laboratory Information System
KEOGHRIS	HSE NE Radiology Information System
ADASTRA	HSE NE Out of Hours Co-operative
iLAB.ICE	HSE SE Laboratory Information System with Anglia ICE Middleware
APEX.ICE	HSE S Laboratory Information System with Anglia ICE Middleware
TOREXRIS	St James's Hospital Radiology Information System
ADASTRA 2	HSE SE Out of Hours Co-operative, CareDoc
HEALTHONE	Message Generated by HealthOne Practice Management System
HELIXPM	Message Generated by Helix Practice Manager Practice Management System

Value	Description
SOCRATES	Message Generated by Socrates Practice Manager Practice Management System
COMPLETEGP	Message Generated by CompleteGP Practice Management System

Table 56 - HL7 User-defined Table 0362 – Sending facility

Value	Description
0002	Caredoc
0003	Shannon Doc
0100	St. Mary's Hospital, Phoenix Park
0101	St. Colmcille's Hospital, Loughlinstown
0102	Naas County Hospital
0106	Cherry Orchard Hospital, Ballyfermot
0108	James Connolly Memorial Hospital
0201	Portlaoise General Hospital
0202	Mullingar General Hospital
0203	Tullamore General Hospital
0300	Regional Hospital, (Dooradoyle) Limerick
0301	Regional Maternity Hospital, Limerick
0302	Regional Orthopaedic Hospital, Croom
0304	Nenagh County Hospital
0305	Ennis County Hospital
0400	Dundalk County Hospital
0402	Cavan General Hospital
0403	Our Lady's County Hospital, Navan
0404	Monaghan County Hospital
0500	Letterkenny General Hospital
0501	Sligo General Hospital
0502	Our Lady's Hospital, Manorhamilton
0600	Waterford Regional Hospital (Ardkeen)
0601	St Lukes Hospital, Kilkenny
0602	Orthopaedic Hospital, Kilcreene
0605	Wexford General Hospital

Value	Description
0607	South Tipperary General Hospital
0608	Our Lady's Hospital, Cashel
0701	St. Mary's Orthopaedic Hospital, Gurrenabraher
0703	Mallow General Hospital
0704	Bantry General Hospital
0705	St. Finbarr's Hospital, Cork
0724	Cork University Hospital
0725	Erinville Hospital, Cork
0726	Tralee General Hospital
0800	University College Hospital Galway
0801	Regional Hospital, Merlin Park, Galway
0802	Castlebar County Hospital
0803	Roscommon County Hospital
0805	Ballina District Hospital
0901	Adelaide Hospital, Dublin
0903	Meath Hospital, Dublin
0904	St. James's Hospital, Dublin
0908	Mater Misericordiae Hospital, Dublin
0910	St. Vincent's Hospital, Elm Park
0912	St. Michael's Hospital, Dun Laoghaire
0913	Mercy University Hospital, Cork.
0915	South Infirmary/Victoria, Cork
0918	St. John's Hospital, Limerick
0919	Portiuncula Hospital, Ballinasloe
0922	Our Lady of Lourdes Hospital, Drogheda
0923	Beaumont Hospital, Dublin
0925	Peamount Hospital, Newcastle
0930	Coombe Women's Hospital, Dublin
0931	National Maternity Hospital, Holles St, Dublin
0932	Rotunda Hospital, Dublin

Value	Description
0934	Waterford Maternity Hospital
0940	The Children's Hospital, Temple St, Dublin
0941	Our Lady's Hospital, Crumlin
0943	National Children's Hospital, Harcourt St
0945	St. Anne's Hospital, Dublin
0946	Hume St. Hospital, Dublin
0947	St. Luke's & St. Anne's Hospital, Dublin
0950	Royal Victoria Eye & Ear Hospital, Dublin
0954	Incorporated Orthopaedic Hospital, Clontarf
0955	St. Mary's Hospital, Cappagh
0956	St. Mary's Auxiliary Hospital, Baldoyle
0960	Our Lady of Lourdes Hospital, (NMRC), Dun Laoghaire
0978	Our Lady's Hospice, Harold's Cross, Dublin
1225	St. Joseph's Unit, Harold's Cross
1270	Adelaide, Meath Incorporating National Children's Hospital (AMNCH), Tallaght

Table 57 - HL7 User-defined Table 0363 - Assigning Authority

Value	Description
	No values Defined

Table 58 - HL7 User-defined Table 0430 – Mode of arrival code

Value	Description
A	Ambulance
C	Car
F	On foot
H	Helicopter
P	Public Transport
O	Other
U	Unknown

Table 59 - HL7 User-defined Table 0445 - Identity reliability code

Value	Description
UD	Unknown/Default Date of Birth

Appendix 3: Message Validation Results for Laboratory and Emergency Department Attendance Profiles

This appendix provides more examples of the message validation reports produced for sample messages against other message profiles created for the GPMS.

- **Laboratory Order OML_O21 Conformance Profile**

This profile is the first profile required for the Laboratory Order scenario defined by the GPMS. The abstract message type used for the laboratory order is the OML_O21 message type. For the purpose of the GPMS the minimum laboratory order message OML_O21 contains the following segments:

- MSH Message Header
- PID Patient Identification
- PV1 Event Type/Patient Visit
- ORC Common Order Segment
- OBR Observation Request
- SAC Specimen Container Details
- OBX Observation Response
- DG1 Diagnosis

The following conditions are also applied when generating a laboratory order message OML_O21:

- OBR.2 (Placer Order Number). This element is required
- OBR.7 (Observation Date/Time). This element is required when the specimen accompanies the laboratory order

Table A shows the abstract message structure for the OML_O21 laboratory order message. The table also shows which libraries were used by MWB to compile the profile.

Table A: OML_O21 Laboratory Order Abstract Message Structure

Segment	Description	Library compiled from
MSH	Message Header	GPMS
[{NTE}]	Notes and Comments (for Header)	GPMS
[		
PID	Patient Identification	GPMS
[PD1]	Additional Demographics	HL7
[{NTE}]	Notes and Comments (for Patient ID)	GPMS
[PV1	Patient Visit	GPMS
[PV2]]	Patient Visit- Additional Info	HL7
[{IN1	Insurance	HL7
[IN2]	Insurance Additional Info	HL7
[IN3]	Insurance Add'l Info - Cert.	HL7
}]		
[GT1]	Guarantor	HL7
[{AL1}]	Allergy Information	HL7
]		
{		
[		
SAC	Specimen Container Details	GPMS
[{OBX}]	Additional Specimen Characteristics	GPMS
]		
{		
ORC	Common Order	GPMS
[		
OBR	Observation Request	GPMS
[{		
SAC	Specimen Container Details	GPMS
[{OBX}]	Additional Specimen Characteristics	GPMS
}]		
[TCD]	Test Code Details	HL7
[{NTE}]	Notes and Comments (for Detail)	GPMS
[{DG1}]	Diagnosis	GPMS
[{		
OBX	Observation/Result	GPMS
[TCD]	Test Code Detail	HL7
[{NTE}]	Notes and Comments (for Results)	GPMS
}]		
[{		
[PID	Patient Identification – previous result	GPMS
[PD1]]	Additional Demographics – previous result	HL7
[PV1	Patient Visit – previous result	GPMS
[PV2]]	Patient Visit Add. Info – previous result	HL7
[{AL1}]	Allergy Information - previous result	HL7
{		

```
        [ORC]          Common Order - previous result          GPMS
        OBR            Order Detail - previous result          GPMS
        {[NTE]}        Notes and Comments - previous result    GPMS
        {
            OBX        Observation/Result - previous result    GPMS
            [{NTE}]    Notes and Comments - previous result    GPMS
         }
       }
      }]
   ]
   [{FT1}]             Financial Transaction                   HL7
   [{CTI}]             Clinical Trial Identification           HL7
   [BLG]               Billing Segment                         HL7
 }
]
```

OML_O21 Test Message:

Shown here is the complete content of the sample OML_O21 message that was tested for validation against this profile. This message provides an indication into how complicated HL7 messages can get and also the work involved in analysing the resulting message validation report.

```
<?xml version="1.0" encoding="utf-8"?>
<OML_O21>
<MSH>
<MSH.1>|</MSH.1>
<MSH.2>^~\&amp;amp;</MSH.2>
<MSH.3>
<HD.1>HLONLINE.HEALTHLINK.1</HD.1>
<HD.2 />
<HD.3 />
</MSH.3>
<MSH.4>
<HD.1>Test,Practice</HD.1>
<HD.2>003539</HD.2>
<HD.3>L</HD.3>
</MSH.4>
<MSH.5>
<HD.1 />
<HD.2 />
<HD.3 />
</MSH.5>
<MSH.6>
<HD.1>Mater Public Hospital</HD.1>
<HD.2>908</HD.2>
<HD.3>L</HD.3>
</MSH.6>
<MSH.7>
<TS.1>201006110919</TS.1>
</MSH.7>
<MSH.9>
<MSG.1>OML</MSG.1>
<MSG.2>O21</MSG.2>
</MSH.9>
<MSH.10>OML1402514</MSH.10>
<MSH.11>
<PT.1>P</PT.1>
</MSH.11>
<MSH.12>
```

```
<VID.1>2.4</VID.1>
</MSH.12>
</MSH>
<OML_O21.PATIENT>
<PID>
<PID.1 />
<PID.3>
<CX.1>hl0001</CX.1>
<CX.4>
<HD.1>HEALTHLINK</HD.1>
</CX.4>
<CX.5>MRN</CX.5>
</PID.3>
<PID.5>
<XPN.1>
<FN.1>test</FN.1>
</XPN.1>
<XPN.2>testname</XPN.2>
<XPN.3 />
<XPN.4 />
<XPN.5 />
<XPN.6 />
<XPN.7 />
</PID.5>
<PID.7>
<TS.1>19780801</TS.1>
</PID.7>
<PID.8>F</PID.8>
<PID.11>
<XAD.1>
<SAD.1>Tst Road</SAD.1>
</XAD.1>
<XAD.2>ballymun</XAD.2>
<XAD.3 />
<XAD.4 />
<XAD.5 />
</PID.11>
<PID.12 />
</PID>
<NTE>
<NTE.1 />
<NTE.2 />
<NTE.3 />
</NTE>
<OML_O21.PATIENT_VISIT>
<PV1>
<PV1.2>O</PV1.2>
<PV1.3>
<PL.4>
<HD.1>1327</HD.1>
</PL.4>
</PV1.3>
<PV1.7>
<XCN.1 />
<XCN.2>
<FN.1 />
</XCN.2>
<XCN.3 />
<XCN.4 />
<XCN.5 />
<XCN.6 />
</PV1.7>
<PV1.8>
<XCN.1 />
<XCN.2>
<FN.1>Referring</FN.1>
</XCN.2>
<XCN.3>Test</XCN.3>
<XCN.4 />
<XCN.5 />
<XCN.6 />
</PV1.8>
<PV1.15>B8</PV1.15>
</PV1>
</OML_O21.PATIENT_VISIT>
```

```
</OML_O21.PATIENT>
<OML_O21.ORDER>
<OML_O21.ORDER_PRIOR>
<ORC>
<ORC.1>NW</ORC.1>
<ORC.14>
<XTN.1>8467094</XTN.1>
</ORC.14>
<ORC.22>
<XAD.1>
<SAD.1>1st Floor</SAD.1>
</XAD.1>
<XAD.2>Ballymun Civic Centre</XAD.2>
<XAD.3>Main Street, Ballymun</XAD.3>
<XAD.4>Dublin 9</XAD.4>
<XAD.5 />
</ORC.22>
</ORC>
<OML_O21.OBRSACOBXTCDNTEDG1OBXTCDNTEPIDPD1PV1PV2AL1ORCOBRNTEOBXNTE>
<OBR>
<OBR.1>1</OBR.1>
<OBR.2>
<EI.1>OML1402514</EI.1>
<EI.2 />
</OBR.2>
<OBR.3>
<EI.1 />
<EI.2 />
<EI.3 />
<EI.4 />
</OBR.3>
<OBR.4>
<CE.1>TFT</CE.1>
<CE.2>Thyroid Function Test</CE.2>
<CE.3>L</CE.3>
<CE.4 />
<CE.5 />
<CE.6 />
</OBR.4>
<OBR.7>
<TS.1>201006110919</TS.1>
</OBR.7>
<OBR.12>
<CE.1 />
<CE.2 />
<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</OBR.12>
<OBR.13>tatt</OBR.13>
<OBR.15>
<SPS.1>
<CE.1>11</CE.1>
<CE.2>BLOOD CLOTTED</CE.2>
<CE.3>L</CE.3>
<CE.4 />
<CE.5 />
<CE.6 />
</SPS.1>
<SPS.2 />
<SPS.4>
<CE.1 />
<CE.2 />
<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</SPS.4>
<SPS.5>
<CE.1 />
<CE.2 />
<CE.3 />
<CE.4 />
<CE.5 />
```

<CE.6 />
</SPS.5>
</OBR.15>
<OBR.16>
<XCN.1>00569</XCN.1>
<XCN.2>
<FN.1>Referring</FN.1>
</XCN.2>
<XCN.3>Test</XCN.3>
<XCN.4 />
<XCN.5 />
<XCN.6 />
</OBR.16>
<OBR.24>EDO</OBR.24>
<OBR.27>
<TQ.4>
<TS.1>R</TS.1>
</TQ.4>
</OBR.27>
</OBR>
<NTE>
<NTE.1 />
<NTE.2 />
<NTE.3 />
</NTE>
<DG1>
<DG1.1 />
<DG1.2 />
<DG1.3>
<CE.1 />
<CE.2 />
<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</DG1.3>
<DG1.4 />
<DG1.5>
<TS.1 />
</DG1.5>
<DG1.6 />
<DG1.16>
<XCN.1 />
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<FN.1 />
</XCN.2>
<XCN.3 />
<XCN.4 />
<XCN.5 />
<XCN.6 />
</DG1.16>
</DG1>
</OML_O21.OBRSACOBXTCDNTEDG1OBXTCDNTEPIDPD1PV1PV2AL1ORCOBRNTEOBXNTE>
</OML_O21.ORDER_PRIOR>
<OML_O21.ORDER_PRIOR>
<ORC>
<ORC.1>NW</ORC.1>
<ORC.14>
<XTN.1>8467094</XTN.1>
</ORC.14>
<ORC.22>
<XAD.1>
<SAD.1>1st Floor</SAD.1>
</XAD.1>
<XAD.2>Ballymun Civic Centre</XAD.2>
<XAD.3>Main Street, Ballymun</XAD.3>
<XAD.4>Dublin 9</XAD.4>
<XAD.5 />
</ORC.22>
</ORC>
<OML_O21.OBRSACOBXTCDNTEDG1OBXTCDNTEPIDPD1PV1PV2AL1ORCOBRNTEOBXNTE>
<OBR>
<OBR.1>2</OBR.1>
<OBR.2>
<EI.1>OML1402514</EI.1>

<EI.2 />
</OBR.2>
<OBR.3>
<EI.1 />
<EI.2 />
<EI.3 />
<EI.4 />
</OBR.3>
<OBR.4>
<CE.1>FES</CE.1>
<CE.2>Iron Studies</CE.2>
<CE.3>L</CE.3>
<CE.4 />
<CE.5 />
<CE.6 />
</OBR.4>
<OBR.7>
<TS.1>201006110919</TS.1>
</OBR.7>
<OBR.12>
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<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</OBR.12>
<OBR.13>tatt</OBR.13>
<OBR.15>
<SPS.1>
<CE.1>78</CE.1>
<CE.2>SERUM GEL</CE.2>
<CE.3>L</CE.3>
<CE.4 />

<CE.5 />
<CE.6 />
</SPS.1>
<SPS.2 />
<SPS.4>
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<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</SPS.4>
<SPS.5>
<CE.1 />
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<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</SPS.5>
</OBR.15>
<OBR.16>
<XCN.1>00569</XCN.1>
<XCN.2>
<FN.1>Referring</FN.1>
</XCN.2>
<XCN.3>David </XCN.3>
<XCN.4 />
<XCN.5 />
<XCN.6 />
</OBR.16>
<OBR.24>CH</OBR.24>
<OBR.27>
<TQ.4>
<TS.1>R</TS.1>
</TQ.4>
</OBR.27>
</OBR>
<NTE>
<NTE.1 />

```
<NTE.2 />
<NTE.3 />
</NTE>
<DG1>
<DG1.1 />
<DG1.2 />
<DG1.3>
<CE.1 />
<CE.2 />
<CE.3 />
<CE.4 />
<CE.5 />
<CE.6 />
</DG1.3>
<DG1.4 />
<DG1.5>
<TS.1 />
</DG1.5>
<DG1.6 />
<DG1.16>
<XCN.1 />
<XCN.2>
<FN.1 />
</XCN.2>
<XCN.3 />
<XCN.4 />
<XCN.5 />
<XCN.6 />
</DG1.16>
</DG1>
</OML_O21.OBRSACOBXTCDNTEDG1OBXTCDNTEPIDPD1PV1PV2AL1ORCOBRNTEOBXNTE>
</OML_O21.ORDER_PRIOR>
</OML_O21.ORDER>
</OML_O21>
```

Message Validation Report and Analysis:

- *Error: MSH.3.2 [Sending Application.universal ID] - Captured Msg missing required element - truncated*
  Error: MSH.3.3 [Sending Application.universal ID type] - Captured Msg missing required element – truncated

  According to the GPMS MSH 3.2 and MSH 3.3 are specified as required elements [12]. The example message shown only populates the MSH 3.1 field. This demonstrates that the process can return valid errors relating to required elements defined by the GPMS that must be included in all messages.

- *Error: MSH.4.1 [Sending Facility.namespace ID][1.4.1] - CODE value (Test,Practice) not an element of table 0362 - Sending/receiving facility (USER table type)*
  Error: MSH.6.1 [Receiving Facility.namespace ID][1.6.1] - CODE value (Mater Public Hospital) not an element of table 0362 - Sending/receiving facility (USER table type)

Neither entry highlighted is present in table 0362 of the GPMS. This demonstrates that valid violation errors for coded entries are being produced.

- *Error: PATIENT.PATIENT_VISIT.PV1.15 [PATIENT_VISIT.PV1.Ambulatory Status][3.15] - CODE value (B8) not an element of table 0009 - Ambulatory status (USER table type)*

  Analysis of table 0009 in the GPMS shows that B8 is a defined element in this table. A crosscheck of this table within MWB revealed that this table is only populated up to and including entry B6. This is a clear example of an input error produced during the creation of the constrained table file described in 4.3.3. This issue will need to be addressed in further revisions of the constrained table file.

- *Error: PATIENT.INSURANCE.G4R [INSURANCE.G4R][4] - MISSING SegGroup*

  This error relates to the following segment group shown in the abstract message syntax.

[{IN1	Insurance	HL7
[IN2]	Insurance Additional Info	HL7
[IN3]	Insurance Add'l Info - Cert.	HL7
}]		

  This segment group is not required by the GPMS but is present within the MWB profile. The abstract message structure shows that this segment group is optional and also can repeat e.g. [{}]. An analysis of the MWB profile has shown that the "optional" component has been removed and this has been set to "required". This highlights an issue with this profile and can be addressed by changing the optional code for this segment group from required to optional within MWB.

- *Error: ORDER_GENERAL.ORDER [ORDER][5] - MISSING SegGroup*

  This error relates to the following segment group shown in the abstract message syntax.

  {
  ORC Common Order GPMS

  The {specifies that the Segment group can repeat but makes no reference to the optionality status of the Segment Group. MWB assigns the optionality code of "required" to this Segment group but it is not clear why. Further investigation would be required to find the root cause of this error.

- *Error: ORDER_GENERAL.ORDER.ORC [ORDER.ORC] - Required SEGMENT not present in captured message*

  The ORC segment is a required segment for this profile as defined by the GPMS. The ORC segment is also present in the message but in two separate locations under the XML tag <OML_O21.ORDER_PRIOR>. It is unclear whether it is the message or the profile that is producing this error and further investigation will be required to determine the source of this error.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.4.3 [ORDER.OBSERVATION_REQUEST.OBR.Universal Service Identifier.name of coding system][5.4.3] - CODE value (L) not an element of table 0396 - Coding System (USER table type)*

  The GPMS specifies OBR.4.3 to use table 0396. However table 0396 is not defined in the GPMS standard. This is a failing of the standard and this table will need to be supplied or reference to within the segments removed.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.15.1.2 [ORDER.OBSERVATION_REQUEST.OBR.Specimen Source.specimen source name or code.text][5.15.1.2] - HL7 CODE value (BLOOD CLOTTED) not an element of HL7 table 0070 - Specimen source codes*

An analysis of table 0070 as defined by the GPMS does not contain this coded value “BLOOD CLOTTED”. This reported violation is valid.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.16.2.1 [ORDER.OBSERVATION_REQUEST.OBR.Ordering Provider.family name.surname][5.16.2.1] - specified value LENGTH (3) exceeded - "Referring" (9)*

  Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.16.3 [ORDER.OBSERVATION_REQUEST.OBR.Ordering Provider.given name][5.16.3] - specified value LENGTH (3) exceeded - "Test" (4)

  The GPMS does not make any reference to either of these fields in the OBR segment. However it does define OBR.16.1, OBR 16.6 and OBR 16.16. Given that this is the case it was necessary to leave all other elements of the OBR.16 field as “optional” in MWB, which also meant that the default lengths of these optional fields, as defaulted by MWB were used. In this example the default length of both OBR.16.2.1 and OBR.16.3 are by default 3 characters. Further investigation would be required to see if these elements, which are not defined by the GPMS but which can legitimately be sent in a message, can be removed from the validation process within MWB. This would remove the load on validating messages and also on the reporting of violations.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.24 [ORDER.OBSERVATION_REQUEST.OBR.Diagnostic Serv Sect ID][5.24] - HL7 CODE value (EDO) not an element of HL7 table 0074 - Diagnostic service section ID*

  The GPMS specifies this table for use with OBR.24. However this value *EDO* is not defined in table 0074 demonstrating valid message violations.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBR.27.4.1 [ORDER.OBSERVATION_REQUEST.OBR.Quantity/Timing.start date/time.Date/Time][5.27.4.1] - specified value LENGTH (0) exceeded - "R" (1)*

  The GPMS does not specify OBR.27.4.1however it does specify OBR.27.1. Given that this is the case it was necessary to leave all other elements of the OBR.16 field as "optional" in MWB, which also meant that the default lengths of these optional fields, as defaulted by MWB were used. In this example the default length of OBR.27.4.1is 0 characters. Further investigation would be required to see if this element, which is not defined by the GPMS but which can legitimately be sent in a message, can be removed from the validation process within MWB. This would remove the load on validating messages and also on the reporting of violations.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.CONTAINER_2.G10R [ORDER.OBSERVATION_REQUEST.CONTAINER_2.G10R][6] - MISSING SegGroup*

  This error report relates to the following segment group shown in the abstract message syntax.

  ```
  [{
    SAC          Specimen Container Details          GPMS
    [{OBX}]      Additional Specimen Characteristics GPMS
  }]
  ```

  The abstract message structure shows that this segment group is optional and also can repeat e.g. [{}]. An analysis of the MWB profile has shown that the "optional" component has been removed and this has been set to "required". This highlights an issue with this profile and can be addressed by

changing the optional code for this segment group from required to optional within MWB.

- *Error: ORDER_GENERAL.ORDER.OBSERVATION_REQUEST.OBSERVATION.G12R [ORDER.OBSERVATION_REQUEST.OBSERVATION.G12R][7] - MISSING SegGroup*

  Similar to the previous violation, this error report relates to the following segment group in the OML_O21 abstract message syntax:

[{		
OBX	Observation/Result	GPMS
[TCD]	Test Code Detail	HL7
[{NTE}]	Notes and Comments (for Results)	GPMS
}]		

The abstract message structure shows that this segment group is optional and also can repeat e.g. [{}]. An analysis of the MWB profile has shown that the "optional" component has been removed and this has been set to "required". This highlights an issue with this profile and can be addressed by changing the optional code for this segment group from required to optional within MWB.

- **Emergency Department Attendance Conformance Profile**

The message type used for this profile is the ADT_A01 message type. For the purposes of the GPMS the minimum emergency department attendance notification message should contain the following segments:

- MSH Message Header
- PID Patient Identification
- ENV Event Segment
- PV1 Event Type/Patient Visit
- PV2 Event Type/Additional information.

The following conditions are also applied when generating an emergency department attendance notification message:

- PV1.14 (Admit Source). This element is required
- PV1.44 (Admit Date/Time.) This element is required.

Table shows the abstract message structure for the ADT_A01 laboratory order message. The table also shows which libraries were used by MWB to compile the profile. Although the OBX and DG1 segments are taken from the GPMS Segment library there are defined as optional for this message type.

Table 0-60: ADT_A01 Admit/Visit Notification Abstract Message Structure

Segment	Description	Library Compiled from
MSH	Message Header	GPMS
EVN	Event Type	GPMS
PID	Patient Identification	GPMS
[PD1]	Additional Demographics	HL7
[{ ROL }]	Role	HL7
[{ NK1 }]	Next of Kin / Associated Parties	HL7
		GPMS

Segment	Description	Library Compiled from
PV1	Patient Visit	
[PV2]	Patient Visit - Additional Info.	GPMS
[{ ROL }]	Role	HL7
[{ DB1 }]	Disability Information	HL7
[{ OBX }]	Observation/Result	GPMS
[{ AL1 }]	Allergy Information	HL7
[{ DG1 }]	Diagnosis Information	GPMS
[DRG]	Diagnosis Related Group	HL7
[{		
PR1	Procedures	HL7
[{ ROL }]	Role	HL7
}]		
[{ GT1 }]	Guarantor	HL7
[{		
IN1	Insurance	HL7
[IN2]	Insurance Additional Info.	HL7
[{ IN3 }]	Insurance Additional Info - Cert.	HL7
[{ ROL }]	Role	HL7
}]		
[ACC]	Accident Information	HL7
[UB1]	Universal Bill Information	HL7
[UB2]	Universal Bill 92 Information	HL7
[PDA]	Patient Death and Autopsy	HL7

ADT_A01 Test Message :

```
MSH|^~\&|TOREX.HEALTHLINK.4|MATER MISERICORDIAE HOSPITAL^908^L||DR
DAVID TEST^00359^L|201002070101||ADT^A01|2371190|P|2.4

EVN||201002070101

PID|||0436778^^^MATER                                    MISERICORDIAE
HOSPITAL^MRN||Test^ASHLING^^^MS^^L||19460206|F|||22              Test
St.^FINGLAS^DUBLIN 11|||||||||||||||||||N

PV1||E|^^^^^^^^Emergency      Department||||^ED      Consultant||^ED
Consultant|||||9|||||||||||||||||||||||||||201002070101|||||||A

PV2|||||||||||||||||||||||||||||||||||A^Ambulance^HL70430
```

Message Validation Report from MWB and Analysis for Test Message 1:

- *Error: MSH.4.1 [Sending Facility.namespace ID][1.4.1] - CODE value (MATER MISERICORDIAE HOSPITAL) not an element of table 0362 - Sending/receiving facility (USER table type)*

- *Error: MSH.6.1 [Receiving Facility.namespace ID][1.6.1] - CODE value (DR DAVID TEST) not an element of table 0362 - Sending/receiving facility (USER table type)*

  Neither entry highlighted is present in table 0362 of the GPMS..

This demonstrates that valid violation errors for coded entries are being produced. However, even from the small sample of test messages available, there is a clear trend in violations against table 0362. This may be due to the fact that table 0362 is incomplete in its specification or messaging sites don't adhere to a clear coded system for these fields.