Canonical Sentences to Reveal Semantic Meaning of Structured Data

Lisa Nelson

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Problem

It is difficult to translate information from a structured, machine-readable format into a human readable form. The challenge increases when negation and temporal nuances are included.

Solution

Could a set of canonical sentences be designed for the machine-readable formats of the data which would make it easier to consistently extract the semantic meaning? The canonical sentences would not need to be stylistically eloquent because they would not necessarily be used in a clinical report. They would solely be used to determine if the information in the narrative text represented the logical equivalent of the structured data.

Hypothesis

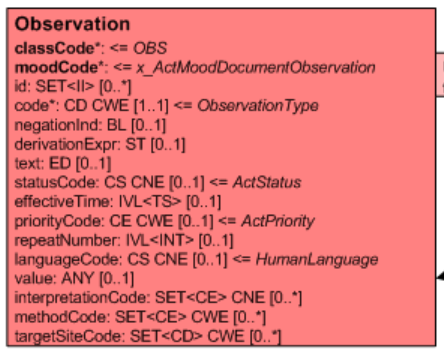
Ho: It is not possible to produce a set of canonical sentences which reveal the semantic mean of data stored in CDA entry structures.

Approach

This study will examine the CDA act classes used to for clinical statements to determine if unambiguous sentences can be developed which accurately reflect the semantic meaning within the encoded forms. The examination will iterate through all possible temporal representations and consider the impact of negation on each. Experts from the HL7 Vocabulary Workgroup will be asked to evaluate the sentences and determine if they accurately reflect the semantics inherent in the structured data. If a set of sentences for every semantic variation of the nine (9) CDA act-class data structures is approved by the panel of experts, then the hypothesis will be rejected and this study will conclude that it is possible to devise canonical sentences to be used for the intended purpose.

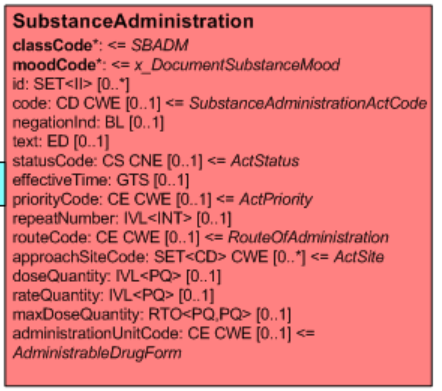
**Analysis**

1. Observation



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| --- | --- |
| Observation | |
| classCode  OBS  moodCode  EVN  negationInd  false | Considering information supplied by the informant(s), the author(s) made the following observation about the subject.    [code] was observed.  The observation was this data type: [value xsi:type].  The observation was: [value/@value with units or value/@code].  The observation was interpreted to mean this: [interpretationCode].  The observation was made at or during this time period: [effectiveTime].  The observation was made with a priority status of: [priorityStatus].  The observation was made in a series and was number: [repeatNumber].  The observation was made at this location: [targetSiteCode]  The observation was made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode]. |
| classCode  OBS  moodCode  EVN  negationInd  true  (We need to add variations to deal with flavors of null for cases when the observation was not made.) | Considering information supplied by the informant(s), the author(s) made the following observation about the subject.  It is not the case that: [code] was observed.  (Note: The observation was made and it is not the case that [diabetes] was observed, or it was not the case that [arrhythmia] was observed.)  Adding additional concepts narrows the meaning of the expression. For example, adding an effectiveTime element would change the meaning of the clinical statement to be more precise.  It is not the case that:  [code] was observed at or during this time period: [effectiveTime]. |
| classCode  OBS  moodCode  INT  negationInd  false | Considering information supplied by the informant(s), the author(s) intend to make the following observation about the subject.  Note: this entry is expressing the author’s intension.  [code] is intended to be observed.  The observation is intended to be this data type: [value xsi:type].  The observation is intended to have these units or come from this value set: [value/@value with units or value/@valueSet (need to confirm how this xml would work)].  The observation was interpreted to mean this: [interpretationCode] when the referenceRange is: [referenceRange] (The cardinality of this sentence equals the number of possible values for interpretationCode.)  The observation is intended to be made at or during this time period: [effectiveTime].  The observation is intended to be made with a priority status of: [priorityStatus].  The observation is intended to be made in a series and was number: [repeatNumber].  The observation is intended to be made at this location: [targetSiteCode]  The observation is intended to be made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode]. |
| classCode  OBS  moodCode  INT  negationInd  true | Considering information supplied by the informant(s), the author(s) made the following observation about the subject.  Note: this entry is expressing the author’s intension.  It is not the case that:  [code] is intended to be observed.  Adding additional concepts narrows the meaning of the expression.  Example: This could be used to exclude some part of a guideline that author does not intend to follow. It could be used to identify observations that are out of scope, so as to sharpen the clarity about what is in scope. |
| classCode  OBS  moodCode  DEF  negationInd  false | Considering information supplied by the informant(s), the author(s) made the following observation about the subject.  A [code] observation is:  The observation is data type: [value xsi:type].  The observation has these units or come from this value set: [value/@value with units or value/@valueSet (need to confirm how this xml would work)].  The observation means this: [interpretationCode] when the referenceRange is: [referenceRange] (The cardinality of this sentence equals the number of possible values for interpretationCode.)  The observation is defined to be made at or during this time period: [effectiveTime].  The observation is defined to be made with a priority status of: [priorityStatus].  The observation is defined to be made in a series with the following number of repeats: [repeatNumber].  The observation is defined to be made at this location: [targetSiteCode]  The observation is defined to be made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode].  Example: This could be used to define a guideline.  Example: This could be used to define the observation that will be made for a certain lab test. |
| classCode  OBS  moodCode  DEF  negationInd  true | Considering information supplied by the informant(s), the author(s) made the following observation about the subject.  It is not the case that a [code] observation is defined.  Adding additional concepts narrows the meaning of the expression.  Example: This could be used in conjunction with a positive definition statement to add clarity. It could create an exclusion for a corresponding definition made with negationInd=false. |
| classCode  OBS  moodCode  GOL  negationInd  false | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  The goal is for [code] to be observed.  The observation goal will be this data type: [value xsi:type].  The observation goal is this value with these units, or is this code from this value set: [value/@value with units or value/@valueSet ]  The observation goal will mean this: [interpretationCode] when the referenceRange is: [referenceRange] (The cardinality of this sentence is 1, citing the referenceRange for the goaled interpretationCode.)  The observation will ideally be made at or during this time period: [effectiveTime].  The observation will ideally be made with a priority status of: [priorityStatus].  The observation will ideally be made in a series and was number: [repeatNumber].  The observation will ideally be made at this location: [targetSiteCode]  The observation will ideally be made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode]. |
| classCode  OBS  moodCode  GOL  negationInd  true | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  It is not the case that [code] is the goal to be observed.  Adding additional concepts narrows the meaning of the expression.  Example: This could be used in conjunction with a positive goal statement to add clarity. It could create an exclusion for a corresponding goal made with negationInd=false. |
| classCode  OBS  moodCode  PRMS  negationInd  false | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  Note: The author is making the promise  [code] is promised to be observed.  The observation will be this data type: [value xsi:type].  The observation will have these units or come from this value set: [value/@value with units or value/@valueSet (need to confirm how this xml would work)].  The observation will be interpreted to mean this: [interpretationCode] when the referenceRange is: [referenceRange] (The cardinality of this sentence equals the number of possible values for interpretationCode.)  The observation will be made at or during this time period: [effectiveTime].  The observation will be made with a priority status of: [priorityStatus].  The observation will be made in a series and was number: [repeatNumber].  The observation will be made at this location: [targetSiteCode]  The observation will be made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode]. |
| classCode  OBS  moodCode  PRMS  negationInd  true | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  Note: The author is making the promise  It is not the case that [code] is promised to be observed.  Adding additional concepts narrows the meaning of the expression.  Example: This refutes that a particular promise is made. In a case where the patient is the author, a clinical statement could be made by the patient to state that it is not the case that smoking cessation is promised to be observed. |
| classCode  OBS  moodCode  PROP  negationInd  false | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  Note: The author is making the proposal for the subject  [code] is proposed to be observed  The observation would be this data type: [value xsi:type].  The observation would have these units or come from this value set: [value/@value with units or value/@valueSet (need to confirm how this xml would work)].  The observation would be interpreted to mean this: [interpretationCode] when the referenceRange is: [referenceRange] (The cardinality of this sentence equals the number of possible values for interpretationCode.)  The observation would be made at or during this time period: [effectiveTime].  The observation would be made with a priority status of: [priorityStatus].  The observation would be made in a series and was number: [repeatNumber].  The observation would be made at this location: [targetSiteCode]  The observation would be made using this method: [methodCode].  This observation is identified using id: [id].  The act of making this observation is in this state: [statusCode].  The textual representation of this information is found here: [text]  The textual representation is written in this language: [languageCode].  Example: This makes a particular proposal. In the case where the author is a clinician, this could propose that surgery, or some other procedure be performed. It could trigger the need to get the patient’s consent. In a case where the patient is the author, a clinical statement could be made by the patient to state that a course of antibiotics is proposed. |
| classCode  OBS  moodCode  PROP  negationInd  true | Considering information supplied by the informant(s), the author(s) made the following observation about the subject:  It is not the case that [code] is proposed to be observed.  Adding additional concepts narrows the meaning of the expression.  Example: This refutes that a particular proposal is made. In a case where the patient is the author, a clinical statement could be made by the patient to state that it is not the case that surgery is proposed. This could be a way of removing a proposal from further consideration. |

1. Substance Administration



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| Substance Administration | |
| classCode  SBADM  moodCode  EVN  negationInd  false | Considering information supplied by the informant(s), the author(s) assert that the following substance was administered to the subject. If a performer is included, then the author is documenting the administration of the substance by the performer(s). Without the performer, one cannot conclude that the author administered the substance.    A [code] substance was administered. (This is an issue. Currently code is not specified. I think this should be a value set for “prescribed substance”, “non-prescribed substance”. Currently, without a code element, we are saying, “A substance was administered.”)  The administration of the substance was made using this route: [routeCode].  The administration of the substance was made using this approach site: [approachSiteCode].  The administration of the substance was this dose quantity: [doseQuantity].  The administration of the substance was this rate quantity: [rateQuantity].  The administration of the substance was over this time interval: [effectiveTime[@operator=”A”] note: @xsi:type=”PIVL\_TS” or “EIVL\_TS”].  The maximum dose administered was: [maxDoseQuantity].  The administration of the substance was made using this drug form: [administrableDrugForm].  The consumable manufactured product was this material: [consumable/manufacturedProduct/material/code].  The administration of the substance was made at or during this time period: [effectiveTime].  The administration of the substance was made with a priority status of: [priorityStatus].  The administration of the substance was made in a series and was number: [repeatNumber].  The administration of the substance was made at this location: [targetSiteCode]  The administration of the substance was made using this method: [methodCode].  This administration of a substance is identified using id: [id].  The act of administering this substance is in this state: [statusCode].  The textual representation of this information is found here: [text]. |
| classCode  SBADM  moodCode  EVN  negationInd  true | Considering information supplied by the informant(s), the author(s) state:    It is not the case that [code] substance was administered to the subject. (This is an issue. Currently code is not specified. I think this should be a value set for “prescribed substance”, “non-prescribed substance”. Currently, without a code element, we are saying, “It is not the case that a substance was administered.”)  Adding additional concepts narrows the meaning of the expression. Note: If a performer is included, then the author is documenting that it is not the case that [code] substance was administered by the performer(s). This additional information prevents the conclusion that the substance was not administered at all.  This administration of a substance is identified using id: [id].  The act of administering this substance is in this state: [statusCode].  The textual representation of this information is found here: [text]. |
| classCode  SBADM  moodCode  INT  negationInd  false | Considering information supplied by the informant(s), the author(s) intends the following substance to be administered to the subject. If a performer is included, then the author is documenting the intension for the substance to be administered by the performer(s).    It is intended that a [code] substance will be administered. (This is an issue. Currently code is not specified. I think this should be a value set for “prescribed substance”, “non-prescribed substance”.  The administration of the substance will be made using this route: [routeCode].  The administration of the substance will be made using this approach site: [approachSiteCode].  The administration of the substance will be this dose quantity: [doseQuantity].  The administration of the substance will be this rate quantity: [rateQuantity].  The administration of the substance will be over this time interval: [effectiveTime[@operator=”A”] note: @xsi:type=”PIVL\_TS” or “EIVL\_TS”].  The maximum dose administered will be: [maxDoseQuantity].  The administration of the substance will be made using this drug form: [administrableDrugForm].  The consumable manufactured product will be this material: [consumable/manufacturedProduct/material/code].  The intention to administer the substance was made at or during this time period: [effectiveTime].  The intention to administer the substance was made with a priority status of: [priorityStatus].  The intention to administer the substance was expressed as a series to be repeated this number of times: [repeatNumber].  The administration of the substance will be made at this location: [targetSiteCode]  The administration of the substance will be made using this method: [methodCode].  This administration of a substance is identified using id: [id].  The act of intending this administration of a substance is in this state: [statusCode].  The textual representation of this information is found here: [text]. |
| classCode  SBADM  moodCode  EVN  negationInd  true | Considering information supplied by the informant(s), the author(s) intend the following substance to be administered to the subject.    It is not the case that [code] substance is intended to be administered.  Adding additional concepts narrows the meaning of the expression. Note: If a performer is included, then the author is documenting that it is not the case that [code] substance was administered by the performer(s). This additional information prevents the conclusion that the substance was not administered at all.  This administration of a substance is identified using id: [id].  The act of administering this substance is in this state: [statusCode].  The textual representation of this information is found here: [text]. |

**Reference Material: Possible moodCodes for Observations**

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| **A: x\_ActMoodDocumentObservation** | V18943 |  |  | Used to enumerate the moods that an observation can take within the body of a clinical document. |
| 2 | L:  (INT) | V10199 | INT | intent | An intention or plan to perform a service. Historical note: in previous RIM versions, the intent mood was captured as a separate class hierarchy, called Service\_intent\_or\_order. |
| 2 | L:  (DEF) | 10198 | DEF | definition | A definition of a service (master).  Historical note: in previous RIM versions, the definition mood was captured as a separate class hierarchy, called Master\_service. |
| 2 | L:  (EVN) | 10201 | EVN | event (occurrence) | A service that actually happens, may be an ongoing service or a documentation of a past service.  Historical note: in previous RIM versions, the event mood was captured as a separate class hierarchy, called Patient\_service\_event, and later Service\_event. |
| 2 | L:  (GOL) | 18864 | GOL | Goal | Expectation to make a specific observation with a desired value at a predefined future time |
| 2 | L:  (PRMS) | 16728 | PRMS | promise | An intent to perform a service that has the strength of a commitment, i.e., other parties may rely on the originator of such promise that said originator will see to it that the promised act will be fulfilled. A promise can be either solicited or unsolicited. |
| 2 | L:  (PRP) | 16726 | PRP | proposal | A non-mandated intent to perform an act. Used to record intents that are explicitly not Orders. Professional responsibility for the 'proposal' may or may not be present. |
| 2 | L:  (RQO) | 19973 | RQO | request | A request or order for a service is an intent directed from a placer (request author) to a fulfiller (service performer).  *Rationale:* The concepts of a "request" and an "order" are viewed as different, because there is an implication of a mandate associated with order. In practice, however, this distinction has no general functional value in the inter-operation of health care computing. "Orders" are commonly refused for a variety of clinical and business reasons, and the notion of a "request" obligates the recipient (the fulfiller) to respond to the sender (the author). Indeed, in many regions, including Australia and Europe, the common term used is "request."  Thus, the concept embodies both notions, as there is no useful distinction to be made. If a mandate is to be associated with a request, this will be embodied in the "local" business rules applied to the transactions. Should HL7 desire to provide a distinction between these in the future, the individual concepts could be added as specializations of this concept.  The critical distinction here, is the difference between this concept and an "intent", of which it is a specialization. An intent involves decisions by a single party, the author. A request, however, involves decisions by two parties, the author and the fulfiller, with an obligation on the part of the fulfiller to respond to the request indicating that the fulfiller will indeed fulfill the request. |

**Reference Material: Possible moodCodes for SubstanceAdministrations**

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| **A: x\_DocumentSubstanceMood** | V19461 |  |  | Used to enumerate the moods that a substance administration can take within the body of a clinical document. |
| 2 | L:  (INT) | V10199 | INT | intent | An intention or plan to perform a service. Historical note: in previous RIM versions, the intent mood was captured as a separate class hierarchy, called Service\_intent\_or\_order. |
| 2 | L:  (EVN) | 10201 | EVN | event (occurrence) | A service that actually happens, may be an ongoing service or a documentation of a past service.  Historical note: in previous RIM versions, the event mood was captured as a separate class hierarchy, called Patient\_service\_event, and later Service\_event. |
| 2 | L:  (PRMS) | 16728 | PRMS | promise | An intent to perform a service that has the strength of a commitment, i.e., other parties may rely on the originator of such promise that said originator will see to it that the promised act will be fulfilled. A promise can be either solicited or unsolicited. |
| 2 | L:  (PRP) | 16726 | PRP | proposal | A non-mandated intent to perform an act. Used to record intents that are explicitly not Orders. Professional responsibility for the 'proposal' may or may not be present. |
| 2 | L:  (RQO) | 19973 | RQO | request | A request or order for a service is an intent directed from a placer (request author) to a fulfiller (service performer).  *Rationale:* The concepts of a "request" and an "order" are viewed as different, because there is an implication of a mandate associated with order. In practice, however, this distinction has no general functional value in the inter-operation of health care computing. "Orders" are commonly refused for a variety of clinical and business reasons, and the notion of a "request" obligates the recipient (the fulfiller) to respond to the sender (the author). Indeed, in many regions, including Australia and Europe, the common term used is "request."  Thus, the concept embodies both notions, as there is no useful distinction to be made. If a mandate is to be associated with a request, this will be embodied in the "local" business rules applied to the transactions. Should HL7 desire to provide a distinction between these in the future, the individual concepts could be added as specializations of this concept.  The critical distinction here, is the difference between this concept and an "intent", of which it is a specialization. An intent involves decisions by a single party, the author. A request, however, involves decisions by two parties, the author and the fulfiller, with an obligation on the part of the fulfiller to respond to the request indicating that the fulfiller will indeed fulfill the request. |