The Need for Normalized Terminology and Statement Models: The Case for Solor and Analysis Normal Form using a Wound Care Assessment Example

Timothy Williams, BS[1], Raja A. Cholan, MS[1], Andrew Sills, BS[1], Alice Li, BA[1], Andy Chen Wang, MPA[1], Keith E. Campbell, MD, PhD[2], Jonathan Nebeker, MD, MS[2] and Steven Brown, MD, MS[2]

[1]Deloitte Consulting LLP; [2]Veterans Health Administration

What might the attendee be able to do after being in your session?

This presentation will introduce the need for—and highlight the benefits of—Solor and Analysis Normal Form (ANF) – open source projects sponsored by the Department of Veterans Affairs (VA) to help achieve semantic interoperability. Attendees will also understand the impact of using Solor and ANF through a LOINC Wound Care Assessment Panel example.

Description of the Problem or Gap

More than 95%[1] of hospitals across the US have certified Electronic Health Record (EHR) technology that depends on the semantic interoperability of clinical data used across terminology standards such as SNOMED CT, LOINC, and RxNorm. However, each EHR system may have integrated these terminologies in an inconsistent way by using mapping practices, which reduces the reliability of this data when exchanged between systems, leading to severe consequences for patient safety and health outcomes. Furthermore, the clinical data in these systems are represented in clinical information models, using a variety of standard or ad-hoc information models or "statement models." In most cases data quality issues pose immense obstacles to analysis, but even in the case of structured, semantically-clear information, inconsistency across sources of information is a barrier.

Solor was developed to tackle the semantic interoperability challenge as an open-source project sponsored by VA and Logica https://www.logicahealth.org/. Solor integrates various terminology standards into a single model that also supports custom extensions to standard content. This ability to extend allows informaticists and developers to convert user-supplied terminologies into an integrated model rather than relying upon manual mapping practices which can degrade data quality.

The purpose of Analysis Normal Form (ANF) is to introduce a standards-based, normalized representation of clinical statements from heterogeneous sources using an objective measure to help evaluate the result, presence, and magnitude of a specific finding, request, or observation. ANF is intended to safely and reliably support data analysis that can be used to aggregate data created using any standard or non-standard input form or exchange mechanism.

Methods: What did you do to address the problem or gap?

We identified an example for modeling Wound Assessments in which there are at least five distinct ways to represent wound care clinical data in a statement model within Fast Healthcare Interoperability Resources (FHIR). There were 37 different potential FHIR observations with multiple ways of representing the same data (e.g., 'Body site = Left Arm' or 'Body Site = Arm + Laterality= Left') and application of different terminologies for convergent concepts (e.g., LOINC Answer versus SNOMED CT). We then applied a harmonized terminology solution (i.e., Solor) and a normalized statement model (i.e., ANF) to transform the multiple representations of entered clinical data for wound care into a single representation. Solor incorporates the two main terminologies used in the Wound Assessment model, SNOMED CT and LOINC, in a harmonized terminology model allowing for the seamlessly analysis of terminology. By using a harmonized terminology model certain observations, like body site and laterality are merged into the wound type observation and only represented using the terminology model.

Results: What was the outcome(s) of what you did to address the problem or gap?

We reduced the 37 FHIR Observations that could be represented in multiple possible representations using various combinations of observations and terminologies into a single representation of 33 associated ANF Statements using harmonized terminology expressions leveraged from Solor. These new representations eliminate the potential overlaps between the statement model and terminology model allowing for easier aggregation and analysis of Wound Assessment observations. Table 1 below shows the four statements from the Wound Assessment model that were merged into the Wound type observation to eliminate any potential redundancies.

LOINC #	Observation Name	ANFStatement.id
39135-9	Wound Assessment Panel	Not used
81666-0	Wound number [Identifier]	Statement 2
72300-7	Wound type	Statement 1 (Main Statemen
89250-5	Device or anatomic structure visible in wound	Statement 3
89251-3	Condition present on admission	Statement 4
11373-8	Injury cause	part of Statement 1
88878-4	Date of condition abatement	Statement 5
72170-4	Photographic image	Statement 6
89252-1	Episode of Wound	Statement 7
89253-9	Trend	Statement 8
85585-8	Date of Onset of Impairment	Statement 9
72369-2	Body site identification panel	Not used
39111-0	Body site	part of Statement 1
39112-8	Body location qualifier	part of Statement 1
20228-3	Anatomic part Laterality	part of Statement 1
72301-5	Description of Periwound	Statement 10
72527-5	Pressure ulcer stage NPUAP	Statement 11
72372-6	Wound bed and edge panel	Not used
89254-7	Wound bed panel	Not used
72371-8	Appearance of Wound base	Statement 12
72370-0	Area of identified wound bed appearance/Area of wou	Statement 13
39132-6	Color of Wound base	Statement 14
89255-4	Wound bed area identified by color/Area of wound be	Statement 15
89256-2	Wound edge panel	Not used
72304-9	Edge of wound description	Statement 16
39133-4	Color of Wound edge	Statement 17
72299-1	Wound tunneling and undermining panel	Not used
89257-0	Wound tunneling panel	Not used
72298-3	Tunneling of Wound	Statement 18
72296-7	Tunneling [Length] of Wound	Statement 19
72297-5	Tunneling clock position of Wound	Statement 20
89258-8	Wound undermining panel	Not used
72295-9	Undermining of Wound	Statement 21
72293-4	Undermining [Length] of Wound	Statement 22
72294-2	Undermining clock position of Wound	Statement 23
72292-6	Wound exudate panel	Not used
89259-6	Presence of wound exudate	Statement 24
89260-4	Area of wound	Statement 25
39116-9	Drainage amount of Wound	Statement 26
72288-4	Odor of Exudate from wound	Statement 27
72289-2	Color of Exudate from wound	Statement 28
72290-0	Appearance of Exudate from wound	Statement 29
72287-6	Wound size panel	Not used
39125-0	Width of Wound	Statement 30
39127-6	Depth of Wound	Statement 31
39126-8	Length of Wound	Statement 32
80338-7	Wound assessment [Interpretation]	Statement 33

Table 1. Mapping of FHIR Observations to ANF Statements

Conclusion

Utilizing Solor and ANF, modelers of clinical data can seamlessly process existing wound care clinical statements into a series of normalized ANF statements that rely on normalized terminology expressions (SNOMED + LOINC + RxNorm) and a terminological description-logic based concept model. Currently, implementers of FHIR must traverse the distinct hierarchies and versions of SNOMED CT, RxNorm, and LOINC. Solor and ANF may assist in providing collaborative, open-source tools to host local extensions and complex terminology expressions, while normalizing the variation that currently exists in FHIR profiles intending to represent the same clinical statements. Next steps include collaboration with HL7 FHIR implementers and developers on creating an ANF enabled FHIR Resource, potentially for representing Observations.

Attendee's Take-away Tool

Increased awareness about the need for and the benefits of Solor and ANF. More information about Solor is available at www.solor.io and ANF is accessible at https://confluence.hl7.org/display/CIMI/Analysis+Normal+Form+%28ANF%29+Project

References

1. Dashboard.healthit.gov. (2019). *Percent of Hospitals, By Type, that Possess Certified Health IT*. [online] Available at: https://dashboard.healthit.gov/quickstats/pages/certified-electronic-health-record-technology-in-hospitals.php [Accessed 2 Dec. 2019].