Public Health Information Network
Notification Messaging Basic Description
Version 2

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Centers for Disease Control and Prevention

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1 INTRODUCTION

This document provides an overview of the Notification Messaging component of the Public Health Information Network (PHIN). PHIN is a comprehensive architecture of data and information systems standards intended to advance the development of efficient, integrated, and interoperable public health surveillance systems. The exchange of health-related information between healthcare providers and public health agencies is an essential aspect of public health surveillance. Messaging – the electronic exchange of data between computerized information systems – is a key element of the PHIN architecture. Health Level Seven (HL7) standards are the prevailing industry standards for communicating clinical and laboratory data in the form of electronic messages. The reader should note that the message specification described below is also being forwarded as a national standard though the HL7 Version 3.0 ballot process.

This document is designed to supplement the Notification Messaging Implementation Guides, and to provide sufficient background on the Notification Message to orient the users of those guides. The document will be useful to all parties who provide notifiable disease messages to CDC, however it is particularly relevant to PHIN partners who do not implement the PHIN Base System
State and Local Health Departments that provide notifiable disease information to CDC are expected to collect the relevant information for disease cases, format that information using HL7 compliant PHIN notification messaages, and transmit those messages to CDC. The PHIN Base System includes the capabilities to support this messaging. Therefore, for parties who install the Base System, this document will provide a reference to those messaging capabilities. In conjunction with the disease specific Implementation Guides, the document provides information on the particulars of the data that are reported on a specific case.

Health Departments that do not install the PHIN Base System will need to implement Notification Messaging on their own in order to enable nationally notifiable disease reporting to CDC in the form of electronic messages. This requirement implies development of the capabilities to a) collect the needed information, b) extract the data from the relevant application database(s), c) format the data into the mandated message structure, and d) pass the formatted message to CDC conformant to PHINmandated security and data transmission standards. The PHIN Messaging Basic Description provides information on that mandated message structure, and on the process by which the message format has been defined. In conjunction with the disease specific Implementation Guides, it should be used to determine the specific data to be reported with a case. Documentation of the PHIN Messaging System provides information on standards for security and data transmission.

1.1 PHIN Messaging Documentation

This document introduces Version 1 of the Notification Messaging specifications. It contains the following sections.

- **Requirements for PHIN Messaging**: This section includes a discussion of the message interactions and the contents of notification messages. The interactions and trigger events to be supported are included.
- **HL7 Message Development Methodology**: The use of HL7's Message Development Framework (MDF) for PHIN messaging is summarized.
- **Message Structure and Comment**: The logical structure of the message is shown and discussed. The Excel Spreadsheet showing the HL7 Hierarchical Message Description is included as a companion document.[1]
- **Vocabulary Issues**: The list of the PHIN supported value sets that are used within the notification messages is included. The contents of the value sets, which closely correspond to the PHIN System Reference Tables (SRTs), are available elsewhere in a separate document.
- **Message Mapping using Condition Specific Implementation Guides**: Discussion of the message mapping process including requirements for non-base system users. This section also includes a discussion of the requirements for supporting the HL7 datatypes. The specific mapping requirements for individual notifiable diseases are provided in the Notification Messaging Implementation Guides.
- **Message Implementatio**n: The section discusses implementation requirements that are specific to Notification messaging.

1.2 Notification Messaging Versions

The Notification Messaging specifications introduced in this document are based on two sources a) the requirements defined for the PHIN Base System in October, 2001, and b) the requirements as documented in draft implementation guides through September, 2002. Data structures have also been introduced to address some additional known messaging requirements.

As new requirements are identified and specified they will be incorporated into subsequent versions of the Notification Message, and these new requirements will be introduced into the HL7 Standardization process.. These requirements are based on: a) continuing work on the PHIN Program Area Modules, and development of messaging to support Bio-terrorism Response and other forms of case reporting.[2]

[1] Implementers should refer to Health Level 7, and to the NEDSS developers for more information on the XML schemas that are used in constructing message instances based on the Hierarchical Message Description.

[2] The reader should note that a similar but not identical format has been introduced to support safety reporting requirements such as FDA drug reaction reporting.

2 NOTIFICATION MESSAGING REQUIREMENTS

Notification messaging within PHIN is directed at communications involved in the surveillance of the incidence and distribution of health problems and risk factors within a jurisdiction or population. The surveillance data are used to monitor trends in disease, to evaluate public health programs, and to identify unusual occurrences of conditions that may require further epidemiologic investigation.

The NEDSS Overview[2] describes the use cases to be supported by the PHIN Base System. Each use case involves sending and managing disease notifications and encompasses all activities associated with submitting notifications to the message router and communicating success of message transfer to the recipient.

2.1.1 Messaging Scenarios

A set of message exchanges, referred to as a messaging scenario, is needed to fulfill the defined use case[3] In HL7 terms, each message scenario involves a set of related interactions. For example, a message can be sent and accepted, or it can be sent and responded to by a request for clarification.

The choice of messaging scenarios is based on the desire to simplify the system design. Each scenario stands on its own, and will be supported by a message followed by acknowledgement of message receipt. The following message scenarios have been chosen to support current Nationally Notifiable Disease (NND) reporting functionality:

I. **Condition Notification**: Notification Source in a State or another reporting system sends a notification to the Notification Recipient (CDC). The Notification Recipient will acknowledge receipt. A negative acknowledgement will be sent if the message that has been received cannot be processed.
II. **Change/Retraction of Prior Notification**: Notification Source in a State or another reporting system sends a notification update/change/retraction. This message will always provide a reference to the earlier notification that is being updated, changed, or retracted. The Notification Recipient will acknowledge receipt. A negative acknowledgement will be sent if the message that has been received cannot be processed.
III. **Summary Notification**: Notification Source in a State or another reporting system provides total number of cases, during a specified time period, of a specific disease or condition reported to the Notification Recipient. The Notification Recipient will acknowledge receipt. A negative acknowledgement will be sent if the message that has been received cannot be processed.
IV. **Notification Response**: The Notification Recipient will provide a response to the Notification Source in a State or another reporting system once the Notification Recipient has processed the message. This message will indicate that the message was successfully processed by the interface engine. The Notification Source in a

[3] The term, scenario, is used in many different ways. In the UML, it is defined as "a specific sequence of actions that illustrate behavior" [The Unified Modeling Language User Guide, Page 466].

State or another reporting system will acknowledge receipt. A negative acknowledgement will be sent if the message that has been received cannot be processed.

These message scenarios are applicable beyond NND notification. No matter what the condition being managed, it will be important to send notifications, to update previous transmissions, to provide summary information, and to have the capability to acknowledge message processing.

2.1.2 Interaction Documentation

Each messaging scenario chosen for implementation translates into a single interaction as shown on the collaboration diagram below. Note that the message acknowledgements are not shown.

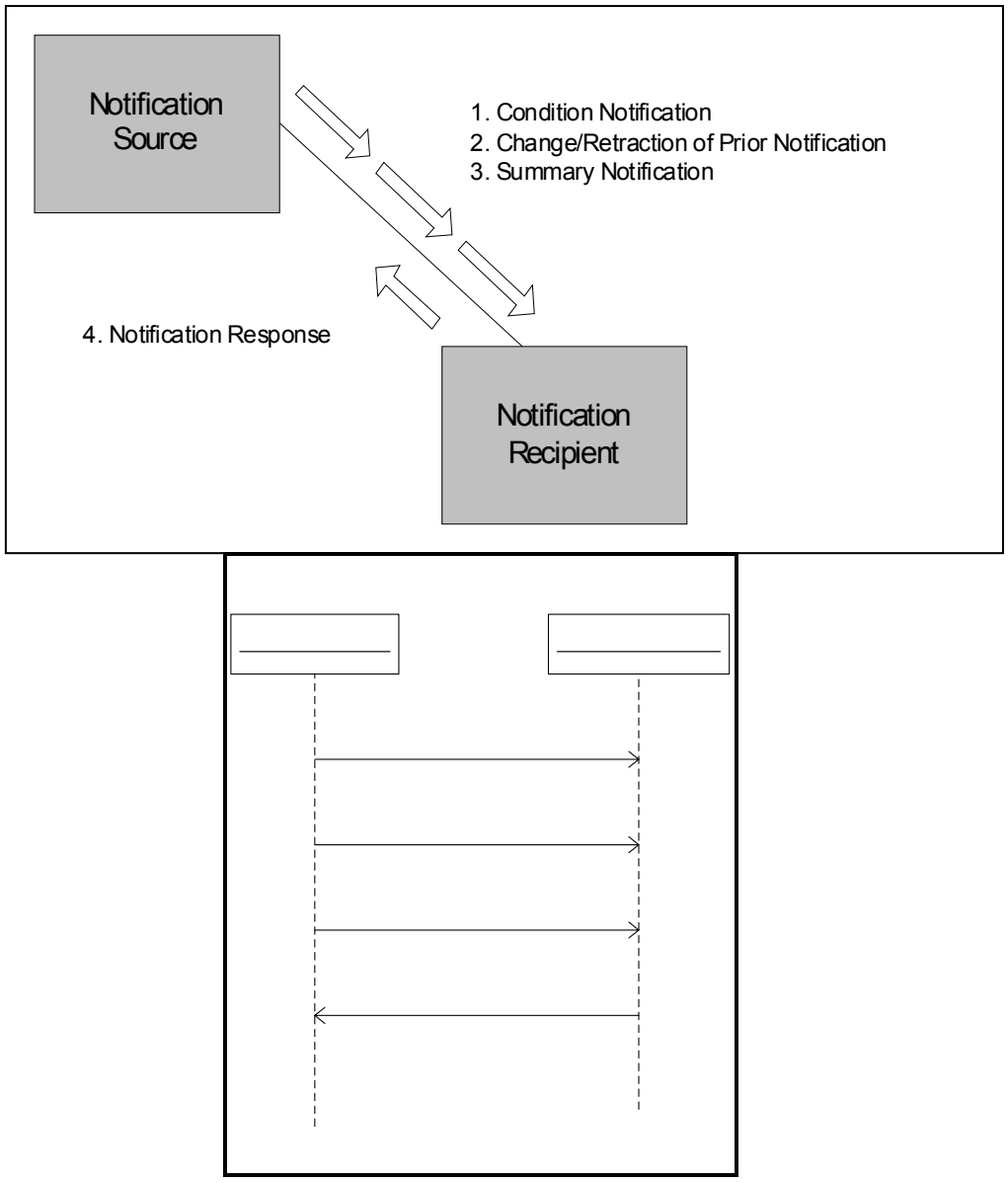

Figure 1: Notification Interactions

The HL7 Version 3 methodology was used to fully specify the above interactions by identifying trigger events, event preconditions, and receiver responsibilities as shown below.

ID	Interaction Name	Trigger Event	Event Precondition	Sender	Receiver	Receiver Responsibility
CDCNND1	Notification Report	Notification Criteria Met	Relevant observations in hand	Notification Source	Notification Recipient	Send # 4 Confirmation
CDCNND 2	Notification Revision	Modified Case Information Available	Error or omission detected in previously sent message	Notification Source	Notification Recipient	Send # 4 Confirmation
CDCNND 3	Notification Retraction	Determination that no case took place	Error in initial report transmission	Notification Source	Notification Recipient	Send # 4 Confirmation
CDCNND 4	Acceptance Confirmation	Case Notification Accepted	Receipt of notification message from Notification Source.	Notification Recipient	Notification Source	None

Table 1: Notification Interaction Specification[4]

3 NOTIFICATION MESSAGE SPECIFICATION DEVELOPMENT PROCESS

The PHIN notification message specifications provide the format for definition and transmission of a collection of predefined, standardized datasets designed specifically for the electronic exchange of public health surveillance information. Each dataset is an organized sequenced collection of data elements containing the information of interest about the classes of information included in the message. Note that not all data elements in each dataset are pertinent to all patients, e.g., pregnancy status in the sexually transmitted diseases (STD) dataset when the patient is male. It is also important to recognize that there is a single specification for case notification. However, based on the fact that the array of data that is passed differs greatly between individual diseases or conditions, implementation guides are constructed to specific the particular data required for a particular type of case.

Design of the messaging datasets follows a development process based upon the **HL7** message development framework.

3.1 The HL7 Message Development Methodology

The **HL7 Version 3 (V3)** development process uses a model-based, object-oriented development methodology.[5] The methodology includes a specified set of analysis and

[4] The PHIN messaging team is currently researching the need for a "Summary Notification" – a message that will address periodic reporting of the number of cases of a particular disease or condition.

design models, development tools, and development rules and guidelines. The HL7 V3 development methodology has produced the most definitive HL7 standards to-date, incorporating more trigger events and message formats with much less optionality compared to previous HL7 versions. The HL7 V3 vocabulary work assures that systems sending and receiving V3 HL7 messages have an unambiguous understanding of the code sources and code value domains they are using.

The PHIN notification messages have been developed using the HL7 message development process, and contain elements drawn from the HL7 Reference Information Model (RIM) as specified by that process. As initially developed, these messages constitute a standard for use within the PHIN environment. However, PHIN plans to submit the notification messaging specifications to the HL7 organization for consideration as HL7 V3 standard specifications.

3.2 The HL7 Reference Information Model

The HL7 Reference Information Model (RIM) plays a central role in the HL7 V3 development methodology. An information model documents information from a functional domain using a formal specification language. It consists of a graphical expression accompanied by a data dictionary, both of which use predefined symbols, semantics, and rules of construction. The purpose of an information model is to reveal assumptions, reduce ambiguity, reconcile and expand understanding, and consolidate ideas about an information domain.

The HL7 RIM is the information model from which the information-related content of the HL7 V3 standards is drawn. The HL7 RIM is the consensus view of health-related information as defined by the HL7 working group and international affiliates. It uses notation based on the Uniform Modeling Language (UML) and the information modeling conventions outlined in the HL7 message development framework.

3.3 Refined Message Information Models

The HL7 RIM is used as the basis for developing HL7 messaging specifications, and it plays the same role here.[6] The first step in this process is to construct a refined message information model (R-MIM) that defines the contents of the message in the form of a data model. The R-MIM is a subset of the RIM that is refined to be specific to the information requirements of the PHIN case notification messages. The notification report message R-MIM is an information model whose classes, relationships, and attributes are extracted from the HL7 RIM. Once the "base classes" that are needed have been selected, the model is refined to be specific to case

[5] This document provides a high level overview of HL7's methodology for message specification. For more details, the reader should refer to the Version 3 Guide published by HL7 as a component of the Version 3.0 Ballot Package. The document is available from HL7, and may be obtained from the HL7 Web site at http://www.hl7.org.

[6] The reader should refer to the Version 3 Guide published by HL7 for more information on the message creation process.

notification by cloning (copying and renaming) classes. For example, in the Case Notification RMIM one will find the following classes: Case Source, Provider Organization, Person(Case Subject), Contact, Manufactured Material. Each of these represents entities who play a role in the notification process, and each has been cloned from the RIM class: Entity. The model is further refined by introducing clones of Role, Participation, and Act classes and the associated relationships. The final R-MIM is then used to allocate vocabulary domains to attributes and derive a Hierarchical Message Description.

3.4 Vocabulary Domain Specifications

A vocabulary domain is a collection of coded concepts. Vocabulary domains are associated with attributes in the R-MIM and define the set of allowable values for the associated attribute. For example, the attribute Certainty Level may be associated with the concepts Confirmed, Probable, and Suspect. A vocabulary domain including these concepts is defined and potential code sources are identified and evaluated.

It is important to recognize that, while a vocabulary domain identifies a collection of concepts, an implemented system of messages has to supply coded values that represent those concepts. These coded values are drawn from one or more coding systems. It is not always simple, given the wide range of functions that have to be supported, to properly define the source or sources for the set of codes that is valid for a particular message. On the other hand, given the need to maintain and update the code sets used for a particular purpose, it is essential to record and manage this definition.

In order to understand how a vocabulary domain is related to the code values that are allowed for a particular attribute in a message, the following points need to be grasped:

1. Every coded RIM attribute is associated with a vocabulary domain that defines the set of concepts which valid for association with the use of that attribute within a message instance.
2. A coding system is "a scheme for representing concepts using short (usually) concept identifiers to denote the concepts that are members of the system. Examples of coding systems are ICD-9, LOINC and SNOMED."[7]
3. HL7 will attempt to associate one or more coding systems with a vocabulary domain. Ideally there will only be one that is associated with a domain across all realms in which HL7 is used. Preferably, a single coding system is used within the context of a given realm.
4. A realm is "a categorization of the geographical, organizational, or political environment where the HL7 standard is being used."[8] It is expected that a realm for US Public Health Messaging will be defined.

[7] HL7 Version 3 Ballot Package, Glossary: coding system.

5. In some cases, only a subset of the codes in a coding system is appropriate for representing the domain that is relevant for an attribute. This is more likely to be true in the context of an attributes use within a particular domain. When this happens, a value set is defined that contains the desired subset of the codes in a domain. A value set is "a vocabulary domain that has been constrained to a particular realm and coding system."[9]
6. It is also possible, given the way that attributes are used in a particular messaging context, for messages to contain codes drawn from multiple coding systems. For example, many, but not all of the disease entities that are reportable are defined as SNOMED codes. As a result the domain for PublicHealthCase.code, when used for public health reporting, has to be constrained to allow a subset of the SNOMED codes, plus a set of additional codes. When this happens, a value set is defined for the set of codes needed from each coding system. An additional, "compound value set" is constructed which unites the two coding system specific one. The compound value set can then be assigned for use in the message.
7. When a coded attribute is used in a message specification, it will either be associated with a value set, or with a coding system. The assignment to a coding system takes place when any value from that coding system is valid for use within the particular context. Otherwise, a value set is defined that contains the set of codes that are allowed.

HL7 has a rigorous process for identifying and evaluating potential code sources for RIM attributes. HL7 is a significant reference source for the vocabulary domains associated with coded attributes used in PHIN message specifications. In many cases, however, the current vocabulary domains identified by HL7 were found insufficient for the requirements of PHIN and had to be amended or defined by the PHIN message design team. Regardless of the source of the domain, every vocabulary domain has the following properties: Domain Name, Description, Source, CDC Identifier, and a list of Coded concepts with codes.

The Notification Message will be implemented using HL7 vocabulary domains for structural elements within the message, and using PHIN defined coding systems and value sets for other attributes. Management of these coding systems and value sets is described in the documentation for the PHIN Base System.

3.5 Hierarchical Message Descriptions

After defining the information content needed for the PHIN messages in an R-MIM and assigning vocabulary domains to the coded attributes, the data elements of the messages are arranged into a hierarchy. The Hierarchical Message Description (HMD) is an ordered collection of attributes from the R-MIM with message specific constraints defined. It is the specification of the dataset that is the message.

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[8] HL7 Version 3 Ballot Package, Glossary: realm.

[9] HL7 Version 3 Ballot Package, Glossary: value set.

The order of the data elements in the HMD has some significance but for the most part the order is fairly arbitrary. A class from the R-MIM is chosen as a starting point or message root class. For the PHIN notification messages the Notification Act was selected as the root class. The attributes from that class forms the beginning of the HMD. From there, the relationships stemming from the root class are traversed to determine the next class whose attributes are to be added to the hierarchy. The process is repeated until all relationships have been traversed and attributes from all classes have been added to the hierarchy. Within the hierarchy, classes and their attributes are grouped into collections based upon the relationships traversed in the R-MIM.

Certain concepts recur constantly within the body of the HL7 message specifications. For example, many messages require references to practitioners related to an act or observation, to patients who are the subject of care, to specimens that are tested. In order to reduce duplication and to ease the development burden, HL7 has defined a structure known as a Common Message Element Type (CMET). A CMET is best thought of as an HMD fragment that is reused across the set of HL7 messages. Use of CMETS improves the consistency of HL7 messages, and allows common concepts to be developed once.

The HMD is the specification of a message dataset including the order and grouping of data elements and a specification of their constraints. Within an HMD, it is possible to define multiple message types. Each message type consists of a specific set of constraints on the data elements making up the HMD.

HL7 has developed tooling that automates the process of creating XML schemas to support an HMD. The Rose Tree tool is copyrighted by HL7, but is made freely available to developers of messages within the umbrella of HL7 standardization. The schema that is produced relies on additional schemas for any CMETs that are referred to by the HMD, as well as the schema for the HL7 datatypes, and a schema that represents the common elements defined for the XML implementation of HL7 V3 messages. As a result, the message specification received by an implementer will consist of a set of schemas, one of which contains the main contents of the message type being implemented.

3.6 Message Schemas

The message specifications are directly useful when transformed into an XML schema.[10] The schema acts as a template for the message instance. That is to say, the schema:

- defines the set of attributes that comprises the valid content of a message,
- indicates the required associations and order of elements,
- specifies the datatypes that control the internal composition of individual attributes,

[10] See the appendices below for more information on HL7's and Notification Messaging's use of XML schemas.

- indicates the domain to be applied for coded elements, and conveys the valid code set to be used for a domain.

There is a single schema that corresponds to each message specification, and that captures the particular definitions documented in the RMIM and HMD. This schema is useful within the context of the HL7 Implementable Technology Specification (ITS) for XML based messaging. There are four basic types of schemas that are used within the context of HL7 Version 3 XML based messaging. The basic types are:

- **Wrapper schemas**: There is a shared context for all HL7 messages that is expressed by defining a pair of schemas that are used across the range of HL7 messages. These schemas are known as "wrappers" because they can be thought of as structures, like an envelope for a letter, that enclose the contents of the message. There is a "transport" wrapper that captures basic message identification and date/time information, as well identifying message sender and receiver. This is the kind of information commonly carried in a message header. There is also a "control act" wrapper that captures includes general administrative information related to a controlled act that is being communicated as a messaging interaction. For notification messaging, this controlled act is the actual notification, and the wrapper captures information directly relevant to the notification.
- **Supporting schemas**: Any HL7 message draws upon a unified foundation: a common set of datatypes, common class definitions captured in the HL7 Reference Information Model, and shared vocabulary domains. There is a supporting schema for each of these, and they are included in the schemas for the messages.
- **Common Message Element Type (CMET) Schemas**: HL7 message development has defined a collection of common structures that are shared across the HL7 message set. These include structures that are commonly reused, and that need to be consistently represented. There are, for example, CMETs to represent information for patients, for persons assigned to a task, for specimens used in testing. Each CMET has its own schema which is included within the message schema that uses it. Note, a CMET may itself include CMETs.
- **Message Content Schemas**: These are the schemas that express the individual and unique content of the particular message. A single message content schema – the schema for the notification message itself is presented in this document. The HL7 Version 3 specification contains many message content schemas.

4 PHIN MESSAGE SPECIFICATIONS

A single message specification has been defined to address the information needs of the four PHIN disease notification interactions. This specification is documented as an HL7 RMIM, and as a single HMD that includes multiple message types.

4.1 Notification Report Message

The Case Reporting Refined Message Information Model captures the information needed to support case reporting to and from State and Local health departments. This specification includes, most particularly, reporting of cases subject to mandatory

reporting by statute. That is to say, it supports reporting of notifiable diseases or conditions. It also supports related reporting such as the messages that would be sent by a field investigation team back to its supporting health department. The following two pages show the Refined Message Information Model (RMIM) for this message specification.

Figure 2: Notification Message R-MIM – Left Side

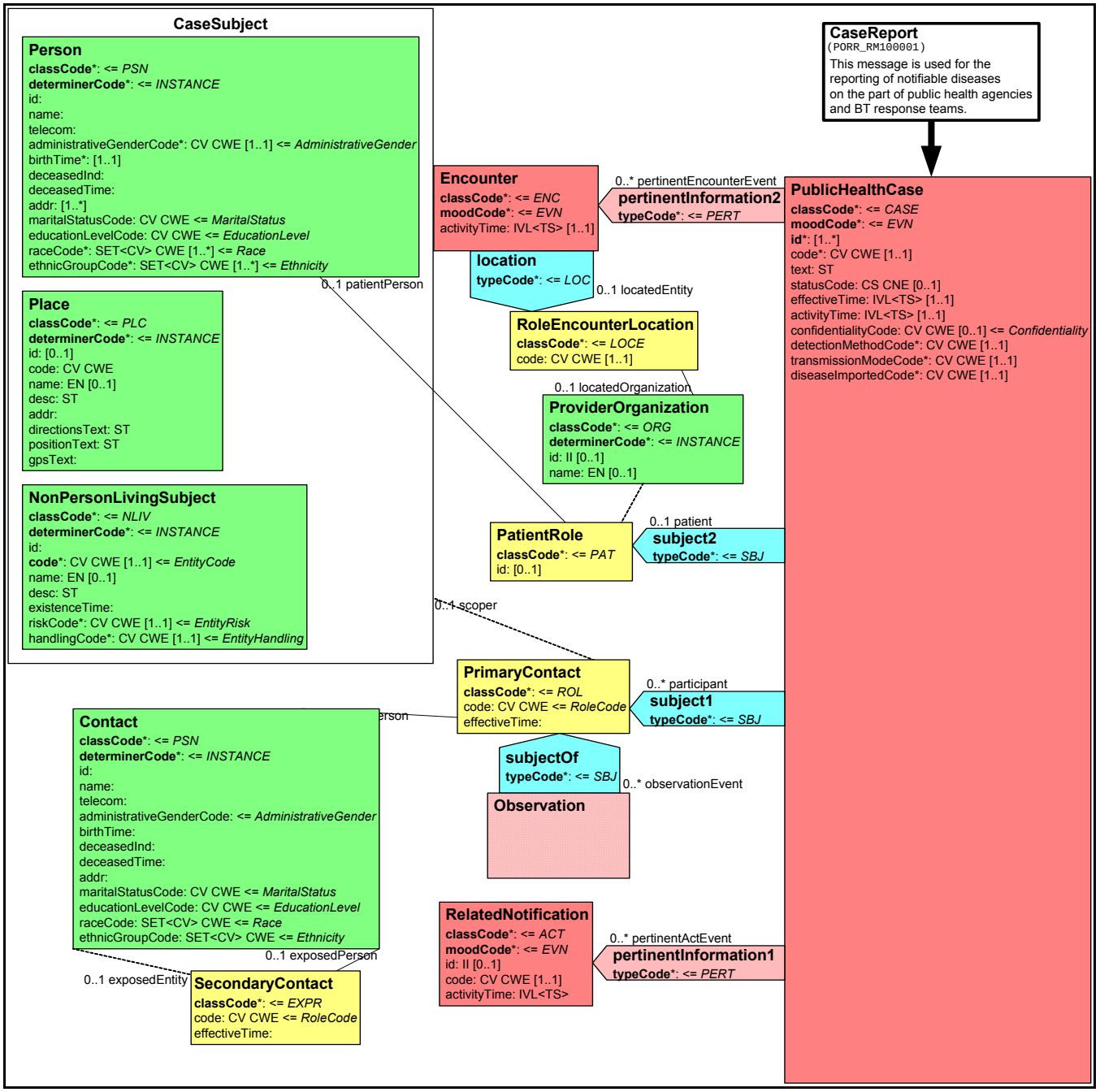
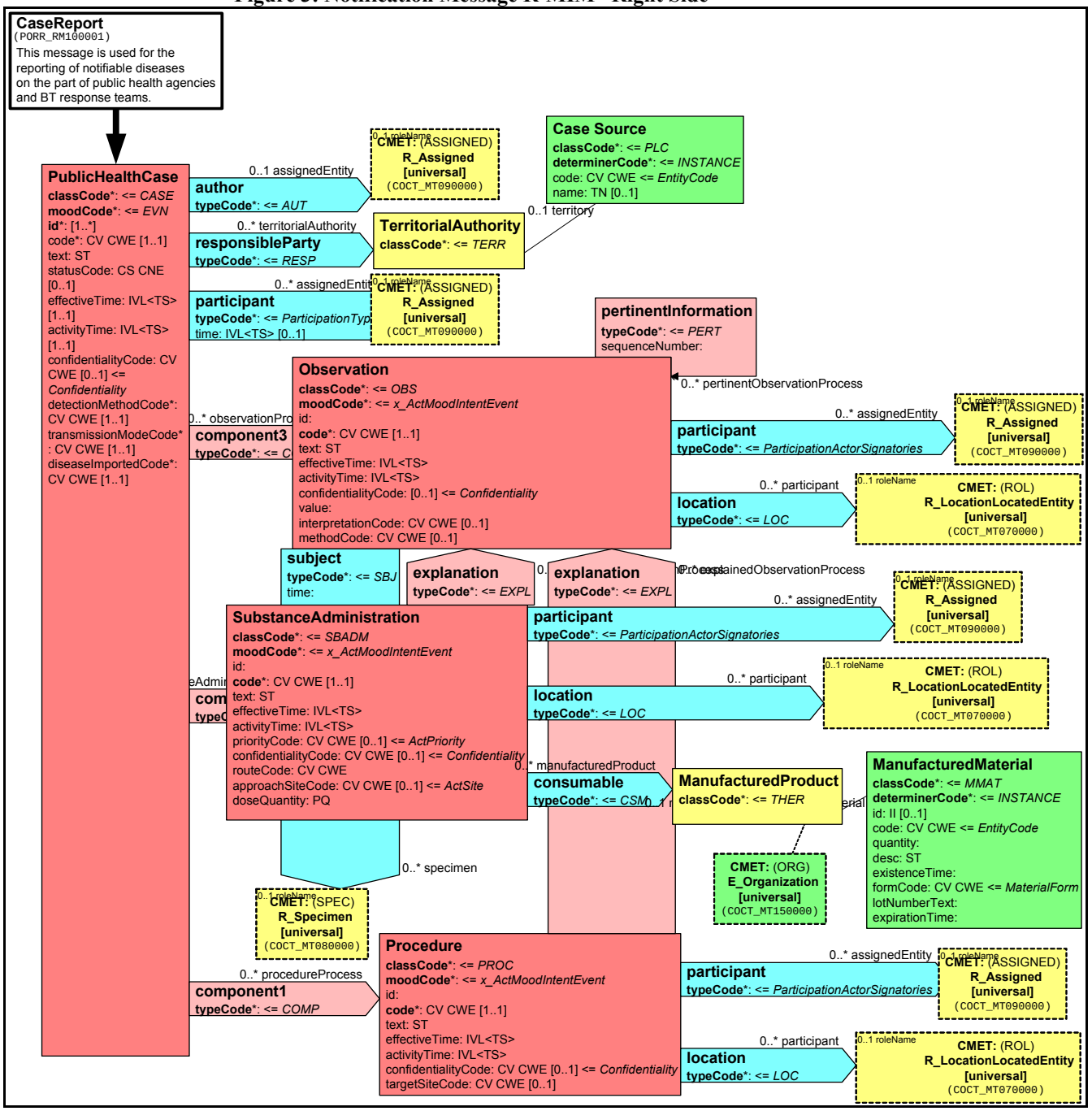


Figure 3: Notification Message R-MIM –Right Side



The Public Health Case serves as the entry point for messaging. For case reporting, a case is typically an incident of disease, whether infectious or not. It could also reflect an incident of another type, such as an automobile or a violent crime that is being tracked for public health purposes.

In the United States, identifying data for affected purposes is commonly removed when cases are reported from a State Health Department to the Federal government (.e.g., Centers for Disease Control and Prevention). There are other circumstances, for example, reporting from a local authority or provider to a State Health Department, or reporting between states in which identifying information is included.

Participations and Act Relationships

The following participations and act relationships are defined for a case. Each association captures the relationship between the case and an entity or another type of act that plays a significant part in the case. (Note, the participations have been ordered by "walking" around the central case in a clockwise direction.

- *Author*: The author is the party, generally a person, who takes responsibility for the contents of the case report.
- *Responsible Party (Territorial Authority)*: The responsible territorial authority indicates the jurisdiction within which the case has taken place. Note, in some circumstances, this jurisdiction is different from the jurisdiction actually reporting the case. (The reporting jurisdiction, is identified within the transport "wrapper" section of the message.)
- *Responsible Party (Assigned)*: The responsible assigned party indicates a person or organization which is directly responsible for some aspect of managing or working on the case.
- *Component(Observation)*:</I> Typically, a case report consists of a collection of significant observations related to the case. These observations include the relevant clinical or contextual facts that are captured for the case. The attribute, ActCode, plays a key role for these. It identifies the type of act that is being recorded or requested. \It is important to note that Component Observations can have additional observations linked to them. This makes it possible to capture clusters or related observations which, as a whole, are related to the case. It is also possible, and sometimes relevant, to capture participating entities, and the relevant location for an observation. In a similar fashion, it may be relevant to capture specimen information that is linked to a test that has been or will be carried as an aspect of confirming or developing relevant information about the case.
- *Component(Substance Administration)*: It is often relevant to capture substance administrations related to a public health case. A common example is the record of vaccinations that have been received by a patient. In some cases, this could include orders for vaccinations to be administered to the patient. It is important to note that Component Substance Administrations can have observations linked to them. It is also possible, and sometimes relevant,

to capture participating entities, and the relevant location for a substance administration.

- *Component(Procedure)*:</I> It is often relevant to capture procedures related to a public health case. It is important to note that Component Procedures can have observations linked to them. It is also possible, and sometimes relevant, to capture participating entities, and the relevant location for a procedure.
- *Pertinent Information(Related Notification)*: Associated notifications are a key item that is reported for infectious disease reporting and for drug incident reporting. The record of this information has been kept as a participation in its own right, as a recognition of its role, and to ease the mapping process.
- *Subject (Primary Contact/Case Subject*: It is often the case that the underlying justification for public health's interest in a disease or condition (This interest is what lies behind the designation of something as a case.) is related to the disease's potential to be communicated to others. Such communicability is clearly relevant for infectious diseases; it is also relevant for toxins such as anthrax which can be dispersed from a place to persons, and passed from person to person through casual contact. This participation captures information about persons who play the role of contact with respect to the person, place, or non-person living thing that is the subject of the case (the scoper of the contact role). It is also possible to identify persons – secondary contacts – who come in contact with primary contacts or other secondary contacts.
- *Patient*: An incident of human disease or other person related incident is the predominant trigger for case reporting. Information about the person who has come down with the disease is captured within the patient participation.
- *Pertinent Information(Encounter)*: Associated patient encounters are a key item that is reported for infectious disease reporting. The record of this information has been kept as a participation in its own right, as a recognition of its role, and to ease the mapping process.

The complete message specification includes this R-MIM, the Hierarchical Message Description (HMD) that provides detailed message contents, and the assembled vocabulary specifications that identify the vocabulary domains (code sets) that need to be supported.

4.2 Additional Model Constructs

There are a number of additional models constructs that are needed to fully define the notification message. These include the generic constructs that HL7 has devised for supporting message structures common to the body of message – the message "wrappers" noted above, and the Common Message Element Types (CMETs) that are used. These structures are defined below.[11]

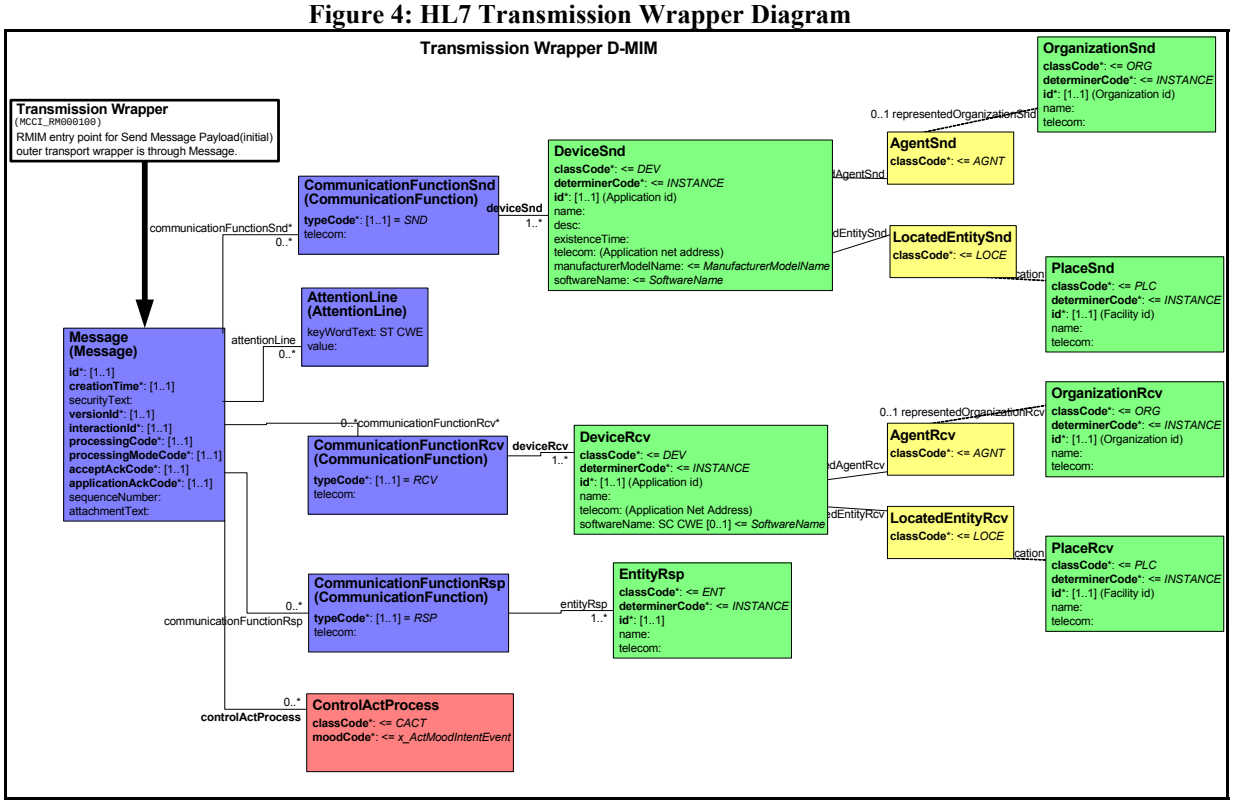
[11] The reader should note that all of the structures shown as additional model constructs are drawn directly from the HL7 Version 3 ballot package published by Health Level Seven.

4.2.1 Transport Wrapper

The outer HL7 "Transmission wrapper" includes information needed by a sending application or message handling service to package and route the V3 Composite Message Payload to the designated receiving application(s) and/or message handling service(s). This wrapper also includes attributes that identify a generic messaging mode. This generic messaging mode has a handling behavior that is consistent with the HL7 defined messaging interaction for which the composite message payload instance has been created. All HL7 Version 3 messages have an appropriately configured outer HL7 "Transmission wrapper".

The RMIM for the transmission wrapper is shown below:

Figure 4: HL7 Transmission Wrapper Diagram



The message class is the central construct for the transmission wrapper RMIM. 'Message' deals with the message as a "thing", rather than actual healthcare information itself. The following associations are defined for a message:

- *Communication Function Send*: The party who is sending the message is identified, as well as relevant characteristics of the sending device, e.g., application net address. Note that a sending facility or place, as well as a sending application can be indicated.
- *Attention Line*: The attention line class allows parameters for a technology specific transport to be represented in the V3 message transmission wrapper. It allows the sender to attach additional information (using the keyWordText and value attributes) that may be of use in routing the message.
- *Communication Function Rcv*: The party who is to receive the message is identified, as well as relevant characteristics of the receiving device, e.g.,

application net address. Note that a receiving facility or place, as well as a receiving application can be indicated.

- *Communication Function Rsp*: This is the "respondTo" entity. It designates the party to whom the receiver should send its response or reply.
- *Control Act Process*: The control act process in this model is a proxy for the control act structure handled in a separate model. When the XML schema is created, the reference corresponding to the class is edited so that the Transmission Wrapper schema is joined with the Control Act schema.

4.2.2 Application Level Acknowledgement Message

The application level acknowledgement message carries the information necessary for a receiving application to either acknowledge receipt and successful processing of a message, or to send an error message that indicates the reason for the failure of message processing. The error type code could indicate, for example, that required data was not provided, or that inconsistent data was included.

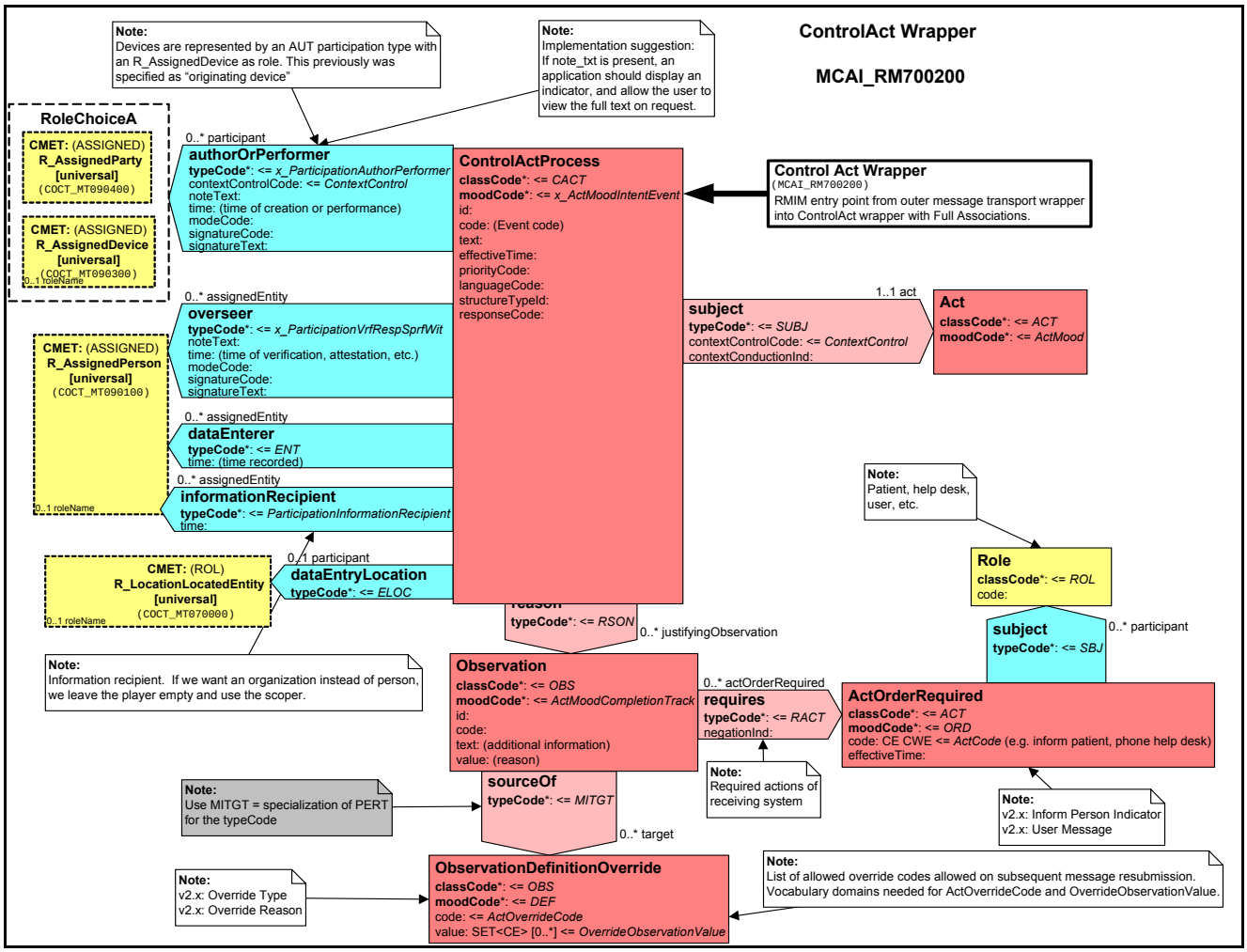
The RMIM for the application level acknowledgement message is shown below.

4.2.3 Control Act Wrapper

The intermediate HL7 "Control Act wrapper" includes domain specific administrative information related to the "controlled act" which is being communicated as a messaging interaction. For notification messaging, the “control act” or trigger event includes the data for the notification of the case, as opposed to the data that characterizes the case itself.

The RMIM for the control act wrapper is shown below:

Figure 5: Control Act Wrapper Message Structure



The control act process class is the central construct for the transmission wrapper RMIM. It captures information related to the specific act – the trigger event – that is central to the message. For notification messaging, the notification itself, the determination that a public health entity needs to be notified, is the control act for the message.

The following attributes are central to using the control act:

- *Id*: The identifier that has been designated for the control act or notification.
- *Code*: The coded indicates the type of act or notification that has been sent. For public health notifications, the code indicates the whether a condition notification or summary notification is being sent.
- *effectiveTime*: The date and time on which the control act or notification was composed and authorized for transmission.
-

The following associations are defined for a control act:

- *Author or Performer*: There are zero to many parties recorded as author or performer for a control act. The author of any act is the person who takes responsibility for its creation. This could be the doctor who orders a test or the public health professional who decides to notify a local, state, or national

public health entity. In some cases, it is desirable to indicate a performer as well as an author, for an act. The performer is the party who actually performs the act, in this case, a notification. One can presume that there is an author for a control act, however it is not required to record information about the author. At the same time, while in is generally assumed that only a single author is allowed, many performers can be specified. The actual party involved is either a device or a person, and the particular information involved is specified in the Assigned Person, and the Assigned Device CMET. The reader should note that, in many cases, it is the organization responsible for authoring or performing an act that is recorded as opposed to the person. In this case, the Assigned Person CMET is still used. However, the organization that scopes the performer role is recorded.

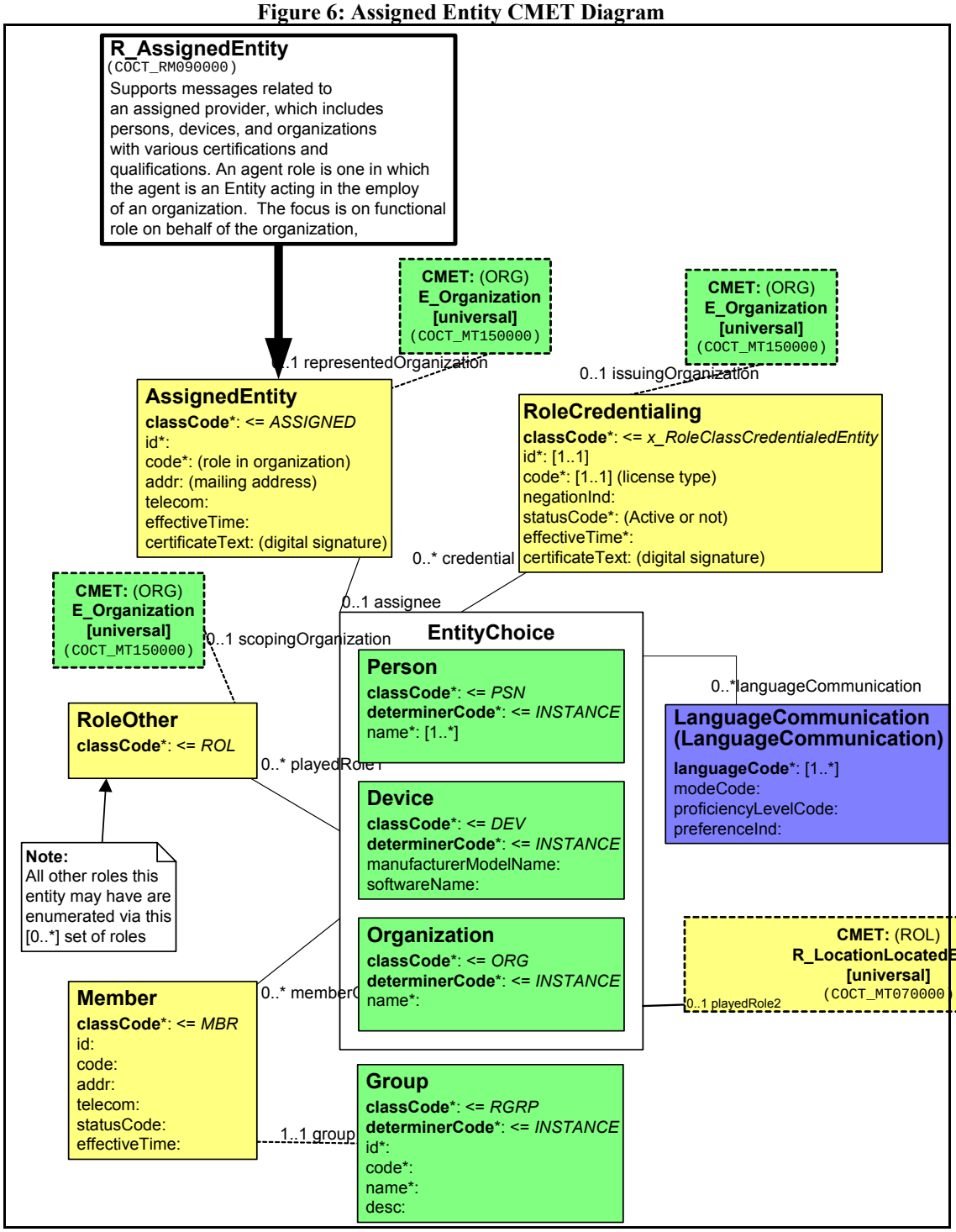
- *Overseer*: There are zero to many overseers for a control act. In some cases but by no means all, it is relevant to record information about a person who oversees the work of the acts author or performer. This is particularly relevant in instructional situations. It is possible, but unlikely for there to be many parties acting as overseer.
- *Data Enterer*: If relevant, the party who enters data associated with the control act may be recorded. It is possible for multiple parties to provide data entry.
- *Recipient*: There are zero to many designated information recipients for a control act. These are the parties who are intended to receive the information that is included in the message. Information recipients are differentiated from message receivers (as shown in the Transmission Wrapper) because the information receivers do not have a role in the actual message management and transmission.
- *Data Entry Location*: There is zero to one data entry location that is recorded. That is to say, while the data must be entered somewhere, this may or may not be relevant for inclusion in the message.
- *Observation*: The control act is associated with zero to many observations. This association will not be used for notification messages.
- *Subject (Act)*: The control act has a single subject act. This class provides an entry point into the data structure that is conveyed in the body of the message. Once the control act and message schema have been constructed, the two will be linked by editing the control act schema so as to include the contents of the message schema.

4.2.4 Assigned Entity Common Message Element Type

This common message element type (CMET) is used at several points by the notification message. It is used to capture information about an entity – either person, organization or device – that is assigned to a particular responsibility within the context of an HL7 message. The closely related Assigned Person appears within the control act wrapper RMIM[12].

[12] The Assigned Person CMET is sufficiently similar to the Assigned Entity CMET that it does not need to be discussed here. The only difference between the two is that the choice box allowing either a person, organization or device to play the role is replaced with a single entity – person.

Figure 6: Assigned Entity CMET Diagram



The entry point to the CMET is the assigned entity role. The following discussion reviews key elements within the CMET.

- *Assigned Entity (role)*: The role class, assigned entity, captures the critical information of the party playing the role in question. This includes an identifier for the role, mailing address, phone number, and the time within which the role is played. The model identifies zero to one party playing the

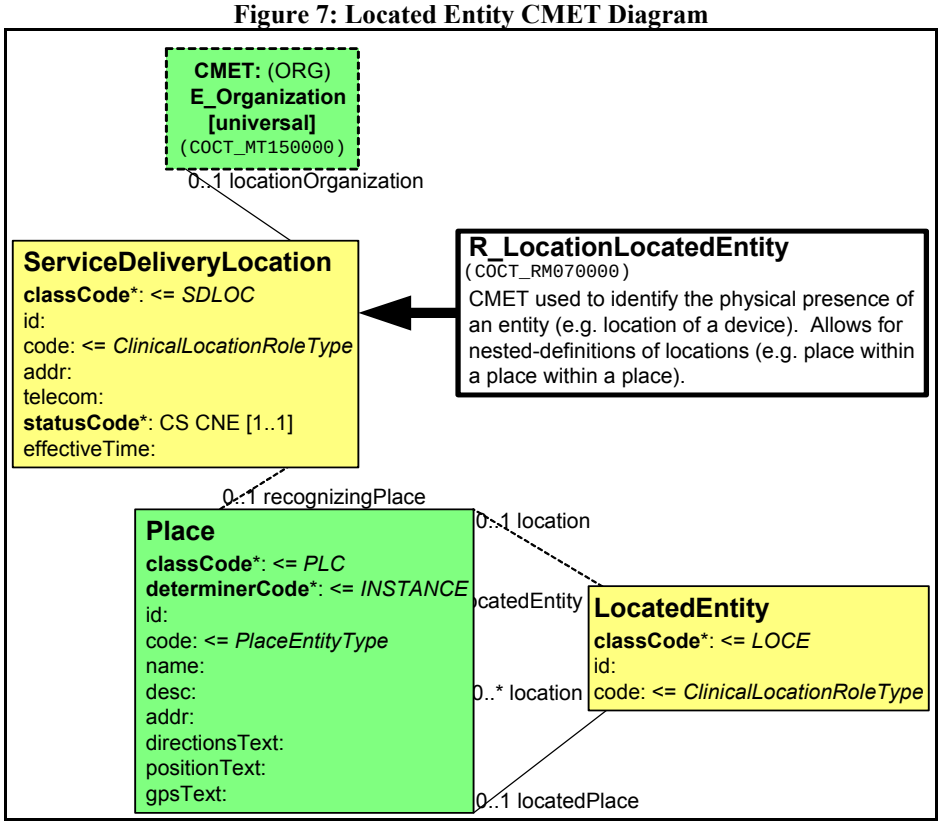
role. This supports the case in which information directly related to the playing party is not needed. The role player is captured as a choice of either a person, device or organization. The role is scoped by zero to one organization. The scoping organization – which like the role player may be omitted if not needed, provides the organizational context for the entity that actually plays the role. For example, the role scoper will normally be the party that assigns the identifier for the role.

- *Entity Choice*: As previously noted, the role of assigned entity can be played by either a person, organization or device. At this point, minimal information is captured for each. The reader should also note that it is possible to capture language information for the person, and to identify the location (as shown by the Located Entity CMET) at which the role is generally played.
- *Credentialing (role)*: The assigned entity may have zero to many credentialing roles. Credentialing captures information for licenses or credentials that may be relevant, and that have been issued to the assigned entity. This structure is not expected to be used for notification messaging.
- *Other Role*: The assigned entity may play zero to many other roles. The other role structure makes it possible to capture a list of roles that the entity plays. This structure is not expected to be used for notification messaging.
- *Member (role)*: The assigned entity may belong to zero to many groups. Information related to the party's membership, and to the group itself is captured. This structure is not expected to be used for notification messaging.

4.2.5 Located Entity Common Message Element Type

The Located Entity CMET captures information related to a place where an entity is located, or where something happens. The CMET is used by the Notification Message, the message wrappers, and by included CMETS. Its diagram appears below.

Figure 7: Located Entity CMET Diagram

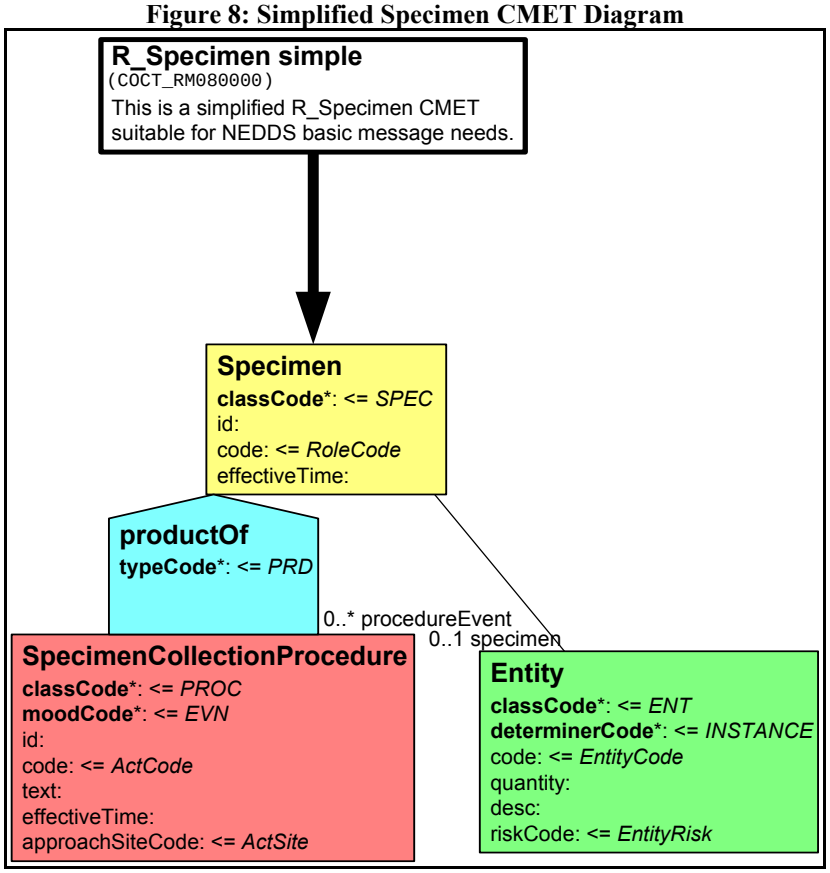


The Place class captures information about the located place. This includes descriptive text to provide directions, geo-positioning code values, and address. The following associationsxx
Xxx Add text here xxxx

4.2.6 Specimen Common Message Element Type

HL7 has defined an extremely rich and complex CMET to support a range of requirements for specimen processing. Notification messaging currently has far more limited requirements, as shown in the diagram below.

Figure 8: Simplified Specimen CMET Diagram



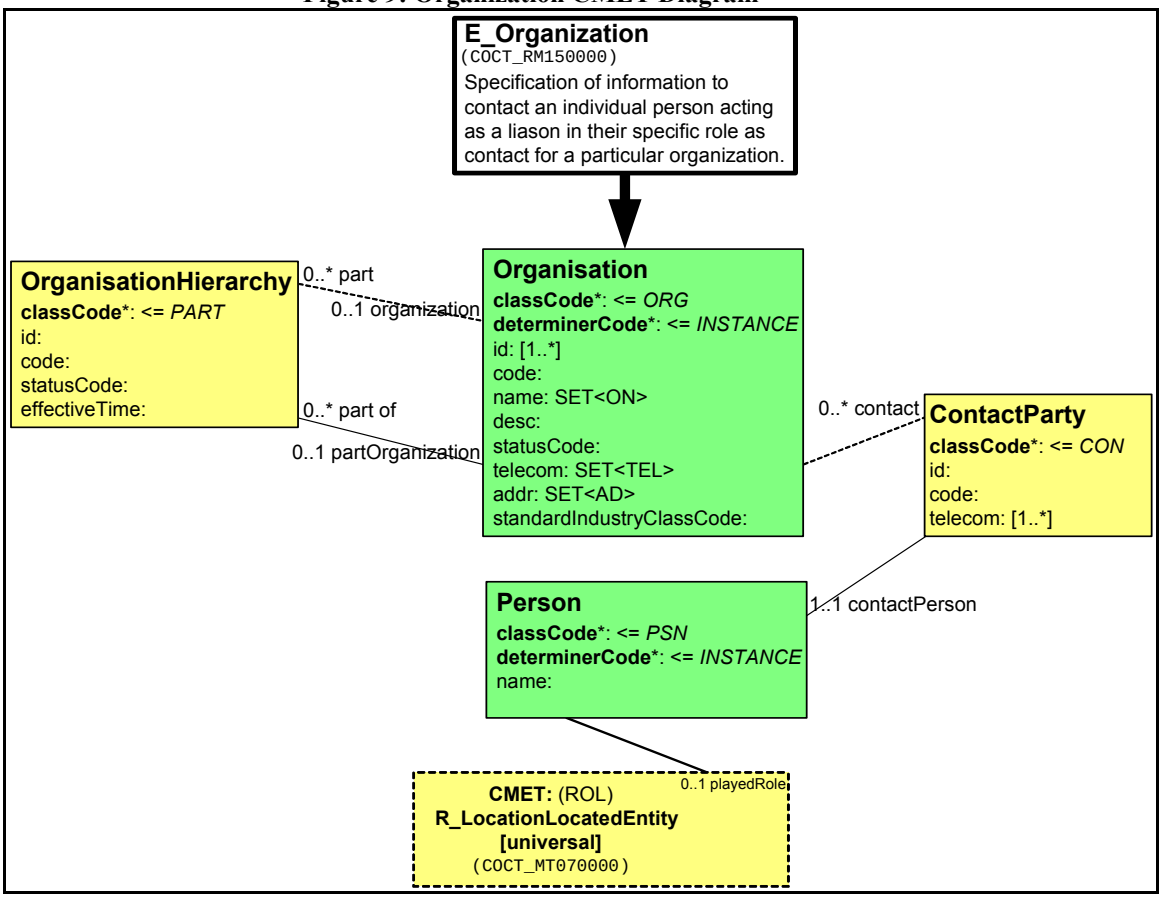
A specimen is defined as a "small sample or part taken to show the nature of the whole, as a small quantity of urine for analysis, or a small fragment of tissue for microscopic studyBeing a specimen is a role that is played by an entity, either natural or manufactured. All specimens share the Role Class Code, Specimen. When available, coded information that reveals the specimen type, and a specimen identifier is collected as well. The truncated specimen CMET shown above displays the following associations.

- *Playing Entity*:</I>.The role of specimen is played by an entity. Entity code will indicate the specimen type, whether a specimen drawn from a person, or an environmental specimen.
- *ProductOf (Specimen Collection)*: A specimen may be the product of a specimen collection procedure (That is to say, one might want to include information about specimen collection along with the specimen.

4.2.7 Organization Common Message Element Type

The Organization CMET captures common and basic information for an organization. This CMET does not appear within the Notification Message, but is used by CMETS that are included in the message specification. This includes such attributes within the organization class as identifier, organization type (code), telephone number, and address.

Figure 9: Organization CMET Diagram



The following associations are defined for an organization:

- *Organization Hierarchy*: The role class makes it possible to define an organizational hierarchy, and to embed the organization in question within that hierarchy. Since the same class both plays and scopes the role, there is a recursive structure that can be used to create multi-level hierarchies.
- *Contact Party*: It is also possible to capture information related to zero to many persons who take on the role of contact for the organization. ContactParty.code indicates the contact type.

4.3 Notification Vocabulary Specification

The PHIN notification report message types have a complex structure derived from the HL7 RIM. At a minimum, a notification message will contain information about the notification process, data directly related to the case, data for participants in the case – the patient at least, and observations related to the case.

Case related observations contain data such as the number of children in the household, whether the patient died, case related laboratory information, and number of sex partners. Most of the data, and particularly the data specific to a particular disease is captured as a case-related observation.

Much of this data is captured in the form of coded attributes. For example:

- Many of the attributes defined within the notification messages are coded attributes. Examples include Act.methodCode, Public Health Case. transmissionModeCode, Person.raceCode. Each of these attributes is associated with a vocabulary domain that lists the values that are valid for that attribute.
- In some cases, attributes have composite datatypes, and the individual components of the datatype may be coded. For example, the datatype, address, is composed of several address parts. There is a vocabulary domain that contains the list of valid address parts.
- Many of the observation types that are used in the messages have coded responses or values. For example, the response to the observation "2-6 week travel destination," has to be drawn from a particular domain, the list of valid countries. (This observation is associated with the question – "What country or countries did the patient visit during the 2-6 weeks prior to symptoms?" used in hepatitis A surveillance.) All observation types that have coded responses are associated with a vocabulary domain.

The following table shows the set of vocabulary domains that are currently supported for Notification Messaging.

4.3.1 The key role of "Observation"

It is important to note how the generic, observation-based structure, used in the HL7 RIM and followed by the Notification message, makes vocabulary specification a critical ingredient. Items of clinical data are carried as observations. The type of information carried is captured as the observation type – determined by the value of an instance of Observation.code within the message. The actual observation value is captured as Observation.value. It is important to note:

a) that the observation value has no significance unless the code value is known,
b) that information will not be meaningfully passed between systems except through a shared set of observation types.

Here is a simple example using observations drawn from the notification message to be used for hepatitis. In the current design, alongside may other elements, data is collected on a) the reason for a person being tested for hepatitis, and b) whether or not the patient is pregnant. Each of these is an element on the data collection page used to support hepatitis within the PHIN Base System, and each is included in the message that supports hepatitis notification. Each also is supported as an observation within the HL7 message specification. That is, it is not a discrete data element with a particular value, it is one of many observations, each with its identifying code, and its value. Support as an observation implies that:

- The data value is captured as the value of the observation. The range of allowable values – the domain – will vary depending on the observation type.

- An identifier for the observation type is recorded.
- Other relevant data, such as the date/time of data collection is recorded as needed.

Here are some examples:

Source Data	Observation Code[13]	Value	Allowable Value Domain	Additional Data
The reason the patient was tested for hepatitis.	HEP100	AHEP (Symptoms of acute hepatitis)	H_RSN_FOR_ TEST	08/25/2002 – activity time (date/time of data collection
Was the patient pregnant?	HEP106	N (N0)	YNU	08/25/2002 – activity time
How many doses of hepatitis B vaccine did the child receive?	HEP246	2	(integer)	08/25/2002 – activity time
The date the child received the first dose of hepatitis B vaccine.	HEP247	06/15/02	(date)	08/25/2002 – activity time

In essence, a set of discrete data element – each could be an element on a form and/or a named attribute in a database – is transformed into a collection of observations. Each observation has an identifying code, and a value drawn from a particular value domain (For coded elements, the current set of allowed values has been drawn from the System Reference Tables defined for the NEDSS Base System).

5 MESSAGE MAPPING

Message implementation requires specification of the data that will be used to populate outbound messages, as well as the database destination of data included on inbound messages. For NND messaging, data will flow from states or other reporting jurisdictions to CDC. In many cases, both the sending and receiving systems will be using the PHIN Base System, and its database (This will be true for the initial implementations). In these cases, the mapping that is required will be provided by the PHIN system developers. The discussion below is intended to provide some assistance to states that plan to use Notification Messaging without implementing the PHIN Base System.

The message mapping process is based on recognizing the constituent elements of the Notification message, and specifying how each element within the message is correlated with the corresponding element within a system database. Even though this is basically a single process, it appears differently for a) the creation of messages to be sent to another party, and b) the receipt of messages that need to be parsed and committed to the database of the receiving system.

[13] Currently, observation codes are based on element identifiers assigned within the NEDSS Base System. Most are prefixed with a tag for the program area that collects the element.

As described above, the notification message – as is the case with any Version 3 HL7 message – consists of Acts, and Entities. Essentially the message contains a notification (shown as an Act) that is associated with a case (shown as an Act.). There are parties associated with the notification – the sender and the receiver; there are parties associated with the case – most notably the patient. There are additional acts associated with the case, observations for the most part, but also hospital stays and additional notifications. In some cases, there are parties and additional observations that are associated with the observations for a case.

5.1 Creating Outbound Message Instances

For Base System and non-Base System implementations, the data to construct a message instance must be extracted from the application database and mapped into the XML document that is the message instance. The functionality to construct the message instance is provided in the Base System. For non-Base System implementations many different ways are available to implement this process. From a logical perspective, the process of creating an outbound message instance involves determining[14]:

a) Whether a piece of information is an attribute of the case or of the notification.
b) If a piece of information is not directly shown as an attribute of the case or of the notification, whether it is to be passed as an act or an entity.[15]
c) How that piece of observation is related to the case or notification. For the most part, the items of data related to the notification will be clear. These will relate either to the sender of the notification or the receiver. Data related to the case may be related directly or via an intermediate result.
d) For each item that is created, it is necessary to ensure that mandatory data items are valued. For example, when an observation related to a case is created, it will be necessary to value Act:classCode with the value "OBS", and to value Act:code with the identifier for that observation type (These identifiers are included in the Implementation Guides.) A value of Act:moodCode must also be provided. When an entity is being created, Entity:classCode must be valued to indicate whether this is a person, organization, place, etc. The Entity:determinerCode must also be valued. The actual data items to be passed should be valued as well.
e) Once the way an item is related to the case has been determined, linking structures in the message will need to be created. A case is a kind of Act. If the item being linked is another act, than an Act Relationship class will need to be instantiated. If the item being linked is an entity, than Participation and Role classes will need to be instantiated.
f) For intermediate classes that are created, e.g., Act Relationship, Participation, Role, their mandatory attributes – typeCode for Act Relationship and Participation, classCode and code for Role – must be given values. For the most

[14] The reader should note that the disease/condition specific implementation guides are designed precisely to offer assistance in this mapping process.

[15] If the discussion of "act" and "entity" is not clear, the reader should refer to Section 7.1 that reviews the high level structure of the HL7 Reference Information Model.

part, the value to be used will be documented in the relevant Implementation Guide.

g) In some cases, composite datatypes will require the valuing of multiple properties of the datatype[16]. For example, when a code value is passed, the identifier of the coding system and version should be supplied as well.

To summarize, the data to be passed in the message must be extracted from the application database. The structures that will hold this data in the message need to be identified, and additional information that supplies context in terms of the Notification Message structure needs to be added.

5.2 Receiving Notification Messages.

The process of receiving a message is essentially the reverse of the transmission process. The data within the message is extracted, and mapped to the structure used in the receiving system database. Depending on the database schema, it may be important to evaluate contextual information such as Role:cd, participation:typeCode, and Act Relationship:typeCode to determine where a data element should be placed.

5.3 HL7 Datatypes

This section discusses the HL7 Version 3 datatypes supported by the Notification Message. The datatype section within the document Appendix indicates their mapping to the PHIN database schema.

The reader should note that all datatypes are implicitly descended from the ANY datatype. This implies that the datatype for any data value is declared directly and that a flavor of null can be passed in place of a value. The implementation of null flavors within the message instance is managed by the XML ITS.

[16] Refer to Section 7.4 for a discussion of the HL7 datatypes.

The following HL7 datatypes are supported within the Notification Message Specification:

Datatype	Discussion
AD	Address. Addresses are represented as a typed collection of Address Parts (ADXP)
ANY	ANY is used to support observation values. The message supports five "flavors" of ANY: CV, INT, PQ, REAL, ST, TS (including IVL<TS>)
BL	Boolean.
CE	Coded Element. A coded value representation that includes multiple equivalent codes for a concept.
CS	Coded Simple. A pared down representation of a coded value that only includes codes and description. Used for HL7 defined, structural codes.
CV, SET<CV>	Coded Value. The datatype indicates the coding system as well as other relevant documentation to fully identify a coded value. This includes the ability to pass multiple values where relevant.
EN, BAG<EN>	Entity Name. Names are represented as a typed collection of Entity Name Parts (ENXP)
II, SET<II>	Instance Identifier.
INT	Integer
PQ	Physical Quantity.
Real	Real Number
ST	String.
TEL, BAG<TEL>	
TS, IVL<TS>	Time Stamp. The interval of time stamps (IVL<TS>) is used to support start date, stop date, and duration.

The reader should refer to the Appendix for a discussion of the representation of these datatypes.

6 . CONDITION SPECIFIC IMPLEMENTATION GUIDES

The notification report message is not specific to reporting any particular condition but sufficiently generic to be used for reporting of all conditions of interest to public health. Condition specific implementation guides are required to extend the notification report message specification to include condition-specific constraints on message elements, including condition-specific vocabulary domains.

Each set of notification messages that is constructed for a particular use, e.g., for supporting the notification requirements of a specific program within the PHIN context, requires specific instructions to guide message implementation.. These instructions indicate the data that is needed to support a specific set of notification requirements and contains a mapping to the data definitions used within a specific program or other use of the message.

The tabular material for a particular disease or condition is intended to provide the guidance needed to specify the interface on a logical level, i.e., to enable the interface parties to assemble the information needed for a complete specification and to support information transmission to CDC in accordance with PHIN specifications. Key components of implementation are:

- The goal is to identify all the attributes included on the case report for a particular disease or condition and to provide a mapping to the message format. Many of the attributes on the case report correspond directly to an attribute on the message format and this mapping will be provided. The case report attributes will be identified using the Unique IDs used within the PHIN Base System.
- Much of the data captured for a case is defined, for the purposes of messaging, as clinical observations related to a case.[17] This information will be mapped to the attribute A_Case_Observation:value. The related A_Case_Observation:value:cd, and the value domain will be referenced as well.

7 APPENDICES

The appendices provide additional information about the HL7 information models and messaging standards, their development, and use.

7.1 High Level Structure of the HL7 Reference Information Model

The HL7 RIM consists of classes, class relationships, attributes, and datatypes arranged into six primary subject areas and linked to vocabulary domains. A "class" is something about which information is collected such as persons, places, material, and actions. A class "relationship" is a defined connection between two classes of information describing the semantic linkage between them such as generalization/specialization, whole/part, and container. An "attribute" is a named component of information about a class such as person name, place address, material quantity, or action date. A "datatype" is a technology-neutral, specification of the properties, format, and structure of an attribute. An example of a datatype is the person name datatype with declares that a person name is an ordered collection of name parts where each name part includes a text string which is a code indicating the name part type, followed by a string containing the name part text itself.

[17] Note, the paradigm of case and case related observation is also supported by the logical and physical data models that underlie the NEDSS Base System database schema. This fact substantially eases the task of mapping data from the message to the receiving database.

The HL7 RIM is subdivided into six major subject areas: Entities, Roles, Participations, Acts, Structured Documents, and Message Control. The core of the model is contained in four subject areas: Entities, Roles, Participations, and Acts. An "Entity" is a physical thing or an organization/group of physical things capable of participating in Acts. A "role" is a classification or characterization of an entity defined by the relationship of the entity to a scoping entity. A "participation" is an association between a role and an act that represents the function assumed by the role within the context of the act. An "act" is a discernible action of interest in the healthcare domain. The four core subject areas correspond with the four core classes forming the backbone of the HL7 RIM as depicted in the following diagram.

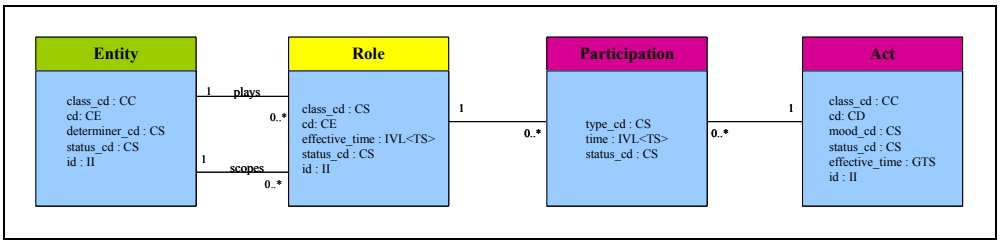


Figure 10: Reference Information Model Core Classes

The boxes in the diagram are the core classes. The name of each class in centered in the top partition of the box. The text within the lower partition of the box is the list of attributes along with their assigned datatypes. The lines connecting the boxes are the class relationships. Although the RIM is composed of slightly over 100 classes, these four provide the basic semantic underpinning for the entire model:

- Entities play Roles.
- Roles are scoped by Entities.
- Roles have zero or many Participations with Acts.
- Acts have zero or many Participating Roles.

Beyond these basic semantics is a collection of specializations for each of these generic concepts. Specializations of Entity include Living Subjects, Organization, Material, and Place. Further specializations of Living Subjects include Person and non-person living subjects. All of these specializations are Entities, and are capable of playing Roles and Participating in Acts. Each also has it own unique set of attributes, datatypes, and vocabulary constraints. Specializations of Act include Patient Encounters, Procedures, Observations, and Substance Administration. Each of these is an Act - a discernible action of interest in the healthcare domain – capable of being related to Participating Roles played by Entities.

This simple structure, four classes, their relationships, and their specializations, is a powerful, flexible, and extensible structure for representing health-related information. It provides for the capture of information related to persons in the role of patients participating as the subjects in a patient encounter, non-person living subjects in the role of specimens participating as the subject of a laboratory observation, and organizations in the role of Public Health Agency participating as the reporting party of a public health case.

The RIM also contains the classes "Act Relationship" and "Role Relationship" which capture information pertaining to the relationships between Act and Act and Role and Role respectively. These classes allow infinitely complex health-related scenarios to be depicted. For example the public health case Act can be linked to the laboratory observation Act and the patient encounter Act providing the basis for expressing the complex relationships between the person Entity in the patient Role, the non-person living subject Entity in the specimen Role, and the organization Entity in the public health agency Role.

The HL7 RIM is extremely robust and is in a constant state of review and refinement by the diverse collection of health, healthcare, and healthcare technology experts within the HL7 organization. The HL7 RIM is the source for the information content of HL7 v3 message specifications and is the source of the PHIN case notification message specifications. The designers of the PHINNEDSS case notification message specifications participate actively in the HL7 message development process and in the deliberations concerning refinements to the HL7 RIM.

7.2 HL7 Message Development Framework

This section on the HL7 methodology is drawn directly from HL7's V3 Guide, and consists of sections from that document.[18].

7.2.1 Information Model

The information model defines all the information from which the data content of HL7 messages are drawn. It follows object-oriented modeling techniques, where the information is organized into classes that have attributes and that maintain associations with other classes. The information model forms a shared view of the information domain used across all HL7 messages independent of message structure. Thus, the information model provides a means for discovering and reconciling differences in data definition.

7.2.1.1 3.1 Information Model Components

The information model consists of the following components:

- classes, their attributes, and relationships between the classes;
- state transition models for some classes;
- data types and constraints.

[18] This HL7 V3 Guide was created for use by members of the Health Level Seven (HL7) Working Group as a companion to the V3 Standard. The information contained in this document is based on and was drawn from the HL7 Message Development Framework (MDF). In fact, the V3 Guide can be considered a "condensed" version of the MDF in that it contains only the methodological information an HL7 member needs to understand the V3 publication. Most of the theoretical and technical discussions provided in the MDF are not included in the V3 Guide. The V3 Guide is a copyrighted component of the HL7 Version 3 Ballot Package published by HL7.

Large portions of the information model have graphical representations in the Unified Modeling Language (UML). This includes the class diagram, the state transition diagram, and the data type diagram. Those graphical representations are views into the respective information model component. Some of the information model is specified informally in descriptive text and accompanying documents.

The information model notation is based largely on the Unified Modeling Language (UML), a modeling language that unifies the object-oriented modeling methods of Grady Booch, Jim Rumbaugh, Ivar Jacobson, and others. The UML is a rich, mainly graphical, means of expressing object-oriented concepts. To obtain more information about UML see http://www.rational.com/uml/ or the book UML Distilled by Martin Fowler (ISBN 0-201-32563-2)

7.2.1.2 Information Model Types

The information modeling process recognizes three different types of information models. Each of the model types uses the same notation and has the same underlying meta-model. The models differ from each other based on their information content, scope, and intended use. The three types of information models are:

- Reference Information Model (RIM): The RIM is used to express the information content for the collective work of the HL7 Working Group. The RIM is a coherent, shared information model that is the source for the data content of all HL7 messages. The RIM is maintained by a collaborative, consensus building process involving all Technical Committees and Special Interest Groups. Through a process known as model harmonization, domain model information content submitted as RIM change proposals is debated, enhanced, and reconciled by Technical Committee representatives and applied to the RIM.
- Message Information Model (MIM): The MIM is used to express the information content for one or more related messages. A Technical Committee extracts this model from the RIM during the Message Design stage of the message development process. The MIM starts out as a proper subset of the RIM. The Technical Committee may add message specific information constraints. No new information content is added at this point in the message development process and information constraints added at this point are not allowed to relax constraints specified in the RIM.
- Refined Message Information Model (R-MIM): The R-MIM is used to express the information content for a message or set of messages with annotations and refinements that are message specific. The content of the R-MIM is drawn from the RIM. The R-MIM may include clones of selected classes with alias names specific to the perspective of the message(s) to be derived. Generalization hierarchies in the RIM may be collapsed in the R-MIM. Essentially, the R-MIM is used to create a certain message-specific projection of the RIM for the purpose of being context specific while maintaining the semantic link to the more generic RIM.

7.2.2 Vocabulary

7.2.2.1 HL7 Vocabulary Domains

Within the HL7 message framework, a vocabulary domain is the set of all concepts that can be taken as valid values in an instance of a coded field or attribute. For example, in the RIM, the LivingSubject class has a coded attribute administrativeGenderCode. If the administrativeGenderCode attribute becomes part of a Hierarchical Message Description (HMD), and a message instance is subsequently created as part of an implemented interface, the administrativeGenderCode field might have as possible values the concepts male and female.

It is important to note that a value domain consists of a set of concepts, not a set of words or codes. In different implementations of an interface, the same concept could be represented using different coding systems. Thus, each concept in a vocabulary domain has a one-to-many relationship to codes that might be used as representations for the concept in a message instance.

The general meaning of code system is a scheme for representing concepts using (usually) short concept identifiers to denote the concepts that are members of the system. A coding scheme defines a set of unique concept codes.

7.2.2.2 Vocabulary Domains and RIM Attributes

Each coded attribute in the RIM (i.e., with a data type of CC, CD, CE, CS, CV, SET<CD>, SET<CE>, SET<CS>, or SET<CV>) will be associated with one and only one vocabulary domain. The association between a RIM attribute and a vocabulary domain is made via a vocabulary domain specification. In other words, each coded RIM attribute will itself have a vocabulary domain specification as a property. Some vocabulary domains are associated with more than one RIM attribute (e.g., UnitsOfMeasure with the "qty" attribute on several RIM classes). The vocabulary domain table may be an HL7-defined table, an HL7-recognized external coding scheme (e.g., LOINC, SNOMED, HIPAA) or some combination of those, or may contain locally defined codes.

The HL7-defined vocabulary domain tables that have been developed for coded class attributes are stored in the HL7 repository, from which a number of printable views have been extracted to produce the HL7 Vocabulary Domain Listings for the RIM. (Note that these views only contain domain tables for attributes that will be used in building HL7 messages. Domain tables for other uses are present in the repository but are not provided in print form.) The views are presented in table format and include the HL7 Vocabulary Domain Values list and the HL7 Domain Tables and Coded Attributes list. HL7-recognized external vocabulary domains are described in the External Domains list. Links are provided between these tables and attributes in the RIM.

The HL7 Vocabulary Domain Values table includes a mnemonic code, concept identifier, print name, and definition/description for each value. This table also shows any hierarchical relationship that exists between values in each domain table.
The HL7 Domain Tables and Coded Attributes table names the coded attribute(s) in the RIM that are supported by that vocabulary domain.

The External Domains table includes concept identifier, defining Express, code system abbreviation, description, and a link to the source for each table.

7.2.2.3 Vocabulary Domain Qualifiers

A vocabulary domain specification consists of two main parts: the name of the vocabulary domain, and a list of zero or more vocabulary domain qualifiers. These qualifiers in fact have their own vocabulary domain table (called VocabularyDomainQualifier). There are presently only two vocabulary domain qualifiers: Extensibility and Realm. Currently, the Extensibility qualifier is the only qualifier that can be used in domain specifications. Both the Realm and Extensibility qualifiers can be used in domain constraints. The Extensibility qualifier has two possible values: CNE (coded no exceptions), and CWE (coded with exceptions).

The vocabulary domain name and the associated Extensibility qualifier for each coded attribute in the RIM are specified in the RIM narrative. This specification occurs as the first line of the description for a coded RIM class attribute in the following format:
Vocabulary Domain: "MyVocabularyDomain" (CWE)

There is a link between the vocabulary domain name (MyVocabularyDomain) and its entry in the HL7 Vocabulary Domain Values table. For those domains that are not yet developed, a domain name has been assigned but the table contains no values.

The CWE value for the Extensibility qualifier means that the code set can be expanded to meet local implementation needs. When a coded attribute is sent in a message, local concepts or free text may be sent in place of a standard code if the desired concept is not represented in the standard vocabulary domain.

The CNE value for the Extensibility qualifier means that the code set is fixed and cannot be extended. A concept from the specified domain must be sent as the value of the coded field in a message. If the field cannot be valued from the concepts that exist in the specified domain, the field cannot be placed in the message. If a CNE field is required in a message, but the field cannot be valued from the concepts that exist in the specified domain, then no valid message can be created.

The Realm qualifier allows the domain of a coded attribute to be specialized according to the geographical, organizational, or political environment where the HL7 standard is being used. For example, the Realm qualifier would allow the Gender domain to hold a somewhat different value set for HL7 messages when used in Japan versus when the Gender domain is used in HL7 messages in the United States.

All domain qualifiers are values in the VocabularyDomainQualifier domain.

7.2.2.4 Class codes and Codes

As the RIM has become more abstract and the number of classes reduced, the specialization previously expressed with classes has been pushed down into the type codes for the classes. As of the most recent RIM, type codes have been split into two conceptual kinds of attributes: class_cd and cd.

- class_cd is a structural attribute. When the attribute occurs on three of the core RIM classes - Act, Entity, and Role - it acts as a subtype discriminator for the class. Class codes are concepts that could possibly have different attributes. In a less abstract model, they might be modeled as specializations or sub-types of a class. For example, this code specifies the kind of Act - values include things like outpatient encounter or financial transaction. Each class_cd domain is of data type CS with a CNE qualifier. A new value must be both harmonized and balloted before it can be used.
- cd is a classifying attribute of the class, more like the old type_cd. It provides a way to categorize instances of the class and the categories may apply across all class_cd instances. The domain is of data type CD (in Act) or CE (in Role and Entity) with a CWE qualifier. As a result, multiple equivalent codes can be communicated. Values can be used after harmonization; no ballot is required.

7.2.2.5 Vocabulary Domains and V3 Data Types

Some V3 data types have a set of allowed values, which are properties that are defined by the data type. In addition, a property for a given data type may have a value set. For example, some possible properties of the Entity Name (EN) data type are "use" and "validTime"; some possible values in the value set for the "use" property are "legal", "artist/stage", and "religious".

In other cases, the data type specification includes tables for some allowed codes values. For example, the General Timing Specification (GTS) data type has a set of abbreviations that can be used instead of the equivalent GTS term. The domain name is GTSAbbreviation and includes things like AM (every morning at institution specified time) and BID (two times a day at institution specified time).

In fact, the data types themselves are listed in a domain table named DataType.

All of these vocabulary domains (value sets) are published in the V3 Data Types Part I specification, and most are also stored in the RIM repository. The domain name for those that have vocabulary domains in the repository is specified in the title of the table in the V3 Data Types specification. some cases where the complete domains are large, only a sample of possible values is published.

7.2.3 Understanding Hierarchical Message Descriptions

This chapter describes how a message structure uses the Hierarchical Message Descriptions (HMD), a normative expression of the standard.

Some questions that are frequently asked are: "Why do we need to create an HMD? If we already know the sender, the receiver, the trigger event and the classes, why not just send the data?" There are several important answers to this question.

- The information model contains a group of classes that frequently are interconnected in more than one way. For example, there may be associations that lead from Patient to Person directly (this is the person who is the patient) and indirectly (this is the person who is the next of kin or the patient, or this is the person who is the primary physician of the patient). *The communicating systems must be able to determine which of the objects derived from these classes contain the data to be sent. Furthermore, they must be able to navigate to the related objects through the associations that are defined for the classes.*
- The same attributes may not be appropriate for different objects. Although both the patient and the physician associated with a clinical order are people, it is unlikely that we will send the physician's religion, date of birth, or sex each time we process an order for the patient. *The communicating systems must be aware which of the objects will be sent.*
- Finally, to send data over the wire, the computer must organize it sequentially. There are many different ways to organize the data from a group of objects interconnected by their associations. If the sender and the receiver do not agree exactly on that order, the communication is frustrated. If the sender transmits information about the attending physician before that of the primary care physician, and the receiver is expecting the opposite order, there will be a problem. *The communicating systems must know the exact sequence in which information will be sent.*

The Hierarchical Message Description specifies these choices. It defines a single message structure that is used for an interaction without reference to the implementation technology. The Implementation Technology Specification describes how to combine data with the message structure in order to create a message instance. This means that a message sent in the format of one implementation technology can be easily transliterated into the format of another.

In simplest terms, an HMD is a tabular representation of the sequence of elements (i.e., classes, attributes and associations) that may be used to generate HL7 messages. The HMD is composed of three sections. The leftmost section maps the elements (classes, attributes and associations) to the RIM. The center section, called the common message, is a generic template for the specific instances described on the rightmost part of the HMD. The common message will never be sent, and does not have a corresponding trigger event. The specific instances of the message, called

message types, described on the rightmost part of the HMD may be communicated in response to a trigger event.

7.2.3.1 Hierarchical Message Description (HMD) Column Descriptions

No - Row number. Each row is sequentially numbered and identifies the order in which the data within the message is sent.
Row - Identifies the type of element. Valid values are class, attr (attribute), and assoc (association).
Property - The name of the class, attribute or association role name as it appears in the RIM.
RIM Source - Identifies the class from which the attribute or association originates.
Element Name - The name of the element as it appears in the R-MIM. This may or may not be the same as the value in Property. This value will be different when a class, association or role is cloned and renamed in the process of creating the R-MIM.
Short Name - The name of the element in the XML ITS. Refer to the HL7 Version 3 Standard: XML Implementation Technology Specification for more details.
InMET - In Message Element Type. This column points to the parent of the element within the current hierarchy.
OfMET - Of Message Element Type. Identifies the data type of attributes or class name of associations.
S - Message Element Type Source. Valid values are D (data type), N (new, being defined starting at this row), U (reused, meaning that an element, but not its value, from a previous row in the HMD is being reused), C (CMET), I (Instance, refers to the reuse of a particular element and its value as defined previously in the HMD), and R (recursive, into itself).
Each group of the following columns appears in both the template and the Message Types:
C - Cardinality. This specifies the minimum and maximum number of occurrences of the message element.
D - Vocabulary Domain Specification. Clicking on this link will take you to the Domain Specification for this element.
CS - Coding Strength. Valid values are CWE (coded with exceptions, meaning that the code set can be expanded to meet local implementation needs) and CNE (coded no exceptions, meaning that the code set cannot be expanded).
M - Mandatory. Valid values are M (Mandatory) or Blank. An M in the field requires that some data be sent for this element. If the data is not known, a value of unknown, not given, etc. must be sent. An M in this column (for Mandatory) differs from a 1 in the Cardinality column in that an M indicates that the message cannot be validly parsed without a value in this field or without defining a default. If no default is provided, you either do not send a message or must send a value. An M in this column also differs from an R in the Conformance column (explained below).
N - Note. If one is provided, this is simply a free text note provided by the committee.
D - Default. Default value provided by the committee. If null is sent, the default should be substituted on receipt (i.e., if the default value is 10 and a null is sent, the receiving system should substitute 10).

D - Default Update Mode. This is a heading for the allowable set of values defined in the Update Mode Set column.
U - Update Mode Set. The allowable set of values for the mode identified in the Default Update Mode column.
C - Conformance. Valid values are R (required), NP (not permitted), and Blank (not required). A value of R (required) means that the message elements must appear every time the message description is used for an Interaction. If the data is available, the element must carry the data. If the data is not available, a blank may be sent. NP (not permitted) means that the message element is never sent for this message type. Blank means that conformance for this element is to be negotiated on a site-specific basis.

7.2.3.2 Common Message Element Types (CMETs)

CMETS (Common Message Element Types) are a work product produced by a particular committee for expressing a common, useful and reusable concept. A CMET defines the message elements for that concept using the same tabular format as the HMD. Like other artifacts, the CMET is assigned a unique identification number, and it is used within an HMD by referencing that unique identification number. The CMET is referenced within the HMD by a single line that contains C in the Source column and the unique identifier in the OfMET column.

7.3 HL7 VISIO representation

HL7 has chosen to use Microsoft's Visio drawing tool as the source for documentation of Refined Message Information Models (R-MIM). Visio is used along with an HL7 provided stencil that contains the key classes from the HL7 RIM. Tooling has been provided so that models created using Visio can be easily imported into HL7's Rose Tree tool[19]. This makes it easier to create HMDs, and to create the schemas needed to implement HL7 messaging using XML. The goal is to provide a graphical expression of the HL7 models that can be easily discussed and manipulated in a group setting. The Visio expression of an HL7 model takes advantage of the abstract structure of the RIM by using colors to express the base class for the clones expressed in an RMIM. Experience has shown that the Visio models are easy to develop in groups of domain experts, and are easily accessible to non-modelers.

The Visio representation is centered on the five core classes of the RIM. Each of these core classes is assigned a different color:

- Entity: Green
- Role: Yellow
- Participation: Blue
- Act: Red
- Act Relationship: Pink

The Relationship Link is yellow like the roles it links together. All the other classes, which at this point are mostly involved in supporting message control and document

[19] HL7 tooling has been provided by a capable group of volunteers. These tools are available for use in HL7 standards development, and their copyrights are held by the tool developers. Refer to the HL7 web site, http://www.hl7.org, for more information on tooling to support Version 3 development.

structures are purple. The use of colors makes it possible to immediately grasp which base class is involved as the source of a clone in an RMIM.

Within the Visio representation, different shapes are used for the different core classes. The shapes used reflect the central role of Act in the RIM, and the fact that Participation and Act Relationship primarily appear to link other classes to a primary Act. Therefore Participation and Act Relationship are drawn as arrows that link a source act with a target class that is either another Act, or a Role. On the other hand, Act, Entity, and Role appear more traditionally as rectangles. In all cases, the name of the class is given at the top of the shape, and the attributes are included underneath. (Unlike UML, there is no line between class name and attribute list, however, the class name is bolded.).

The treatment of the Role class is a bit different from the other "linking" classes, Participation and Act Relationship, because Role both links Entity and Participation, and has a dual association with Entity. Entities play Roles, and Entities scope Roles. The Visio representation captures this by showing lines between Role and Entity. A solid line links a Role to the Entity playing that Role, and a dashed line links a Role to the Entity scoping the Role.

An HL7 R-MIM, by its nature, consists of several clones of HL7 base classes. The clones represent specific uses of those classes in the context of the R-MIM. The base class for a clone is shown both by color, as discussed above, and by naming convention. The name of each class in an RMIM starts with the initial or initials of its base class.

The HL7 RIM makes substantial use of inheritance (aka generalization/specialization structures) in order to capture the specific features of different kinds of Acts, Roles, or Entities. In an RMIM, a clone typically represents a single specialization of its base class, and can contain attributes from all points in the RIM inheritance structure. However, in some cases, it is necessary to represent the possibility that an instance in a message might require a choice of subtype or of specialization. It that case, a dashed rectangle is shown, and the possible alternatives are contained within that rectangle.

The cardinality of associations between classes is shown, UML style, on the far end of the association between two classes. Since Act Relationship and Participation instances always provide links between a single Act and a single role (Participation) or a single other Act (Act Relationship), the "one side" of their associations are not shown. That is to say, if a Participation or Act Relationship is instantiated it, by definition is associated with one and only one act. The question is, how many Participations or Act Relationships, can the Act clone have?

The modeling features that have just been described are demonstrated in the diagram shown below. This diagram, which does not represent a situation currently addressed by HL7, has been constructed to illustrate Visio R-MIM features. Note, attributes

have been left out in order to focus on the classes and their associations. However the Visio representation, by default, includes the key structural attributes for each class.

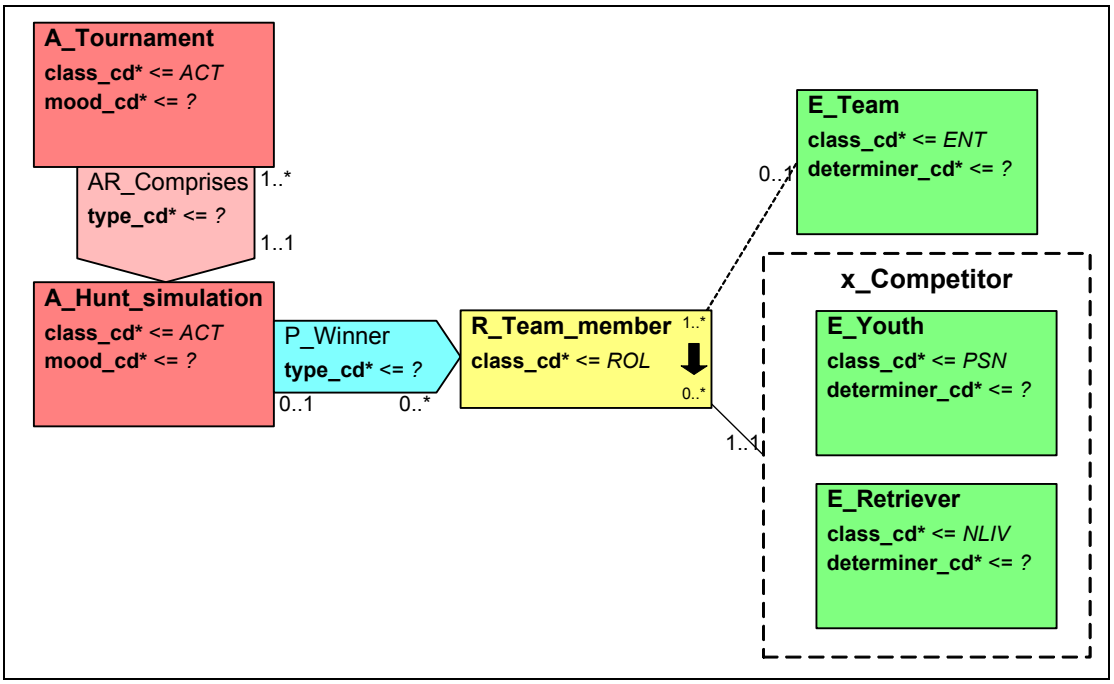


Figure 11: Imaginary HL7 RMIM

The following points can be seen from the example diagram:

- Tournaments and Hunt Simulations are both Acts. We describe their association by saying that "A tournament is *comprised* of hunt simulations." Each Tournament is associated with one to many Hunt Simulations, while a Hunt simulation is associated with one and only one Tournament.
- Hunt Simulations are participated in a Winner. They either have one or none of these. (Clearly there may be other participations. This was the only considered significant by the modeler.)
- The Role that participates in a Hunt Simulation is known as a Team Member. The Team Member role can participate in zero to many Hunt Simulations.
- The Role of Team Member is played by a Competitor. A Competitor is either a Youth, or a Retriever (which happens to be a "Non-Person Living Subject).
- The Role of Team Member is scoped by a Team. That is to say, the role of Team Member is played in the context of a particular team.

HL7 continues to use UML as its modeling language, and the Visio RMIM expressions are essentially UML compliant. This compliance is not always apparent because of the differences in the look and feel of the diagrams. However, at the end of the day, structures in a UML based tool such as Rational Rose can be fully represented within the HL7 Visio tooling. The reverse is also true.

7.4 Using HL7 Datatypes

This section discusses the HL7 datatypes that are supported within the set of HL7 Version 3 messages used within the PHIN environment. Each datatype is described, and the properties that comprise it are indicated. The descriptions indicate whether a particular property should be supported within the Notification Message. The mapping from each datatype to the corresponding elements within the PHIN Base System is given to provide additional context.[20]

The reader should note that all datatypes are implicitly descended from the ANY datatype. This implies that the datatype for any data value is declared directly, and that a flavor of null can be passed in place of a value. The implementation of null flavors within the message instance is managed by the XML ITS.

In the discussion below, the rows for datatype properties that will not be supported are greyed out.

7.4.1 Address: AD

Mailing and home or office addresses. A sequence of address parts, such as street or post office Box, city, postal code, country, etc. The AD data type is primarily used to communicate data that will allow printing mail labels, or that will allow a person to physically visit that address. The postal address data type is not supposed to be a container for additional information that might be useful for finding geographic locations (e.g., GPS coordinates) or for performing epidemiological studies. Such additional information is captured by other, more appropriate HL7 elements. Structurally, the postal address data type is a sequence of address part values with an added "use" code and a valid time range for information about if and when the address can be used for a given purpose.

7.4.1.1 AD Components

Property Name	Property Type	Base System Mapping	Comment
text	List <ADXP>	See ADXP	Repeats
Use	Set <CS>	Entity_Locator_ Participation:Use_cd	A single Use code is supported
ValidTime	GTS	Entity_Locator_ Participation: To_time, From_time	This can be supported as an Interval of Time Stamps. However, the component is not currently valued by the Notification Message.

7.4.1.2 Address Part: ADXP

An address part is a character string that may have a type-tag signifying its role in the address. Typical parts that exist in about every address are street, house number, or post box, postal code, city, country but other roles may be defined regionally, nationally, or on an enterprise level (e.g. in military addresses). Addresses are usually

[20] This discussion of HL7 datatypes draws heavily – in many cases by direct copying – from the discussion of HL7 data types provided in the HL7 Version 3.0 ballot package. All the material drawn directly from the HL7 documentation is copyrighted by HL7.

broken up into lines, which are indicated by special line-break tokens (e.g., carriage return).

Property Name	Property Type	Base System Mapping	Comment
data	ST	If type = CNT Then = cntry_cd If type = STA Then = state_cd If type = CPA Then = cnty_cd If type = CTY Then = city_cd, city_desc_text If type = ZIP Then = zip_cd If type = SAL Then = street_address1, street_address2	The mapping is based on the type value that is passed. Note, for city, the CS is mapped to component datatypes. Note, for street addresses, if there is only one SAL instance, it is mapped to streeet_address1. If there are multiple SAL instances, the first is mapped to street_address1, the second to street_address2.
type	CS	NA	The following values are accepted at this time: CNT, STA, CPA, CTY, ZIP, SAL.

7.4.2 Any: ANY

The ANY datatype serves as the base type for all the rest. Within a message, it appears directly as the datatype assigned to Observation.value. The following list of datatypes are supported in place of ANY: CD, CV, INT, PQ, ST, TS, IVL<TS>. That is to say, the only types of observation value that are supported within the PHIN database, and that should be transmitted using the Notification Message, are , coded values, text, dates, date ranges, physical quantities, or integers.

See the discussion of a specific datatype for details on how it is supported and mapped.

7.4.3 Boolean: BL

The Boolean type stands for the values of two-valued logic. A Boolean value can be either *true* or *false*, or, as any other value may be NULL.

7.4.4 BL Properties

Boolean is an atomic type, with a single component.

Property Name	Property Type	Base System Mapping	Comment
{content}		various	The value may be true, false, or null.

7.4.5 CE: Coded Element

Coded data, consists of a coded value (CV) and, optionally, coded value(s) from other coding systems that identify the same concept. This datatype is used when alternative codes may exist. Note, CE is not directly supported within the Notification Message; however, it is described because it is referred to within datatype descriptions.

7.4.5.1 CE Properties

Property Name	Property Type	Base System Mapping	Comment
code	ST	…_cd, code	The full name of the source or destination attribute is determined by the context.

Property Name	Property Type	Base System Mapping	Comment
Code system	OID	Code_system_cd	The full name of the source or destination attribute is determined by the context.
Code system name	ST	Code_system_desc_txt	The full name of the source or destination attribute is determined by the context.
Code system version	ST	Code_version	The full name of the source or destination attribute is determined by the context.
Display name	ST	Display name	The display name is optional, and will not usually be transmitted. The full name of the source or destination attribute is determined by the context.
Original text	ST	Value text	Original text is provided when the coding system being used does not contain the concept being passed. This is only allowed for CWE (coded with exception) code sets.
translation	SET<CV>	See the discussion of the CV datatype for mappings	

7.4.6 CD: Concept Descriptor

A concept descriptor represents any kind of concept usually by giving a code defined in a code system. A concept descriptor can contain the original text or phrase that served as the basis of the coding and one or more translations into different coding systems. A concept descriptor can also contain modifiers to describe, e.g., the concept of a "left foot" as a post-coordinated term built from the primary code "FOOT" and the modifier "LEFT". In exceptional cases, the concept descriptor need not contain a code but only the original text describing that concept.

The CD datatype is only used as a type of observation, and it is only used in that context for data that includes code values, and code modifiers. CD is not directly supported within the Notification Message; however, it is referred to within datatype descriptions.

7.4.6.1 CD Properties

Property Name	Property Type	Base System Mapping	Comment
code	ST	…_cd, code	The full name of the source or destination attribute is determined by the context.
Code system	OID	Code_system_cd	The full name of the source or destination attribute is determined by the context.
Code system name	ST	Code_system_desc_txt	The full name of the source or destination attribute is determined by the context.
Code system version	ST	Code_version	The full name of the source or destination attribute is determined by the context.
Display name	ST	… value_txt, display name	The display name is optional, and will not usually be transmitted. The full name of the source or destination attribute is determined by the context.
Modifier	CR	See discussion of CR for mapping	

Property Name	Property Type	Base System Mapping	Comment
Original text	ST		Original text is provided when the coding system being used does not contain the concept being passed. This is only allowed for CWE (coded with exception) code sets.
translation	SET<CV>	See the discussion of the CV datatype for mappings	

7.4.7 Concept Role: CR

A concept modifier code with optionally named role. Both modifier role and value codes must be defined by the coding system. For example, if SNOMED RT defines a concept "leg", a role relation "has-laterality", and another concept "left", the concept role relation allows to add the modifier "has-laterality: left" to a primary code "leg" to construct the meaning "left leg".

The use of modifiers is strictly governed by the code system used. The CD does not permit using code modifiers with code systems that do not provide for modifiers (e.g. pre-coordinated systems, such as LOINC, ICD-10 PCS.) The rules of the modifier use must be governed by the code system (e.g., recent SNOMED RT revision, GALEN.)

7.4.7.1 CR Properties

Property Name	Property Type	Base System Mapping	Comment
Name	CV	Obs_coded_val_mod: code_mod_cd, code_system_cd, code_version	
Value	CD	Obs_coded_val_mod: code	Only the code component of the CD is used.
Inverted	Boolean		The inversion of modifiers is not currently supported.

7.4.8 Coded Simple: CS

Coded data in its simplest form consists of a code and display name. The code system and code system version is fixed by the context in which the CS value occurs. CS is used for coded attributes that have a single HL7-defined value set.

7.4.8.1 CS Properties

Property Name	Property Type	Base System Mapping	Comment
Code	String	…_cd	The full name of the source or destination attribute is determined by the context.
Display name	String	…_txt	The full name of the source or destination attribute is determined by the context.

7.4.9 Coded Value: CV

Coded data, consists of a code, display name, code system, and original text. Used when a single code value must be sent.

7.4.9.1 CV Properties

Property Name	Property Type	Base System Mapping	Comment
code	ST	…_cd, code	The full name of the source or destination attribute is determined by the context.
Code system	UD	Code_system_cd	The full name of the source or destination attribute is determined by the context.
Code system name	ST	Code_system_desc_txt	The full name of the source or destination attribute is determined by the context.
Code system version	ST	Code_version	The full name of the source or destination attribute is determined by the context.
Display name	ST	display name	The display name is optional, and will not usually be transmitted. The full name of the source or destination attribute is determined by the context.
Original text	ST	..value_text	Original text is provided when the coding system being used does not contain the concept being passed. This is only allowed for CWE (coded with exception) code sets.

7.4.10 SET< CV>

The HL7 feature of allowing multiple instances of a CV datatype is only supported for two attributes within the Notification Message: Ethnic Group, and Race.

7.4.11 Entity Name: EN

A name for a person, organization, place or thing. A sequence of name parts, such as first name or family name, prefix, suffix, etc. Structurally, the entity name data type is a sequence of entity name part values with an added "use" code and a valid time range for information about if and when the name can be used for a given purpose.

7.4.11.1 EN Properties

Property Name	Property Type	Base System Mapping	Comment
Text	List <ENXP>	See ENXP	Repeats
Use	Set <CS>	Person_name, Organization_name: use_cd	Some name uses are directly supported as explicit attributes, for example, the primary name for a person.
ValidTime	GTS	Person_name: from_time, to_time.	This component is not supported for organizations.

7.4.11.2 Entity Name Part: ENXP

A character string token representing a part of a name. May have a type code signifying the role of the part in the whole entity name, and a qualifyer code for more detail about the name part type. Typical name parts for person names are given names, and family names, titles, etc

Property Name	Property Type	Base System Mapping	Comment

Property Name	Property Type	Base System Mapping	Comment
this	ST	If type = FAM Then = last_name If type = GIV Then = first_name, middle_name. If type = PFX Then = name_prefix If type = SFX Then = name_suffix If type = " " Then Organization_name. nm_txt	The mapping is based on the type value that is passed. If multiple given names are passed, the first received is carried as the first name. If multiple organization names are passed, their order is evaluated to determine organization_name_seq.
type	CS	NA	The following values are accepted at this time: FAM, GIV, PFX, SFX. Note, first and middle name are both considered of type "GIV". They are differentiated by their ordering within the message.
Qualifier	SET<CS>		Not supported at this time.

7.4.12 Instance Identifier: II

An instance identifier is an identifier that uniquely identifies a thing or object. Examples are object identifier for HL7 RIM objects, medical record number, order id, service catalog item id, Vehicle Identification Number (VIN), etc. Instance identifiers are defined based on ISO object identifiers. Some identifier schemes define certain style options to their code values. For example, the U.S. Social Security Number (SSN) is normally written with dashes that group the digits into a pattern "123-12-1234". However, the dashes are not meaningful and a SSN can just as well be represented as "123121234" without the dashes.

In the case where identifier schemes provide for multiple representations, HL7 shall make a ruling about which is the preferred form. HL7 shall document that ruling where that respective external identifier scheme is recognized. HL7 shall decide upon the preferred form based on criteria of practicality and common use. In absence of clear criteria of practicality and common use, the safest, most extensible, and least stylized (the least decorated) form shall be given preference.

Leading zeroes in identifiers are deprecated. They frequently lead to confusion because some applications may or may not strip those zeroes. They are also sometimes used to indicate a certain maximum number of digits. This is in itself to be discouraged, because it the notion of a maximum identifier leads to overflow conditions which make identifiers non-unique and thus violate this specification.

7.4.12.1 II Properties

Property Name	Property Type	Base System Mapping	Comment
Root	UID	Entity_id, Act_id: type_cd + assigning_authority_cd	HL7 expects that an ISO UID will be assigned to each combination of entity type and assigning authority. HL7 will provide UIDs in some cases. However, other parties can define them as well.
Extension	ST	Entity_id, Act_id:Root_ extension_txt	This is the identifier "value"
Assigning authority name	ST	Entity_id, Act_id: Assigning_authority_ descriptive_txt	
ValidTime	IVL<TS>	Entity_id, Act_id: effective_from_time, effective_to_time	

7.4.13 Integer: INT

Positive and negative whole numbers typically the results of counting and enumerating. The standard imposes no bounds on the size of integer numbers.

7.4.13.1 INT Properties

Integer is an atomic type, with a single component.

Property Name	Property Type	Base System Mapping	Comment
{content}		various	

7.4.14 Physical Quantity: PQ

Within the current notification message, this will only be encountered as one of the possible types for observation value.

7.4.14.1 PQ Properties

Property Name	Property Type	Base System Mapping	Comment
Value	REAL	Obs_value_numeric. numeric_value	The quantity goes here.
Unit	CS	Obs_value_numeric. numeric_unit_cd	The unit of measure goes here.
Original value	REAL		Not supported at this time.
Original unit	CV		Not supported at this time.

7.4.15 Real: REAL

Real numbers are also known as fractional numbers. These values are ypically used whenever quantities are measured, estimated, or computed from other real numbers. The typical representation is decimal, where the number of significant decimal digits is known as the precision.

7.4.15.1 REAL Properties

Real is an atomic type, with a single component.

Property Name	Property Type	Base System Mapping	Comment
{content}		Obs_value_numeric	The value may be true, false, or null.

7.4.16 Time Stamp: TS

HL7 found it necessary to take special measures with this datatype since, for W3C, the timestamp data does not allow the expression of dates and date/times with variable levels of precision. Such an expression is a requirement for HL7. Essentially, the TS datatype contains a single component that can either express a date/time, a date, a year and month, or a year.

7.4.16.1 TS Properties

Property Name	Property Type	Base System Mapping	Comment
{content}	TS	..date, ..time, ..	The mapping is dependent on the context. Note, however, that HL7 date/times exist on variable levels of precision..

7.4.17 Interval of Time Stamp: <IVL> TS

The notion of time stamp intervals includes open intervals, that is, where only start or stop date are valued. It also includes durations, periods of time without either start or stop date valued. Note, HL7 has defined interval (IVL) as a generic datatype that can apply to any ordered datatype. PHIN messaging only uses it for intervals of time stamps

7.4.17.1 IVL <TS> Properties

Property Name	Property Type	Base System Mapping	Comment
Low	TS	..from_time, ..start_time	
High	TS	.. to_time, ..stop_time	
LowClosed	BL		Value if the start date or time is not known
HighClosed	BL		Value if the stop date or time is not known
Width	PQ	.. duration_amount, .. duration_unit_cd	Refer to the discussion of PQ for valuing this component.
Center	TS		Not supported at this time.

7.5 Notification Messaging HMD

The core contents of the Notification Messaging Notification Report HMD is shown below, in a section in which page formatting has been switched to Landscape to do a better job of showing the message contents.

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
1	**PublicHealthCase**	0..1			PublicHealthCase	PublicHealthCase	N				
2	classCode	1..1	M	R	Act	CS	D	CASE	CNE		
3	moodCode	1..1	M	R	Act	CS	D	EVN	CNE		
4	id	1..*	M	R	Act	SET<II>	D				
5	code	1..1		R	Act	CV	D	ActCode	CWE		
6	text	0..1			Act	ST	D				
7	statusCode	0..1			Act	CS	D	ActStatus	CNE		
8	effectiveTime	1..1			Act	IVL<TS>	D				
9	activityTime	1..1			Act	IVL<TS>	D				
10	confidentialityCode	0..1			Act	CV	D	Confidentiality	CWE		
11	detectionMethodCode	1..1		R	PublicHealthCase	CV	D	CaseDetectionMethod	CWE		
12	transmissionModeCode	1..1		R	PublicHealthCase	CV	D	CaseTransmissionMode	CWE		
13	diseaseImportedCode	1..1		R	PublicHealthCase	CV	D	CaseDiseaseImported	CWE		
14	**author**	0..1			Act	Author	N				
15	typeCode	1..1	M	R	Participation	CS	D	AUT	CNE		
16	***assignedEntity***	1..1			Participation	COCT_MT090000	C				
17	**participant**	0..*			Act	SET<Participant>	N				
18	typeCode	1..1	M	R	Participation	CS	D	ParticipationType	CNE		
19	time	0..1			Participation	IVL<TS>	D				
20	***assignedEntity***	1..1			Participation	COCT_MT090000	U				
21	**responsibleParty**	0..*			Act	SET<ResponsibleParty>					
22	typeCode	1..1	M	R	Participation	CS	D	RESP	CNE		
23	**territorialAuthority**	1..1			Participation	TerritorialAuthority	N				
24	classCode	1..1	M	R	Role	CS	D	TERR	CNE		
25	**territory**	0..1			Role	Case Source	N				
26	classCode	1..1	M	R	Entity	CS	D	PLC	CNE		
27	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
28	code	0..1			Entity	CV	D	EntityCode	CWE		
29	name	0..1			Entity	TN	D				
30	**subject1**	0..*			Act	SET<Subject1>	N				
31	typeCode	1..1	M	R	Participation	CS	D	SBJ	CNE		
32	**participant**	1..1			Participation	PrimaryContact	N				
33	classCode	1..1	M	R	Role	CS	D	ROL	CNE		

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
34	code	0..1			Role	CV	D	RoleCode	CWE		
35	effectiveTime	0..1			Role	IVL<TS>	D				
36	**playingPerson**	0..1			Role	Contact	N				
37	classCode	1..1	M	R	Entity	CS	D	PSN	CNE		
38	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
39	id	0..*			Entity	SET<II>	D				
40	name	0..*			Entity	BAG<EN>	D				
41	telecom	0..*			Entity	BAG<TEL>	D				
42	administrativeGenderCode	0..1			LivingSubject	CE	D	AdministrativeGender	CWE		
43	birthTime	0..1			LivingSubject	TS	D				
44	deceasedInd	0..1			LivingSubject	BL	D				
45	deceasedTime	0..1			LivingSubject	TS	D				
46	addr	0..*			Person	BAG<AD>	D				
47	maritalStatusCode	0..1			Person	CV	D	MaritalStatus	CWE		
48	educationLevelCode	0..1			Person	CV	D	EducationLevel	CWE		
49	raceCode	0..*			Person	SET<CV>	D	Race	CWE		
50	ethnicGroupCode	0..*			Person	SET<CV>	D	Ethnicity	CWE		
51	**exposedEntity**	0..1			Entity	SecondaryContact	N				
52	classCode	1..1	M	R	Role	CS	D	EXPR	CNE		
53	code	0..1			Role	CV	D	RoleCode	CWE		
54	effectiveTime	0..1			Role	IVL<TS>	D				
55	***exposedPerson***	0..1			Role	Contact	R				
56	**scoper**	0..1			Role	CaseSubject | CaseSubject_comp1_1 | Person | CaseSubject_comp3_1 | NonPersonLivingSubject | Place				Y	
57	**scoper_CaseSubject_comp1_1**	1..1			Entity	CaseSubject_comp1_1 | Person				Y	
58	**scoper_Person**	1..1			LivingSubject	Person	N				
59	classCode	1..1	M	R	Entity	CS	D	PSN	CNE		
60	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
61	id	0..*			Entity	SET<II>	D				
62	name	0..*			Entity	BAG<EN>	D				
63	telecom	0..*			Entity	BAG<TEL>	D				
64	administrativeGenderCode	1..1		R	LivingSubject	CV	D	AdministrativeGender	CWE		
65	birthTime	1..1		R	LivingSubject	TS	D				

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
66	deceasedInd	0..1			LivingSubject	BL	D				
67	deceasedTime	0..1			LivingSubject	TS	D				
68	addr	1..*			Person	BAG<AD>	D				
69	maritalStatusCode	0..1			Person	CV	D	MaritalStatus	CWE		
70	educationLevelCode	0..1			Person	CV	D	EducationLevel	CWE		
71	raceCode	1..*		R	Person	SET<CV>	D	Race	CWE		
72	ethnicGroupCode	1..*		R	Person	SET<CV>	D	Ethnicity	CWE		
73	**scoper_CaseSubject_comp3_1**	1..1			Entity	CaseSubject_comp3_1 | NonPersonLivingSubject				Y	
74	**scoper_NonPersonLivingSubject**	1..1			LivingSubject	NonPersonLivingSubject					
75	classCode	1..1	M	R	Entity	CS	D	NLIV	CNE		
76	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
77	id	0..*			Entity	SET<II>	D				
78	code	1..1	M	R	Entity	CV	D	EntityCode	CWE		
79	name	0..1			Entity	EN	D				
80	desc	0..1			Entity	ST	D				
81	existenceTime	0..1			Entity	IVL<TS>	D				
82	riskCode	1..1		R	Entity	CV	D	EntityRisk	CWE		
83	handlingCode	1..1		R	Entity	CV	D	EntityHandling	CWE		
84	**scoper_Place**	1..1			Entity	Place	N				
85	classCode	1..1	M	R	Entity	CS	D	PLC	CNE		
86	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
87	id	0..1			Entity	SET<II>	D				
88	code	0..1			Entity	CV	D	EntityCode	CWE		
89	name	0..1			Entity	EN	D				
90	desc	0..1			Entity	ST	D				
91	addr	0..1			Place	AD	D				
92	directionsText	0..1			Place	ST	D				
93	positionText	0..1			Place	ST	D				
94	gpsText	0..1			Place	ST	D				
95	**subjectOf**	0..*			Role	SET<Subject3>	N				
96	typeCode	1..1	M	R	Participation	CS	D	SBJ	CNE		
97	**observationEvent**	1..1			Participation	Observation	N				
98	classCode	1..1	M	R	Act	CS	D	OBS	CNE		
99	moodCode	1..1	M	R	Act	CS	D	x_ActMoodIntentEvent	CNE		

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
100	id	0..*			Act	SET<II>	D				
101	code	1..1	M	R	Act	CV	D	ActCode	CWE		
102	text	0..1			Act	ST	D				
103	effectiveTime	0..1			Act	IVL<TS>	D				
104	activityTime	0..1			Act	IVL<TS>	D				
105	confidentialityCode	0..1			Act	SET<CE>	D	Confidentiality	CWE		
106	value	0..*			Observation	SET<ANY>	D				
107	interpretationCode	0..1			Observation	CV	D	ObservationInterpretation	CWE		
108	methodCode	0..1			Observation	CV	D	ObservationMethod	CWE		
109	**location**	0..*			Act	SET<Location3>	N				
110	typeCode	1..1	M	R	Participation	CS	D	LOC	CNE		
111	***participant***	1..1			Participation	COCT_MT070000	C				
112	**participant**	0..*			Act	SET<Participant2>	N				
113	typeCode	1..1	M	R	Participation	CS	D	ParticipationActorSignatories	CNE		
114	***assignedEntity***	1..1			Participation	COCT_MT090000	U				
115	**subject**	0..*			Act	SET<Subject4>	N				
116	typeCode	1..1	M	R	Participation	CS	D	SBJ	CNE		
117	time	0..1			Participation	IVL<TS>	D				
118	***specimen***	1..1			Participation	COCT_MT080000	C				
119	**pertinentInformation**	0..*			Act	SET<PertinentInformation3>					
120	typeCode	1..1	M	R	ActRelationship	CS	D	PERT	CNE		
121	sequenceNumber	0..1			ActRelationship	INT	D				
122	***pertinentObservationProcess***	1..1			ActRelationship	Observation	R				

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
123	**subject2**	0..1			Act	Subject2	N				
124	typeCode	1..1	M	R	Participation	CS	D	SBJ	CNE		
125	**patient**	1..1			Participation	PatientRole	N				
126	classCode	1..1	M	R	Role	CS	D	PAT	CNE		
127	id	0..1			Role	SET<II>	D				
128	*patientPerson*	0..1			Role	Person	U				
129	**component2**	0..*			Act	SET<Component1>	N				
130	typeCode	1..1	M	R	ActRelationship	CS	D	COMP	CNE		
131	**substanceAdministrationProcess**	1..1			ActRelationship	SubstanceAdministration					
132	classCode	1..1	M	R	Act	CS	D	SBADM	CNE		
133	moodCode	1..1	M	R	Act	CS	D	x_ActMoodIntentEvent	CNE		
134	id	0..*			Act	SET<II>	D				
135	code	1..1	M	R	Act	CV	D	ActCode	CWE		
136	text	0..1			Act	ST	D				
137	effectiveTime	0..1			Act	IVL<TS>	D				
138	activityTime	0..1			Act	IVL<TS>	D				
139	priorityCode	0..1			Act	CV	D	ActPriority	CWE		
140	confidentialityCode	0..1			Act	CV	D	Confidentiality	CWE		
141	routeCode	0..1			SubstanceAdministration	CV	D	RouteOfAdministration	CWE		
142	approachSiteCode	0..1			SubstanceAdministration	CV	D	ActSite	CWE		
143	doseQuantity	0..1			SubstanceAdministration	PQ	D				
144	**consumable**	0..*			Act	SET<Consumable>	N				
145	typeCode	1..1	M	R	Participation	CS	D	CSM	CNE		
146	**manufacturedProduct**	1..1			Participation	ManufacturedProduct	N				
147	classCode	1..1	M	R	Role	CS	D	THER	CNE		
148	**manufacturedManufacturedMaterial**	0..1			Role	ManufacturedMaterial	N				
149	classCode	1..1	M	R	Entity	CS	D	MMAT	CNE		

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
150	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
151	id	0..1			Entity	II	D				
152	code	0..1			Entity	CV	D	EntityCode	CWE		
153	quantity	0..*			Entity	SET<PQ>	D				
154	desc	0..1			Entity	ST	D				
155	existenceTime	0..1			Entity	IVL<TS>	D				
156	formCode	0..1			Material	CV	D	MaterialForm	CWE		
157	lotNumberText	0..1			ManufacturedMaterial	ST	D				
158	expirationTime	0..1			ManufacturedMaterial	IVL<TS>	D				
159	**location**	0..*			Act	SET<Location4>	N				
160	typeCode	1..1	M	R	Participation	CS	D	LOC	CNE		
161	***participant***	1..1			Participation	COCT_MT070000	U				
162	**participant**	0..*			Act	SET<Participant3>	N				
163	typeCode	1..1	M	R	Participation	CS	D	ParticipationActorSignatories	CNE		
164	***assignedEntity***	1..1			Participation	COCT_MT090000	U				
165	**explanation**	0..*			Act	SET<Explanation2>	N				
166	typeCode	1..1	M	R	ActRelationship	CS	D	EXPL	CNE		
167	***explainedObservationProcess***	1..1			ActRelationship	Observation	U				
168	**component1**	0..*			Act	SET<Component2>	N				
169	typeCode	1..1	M	R	ActRelationship	CS	D	COMP	CNE		
170	**procedureProcess**	1..1			ActRelationship	Procedure	N				
171	classCode	1..1	M	R	Act	CS	D	PROC	CNE		
172	moodCode	1..1	M	R	Act	CS	D	x_ActMoodIntentEvent	CNE		
173	id	0..*			Act	SET<II>	D				

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
174	code	1..1	M	R	Act	CV	D	ActCode	CWE		
175	text	0..1			Act	ST	D				
176	effectiveTime	0..1			Act	IVL<TS>	D				
177	activityTime	0..1			Act	IVL<TS>	D				
178	confidentialityCode	0..1			Act	CV	D	Confidentiality	CWE		
179	targetSiteCode	0..1			Procedure	CV	D	ActSite	CWE		
180	**location**	0..*			Act	SET<Location2>	N				
181	typeCode	1..1	M	R	Participation	CS	D	LOC	CNE		
182	***participant***	1..1			Participation	COCT_MT070000	U				
183	**participant**	0..*			Act	SET<Participant1>	N				
184	typeCode	1..1	M	R	Participation	CS	D	ParticipationActorSignatories	CNE		
185	***assignedEntity***	1..1			Participation	COCT_MT090000	U				
186	**explanation**	0..*			Act	SET<Explanation1>	N				
187	typeCode	1..1	M	R	ActRelationship	CS	D	EXPL	CNE		
188	***explainedObservationProcess***	1..1			ActRelationship	Observation	U				
189	**component3**	0..*			Act	SET<Component3>	N				
190	typeCode	1..1	M	R	ActRelationship	CS	D	COMP	CNE		
191	***observationProcess***	1..1			ActRelationship	Observation	U				
192	**pertinentInformation1**	0..*			Act	SET<PertinentInformation1>					
193	typeCode	1..1	M	R	ActRelationship	CS	D	PERT	CNE		
194	**pertinentActEvent**	1..1			ActRelationship	RelatedNotification	N				
195	classCode	1..1	M	R	Act	CS	D	ACT	CNE		
196	moodCode	1..1	M	R	Act	CS	D	EVN	CNE		
197	id	0..1			Act	II	D				

No	Element Name (Link to tabular view)	Card	Mand	Conf	Rim Source	of Message Element Type		Domain	CS	Abst	Nt
	PHINNotificationHMD	**Common message for PORR_HD100001**									
198	code	1..1			Act	CV	D	ActCode	CWE		
199	activityTime	0..1			Act	IVL<TS>	D				
200	**pertinentInformation2**	0..*			Act	SET<PertinentInformation2>					
201	typeCode	1..1	M	R	ActRelationship	CS	D	PERT	CNE		
202	**pertinentEncounterEvent**	1..1			ActRelationship	Encounter	N				
203	classCode	1..1	M	R	Act	CS	D	ENC	CNE		
204	moodCode	1..1	M	R	Act	CS	D	EVN	CNE		
205	activityTime	1..1			Act	IVL<TS>	D				
206	**location**	0..1			Act	Location1	N				
207	typeCode	1..1	M	R	Participation	CS	D	LOC	CNE		
208	**locatedEntity**	1..1			Participation	RoleEncounterLocation					
209	classCode	1..1	M	R	Role	CS	D	LOCE	CNE		
210	code	1..1			Role	CV	D	RoleCode	CWE		
211	**locatedOrganization**	0..1			Role	ProviderOrganization	N				
212	classCode	1..1	M	R	Entity	CS	D	ORG	CNE		
213	determinerCode	1..1	M	R	Entity	CS	D	INSTANCE	CNE		
214	id	0..1			Entity	II	D				
215	name	0..1			Entity	EN	D				