The Unified^2 Service Action Model

PART B

Mapping of HL7 v2 Content

3 Mapping of HL7 v2 Content

3.1 General Orders and Observations

3.1.1 Structured data vs. narrative reports

In HL7 version 2, narrative reports as well as structured observations are sent using nested OBR and OBX segments. For narrative reports the segments represented sections of the report. For HL7 version 3 it is not clear whether the same approach will be used. Most importantly, the Patient Record Architecture working group within HL7 is now working on structured documents using XML. It seems as if XML is becoming widely deployed and is ideal for textual reports. Most importantly using XML (including HTML) for textual reports is actually much simpler than OBR/OBX segments. Therefore, in the following we only care about mapping structured medical information.

3.1.2 ORC – The Genuine Order

3.1.2.1 Order control (ID) 00215

Determines the function of the order segment. […] This field may be considered the "trigger event" identifier for orders. The codes fall roughly into the following categories: a) event request […] b) event acknowledgement […] c) event notification. […].

The order control code communicates an "function" that usually change the state of the order. Thus, the order control code itself is not part of the state, and is not usually stored in a data base. In HL7 version 3 order control codes live on as transitions in state-transition models and as event codes in interaction models. Such codes are not part of the information model (class diagram.)

3.1.2.2 Placer order number (EI) 00216

This field is the placer application's order number. […] It is assigned by the placer (ordering application). It identifies an order uniquely among all orders [from a particular ordering application].

3.1.2.3 Filler order number (EI) 00217

This field is the order number associated with the filling application. It is assigned by the order filler (receiving) application. […] This string must uniquely identify the […] from other orders in a particular filling application […]. This uniqueness must persist over time. […] The second component of the filler order number always identifies the actual filler of an order. […] the filler application ID in this field may not be the same as any sending and receiving application on the network (as identified in the MSH segment).

[…]

The filler order number (OBR-3 or ORC-3) also uniquely identifies an order and its associated observations. For example, suppose that an institution collects observations from several ancillary applications into a common database and this common database is queried by yet another application for observations. In this case, the filler order number and placer order number transmitted by the common database application would be that of the original filler and placer, respectively, rather than a new one assigned by the common database application.

Similarly, if a third-party application, not the filler or placer, of an order were authorized to modify the status of an order (say, cancel it), the third-party application would send the filler an ORM message containing an ORC segment with ORC-1-order control equal to "CA" and containing the original placer order number and filler order number, rather than assign either itself.

3.1.2.4 Placer group number (EI) 00218

This field allows an order placing application to group sets of orders together and subsequently identify them. […] It] uniquely identifies all order groups from the given placer application. […] It is assigned by the placer application and may come from the same series as the placer order number of the ORC, but this is not required.

3.1.2.5 Order status (ID) 00219

This field specifies the status of an order. […] It does not initiate action. It is assumed that the order status always reflects the status as it is known to the sending application at the time that the message is sent. Only the filler can originate the value of this field. Although it contains many of the same values […] of the] Order control code […], the purpose is different.

This field communicates the state of the order as defined in the state-transition model. Its mapping is straight forward to the Service.status_cd. However, note that the state-transition model of the Service in version 3 may be different to the order in version 2 and the status codes will certainly be different. Mapping of status codes (and control codes) are explained in a later chapter.

3.1.2.6 Response flag (ID) 00220

This field allows the placer (sending) application to determine the amount of information to be returned from the filler. Sometimes the requested level of response may not be possible immediately, but when it is possible, the filler (receiving) application must send the information. When the field is null, D is the default value of the field.

This field controls the details of communication, that is, it constrains the amount of information sent in messages. The response flag is not part of the application information itself, i.e. it is not part of the electronic medical record. This kind of message control information will be handled generically in the message control infrastructure (version 3 Message Header) but is not part of the information model.

This issue has been forwarded to the Control Query TC to resolve.

3.1.2.7 Quantity/timing (TQ) 00221

This field determines the priority, quantity, frequency, and timing of an atomic service. Order segments should be thought of as describing an atomic service. […] For example, if an OBR segment describes a unit of blood, this field might request that three (3) such units be given on successive mornings. In this case ORC-7-quantity/timing would be "`1^XQAM^X3`.

The composition of timed and conditioned service plans and orders is one of the main interests of the HL7 version 3 modeling work. Most of the components of this field are found in the Relationship class. Refer to a section below to see the details of the mapping of the TQ components to HL7 v3.

3.1.2.8 Parent (CM) 00222

This field relates a child to its parent when a parent-child relationship exists. […] The first component has the same format as ORC-2-placer order number (Section 3.1.2.2). The second component has the same format as ORC-3-filler order number (Section 3.1.2.3).

The construction of parent and child services in HL7 v3 is very similar to that of HL7 v2, only the representation of those structures are different. Hierarchical parent-child structures are built using the relationship class. The use of parent/child orders was usually to construct a battery of services and sometimes to construct a coordinated sequence of services. The nature of the parent/child relationship is indicated precisely using the relationship type code.

3.1.2.9 Date/time of transaction (TS) 00223

This field contains the date and time the current transaction enters the ordering application. For messages creating new orders, this is the date and time the order was entered. […] For other messages, this is the date and time the current transaction (e.g., cancellation) enters the sending application. This date and time is for the current transaction and is not a "replacement" time for a correction to the original order. Similarly, ORC-10-entered by, ORC-11-verified by, and ORC-13-enterer's location of this segment relate to the current transaction, not the original order.

This field explicitly refers to the time of a given transaction, that is, it is not so much information about the order itself than about the (last) change to an order. It is the same as the *EVN-2-recorded-date/time* used by the HL7 v2 ADT messages. Just like the order control code, this information is no longer considered part of the application layer information model but is handled generically by the messaging support fields as defined in the version 3 Message Header.

3.1.2.10 Entered by (XCN) 00224

This field contains the identity of the person who actually keyed the request into the application. It provides an audit trail in case the request is entered incorrectly and the ancillary department needs to clarify the request. By local agreement, either the ID number or name component may be omitted.

A data entry person is an active participant in a service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows to represent the audit trail more completely using the Actor.tmr (time range) attribute.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.2.11 Verified by (XCN) 00225

This field contains the identity of the person who verified the accuracy of the entered request. It is used in cases where the request is entered by a technician and needs to be verified by a higher authority (e.g., a nurse). […]

A person verifying a service request is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows representing the audit trail more completely using the Actor.tmr (time range) attribute.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specifying the actual responsibility of every person at different points in the service's life cycle.

3.1.2.12 Ordering provider (XCN) 00226

This field contains the identity of the person who is responsible for creating the request (i.e., ordering physician.) […]

A person ordering an service request is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.2.13 Enterer's location (PL) 00227

This field specifies the location (e.g., nurse station, ancillary service location, clinic, floor) where the person who entered the request was physically located when the order was entered.

This information is another kind of audit trail information. Given that the identity of every participant in the service is well known, the only additional benefit of this information is to track down spurious orders, where the true identity of the enterer is dubious. Today as up-front authentication of electronic transactions is more and more required by law, this particular data element seems no longer to be of special importance. In any way, this information is not specific to orders and should therefore be communicated in the version 3 message header if it is useful at all.

3.1.2.14 Call back phone number (XTN) 00228

This field contains the telephone number to call for clarification of a request or other information regarding the order.

Instead of just a phone number, in version 3 a person or organization with phone number(s) can be linked to a Service as an Actor of type "clarification-contact." No special data element is needed.

3.1.2.15 Order effective date/time (TS) 00229

This field contains the date/time that the changes to the request took effect or are supposed to take effect.

If ORC-9-date/time of transaction is after or equal to ORC-15-order effective date/time, the data values in the ORC and its subordinate segments took effect on the order effective date/time.

If ORC-9-date/time of transaction is before the time specified in ORC-15-order effective date/time, the data values in ORC and its subordinate segments are planned to take effect on the order effective date/time.

If ORC-15-order effective date/time is left blank, its value is assumed to be equal to that specified in ORC-9-date/time of transaction or MSH-7-date/time of message if the transaction date/time is blank.

In the case where the time specified in ORC-15-order effective date/time (for the order control code event in the same ORC segment) is different from the corresponding date/time in ORC-7-quantity/timing, the time specified in ORC-15-order effective date/time takes precedence. Thus if the ORC event is a discontinue request to the filler for a continuing order, and the order-effective date/time is prior to the end date/time of ORC-7-quantity/timing, the order effective date/time should take precedence. If the order identified in the ORC has children, the children which have not started should be canceled; if there is a child in process, it should be discontinued; if a child has progressed beyond the point where it can be discontinued, its status is unaffected.

The use of this field has three different aspects,

- information about some time related to the Service. For example, usually it is the time the service is supposed to start but also the time the order is supposed to end (in context of a discontinue request.)

- information about the mood of the Service, that is, whether it is just a report when something took effect or it is a command when some action is supposed or planned to take effect.

- information about a particular transaction request for the order (defaulting to the *MSH-7-date/time of message*) as opposed to a time that will affect the service actually carried out.

In version 3 these different aspects are all factored into specific data elements that are consistent and uniform in their interpretation. In version 2 this data element had alternative data elements to carry the same information, such as in the MSH and in the TQ, and thus was redundant. Therefore this field will not be carried forth as such in version 3, but will be decomposed in its different meanings:

- The actual start and end times of a service action will be communicated in Service.time.

- The mood is factored into the explicit mood code Service.mood_cd.

- Discontinuing a service immediately is done without mentioning any time at all, while a change in the planned end time of a service can be requested by the placer in the Service.time attribute.

- The time of a particular service control transaction (message) will always and only be sent in the version 3 Message Header.

3.1.2.16 Order control code reason (CE) 00230

This field contains the explanation (either in coded or text form) of the reason for the order event described by the order control code (HL7 table 0119). Whereas an NTE after the order-specific segment (e.g., RXO, ORO, OBR) would provide a comment for that specific segment, the purpose of the order control code reason is only to expand on the reason for the order event.

ORC-16-order control code reason is typically not valued when ORC-1-order control is NW, although it could be. In the case of a canceled order, for example, this field is commonly used to explain the cancellation. A Pharmacy system that canceled a drug order from a physician because of a well documented allergy would likely report the fact of the allergy in this field.

If it canceled the order because of a drug interaction this field might contain at least the names (and codes, if needed) of the interacting substances, the text describing the interaction, and the level of severity of the interaction.

This is a reason for a specific transaction on a service, not for the entire service itself.

In HL7 v3, a Service may be connected to other Services through the relationship class describing a rationale for ordering or carrying out the Service. This kind of rationale is a medical rationale and will refer to medical record items. For example, Acetaminophen (Tylenol®) 1000 mg ordered because of body temperature = 103.6 °F (39.8 °C).

However, the order control reason code in version 2 was not usually used to describe the reason for new orders, as the original v2 text explains, but rather to give reasons for subsequent events/transactions on an order or service. Notably, as the above example from v2 describes, an order may be cancelled for specific reasons different (e.g., allergy) from why it was originally ordered (e.g., infection). This information is considered part of the medical record.

This poses a problem to our methodology, since properties of objects (attributes and relationships) describe state and not the changing of state. Thus the reason for a Service (e.g. infection) is different from the reason for a change of state (e.g., allergy.) The problem can be solved by relationship types "reason" vs. "contraindication" so that the infection would be linked as reason to the order and the allergies would later be linked as contraindications. However, this has still not solved the problem that there is a Service object, but not a Service-cancellation object. In addition the reason and contraindications are linked at different sequences (first reason, then contraindication) and by different people (reason: doctor, contraindication: pharmacist.)

There are also reasons for transitions of the form "order cancelled because it was entered erroneously." Those reasons are not a medical rationale that can be described through linking existing medical record items to the request and are likely to require different methods.

3.1.2.17 Entering organization (CE) 00231

This field identifies the organization that the enterer belonged to at the time he/she enters/maintains the order, such as medical group or department. The person who entered the request is defined in ORC-10 -entered by.

A data entry person is an active participant in a service. All information about actors will be communicated using the Actor participation class linking a person to a service. This includes the organizational affiliation of an entering person.

3.1.2.18 Entering device (CE) 00232

This field identifies the physical device (terminal, PC) used to enter the order.

This information is another kind of audit trail information. Given that the identity of every participant in the service is well known, the only additional benefit of this information is to track down spurious orders, where the true identity of the enterer is dubious. Today as up-front authentication of electronic transactions is more and more required by law, this particular data element seems no longer to be of special importance. In any way, this information is not specific to orders and should therefore be communicated in the version 3 message header if it is useful at all.

3.1.2.19 Action by (XCN) 00233

This field contains the identity of the person who initiated the event represented by the corresponding order control code. For example, if the order control code is CA (cancel order request), this field represents the person who requested the order cancellation. This person is typically a care provider but may not always be the same as ORC-12 ordering provider.

A person ordering an Service change request is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

There is a methodological issue: objects reflect current state not the changing of state. Thus there is no Service cancellation object that an actor can be bound to. One solution is to add participation types for every transaction to the Service (new – orderer, cancel – caneller, hold – holder, release – releaser., …) but this is obviously not practical. Another approach is to regard the "action by" person as the responsible party for a particular HL7 v3 message, independent from what the message contains. In that case the action-by person would be communicated as part of the version 3 Message Header.

3.1.2.20 Advanced beneficiary notice code (CE) 01310

This field indicates the status of the patient's or the patient's representative's consent for responsibility to pay for potentially uninsured services. This element is introduced to satisfy HCFA Medical Necessity requirements for outpatient services. This element indicates (a) whether the associated diagnosis codes for the service are subject to medical necessity procedures, (b) whether, for this type of service, the patient has been informed that they may be responsible for payment for the service, and (c) whether the patient agrees to be billed for this service

An advanced beneficiary notice is a kind of consent. It is represented by an associated service linked to the procedure (or other service) which the advanced beneficiary notice addresses. The Consent service has specifies the type of consent or agreement in the Consent.type_cd and the consenting or agreeing parties are associated to the consent as Actors. The consenting party is of Actor.type_cd = *consenter*, and the person obtaining the consent is of Actor.type_cd = *consent obtianer*. Whether each party must sign or have signed the consent is stated in the Actor.signature_cd, where an X indicates a signature requirement and an S indicates that the signature is on file.

The following table shows the HL7 v2.3.1 codes and their mapping onto HL7 v3 structures.

Table 1: Advanced beneficiary notice code mapping

HL7 v2.3 advanced beneficiary notice code (0339)		HL7 v3 mapping
Value	**Description**	
1	Service is subject to medical necessity procedures	Consent.type_cd = AB1
2	Patient has been informed of responsibility, and agrees to pay for service	Consent.type_cd = AB2
3	Patient has been informed of responsibility, and asks that the payer be billed	Consent.type_cd = AB3
4	Advanced Beneficiary Notice has not been signed	Consent.type_cd = AB, AB1, AB2 associated Actor or type consenter has Actor.signature_cd = S (signed.)

3.1.2.21 Ordering facility name (XON) 01311

This field contains the name of the facility placing the order.

Remark: whether and what possible overlap exists between this field and the "Entering organization" is left unclear by HL7 v2.3.1. This field is relatively new to HL7 v2 and reflects the need for a better support of inter-institutional order transactions.

An organization (facility) as the party ordering a Service is an active participant in the Service. Active participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.2.22 Ordering facility address (XAD) 01312

This field contains the address of the facility placing the order.

An organization (facility) as the party ordering a Service is an active participant in the Service. Active participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service. This includes the.

3.1.2.23 Ordering facility phone number (XTN) 01313

This field contains the telephone number of the facility placing the order.

An organization (facility) as the party ordering a Service is an active participant in the Service. Active participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service. This includes the phone number.

3.1.2.24 Ordering provider address (XAD) 01314

This field contains the address of the care provider requesting the order.

An organization (facility) as the party ordering a Service is an active participant in the Service. Active participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service. This includes the address information.

3.1.3 TQ – Timing and Quantity

Quantity/timing provides a means of specifying when the service described by the order segment is to be performed and how frequently. It is a complex multicomponent field that can have repeats; i.e., more than one quantity/timing specification, separated by repeat delimiters, may appear.

3.1.3.1 Quantity component (CQ)

This field specifies the quantity of the service that should be provided at each service interval. For example, if two blood cultures are to be obtained every 4 hours, the quantity would be 2. If three units of blood are to be typed and cross-matched, the quantity would be 3. The default value is 1. When units are required, they can be added […].

When one service is to be done multiple times without significant waiting period between those multiple occurences there is most likely another difference between those services. For example, different routes, different targets, different methods, or even a small waiting period. Therefore, when each instance of a repeating service is in fact multiple services, this can be specified through service plan components subordinate to the repeating service.

3.1.3.2 Interval component (CM)

This field determines the interval between repeated services. The default is one time only, the first subcomponent is the repeat pattern, and the second subcomponent is the explicit time at which pattern is to be executed.

3.1.3.2.1 Repeat pattern

The repeating frequency with which the treatment is to be administered. It is similar to the frequency and SIG code tables used in order entry systems. The following is preferred syntax for repeat patterns:

All aspects of timing of services are communicated in the attributes Service.time and Service.critical_time. The difference between (total) time and critical_time is that most medical services (e.g., treatment) require work to be done before and after the real treatment. A physician usually is concerned with the time of the treatment only (the critical time) whereas scheduling must consider the margin around that time (total time.) Please see Section **Error! Reference source not found.** for more on the difference between Service.time and Service.critical_time. For physician's orders, critical_time is normally used.

Both attributes Service.time and Service.critical_time has the General Time Specification (GTS) data type. This data type has a literal expression that allows one to construct arbitrarily complex sets of time (points and intervals.) For the purpose of mapping to and from HL7 v2.3, the following table can be used:

Table 2: Mapping of HL7 v2.3 repeat pattern to the v3 general time specification

User-defined table 0335 - Repeat pattern		Mapping to v3 General Time Specification	
Value	**Meaning**	**Value**	**Note**
Q<integer>S	every <integer> seconds	S/<integer>	
Q<integer>M	every <integer> minutes	N/<integer>	
Q<integer>H	every <integer> hours	H/<integer>	
Q<integer>D	every <integer> days	D/<integer>	
Q<integer>W	every <integer> weeks	W/<integer>	
Q<integer>L	every <integer> months (Lunar cycle)	M/<integer>	
Q<integer>J<day#>	repeats on a particular day of the week, from the French *jour* (day). If <integer> is missing, the repeat rate is assumed to be 1. Day numbers are counted from 1=Monday to 7=Sunday. So Q2J2 means every second Tuesday; Q1J6 means every Saturday.	W/<integer> J<day#>	Every <integer> week on the weekday designated by <day#>. 1=Monday to 7=Sunday.
BID	twice a day at institution-specified times (e.g., 9AM-4PM)	H/12 IST BID	Note: timing of such repeating events is statistical by default and subject to reasonable interpretation of the filler. Additionally "IST" indicates the Institution Specified Time explicitly, although that is not strictly needed.
TID	three times a day at institution-specified times (e.g., 9AM-4PM-9PM)	H/8 IST TID	
QID	four times a day at institution-specified times (e.g., 9AM-11AM-4PM-9PM)	H/6 IST QID	
xID	"X" times per day at institution-specified times, where X is a numeral 5 or greater. E.g., 5ID=five times per day; 8ID=8 times per day	H/<24 / X> IST	BID, QID, and TID are retained for backward compatibility.
QAM	in the morning at institution-specified time	AM	
QSHIFT	during each of three eight-hour shifts at institution-specified times	SHIFT	
QOD	every other day (same as Q2D)	D/2	
QHS	every day before the hour of sleep	HS	
QPM	in the evening at institution-specified time	PM	
C	service is provided continuously between start time and stop time	Whether and how a service can be delivered "continuously" depends on the nature of the service. For continuous i.v. medication one can specify a Medication.rate_qty	
U <spec>	for future use, where <spec> is an interval specification as defined by the UNIX cron specification.	This literal expression for general time specification takes some ideas from UNIX cron, but an alternative syntax is not allowed.	
PRN	given as needed	PRN is not a time specification but a precondition or trigger. It is specified using a precondition observation that indicates what constitutes a "need."	
PRNxxx	where xxx is some frequency code (e.g., PRNQ6H); given as needed over the frequency period.		
Once	one time only. This is also the default when this component is null.	When no periods are contained in the time specification and Service.max_repetition_nmb is 1 (the default) then there will be at most one occurrence. No special code is required here.	
Meal Related Timings	<timing>C ("cum")<meal>	These meal related timing codes have been preserved as is in the HL7 v3 time specification. So, ACM, PCV, and all the other combinations are defined just the same way.	
A	Ante (before)		

P	Post (after)
I	Inter (e.g., between this meal and the next, between dinner and sleep
M	Cibus Matutinus (breakfast)
D	Cibus Diurnus (lunch)
V	Cibus Vespertinus (dinner)

The first subcomponent may repeat, with repeat values separated by a space. The repeats are interpreted as connected by logical ANDs. E.g., twice per day, every other day: BID QOD; three times per day, Monday Wednesday and Friday: TID QJ135.

Note HL7 v2.3.1 indicated that there was a big difference between something specified at Q12H or at BID. Aside from any conventions, there is a physical difference between "twice a day" and "every 12 hours". Both have the exact same meaning and no one is more or less exact than the other. Twice a day is simply a frequency, while "every 12 hours" specifies a period duration. Frequency and period duration are reciprocal measures for repeating events, so no difference in exactness exists.

In practice of HL7 v2.x Q12H was not an exact measure either, at most the expectation for timeliness. Instead of interpreting a difference into frequency or period duration in HL7 v3 one can specify the timeliness in terms of standard deviations from the specified period duration. For example, if one needs to be Q12H exact within 30 minutes, one can write "H/12(.5) where 0.5 is the standard deviation of the period length. By default, if only H/12 is given, a statistical timing is assumed rather than an "exact" timing, and it is left up to the reasonable judgement of the filler to choose the actual time of the service.

One general time specification can contain multiple elements so that arbitrary complex schedules can be constructed. Please refer to, for more detail on how this is done.

3.1.3.2.2 Explicit time interval

This field explicitly lists the actual times referenced by the code in the first subcomponent, in the following format: HHMM,HHMM,HHMM,…. This second subcomponent will be used to clarify the first subcomponent in cases where the actual administration times vary within an institution. If the time of the order spans more than a single day, this new subcomponent is only practical if the same times of administration occur for each day of the order. If the actual start time of the order (as given by the fourth subcomponent of the quantity/timing field) is after the first explicit time, the first administration is taken to be the first explicit time after the start time. In the case where the patient moves to a location having a different set of explicit times, the existing order may be updated with a new quantity/timing field showing the changed explicit times.

In HL7 v3 exact repeating points or intervals can be given in the general time specification of the attributes Service.time and Service.critical_time. Unlike the HL7 v2.3.1 "explicit time interval", these times are not limited to a time of day. One can write "**H***hhmm* + **H***hhmm* + **H***hhm*m" but one can also give any other specific date or additional constraints. For example, for a service to happen on September 27 1999 for 10 minutes between 3 and 4 PM, and thereafter every day Monday to Thursday for 10 minutes anywhere from 8 AM to 5 PM and on Friday from only until 1 PM one can write "19990927 H03-04 [10 min] + 19990928-* J1-4 H08-17 [10 min] + 19990928-* J5 H08-13 [10 min]". or shorter "(1999092703-04 + 19990928-* (J1-4 H08-17 + J5 H08-13)) [10 min]". Note that we are currently about to define the full syntax and semantics of this general time expression, so the actual form may change slightly.

3.1.3.3 Duration component (ST)

This field indicates how long the service should continue after it is started. The default is INDEF (do indefinitely). This component is coded as follows: [see Table below]

In a repeated service there are four different kinds of duration, that need to be distinguished:

1) duration of the entire sequence of a repeating service
2) duration of one instance of the a repeating service
3) duration between two instances of the repeating service (pause)
4) duration between two different services in a sequence

While the pause between two service is specified further below, it is not clear in HL7 v2 whether the duration times the entire service or one of its repetitions. It sounds as if the HL7 v2 TQ duration component specifies the duration of the entire sequence of the repeating service. On the other hand, it seems as if this same information, can also appear as explicit start and end times of the entire repeating service. So more importantly one would need a way to specify the duration of every single instance of a repeating service.

Because the different aspects of timing are all related, all the kinds of duration 1–3, including start and end time, are now represented in the same time specification attribute as the start time of the service. However, there will be no ambiguity. As explained in Section **Error! Reference source not found.**, even the most complex time specification with multiple levels of repetitions and intervals can be normalized into an *outer bound interval*, that spans the entire repeating service, and a sequence of intervals or singular time points, where each represents one occurrence of the repeating service.

In the simplest case of a service that is executed only once, the duration is the difference between start time and end time. So, if we specify the Service.critical_time as “199909160930–199909160945” the duration is 15 minutes. There is no need to specify duration in a separate attribute. If the start or end time is not known, which is often the case in orders, one can specify the duration as “[15 min]”. So, if the rule is “three times a day for 10 minutes” one can write “H/8 [10 min]”.

The following table shows the simple mapping from the HL7 v2.3.1 duration component to a part of the general time specification. Note that the v3 time specification will contain other parts

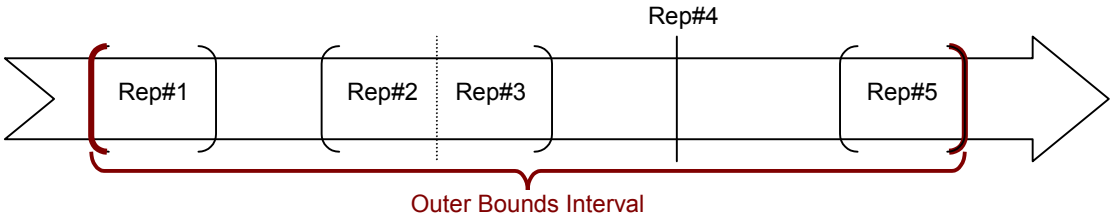

Figure 1: Any arbitrarily complex time specification can be interpreted as a simple sequence of time points and intervals. The outer bounds interval encloses the entire sequence from the beginning of the first interval to the end of the last. Every repeated service occurrence happens in one such interval (e.g., Rep#1, Rep#2, Rep#3 and Rep#5.) If only one time point is given (Rep#4), the service is started at that point. An interval is any continuous set of time points. If for some reason the same services needs to be repeated two times without a pause, one can specifying an interval and then remove precisely one point in time from that interval. This causes the interval to contain a “hole” and since intervals must be continuous, that hole causes the interval to be split into two.

Table 3: Mapping of the HL7 v2.3 duration component to the General Time Specification.

HL7 v2.3.1 Duration component		Mapping to v3 General Time Specification	
Code	**Meaning**	**Code**	**Note**
S<integer>	<integer> seconds	[<number> s]	
M<integer>	<integer> minutes	[<number> min]	
H<integer>	<integer> hours	[<number> h]	
D<integer>	<integer> days	[<number> d]	
W<integer>	<integer> weeks	[<number> wk]	
L<integer>	<integer> months	[<number> mon]	
X<integer>	<integer> times at interval specified in the order. A request for 2 blood cultures Q2H X3 would imply obtaining 2 blood cultures 3 different times at 2-hour intervals for a total of 6 blood cultures.	The maximum number of repetitions can be set in the Service.max_repetition_nmb field, which is 1 by default. For what was "Q2H X3" in HL7 v2.3, we can now write Service.critical_time = "H/2" Service.max_repetition_nmb = 3	
T<integer>	at the interval and amount stated until a total of <integer> "DOSAGE" is accumulated. Units would be assumed to be the same as in the QUANTITY field.	If we state an amount and frequency we can convert the dosage accumulated in the repeating service to a maximum number of repetitions. This is the preferred method. If a problem is so complex that an amount per repetition can not be specified (in which case the HL7 v2.3 TQ did not work) one can specify termination criteria as associated conditions (see Section **Error! Reference source not found.**.)	
INDEF	do indefinitely - also the default	The default in HL7 v3 is to do a service once. The maximum number of repetitions can be left open by setting the Service.max_repetition_nmb to the positive infinity (a special kind of NULL value.) In that case the repeating service will be terminated by other means, either by timing (end time reached) or by conditions.	

3.1.3.4 Start date/time component (TS)

This field may be specified by the orderer, in which case it indicates the earliest date/time at which the services should be started. In many cases, however, the start date/time will be implied or will be defined by other fields in the order record (e.g., urgency - STAT). In such a case, this field will be empty. The filling service will often record a value in this field after receipt of the order, however, and compute an end time on the basis of the start date/time for the filling service's internal use.

Start and end times of a service are specified in the general time specification in the attributes Service.time and Service.critical_time. The difference between (total) time and critical_time is that most medical services (e.g., treatment) require work to be done before and after the real treatment. A physician usually is concerned with the time of the treatment only (the critical time) whereas scheduling must consider the margin around that time (total time.) Please see Section **Error! Reference source not found.** for more on the difference between Service.time and Service.critical_time. For physician's orders, critical_time is normally used.

Both attributes Service.time and Service.critical_time has the General Time Specification (GTS) data type. This data type has a literal expression that allows one to construct arbitrarily complex sets of time (points and intervals.) For something as simple as a start and end date/time, the expression would have the format of two time stamps and a hyphen between them for low and high bounds of a single interval of time. For example the time interval from September 27 1999 to October 1 1999 would be specified as "19990927-19991001".

3.1.3.5 End date/time component (TS)

When filled in by the requester of the service, this field should contain the latest date/time that the service should be performed. If it has not been performed by the specified time, it should not be performed at all. The requester may not always fill in this value, yet the filling service may fill it in on the basis of the instruction it receives and the actual start time. Regardless of the value of the end date/time, the service should be stopped at the earliest of the date/times specified by either the duration or the end date/time.

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3.1.3.6 Priority component (ST)

This field describes the urgency of the request

This field is mapped to the Service.priority_cd attribute. It is a coded value and not a free string. All the values of the v2.3 table have been retained as is, so mapping is straight forward. The only exception is that the *timing critical* code "T" must not be followed by the time range.

If using the value "T" (timing critical), the degree of criticality can be specified [… as]

Timing criticality is specified through probability distributions around the start times. The following table shows how this is done in the general time specification.

Table 4: Mapping of timing critical range to the general time specification

HL7 v2.3.1 priority – timing critical range		Mapping to v3 General Time Specification	
Code	**Meaning**	**Code**	**Note**
TS<integer>	within <integer> seconds	S/30(1)	Every 30 seconds with timing critical to ±2 seconds.
TM<integer>	within <integer> minutes	N/60(2.5)	Every 60 minutes with timing critical to ±5 minutes.
TH<integer>	within <integer> hours	H/6(0.25)	Every 6 hours with timing critical to ±30 minutes.
TD<integer>	within <integer> days	CD/10(0.5)	Every 10 days with timing critical to ±1 day. Note that this timing criticality requires continuous days (CD) – not day of the month (D) – to be selected as the period.
TW<integer>	within <integer> weeks	W/4(0.14)	Every 4 weeks with timing critical to ±1 day (1/7 week).
TL<integer>	within <integer> months	CM/18(1)	Every 24 months with timing critical to ±2 months. Note that this timing criticality requires continuous months (CM) – not month of the year (M) – to be selected as the period.

For the sequential orders specification, these values specify the time criticality with which the predecessor order must be followed by the given order. The priority component may repeat; separate repeating values with the repeat delimiter separated by a space.

The Service_relationship.pause_qty is used to specify the minimal pause between the end of the previous service and the beginning of the service at the target end of that Service_relationship. Just as the repetition period, this pause quantity is a stochastic parameter, i.e., it is up to the filler's reasonable judgement to be more or less timely. If the pause_qty must be specified more exactly one can send it as a probability distribution seting a small standard deviation to request greater timeliness.

3.1.3.7 Condition component (ST)

This is a free text field that describes the conditions under which the drug is to be given. For example, ***PRN pain****, or* ***to keep blood pressure below 110****. The presence of text in this field should be taken to mean that human review is needed to determine the how and/or when this drug should be given.*

Conditions are communicated using associated observations in criterion mood or trigger mood (PRN) or in goal mood (blood pressure < 110 mm[Hg]) The condition value is communicated in the Observation.value. With numeric observations, the predicate to test for is often not an equality but some inequality such as "< 100 mm[Hg]" or "> 90 mm[Hg]".

In HL7 v3 such inequalities are represented as intervals. When the observation value is specified as an interval the test is whether the actual value is an element of the specified interval. Thus "< 100" can be represented as the interval [0;100[(low boundary = 0, closed; high boundary = 100, open).

In this example, it seems as if the HL7 v3 interval form contains more information than the simple "< 100", i.e., the low boundary. It even seems as if the interval form contains an inappropriate implication, as if a blood pressure value down at 25 mmHg would be acceptable. However, this misunderstanding is possible with just "< 100" as well, since 25 < 100 is true. Thus, the interval form has not introduced any inappropriate implications that did not exist before. Conversely it shows that the requirement should be states more precisely (e.g., [90;110]) unless the ordering person trusts the filler to apply reasonable judgement as to the minimum blood pressure.

In order to avoid all misunderstandings, an interface engine translating between HL7 v2.x and HL7 v3 can set the lower boundary to the null value.

3.1.3.8 Text component (TX)

This field is a full text version of the instruction (optional).

Any instruction text is mapped to the Service.descr field of the order.

3.1.3.9 Conjunction component (ST)

This non-null component indicates that a second timing specification is to follow using the repeat delimiter. This field can take three values:

a) S = Synchronous

Do the next specification after this one (unless otherwise constrained by the following components: ORC-7^4-start date/time and ORC-7^5-end date/time).

An "S" specification implies that the second timing sequence follows the first, e.g., when an order is written to measure blood pressure Q15 minutes for the 1st hour, then every 2 hours for the next day.

b) A = Asynchronous

Do the next specification in parallel with this one (unless otherwise constrained by the following components: ORC-7^4-start date/time and ORC-7^5-end date/time). The conjunction of "A" specifies two parallel instructions, as are sometimes used in medication, e.g., prednisone given at 1 tab on Monday, Wednesday, Friday, and at 1/2 tab on Tuesday, Thursday, Saturday, Sunday.

c) C = This is an actuation time

It will be followed by a completion time for the service. This code allows one to distinguish between the time and priority at which a service should be actuated (e.g., blood should be drawn) and the time and priority at which a service should be completed (e.g., results should be reported).

HL7 v2.3 supports parallel and sequential service plans. What the HL7 v2.3 specification calls "synchronous" is in fact a sequential following of two services, which is indicated by connecting the two services to a super-service with the Service_relationship.sequence_nmb indicating which service comes first and which one follows. Note that in a sequential plan construct it makes very few sense to set a start and end time for each service individually, although it can be done. However, a service that comes later in a sequence risks not being performed at all if its absolute timing is over before the sequence is up to that service.

Parallel service plans (which HL7 v2.3 calls "asynchronous") can be constructed by setting the sequence numbers of one or more service_relationships to the same value. In such concurrent constructs, further control is given over the dynamic relationships between the services using the Service_relationship.split_cd and join_cd. Please refer to Section **Error! Reference source not found.** for a description of the v3 service plan capabilities.

What the v2.3 standard means by "actuation time" can be controlled in HL7 v3 by giving the specimen drawing service a different priority than the lab observation service itself. This can be done, although it is probably quite a rare requirement.

For continuous or periodic services, the point at which the service is actually stopped is determined by the components ORC-7^5-end date/time and ORC-7^3-duration, whichever indicates an earlier stopping time. Ordinarily, only one of these components would be present, but if one requested an EKG with the specification

```
^1^QAM^X3^D10
```

then the EKG would be done for only three days since the number of repeats (3) defined the earlier stopping time.

HL7 v2.3 repeating services are controlled by three principle means: (1) timing (Service.time, Service.critical_time,) (2) counting (Service.max_repetition_nmb,) and (3) conditions (related through Service_relationships.) A service must have clearance from all three kinds of constraints to execute. So the rules of "whichever comes first" are quite similar between HL7 v2.3 and HL7 v3.

3.1.3.10 Order sequencing component (CM)

There are many situations, such as the creation of an order for a group of intravenous (IV) solutions, where the sequence of the individual intravenous solutions (each a service in itself) needs to be specified, e.g., hyperalimentation with multi-vitamins in every third bottle.

There are other situations where part of the order's instructions contains a results condition of some type, such as "PRN pain." There is currently a free text "condition" component of ORC-7-quantity/timing which allows any condition to be specified. However, to support a fully encoded version of order sequencing, or results condition, we have defined in the following paragraphs a 10th component of ORC-7-quantity/timing.

The sequencing conditions supported by this 10th component are based on the completion of a predecessor service.

This 10th component of the TQ does many things. But it mainly compensates for the quite unclear relationship between services. It gives additional parameters of sequencing and it provides the notion of "cyclic order groups". All this can be done in HL7 v3, although one would need to more thorroughly look at this on a case by case basis, since the use of this functionality is not very main-stream in HL7 v2.3 and so, an automatic symbolic translation between v2.3 and v3 risks to be inadequate.

In general, cyclic groups are specified by a repeating service that contains a sequence of sub-services. The repetition causes the sub-services to be executed in a cyclic sequence.

In HL7 v2.3 we considered to define an attribute that specifies for the pause_qty whether it measures the pause between services between start-start, end-end, start-end, or end-start, however, the use of this seems fairly limited. In general, the pause_qty measures end to start (which may be different if waiting conditions are associated with the second service.) Start to start timing can be done easily in the Service.time general time specification (and could be done in TQ using components 1 to 9.) End to end and start to end as such pose requirements that are almost impossible to meet. If one knows the service duration, one can specify start to start or end to start timing, if not, the question is what the filler should do to comply with the requirement?

However, with parallel service plan sections and appropriate settings for split and join codes, one can define plans in which a supporting service is to end at the same time at which a main service ends. This would allows one to describe the end of an anesthesia with the last suture of the surgery, if need be. Since these are rather constructed use cases, we do not describe a mapping strategy in more detail. Please refer to Section **Error! Reference source not found.** for a description of the v3 service plan capabilities.

However, we will pick up the more useful examples of HL7 v2.3 later to show how the same function is achieved with HL7 v3.

3.1.3.10.1 Subcomponents of sequences

3.1.3.10.2 Inheritance of order status

Cancellation/discontinuation/hold order control events:

This logic implies the normal execution of the referenced predecessor order. Thus a cancel (or discontinuation or hold) of a predecessor order implies the cancellation (or discontinuation or hold) of all subsequent orders in the chain.

If the referenced order has been canceled (or discontinued or held), the current order inherits that same status.

In the case of hold, the removal of the hold of the predecessor implies a removal of the hold for the given order (which can then be executed according to the specification in the 10th component).

In HL7 v3 sequential services are grouped underneath a super-service, not chained, as in version 2.3. However, the "inheritance" of status and transitions is similar. Notably an interruption of a super-service will interrupt it's sub-services. However, any (sub-)service can specify that it is not interruptible, which is necessary to prevent critical plan regions to be interrupted causing a dangerous situation.

Although the new HL7 v3 plan construction features go quite a long way in specifying almost fully automated processing logic, as is typical in the manufacturing sector, most healthcare services are preformed with numerous human intelligence that is not asked to simply comply to automated instructions if this compliance would cause a dangerous situation. Thus, in constructing health care plans, there is normally much less scrutiny required to the issues of timing.

3.1.3.11 Occurrence duration component (CE)

This field contains the duration for a single performance of a service, e.g., whirlpool twenty minutes three times per day for three days. It is optional within TQ and does not repeat.

The use of this component is not at all clearly defined, so it can not be mapped without further investigation how it is used at each site. It appears, however, that it does not cover any functionality that would not be covered by means described above. Especially it seems unclear why a quantitative concept as "duration" could possibly be described using a Coded Element?

3.1.3.12 Total occurrences component (NM)

This field contains the total number of occurrences of a service that should result from this order. It is optional within TQ and does not repeat. If both the end date/time and the total occurrences are valued and the occurrences would extend beyond the end date/time, then the end date/time takes precedence. Otherwise the number of occurrences takes precedence.

Not clear if this adds anything that is not already covered. See the "duration component" above, especially of the form "X<integer>".

3.1.3.13 Examples of quantity/timing usage

Perform the service twice at bedtime, e.g., give a unit of blood at bedtime on two sequential nights.

(Service :mood_cd ORD
:critical_time "HS"
:max_repetition_nmb 2)

Do a service continuously for 3 days.

(Service :mood_cd ORD
:critical_time "[3 d]"
:max_repetition_nmb *null*)

Note: whether the service can be done "continuously" or whether it must repeat over the 3 day period depends entirely upon the nature of the service.

Perform an EKG every hour up to a maximum of 4 EKGs, if patient is having more than 10 PVCs per minute.

```
(Observation :mood_cd ORD
        :type_cd EKG
        :critical_time "H/1"
        :max_repetition_nmb 4
        :is_source_of  (Service_relationship :type_cd PRCN
                :has_target  (Observation :mood_cd (EVN CRT)
                        :type_cd PVC:FREQ
                        :value (PQ :value (IVL :low 10) :unit /min))))
```

Perform a service every Tuesday at 2:32 p.m.

```
(Service :mood_cd ORD
        :critical_time "J2 H1432")
```

Perform a test before 11/21/89 0800, e.g., some preop laboratory tests.

```
(Service :mood_cd ORD
        :time "19891120"
        :priority A)
```

Note that with preoperative values one would not usually use a deadline timing (before 8 o'clock) but one would just order the services the day before, or, if the value is missing on the day of the operation, one would use an ASAP or STAT order. There are few labs who would understand a deadline order. If, however, one wishes to express the fact that the test is a precondition for the procedure, one could describe this in detail as follows:

```
(Service :mood_cd ORD
        :is_target_of (Service_relationship :type_cd PRCN
                :has_source (Procedure :mood_cd SCH
                        :time "198911200800")))
```

Perform a service every hour for 5 hours starting at 10:30 a.m. 11/5/89, e.g., draw a blood glucose.

```
(Service :mood_cd ORD
        :critical_time "19891105 H1030-1700 H/1"
        :max_repetition_nmb 5)
```

Note that if the requirement is 5 services one should use the max_repetition_nmb rather than trying to express the number 5 in terms of time. Therefore we have set no end time of the hourly repetition.

Perform a service every morning for 3 days and then do it every other morning for 4 days (i.e., max twice) if the serum potassium is greater than 5.5.

```
(Service :mood_cd ORD
        :is_source_of (Service_relationship :type_cd PCMP
                :sequence_nmb 1
                :has_target (Service :mood_cd ORD
                        :critical_time "AM"
                        :max_repetition_nmb 3))
        :is_source_of (Service_relationship :type_cd PCMP
                :sequence_nmb 2
                :has_target (Service :mood_cd ORD
                        :critical_time "AM/2"
```



```
                    :max_repetition_nmb 2))
        :is_source_of (Service_relationship :type_cd PCND
                :checkpoint_cd T
                :has_target (Observation :mood_cd (EVN CND)
                                :type_cd POTASSIUM:SCNC:SER
                                :value (PQ :value (IVL :low 5.5) :unit mmol/L))))
```

The first repeat instructs to draw a blood specimen exactly at 8:00 a.m. on 12/12/1988. The second repeat specifies to report results routinely.

```
(Service :mood_cd ORD
        :has_target (Target :type_cd SPEC
                :has_target (Material :type_cd BLDV
                        :is_target (Target :type_cd PROD
                                :is_target (Procedure :mood_cd ORD
                                        :type_cd draw-venous-blood
                                        :critical_time "198812120800@"
                                        :priority_cd "T")))))
```

3.1.4 OBR – Filler Orders and Report Headers.

The Observation Request (OBR) segment is used to transmit information specific to an order for a diagnostic study or observation, physical exam, or assessment.

The Observation Request segment defines the attributes of a particular request for diagnostic services (e.g., laboratory, EKG) or clinical observations (e.g., vital signs or physical exam). When a placer requests a given set of observations, always include an order segment. For lab tests, the information in the order segment usually applies to a single specimen. However, there is not a one-to-one relationship between specimen and tests ordered. Different test batteries will usually require their own order segments even when they can be performed on a single specimen. In this case, the specimen information must be duplicated in each of the order segments that employ that specimen. For other diagnostic studies, e.g., chest X-ray, a separate order segment will usually be generated for each diagnostic study.

Though multiple observation batteries can be ordered on a single order segment, the observation filler shall generate a separate order segment for each battery that it processes independently, e.g., electrolyte, CBC, vital signs. When reporting the observations, the filling service shall copy the appropriate order (specimen) information from the original order segment into each of the new order segments so that a separate "order" segment is returned to the placer as a "header" for each separate battery of observations.

In the event that an ordered battery of observations cannot be performed, e.g., because of hemolysis on a blood sample, an order segment will be returned to the placer with OBR-25-result status equal to X (to indicate that the study was not performed). In this case, no observation segments will be transmitted.

When observations are successfully completed, the message returned to the placer will include the order segment (OBR) followed by observation (OBX) segments for each distinct observation generated by the order (see Chapter 7). The number of such observation segments will depend upon the number of individual measurements performed in the process.

OBX segments can be sent by the placer along with an order to provide the filling service with clinical data needed to interpret the results. (See Chapter 7 for OBX details.)

[…]

The daggered (+) items in this segment are known to the filler, not the placer. They are valued by the filler as needed when the OBR segment is returned as part of a report.

The starred (*) fields are only relevant when an observation is associated with a specimen. These are completed by the placer when the placer obtains the specimen. They are completed by the filler when the filler obtains the specimen.

OBR-7-observation date/time and OBR-8-observation end date/time (flagged with #) are the physiologically relevant times. In the case of an observation on a specimen, they represent the start and end of the specimen collector. In the case of an observation obtained directly from a subject (e.g., BP, Chest X-ray), they represent the start and end time of the observation.

The HL7 v2 segment OBR maps to the HL7 v3 class Observation, subclass of Service. The ORC segment, that may precede an OBR in HL7 v2 messages maps to the class Service. Indeed the pairing of ORC and order-detail segment (OBR) perfectly emulates the superclass-subclass relationship of object oriented modeling.

The fields in the OBR segment that refer to a specimen are mapped to the class Specimen in HL7 v3. This decomposition of the OBR into Service/Order and Specimen facilitates representation of multiple orders per specimen and more clearly distinguished the different life cycles of a Specimen and its associated orders.

The remaining fields of OBR that pertain genuinely to the ordered service had two different but related uses:

1) to represent the details of a diagnostic test order, and
2) to represent the “header” of an observation report.

This same overloading of slight variations of the same service (i.e. as ordered vs. as performed) is preserved in HL7 v3. However, in HL7 v3 the variations of meaning are made explicit in the Service.mood_cd attribute. Especially the service as ordered is always distinguished from the service as scheduled or performed. For example, a test order may be represented in one Observation service object of *order* (ORD) mood. This Observation order object is clearly attributed to the placer. The test report and all updates on the current test service status is communicated in a separate Observation service object of *actual event* (EVN) mood. This second observation object is attributed to the filler. The distinction between a so called “placer order” and “filler order” did exist in HL7 v2.x all along, though it was never absolutely clear what kind of order any particular OBR segment described. In HL7 v3 this difference is made clear through the mood code.

Note that HL7 v3 does not distinguish between HL7 v2’s OBR and OBX. The distinction between OBR and OBX has never been completely clean in HL7 v2 (alternative ways to construct complex results using child-OBRs with OBXs versus use of OBX sub ids) in HL7 v3 this distinction is removed completely.

3.1.4.1 Set ID - OBR (SI) 00237

Set Id is a presentation layer (encoding rule dependent) field that has no place in an application layer information model.

3.1.4.2 Placer order number (EI) 00216

This field is identical to *ORC-2-placer order number* (see Section 3.1.2.2).

3.1.4.3 Filler order number (EI) 00217

This field is identical to *ORC-3-filler order number*.

3.1.4.4 Universal service ID (CE) 00238

> *This field contains the identifier code for the requested observation/test/battery. This can be based on local and/or "universal" codes. We recommend the "universal" procedure identifier.*

The "universal service id" readily maps to the Service.type_cd. Note that the term "ID" (identifier) is ambiguous. In HL7 v3 we clearly distinguish between individually identified object instances and classes, types, kinds, of objects or concepts. The "universal service id" is a coded concept of a service, not an identifier for an individual service instance. In HL7 v3 an identifier is represented by the data type Instance Identifier (II,) whereas coded concepts are represented (in this case) by the type CD.

3.1.4.5 Priority-OBR (ID) 00239

> *This field has been retained for backward compatibility only. It is not used [...] but [...] is carried as the sixth component of OBR-27-quantity/timing.*

Mapped to Service.priority_cd.

3.1.4.6 Requested date/time (TS) 00240

> *This field has been retained for backward compatibility only. It is not used [...] This information is now carried in the fourth component of the OBR-27-quantity/timing.*

Mapped to Service.critical_time or Service.time.

3.1.4.7 Observation date/time (TS) 00241

> *This field is the clinically relevant date/time of the observation. In the case of observations taken directly from a subject, it is the actual date and time the observation was obtained. In the case of a specimen-associated study, this field shall represent the date and time the specimen was collected or obtained. (This is a results-only field except when the placer or a third party has already drawn the specimen.) This field is conditionally required. When the OBR is transmitted as part of a report message, the field **must** be filled in. If it is transmitted as part of a request **and** a sample has been sent along as part of the request, this field must be filled in because this specimen time is the physiologically relevant date/time of the observation.*

For reports this field readily maps to Observation.critical_time. In an observation report, the critical time is usually a simple time stamp.

For orders the value Observation.critical_time is not used, because the time the specimen was collected is found in Specimen:Material.extent_tmr.low.

3.1.4.8 Observation end date/time (TS) 00242

> *This field contains the end date and time of a study or timed specimen collection. If an observation takes place over a substantial period of time, it will indicate when the observation period ended. For observations made at a point in time, it will be null. This is a results field except when the placer or a party other than the filler has already drawn the specimen.*

The end date/time of the observation action may be found in Service.time.

A clinically relevant end time of the biological condition represented by the observation is hard to determine, which is why any time range reported in Observation.critical_time does not tell anything about the physiological state observed (e.g., when a certain blood pH value changed in the body,) but is only about the observation activity.

The value Specimen:Material.extent_tmr.high is not the time that the specimen collection ended, but the time the specimen was finally discarded. In pathology specimen are often kept deep frozen for an indefinite amount of time, in which case the Specimen:Material.extent_tmr has no high boundary.

The end time of a specimen collection activity is carried in the Service.time value (usually a time interval begin-end) of the Service instance representing the specimen collection activity.

The rationale for this distribution over various HL7 v3 classes/objects/attributes is simple: a specimen collection is modeled as an activity separate from the observation action. The specimen itself is a material with a different life-cycle than any single observation action that uses the specimen. Finally the HL7 v3 Observation class does distinguish between the observation action and the physiological state it observes. A definitive begin and end time of a physiological state is rarely known and often not reasonable to state. Therefore, the Observation.critical_time is only a rough approximation.

3.1.4.9 Collection volume (CQ) 00243

For laboratory tests, the collection volume is the volume of a specimen. The default unit is 1 mL. […] This is a results-only field except when the placer or a party has already drawn the specimen.

Maps to Specimen.volume_qty : PQ, which is a quantity with unit of volume, i.e. convertible to 1 L, 1 mL, 1 m^3, etc.

3.1.4.10 Collector identifier (XCN) 00244

When a specimen is required for the study, this field will identify the person, department, or facility that collected the specimen. Either name or ID code, or both, may be present.

A person collecting a specimen is an active participant in the specimen collection service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

In case a system does not send any other information about a specimen collection service, the "specimen collector" is a distinct participant type for the Actor.type_cd attribute. That way, the specimen collector can be associated with the observation service rather than the specimen collection service. A "specimen collector" Actor is only permitted for an observation action, not for a specimen collection action. For a proper specimen collection action, the Actor.type_cd is the simple "performing actor."

3.1.4.11 Specimen action code (ID) 00245

This field identifies the action to be taken with respect to the specimens that accompany or precede this order. The purpose of this field is to further qualify (when appropriate) the general action indicated by the order control code contained in the accompanying ORC segment. For example, when a new order (ORC - "NW") is sent to the lab, this field would be used to tell the lab whether or not to collect the specimen ("L" or "O").

Table 0065 - Specimen action code

Value	Description
A	Add ordered tests to the existing specimen
G	Generated order; reflex order
L	Lab to obtain specimen from patient
O	Specimen obtained by service other than Lab
P	Pending specimen; Order sent prior to delivery
R	Revised order
S	Schedule the tests specified below

The specimen collection activity in HL7 version 3 is modeled as a separate Service action. Thus all the generic order/activity management features of HL7 v3 apply just as well for a specimen. This means, that whether the specimen is already collected or whether the specimen collection is ordered and to whom it is ordered is clearly specified by a separate specimen object and/or a specimen collection service order.

In general all HL7 v2 "action codes" or "control codes" are mapped to transitions or trigger-events ion HL7 v3. This action code, however, contains both action/transition and status codes. The HL7 v2 specimen action codes A, G, R, and S are mapped to specimen management or order management trigger events. Conversely, the codes L, O, and P are clearly representing states and can be inferred/mapped from and to the Material.status_cd (for Specimen.)

3.1.4.12 Danger code (CE) 00246

This field contains the code and/or text indicating any known or suspected patient or specimen hazards, e.g., patient with active tuberculosis or blood from a hepatitis patient.

Maps directly to Specimen.danger_cd : CD

3.1.4.13 Relevant clinical info (ST) 00247

This field contains the additional clinical information about the patient or specimen. This field is used to report the suspected diagnosis and clinical findings on requests for interpreted diagnostic studies. Examples include reporting the amount of inspired carbon dioxide [oxygen ?] for blood gasses, the point in the menstrual cycle for cervical pap tests, and other conditions that influence test interpretations. For some orders this information may be sent on a more structured form as a series of OBX segments (see Chapter 7) that immediately follow the order segment.

This field is not represented in HL7 v3 in order to reduce the amount of unintelligible free text information. In HL7 v3 relevant clinical observations should always be sent properly as Observation instances. All the examples mentioned in the HL7 v2 definition cited above can be readily represent in quantitative or coded form in an Observation instance.

If an old HL7 v2 interface that uses this field must be mapped to HL7 v3, the general annotation functionality (what was the NTE segment in HL7 v2) can be used as a last resort.

3.1.4.14 Specimen received date/time (TS) 00248

*For observations requiring a specimen, the specimen received date/time is the actual login time at the diagnostic service. This field must contain a value when the order is accompanied by a specimen, or when the observation required a specimen **and** the message is a report.*

The time the specimen is received in the lab one of those times associated with a particular life-cycle event. There is currently no attribute in the Specimen class to which this would be mapped. The rationale is that it is unreasonable to choose a few life cycle events to be time-stamped in special attributes while neglecting others. However, if this information is important, HL7 version 3 allows the specimen transport activity to be represented in a Transportation Service object. If a Transportation service action for the specimen to the lab exists, the high boundary of the Transportation.critical_time is the proper mapping for specimen received time.

3.1.4.15 Specimen source (CM) 00249

This field identifies the site where the specimen should be obtained or where the service should be performed.

The anatomical site where a service should be performed maps to the Service.body_site_cd : CD. If it is a direct patient observation, this is the body_site_cd of the observation Service instance. For a service requiring a specimen, and if the specimen collection is accounted for in a specimen collection Service, the HL7 v2 "specimen source" maps to that specimen collection Service's body_site_cd.

The first component contains the specimen source name or code [...]

The term specimen "source" is ambiguous. For example, "blood" is a kind of specimen, while a blood vessel would be it's source. In HL7 v3 the kind of specimen (e.g., blood, urine, lymphatic nodule) is mapped to the Specimen.type_cd : CD. The site where the specimen is taken from is specified in the Service.body_site_cd of the specimen collection service. Unless otherwise ruled, HL7 v3 will continue to use the HL7 v2.3.1 table for the Specimen.type_cd:

The second component should include free text additives to the specimen such as Heparin, EDTA, or Oxalate, when applicable.

Additives are represented as associated Material objects with Material_relationship.type_cd = *additive* (ADDV.) The additives are usually associated with the container before the container is filled with specimen. Thus, an empty EDTA blood container would be described as

(Material :type_cd *EDTA-Vacutainer*
:role (Container :capacity_qty "2 ml")
:is_source (Material_relationship :type_cd CONT
:qty "1 uL"
:has_target (Material type_cd *EDTA*)))

The container filled with blood can be described in multiple ways depending on what is the main object of interest. If the object of interest is still the container, the container would appear at the top level and EDTA and the blood would both be content of the container:

(Material :type_cd *EDTA-Vacutainer*
:role (Container :capacity_qty "2 ml")
:is_source (Material_relationship :type_cd CONT
:qty "1 uL"
:has_target (Material type_cd *EDTA*))
:is_source (Material_relationship :type_cd CONT
:qty "2 mL"
:has_target (Material type_cd BLDV)))

However, usually the specimen (blood) is the main object of interest, not the container. So, the blood can appear at the main material, with EDTA associated to the blood an additive and the mixture of blood and additive would be content of the container:

(Material :type_cd BLDV
:qty "2 mL"
:is_source (Material_relationship :type_cd ADDV
:qty "10 uL"
:has_target (Material type_cd *EDTA*))
:is_target (Material_relationship :type_cd CONT
:has_source (Material :type_cd *EDTA-Vacutainer*
:role (Container :capacity_qty "2 ml")))

The third is a free text component describing the method of collection when that information is a part of the order. When the method of collection is logically an observation result, it should be included as a result segment.

The method of a specimen collection is the attribute Service.method_cd : CD of the specimen collection service. It is hard to decide whether the method of some activity is "logically an observation result." In HL7 v2 many things have been sent as observation results, even though they were not really observations, only because the OBX had the flexible tag/value structure. In HL7 v3 methods are not considered observations but are an attribute of Service. If the method needs to be described in greater detail (such as in a surgical procedure) the Service can be decomposed into a sequence of sub-services, which allows a very granular, yet still well-formed description of the activity.

The fourth component specifies the body site from which the specimen was obtained, and the fifth is the site modifier. For example, the site could be antecubital fossa, and the site modifier "right." The components of the CE fields become subcomponents.

This is the Service.body_site_cd : CD of the specimen collection Service instance. Unless otherwise decided HL7 v3 will continue to use the following table of body sites from HL7 v2.3.2:

The fifth component indicates whether the specimen is frozen as part of the collection method. Suggested values are F (Frozen); R (Refrigerated). If the component is blank, the specimen is assumed to be at room temperature.

This data element is mapped to the Specimen.handling_cd.

3.1.4.16 Ordering provider (XCN) 00226

This is the same as ORC-12-ordering provider.

3.1.4.17 Order callback phone number (XTN) 00250

This field contains the telephone number for reporting a status or a result.

Instead of just a telephone number, in HL7 v3 one can link an entire record about a person or organization with telephone number(s) to a Service. This is done through the participation class Actor of type "reporting-contact." No special data element is needed.

3.1.4.18 Placer field 1 (ST) 00251

Text sent by the placer will be returned with the results.

Currently not mapped. An attribute Service.echo_back_txt was agreed to be defined for this purpose. In the sake of a clean and minimal specification, however, this is left pending again. If a receiver echoing-back a field of an unspecified meaning is an important functionality, one should consider to add such a mechanism to all HL7 messages in a general manner..

Actors can leave a note in the attribute Actor.note_txt, but there is no requirement for anyone to echo back this note.

3.1.4.19 Placer field 2 (ST) 00252

This field is similar to placer field #1.

Not mapped. Same rationale as above.

3.1.4.20 Filler field 1 (ST) 00253

This field is definable for any use by the filler (diagnostic service).

This HL7 v2 field has no defined semantics. It can thus not be mapped to any information model field. In addition it has no such functional use as being echoed back. The actual use of this field can be covered by a general annotation.

Actors can leave a note in the attribute Actor.note_txt, but there is no requirement for anyone to echo back this note.

3.1.4.21 Filler field 2 (ST) 00254

This field is similar to filler field #1.

This HL7 v2 field has no semantics and can thus not be mapped to any information model field. In addition it has no such functional use as being echoed back. The actual use of this field can be covered by a general annotation.

3.1.4.22 Results rpt/status chng - date/time (TS) 00255

This field specifies the date/time when the results were reported or status changed. This field is used to indicate the date and time that the results are composed into a report and released, or that a status, as defined in ORC-5 order status, is entered or changed. (This is a results field only.) When other applications (such as office or clinical database applications) query the laboratory application for untransmitted results, the information in this field may be used to control processing on the

communications link. Usually, the ordering service would want only those results for which the reporting date/time is greater than the date/time the inquiring application last received results.

This field is another one of a kind with poorly defined or ambiguous meaning. The last time a status has changed can generically be sent as a history list of the relevant status_cd using the history data type. This allows to tag the last status (an possibly prior status codes) with a time range (for the last status code the time range would be open at the high boundary.) However, it is not clear what the strong use case for such a functionality would be. The HL7 v2 standard cites "control processing on the communication link" as a possible use, however, such is a general control use case that is better handled in a Message Header field.

For a results query application being able to specify a time range for the query is of course an essential requirement, but this needs to be handled in a generic query specification for HL7 v3. If the existing classes are used to specify a query (query by example) the constraint on the time of results can be applied using the Service.time (the end of the observation service) that produced the result.

3.1.4.23 Charge to practice (CM) 00256

This field is the charge to the ordering entity for the studies performed when applicable. The first component is a dollar amount when known by the filler. The second is a charge code when known by the filler (results only).

The charge of a service is outside the direct scope of this clinical part of HL7 v3. The attribute Service.charge_qty : MO exists only as a placeholder to a revised administrative part of the HL7 v3 reference information model. Preferably the charge should be represented by a financial transaction object that would indicate all kinds of codes and account routing information in addition to the plain currency amount.

3.1.4.24 Diagnostic serv sect ID (ID) 00257

This field is the section of the diagnostic service where the observation was performed. If the study was performed by an outside service, the identification of that service should be recorded here.

Table 0074 - Diagnostic service section ID

Value	Description	Value	Description
AU	Audiology	OUS	OB Ultrasound
BG	Blood Gases	OT	Occupational Therapy
BLB	Blood Bank	OTH	Other
CUS	Cardiac Ultrasound	OSL	Outside Lab
CTH	Cardiac Catheterization	PHR	Pharmacy
CT	CAT Scan	PT	Physical Therapy
CH	Chemistry	PHY	Physician (Hx. Dx, admission note, etc.)
CP	Cytopathology	PF	Pulmonary Function
EC	Electrocardiac (e.g., EKG, EEC, Holter)	RAD	Radiology
EN	Electroneuro (EEG, EMG,EP,PSG)	RX	Radiograph
HM	Hematology	RUS	Radiology Ultrasound
ICU	Bedside ICU Monitoring	RC	Respiratory Care (therapy)
IMM	Immunology	RT	Radiation Therapy
LAB	Laboratory	SR	Serology

MB	Microbiology	SP	Surgical Pathology
MCB	Mycobacteriology	TX	Toxicology
MYC	Mycology	VUS	Vascular Ultrasound
NMS	Nuclear Medicine Scan	VR	Virology
NMR	Nuclear Magnetic Resonance	XRC	Cineradiograph
NRS	Nursing Service Measures		

The service section id is a field of multiple different uses. It is a remnant of the time in which HL7 was primarily designed for use within one hospital with various departments (also called service sections.)

A department, person, or outside organization that performs a service is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. The organization class contains a classifier code that can represent the kind of service section aside from the individual department id.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

The service section code has often also be used to roughly classify results so as to show only results from different subsets of the service sections to different users. However, any kind of classification of observations should be designed separate and is clearly part of the functionality of an application system. Classifications of observations may be part of the connotations that come with a coding system, or may be added on top of a coding system (e.g. SNOMED-RT.) Therefore the service section code is no longer a classifying attribute of the Observation (or Service activity.) If necessary, it can be found as a classifier of the performing organization.

3.1.4.25 Result status (ID) 00258

This field contains the status of results for this order [...]

Mapped to Service.status_cd. Note that the subtle differences that existed between ORC order-status, OBR result status, and OBX result status are no longer an issue in version since they all map to the same attribute Service.status_cd, but of different instances of class Service (placer order, filler service action and its sub-services down to individual observations.)

3.1.4.26 Parent result (CM) 00259

This field is defined to make it available for other types of linkages (e.g., toxicology). This important information, together with the information in OBR-29-parent, uniquely identifies the parent result's OBX segment related to this order. The value of this OBX segment in the parent result is the organism or chemical species about which this battery reports. For example, if the current battery is an antimicrobial susceptibility, the parent results identified OBX contains a result which identifies the organism on which the susceptibility was run. This indirect linkage is preferred because the name of the organism in the parent result may undergo several preliminary values prior to finalization.

The third component may be used to record the name of the microorganism identified by the parent result directly. The organism in this case should be identified exactly as it is in the parent culture.

We emphasize that this field does not take the entire result field from the parent. It is meant only for the text name of the organism or chemical subspecies identified. This field is included only to provide a method for linking back to the parent result for those systems that could not generate unambiguous Observation IDs and sub-IDs.

This field is present only when the parent result is identified by OBR-29-parent and the parent spawns child orders for each of many results. (See Chapter 7 for more details about this linkage.)

A second mode of conveying this information is to use a standard observation result segment (OBX). If more than one organism is present, OBX-4-observation sub-ID is used to distinguish them. In this case, the first OBX with subID N will contain a value identifying the Nth microorganism, and each additional OBX with subID N will contain susceptibility values for a given antimicrobial test on this organism.

All the complexity and subtleties that this field addressed in HL7 v2 is no longer an issue in HL7 v3, where the relationship between individual Service and Specimen records is explicitly modeled and unambiguously represented in the message. Refer to the section on Microbiology profiles for how Microbiology (and similarly Toxicology) results would be represented.

3.1.4.27 Quantity/timing (TQ) 00221

This field is the same as *ORC-7 quantity/timing* and described in Section 3.1.2.7 above.

3.1.4.28 Result copies to (XCN) 00260

This field identifies the people who are to receive copies of the results.

A person receiving reports about a service is (quite indirectly) an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. It may seem strange that a report recipient would be considered an *actor* in a service event where he merely receives a copy of the report. However, the fundamental rules of medical confidentiality require that patient information is disclosed only to entities that have a professional business in the care of the patient. In that sense these report recipients must be somehow active contributers in the care of the patient.

This information is increasingly important in presence of laws and regulations for confidentiality and privacy of health care information. In the version 3 model, all persons having responsibilities or any other business in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.4.29 Parent (CM) 00261

This field is identical to ORC-8-parent. [See Section 3.1.2.8 above.]

3.1.4.30 Transportation mode (ID) 00262

This field identifies how (or whether) to transport a patient, when applicable.

Transportation of patients or specimen (or other payload) is consistently specified using the Transportation Service class. The Transportation.type_cd attribute will specify the mode of transportation. For Transportation.type_cd we use a code that is backward compatible with HL7 v2.3.1.

3.1.4.31 Reason for study (CE) 00263

This field is the code or text using the conventions for coded fields given in the Control/Query Chapter (Chapter 2). This is required for some studies to obtain proper reimbursement.

A reason for a Service can be specified as a prior Service linked to the new Service through a relationship object of type "reason." Usually the reason of a service may be a specific condition (diagnosis or condition thread) but may also be any other service, such as a procedure. Allowable reasons can be specified using Service event structures that represent guidelines and care protocols. See the examples in a section below.

3.1.4.32 Principal result interpreter (CM) 00264

This field identifies the physician or other clinician who interpreted the observation and is responsible for the report content.

A person interpreting results is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. For diagnostic studies, the principle result interpreter is of Actor.type_cd *performer.*

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.4.33 Assistant result interpreter (CM) 00265

This field identifies the clinical observer who assisted with the interpretation of this study.

A person assisting in the interpretation of results is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. For diagnostic studies, the assistant result interpreter is of Actor.type_cd *assistant.*

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.4.34 Technician (CM) 00266

This field identifies the performing technician.

A person performing technical actions in an service is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows to represent the audit trail more completely using the Actor.tmr (time range) attribute.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the

service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.4.35 Transcriptionist (CM) 00267

This field identifies the report transcriber.

A person transcribing a report in an service is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.4.36 Scheduled date/time (TS) 00268

This field is the date/time the filler scheduled an observation, when applicable (e.g., action code in OBR-11-specimen action code = "S"). This is a result of a request to schedule a particular test and provides a way to inform the placer of the date/time a study is scheduled (result only).

HL7 v3 clearly distinguishes between (placer-) order and (filler-) service. The date and time for whch a service is scheduled to happen is represented in the Service.time of the filler service.

3.1.4.37 Number of sample containers (NM) 01028

This field identifies the number of containers for a given sample. For sample receipt verification purposes; may be different from the total number of samples which accompany the order.

The number of sample containers is usually a derived value in HL7 v3 and can be found by counting the associated specimen (containers) of a Service. Given the detailed information about each specimen container such a derived attribute seems of limited additional value and is thus not mapped to an explicit attribute in HL7 v3. However, if the meaning is to count the number of containers of the same kind, this can be represented by the Material.qty attribute of the Specimen or Container material used or produced in the service.

3.1.4.38 Transport logistics of collected sample (CE) 01029

This field is the means by which a sample reaches the diagnostic service provider. This information is to aid the lab in scheduling or interpretation of results. Possible answers: routine transport van, public postal service, etc. If coded, requires a user-defined table.

Transportation of specimen (or other payload) is consistently specified using the Transportation Service class. The attribute Transportation.type_cd inherited from the Service class will convey the mode of transportation.

This field duplicates the field *OBR-30 transportation mode* and is used here to suggest additional values to the table of Transportation.method_cd values. See 3.1.4.30 above.

3.1.4.39 Collector's comment (CE) 01030

This field is for reporting additional comments related to the sample. If coded, requires a user-defined table. […] e.g., "difficult clotting after venipuncture and echymosis."

Maps to specimen collection Service.descr, or, if no explicit specimen collection service is used, the collector's comments can appear in the Actor.notes_txt field of the collector.

3.1.4.40 Transport arrangement responsibility (CE) 01031

This field is an indicator of who is responsible for arranging transport to the planned diagnostic service. Examples: Requester, Provider, Patient. If coded, requires a user-defined table.

Transportation in HL7 v3 is factored into a separate Transportation Service class. That way it can be managed, ordered, scheduled and billed like any other service. This code is not mapped literally to any HL7 v3 codes, but must be mapped semantically correct to the transportation Service.status_cd.

3.1.4.41 Transport arranged (ID) 01032

This field is an indicator of whether transport arrangements are known to have been made.

Transportation in HL7 v3 is factored into a separate Transportation Service class. That way it can be managed, ordered, scheduled and billed like any other service. This code is not mapped literally to any HL7 v3 codes, but must be mapped semantically correct to the transportation Service.status_cd.

3.1.4.42 Escort required (ID) 01033

This field is an indicator that the patient needs to be escorted to the diagnostic service department. Note: The nature of the escort requirements should be stated in OBR-43-planned patient transport comment.

Transportation in HL7 v3 is factored into a separate Transportation Service class. That way it can be managed, ordered, scheduled and billed like any other service. This includes the ability to specify additional Actor participants for the transportation service, such as an escort.

The requirement of an escort in a transport order can be specified as an Actor participation with a no-information value in place of the association to a person. See below.

3.1.4.43 Planned patient transport comment (CE) 01034

This field is the code or free text comments on special requirements for the transport of the patient to the diagnostic service department.

Transportation in HL7 v3 is factored into a separate Transportation Service class. That way it can be managed, ordered, scheduled and billed like any other service. Any free text comments are associated with Services as either the Service.descr attribute or a general annotation. This field has been used to describe the nature of escort requirements.

In HL7 v3 such requirements can be specified in an interoperable manner through RIM class instance patterns. For example, if a registered nurse is required to escort a patient transport (e.g., from the post operative watch to the floor) this requirement could be stated by an Individual_health_care_practitioner

record or type R.N. as associated with an active participation of type “escort”. That way, not a specific individual has been selected but any individual that matches the given constraints.

3.1.4.44 Procedure code (CE) 00393

This field contains a unique identifier assigned to the procedure, if any, associated with the Universal Service ID reported in field 4. User-defined table 0088 - Procedure code is used as the HL7 identifier for the user-defined table of values for this field. This field is a CE data type for compatibility with clinical and ancillary systems. This field will contain the HCPCS code associated with the order.

This and the following field have been added on an ad-hoc basis into HL7 version 2.3.1 with the understanding that it is a somewhat misplaced representation of procedure codes in OBR segments. In HL7 v3 these procedure codes are consistently represented as Service.type_cd : CD attribute values.

3.1.4.45 Procedure code modifier (CE) 01316

This field contains the procedure code modifier to the procedure code reported in field 44, when applicable. Procedure code modifiers are defined by regulatory agencies such as HCFA and the AMA. Multiple modifiers may be reported. Refer to user-defined table 0340 - Procedure code modifier for suggested values.

This field have been added on an ad-hoc basis into HL7 version 2.3.1 with the understanding that it is a somewhat misplaced representation of procedure codes in OBR segments. In HL7 v3 these procedure codes are consistently represented as Service.type_cd : CD attribute values. The Concept Descriptor data type (CD) is suited to convey codes with modifiers and an infinite number of translations, so that several local codes, several medical codes (e.g. SNOMED or ICD-10 PCS) and several billing specific codes can be sent all in the same attribute.

3.1.5 OBX – Clinical Observations

3.1.5.1 Set ID - OBX (SI) 00569

Set Id is a presentation layer (encoding rule dependent) field that has no place in an application layer information model.

3.1.5.2 Value type (ID) 00570

This field contains the format of the observation value in OBX. It must be valued if OBX-11-Observ result status is not valued with an ‘X”. If the value is CE then the result must be a coded entry. When the value type is TX or FT then the results are bulk text. […] The observation value must be represented according to the format for the data type defined in Chapter 2, Section 2.8, “Data Types.” For example, a PN consists of 6 components, separated by component delimiters. Although NM is a valid type, observations which are usually reported as numbers will sometimes have the string (ST) data type because non-numeric characters are often reported as part of the result, e.g., >300 to indicate the result was off-scale for the instrument. In the example, ">300", ">" is a symbol and the digits are considered a numeric value. However, this usage of the ST type should be discouraged since the SN (structured numeric) data type now accommodates such reporting and, in addition, permits the receiving system to interpret the magnitude. […] All HL7 data types are valid, and are included in Table 0125 except CM, CQ, SI, and ID. For a CM definition to have meaning, the specifics about the CM must be included in the field definition. OBX-5-observation value is a general field definition that is influenced by the data type OBX-3, so CMs are undefined in this context. CQ is invalid because units for OBX-5-observation value are always specified explicitly in an OBX segment with OBX-6 units. SI is invalid because it only applied to HL7 message segments, and ID because it requires a constant field definition.

This field is a presentation layer field, not part of the application layer information. In an Implementation Technology that does not send explicit type information anyway, the "ANY" data type used in the value field will have to explicitly carry the type information. None of the above-mentioned special considerations with respect to data types are necessary for HL7 v3. Note that the use of "comparator" symbols as discussed for the HL7 v2 SN data type is covered by the v3 generic type Interval. Typical data types for quantitative observations are Physical Quantity (PQ) and Interval of Physical Quantity (IVL⟨PQ⟩). Titers are reported using the Ratio (RTO) data type.

3.1.5.3 Observation identifier (CE) 00571

> *This field contains a unique identifier for the observation […] In most systems the identifier will **point** to a master observation table that will provide other attributes of the observation that may be used by the receiving system to process the observations it receives. A set of message segments for transmitting such master observation tables is described in Chapter 8 […] When local codes are used as the first identifier in this field we strongly encourage sending a universal identifier as well to permit receivers to equivalence results from different providers of the same service (e.g., a hospital lab and commercial lab that provides serum potassium to a nursing home). One possible **universal** identifier is LOINC codes for laboratory and clinical measurements.*

The "observation identifier" readily maps to the Service.type_cd. Note that the term "ID" (identifier) is ambiguous. In HL7 v3 we clearly distinguish between individually identified object instances and classes, types, kinds, or concepts. The "universal service id" is a coded concept of a service, not an identifier for an individual service instance. In HL7 v3 an identifier is represented by the data type Instance Identifier (II,) whereas coded concepts are represented (in this case) by the type CD. The observation identifier maps to the Service.type_cd : CD.

Note: there is no fundamental difference between a OBR "universal service id" and an OBX "observation identifier." In practice systems have used the same code system for both fields (e.g. LOINC codes.) One of the essential parts of the HL7 v3 model is to identify the observation result identifier with the observation service/procedure identifier.

3.1.5.3.1 Observation ID Suffixes

Observation ID suffixes are closely related to Service moods and relationship types. The following subsections define each of the suffices except for the specialized waveform suffices.*Diagnostic impression (IMP)*

A diagnostic impression is an observation based on other observation. The term "impression" implies some subjectivity and uncertainty. We have to realize, though, that all measurement actions and all conclusions are to some extent "flawed" with uncertainty and subjectivity. So, a diagnostic impression may be differ gradually from a measurement observation, but is essentially the same as any other observation.

3.1.5.3.1.2 Recommendation (REC)

> *[…] representing the reading physician's recommendations about repeat testing, follow up or therapy. For example, when an ambiguous lesion result is seen on a mammogram, the reading physician might recommend a repeat mammogram in six months, or a needle biopsy immediately.*

Whereas in HL7 v2 the recommended procedures were sent as coded observation values, in HL7 v3 recommended tests or treatments are represented through associated Observation, Procedure, or Medication objects.

3.1.5.3.1.3 Confirming procedures (CNP)

> *The confirming procedure [...] suffix identifies additional studies used to confirm the [diagnostic impression. ...] Confirming procedures are most important in surgical pathology reports. But they might also be used by services such as endoscopy, to record the fact that a biopsy, culture, etc., was taken during the procedure.*

Whereas in HL7 v2, the confirming procedure code was sent as an observation result value, in HL7 v3 confirming procedures are sent as associated Observation objects.

3.1.5.3.1.4 Procedure medication (MED)

> *[For] information about medication given as part of the procedure -- contrast medication, medication intended to invoke a physiologic response (e.g., to be used in stress testing) or premedication..[...] may also be used to define a medication administered during recording of digital waveform data or other extended diagnostic procedure, e.g., exercise test.*

Whereas in HL7 v2 the medication codes were sent as *OBX-3-observation identifier*, and either textual name or the dosages (!) was sent in the *OBX-5-observation value*, in HL7 v3 the procedure medication is reported as associated Medication objects.

3.1.5.3.1.5 Anatomic site (ANT)

> *Some diagnostic studies include observations about more than one anatomic site within one report. If, for example, a patient had an appendectomy incidental to gallbladder surgery, the pathologist's assessment of both specimens would usually be included under a single specimen number in one report.*

Whereas in HL7 v2 a code for the anatomic site was sent as an observation value, in HL7 version 3 the attribute Service.body_site_cd is available for every observation. The Service.body_site_cd is of type Concept Descriptor (CD) which allows code "modifiers", multiaxial codes, as well as complex code expression to be used to identify an anatomic site. Association of multiple Services to the same site are indicated by the same code for the site for each service. Subordinate services will by default assume the body site code of their parent.

3.1.5.3.1.6 Device/Instrument (DEV)

3.1.5.3.1.7 Serial # Device/Instrument (SER)

> *Examples include: an automated instrument in the laboratory; an imaging device and model number in radiology; or an automatic blood pressure machine on the ward.*

Whereas in HL7 v2 the device was specified as the value of an associated observation, in HL7 v3, this information can be sent as an associated Material target of Target.type_cd = device.

If the kind of device really specifies a method (e.g. automatic blood pressure machine,) one can alternatively use the attribute Service.method_cd, or a Service.type_cd that pre-coordinates the method into the service code.

3.1.5.3.1.8 Gross or general description (GDT)

3.1.5.3.1.9 Microscopic or Secondary description (MDT)

These suffixes were used exclusively for narrative reports and are thus covered elsewhere.

3.1.5.3.1.10 Technician's comment (TCM)

Any actor associated with a Service can leave a comment in the attribute Actor.note_txt. There is no need to send a comment as an observation.

3.1.5.3.1.11 Addendum note (ADT)

Addenda of textual reports are covered elsewhere (Medical records TC and PRA.) Revisions and addenda of structured information are represented by service relationships that link the addendum to the original. The service relationship type is from the "revision" category.

3.1.5.3.1.12 Diagnosis (problem) onset date/time (ITM)

3.1.5.3.1.13 Diagnosis (problem) resolution date/time (RTM)

Used to record the date-time that a problem was first perceived to exist (respectively cured or remitted.) This same feature has been covered by the Patient Care TC in chapter 12 and is described further below.

3.1.5.3.1.14 Comparison study (CMS)

3.1.5.3.1.15 Comparison date/time (CMT)

3.1.5.3.1.16 Comparison results (CMR)

3.1.5.3.1.17 Comparison change (CMC)

Comparison studies are attached to the main study as separate Observation objects.

Changes can be calculated as differences (new value – old value,) as ratio (new value / old value,) as rates ($\Delta x_t/\Delta t$) and possibly other values. These are all different kinds of calculated observations and need to be precisely defined in order to be shared meaningfully. Since the change value can be recalculated given the old and new values using the receiver's preferred method, there is no strong need to send this information in a message.

3.1.5.3.1.18 Predicted Value (PRD)

When an observation has a predicted value as is the case for many spirometry tests, this suffix identifies the predicted observation as distinguished from the actual observation.

Prediction, vs. observation of a fact is an important distinction that can be made in the mood code.

3.1.5.3.1.19 Percent predicted (PPR)

This is a computed observation `= (actual observation)/(predicted observation.` For forced vital capacity the percent predicted would be identified as 94010.1&PPR.

This is a specific kinds of calculated observations and need to be precisely defined in order to be shared meaningfully. Since this ratio can be recalculated given the actual and predicted values, there is no strong need to send this information in a message.

3.1.5.3.1.20 After drug observed (AFD)

An observation might be taken before and after a drug is given. This occurs especially in Spirometry. The predose observation is identified by the base ID. The post drug measure is identified by the AFD suffix. Using the AS4 base code for the forced vital capacity the post drug result would be identified by 94010.1&AFD.

The relationship of observations to challenges and other procedure medications are represented as observations associated with Services in the sense of preconditions and outcomes. For example, the baseline observation, the challenge medication, and the post challenge observation(s) would be represented as a sequence of sub-services all part of a common super-service.

3.1.5.3.1.21 Predicted value after drug (ADP)

3.1.5.3.1.22 Percent predicted after drug (APP)

This is the Cartesian product several of the above mentioned suffixes and are represented accordingly.

3.1.5.3.1.23 Timing Information (TIM)

3.1.5.3.1.24 Channel Definition Data (CHN)

3.1.5.3.1.25 Waveform Digital Data (WAS)

3.1.5.3.1.26 Waveform Annotation (ANO)

These suffix are used only for transmitting waveform data as described further below.

3.1.5.4 Observation sub-ID (ST) 00572

This field is used to distinguish between multiple OBX segments with the same observation ID organized under one OBR. For example, a chest X-ray report might include three separate diagnostic impressions. The standard requires three OBX segments, one for each impression. By putting a 1 in the Sub-ID of the first of these OBX segments, 2 in the second, and 3 in the third, we can uniquely identify each OBX segment for editing or replacement.

The sub-identifier is also used to group related components in reports such as surgical pathology. It is traditional for surgical pathology reports to include all the tissues taken from one surgical procedure in one report […] for example, a single surgical pathology report that describes the examination of gallbladder and appendix tissue[…]

The observation sub ID has other grouping uses. It can be used to organize the reporting of some kinds of fluid intakes and outputs. For example, when intake occurs through multiple intravenous lines, a number of separate observations (OBX segments), the intake volume, the type of intake (Blood, D5W, Plasma, etc.), the site of the IV line, etc. may be needed for each intravenous line, each requiring a separate OBX segment. If more than one IV line is running, we can logically link all of the OBX segments that pertain to the first IV line by assigning them an observation sub ID of 1. We can do the

same with the second IV line by assigning them a sub ID 2 and so on. The same would apply to the outputs of surgical drains when there are multiple such drains.

The use of the sub ID to distinguish repeating OBXs for the same observation ID is really a special case of using the sub ID to group, […which] is equivalent to defining a table, and the use of sub IDs to distinguish repeats is just a special case, represented by one column in this table. However, this approach introduces ambiguities if we have a set of repeating observations within a group, e.g., if the appendix observations include two impressions as in the 8th and 9th OBXs. This really represents the existence of a row nested within a single cell of the table given above.

The text under OBX-5-observation value provides guidance about dealing with two OBXs with the same observation ID and observation sub IDs. They are sent and replaced as a unit. However, some systems will take this to mean that the set of OBXs is to be combined into one composite observation in the receiving system. We suggest the use of a dot and a string (similar to the Dewey Decimal system) [i.e. OBX sub ids of the form "1.2"] when users wish to distinguish each of the repeats within one type, or results within a cell for editing and correction purposes. […] If there are cases where such nesting occurs at even deeper levels, this approach could be extended.

If the observation includes a number of OBXs with the same value for the observation ID OBX-3, then one must use different values for the sub-ID. This is in fact the case of the repeats depicted in Figure 7-8, but without any need to group sets of OBXs. Three such OBXs could be distinguished by using sub-IDs 1,2,e; alternatively, sub-IDs 1.1, 1.2, 1.3 could be used […]

The use of the OBX sub id is entirely to compensate for missing explicit techniques to represent associations and groupings in the HL7 v2 message syntax. In HL7 v3 observations can be explicitly related to observation targets (e.g. Patient or Specimen) or related to other services (using the Service-relationship class with or without the class Condition-node.) Thus there is no direct mapping from the OBX sub id to some attribute or construct in HL7 v3. To map HL7 v2 messages that use the sub-id one needs to first reconstruct the semantics of the OBX interrelationships and then express that semantics in HL7 v3. Please refer to the model description, and the profiles and examples on microbiology and waveforms, for how this is done.

3.1.5.5 Observation value (*) 00573

This field contains the value observed by the observation producer.

This field readily maps to Observation.value in HL7 version 3. The semantics is the same as in version 2. Note that in most cases the observation value in HL7 version 3 must contain a properly typed value, not just some ad-hoc string representation. See the short data types overview in a section above or the HL7 v3 data types manual for more information.

Also note that the mechanisms for most free text reports in HL7 v3 will be defined elsewhere. The observation value field in version 3 should be used mainly for readily machine accessible information (e.g., physical quantities or properly coded values)

OBX-2-value type contains the data type for this field according to which observation value is formatted. It is not a required field because some systems will report only the normalcy/abnormalcy (OBX-8), especially in product experience reporting.

Note that the data type information will be carried in some Implementation Technology dependent manner, thus, "value type" is not an information model field.

Just as in HL7 v2, the value field in HL7 v3 may contain no information.

> *Though two independent diagnostic **statements** cannot be reported in one OBX segment, multiple categorical responses are allowed (usually as CE data types separated by repeat delimiters), so long as they are fragments (modifiers) that together construct one diagnostic statement. Right upper lobe (recorded as one code) and pneumonia (recorded as another code), for example, could be both reported in one OBX segment. Such multiple "values" would be separated by repeat delimiters.*

In HL7 v3 codes and their "modifiers" are combined in one data type, the Concept Descriptor (CD). In HL7 v3 a collection of Observation.values does not express codes and their modifiers. A "repeated" OBX value field for codes and modifers in HL7 v2 messages **must not** be translated into a set of observation values in HL7 v3. Instead the CD data type must be used.

If in HL7 v3 the observation value contains a set of values instead of one value, this always means that all given elements of the value set are probable / possible results for the test. In "master file" records, this is the entire set of possible outcomes of a test. In actual results, this may be the likely alternative results in case there is ambiguity. If probabilities are known to the alternative results this can be sent using the probability distribution generic data types (See the data type review above or the data type manual.)

> *In some systems, a single observation may include **fragments** of more than one data type. The most common example is a numeric result followed by coded comments (CE). In this case, the logical observation can be sent in more than one OBX segment. For example, one segment of numeric or string data type for the numeric result and another segment of CE data type for coded comments. If the producer was reporting multiple coded comments they would all be sent in one OBX segment separated by repeat delimiters because they all modified a single logical observation. Multiple OBX segments with the same observation ID and sub ID should always be sent in sequence with the most significant OBX segment (the one that has the normal flag/units and or reference range and status flag) first. The value of OBX-6 through 12 should be null in any following OBX segments with the same OBX-3-observation identifier and OBX-4-observation sub-ID. For the purpose of replacement or deletion, multiple OBX segments with the same observation ID and sub ID are treated as a unit. If any are replaced or deleted, they all are replaced.*

One of the main motivations for the data type redesign in HL7 v3 was to avoid splitting semantic units into multiple fragments scattered into multiple attributes or observations. For that reason, one minimal logical unit of an observation can usually be represented by one and only one instance of an Observation class. That is, if the observation value (e.g., a physical quantity) needs to be commented, those comments can appear as an annotation (e.g. Annotated Physical Quantity, ANT⟨PQ⟩) right in the same observation value field.

Note: There is a fundamental difference between an annotation to an observation result and other observations that report the context of a given observation. For example, in blood gas analysis the inspired oxygen fraction (FIO_2) would be an associated observation, not a comment on an observation. Note also that many of the things that used to be non-standardized comments in HL7 v2 have a proper place or proper constructs in which to report them. Work on standardizing common HL7 v2 comments is underway.

> *When an OBX segment contains values of CE data types, the observations are stored as a combination of codes and/or text. […] The observation may be an observation battery ID (for recommended studies), a diagnostic code or finding (for a diagnostic impression), or an anatomic site for a pathology report, or any of the other kinds of coded results.*

The HL7 v3 data type for those kinds of codes is the Concept Descriptor. The CD is similar to HL7 v2's CE in that it allows a meaning to be expressed as free text and in more than one coding system. In addition and beyond the CE, the CD allows for composite codes (code + modifier) and for more than two coding systems to be used.

*It is not necessary to always encode the information stored within a coded observation. For example, a chest X-ray impression could be transmitted as pure text even though it has a CE data type. In this case, the test must be recorded as the second component of the **result code** […] However, separate impressions, recommendations, etc., even if recorded as pure text, should be recorded in separate result segments. That is, congestive heart failure and pneumonia should not be sent as [two different observations.]*

In HL7 v3 it will still be possible to send a CD value with only text and no codes in it. However, the use of the free text string as an undefined code will not be permitted. Of course, HL7 can not and will not prevent smart natural language interpretation modules from encoding free text. However, any interface that requires the text to be drawn from a "table" or to use certain keywords will not be HL7 v3 compliant. At least those interfaces should define a local code system and provide a mapping of the local codes to some standardized vocabulary.

3.1.5.6 Units (CE) 00574

This field contains the units […] The default coding system for the units codes consists of the ISO+ abbreviation for a single case unit (ISO 2955-83) plus extensions […]

One of the main motivations for the data type redesign in HL7 v3 was to avoid splitting semantic entities into multiple fragments scattered over multiple attributes or observations. For that reason, there is no longer an information model attribute for units of measure. A physical quantity must always be sent as a proper value of type PQ with proper physical units specified.

Rather than allowing different code systems for units to be used, HL7 v3 will require the use of the Unified Code for Units of Measure (UCUM) that covers all possible physical units and algebraic combinations of those. UCUM is based on the SI unit system and is motivated from an analysis of the HL7 v2 ISO+ units. USUM integrates all U.S. customary units and defines precise translations between the customary units and SI units. Since such translations between units are relatively simple to do, no HL7 specification and no interface should require one particular unit to be used (e.g. mL instead of L or cm^3.) Please refer to the UCUM manual for more information.

3.1.5.7 References range (ST) 00575

Components: for numeric values in the format:

a) lower limit-upper limit (when both lower and upper limits are defined, e.g., for potassium 3.5 - 4.5)

b) > lower limit (if no upper limit, e.g., >10)

c) < upper limit (if no lower limit, e.g., <15)

alphabetical values: the normal value may be reported in this location

When the observation quantifies the amount of a toxic substance, then the upper limit of the range identifies the toxic limit. If the observation quantifies a drug, the lower limits identify the lower therapeutic bounds and the upper limits represent the upper therapeutic bounds above which toxic side effects are common.

In HL7 v3 there is no attribute for reference ranges (normal ranges.) Instead reference ranges are communicated as follows.

Reference ranges are a simplified notation for a probability distribution of test outcomes for a certain population. Usually "normal ranges" refer to the outcome distribution over a population considered

"healthy," but reference ranges for populations with special conditions exist (and are known to be more useful in diagnosing than the simple deviation from the "norm".) Oftentimes the population of "healthy humans" is subdivided by gender, age and race, but other classifiers exist.

Even though reference ranges are (and are determined as) a probability/frequency distribution over the possible text outcomes, most textbooks and tables usually discard the information about the details of a distribution. Thus usually the probability/frequency distribution is degraded to a simple reference range, as an interval with low and high boundary, that cut the distribution off at both sides to contain 95% of that population. For nominal (coded) observations, reference ranges are subsets of the observation value domain.

In HL7 v3 the probability distributions can be represented as parametric distributions, or as simple reference intervals.

Since the normal ranges are possible outcomes of a test, they are themselves outcomes, and thus reported in the same attribute Observation.value as individual measurement values. A specific mood of the Observation class is used to carry normal ranges (mood_cd = "reference value".) In a report message of specific results (corresponding to the HL7 v2 ORU message), the applicable reference ranges are sent as associated observation instances of mood "reference value" along with the actual observations.

There is never an ambiguity whether an Observation instance contains a reference range or an actual value, since the mood code "actual" vs. "reference" will clearly distinguish the meaning. It is important however to accept that reference ranges are nothing special but consolidated observation on a population (as opposed to an individual.)

Note that consolidated observations on populations are communicated in medicine for epidemiologic studies, clinical trials, an quite commonl in veterinary medicine. Such consolidated observations can be reported in the same way as reference ranges but the mood code would clearly indicate that it is an actual observation rather than a reference range.

Refer to Section **Error! Reference source not found.** for an example of how reference ranges are defined and used.

3.1.5.8 Abnormal flags (ID) 00576

This field contains a table lookup indicating the normalcy status of the result. We strongly recommend sending this value when applicable. If the observation is an antimicrobial susceptibility, the interpretation codes are: S=susceptible; R=resistant; I=intermediate; MS=moderately susceptible; VS=very susceptible. […] When the laboratory can discern the normal status of a textual report, such as chest X-ray reports or microbiologic culture, these should be reported as N when normal and A when abnormal. Multiple codes, e.g., abnormal and worse, would be separated by a repeat delimiter, e.g., A~W.

*Results may also be reported in **shorthand** by reporting the normalcy status without specifying the exact numeric value of the result. Such shorthand is quite common in clinical notes, where physicians will simply say that **the glucose result was normal.** Such shorthand reporting is also seen in drug experience reporting. In such cases, the result can be reported in the OBX by reporting the normalcy code in OBX-8-abnormal flags without specifying any value in OBX-5-observation value.*

The "abnormal flags" will continue to exist in HL7 v3 as Service.interpretation_cd : SET⟨CV⟩ using the values of HL7 v2.3 table 0078 essentially unchanged.

One could argue, that abnormal flags are really nominal observations derived from other (actually measured) observations. However, the use of the abnormal flags is to have a very abstract qualification on the clinical event. Note that an abnormal flag may be provided for any kind of service, not just for observations. For instance if a surgical procedure took a complicated course, it can (and should) be flagged as "A" for abnormal. For the drug experience reporting example, the abnormal flag can be sent with the Medication service report and does not have to be sent in an otherwise "empty" observation service (although the evidence of the drug incident will be reported using the Observation class.)

3.1.5.9 Probability (NM) 00577

This field contains the probability of a result being true for results with categorical values. It mainly applies to discrete coded results. It is a decimal number [...] that must be between 0 and 1, inclusive.

Probabilities of values in HL7 version 3 are sent consistently as "Uncertain Values." For nominal (discrete) observations (e.g. coded results) this can be a simple probability number attached to the observation value. For continuous (quantitative) observations, however, a simple probability number was inadequate to communicate uncertainty of such value.

The HL7 v3 data types allow one to more completely express uncertain values, including continuous values that can not rationally be tagged by a simple probability number. Parametric and non-parametric probability distributions (including the notion of confidence interval) can be sent for such values. Also, with some nominal (coded) observations, absolute discrimination between two or more possible values may be impossible. In that case the Observation.value may contain a probability "histogram" showing multiple outcomes with their probabilities.

Note that really all measurements are only able to limit all possible outcomes to a certain range. That is, all measurements have error that can (and should) be reported as a standard deviation using the probability extensions of the HL7 v3 data types.

3.1.5.10 Nature of abnormal test (ID) 00578

This field contains the nature of the abnormal test. Refer to HL7 table 0080 - Nature of abnormal testing for valid values. As many of the codes as apply may be included, separated by repeat delimiters. For example, normal values based on age, sex, and race would be codes as A~S~R.

The "nature of abnormal test" code was meant to specify which population reference range has been applied in generating the abnormal flag for the observation (and not, as it may sound, to specify a reason why the value is abnormal.) One could identify a generic normal population (N), or a population based on age (A), sex (S), or race (R).

As noted above, reference ranges can be based on different populations that differ by their inclusion criteria. Most frequently the criteria for an individual to belong to a reference range population are based on age, gender and race groups. However, those are not the only criteria on which population reference ranges can be based, in fact, it is widely agreed by pathologists that reference ranges based on "abnormal" populations (i.e. those patients with a certain condition) are actually more sensible in diagnostics than assessing deviations from the "norm."

In HL7 v3 reference ranges are reported as separate observation records flagged as being an observation "reference" rather than an actual observation on a patient. The "nature of abnormal tests" in turn is reported as another kind of observation linked to the reference observation (using link type "reference population criterion".) That way, the above codes are represented in a slightly longer form explicitly as observation criteria. Conceptually the quantity "age" and the nominal values for "sex" and "race" are

considered parts of the *medical* record just as any other observation. Thus, although these values are usually transmitted as administrative data, in the clinical context we refer to these as clinical observations.

Refer to Section **Error! Reference source not found.** for an example of how reference ranges for different populations are defined and used.

3.1.5.11 Observ result status (ID) 00579

This field contains the observation result status. This field reflects the current completion status of the results for one Observation Identifier.

Maps to the attribute Service.status_cd. Note however that the state-transition model of results in HL7 v2 and HL7 v3 are different. Refer to chapter **Error! Reference source not found.**.

3.1.5.12 Date last obs normal value (TS) 00580

This field contains the changes in the observation methods that would make values obtained from the old method not comparable with those obtained from the new method.

Null if there are no normals or units. If present, a change in this date compared to date-time recorded, the receiving system's test dictionary should trigger a manual review of the results to determine whether the new observation ID should be assigned a new ID in the local system to distinguish the new results from the old.

Whenever the method of a test changes so that results are truly not comparable, systems should be notified by master file management messages. Such a check in each and every result message is not required. Better yet, no "universal service id, " "observation id" and no code reported in Service.type_cd should ever change its meaning in an incomparable/incompatible way. Rather, when meanings change, new codes should be established so that old data remains valid.

3.1.5.13 User defined access checks (ST) 00581

This field permits the producer to record results-dependent codes for classifying the observation at the receiving system. This field should be needed only rarely, because most classifications are fixed attributes of the observation ID and can be defined in the associated observation master file (see description in Chapter 8).

However, there are a few cases when such controls vary with the value of the observation in a complex way that the receiving system would not want to re-calculate. An example is an antimicrobial susceptibility result. Some systems prefer to display only the susceptibility results of inexpensive antimicrobials depending upon the organism, the source of the specimen and the patient's allergy status. The sending service wants to send all of the susceptibilities so that certain privileged users (e.g., Infectious Disease specialists) can review all of the results but nonprivileged users would see only the "preferred" antimicrobials to which the organism was susceptible. We expect that other cases also occur.

This attribute is not mapped onto HL7 version 3 for two reasons. First, those "access checks" the cited use case really is an application consideration and thus the responsibility of the receiving system (and subject to its policy.) While it seems reasonable to enforce cost control measures on order entry systems, by reminding physicians to choose the less expensive equally effective medication, it seems questionable to withhold information to the clinician.

Second, such "access checks" are well-known as Access Control Lists (ACL) today. HL7 version 3 needs (and will have eventually) a general mechanism to maintain role-based ACLs on all medical record information. Using a special attribute in an observation class seems not warranted, for general problems always deserve general solutions! For an interim period, some kind of explicit and dynamic access control can be communicated using "actor" participation class instances as discussed under section 3.1.4.28 above.

3.1.5.14 Date/time of the observation (TS) 00582

[…] In all cases, the observation date-time is the physiologically relevant date-time or the closest approximation to that date-time. In the case of tests performed on specimens, the relevant date-time is the specimen's collection date-time. In the case of observations taken directly on the patient (e.g., X-ray images, history and physical), the observation date-time is the date-time that the observation was performed.

Mapped to Service.critical_time.

3.1.5.15 Producer's ID (CE) 00583

This field contains a unique identifier of the responsible producing service. It should be reported explicitly when the test results are produced at outside laboratories, for example. When this field is null, the receiving system assumes that the observations were produced by the sending organization. This information supports CLIA regulations in the US. The code for producer ID is recorded as a CE data type. In the US, the Medicare number of the producing service is suggested as the identifier.

A person "producing a result" is one who performs a test service, and thus is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. Actor participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service. This includes, but is not limited to, various ids.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.5.16 Responsible observer (XCN) 00584

When required, this field contains the identifier of the individual directly responsible for the observation (i.e., the person who either performed or verified it). In a nursing service, the observer is usually the professional who performed the observation (e.g., took the blood pressure). In a laboratory, the observer is the technician who performed or verified the analysis. The code for the observer is recorded as a CE data type. If the code is sent as a local code, it should be unique and unambiguous when combined with OBX-15-producer ID.

A responsible observer is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. Actor participants can be any Stakeholder, this includes individual (natural) persons as well as organizations (legal persons.) All information about actors will be communicated using the Actor participation class linking a "Stakeholder" to a Service. This includes, but is not limited to, various ids.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.1.5.17 Observation method (CE) 00936

This optional field can be used to transmit the method or procedure by which an observation was obtained when the sending system wishes to distinguish among one measurement obtained by different methods and the distinction is not implicit in the test ID. Chemistry laboratories do not usually distinguish between two different methods used to measure a given serum constituent (e.g., serum potassium) as part of the test name. See the LOINC Users Manual[1] for a more complete discussion of these distinctions. If an observation producing service wanted to report the method used to obtain a particular observation, and the method was NOT embedded in the test name, they can use this field.

The Centers for Disease Control and Prevention (CDC) Method Code (CDCM) (see Fiure 7-3) is one candidate code system for reporting methods/instruments. EUCLIDES method codes are another. User-defined tables are an alternative

Maps to Service.method_cd.

3.1.6 OBX Profile for Waveform Data

3.1.6.1 TIM – Timing Information

The TIM category OBX result segment establishes the date and time of the first data point in a given Observation Sub-ID grouping of waveform channels. If there is a gap in the time sequence of waveform data, this should be indicated by the transmission of a new TIM category result segment prior to subsequent WAV category result segments with the same Observation Sub-ID. The data type is TS.

The *OBX-5 observation value* of a TIM OBX is mapped to Service.critical_time. That is, start and end of the waveform are specified by the physiologically relevant time range of the observation service. In case the waveform sampling is "interrupted" a different Observation service will be used. All the observations for the waveform fragments can be collected under the high level observation, which is the observation instance corresponding to the HL7 version 2 OBR segment.

3.1.6.2 CHN – Channel Definition

The CHN category OBX result segment defines recording channels for digitally sampled time-series waveforms. Subsequent WAV category result segments carry the actual waveform samples. Each CHN category result segment defines one or more channels; the OBX-5-Observation Value field may repeat to define additional channels. Each instance or repetition is formatted as a CD data type.

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[1] LOINC Committee. Logical Observation Identifier Names and Codes. Indianapolis: Regenstrief Institute and LOINC Committee, 1995. c/o Kathy Hutchins, 1001 West 10th Street RG-5, Indianapolis, IN 46202. 317/630-7433. Available via FTP/Gopher (dumccss.mc.duke.edu/standards/HL7/ termcode/ loinclab) and World Wide Web (http://dumccss.mc.duke.edu/standards HL7/termcode/ loinclab/). The LOINC Code System is described in Forrey AW, McDonald CJ, DeMoor G, Huff SM, Leavelle D, Leland D, et.al. Logical Observation Identifier Names and Codes (LOINC) database: a public use set of codes and names for electronic reporting of clinical laboratory test results. Clinical Chemistry 1996;42:81-90

Each channel has a number (which generally defines its position in a multichannel display) and an optional name or label (also used in displays). One or two named waveform sources may also be associated with a channel (providing for the use of differential amplifiers with two inputs). A channel also has an associated sensitivity, calibration parameters (sensitivity correction factor, baseline, and time skew), sampling frequency, and minimum and maximum values. The sampling frequency refers to the number of samples per unit time for the data reported in the subsequent WAV category result segments.

When multiple channels are defined within a single CHN category result segment, if the channel sensitivity/units (third component), sensitivity correction factor (first subcomponent of component 4), baseline (second subcomponent), time skew (third subcomponent), sampling frequency (fifth component), minimum data value (first subcomponent of component 6), or maximum data value (second subcomponent) is not present in any repetition of the OBX-5-observation value field, the value given in the last repetition in which the item was present may used by the receiver system. This is referred to as a "sticky default." For example, if all channels have the same sensitivity, sensitivity correction factor/baseline/time skew, sampling frequency, and minimum/maximum data values, these may be specified for the first channel but omitted in all subsequent channel definitions in the same CHN category result segment, thus reducing the length of the segment. If the sensitivity correction factor, baseline, or time skew is not present in the first channel being defined, values of 1, 0, and 0 (respectively) may be used. No other default values are assumed for components which are not present.

When using the OBX for the CHN category, OBX-2 should be valued to CD. Consequently, OBX-5 could have a length of up to 65536 given the format of the CD data type. Note the expectations on which fields are required as well as the fields that should not be valued.

3.1.6.3 WAV – Waveform Digital Data

The WAV category OBX result segment is used to transmit the actual waveform data (the time-series digitized values from an analog-to-digital converter (ADC) or other source of sampled digital data). WAV category result segments are associated with their corresponding channel definitions (CHN category OBX result segment) via the Observation Sub-ID. The number of channels defined in the CHN category result segment specifies the number of channels of multiplexed data contained in the WAV category result segments associated with it. For example, if a CHN category result segment contains only a single channel definition, then each WAV category result segment with the same Observation Sub-ID contains only one channel of data. However, if a CHN category result segment contains three channel definitions then each WAV category result segment with the same Observation Sub-ID must contain three channels of data. A given set of waveform data for all channels and at multiple successive times may be transmitted in a single WAV category result segment (provided that the length of the observation value field does not exceed the maximum defined field length for OBX segments, 65536), or in multiple successive WAV category result segments, possibly with interspersed result segments of other types (for example, containing annotations, or comments).

The data type of the WAV category result segment can be NA (Numeric Array) or MA (Multiplexed Array). Using the NA data type, the data values are formatted in "channel-block", or "unmultiplexed" format. The digital samples for each channel are separated using component delimiters, and successive channels are separated using the repeat delimiter. Using the MA data type, the data values are formatted in "channel multiplexed" format, i.e., the values for the first time sample (all channels) are transmitted first, then the values for the second time sample (all channels) are transmitted, and so on until all samples have been transmitted. The digital samples for each channel are separated by the component delimiter, and successive samples are separated by the repeat delimiter. Channel multiplexed format can only be used if all of the multiplexed channels have the same effective sampling frequency.

When using the OBX for the WAV category, OBX-2 can be valued as either NM or MA. Consequently, OBX-5 could have a length of up to 65536 given the format of the data types. Note the expectations on which fields are required as well as the fields that should not be valued.

3.1.6.4 ANO – Waveform Annotation

The ANO category OBX segment is used to transmit waveform annotations (coded entry associated with a given point in time during the waveform recording). The ANO category result segments are referenced to their corresponding channel definitions (CHN category OBX result segment) via the Observation Sub-ID. The number of channels defined in the CHN category result segment specifies the number of channels of annotation contained in any ANO category result segments associated with it. For example, if a CHN category result segment contains only a single channel definition, then any ANO category result segments with the same Observation Sub-ID will contain only one annotation coded entry. However, if a CHN category result segment contains three channel definitions then any ANO category result segments with the same Observation Sub-ID must contain three separate annotation coded entries.

The data type of the ANO category result segment is CE. The annotation coded entries for successive channels are separated using the repeat delimiter. Adjacent repeat delimiters are used when there is no annotation coded entry for a channel in a multichannel result segment. Refer to user defined table 0317 - Annotations for suggested values.

User-defined table 0317 - Annotations

Value	Description
9900	Pace spike
9901	SAS marker
9902	Sense marker
9903	Beat marker
9904	etc.

When using the OBX for the ANO category, OBX-2 should be valued to CE. Consequently, OBX-5 could have a length of up the 65536 given the format of the data types. Note the expectations on which fields are required as well as the fields that should not be valued.

3.1.7 BLG – Order Billing

The BLG segment is used to provide billing information, on the ordered service, to the filling application.

It is currently not mapped to HL7 v3 as it appears to be related more with administration/finanacial management, which this proposal is not concerned. One way of supporting these fields is to map them to a class "Financial Transaction." Just as we use mood codes to distinguish between actual services, orders, and service definitions (masters), financial transactions could be distinguished to be actual charges, pending charges, or possible charges ("charge master".)

3.1.7.1 When to charge (CM) 00234

*This field specifies when to charge for the ordered service. The first component contains a value defined in HL7 table 0100 - When to charge. The second component is used to express the exact time to charge for the ordered service; it is used only when the **when to charge** value is T. When used, it is expressed as a TS data type.*

Table 0100 - When to charge

Value	Description
D	On discharge

Value	Description
O	On receipt of order
R	At time service is completed
S	At time service is started
T	At a designated date/time

3.1.7.2 Charge type (ID) 00235

This field identifies someone or something other than the patient to be billed for this service. It is used in conjunction with BLG-3-account ID. Refer to HL7 table 0122 - Charge type for valid values.

Table 0122 - Charge type

Value	Description
CH	Charge
CO	Contract
CR	Credit
DP	Department
GR	Grant
NC	No Charge
PC	Professional
RS	Research

3.1.7.3 Account ID (CX) 00236

This field identifies the account to be billed. It is used in conjunction with BLG-2-charge type.

There is an association between the classes Service and Account. This field therefore maps to HL7 version 3 by inclusion of a Account record in the message. This account record would not contain more than the account id (an object view with just the id attribute valued is called an "object stub.")

3.2 Diagnoses, Procedures, and Allergies

3.2.1 DG1 – Diagnoses

The DG1 segment contains patient diagnosis information of various types, for example, admitting, primary, etc. The DG1 segment is used to send multiple diagnoses (for example, for medical records encoding). It is also used when the FT1-19-diagnosis code-FT1 does not provide sufficient information for a billing system. This diagnosis coding should be distinguished from the clinical problem segment used by caregivers to manage the patient (see Chapter 12, Patient Care). Coding methodologies are also defined.

Clinical diagnoses (as well as billing diagnoses) are essentially observations on patients. Some would prefer the term "meta-observation" to express that a diagnosis is not as immediate an observation as, e.g., a temperature reading. However, this is entirely dependent on the scope and scrutiny of the one using the term "meta-observation." There is hardly any reasonable argument for holding the construction of a "temperature" information by measuring the length of a mercury cylinder in a section of a small glass capillary (or even more complex electronic circuits) much more of a direct observation than proclaiming a temperature reading of 102.6 °F "FEVER." The problem becomes even more

dramatic if we compare the "diagnosis" ERYTHRODERMIA with the complex derived "observation" of a creatinine clearance. Thus diagnoses are observations as direct or indirect as observations can be.

Table 5: Observation type codes for diagnoses, problems and complaints.

Kind of observation	Code	Definition	LOINC
Diagnosis	DX	The most general not further specified kind of diagnosis.	
Clinical Diagnosis	DXC	A diagnosis issued by a clinician.	
Admission Diagnosis	DXA	A preliminary diagnosis issued by a clinician as a reason for admission into a hospital. May often be issued by a referring physician, reported to and entered by an admission clerk.	
Working Diagnosis	DXW	A diagnosis on which current clinical work (confirmation and treatment) is based.	
Emergency Room Diagnosis	DXWE	A working diagnosis issued in an emergency room setting. ER diagnoses are pragmatic, to determine the most effective therapeutic actions, not necessarily to make the most fine-grained diagnostic distinctions.	11301-9 11300-1
Pre-operative Diagnosis	DXWP	A concept used (only?) in cancer su7rgery to set a landmark on the stage of the tumor before intervention. This is the mark typically used for prognosis and treatment studies.	
Post-operative Diagnosis	DXWQ	Occurs together with the preoperative diagnosis. The intra-operative findings concerning a tumor may often revise the staging and prognosis to the worse. Post-operative diagnosis does *not* refer to the improved state achieved by the operative intervention. So, it's really an "intra-operative" diagnosis.	
Differential Diagnosis	DXD	A diagnosis that is considered as a possible alternative to the working diagnosis, but that is not primarily pursued in subsequent workup and treatment.	
Discharge Diagnosis	DXD	A discharge diagnosis is a rendition of the current working diagnosis written on the discharge letter. It reflects the clinician's best guess of the curse of the inpatient encounter. Discharge diagnoses are sometimes slightly biased towards higher certainty, higher specificity and higher severity than is actually justified from the facts.	
Ancillary Diagnosis	DXX	An ancillary diagnosis is made from the standpoint of a specialist who will concentrate on his area of specialty and considering primarily the facts that are accessible to his methods.	
Tissue Diagnosis	DXXT	A diagnosis issued by a pathologist from histological analysis of tissue.	
Frozen Sections	DXXTF	A tissue examination from a section prepared quickly using deep frozen tissue. This examination is performed intra-operatively in cancer surgery. The surgeon interrupts the procedure and waits for the result to decide how to continue the operation.	
Final Paraffin Sections	DXXTP	Frozen sections will only give a cursory result and is always followed by a thorough histologic examination of paraffin sections to find out the type and spread of the cancer cells more exactly.	
Radiology Diagnosis	DXXR	A diagnosis issued in the radiology department, based on imaging methods such as conventional X-ray, CAT scans, MRI scans, PET scans, etc. Ultrasonography typically is a radiology discipline in the U.S., while in European countries is done by Internists.	
Billing Diagnosis	DXB	A diagnosis made for billing purpose.	
Allergy	AL	An allergy is a diagnosis too. However, allergy information is most often stated based only on historical information gathered from the patient. Most allergies of record are not confirmed. The observation result will code one or more allergens.	
Allergy History	ALH		

Confirmed Allergy	ALC		19058-7
Symptom	SX	A subjective finding reported by the patient or a next of kin that the patient perceives as pertinent to his problem.	
Chief Complaint	SXC	The primary symptom for which the patient seeks help.	8661-1
Signs & Physical Findings	PX	Typically categorical observations made by the physician in the physical examination.	

3.2.1.1 Set ID - DG1 (SI) 00375

Set Id is a presentation layer (encoding rule dependent) field that has no place in an application layer information model.

3.2.1.2 Diagnosis coding method (ID) 00376

[In HL7 v2.3] this field has been retained for backward compatibility only.

Maps to the code system component of a Code Value in the attribute Observation.value.

3.2.1.3 Diagnosis code - DG1 (CE) 00377

[...] contains the diagnosis code assigned to this diagnosis.

Maps to a Concept Descriptor (CD) assigned to the attribute Observation.value.

Note that sometimes billing diagnoses contain procedure codes, as for example with ICD-9 codes beginning with V or for ICD-10 PCS codes. Such codes are not referring to diagnoses and should not be reported as a diagnosis but as a service (in the Service.type_cd attribute.)

3.2.1.4 Diagnosis description (ST) 00378

[In HL7 v2.3] this field has been retained for backward compatibility only.

Maps to the print-name component of a Code Value (or original text in the Concept Descriptor) assigned to the attribute Observation.value.

3.2.1.5 Diagnosis date/time (TS) 00379

This field contains the date/time that the diagnosis was determined.

Maps to Service.critical_time. Typically this is set to be just one point in time.

3.2.1.6 Diagnosis type (IS) 00380

This field contains a code that identifies the type of diagnosis being sent [...] This field should no longer be used to indicate "DRG" because the DRG fields have moved to the new DRG segment.

The various types of diagnoses are communicated using the attribute Observation.type_cd. The HL7 v2.3 table 0052 for this field contained three values: admitting (A), working (W) and final (F). These are mapped to version 3 as admission diagnosis (DXA,) working diagnosis (DXW,) and discharge diagnosis (DXD,) respectively. Note that the term final diagnosis is misleading, as if one could at any point assume that current knowledge about a patient condition is be "final." The diagnosis at time of discharge is therefore better called discharge diagnosis.

3.2.1.7 Major diagnostic category (CE) 00381

[In HL7 v2.3] this field has been retained for backward compatibility only [… it] should only be used in a master file transaction.

What a "major diagnostic category" is depends entirely on the exact purpose for which this field is used. Since this purpose has not been standardized and no standard vocabulary has been devised, this field is not mapped to any HL7 v3 attribute. Classifications are either implicitly or separately defined by the vocabulary.

3.2.1.8 Diagnostic related group (CE) 00382

The DRG code can be specified as an observation just as any other diagnosis. However, as long as there is a DRG class in the HL7 RIM, it must be used instead.

3.2.1.9 DRG approval indicator (ID) 00383

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.10 DRG grouper review code (IS) 00384

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.11 Outlier type (CE) 00385

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.12 Outlier days (NM) 00386

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.13 Outlier cost (CP) 00387

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.14 Grouper version and type (ST) 00388

The DRG class in the HL7 RIM must be used to for this field. This is out of the scope of the mapping of clinical data.

3.2.1.15 Diagnosis priority (ID) 00389

This field contains the number that identifies the significance or priority of the diagnosis code.

Every use and every user might assign different priorities / importance rankings to service events and their outcomes. Therefore importance ranking can be done through Stakeholder owned lists (cf. Section **Error! Reference source not found.**.)

3.2.1.16 Diagnosing clinician (XCN) 00390

This field contains the individual responsible for generating the diagnosis information. Multiple names and identifiers for the same person may be sent in this field, not multiple diagnosing clinicians. The legal name is assumed to be in the first repetition. When the legal name is not sent, a repeat delimiter must be sent first for the first repetition. The components for this field are described in Chapter 2.

An individual being responsible for asserting a diagnosis is an active participant in that observation service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

3.2.1.17 Diagnosis classification (IS) 00766

This field indicates if the patient information is for a diagnosis or a non-diagnosis code.

This table is to be merged with the Service.type_cd table used for diagnoses, onto which *DG1-6 diagnosis type* is also mapped.

HL7 v2.3 table 0228 diagnosis classification		**HL7 v3 mapping**	
Code	**Description**	**Code**	**Comment**
C	Consultation		Not mapped, this concept seems not to fit into diagnosis types, it is more an encounter type.
D	Diagnosis	DX	Diagnosis (DX)
M	Medication (antibiotic)		This is not a diagnosis at all, although there may be IC**D**-9 codes for some treatment services.
O	Other		Use a null value (*other*)
R	Radiological scheduling (not using ICD codes)		Not mapped, does not seem like a diagnosis either.
S	Sign and symptom	PX SX SXC	Signs (PX), symptoms (SX), chief complaint (SXC) are distinguished concepts.
T	Tissue diagnosis	DXT	Tissue diagnosis (DXT)
I	Invasive procedure not classified elsewhere (I.V., catheter, etc.)		A procedure is not a diagnosis. Use class Procedure (or Medication) instead.

3.2.1.18 Confidential indicator (ID) 00767

This field indicates whether the diagnosis is confidential.

Mapped to the Service.confidentiality_cd. Note that every medical record item is confidential, so, a negative confidentiality indicator can never exist. See **Error! Reference source not found.** above for defined confidentiality codes.

3.2.1.19 Attestation date/time (TS) 00768

This field contains the time stamp that indicates the date and time that the attestation was signed.

This field is one of a kind that deals with the life-cycle state of an object by means of slotted time stamps. Instead of a clearly defined state-transition model from which state codes are derived, a time stamp is entered into a dedicated field. That way some states may be represented and some may not.

This "slotted time stamp" approach had a side effect in creating a pseudo use case of a sparse audit trail. Knowing the date some state became effective may be useful in tracking down problems in business processes. However, it remains largely coincidence which states become part of the audit trail and which don't.

In HL7 v3 all states are clearly represented in a status_cd attribute of the relevant object whose state is to be reported. If an audit trail of state effective time stamps is required, the history generic data type can be used to send past states with their associated effective time ranges.

Another frequent use of slotted time stamps is to communicate authentication information. Attestation is a legal act that requires evidence to substantiate the mere assertion. It is apparently felt that a timestamp is more evidence for the assertion the diagnosis is attested than a simple Boolean value (Y/N indicator.) However, in light of higher standards for accountability of authenticated information the attestation may need to be substantiated by means of electronic signatures.

For the time being attestation can be asserted by including an actor participant of type "attester" that way there is at least full information not only about the time of attestation but also about the attesting person. It is likely that a strong authentication of Actor participation assertions will be available in the future.

3.2.2 PR1 – Procedures

The PR1 segment contains information relative to various types of procedures that can be performed on a patient. The PR1 segment can be used to send procedure information, for example: Surgical, Nuclear Medicine, X-ray with contrast, etc. The PR1 segment is used to send multiple procedures, for example, for medical records encoding or for billing systems.

Obviously a procedure is a kind of a service. PR1 maps largely to the HL7 v3 class Procedure, at least this is true where Procedures are truly direct care procedures (such as surgery, specimen drawings, or endoscopy, etc.) If in doubt the general Service class should be used in order to avoid accidently reporting a medication service as a surgical procedure.

3.2.2.1 Set ID - PR1 (SI) 00391

Set Id is a presentation layer (encoding rule dependent) field that has no place in an application layer information model.

3.2.2.2 Procedure coding method (IS) 00392

[In HL7 v2.3] this field has been retained for backward compatibility only.

Maps to the code system component of a Code Value in the attribute Service.type_cd.

3.2.2.3 Procedure code (CE) 00393

[…] This field contains a unique identifier assigned to the procedure.

Maps to the attribute Service.type_cd.

3.2.2.4 Procedure description (ST) 00394

[In HL7 v2.3] this field has been retained for backward compatibility only.

Maps to the print-name component of a Code Value (or original text in the Concept Descriptor) assigned to the attribute Observation.value.

3.2.2.5 Procedure date/time (TS) 00395

This field contains the date/time that the procedure was performed.

Maps to Service.time, which allow the start and end time of the procedure to be communicated.

3.2.2.6 Procedure functional type (IS) 00396

This field contains the optional code that further defines the type of procedure.

User-defined Table 0230 - Procedure functional type

Value	Description
A	Anesthesia
P	Procedure for treatment (therapeutic, including operations)
I	Invasive procedure not classified elsewhere (e.g., IV, catheter, etc.)
D	Diagnostic procedure

This is a classifier that is a connotation of vocabularies. Despite the HL7 v2.3 definition this field never provided "further definition" of the procedure. Once the procedure is specified with a distinct code (e.g a CPT-4 code) it is implicit whether the procedure is an anesthesia, a medication or a surgery. This kind of classification is implied in the procedure type code, and need not be communicated explicitly in addition to the procedure type code. We do have the option to define a special attribute Procedure.class_cd for this field, but not before we have a clear and strong use case.

3.2.2.7 Procedure minutes (NM) 00397

This field indicates the length of time in whole minutes that the procedure took to complete.

This is simply the width of an interval of time communicated in Service.time. The receiving system can adjust this result to any granularity it needs (minutes, seconds, 15 minutes …)

3.2.2.8 Anesthesiologist (XCN) 00398

An anesthesiologist is an active participant in a procedure service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle.

Note that anesthesia may be considered an integral part of a surgical procedure or a separate service that is strongly related to the surgery. If anesthesia is considered integrated with the surgery service, the anesthesiologist can be reported as an Actor of type "anesthesiologist" connected directly to the surgery service. In a more fine grained perspective were anesthesia is a service on its own, the anesthesiologist will be associated with the anesthesia service rather than the surgery service.

3.2.2.9 Anesthesia code (IS) 00399

This field contains a unique identifier of the anesthesia used during the procedure.

This field refers to a description of the kind of anesthesia provided. This really implies that there is a separate service event related to the surgical procedure. So this field maps to the Service.type_cd of an anesthesia service related to the surgical Procedure service. The relationship between the two services surgery and anesthesia is established through the service Relationship class of any relationship type from the categories *set* or *pre-condition*.

3.2.2.10 Anesthesia minutes (NM) 00400

This field contains the length of time in minutes that the anesthesia was administered.

This field refers to a duration of an anesthesia service provided during and in support of the surgical procedure This field maps to the Service.time or Service.critical_time of an anesthesia service related to the surgical Procedure service. The relationship between the two services surgery and anesthesia is established through the service Relationship class of any relationship type from the categories *set* or *pre-condition*. Service.time contains the total time of service, whereas critical_time contains just the time of the critical period (e.g., between induction of anesthesia to patient's regaining of consciousness and vital protection reflexes.)

Anesthesia "minutes" is simply the width of an interval of time communicated in Service.time of the anesthesia service. The receiving system can adjust this result to any granularity it needs (minutes, seconds, 15 minutes …)

3.2.2.11 Surgeon (XCN) 00401

A surgeon is an active participant in a surgical procedure service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle (e.g., performing surgeon, first assistant, second assistant, etc.)

3.2.2.12 Procedure practitioner (XCN) 00402

This field contains the different types of practitioners associated with this procedure. The ID and name components follow the standard rules defined for a composite name (XCN) field. The last component, identifier type code, indicates which type of procedure practitioner is shown. When the identifier type component is unvalued, it is assumed that the practitioner identified is a resident.

Procedure practitioners are active participants in the procedure service. All information about actors will be communicated using the Actor participation class linking a person to a service.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specify the actual responsibility of every person at different points in the service's life cycle (e.g., performing surgeon, first assistant, second assistant, etc.)

The identifier type code that has been (ab-)used by HL7 v2 to accommodate participation type codes must be mapped to the appropriate HL7 v3 standard participation type code. Note that a participation type code expresses the specific, possibly transient, role an actor plays in a particular service and not so much the static role he/she has in an institution. Also note the difference between participation types and credentials/specialties. For example, in principle a student or intern can act as a performing surgeon on a part or all of a surgery, provided that a responsible surgeon is supervising his actions.

Table 6: Mapping of procedure practitioner identifier type code to HL7 v3 actor type codes.

HL7 v2.3 table 0133 – Procedure practitioner		HL7 v3 Mapping	
Code	**Description**	**Code**	**Description**
AN	Anesthesiologist	ANS	Anesthesia practitioner. Note that the Actor.type_cd is not a specialty code. The performing anesthesia practitioner may well be a resident or even a nurse.
PR	Procedure MD (surgeon)	PRF	Procedure MD (surgeon)
RD	Radiologist	(PRF)	Note that the Actor.type_cd is not a specialty code. In an invasive radiology procedure, the radiologist is the performing physician (PRF).
RS	Resident	(PRF)	Note that the Actor.type_cd is not a credential code. A resident can well be a performing practitioner (PRN)
NP	Nurse Practitioner	(PRF)	Note that the Actor.type_cd is not a credential code. A nurse can be a performer (PRF) as well, although in many cases the nurse will be an assistant.
CM	Certified Nurse Midwife	(MWF)	Note that the Actor.type_cd is not a credential code and does not care about "certification." What counts is what function the actor takes over in the service. A midwife may be performer (PRF) or assistant (ASS) or, in a special obstetric setting, may be distinguished as a midwife (MWF).
SN	Scrub Nurse		Scrub Nurse
PS	Primary Surgeon	SPR	
AS	Assistant Surgeon	SA1	

3.2.2.13 Consent code (CE) 00403

This field contains the type of consent that was obtained for permission to treat the patient.

This field maps to the Service.consent_cd.

3.2.2.14 Procedure priority (NM) 00404

This field contains a number that identifies the significance or priority of the procedure code.

Every use and every user might assign different priorities / importance rankings to service events and their outcomes. The maintenance of priority lists both for scheduling (work-lists) and reporting is an outstanding open issue that will soon be addressed generally.

Note that HL7 v2.3.1 suggests certain conceptual connotations to the otherwise purely numerical priority. An "admitting" procedure is a procedure that was assumed to be performed in a certain encounter. Later on the actually performed procedure(s) may be different. Whether or not a procedure have been performed or where merely assumed as an "encounter procedure" on admission, is made explicit in the Service.mood_cd and Service.status_cd.

3.2.2.15 Associated diagnosis code (CE) 00772

This field contains the diagnosis which is the primary reason this procedure was performed, e.g., Medicare wants to know for which diagnosis this procedure is submitted for inclusion on HCFA 1500 form.

Diagnoses can be associated with a procedure using the service relationship of type pre-condition (e.g. reason.)

3.2.2.16 Procedure code modifier (CE) 01316

This field contains the procedure code modifier to the procedure code reported in field 3, when applicable. Procedure code modifiers are defined by regulatory agencies such as HCFA and the AMA. Multiple modifiers may be reported.

In HL7 version 3 the Service.type_cd is of data type Concept Descriptor (CD) which allows codes to be sent with modifiers. No special attribute is needed to send just the modifiers.

3.2.3 AL1 – Allergies

The AL1 segment contains patient allergy information of various types. Most of this information will be derived from user-defined tables. Each AL1 segment describes a single patient allergy.

In HL7 version 3 allergies are not represented by a special class. Instead allergies are considered diagnoses of an allergy condition. Diagnoses, in turn, are just certain kinds of observations. Thus an allergy is reported as an observation. The advantage of reporting allergies just as any other diagnosis or observations is found in the use of the AL1 segment. The AL1 segment is heavily used by ancillary departments, such as pharmacy and the dietary service to avoid exposing the patient to known allergens. Conceptually, however, allergies are not the only diagnoses that ancillary services need to be aware of. For example, Diabetes mellitus is one of the diagnoses that are important for both pharmacy and dietary services although it is not an allergy.

There are two very different use cases of the allergy information. Most often allergies are reported to ancillary services as described above. In the medical record, however, allergies can play the role of any other diagnosis, i.e., can be a working diagnosis, differential diagnosis, can be confirmed or ruled out, can be part of the patient's problem lists, and can be treated with medications, etc. In the medical record, an allergy behaves just like a diagnosis. For ancillary services, whose systems are not capable of dealing with the complexities of an electronic medical record, however, it is important to report allergy information in a concise and well distinguished form.

This allergy reporting requires a vocabulary for Service.type_cd that allows clear determination of the fact that an observation is an allergy. Ancillary systems can not be expected to deal with the complexities of modern terminology systems. Therefore the requirement is that:

a) allergies must be reported using one HL7 standardized allergy code for Service.type_cd.

b) if several allergy types need to be distinguished in the Service.type_cd, this the fact that all of those codes are allergies must be unambiguously implied in the literal *code* value. It is not acceptable to send a concept identifier that requires querying a terminology system only to find out that it is an allergy.

Table 7: Observation type codes for diagnoses, allergies, problems and complaints.

Kind of observation	Code	Definition	LOINC
Diagnosis	DX	The most general not further specified kind of diagnosis.	
Clinical Diagnosis	DXC	A diagnosis issued by a clinician.	
Admission Diagnosis	DXA	A preliminary diagnosis issued by a clinician as a reason for admission into a hospital. May often be issued by a referring physician, reported to and entered by an admission clerk.	
Working Diagnosis	DXW	A diagnosis on which current clinical work (confirmation and treatment) is based.	
Emergency Room Diagnosis	DXWE	A working diagnosis issued in an emergency room setting. ER diagnoses are pragmatic, to determine the most effective therapeutic actions, not necessarily to make the most fine-grained diagnostic distinctions.	11301-9 11300-1
Pre-operative Diagnosis	DXWP	A concept used (only?) in cancer su7rgery to set a landmark on the stage of the tumor before intervention. This is the mark typically used for prognosis and treatment studies.	
Post-operative Diagnosis	DXWQ	Occurs together with the preoperative diagnosis. The intra-operative findings concerning a tumor may often revise the staging and prognosis to the worse. Post-operative diagnosis does *not* refer to the improved state achieved by the operative intervention. So, it's really an "intra-operative" diagnosis.	
Differential Diagnosis	DXD	A diagnosis that is considered as a possible alternative to the working diagnosis, but that is not primarily pursued in subsequent workup and treatment.	
Discharge Diagnosis	DXD	A discharge diagnosis is a rendition of the current working diagnosis written on the discharge letter. It reflects the clinician's best guess of the curse of the inpatient encounter. Discharge diagnoses are sometimes slightly biased towards higher certainty, higher specificity and higher severity than is actually justified from the facts.	
Ancillary Diagnosis	DXX	An ancillary diagnosis is made from the standpoint of a specialist who will concentrate on his area of specialty and considering primarily the facts that are accessible to his methods.	
Tissue Diagnosis	DXXT	A diagnosis issued by a pathologist from histological analysis of tissue.	

Frozen Sections	DXXTF	A tissue examination from a section prepared quickly using deep frozen tissue. This examination is performed intra-operatively in cancer surgery. The surgeon interrupts the procedure and waits for the result to decide how to continue the operation.	
Final Paraffin Sections	DXXTP	Frozen sections will only give a cursory result and is always followed by a thorough histologic examination of paraffin sections to find out the type and spread of the cancer cells more exactly.	
Radiology Diagnosis	DXXR	A diagnosis issued in the radiology department, based on imaging methods such as conventional X-ray, CAT scans, MRI scans, PET scans, etc. Ultrasonography typically is a radiology discipline in the U.S., while in European countries is done by Internists.	
Allergy	AL	An allergy is a diagnosis too. However, allergy information is most often stated based only on historical information gathered from the patient. Most allergies of record are not confirmed. The observation result will code one or more allergens.	
Allergy History	ALH		
Confirmed Allergy	ALC		19058-7
Symptom	SX	A subjective finding reported by the patient or a next of kin that the patient perceives as pertinent to his problem.	
Chief Complaint	SXC	The primary symptom for which the patient seeks help.	8661-1
Signs & Physical Findings	PX	Typically categorical observations made by the physician in the physical examination.	

Thus, the simplest form of an allergy report is Service.type_cd = *AX*, Observation.value = ⟨*allergen*⟩.

3.2.3.1 Set ID - AL1 (SI) 00203

Set Id is a presentation layer (encoding rule dependent) field that has no place in an application layer information model.

3.2.3.2 Allergy type (IS) 00204

This field indicates a general allergy category (drug, food, pollen, etc.).

User-defined Table 0127 - Allergy type

Value	Description
DA	Drug allergy
FA	Food allergy
MA	Miscellaneous allergy
MC	Miscellaneous contraindication

Allergies might be classified in various ways just as any diagnosis or observation can be classified (e.g., by specialty, by body system, etc.) However there is more than just one classification and the choice of classification used depends on the objectives. In other words, it is the connotation or business process consequences of such classifiers that will guide the decision for one particular classification scheme.

In general, classification is a knowledge base / terminology issue and classifiers can better be looked up in separate data bases that are appropriate for the objective for using classifiers, so that they don't need to be sent in HL7 messages.

This particular allergy type classifier of HL7 v2 invites a use that HL7 should not encourage, that is, to show or process only those allergy records that happen to be marked with a specific classifier and to hide others. That way important information may risk to get lost only because it wasn't classified as expected. Instead, the decision whether or not allergies are relevant for a specific service should be made *entirely* on the allergen, not on explicit classifiers. An example to illustrate the problem: a chicken-egg allergy is most likely to be classified as a "food allergy" (FA), when in fact it is highly relevant as a drug allergy for vaccines from chicken-egg virus cultures (e.g., yellow fever vaccine.)

3.2.3.3 Allergy code/mnemonic/description (CE) 00205

This field uniquely identifies a particular allergy. This element may conform to some external, standard coding system (that must be identified), or it may conform to local, largely textual or mnemonic descriptions.

This is really not a "unique identifier" for a specific patient allergy instance but rather a code for a specific kind of allergy. This code will be carried in HL7 v3 in the Observation.value. In general, there are as many kinds of allergies as there are allergenes, and virtually every conceivable chemical substance can be an allergen. Since allergy records sent to ancillary services are considered diagnoses, the code for the value of Observation.value is really a diagnosis concept, say, FISH-ALLERGY rather than a concept for an allergen, such as a certain fish protein.

3.2.3.4 Allergy severity (IS) 00206

This field indicates the general severity of the allergy (severe, moderate, mild, etc.).

User-defined Table 0128 - Allergy severity

Value	Description
SV	Severe
MO	Moderate
MI	Mild

Severity of a condition is a general concept that warrants its own representation. The concept of severity however is both ambiguous and not well defined. First, severity may be an assessment of the overall health state of a patient, and as such it is a composite observation (e.g., a score such as APGAR for neonates or APACHE for ICU patients.) The allergy severity is the severity of a condition. This could be sent as either a related observation or an attribute, and still the meaning of it would be ill defined. At this point severity is mapped to the Service.interpretation_cd attribute (was: abnormal_flags_cd) whose code table needs to be expanded by the above values.

3.2.3.5 Allergy reaction (ST) 00207

This field contains a short, textual description of the specific allergy reaction (convulsions, sneeze, rash, etc.)

This will not be mapped to HL7 v2 as a separate attribute. A description of an allergy reaction is in fact an observation, that can be associated with the allergy diagnosis. Depending on the use case the mechanism used will vary. If the allergy is the focus of clinical work-up the allergy should be managed as a condition thread (using the Condition_node feature.) In that case associated observations will be linked to the condition thread.

If, however, the use of the allergy information is for ancillary systems, the kind of allergy reaction can be sent as an observation directly linked to a allergy diagnosis using the Service relationship of type "manifestation" (meaning "this allergy is manifest by the following reaction" .)

3.2.3.6 Identification date (DT) 00208

This field contains the date that the allergy was identified.

This will be given as the value Service.critical_time. Note that the date the observation was made is different from the extent of a condition. Usually the condition's onset is before its first diagnosis.

3.3 Medications

HL7 v2.3 medication messages are unique among other HL7 messages in that they define multiple segments all containing similar information but for different transactions. In other words, instead of reusing the same segment for multiple different transaction events, as is done with all the other HL7 v2.x segments, there is one distinct medication segment per major transaction. The HL7 v2.3 pharmacy transactions and the specialized segments are shown in Table 8.

Table 8: Pharmacy transactions and segments and their mapping to version 3

HL7 version 2.3				**HL7 version 3 Mapping**		
Segment	**Transaction**	**Originator**	**Responder**	**Class**	**Mood**	**Note**
RXO	Physician order	Physician	Pharmacy	Medication	ORD *order*	We expect most prescription orders to be already encoded. The encoding by the pharmacists can still be communicated as an order revision
RXE	Prescription encoding	Pharmacy	Physician	Medication	INT *intent*	
RXD	Medication dispense	Pharmacy	Payer or Physician	Supply	EVT *event*	Dispensing medication is a kind of supply service, where the product is the therapeutic agent. The supply service can be linked to the prescription (or a revision thereof) to retain the link to the medication service, where necessary.
RXG	Give notice	Pharmacy	Nurse	Medication	RXG *give notice*	A give notice is a very special use case, if at all, feasible only in inpatient situations. A give notice is basically an order to administer the drug.
RXA	Administration documentation	Nurse	Physician	Medication	*event*	This is an actual medication service event.
Other segments independent from transaction						
Segment	**Meaning**	**–**	**–**	**Class**	**Mood**	**Note**
RXC	Component / Ingredient	–	–	Material	–	Exact recipes can be specified using Material and material relationships describing the ingredients.
RXR	Route	–	–	Medication	OPT *option*	A medication service order has a primary route, body site, and method. If multiple optional routes need to be specified one can link multiple options to the primary order.

In HL7 version 3 we keep compatibility to the transactions defined in HL7 v2.3. However, we realize that HL7 version 2.3 defined a very detailed business process as the standard, but this business model does not quite fit what is actually done at many sites outside and inside the United States. In most

cases one will only need to implement the medication order, the dispensing, and the administration transactions.

3.3.1 RXO – Medication Order

This is the "master" pharmacy/treatment order segment. It contains order data not specific to components or additives. Unlike the OBR, it does not contain status fields or other data that are results-only.

The HL7 v3 Medication class inheriting from the Service class, represents the pair of segments RXO and ORC of HL7 v2.3. All status information about the medication is found in the Service.status_cd.

It can be used for any type of pharmacy order, including inpatient (unit dose and compound unit dose), outpatient, IVs, and hyperalimentation IVs (nutritional IVs), as well as other nonpharmacy treatments, e.g., respiratory therapy, oxygen, and metabolites.

Just as the RX* segments of HL7 v3, the Medication class is primarily designed for pharmacological treatment. The supply of oxygen may be regarded as a pharmacological treatment as well with oxygen being the therapeutic agent. It is also quite possible that the Medication class provides a data structure suitable for radiotherapy services as well, as radiotherapy is concerned with similar concepts of dosage and route.

The Medication class (just as the many dosage related fields of the RX* segments), however, is not necessarily adequate for respiratory therapy. For ventilator therapy one can use the Service class directly and describe the many possible parameters of ventilation using associated observations in *control setting* (CTR) mood.

In addition to the pharmaceutical information, this segment contains additional data such as provider and text comments.

The Service.descr attribute is available for general instructions and comments. In HL7 version 3, provider information is generally represented as associated Actors. The attribute Actor.note_txt is available to give comments and instructions attributed to specific providers.

A quantity/timing field is not needed in the RXO segment. The ORC segment contains the requested ORC-7-quantity/timing of the original order, which does not change as the order is encoded, dispensed, or administered.

A very similar logic holds for HL7 version 3, where the timing is specified in the Service.critical_time attribute without the need for further timing attributes in the Medication class. Just as with HL7 version 2.3, the dosage quantities and the dose rate information is given in the Medication subclass (RX*) of Service (ORC).

3.3.1.1 Requested give code (CE) 00292

This field identifies the medical substance or product ordered to be given to the patient; it is equivalent to OBR-4-universal service ID in function.

This field maps to Service.type_cd, just as the HL7 v2.3 standard has likened the *give code* to the *universal service id* of OBR, that is also mapped to the Service.type_cd.

The request-to-dispense fields, which define the type and amount of what is to be issued to the patient (see RXO-10 requested dispense code, RXO-11-requested dispense amount, and RXO-12-requested

dispense units), do not necessarily correlate with the instructions of what amount is to be "given" [...] with each dose, and may or may not be specified with the order. For example, the "give" part of the order may convey the field-representation of give 15 mg of Librium every 6 hours, while the request to dispense part of the order may convey issue 30 tablets of 10 mg generic equivalent for this outpatient prescription. When the give code does not include the dosage form, use RXO-5-requested dosage form.

The principle difference between the dispensing of medication versus the administration of medication is further emphasized in HL7 version 3. From the clinical point of view a medication order is foremost an order to administer a drug. Thus the Medication class is only used in the notion of administration.

On the other hand, dispensing of medication, is little more than a supply service: the drug (a material) is handed to the actor who is going to administer the medication. The dispensing of medication therefore is a supply service, where the medication is always represented as material.

If the prescription is transmitted as free text using RXO-6, then RXO-1, RXO-2, and RXO-4 may be blank and the first subcomponent of RXO-6 must be blank. Otherwise, RXO-1, RXO-2 and RXO-4 are mandatory.

Just as results should be encoded in the appropriate standardized data structure, we strongly recommend sending the prescription information in the proper data structure as well. Free text prescriptions should be the exception. Just as with observation orders, free text instructions are carried in the attribute Service.descr.

3.3.1.2 Requested give amount - minimum (NM) 00293

This field is the ordered amount. In a variable dose order, this is the minimum ordered amount. In a nonvarying dose order, this is the exact amount of the order.

The dose is communicated in the Medication.dose_qty attribute. This is a physical quantity, so that any amount kind of quantity may be specified. Refer to on the definition and a list of amount kinds of quantities and their units.

Note: This field is not a duplication of the first component of the quantity/timing field, since in non-pharmacy/treatment orders, that component can be used to specify multiples of an ordered amount.

Another way to say this is that, for pharmacy/treatment orders, the quantity component of the quantity/timing field refers to what is to be given out at each service interval; thus, in terms of the RX order, that first component always defaults to 1. Hence, in the actual execution of the order, the value of 1 in the first component of the quantity/timing field always refers to one administration of the amount specified in this field (the Requested Give Amount field).

In HL7 version 3 there is no longer a quantity attribute independent from the dose_qty attribute, so, none of this confusion will occur.

3.3.1.3 Requested give amount - maximum (NM) 00294

In a variable dose order, this is the maximum ordered amount. In a nonvarying dose order, this field is not used.

A minimum-maximum-pair of dose quantities means that any dose between the boundaries is permitted, yet, the boundaries must not be exceeded. This rule is best represented by a uniform probability distribution. The uniform probability distribution has low and high boundaries that are never exceeded. A uniform probability distribution has a constant probability density between the boundaries, which means that there is no special preference to the mean.

A given pair of minimum dose d_{min} and maximum dose d_{max} is translated into a uniform probability distribution with the mean $\mu = (d_{min} + d_{max}) / 2$, and a standard deviation $\sigma = (d_{max} - d_{min})^2 / 12$. Conversely, one can easily convert a uniform probability distribution into a pair of minimal and maximal value through calculating the width $w = 2\sqrt{3}\,\sigma$, which yields $d_{min} = \mu - w/2$ and $d_{max} = \mu + w/2$.

Alternatively one can specify other probability distributions to express preference of the dosage to stay at a mean or to allow exceptions for the actual value to exceed the boundaries. See the HL7 v3 data type specification for more on probability distributions. Since the concept of probability distributions as data types is fairly new in HL7, we also allow an interval to be sent with low and high boundary. Where a probability distribution is expected, an interval translates into a uniform probability distribution.

3.3.1.4 Requested give units (CE) 00295

This field indicates the units for the give amount.

If the prescription is transmitted as free text using RXO-6, then RXO-1, RXO-2, and RXO-4 may be blank and the first subcomponent of RXO-6 must be blank. Otherwise, RXO-1, RXO-2 and RXO-4 are mandatory.

Note: These units can be a "compound quantity"; i.e., the units may contain the word "per." For example, micrograms per KG (micg/kg) is an acceptable value, which means that the units are micrograms per KG (of body weight). […]

Body-mass (or surface area) dependent orders, should be avoided, since in most cases the body mass (or surface area) is known at the time of ordering and is not expected to change significantly to have an impact on the ordered amount. In medication event reports a dose **must** be given as a plain amount quantity, as defined in Section **Error! Reference source not found.**.

Error! Reference source not found. In medication orders, a dose **should** be given as a plain amount quantity, and exceptions are only allowed for medical reasons. In medication master file definitions, the dose can be specified as a body mass related dose or as a body surface area related doseWith a unit of mass in the denominator, the dose is body mass related. With a unit of area in the denominator, the dose is body surface area related.

Table 9: Compound dosage and mood code

Mood		Compound dose allowed?
Code	**Concept**	
DEF	definition	yes
ORD	order	exceptionally
EVN	event	no

The fact that an amount really is a compound quantity is (at this point) indicated by the choice of the unit. Table 10 shows how one can conclude from the denominator unit to the kind of quantity on which the compound dose is based.

Table 10: The denominator unit implies the kind of quantity

Compound dose denominator		Example
kind of quantity	**example units**	
body mass	kg, [lb_av]	2.5 mg/kg
body surface area	m^2	100 mg/m^2

A table of standard units is needed to define standard abbreviations for compound units. Until such a table is agreed on, a user-defined table is needed for each site. If the interpretation of a compound unit requires knowledge of some observation results (such as body weight or height), these results can be sent in the same order message using the optional OBX segments.

HL7 version 3 strongly recommends, if not requires, the use of the Unified Code for Units of Measure (UCUM) for all physical quantities.

3.3.1.5 Requested dosage form (CE) 00296

This field indicates the manner in which the medication is aggregated for dispensing, e.g., tablets, capsules, suppositories. In some cases, this information is implied by the dispense/give code in RXO-1-requested give code or RXO-10-requested dispense code. Use when both RXO-1-requested give code and RXO-10-requested dispense code do not specify the drug/treatment form.

This code maps to the Medication.doseform_cd. No standard code table is available at this time.

3.3.1.6 Provider's pharmacy/treatment instructions (CE) 00297

This field identifies the ordering provider's instructions to the pharmacy or the non-pharmacy treatment provider (e.g., respiratory therapy). If coded, a user-defined table must be used. If transmitted as a free text field, place a null in the first component and the text in the second, e.g., |^this is a free text treatment instruction|.

There is no standard code of treatment instructions as such, and it is quite unlikely that there will ever be a standard code system covering the domain of treatment instructions. Therefore, HL7 v2.3 has hinted users to use the coded element data type as a free text field with an optional code.

In HL7 v3 there is no dedicated field for specialized instructions, but all free text instructions belong into the Service.descr attribute.

While it is not likely that all treatment instructions will be coded, further analysis of how these instructions are used in practice may lead to additional mapping guidelines. Such mapping can be defined either on existing message structures of HL7 version 3, or may lead to the definition of attributes that cover special aspects of such instructions.

3.3.1.7 Provider's administration instructions (CE) 00298

This field identifies the ordering provider's instructions to the patient or to the provider administering the drug or treatment. If coded, a user-defined table must be used. If transmitted as free text, place a null in the first component and the text in the second, e.g.., |^this is a free text treatment instruction|.

There is no standard code of treatment instructions as such, and it is quite unlikely that there will ever be a standard code system covering the domain of treatment instructions. Therefore, HL7 v2.3 has hinted users to use the coded element data type as a free text field with an optional code.

In HL7 v3 there is no dedicated field for specialized instructions, but all free text instructions belong into the Service.descr attribute.

While it is not likely that all treatment instructions will be coded, further analysis of how these instructions are used in practice may lead to additional mapping guidelines. Such mapping can be defined either on existing message structures of HL7 version 3, or may lead to the definition of attributes that cover special aspects of such instructions. Some administration instruction codes may be mapped to the Service.method_cd.

3.3.1.8 Deliver-to location (CM) 00299

The first components, modeled after the PL data type, contain the inpatient or outpatient location to which the pharmacy provider or treatment supplier is to deliver the drug or treatment device (if applicable). The default (null) value is the current census location for the patient. This component has the same form as PV1-3-assigned patient location. The last component can be used to specify an address. This could be used to fill mail orders to a patient or provider, or to account for home health care.

Locations in HL7 version 3 are uniformly like to services as Targets of Target.type_cd LOC and it's subtypes. A deliver-to location is a *destination* location and must have Target.type_cd DST. Note that locations are roles of Material, so the relationship from a Service to a Location goes via Target and the Material class.

Note that a deliver-to location specifies drug delivery, not administration. In HL7 v3 we distinguish drug administration service (Medication) from a drug dispensing and delivery service (Suppy.) Thus, if at the time of prescription the doctor wants to also order the details of a dispensing service such as package sizes, deliver-to locations, etc., this must be done using an associated Supply service order. This supply service order is linked as the target of a service relationship of type: *dispensing for* (DISP,) with the inversion indicator set to *true*, so that the relationship source is the order. (See example in Figure 2 below.)

3.3.1.9 Allow substitutions (ID) 00300

This field directly translates to Service.substitution_cd. The values are backward compatible.

Table 11: Service substitution code

Concept	Code	Definition
no	N	No substitution allowed.
generic	G	Generic may be substituted for a brand product.
therapeutic	T	Therapeutic substitution is permitted.

3.3.1.10 Requested dispense code (CE) 00301

This field indicates what is to be/was dispensed; it is equivalent to OBR-4-universal service ID in function. It may be present in the order or not, depending on the application. If not present, and values are given for RXO-11-requested dispense amount and RXO-12-requested dispense units, the RXO-1-requested give code is assumed. If the requested dispense code does not include the dosage form, use RXO-5-requested dosage form.

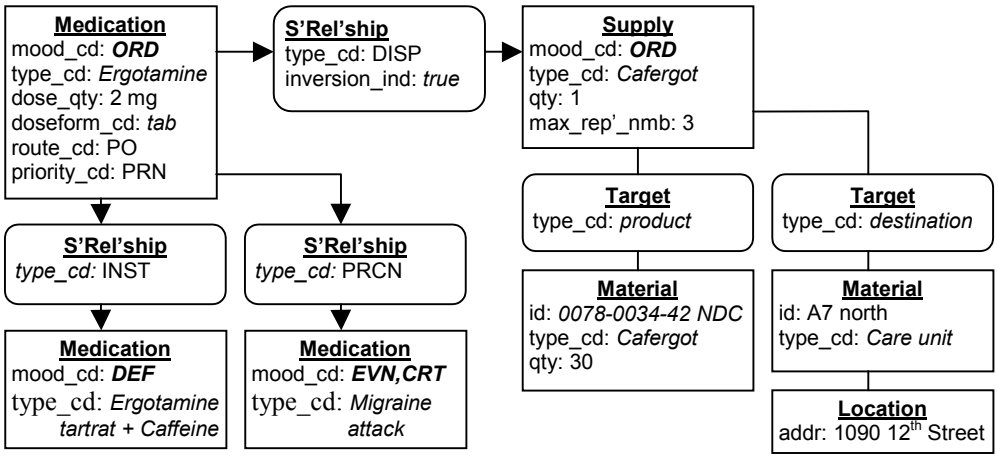

Figure 2: Medication orders are orders to administer medication. If the dispensing needs to be constrained in the order, this is done using a separate Supply service that can indicate package size to be dispensed, number of refills, delivery of the medication to a certain location, and more. For example, Ergotamin is ordered PRN for Migraine attacks. These come as Cafergot® in packages of 1 mg tablets (detailed ingredients not shown in this figure.) The doctor has allowed for one initial dispense plus 2 refils (max_rep'_nmb = 3.) The prescription is ordered for delivery to the care facility "A7 north". Note that refills typically exist in outpatient settings, while delivery locations are mostly relevant in inpatient settings, both will rarely occur together.

Note on request-to-dispense fields: Sometimes an order will be written in which the total amount of the drug or treatment requested to be dispensed has no direct relationship with the give amounts and schedule. For example, an outpatient pharmacy/treatment order might be take four pills a day of <drug name, value>, Q6H (every 6 hours) -- dispense 30 tablets. An inpatient order might be NS/D5W (normal saline with 5% dextrose) at 1000cc/hour—dispense 3 1-liter bottles of NSD5W solution. The request-to-dispense fields support this common style of ordering.

The requested dispense code is the Material.type_cd of a Material associated as a Target of type product with a Supply service order representing the ordered dispensing with all its parameters. See example below.

3.3.1.11 Requested dispense amount (NM) 00302

This field specifies the amount to be dispensed.

The requested dispense amount is the Supply.qty of a Supply service order representing the ordered dispensing with all its parameters. See example in Figure 2.

3.3.1.12 Requested dispense units (CE) 00303

This field identifies the units for the dispense amount. This must be in simple units that reflect the actual quantity of the substance to be dispensed. It does not include compound units.

The requested dispense units is the unit of the Supply.qty of a Supply service order representing the ordered dispensing with all its parameters. See example below. Note that in HL7 version 3, units always occur together with the measurement value in the physical quantity data type.

3.3.1.13 Number of refills (NM) 00304

This field defines the number of times the requested dispense amount can be given to the patient, subject to local regulation. Refers to outpatient only.

The number of refills corresponds to the max_repetition_nmb of the Supply service order representing the ordered dispensing with all its parameters. The max_repetition_nmb is 1 by default, i.e. one dispense is ordered by default. If refills are allowed the number of refills is added to the default max_repetition_nmb. Note the max_repetition_nmb is 1 + the number of refills. For example, if a drug is dispensed once, and two refills are allowed after the first dispense, the max. repetition number is 3. See example in Figure 2.

3.3.1.14 Ordering provider's DEA number (XCN) 00305

This field identifies the provider's controlled substance number, if required by site. It is defined as conditional because it is required when the substance being requested is a controlled substance (e.g., a narcotic).

The ordering provider's DEA number is an attribute of the ordering provider and represented in the RIM class Healthcare_service_provider.

3.3.1.15 Pharmacist/treatment supplier's verifier ID (XCN) 00306

This field is the provider ID of the pharmacist/treatment substance supplier verifier. Use if required by the pharmacy or treatment application or site on orders (or some subgroup of orders), in addition to ORC-11-verified by.

Example: The site requires a "verified by" provider (such as a nurse) and a "verifying pharmacist/treatment supplier" on the order. In this case the first field, ORC-11-verified by, is already present; but the second field, RXO-15-pharmacist/treatment supplier's verifier ID, is needed.

A person verifying a service request is an active participant in the service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows representing the audit trail more completely using the Actor.tmr (time range) attribute. It also allows including as many verifiers as the business rules require.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specifying the actual responsibility of every person at different points in the service's life cycle.

3.3.1.16 Needs human review (ID) 00307

This field uses HL7 table 0136 - Yes/no indicator. The values have the following meaning for this field:

An example of the use of this field is given by the following case:

A smart Order Entry application knows of a possible drug or treatment interaction on a certain order, but the provider issuing the order wants to override the condition. In this case, the pharmacy or treatment application receiving the order will want to have a staff pharmacist or non-pharmacist treatment supplier review the interaction and contact the ordering physician.

The need for human review is indicated through an Actor participation of type *reviewer*, that is not linked to any particular stakeholder entity, thus indicating the need for someone to review the service order.

3.3.1.17 Requested give per (time unit) (ST) 00308

This field identifies the time unit to use to calculate the rate at which the pharmaceutical is to be administered.

This field is defined as conditional because it is required when the ordered substance is to be administered continuously at a prescribed rate (e.g., certain IVs). For example, if the "give amount/units" are 300 ml and the "give per" time unit is H1, the rate is 300ml/hr and the duration of this dose is 1 hour. Thus the give amount and give per time unit define the duration of the service.

This field is distinct from the "interval" component of the quantity/timing field, but it could be used in conjunction with it, as in give 300ml of NS per hr for 1 hour, repeat twice a day.

This is the same as the format specified for the DURATION component of the quantity/timing field, excluding the "X" specification.

The amount given "per time unit" really specifies a dose rate. This field is directly mapped to HL7 v3's Medication.rate_qty. The Medication.rate_qty specifies the denominator of the dose rate term, i.e. the unit of time over which the dose is to be administered. This dose rate denominator is a physical quantity, which is why we no longer need a special coded format for this field. The mapping is very simple as given in the following table:

Table 12: Mapping of HL7 v2.3 "give per" time unit code to a regular physical quantity for version 3.

HL7 v2.3 "give per" time unit		Physical Quantity	
Code	**Meaning**	**Value**	**Unit**
S*x*	*x* seconds	*x*	s
M*x*	*x* minutes	*x*	min
H*x*	*x* hours	*x*	h
D*x*	*x* days	*x*	d
W*x*	*x* weeks	*x*	wk
L*x*	*x* months	*x*	mon

Note that it is still true that the dose rate denominator time is different from the duration of the service (as encoded in the Medication.critical_time General Time Specification.) The duration of the service times the dose rate is the total amount administered in one occurrence of the medication service.

Also note that any proper value in this field indicates that the drug is in fact to be administered continuously. Obviously this is only possible with dose form preparations that are continuously divisible, such as i.v. fluids or gases (e.g., oxygen insufflate nasally at 5 L/min for 20 minutes.)

3.3.1.18 Requested give strength (NM) 01121

Use this field when RXO-1-requested give code does not specify the strength. This is the numeric part of the strength, used in combination with RXO-19-requested give strength units.

This and the next field directly are mapped to Medication.strength_qty. For HL7 version 3 there is nothing to add to the following v2.3 comment that remains valid:

> *The need for strength and strength unit fields in addition to the amount and amount units fields included in various RX_ segments requires explanation. Physicians can write a prescription for a drug such as Ampicillin in two ways. One way would be: "Ampicillin 250 mg tabs, 2 tabs four times a day." In this case the give amount would be 2, the give units would be tabs, the strength would be 250 and the strength units would milligrams. However, the provider could also write the prescription as "Ampicillin 500 mg four times a day." In this case the give amount would be 500 and the give units would be milligrams. The strength would not be reported in the RXO segment because it is not specified; the drug could be given in two 250 mg caps or one 500 mg cap. But the pharmacist would dispense a specific pill size and would record the strength in the RXE segment as 250 or 500, depending upon which pill size was dispensed.*

The Medication.strength_qty is a physical quantity with units. The strength is the amount of the main therapeutic agent administered per one piece of the dose form (e.g., per one tablet.) With integral dose forms ("eaches," e.g. tablets, suppositories) the strength must be an amount kind of quantity as defined in Section **Error! Reference source not found.**.

For continuously divisible dose forms (fluids, gases) the strength quantity may be specified as a concentration of the main ingredient in the substance. For example, with Glucose 5% (D5W,) "5%" is the strength. In this case, the strength is a concentration. Since continuously divisible substances are typically measured in terms of volume, we strongly recommend that the strength be expressed as an amount per volume. So, in the D5W example, instead of 5%, 0.05 g/g or, 50 g/kg, we recommend the strength to be specified as 50 g/L.

However, since we doubt that the proper handling of strength concentrations can be made a conformance criterion, we suggest the following practice in using and interpreting the strength quantity.

Table 13: Compound units for the strengths of fluids and gases

Form	Strength		Notes
	kind of quantity	**example units**	
fluid	volumic mass	50 g/L	This should be most commonly used.
	volumic amount of substance	278 mmol/L	Another preferred (but rather rare) form.
	massic mass	50 g/kg = 5% = 5 g%	**Avoid using mass percentages** because of the confusion with volume percentage. This is often used for crystalline solutions, despite the discouragement from all pertinent standards bodies (e.g. IUPAC)
	volumic volume	130 ml/L = 13%	Volume percentages are used for a mixture of two fluid substances (e.g. Ethanol in Water.) Volume percentages should be avoided, since the actual amount administered depends on the density (and thus on the temperature of the fluid) so that conversion to a biologically relevant amount of substance is difficult.
gas	volumic volume	25 ml/L = 2.5%	For gases volume percentage is permissible since because of the molar volume being a nature constant (22.4 L/mol) the volume fraction is equal to the molar fraction.
	volume ratio	1L:2L = 1:2	For gases that are mixed in terms of flow rates (e.g., O_2 and N_2O mixed at 1L/min : 2L/min.) In this case the qty of Material reltionships of type ingredient is preferred.

HL7 v2.3 did suggest that the quantitative information on dosage and routing could almost completely be replaced by a code for the medication that pre-coordinates the strength, form, and route.

> *Some coding systems imply the strength, units, route of administration, and manufacturer of substances within a single instructional code. NDC codes, for example, usually imply not only the medical substance, but [also] the strength, the units, and the form, e.g., 0047-0402-30^Ampicillin 250 MG TABS^NDC. So all of this information can also be completely specified in RXO-1-requested give code and in the analogous CE fields in other pharmacy/treatment segments. In this case, it is not necessary to use the strength and strength units fields to specify this information.*

Conversely, in HL7 v3 we strongly recommend to send the strength, and dose explicitly, since a complete NDC catalog may not be available to all recipients of the prescription information. In addition, sending the dose and strength quantities explicitly serves as a check to prevent wrong dosage because of a simple coding error. Finally, while a certain NDC code can suggest a default route, the actually ordered or administered route is not pre-coordinated in the NDC code. For example, capsules, usually administered orally, may well be administered rectally; tablets may be crushed and applied through a gastric tube, etc.

3.3.1.19 Requested give strength units (CE) 01122

> *Use when both RXO-1-requested give code and RXO-10-requested dispense code do not specify the strength. This is the unit of the strength, used in combination with RXO-18-requested give strength.*

The attribute Medication.strength_qty is a physical quantity with units. This HL7 v2.3 field is mapped to the unit component.

> *Note:These units can be a "compound quantity;" i.e., the units may express a quantity per unit of time. For example, micrograms per hour (μg/h) is an acceptable value. These compound units are contained in the ISO+ table. See Chapter 7 for full definition of ISO+ units.*

As opposed to HL7 v2.3, however, we require that the strength quantity of integral dose forms be a plain amount kind of quantity with appropriate units, as defined in Section Error! Reference source not found.**.** It seems as if the cited note about compound units is erroneously cut-and-pasted into this place. A strength is a property of an integral thing (e.g., a tablet, capsule, suppository) and can not sensibly be specified in a body mass (or surface area) related form, since this would require the thing to be continuously divisible.

The only exceptions to this rule are allowed for continuously divisible dose forms (fluids and gases,) whose strength is really a concentration. See Table 13 above for how these should be specified.

3.3.1.20 Indication (CE) 01123

> *This field identifies the condition or problem for which the drug/treatment was prescribed. May repeat if multiple indications are relevant.*

In HL7 v2.3 indication was communicated in two alternative ways: either through this coded RXO field, or through one or more OBX segments following the prescription segment group in the order message. In HL7 v2.3, indication in HL7 v3 is represented solely and uniformly through association of the prescription with one or more observations. The indication observation are simply attached to the Medication service order using a service relationship of type *has reason* (RSON.) This is the way to specify all indications, whether for Medications, Procedures, or other Tests.

Note that the indication/reason link is useful in all service moods. In the order mood, it specifies the reason for the ordered treatment, in the event mood it indicates the reason for the performed treatment. In definition mood ("master") the reason link specifies sufficient (OR) or necessary (AND) indications that the defined service may be ordered for.

3.3.1.21 Requested give rate amount (ST) 01218

This field contains the rate at which to administer treatment.

This field is redundant given the HL7 v2.3 "give per" time unit field discussed above. Therefore, the used and mapping in HL7 v3 is identical. See Section 3.3.1.17 above.

3.3.1.22 Requested give rate units (CE) 01219

This field contains the units in which *RXO-21-requested give rate amount* is denominated.

This field is redundant given the HL7 v2.3 "give per" time unit field discussed above. Therefore, the used and mapping in HL7 v3 is identical. See Section 3.3.1.17 above.

3.3.1.23 Total daily dose (CQ) 00329

This field contains the total daily dose for this particular pharmaceutical as expressed in terms of actual dispense units.

This field maps to Medication.dose_check_qty. **Error! Reference source not found.**

3.3.2 RXR – Medication Route

The Pharmacy/Treatment Route segment contains the alternative combination of route, site, administration device, and administration method that are prescribed. The pharmacy, treatment staff and/or nursing staff has a choice between the routes based on either their professional judgment or administration instructions provided by the physician.

In most cases, there will be only one route specified per order, one method, one body site, etc. Therefore, the attributes for route, method, body site, and the mechanisms to specify administrative devices no longer exist as a group as they did in the v2.3 RXR segment.

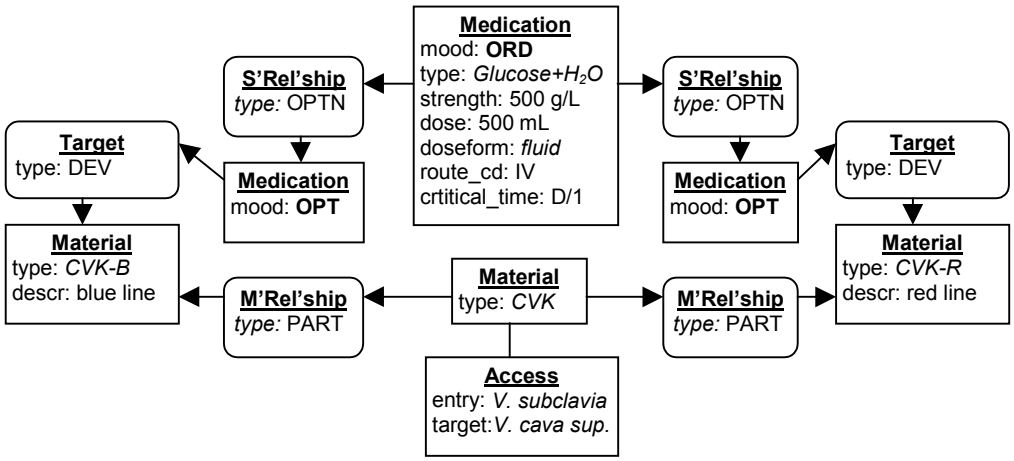

Figure 3: Example for the specification of alternative administration routes and individually identified devices: A Glucose 50% solution (strength = 0.5 kg/L) is ordered as a nutritional i.v. through the central venous catheter (CVK.) Allowed options are the blue line or the red line. Although many object seem to be involved in this expression, the objects are rather small.

The rather exceptional use case where one may want to specify multiple alternative routing options has been generalized in the concept of *option* as a mood of a Service. Multiple Medication services in option mood may be linked to the Medication order to specify alternative values for the routing fields as well as for any other field of the Medication service class. If the fields filled out in the option records are also valued in the main order, the values of the main order are of highest preference.

3.3.2.1 Route (CE) 00309

This field is the route of administration.

Some current "route codes," such as some of the NDC-derived codes include the site already. In such cases, the entire code can be included in this field as a "locally-defined code" for the CE data type. Refer to HL7 table 0162 - Route of administration for valid values.

This field maps to Medication.route_cd. This is an attribute of type Concept Descriptor, which means that one can specify the concepts using translations in multiple coding systems, such as local codes, codes maintained externally to HL7 (e.g., SNOMED.) The codes that HL7 version 3 suggests for the Mediation.route_cd attribute **must** be provided as one of the code translations, if applicable. The typical clinical routes are covered by the HL7 v3 specified concepts, so that those can be communicated interoperably. This mandated HL7 code for routes is backward compatible to HL7 version 2.3.

3.3.2.2 Site (CE) 00310

This field contains the site of the administration route. Refer to HL7 table 0163 - Administrative site for valid values.

As a CE data type, this field may be extended to cover a wide variety of body site codes (e.g., when SNOMED is used as the table source).

This field maps to Service.body_site_cd. There is no comprehensive coding system for body sites specified by HL7 at this time.

3.3.2.3 Administrative device (CE) 00311

This field contains the mechanical device used to aid in the administration of the drug or other treatment. Common examples are IV-sets of different types. Refer to HL7 table 0164 - Administration device for valid entries.

Administrative devices may be of various levels of interest. In many cases, the administrative device is implicitly understood by the route concept and substance. For example, if a bronchiolyticum is to be given *per inhalationem,* it is understood that there is some standard applicator device used, so we don't need to mention it. In general, we only need to mention applicator devices if the device requires special scheduling and handling, or, if it is not usually used for this substance and route.

If a special device must be specified, it can be done using a Material object, associated with the service as a Target of type *device*. This way the device can be specified in various levels of detail. Typical levels of detail for devices are to specify (1) only the device type (Material.type_cd), (2) the device type with instance identification (Material.type_cd and Material.id, e.g., for an inventory number or serial number.) Full specification including manufaturer, parts, and other detail may also be provided.

3.3.2.4 Administration method (CE) 00312

This field identifies the specific method requested for the administration of the drug or treatment to the patient. Refer to HL7 table 0165 - Administration method for valid values.

This field is mapped to Medication.method_cd (implied from service.) See Section **Error! Reference source not found.**.

3.3.2.5 Error! Reference source not found.Routing instruction (CE) 01315

This field provides instruction on administration routing, especially in cases where more than one route of administration is possible. A typical case would be designating which IV line should be used when more than one IV line is a possible route for injection.

In HL7 v3 free text instructions belong into the Service.descr attribute.

However, for the cited use case (which is quite common in intensive care situations,) we have defined a better way to specify the particular i.v. line to use. I.v. lines, catheters, and other accesses and drains are represented as Material. So every access for a patient can have a unique ID and can be tracked very precisely (e.g., when placed? when due for replacement? etc.) For a medication order, the individual line can thus be specified just as any other device, using the Target link between Service and Material (Target type *device*.)

3.3.3 RXC – Medication Component

If the drug or treatment ordered with the RXO segment is a compound drug OR an IV solution, AND there is not a coded value for OBR-4-universal service ID, which specifies the components (base and all additives), then the components (the base and additives) are specified by two or more RXC segments. The policy of the pharmacy or treatment application on substitutions at the RXC level is identical to that for the RXO level.

Ingredients of therapeutic substances (Material) are represented through the material relationship class of type Material. This allows not only for ad-hoc recipe orders for which "there is not a coded value", but it also allows to define ingredients of those medications for which there is a code in some vocabulary. Master file definitions of medications and ad hoc recipes appear in the same form. This

structure allows detail medical knowledge about pharmaceuticals to be shared across systems. It also takes away some of the pressure that exists on terminology systems to make one code available for each and every thing in the world.

3.3.3.1 RX component type (ID) 00313

The values for this field are B for base and A for additive. These values are mapped to the Material_relationship.type_cd. The code is structured so that the concepts *base* and *additive* imply the concept of *ingredient*. In other words, *base* and *additive* are subtypes of *ingredient*. The comments and rulings of HL7 v2.3 continue to be relevant and true for HL7 version 3.

> *For the non-IV case, the "B" value may still apply. For example, if a custom dermatologic salve is being prepared, the "B" item might be a standard base ointment into which other components are mixed.*
>
> *The amount of the "base" specified in the "B" segment(s) is defined to be the quantity into which amounts specified in the "A" components are mixed. Thus the RXC segments as a group define the "recipe" for a particular amount (defined by the base segment(s)). The give amount, as defined in the RXO, does not need to correspond to this base amount. For example, the RXC segments may specify a recipe for a liter of a standard type of saline with 1 gram of a particular antimicrobial, while the give amount (from the RXO) may specify the administration of 2 liters of this IV-solution every 24 hours.*
>
> *The amount specified in each "A" segment is defined to be the quantity to be added to the amount of the base as specified in its RXC segment.*

The amounts of components really talk about the proportion of the ingredients, this is represented in the Material_relationship.qty. The rules are the same as for the component amount of HL7 v2.3, i.e., all the proportion quantities of the ingredients are related to the same total quantity.

> *If any "base" components are present then these should be transmitted first. The first "base" component in the transmission should be considered the "primary base" if such a distinction is necessary. Similarly, the first "additive" in the transmission should be considered the "primary additive" if such a distinction is necessary.*

Distinctions of base and the meaning of the other additives are explicitly represented in the data. No additional rules of sequencing are necessary. The function of the additive can be specified more fine grained as *active ingredient*, *stabilizer*, *preservative*, *flavor*, and *color*.

3.3.3.2 Component code (CE) 00314

> *This field is equivalent to OBR-4-universal service ID. It defines the base or component in the same manner as the give and dispense codes. As with the give and dispense codes, it may contain text only, code only, text + code, or text + code + units (implied or explicit). As with the give and dispense codes, if RXC-4-component units is present, this overrides the units implied by the code. If only text is present, the pharmacy or treatment application must include a manual review or reentering of the component drug or treatment.*

This field maps to the Material.type_cd of a Material instance associated as an ingredient with the compound Material.

3.3.3.3 Component amount (NM) 00315

> *This field identifies the amount of this component to be added to the specified amount of the base.*

This field maps to the Material_relationship.qty, the use is the same as with HL7 v2.3.

3.3.3.4 Component units (CE) 00316

This field identifies the units for the component amount. If present, this overrides the units implied by RXC-2-component code. This must be in simple units that reflect the actual quantity of the component being added. It does not include compound units.

The Material_relationship.qty is of data type Physical Quantity (PQ.) It includes the units. The qty must be of an amount kind of quantity as defined in Section **Error! Reference source not found.**.

3.3.3.5 Component strength (NM) 01124

Use when RXC-2-component code does not specify the strength. This is the numeric part of the strength, used in combination with RXC-6-component strength units.

While strength is customarily used for medications in manufactured form, for the definition of ingredients it is not necessary to have strength. Strength can be an ambiguous concept in a compound with multiple ingredients, which is why ingredient lists are communicated in fully decomposed. For example, instead of adding 5 ml of 5% Lidocaine into a salve recipe, we can prescribe 250 mg Lidocaine to be added (and 5 ml of Water if this degree of precision is required.)

3.3.3.6 Component strength units (CE) 01125

The concept of strength is undefined for material and ingredients.

3.3.4 RXE – Prescription Encoding

The RXE segment details the pharmacy or treatment application's encoding of the order. It also contains several pharmacy-specific order status fields, such as RXE-16-number of refills remaining, RXE-17-number of refills/doses dispensed, RXE-18-D/T of most recent refill or dose dispensed, and RXE-19-total daily dose.

Prescription encoding is a revision of the original order (RXO.) The underlying assumption of "encoding" is that the original order does usually come in a free text form rather than using all of the information structure for dosage and timing. Thus, the pharmacy system is supposed to properly "encode" the information.

The other, probably more important use of the prescription encoding is the verification by the pharmacist. This verification includes medical issues as well as the check whether the prescribed medication meets the requirements of the healthcare coverage plan(s) of the patient, substitution of generics, or other brands that are part of a certain formulary.

Medication order revisions are represented in exactly the same way as original medication orders, with the addition of a service relationship of type *revision* that links the revision to the original. The responsible actor of the revision is usually the pharmacist, while a physician is responsible for the original order.

Since Medication order and medication order revision are represented in the same data structure, we do not comment on RXE fields that are the same as corresponding RXO fields.

3.3.4.1 Quantity/timing (TQ) 00221

Note that ORC-7-quantity/timing has a different meaning from RXE-1-quantity/timing and RXG-3-quantity/timing. The pharmacy or treatment department has the "authority" (and/or necessity) to schedule dispense/give events. Hence, the pharmacy or treatment department has the responsibility to encode this scheduling information in RXE-1-quantity/timing and RXG-3-quantity/timing. ORC-7-quantity/timing does not change: it always specifies the requested give/dispense schedule of the original order.

The Medication class represents the administration of drugs, not the dispensing. If the dispensing of medication needs to be specified one can do so using associated Supply service. Thus, the RXE quantity timing field maps to the Supply.critical_time attribute of an associated supply service.

3.3.4.2 Give code (CE) 00317

See RXO-field of the same name.

3.3.4.3 Give amount - minimum (NM) 00318

See RXO-field of the same name.

3.3.4.4 Give amount - maximum (NM) 00319

See RXO-field of the same name.

3.3.4.5 Give units (CE) 00320

See RXO-field of the same name.

3.3.4.6 Give dosage form (CE) 00321

See RXO-field of the same name.

3.3.4.7 Provider's administration instructions (CE) 00298

See RXO-field of the same name.

3.3.4.8 Deliver-to location (CM) 00299

See RXO-field of the same name.

3.3.4.9 Substitution status (ID) 00322

This field directly translates to Service.substitution_cd. The values are backward compatible. Note that the variance between what was ordered and what the pharmacist has substituted can be seen in detail by comparing the original order with the order revision.

3.3.4.10 Dispense amount (NM) 00323

See RXO-field of the same name.

3.3.4.11 Dispense units (CE) 00324

See RXO-field of the same name.

3.3.4.12 Number of refills (NM) 00304

See RXO-field of the same name.

3.3.4.13 Ordering provider's DEA number (XCN) 00305

See RXO-field of the same name.

3.3.4.14 Pharmacist/treatment supplier's verifier ID (XCN) 00306

See RXO-field of the same name.

3.3.4.15 Prescription number (ST) 00325

This field contains the prescription number as assigned by the pharmacy or treatment application. Equivalent in uniqueness to the pharmacy/treatment filler order number. At some sites, this may be the pharmacy or treatment system (internal) sequential form. At other sites, this may be an external form. This is a required field in RXE when used in pharmacy/treatment messages, but it is not required when used in product experience messages (see Chapter 7).

This is an additional identifier assigned to the medication order in by the pharmacy system. In HL7 version 3, many unique identifiers can be assigned to an order in the one attribute Service.id. The Service.id is a set of Instance Identifier (II) attributes. The systems that issued the identifier will recognize its own identifier by looking at the assigning authority unique identifier component.

3.3.4.16 Number of refills remaining (NM) 00326

Number of refills remaining. This field is conditional because it is required when a prescription is dispensed to an outpatient. It is not relevant to inpatient treatment orders.

The number of remaining refills does not need to be communicated explicitly, since it is the difference between the total refills allowed for a prescription and the number of refills so far dispensed.

Every dispense event is connected to the original prescription through a service relationship of type *dispense for*. That service relationship has a sequence_nmb attribute that will contain the ordinal number of dispenses, where counting begins with one.

Thus the number of refills remaining is the max_repetition_nmb of the dispense part of the prescription, minus the current ordinal number of the dispense event for the prescription.

3.3.4.17 Number of refills/doses dispensed (NM) 00327

This is the sequance_nmb of the service reltionship of type dispense for, that links the current dispensing event with the dispense part of the order.

3.3.4.18 D/T of most recent refill or dose dispensed (TS) 00328

Date/time of the most recent refill or dose dispensed.

The time of the last refill is an attribute of the last refill and is thus specified in the record representing that previous refill. There is no need to specify any additional information in the record of the previous refill if this information is unknown.

3.3.4.19 Total daily dose (CQ) 00329

This field contains the total daily dose for this particular pharmaceutical as expressed in terms of actual dispense units.

The total daily dose is an attribute of a medication administration, not of a medication dispense event. This calculated field does not need to be sent explicitly as it can always be recalculated in a receiving system.

3.3.4.20 Needs human review (ID) 00307

See RXO-field of the same name.

3.3.4.21 Pharmacy/treatment supplier's special dispensing instructions (CE) 00330

This field contains the pharmacy or treatment supplier's provider-generated special instructions to the provider dispensing/administering the order.

There is no standard code of treatment instructions as such, and it is quite unlikely that there will ever be a standard code system covering the domain of treatment instructions.

In HL7 v3 there is no dedicated field for specialized instructions, but all free text instructions belong into the Service.descr attribute.

While it is not likely that all treatment instructions will be coded, further analysis of how these instructions are used in practice may lead to additional mapping guidelines. Such mapping can be defined either on existing message structures of HL7 version 3, or may lead to the definition of attributes that cover special aspects of such instructions. Some administration instruction codes may be mapped to the Service.method_cd.

3.3.4.22 Give per (time unit) (ST) 00331

See RXO-field of the same name.

3.3.4.23 Give rate amount (ST) 00332

See RXO-field of the same name.

3.3.4.24 Give rate units (CE) 00333

See RXO-field of the same name.

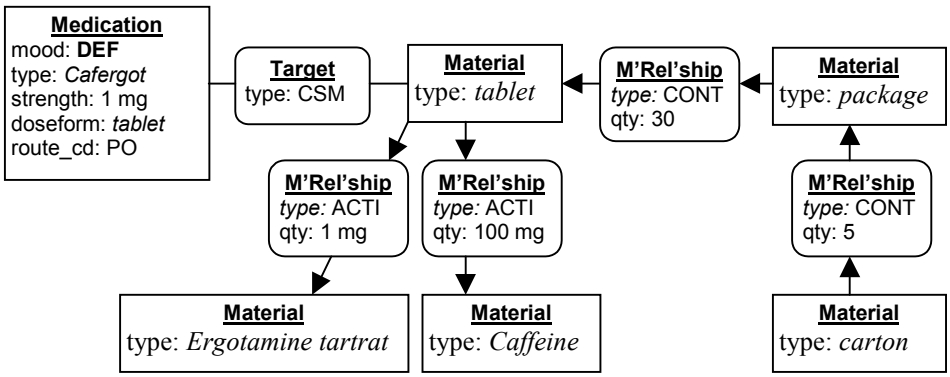

Figure 4: Example for material relationships commonly used with drugs. Cafergot® tablets have two active ingredients: 1 mg of Ergotamine tartrat and 100 mg of Caffeine. The different levels of packaging are described through the Material relationship of type *contains* (CONT): 30 tablets are in a package and five such packages are in a carton.

3.3.4.25 Give strength (NM) 01126

See RXO-field of the same name.

3.3.4.26 Give strength unit (CE) 01127

See RXO-field of the same name.

3.3.4.27 Give indication (CE) 01128

See RXO-field of the same name.

3.3.4.28 Dispense package size (NM) 01220

This field contains the size of package to be dispensed. Units are transmitted in RXE-29-dispense package size unit.

The different kinds and levels of packaging are all expressed in the class Material and Material_relationship (of type *contains*). Thus, one can describe, say, ten tablets on a sheet, three sheets in a package, five packages in a carton, etc. See Figure 4 for an instance example.

The package size is the Material_relationship.qty and the package size unit is the Material (thing) at the target-end of the Material_relationship. For example, a package containing 30 tablets is represented as Package ➔ contains (qty = 30) ➔ Tablet.

3.3.4.29 Dispense package size unit (CE) 01221

This field contains the units in which RXE-28-dispense package size is denominated.

Package units are not units of measure and can not represented by the same vocabulary as units of measure. Package "units" are concrete kinds of things (e.g., tablet, vial, bottle, etc) rather than abstract measurements (meter, pound, etc.) Since the different kinds and levels of packaging are all expressed in the class Material and Material_relationship (of type *contains*), there is no concept of package "unit" in HL7 v3.

The package size is the Material_relationship.qty and the package size unit is the Material (thing) at the target-end of the Material_relationship. For example, a package containing 30 tablets is represented as Package ➔ contains (qty = 30) ➔ Tablet. See Figure 4 for an instance example.

3.3.4.30 Dispense package method (ID) 01222

This field contains the method by which treatment is dispensed. Refer to HL7 table 0321 - Dispense method for valid values.

The dispense package method is represented by the method_cd of the Supply service that stands for the dispense order or evernt.

3.3.5 RXD – Dispensing

Pharmacy dispensing is a kind of supply service. Every dispense event is associated with a medication order (prescription.) The dispense event fulfills part of a medication service order, by handing the drug to the actor who is going to administer the drug. See Figure 5 for an instance example.

3.3.5.1 Dispense sub-ID counter (NM) 00334

This field starts with 1 the first time that medication is dispensed for this order. Increments by one with each additional issuance of medication.

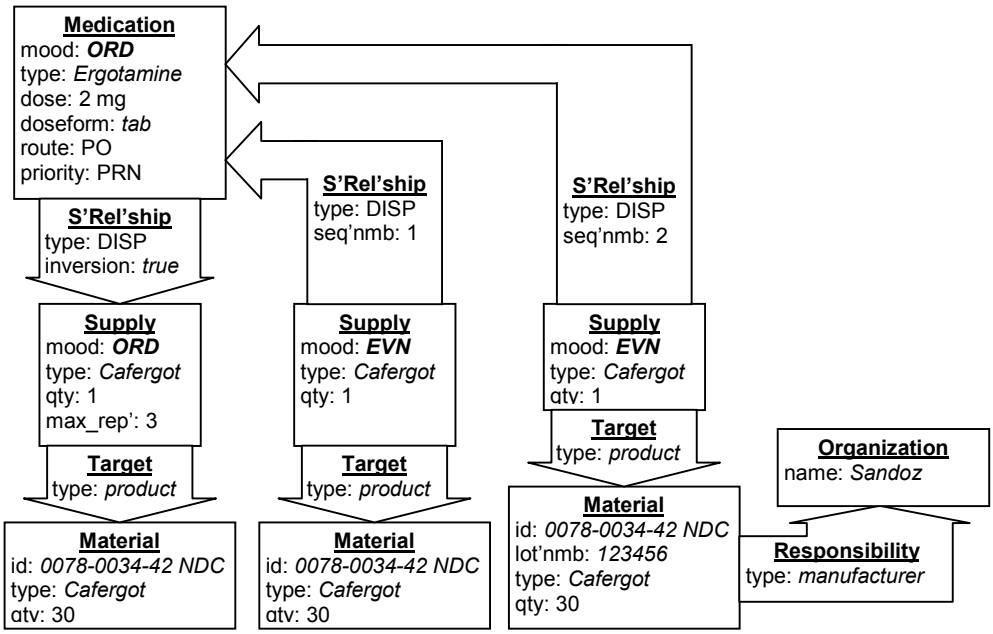

Figure 5: Example of a prescription with one initial dispense and one refill. The prescription (left column) contains of a medication part (upper) and a dispense (supply) part (lower). The dispense part of the order allows for 3 fillings, i.e. one initial dispense and two additional refills. Each dispense for a prescription has an ordinal number in the Service_relationship.sequence_nmb attribute of the relationship linking the dispense event to the prescription. Details about the dispensed drug are found in the Material objects associated to the dispense (supply) service as *product*. This includes NDC and Lot number. The manufacturer is an Organization (Stakeholder) linked to the material through a Responsibility association.

Dispense events can be counted using the sequence number of the service relationship that ties the dispense event to the prescription.

3.3.5.2 Dispense/give code (CE) 00335

See RXE-field of the same name.

3.3.5.3 Date/time dispensed (TS) 00336

This field indicates when the pharmaceutical is dispensed from the pharmacy or treatment supplier. Use the time stamp format.

3.3.5.4 Actual dispense amount (NM) 00337

This field indicates the amount dispensed.

See *RXE-28 dispense package size* and *RXE-29 dispense package size units*.

Note that the difference between ordered and actual information about a service is distinguished by the mood code of the Service object. That is, for a dispense order (mood code = ORD), the Supply.qty is the amount as ordered (or intended.) For a dispense event (mood code = EVN), the Supply.qty is the actual amount dispensed.

3.3.5.5 Actual dispense units (CE) 00338

This field indicates the units dispensed. Site-defined table. This field is required if the units are not implied by the actual dispense code. If present, it overrides units implied by the actual dispense code. This must be in simple units that reflect the actual quantity of the substance dispensed. It does not include compound units.

See *RXE-28 dispense package size* and *RXE-29 dispense package size units*.

Note that there is no coded concept domain of "dispense units" in HL7 version 3. Dispense units are not "units" in the sense of "units of measure" at all. Dispense units are things, concrete objects, represented by instances of the Material class, linked with the dispense service as a Target of type *product*.

3.3.5.6 Actual dosage form (CE) 00339

The dosage form indicates the manner in which the medication is aggregated for dispensing, e.g., tablets, capsules, suppositories. In some cases, this information is implied by the dispense/give code in RXD-2-dispense/give code. Use this field when the give code and the dispense code do not specify the dosage form.

The actual dose form a property of the Material (product) dispensed. It is represented in the Material.form_cd attribute. This field should be valued even if the form is pre-coordinated in the Material.type_cd. Note that even NDC codes are not always unique for the dose form.

3.3.5.7 Prescription number (ST) 00325

See RXE-field of the same name.

3.3.5.8 Number of refills remaining (NM) 00326

See RXE-field of the same name.

3.3.5.9 Dispense notes (ST) 00340

This field contains free text notes to the person dispensing the medication (may include the ordering provider's original notes, as well as any notes from the formulary or the pharmacy or treatment supplier). This may contain free text describing a custom IV, mixture, or salve.

Descriptions about the supplied drug can be carried in the Material.descr attribute, in a drug master file. This can even include a photograph showing the appearance of the pill, such as provided by the *Physician's Desk Reference* (a paper-based drug "master file".) Notes pertaining to the dispense event can be recorded in the Service.descr of the dispense (supply) service. If the pharmacist gives medication dosage instructions or advice (e.g. for prescription-less over-the-counter drugs,) this can be recorded in a medication service event, associated with the supply service event.

3.3.5.10 Dispensing provider (XCN) 00341

This field contains the provider ID of the person dispensing the pharmaceutical.

A person dispensing a drug is an active participant in the supply service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows

representing the audit trail more completely using the Actor.tmr (time range) attribute. It also allows including as many verifiers as the business rules require.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specifying the actual responsibility of every person at different points in the service's life cycle. For a supply service, the dispensing provider is of Actor.type_cd *performer* (PRF.)

3.3.5.11 Substitution status (ID) 00322

See RXE field of the same name.

3.3.5.12 Total daily dose (CQ) 00329

This field contains the total daily dose being dispensed as expressed in terms of the actual dispense units.

Note: The next two fields are equivalent to the corresponding fields of the RXE segment. They are included (optionally) in the RXD so that it may "stand alone" as a dispense result instruction segment.

Note that medication instructions given at the time of dispense form a medication service of their own. There is no duplication of attributes from the Medication class in the Supply class.

3.3.5.13 Dispense-to location (CM) 01303

See RXE field of the same name.

3.3.5.14 Needs human review (ID) 00307

See RXE field of the same name.

3.3.5.15 Pharmacy/treatment supplier's special dispensing instructions (CE) 00330

See RXE field of the same name.

3.3.5.16 Actual strength (NM) 01132

Use when RXD-2-dispense/give code does not specify the strength. This is the numeric part of the strength, used in combination with RXD-17-actual strength unit.

The "strength" of a drug is not represented as an attribute of the Material class but rather as the quantity of the active ingredient(s.)

3.3.5.17 Actual strength unit (CE) 01133

The "strength" of a drug is not represented as an attribute of the Material class but rather as the quantity of the active ingredient(s.)

3.3.5.18 Substance lot number (ST) 01129

This field contains the lot number of the medical substance administered.

Note: The lot number is the number printed on the label attached to the container holding the substance and on the packaging which houses the container. If the substance is a vaccine, for example, and a diluent is required, a lot number may appear on the vial containing the diluent; however, any such identifier associated with a diluent is not the identifier of interest. The substance lot number should be reported, not that of the diluent.

The lot number is found in the Material.lot_nmb attribute of type character string. Note that a lot number is not meant to be a unique identifier, but is meaningful only when the product kind is identified.

Also note, if a substance is mixed from components, the lot numbers of each component *can* be represented in each respective Material instance. If a mixture turns out to be bad (e.g., contaminated, it is not necessarily the "active" ingredient that is contaminated, it could as well be the diluent.

3.3.5.19 Substance expiration date (TS) 01130

This field contains the expiration date of the medical substance administered.

Expiration dates does not always have a "day" component; therefore, such a date may be transmitted as YYYYMM.

The expiration date is the high boundary of the Material.extent_tmr, which is an interval of points in time. That is, the high boundary of that interval is a time stamp.

3.3.5.20 Substance manufacturer name (CE) 01131

This field contains the manufacturer of the medical substance administered.

Note: For vaccines, code system MVX may be used to code this […]. This field may be used if the manufacturer of the substance is not identified by the code used in RXA-5-administered code.

The manufacturer is a responsible Stakeholder associated with the material through a Responsibility instance of type *manufacturer* (MAN). The "MVX" code system that has been provided jointly with HL7 and CDC may be used as a special kind of Instance Identifier. HL7 will provide a OID for the assigning authority component of the Intsance Identifier. The MVX code can then be used as the Identifier value.

3.3.5.21 Indication (CE) 01123

See RXO field of the same name.

3.3.5.22 Dispense package size (NM) 01220

See RXE field of the same name.

3.3.5.23 Dispense package size unit (CE) 01221

See RXE field of the same name.

3.3.5.24 Dispense package method (ID) 01222

See RXE field of the same name.

3.3.6 RXG – Give Notices

A give notice is a very special kind of message that is used as a reminder for every single dose to be administered. Give notices are designed to be sent from a pharmacy system to a nursing information system. In a sense a give notice is an order even though it is not authored individually by a medical doctor. Give notices can be sent as Medication services of mood code RXG (a subcategory of *order* ORD.) The difference between a physician's order and an automatically generated give notice is found in the attribution: the give notice does not have an ordering provider associated with it.

3.3.6.1 Give sub-ID counter (NM) 00342

Use if this RXG segment carries information about a single administration. Starts with 1 for the first scheduled give date/time transmitted by the pharmacy/treatment supplier for this order. Increments by one with each additional scheduled give date/time for this order.

If the RXG segment carries information about multiple administrations, this field's value is zero (0), since in this case a one-to-one matching with the RAS segment is ambiguous.

A give notice should be sent together with the physician's prescription order (although not all detailled information of the original order needs to be sent.) The service relationship of type *fulfills* that links the give notice with the prescription has the attribute sequence_nmb that holds the ordinal number of give notices sent for the prescription.

3.3.6.2 Dispense sub-ID counter (NM) 00334

This is the dispense sub-ID to which this give message is related.

A give notice may be linked with a dispense event. See *RXD-1-dispense sub-id counter* for how those are expressed.

3.3.6.3 Quantity/timing (TQ) 00221

This field contains the quantity/timing specification that refers to either a single scheduled give instruction only or to multiple give instructions. In the former case, RXG-1-give sub-ID counter is a positive integer greater than or equal to one (1). In the latter case, RXG-1-give sub-ID counter is zero (0). The quantity will always be 1. This quantity/timing field may differ from the ORC quantity/timing field, which contains the requested quantity/timing of the original order.

Note: The contents of fields 3-8 should be identical to the comparable fields in the RXE (RXE-2 thru 5).

Give notices are represented by Medication service instances of mood code ORD or SCH. However, a give notice is usually for one single administration. Therefore, no special timing except for the single scheduled administration event should be sent in a Medication service instance representing a give notice. Since a give notice should be accompanied by the prescription, the overall schedule of all administrations can be communicated as the Medication.critical_time for the overall Medication order.

3.3.6.4 Give code (CE) 00317

See RXO field of the same name. Note the difference between requested, scheduled and actual is represented in the mood code of the Service object.

3.3.6.5 Give amount - minimum (NM) 00318

See RXO field of the same name. Note the difference between requested, scheduled and actual is represented in the mood code of the Service object.

3.3.6.6 Give amount - maximum (NM) 00319

See RXO field of the same name.

3.3.6.7 Give units (CE) 00320

See RXO field of the same name.

3.3.6.8 Give dosage form (CE) 00321

See RXO field of the same name.

3.3.6.9 Administration notes (CE) 00351

This field contains notes to the person administering the medication (may include the ordering provider's original notes, as well as any notes from the formulary or the pharmacy or treatment supplier). If coded, a user-defined table must be used. If free text, place a null in the first component and the text in the second, e.g., `|^this is a free text administration note|`.

Any free text notes and instructions should be sent in the Service.descr attribute.

3.3.6.10 Substitution status (ID) 00322

See RXE field of the same name.

3.3.6.11 Dispense-to location (CM) 01303

See RXO field of the same name.

3.3.6.12 Needs human review (ID) 00307

See RXO field of the same name.

3.3.6.13 Pharmacy/treatment supplier's special administration instructions (CE) 00343

See RXE field of analogous name.

3.3.6.14 Give per (time unit) (ST) 00331

See RXO field of the same name.

3.3.6.15 Give rate amount (ST) 00332

See RXO field of the same name.

3.3.6.16 Give rate units (CE) 00333

See RXO field of the same name.

3.3.6.17 Give strength (NM) 01126

See RXO field of the same name.

3.3.6.18 Give strength units (CE) 01127

See RXO field of the same name.

3.3.6.19 Substance lot number (ST) 01129

See RXD field of the same name.

3.3.6.20 Substance expiration date (TS) 01130

See RXD field of the same name.

3.3.6.21 Substance manufacturer name (CE) 01131

See RXD field of the same name.

3.3.6.22 Indication (CE) 01123

See RXO field of the same name.

3.3.7 RXA – Administration Reports

The ORC must have the filler order number and the order control code RE. As a site-specific variant, the RXO and associated RXCs and/or the RXE (and associated RXCs) may be present if the receiving application needs any of their data. The RXA carries the administration data.

The RXA is represented by a Medication service in event (EVN) mood. Most of the attributes have been described an mapped above.

Note that the RXA for vaccination messages is mapped in the exact same way to HL7 version 3 as the RXA for any other drug administration.

3.3.7.1 Give sub-ID counter (NM) 00342

See RXG field of the same name.

3.3.7.2 Administration sub-ID counter (NM) 00344

This is analogous to the dispense and give sub-id counters. Any administration should be linked with the prescription. The administration ordinal number is represented in the sequence number attribute of the service relationship that links the Medication event with the Mediation order.

3.3.7.3 Date/time start of administration (TS) 00345

If the order is for a continuous administration (such as an IV), and the rate is changed at a certain time after the start, an RAS message can be issued to record the change. For such an RAS message, this field records the time the rate was changed to the new value recorded in the RXA-12-administered per (time unit) of the same message.

The attribute Medication service critical time of an administration service is usually just a point in time or a simple interval. The start time is either that single point in time or the low boundary of the interval.

3.3.7.4 Date/time end of administration (if applies) (TS) 00346

If null, the date/time of RXA-3-date/time start of administration is assumed.

The high boundary of the interval assigned to the attribute Medication service critical time of an administration service.

3.3.7.5 Administered code (CE) 00347

This field contains the identifier of the medical substance administered. It is equivalent to OBR-4-universal service ID in function. If the substance administered is a vaccine, CVX codes may be used to code this field (see HL7 table 0292 - Vaccines administered).

Just like the RXO give code this field maps to the Medication.type_cd.

3.3.7.6 Administered amount (NM) 00348

This field contains the amount administered.

Just like the RXO give amount, this field maps to the Medication.dose_qty's value component.

3.3.7.7 Administered units (CE) 00349

This field is conditional because it is required if the administered amount code does not imply units. This field must be in simple units that reflect the actual quantity of the substance administered. It does not include compound units.

Just like the RXO give units, this field maps to the Medication.dose_qty's unit component.

3.3.7.8 Administered dosage form (CE) 00350

The dosage form indicates the manner in which the medication is aggregated for dispensing, e.g., tablets, capsules, suppositories. In some cases, this information is implied by the dispense/give code in RXA-5-administered code. Use this field when the administered code does not specify the dosage form.

Just like the RXO dosage form, this field maps to the Medication.dosefoem_cd.

3.3.7.9 Administration notes (CE) 00351

This field contains notes from the provider administering the medication. If coded, requires a user-defined table. If free text (describing a custom IV, mixture, or salve, for example) place a null in the first component and the text in the second, e.g., |^this is a free text administration note|.

Maps to the Service.descr attribute of the administration service event.

3.3.7.10 Administering provider (XCN) 00352

This field contains the provider ID of the person administering the pharmaceutical.

A person administering a drug is an active participant in the administration service. All information about actors will be communicated using the Actor participation class linking a person to a service. This allows representing the audit trail more completely using the Actor.tmr (time range) attribute. It also allows including as many verifiers as the business rules require.

This information is increasingly important in presence of laws and regulations for accountability and authenticated health care information. In the version 3 model, all persons having responsibilities in a service (order, performance and documentation) are consistently and uniformly associated with the service through the Actor class. The Actor.type_cd allows to precisely specifying the actual responsibility of every person at different points in the service's life cycle. The administering provider is of Actor.type perfomer.

3.3.7.11 Administered-at location (CM) 00353

The first component contains the inpatient or outpatient location at which the drug or treatment was administered (if applicable). The default (null) value is the current census location for the patient. Site-specific table. The first eight components have the same form as the first eight components of PV1-3-assigned patient location. The final eight components replace the ninth component of PV1-3-assigned patient location and represent the full address specification.

The location of the administration service is associated with the administration service through a target participation of type *location* (LOC). Location is a role of Material.

3.3.7.12 Administered per (time unit) (ST) 00354

This field contains the rate at which this medication was administered as calculated by using RXA-6-administered amount and RXA-7-administered units. This field is conditional because it is required when a treatment is administered continuously at a prescribed rate, e.g., certain IV solutions.

Just like the RXO give per (time unit), this field maps to the Medication.rate_qty attribute. See the respective RXO field about the details of this mapping.

3.3.7.13 Administered strength (NM) 01134

Use when RXA-5-administered code does not specify the strength. This is the numeric part of the strength, used in combination with RXA-14-administered strength units.

Just like the RXO strength, this field maps to the Medication.strength_qty attribute. See the respective RXO field about the details of this mapping.

3.3.7.14 Administered strength units (CE) 01135

Just like the RXO strength, this field maps to the Medication.strength_qty attribute's unit component.

3.3.7.15 Substance lot number (ST) 01129

See RXD field of the same name.

3.3.7.16 Substance expiration date (TS) 01130

See RXD field of the same name.

3.3.7.17 Substance manufacturer name (CE) 01131

See RXD field of the same name.

3.3.7.18 Substance refusal reason (CE) 01136

This field contains the reason the patient refused the medical substance. Any entry in the field indicates that the patient did not take the substance.

The fact that an administration has been refused is a status code of a service event. Any reason of this refusal can be communicated in the Service.descr attribute of the administration event as free text. If the refusal needs to be communicated in some coded form (note that there has never been a standard coding system for it) this can be done using a kind of Consent service event. Note that for some refusals a formal consent must indeed be signed in order to protect the provider against liability claims.

3.3.7.19 Indication (CE) 01123

See RXO field of the same name.

3.3.7.20 Completion status (ID) 01223

Status of treatment administration event.

This field maps to the Service.status_cd.

3.3.7.21 Action code - RXA (ID) 01224

Status of record. The information in this field enables the use of the RXA in the vaccine messages [...], where a method of correcting vaccination information transmitted with incorrect patient identifying information is needed. Refer to HL7 table 0323 - Action code for valid values [contains: add, delete, update.]

In HL7 version 3 this message processing information is part of the update semantics rules. See the Message Development Framework about how this is represented.

3.3.7.22 System entry date/time (TS) 01225

Date/time the administration information was entered into the source system. This field is used to detect instances where treatment administration information is inadvertently entered multiple times by

providing a unique identification field. Under usual circumstances, this field would be provided automatically by the computer system rather than being entered by a person.

This field can be mapped to the Actor.tmr (high boundary) value of the actor instance of type *data entry* (ENT.)

3.4 Observation Master Files

Observation master files are used to exchange definitions of orderable tests and of result descriptions. In HL7 version 3, master files can be exchanged for all services (and all material,) not just for observation services. A master file record for a service is simply an instance of that service class with a mood code of *definition* (DEF).

In principle, the master files define the possible, allowable or typical values for each attribute. Therefore, in definition mood, most attributes can be assigned a set of values, although in a service event record one would expect only one value. For coded attributes, "set of values" means an enumerated set of codes. For quantitative attributes, "set of values" typically means a continuous interval (since enumerating individual real numbers is unreasonable.)

3.4.1 OM1 – General Observation Master

The OM1 segment contains the attributes that apply to the definition of most observations. This segment also contains the field attributes that specify what additional segments might also be defined for this observation.

The OM1 segment will usually map to an instance of Observation service with mood_cd = DEF. However, since HL7 version 2.3 lacked any master file support for non-observation services, it practically happens that some sites will use OM1 segments to exchange information about non-observation services. In HL7 version 3, the proper subclass of Service should be used for non-observation services. If in doubt, one should prefer to use the Service class directly rather than pretend a surgical procedure or transportation event to be an "observation."

3.4.1.1 Sequence number – test/observation master file (NM) 00586

This field contains the first OM1 segment in a message and is described as 1, the second as 2, and so on.

This has always been a redundant field. It is message-encoding dependent and can thus not have a useful meaning beyond a single message. It is not mapped to HL7 v3.

3.4.1.2 Producer's test/observation ID (CE) 00587

This field contains the producer's usual or preferred identification of the test or observation. Only three components should be included: <ID code>^<service text name/description>^<source list of code>. All components should be non-null. The source list may be any of those included in ASTM Tables 3 and 5, or a local code.

This identifier is mapped to the Service.id field. Note that HL7 v3 distinguishes between instance identifiers and concept classifiers. Code values are concept classifiers. In HL7 v2.3, however, the Coded Element (CE) data type has been used for both, concepts and instances.

The difference between instance identifiers and concept classifiers is that concept classifiers are a reference into an external system of concepts and their definitions. A code table is such an external system of concepts and their definition and the code symbol itself is the reference into that system.

Conversely, instance identifiers are explained and defined nowhere else than in the master file record. Instance identifiers are thus similar to "local codes," that are not defined (or used) by anyone else than the one who issues these identifiers. In fact, some sites may have used this field to communicate alternative codes.

In HL7 version 3 Instance Identifiers are defined based on ISO Object Identifiers (OID) and a character string identifier value. The OID part of the Instance Identifier refers globally uniquely to the "assigning authority" that assigns the string identifiers.

Every producer who publishes a service catalog via HL7 should assign a unique identifier to every service catalog item. Note that no external vocabulary can be used for this purpose, since even for a very fine-grained vocabulary such as LOINC, a producer may offer several different variation of the service. For example, there could be variants for a bedside test and a test sent to a laboratory, a quick test, and one requiring more time, one version to be done during normal business hours, and another for nights and weekends. The identifier should uniquely identify the service catalog item, without any concern about terminological issues.

In mapping this HL7 v2.3 field to HL7 version 3, one should not map codes from any standard coding system to the Service.id field. Coded values should be sent in the Service.type_cd field.

3.4.1.3 Permitted data types (ID) 00588

This field contains the allowed data type(s) for this observation. The codes are the same as those listed for OBX (a given observation may, under different circumstances, take on different data types). Indeed, under limited circumstances, an observation can consist of one or more fragments of different data types. When an observation may have more than one data type, e.g., coded (CE) and numeric (NM) the allowable data types should be separated by repeat delimiters. Refer to HL7 table 0125 - Value type *for valid values.*

A single test should always result in the same base data type, mostly Physical Quantity (PQ) and Concept Descriptor (CD.) This expected data type is declared in the Observation.value attribute. The observation.value is of data type ANY, which is a composite of two components: a data type tag, and a component of the any data type as selected by the data type tag. In actual values, the data type tag indicates the actual data type, in observation definitions, the data type tag indicates the expected data type.

3.4.1.4 Specimen required (ID) 00589

This field contains a flag indicating whether or not at least one specimen is required for the test/observation. Refer to HL7 table 0136 - Yes/no indicator *as defined in Chapter 2.*

When a specimen is required, segment OM4 will usually be included (one per specimen is required).

In HL7 version 3 a specimen requirement is indicated by one or more specimen records associated with the Observation service. This is any Material record associated with the service definition through a Target participation of type_cd = SPEC. This specimen record describes the specimen requirement in any necessary detail.

3.4.1.5 Producer ID (CE) 00590

This field uniquely identifies the service producing the observation described in this segment. Three components should be included: an identifying code, the name of the producer, and the identity of the coding system (e.g., 323-5678^Acme Special Lab^MC). The identity of the coding system will usually be MC (Medicare provider number or HIBCC site codes) in the United States. Each country may want to specify its preferred coding system and define a coding system ID to identify it.

Remember that the magnitude of a treatment or the setting on a machine, such as a ventilator, can be regarded as an observation. Thus, pharmacy, respiratory care, and nursing may be producers of such observations.

The producer of a service is an active participant, of Actor.type_cd = *performer*.

3.4.1.6 Observation description (TX) 00591

This field contains a text description of this observation.

This field maps to the Service.descr attribute.

3.4.1.7 Other test/observation IDs for the observation (CE) 00592

This field contains all alias codes/identifiers for this observation. If more than one alias code needs to be specified, multiple three-component, CE-format entries (<code 1>^<name 1>^<code system 1>) may be given, separated by repeat delimiters. An observation may have as many names/codes as are applicable (e.g., ICD9, ACR-NEMA, SNOMED, and READ). We encourage the inclusion of as many different codes as may apply to assist cross-system mapping of terminology. All components of each triplet should be non-null (that is, names and coding system IDs within the CE data type are required in addition to codes). The source list may be any of those included in ASTM Tables 3 and 5.

Because the size (dose) of a treatment can also be an observation, codes that identify treatments (e.g., NDC, ICCS) may also be included in this field.

Note: In this field, the names within the CE data type are required.

This field maps to the Service.type_cd attribute. The service.type_cd is a Concept Descriptor that can contain arbitrary many codes from different coding systems, regarded as synonyms for the test defined in this service catalog item.

3.4.1.8 Other names (recognized by the producer for the observation) (ST) 00593

This field contains any test aliases or synonyms for the name in the context of the ordering service. These are alternative names, not associated with a particular coding system, by which the battery, test, or observation (e.g., measurement, test, diagnostic study, treatment) is known to users of the system. Multiple names in this list are separated by repeat delimiters.

Alternate names of the service are currently mapped to the Service.type_cd as well. This same attribute holds codes from various coding systems. The distinction between names and codes is quite blur. We suggest using a local coding system identifier for these names.

The “other names” are typically natural language words or abbreviations that people might use for the test. Intelligent order entry systems will recognize a term by any of those natural language synonyms. In order to support this in version 3, one could, for instance, define a local coding system “99SYN” for local code “synonymes.”

3.4.1.9 Preferred report name for the observation (ST) 00594

This field contains the preferred name for reporting the observation or battery. The name can contain up to 30 characters (including blanks). It is the preferred name for columnar reports that require a maximum name size.

This concept of "preferred report name" is currently not mapped specially. A preferred report name is first of all a report name, and so it is handled as described in the previous field. The notion of "preference" is problematic, since the question is, who prefers that name and for what purpose?

We recommend devising a certain local coding system for all preferred test names, and send the names as codes. Since different applications might prefer a different names, each one might define it's own system of names, which can be distinguished by the local coding system identifier.

For example, consider the following scenario: A clinical laboratory suggests a set of names to be preferred (99LABN) while a departmental information system might prefer different names (99CARDION). Both, the lab system and the departmental information system are legacy systems, and have certain constraints for the character set used and the length of the names (e.g., 8 characters U.S. ASCII, all caps.) Yet another department might install a modern system with graphical user interface, that can show longer names to their users, including special characters, this system would define it's preferred names as 99NEWN.

3.4.1.10 Preferred short name or mnemonic for the observation (ST) 00595

This field contains the name that can be used in space-limited reports (e.g., specimen labels) to identify the observation for the convenience of human readers. The name can contain up to eight characters.

See comment above. Different systems have different constraints and different views, what a "short name is." Short, may mean 5 characters for an older legacy system, while a more modern GUI based system may consider 10 characters as short. Since different sets of names can be defined in different local coding systems, one can store them all in the Concept Descriptor and can defer the selection of preferred names to the various application systems.

3.4.1.11 Preferred long name for the observation (ST) 00596

This field contains the fully-specified name for the observation or battery. It may include the full (unabbreviated) multiple-word names and contain up to 200 characters. It should be as scientifically precise as possible.

Please refer to the comments to the three previous fields.

3.4.1.12 Orderability (ID) 00597

This field indicates whether or not a test/observation is an orderable code. Refer to HL7 table 0136 - Yes/no indicator *for valid values.*

For example, blood differential count is usually an orderable "test," MCV, contained within the differential count, is usually not independently orderable.

This field maps directly to the Service.orderable_ind.

3.4.1.13 Identity of Instrument used to perform this study (CE) 00598

When applicable, this field identifies the instrument or device that is used to generate this observation or battery. Examples are the automated instrument in the laboratory, the imaging device and model number in radiology, and the automatic blood pressure machine on the ward. The instrument is specified as a coded entry in anticipation that these identifiers could be specified as codes. Initially, we expect that most of the information about devices will be transmitted as text in the second component of the CE identifier. If more than one kind of instrument is used, all of them can be listed, separated by repeat delimiters.

Instruments are associated with the service catalog item as targets of type *device* (DEV). That way, the instrument can not only be identified, it may also be described in great detail.

3.4.1.14 Coded representation of method (CE) 00599

This field contains the method(s) used to produce the observation and should be recorded in a computer-understandable (coded) form here. This field should report the same method(s) reported in narrative in the following field. More than one method may be listed, but only if they produce results that are clinically indistinguishable. Multiple methods must be separated by repeat delimiters.

This field maps to Service.method_cd. Since there is no standard for method codes (the domain of all possible methods is overwhelmingly large,) this attribute will often use local codes. If there are different choices of methods that can be requested when a service is ordered, the attribute is really a set of method codes.

3.4.1.15 Portable (ID) 00600

This field indicates whether or not a portable device may be used for the test/observation. Refer to HL7 table 0136 - Yes/no indicator *for valid values.*

Y the observation can be obtained with a portable device brought to the patient;

N the patient or specimen must be transported to the device.

This attribute describes the location where the service is performed. If the service requires a patient transport to a certain location, this location should be recorded as a target of type *location* LOC. If a transport service is usually required, this transport service can be associated as a precondition to the service to be defined.

3.4.1.16 Observation producing department/section (CE) 00601

This field permits the sorting of observation orders and values by the providing service's department/section. It provides "source oriented" reporting when required. The codes for this field should be taken from ASTM Table 15 (Diagnostic Service Codes). Free text may be used instead of these codes, but in that case, they should be recorded as the second "component" of the field to distinguish them from the standard codes. Multiple codes in this field are separated by repeat delimiters.

In service definitions, the Actor participant of type *performer* is usually an Organization. The "diagnostic service section" code that has been used in this field in version 2.3 will continue to live as a classifier code of the Organization class. However, the organization class can identify the organization more individually than was possible with the service section code. This additional level of detail in identifying producer organizations is required for inter-institutional HL7 communication.

3.4.1.17 Telephone number of section (XTN) 00602

This field contains the telephone number for calling responsible parties in this section to ask results or advice about the use of this test.

The producer of the service is an Actor participant of type *performer*. The Actor class links the Service with a Stakeholder. Address and telecommunication contacts are all attribute of Stakeholders and recorded there.

3.4.1.18 Nature of test/observation (IS) 00603

This field indicates whether the definition entry identifies a test battery, an entire functional procedure or study, a single test value (observation), multiple test batteries or functional procedures as an orderable unit (profile), or a single test value (observation) calculated from other independent observations.

Whether the service is individual or a battery, or in whichever way a service is related to other services need not be coded, but is directly expressed in the relationships with other services. For instance, if a service has subordinate plan-components that are not ordered sequentially, one could call it a "battery." However, there is no need for a code if the truth is immediately given in the relationships.

The following table lists the relationship patterns that would be present for each "nature" of observation.

Table 14: Translation of coded "nature of observation" into patterns of related service definitions

Nature of test/observation (table 0174)		**Relationship pattern in HL7 version 3**
Code	**Description**	
P	Profile or battery consisting of many independent atomic observations (e.g., SMA12, electrolytes), usually done at one instrument on one specimen	Service is source of multiple relationships of type *plan components* (PLCM) with no particular sequence and timing constraints. If the same specimen is used it is indicated by all sub-services relating to the same specimen description.
F	Functional procedure that may consist of one or more interrelated measures (e.g., glucose tolerance test, creatine clearance), usually done at different times and/or on different specimens	Service is the source of relationships representing dependence (e.g., preconditions, input parameters, etc.) Or service has a more complex structure of plan components with sequencing and timing.
A	Atomic test/observation (test code or treatment code)	If no subordinate service plan components are present. Note, however, that services are fractal. The atomicity of a service is a matter of perspective; the closer you look the more detail and sub-services you will find.
S	Superset--a set of batteries or procedures ordered under a single code unit but processed as separate batteries (e.g., routines = CBC, UA, electrolytes) This set indicates that the code being described is used to order multiple test/observation batteries. For example, a client who routinely orders a CBC, a differential, and a thyroxine as an outpatient profile might use a single, special code to order all three test batteries, instead of having to submit three separate order codes.	A super set is a battery whose elements are not atomic.
C	Single observation calculated via a rule or formula from other independent observations (e.g., Alveolar—arterial ratio, cardiac output)	A calculated observation is represented as an Observation with one or more input-observations and a formula in the derivation_expr attribute.

3.4.1.19 Report subheader (CE) 00604

This field contains an optional string that defines the preferred header under which this observation should be listed on a standard display. For example, if the test is hemoglobin, this string might be "Complete blood count." It is represented as a coded data type so that a battery can be a header. Only the description part of the string may be included in case the subheader does not have an associated code. When a series of observations is displayed according to the sort order given below, the subheader that groups those observations is presented whenever the subheader changes.

Report header structures can be built using service hierarchies, so that the header is represented by a service object, with the sub-headers represented by other service objects related to the first through service relationships of type PART. It does not matter that in many cases one would not order or directly "perform" the services representing the headers.

3.4.1.20 Report display order (ST) 00605

This field contains an optional string that defines the sort order in which this observation is presented in a standard report or display that contains the many observations.

The order of elements below a header can be specified by using the sequence_nmb attributes. Note that order is a relative concept. A service has not *one* display order position – it all depends on whose display we are in, and what purpose that display wants to serve.

3.4.1.21 Date/time stamp for any change in definition for the observation (TS) 00606

This field contains the date and time that the last of any field change was made and in the host's record corresponding to the OM1 segment.

This field is not currently mapped. Refer to next field for details.

3.4.1.22 Effective date/time of change . (TS) 00607

This field contains the date and time of the last change in the test procedure that would make previous results incompatible with new results, e.g., the last time that normal reference range or units changed for a numeric test/observation.

We strongly suggest that observation producers never use the same observation ID when the measurement procedures change in such a way that results produced under the new procedure are clinically different from those produced with the old procedure. Rather, the producer should try to adjust the new procedure so that its values are clinically indistinguishable from the old. Failing that, one should create a new observation ID for the observation produced under the new procedure.

In the rare circumstances when a procedure change occurs and neither of the above two options is viable, this field shall be used to transmit the effective date/time of the new procedure. The receiving system shall assume that any values that come across under this observation ID are under the new procedure after this date and take appropriate steps to distinguish the old from the new observations.

This number is included to provide a means of communicating with the observation producing service when they have questions about particular observations or results.

Just as medical record items should not be substantially changed, but only amended, services definition records should not be changed either. If this rule is neglected, one loses the ability to interpret old medical record information. Hence, HL7 has strongly suggested to never reuse an observation id if a definition changed substantially.

However, abiding by this suggestion was often difficult, especially for such systems that rely on standard coding systems (such as LOINC) as test identifiers. When a test changed in some way, one could not simply make up a new LOINC code. In HL7 version 3 we clearly distinguish between instance (record) identifiers and coded concepts. We do suggest that every service catalog item has a unique identifier that always refers to the exact same definition. A single coded concept may be instantiated by multiple service catalog items, both to accomplish slightly different methods, and to accomplish changes over time. Thus, with HL7 version 3 instance identifiers, keeping track of changes has become much easier.

We have not provided for the time-stamp based approach to versioning for the following reason. Time stamp-based versioning schemes fail to work reliably for time ranges close around the change time. This is because system clocks may be off by seconds, minutes, even hours between different systems. That way, one can not reliably decide for a service that has just changed it's definition whether one has the old or the new service.

The proper HL7 v3 approach is to "retire" old master file definitions by changing their status code from *active* to *retired*, and by linking the changed service definition to the old definition that was changed. The change is implemented simply by cloning the old definition record, assigning a new id, and then making the changes.

3.4.1.23 Typical turn-around time (NM) 00608

This field contains the typical processing time for single test/observation. This field indicates the time from the delivery of a specimen or transport of a patient to a diagnostic service and the completion of the study. It includes the usual waiting time. The units are measured in minutes.

This and the next field are discussed and mapped together.

3.4.1.24 Processing time (NM) 00609

This field contains the usual length of time (in minutes) between the start of a test process and its completion.

Processing time is generally indicated in the General Time Specification of the attribute Service.time. In this time specification, the processing time for one occurrence of the service is the width of the smallest time interval in the general time specification. For example, for a service that is performed Monday to Thursday from 8 AM to 3 PM, and that takes about 20 minutes, the time specification is "J1-4 H08-15 [20 min]". So the smallest interval is "[20 min]" which happens to be specified only through it's width.

Note that the difference between the previous field and this field has always been ambiguous. What constitutes a turn-around time varies by service. Some services require transports, but some do not. Some services produce instant reports, while others involve some lengthy report processing. Some services involve a waiting time and some don't. We therefore suggest decomposing service definitions into the relevant pieces. The processing time of every part of the service can then be specified more precisely and more clearly. The user can then figure out the total processing time that is of interest to him.

Note that different parties will regard different time intervals in the same service as their relevant turn-around time. For example, the nursing staff who schedules the patient will consider the time span between the patient's leaving the care unit and his return as the relevant turn around time. The physician will most reasonably be concerned with the time between requesting an observation and

receiving the results as the most relevant turn-around time. The ancillary diagnostics department technician, who schedules the department's resources will be most interested in the time from one patient entering the examination room to the next patient entering that same room.

In reality, however, the issues are even more complex, so that the same staff member will consider different time spans as relevant depending on the current task. For instance, the same nurse will prepare a patient's examination schedule, and will organize the work schedule of the entire care unit.

3.4.1.25 Processing priority (ID) 00610

This field contains one or more available priorities for performing the observation or test. This is the priority that can be placed in OBR-27-quantity/timing*. For tests that require a specimen, this field may contain two components in the format <specimen priority>^<processing priority>. The first component in this case indicates the priority with which the specimen will be collected and is the priority that is specified in an OBR segment when ordering the observation. The second component indicates the corresponding priority with which the producer service will process the specimen, produce the observation, and return results, when this differs from collection priority. Refer to* HL7 table 0168 - Processing priority *for valid values.*

The priority for obtaining the specimen is included in OM4. Multiple priorities may be given, separated by repeat delimiters. For example, S~A~R~P~T indicates that the test may be ordered using codes S, A, R, P, or T.

This field and the next are mapped to the Service.priority_cd with compatible concepts. There are slight modifications in the code values, in order to resolve the naming conflicts of merging the two priority concepts.

3.4.1.26 Reporting priority (ID) 00611

This field contains the available priorities reporting the test results when the user is asked to specify the reporting priority independent of the processing priority. Refer to HL7 table 0169 - Reporting priority *for valid values.*

This field and the previous are mapped to the Service.priority_cd with compatible concepts. There are slight modifications in the code values, in order to resolve the naming conflicts of merging the two priority concepts.

3.4.1.27 Outside site(s) where observation may be performed (CE) 00612

This field contains the identification(s) of the outside service(s) that produce(s) the observation. The format of this CE field uses the producer ID (as defined in OM1-5-producer ID) *and the name of the service separated by component delimiters. An example is 39221^ACME lab^MC. If multiple services are used, they should be separated by repeat delimiter(s).*

The performer of a service is an Actor of type code *performer*. The Actor class links to a Stakeholder that allows full detail about the performing organization or practitioner to be specified. The approach is the same, whether it is an in-house provider or a provider in another institution.

3.4.1.28 Address of outside site(s) (XAD) 00613

This field contains the address of the outside services listed in OM1-28-address of outside site(s) *where observation may be performed. If multiple services are recorded in that field, their addresses should be*

separated by repeat delimiters, and the addresses should appear in the same order in which the services appear in the preceding field.

The performer of a service is an Actor of type code *performer*. The Actor class links to a Stakeholder that allows full detail about the performing organization or practitioner to be specified. The approach is the same, whether it is an in-house provider or a provider in another institution.

3.4.1.29 Phone number of outside site (XTN) 00614

This field contains the telephone number of the outside site.

The performer of a service is an Actor of type code *performer*. The Actor class links to a Stakeholder that allows full detail about the performing organization or practitioner to be specified. The approach is the same, whether it is an in-house provider or a provider in another institution.

3.4.1.30 Confidentiality code (IS) 00615

This field contains the degree to which special confidentiality protection should be applied to the observation. For example, a tighter control may be applied to an HIV test than to a CBC. Refer to user-defined table 0177 - Confidentiality code *for suggested values.*

This field directly maps to the Service.confidentiality_cd. The confidentiality concepts defined are backward compatible to the concepts defined for HL7 v2.3.

3.4.1.31 Observations required to interpret this observation (CE) 00616

This field contains the list of variables that the diagnostic service needs to interpret the results of an ordered study. The observations specified here should be sent to the diagnostic service as OBX segments along with the order (OBR) segment.

Example for cervical pap smear:

```
2000.32^date last menstrual period^AS4~2000.33^menstrual state^AS4
```

Example for arterial blood gas:

```
94700^inspired 02^AS4
```

These examples use AS4 codes in code/text format to identify the variables. Separate multiple items by repeat delimiters.

These other observations should be represented as associated observations, either as input-parameters (for derived observations,) or as preconditions.

3.4.1.32 Interpretation of observations (TX) 00617

This field contains the clinical information about interpreting test results. Examples are the conditions (drugs) that may cause false abnormals, and the information about the sensitivity and specificity of the test for diagnoses.

In HL7 v3 a lot of interpretative information of observations can be represented structurally and computer understandable and sharable, rather than in free text form. Generally free text maps to the Service.descr attribute. For master service definitions, the Service.descr may contain textbook-like descriptions, which can cover everything one needs to know in order to sensibly use a service.

3.4.1.33 Contraindications to observations (CE) 00618

This field contains the diagnosis or problem for which the test is a contraindication or of possible danger (e.g., pacemaker, pregnancy, diabetes). For example, if the test identified in OM1 was an intravenous pyelogram, this field would include warnings about the use of contrast media in diabetes. The contraindication diagnoses should be separated by repeat delimiters.

Contraindications are represented by Service predicates associated through service relationships of type *contraindication*. These contraindications can typically be observations (diagnoses,) current medications, or recent procedures.

3.4.1.34 Reflex tests/observations (CE) 00619

This field contains the test names as type CE (i.e., <code>^<text name>^<coding system>) that may be ordered automatically by the diagnostic service, depending on the results obtained from the ordered battery. A screening CBC might trigger a reticulocyte count if the Hgb is less than 12. Multiple reflex tests are separated by repeat delimiters.

Reflex tests are associated with a service through being grouped under a common sub-service. The reflex test will be a second step that is selected only if the reflex criterion is met by the first observation.

```
(Service :mood-cd DEF
        :type-cd “CBC screening”
        :is-source (Service-relationship :type-cd “has plan component”
                :sequence-nmb 1
                :has-target (Service :mood-cd DEF
                :type-cd “CBC”))
        :is-souce (Service-relationship :type-cd “has plan component”
                :sequence-nmb 2
                :has-target (Service :mood-cd DEF
                        :type-cd “Reticulocyte count”
                        :is-source (Service-relationship :type-cd “has precondition”
                                :has-target (Service :mood-cd (CRT EVN)
                                        :type-cd “HGB”
                                        :value <12 g/dl)))))
```

3.4.1.35 Rules that trigger reflex testing (TX) 00620

This field contains the rules that trigger the reflex tests listed above. If multiple reflex tests are listed in OM1-34-reflex tests/observations *separated by repeat delimiters, a set of corresponding rules will be included in this section. The first rule will apply to the first test, the second to the second test, and so on.*

Most reflex rules will usually be transmitted as free text. In such cases, the contents serve only as information for human reading. However, an alternative for machine readable rules also exists. The rule may be defined formally in the Arden Syntax (ASTM 1460-1992) which has syntax for defining algebraic and transcendental equations, as well as temporal and logical selection criteria based on patient information stored in the computer record. Reflex rules that are written in Arden Syntax should begin and end with a double semi-colon (;;), the Arden slot delimiter.

See comment on previous field for how reflex tests and their trigger rules can be defined in HL7 version 3.

3.4.1.36 Fixed canned message (CE) 00621

This field contains the codes and a fixed text message that is always associated with an abbreviation. The field may include multiple messages separated by repeat delimiters.

The use of this field is unclear and can not be mapped without further specification. It is unlikely that this field has been widely implemented in an interoperable way, so that mapping to better defined HL7 v3 structures will be difficult.

3.4.1.37 Patient preparation (TX) 00622

This field contains the tests or observations that require special patient preparation, diet, or medications. For GI contrast studies, this field would contain the pretest diet, e.g., low residue for two days, NPO before study, and the preferred purgatives. Each separate med, diet, or preparation should be delimited by a repeat delimiter. Separate each requirement by a repeat delimiter. Example for a sigmoidectomy: clear liquid diet full day before procedure~take 8 oz mag citrate 6pm day before procedure~take 2 ducat tabs (5m) at 4pm day before procedure~NPO past midnight.

Patient preparation can be modeled as a preconditions, or, by adding the preparations as plan components into the service. For example, the sigmoidectomy preparation can be describes in the following structure:

(Service :mood-cd DEF
:type-cd *sigmoidectomy with preparation*
:is-source (Service-relationship :type-cd PLAN
:sequence-nmb 1
:has-target (Diet :mood-cd DEF
:type-cd LQ *liquid*
:critical_time “[24 h]”))
:is-source (Service-relationship :type-cd PLAN
:sequence-nmb 1
:has-target (Medication :mood-cd DEF
:type-cd *Mg citrate*
:dose 8 [oz_ap]
:critical-time “H18”))
:is-source (Service-relationship :type-cd PLAN
:sequence-nmb 1
:has-target (Medication :mood-cd DEF
:type-cd *Ducat 5m*
:dose 2
:critical-time “H16”))
:is-source (Service-relationship :type-cd PLAN
:sequence-nmb 2
:has-target (Diet :mood-cd DEF
:type-cd FAST
:critical_time “[8 h]”))
:is-source (Service-relationship :type-cd PLAN
:sequence-nmb 3
:has-target (Procedure :mood-cd DEF
:type-cd *sigmoidectomy*)))

3.4.1.38 Procedure medication (CE) 00623

This field contains the treatments that may be needed as part of the procedure. Examples are radioactive iodine for a thyroid screen, and methacholine for a methacholine spirometry challenge. This field should be identified as a CE data type.

See patient preparation example above. Medications as part of procedures are associated Medication services.

3.4.1.39 Factors that may effect the observation (TX) 00624

This field contains the text description of the foods, diagnoses, drugs, or other conditions that may influence the interpretation of the observation. Information about the direction of the effect, and any recommendation about altering the diet, conditions, or drug before initiating the test observation.

In HL7 v3 a lot of interpretative information of observations can be represented in computer-understandable and sharable data structures, rather than in free text form. Generally free text maps to the Service.descr attribute. For master service definitions, the Service.descr may contain textbook-like descriptions, which can cover everything one needs to know in order to sensibly use a service.

The effect of conditions on test outcome is best described using a reference range based on a population having that condition. However, this kind of data is rare, so, one will frequently have to resort to fuzzy text descriptions like "alcohol may result in *elevated* γGT values."

3.4.1.40 Test/observation performance schedule (ST) 00625

This field contains the diagnostic studies/tests that are performed only at certain times during the course of a work day or work week. This field indicates the maximum interval between successive test performances (the test may actually be performed more frequently). The format given in Chapter 4, Section 4.4.2.1, "Repeat Pattern," should be used. If necessary, multiple codes may be given, separated by repeat delimiters. The use of multiple codes indicates that the test is performed at multiple concurrent intervals. For example, Q6H indicates that the test is performed at least once every 6 hours around the clock. QJ1 indicates that the test is performed at least every week on Mondays. QAM~QPM indicates that the test is performed at least once every morning and every evening. QJ1~QJ3~QJ5 indicates that the test is performed at least every week on Mondays, Wednesdays, and Fridays. C indicates that the test is performed continuously, 7 days per week.

Performance schedules are part of the Service.time General Time Specification. For example, to say that a service is available every Monday, Wednesday and Friday, from 9 AM to 2 PM one would write "J1,3,5 H09-02."

3.4.1.41 Description of test methods (TX) 00626

This field contains the text description of the methods used to perform the text and generate the observations. Bibliographic citations may be included.

This field maps to the Service.descr attribute. For service definitions, the Service.descr may be a textbook section describing the service in every detail. This includes a discussion about alternative methodological variances.

3.4.1.42 Kind of quantity observed (CE) 00937

This optional attribute describes the underlying kind of property represented by this observation. This attribute distinguishes concentrations from total amounts, molar concentrations from mass concentrations, partial pressures from colors, and so forth. These are discussed more fully in the LOINC Users' Manual.[2] They are derived from the approach described in 1995 edition of the IUPAC Silver Book.[3] These distinctions are used in IUPAC and LOINC standard codes. Defined categories are listed in HL7 table 0254 - Kind of quantity.

This field maps to Observation.property_cd.

3.4.1.43 Point versus interval (CE) 00938

This optional attribute allows master files to classify observations as measuring the patient's state at a point in time (e.g., spot urines, random urines, serum potassium), or averaged over a interval of time (e.g., concentration, total amount, or clearance over a 24-hour collection). Interval measures most often apply to urine and stool specimens (e.g., 24-hour urines, 3-day stool fats). They also apply to clinical measurements such as urine outputs, which are reported as shift totals and 24-hour totals, and event counts on physiologic monitors such as the number of PVCs on a 24-hour Holter monitor.

This field would only be valued in a transaction if the service sending this master file message classified its observation by point versus time interval. This field is ***not*** *used to record the time collection interval for a particular sample. It is used to specify a characteristic of an observation which has a defined normal range and to distinguish observations of the same kind but observed over varying periods of time. A spot urine sodium would have PT stored in this field. A 24-hour urine sodium and a 24-hour Holter monitor would have 24H stored here. This attribute would only be valued if the filling service classified its observations by timing. Refer to* user-defined table 0255 - Duration categories *for suggested values.*

User-defined Table 0255 - Duration categories

Value	Description
PT	To identify measures at a point in time. This is a synonym for "spot" or "random" as applied to urine measurements.
* (star)	Life of the "unit." Used for blood products.
30M	30 minutes
1H	1 hour
2H	2 hours
2.5H	2½ hours
3H	3 hours
4H	4 hours
5H	5 hours
6H	6 hours

[2] LOINC Committee. Logical Observation identifier Names and Codes. Indianapolis: Regenstrief Institute and LOINC Committee, 1995.

[3] International Union of Pure and Applied Chemistry/International Federation of Clinical Chemistry. The Silver Book: Compendium of terminology and nomenclature of properties in clinical laboratory sciences. Oxford: Blackwell Scientific Publishers, 1995.

7H	7 hours
8H	8 hours
12H	12 hours
24H	24 hours
2D	2 days
3D	3 days
4D	4 days
5D	5 days
6D	6 days
1W	1 week
2W	2 weeks
3W	3 weeks
4W	4 weeks
1L	1 months (30 days)
2L	2 months
3L	3 months

3.4.1.44 Challenge information (TX) 00939

This optional attribute provides information for classifying observations by the challenge component of the test, if a challenge does speciate the observation. For example, distinguishing tests that have a challenge component in database. There co-ascribes the physiologic or drug challenge that is intrinsic to the measurement. To identify, for example, tests that include a glucose challenge.

To construct this text string, use the following template. (Note: This field is not constructed of formally defined components; it is a free text field. Component delimiters are not used and it is not necessary to supply placeholders if some "components" are not used.)

The time delay follows the syntax: n<S|M|H|D|W> where n is a number (possibly a decimal); S denotes seconds; M denotes minutes; H denotes hours; D denotes days; and W denotes weeks. The time delay can be preceded by a 'greater than' (>) sign, e.g. >4H.

HL7 table 0256 - Time delay post challenge *lists possible values for time delay.*

Examples

```
PRE 100 GM GLUCOSE PO
PRE 100 GM GLUCOSE PO
30M POST 100 GM GLUCOSE PO
2H POST 100 GM GLUCOSE PO
TROUGH
```

For drug peak and trough measures the nature of the substance challenged is the same as the analyte name, and need not be included.

We denote the route of the challenge via abbreviations for medication routes (see Chapter 4, Section 4.8.3.1, "Route," HL7 table 0162 - Route of administration*). An oral route of administration would be denoted by "PO," an intravenous route by "IV."*

Details of the drug dose, time the dose was given, route of administration, etc., would be noted in separate OBX, and would have corresponding master observation definitions stored in the observation master file map to different records stored in the master file segments contained in the drug level message.

Table 0256 - Time delay post challenge

Value	Description
BS	Baseline (time just before the challenge)
PEAK	The time post drug dose at which the highest drug level is reached (differs by drug)
TROUGH	The time post drug dose at which the lowest drug level is reached (varies with drug)
RANDOM	Time from the challenge, or dose not specified. (random)
1M	1 minute post challenge
2M	2 minutes post challenge
3M	3 minutes post challenge
4M	4 minutes post challenge
5M	5 minutes post challenge
6M	6 minutes post challenge
7M	7 minutes post challenge
8M	8 minutes post challenge
9M	9 minutes post challenge
10M	10 minutes post challenge
15M	15 minutes post challenge
20M	20 minutes post challenge
25M	25 minutes post challenge
30M	30 minutes post challenge
1H	1 hour post challenge
2H	2 hours post challenge
2.5H	2 1/2 hours post challenge
3H	3 hours post challenge
4H	4 hours post challenge
5H	5 hours post challenge
6H	6 hours post challenge
7H	7 hours post challenge
8H	8 hours post challenge
8H SHIFT	8 hours aligned on nursing shifts
12H	12 hours post challenge
24H	24 hours post challenge
2D	2 days
3D	3 days
4D	4 days
5D	5 days
6D	6 days
7D	7 days
1W	1 week

Value	Description
10D	10 days
2W	2 weeks
3W	3 weeks
4W	4 weeks
1L	1 month (30 days) post challenge
2L	2 months (60 days) post challenge
3L	3 months (90 days) post challenge

The nature of a physiologic (non-drug) challenge may also be specified, using the terms in HL7 table 0257 - Nature of challenge.

Table 0257 - Nature of challenge

Value	Description
CFST	Fasting (no calorie intake) for the period specified in the time component of the term, e.g., 1H POST CFST
EXCZ	Exercise undertaken as challenge (can be quantified)
FFST	No fluid intake for the period specified in the time component of the term

3.4.1.45 Relationship modifier (CE) 00940

This optional attribute provides a mechanism for classifying observations according to the subject, in relation to the patient whose results might be stored with as "patient" data. It is standard practice, for example, to report values for controls, donors, and blood product units as well as the patient's own values, and store them in the patient's record. (This may not be the best way to model such information, but it is the way it is usually reported.) This should be valued when two values (e.g., one for patient and one for a blood product unit) could otherwise be confused.

The default value is "Patient," and if not specified, this value is assumed. The persons sub-component can refer to HL7 table 0258 - Relationship modifier *for valid values.*

Table 0258 - Relationship modifier

Value	Description
CONTROL	Control
PATIENT	Patient
DONOR	Donor
BPU	Blood product unit

3.4.1.46 Target anatomic site of test (CE) 00941

This optional attribute formally indicates the site of the observation (to make it easy for a system to find all tests related to one anatomic site). It can be used to classify the observation by target site of the examination. For example, "heart" might be recorded as the target of the electrocardiogram, cardiac echo, and thallium exercise test. This attribute would be applicable to most imaging and electro-physiologic examinations. The SNOMED topology axis is an example of a coding system for anatomic sites. User-defined tables may also apply here.

3.4.1.47 Modality of imaging measurement (CE) 00942

This optional attribute describes the modality used to classify the observations, e.g., radiograph, ultrasound, CT scan, NMR, etc. This attribute is especially important for imaging studies. Refer to user-defined table 0259 - Modality *for suggested values; it is adopted from DICOM C.7.3.1.1.1 Modality. If these are used, the code source ID would be DCM.*

User-defined Table 0259 - Modality

Value	Description
AS	Angioscopy
BS	Biomagnetic imaging
CD	Color flow doppler
CP	Colposcopy
CR	Computed radiography
CS	Cystoscopy
CT	Computed tomography
DD	Duplex doppler
DG	Diapanography
DM	Digital microscopy
EC	Echocardiography
ES	Endoscopy
FA	Fluorescein angiography
FS	Fundoscopy
LP	Laparoscopy
LS	Laser surface scan
MA	Magnetic resonance angiography
MS	Magnetic resonance spectroscopy
NM	Nuclear Medicine (radioisotope study)
OT	Other
PT	Positron emission tomography (PET)
RF	Radio fluoroscopy
ST	Single photon emission computed tomography (SPECT)
TG	Thermography
US	Ultrasound
XA	X-ray Angiography

Appendix A: Instance Notation

For the purpose of discussion and to be able to show examples of data types we will use an instance notation that is both, readable and concise. We do not use XML as an instance notation since XML is just too verbous, writing XML on a blackboard takes too much time, and the XML markup is too distractive for the human eye to find the real information to be conveyed in the example.

Our notation is borrowed from *Common LISP* and *Scheme*, a syntax also used in the XML world (DSSSL).

This instance notation has only five idioms

1) Atomic values (numbers, strings, symbols) are written in the usual character representation. Atomic values are separated by spaces, unless the spaces are contained within double quotes. For example

`1234.45`	the a number 1234.45
`"hello world"`	a string
`foo`	a symbol

2) Composite values start with an opening parenthesis and end with a closing parenthesis.

   (...)

3) Composite values may contain atoms or other nested composites.

```
(foo :bar (nest :baz))
```

4) Composites always start with a symbol that denotes to the data type of that composite value. In the example above, `foo` would be the symbol of the data type.

5) After the type symbol, composites contain keyword-value pairs. Keywords are symbols that start with a colon (e.g., `:bar`). For example

```
(CodeValue :value      "100.0"
           :codeSystem "ICD-9")
```

would be a Code Value (CV) epresenting the ICD-9 code 100.0 for Leptospirosis icterohemorrhagica.

6) Symbols that start with a pound sign have special meaning. For instance, `#true` and `#false` would be two values for the Boolean type (BL).

7) Collections are composite expressions whose first symbol denotes the kind of collection (i.e., `SET`, `LIST`, or `BAG`). After the collection type symbol the elements of the collections are enumerated. For example,

```
(SET apple orange banana)
```

a set of fruits, cardinality 3.

```
(LIST orange apple banana)
```

the list of fruits ordered by how much I like them, length: 3.

```
(BAG 3 apple 2 orange 5 banana)
```

the shopping bag containing 3 apples, 2 oranges and 5 bananas, size: 10, cardinality: 3. Note that the bag notation uses alternated number-item-pairs.

The beauty of this instance notation is that it can be completely defined by just a few simple rules. Moreover, the examples can usually be understood without the reader having to be able to actively master the rules.

Instead of structured instances we sometimes use short informal forms for brevity that are understandable to humans but do not conform to any formal specification and would not be allowed literally in messages. Most often we'll resort to this informal notation to refer to coded concepts which we either have no code system for or where we want to present the concept so that the reader can immediately understand it without having to consult code tables for the meaning.

In addition many data types, including composite data types will have string literal forms defined. For example, instead of sending a physical quantity in structured form (PQ :value 4.5 :unit "mg/dl") one can send the literal "4.5 mg/dL".