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Supporting SNOMED-CT Implementation Through a Solution Capability Model

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Abstract

Whilst SNOMED-CT has developed extensively as a terminology, it has done so at a pace separate from that of the vast majority of end users and products. The experience and lessons learnt from implementation projects have highlighted significant clinical achievements and variation between solution capabilities and user expectations. This has resulted in an understanding of what factors impact on success including the need to address what a "SNOMED-CT enabled", or a "SNOMED-CT supported" application actually means, the need for cross-vendor consistency, and convergence of terminology support.

A solution capability matrix for SNOMED-CT, which assists in promoting communication and understanding between stakeholders has been developed. Care will be required by all stakeholders when, in the future, local solutions comprise a mix of solution support levels as they cannot readily interoperate without restrictions being imposed. Only when all solutions are at the highest level described in the model, Level 2, will the full benefits of SNOMED-CT be realised. Until that time sophisticated and iterative workarounds will need to be in place and utilised by all users and systems.

Keywords:

systematized nomenclature of medicine, stakeholders, software implementation

Introduction to SNOMED-CT

Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT) is an international medical terminology which has been developed over time, from several source terminologies, by the College of American Pathologists and the UK National Health Service. This comprehensive clinical language is used to encode clinical data in electronic patient records, which may subsequently be used within decision support. It currently consists of 400,000 healthcare concepts, over 1 million descriptions and nearly 1.5 million semantic relationships. As with all clinical terminologies it is, and will always be, a work in progress. SNOMED–CT differs from most previous health terminologies because it aims to achieve domain completeness throughout healthcare. As such it is capable of representing the minutiae of clinical information and is designed to be used by generalists, specialists, indeed all clinical practitioners, including doctors, nurses and allied health professionals.

However whilst SNOMED-CT has developed extensively, it has done so at a pace separate from that of the vast majority of end users and software products.

Value of SNOMED-CT

SNOMED-CT is the foundation stone for achieving the vision of continually improving healthcare outcomes and efficiencies by enabling communication and data analysis at patient, local, national and international levels as indicated in Figure 1. As such, the successful implementation of SNOMED-CT is imperative to patients, care professionals, healthcare organisations, product vendors and the nation as a whole. All parties need to be aware of their role and responsibilities in that achievement. Failure to adopt SNOMED-CT and standardise its use, will ultimately impact:

- safe interchange of clinical information
- decision support's ability to provide consistent responses for safer care delivery
- secondary use of data for research, healthcare improvement and commissioning decisions

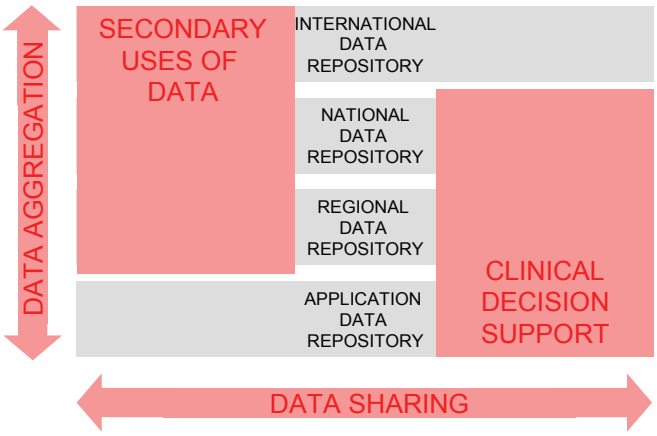

Figure 1- SNOMED-CT enabled data utilisation

Increasingly, clinical information is exchanged at national and international levels for individual and epidemiological use. Countries such as Denmark have used SNOMED-CT as the lingua franca in outsourcing radiology reports to India, so that local resource constraints can be managed. However, product and messaging limitations have compromised the efficiency and effectiveness of this.

In the arena of clinical terminology and messaging there is an immediate benefit, and therefore clear need, for a defined approach to terminology use if communication between different healthcare organisations is to become more effective. In the longer term, benefits of a common terminology used at the point of care will enable clinical statements to be understood and reused, not only at the individual patient level but also when aggregated. This will derive benefits in clinical audit, research and governance, epidemiology and healthcare commissioning.

Supporting clinicians

Clinical terminology supports what clinicians care about by ensuring clinical records meet their needs. Clinicians desire system components that work reliably together; the ability to easily express the clinical information they wish to enter; and the ability to retrieve information to support delivery of care and analysis of aggregated data.

Effective use of codes and medical terminology within clinical information systems is fundamental to maximising the benefit of much of the clinical functionality. This will have an impact on information:

- presented in the system outputs (e.g. discharge summary)
- shared with other organisations or aggregated in a data warehouse
- used to trigger care plans and care pathways
- available in patient medical summary views
- available for clinical decision support
- shared with third party systems (e.g. pharmacy)
- used for clinical/management reporting

Lessons learnt from early implementation

The experience and lessons learnt from implementation projects Dolin RH, Mattison JE et Kaiser Permanente CMT Team. Kaiser Permanente Convergent Medical Terminology. Medinfo 2004. M.Fieshi et al (eds) Amsterdam ,Lopez et al. A Practical Approach to Advanced Terminology Services in Health Information Systems. 2006 Medical Informatics Department, Hospital Italiano of Buenos Aires, Argentina have highlighted significant clinical achievements and variation between solution capabilities and user expectations.

In England the new and ambitious challenge of implementing SNOMED-CT has resulted in a greater understanding of what factors impact on success. These include the need to address what a "SNOMED-CT enabled", or a SNOMED-CT supported" application actually means, the need for cross-vendor consistency, and convergence of terminology support

Semantic interoperability and SNOMED-CT

Semantic interoperability will be the key to successful development and implementation of future Electronic Health Records (EHR)[1] and integrated Electronic Patient Record[2] systems that deliver complex clinical functionality spanning care settings. Such functionality will include clinical decision support, integrated care pathways, enterprise scheduling, and workflow management.

There is increasing awareness and interest from software providers and their purchasers, who are investigating, and in some cases acting on, the application of international standards to help achieve semantic interoperability.

The development and adoption of international standards for patient record interoperability is essential for:

- sharing patient health and care information between health professionals in a multi-disciplinary, shared-care environment
- interoperability between organisations within an enterprise-wide, regional or national healthcare system, and perhaps in the future across national borders
- supporting functional and semantic interoperability between software from different vendors

Such standards cover the important tools within health informatics including messaging, health record architecture, health record extracts, terminology, and logical data models. SNOMED-CT is the internationally adopted standard for terminology and is core to the achievement of semantic interoperability. However, SNOMED-CT must be constrained to be used effectively as there are innumerable ways to express clinical information using SNOMED-CT. Such flexibility left unconstrained will prevent meaningful queries, data extraction and data comparison.

Whilst standards exist for messaging (HL7 v3), health record architecture (openEHR), health record extracts (prEN13606 soon to be CEN13606, HL7 v3 CDA), reference models (openEHR, HL7v3 RIM) and terminology (SNOMED-CT), it is far less clear how they interrelate or should be used together in harmony. One such area of

1 We define Electronic Health Record as the combination of a patient's electronic records held in different systems to form a combined patient electronic record.

2 We define Electronic Patient Record as the patient's electronic record held within a facility (e.g. Hospital)

ambiguity is reference models where HL7 v3 has defined a Reference Information Model for messaging purposes which is insufficient as a reference model for a healthcare record architecture. Whereas the Reference Model and associated models in openEHR are designed for a health record architecture, and are used in CEN13606 for health record extracts. There is clear overlap between the reference models provided by both standards. Figure 2 attempts to crudely illustrate the complexity of how these standards currently overlap.

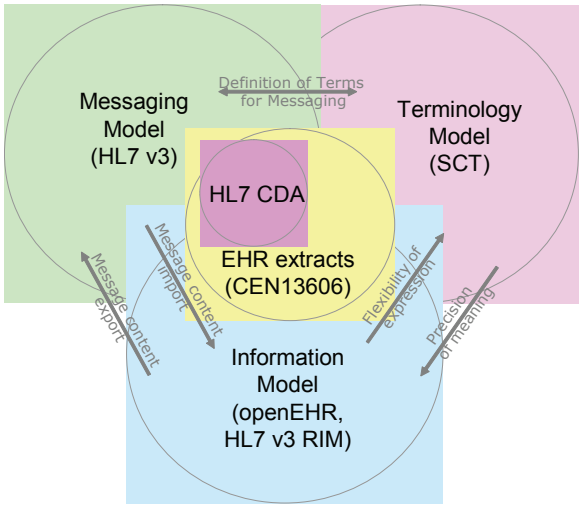

Figure 2- A view of the complexity of how standards overlap

There are several pieces of work underway that will help address how these standards will work together, for example:

- TermInfo – relationship between HL7v3 and SNOMED-CT
- HL7 13606 Implementation Guidance project – relationship between HL7 v3 and CEN13606

The output of such work will guide software vendors in design of their systems to ensure that SNOMED-CT is implemented in a controlled and interoperable way. Successful applications of the future will embrace these standards and learn to unify them into a cohesive application.

In this way SNOMED-CT will assist in:

- translating data entered by users using an interface terminology or SNOMED-CT directly
- transmitting clinical data between applications via messaging or other means whilst maintaining data integrity and meaning
- transmitting aggregated data to common data repositories for secondary use such as reporting

Stakeholder interface

Increasingly the assumption of purchasers will be that SNOMED-CT is used as the common terminology which drives the clinical functionality within products. However the majority of systems and applications have not been designed around a terminology as large and complex as SNOMED-CT.

There is an ever increasing user and customer demand for SNOMED-CT based products with a driver on the vendor community to develop their products and their data models accordingly. This demand for SNOMED-CT based products will increase as all nations are faced with the complexities of an aging population and workforce, with associated complex disease management requirements. Those vendors who have made the investment in developing their products to use SNOMED-CT at its core will be best placed to compete within this evolving market.

Electronic clinical record system providers or solutions who can support post co-ordinated SNOMED-CT will still be constrained by the limitations of others, especially departmental solutions (pathology, radiology, pharmacy being key) for some time to come. These new SNOMED-CT based vendors will add their voice to the increasing demand for SNOMED-CT based solutions.

The implementation of SNOMED-CT requires software applications that exploit its features to meet the real and perceived needs of users. The users of SNOMED-CT are not restricted to end-users who enter or retrieve clinical information experiencing SNOMED-CT through a configured application that uses the terminology. Users also include those who design, commission and configure software for use in a particular clinical environment and those who utilise population and other aggregated data.

Solution capability matrix

A significant risk to SNOMED-CT implementations is that financially and politically costly user implementation and technology strategies are developed and implemented without a clear vision of the end point. It is therefore imperative that there is national and international agreement on the role of SNOMED-CT and the level of support required

The adoption of SNOMED-CT will, by necessity, be incremental. In this extended implementation period, solution providers will need to support workarounds such as maintaining separate clinical terming and classification coding processes. Therefore, there will be a mixed population of systems and users that either can or cannot support SNOMED-CT. This presents new problems. A solution capability model for SNOMED-CT has evolved during the process of implementing at a multi organisational, depart-

mental and cross health care boundary level, which assists in promoting communication and understanding between the stakeholders. This model considers solution capabilities as follows:

Level	Description
0	Systems do not internally support SNOMED-CT. They may not be capable of working in a SNOMED-CT world at all, or may be provided with a mapping function to map outbound messages containing local codes into messages containing SNOMED-CT codes to support communication with other systems or for reporting.
1	Systems support SNOMED-CT internally but with restrictions, which may include shortened descriptions, restricted subsets of terms and limited hierarchical browsing. They will not support inbound post-coordinated expressions. Most existing systems with some SNOMED support would be in this category. Some systems (in the US) have pushed the upper limits but require extensive maintenance overhead to maintain pre-coordinated ('ready defined') terms in line with needs.
2	Systems support post-coordinated expressions and can communicate with other Level 2 systems using messages containing post-coordinated expressions (which adds additional qualifiers to 'terms' to improve clinical detail). They will have potentially many styles of user interface to support different users and user contexts (eg nurses on wards, surgeon in theatre) and their requirements to add information to patient records. These systems would also be able to exploit the encoded data within decision support rules. With its ability to store detail and fully interoperate with similarly supportive systems, level 2 would need substantive development of the existing solutions in terms of user interfaces, processing and database structures, to support the encoded data meaningfully. They also need configuration tools to enable the system to relate to the appropriate SNOMED-CT subsets (also known as reference sets) and hence inbuilt maintenance processes to respond to changes in SNOMED-CT content.

Table 1 –SNOMED-CT Solution Capability Model

This model and its presented levels do not constitute a roadmap for solutions and their development. Level 0 solutions, by definition, cannot be readily engineered to become Level 1 and similarly for Level 1 to Level 2. At best, software vendors need to understand how they can achieve higher support for their products within a level, recognising the constraints imposed by that level. They will then need to determine the re-engineering required to provide an equivalent solution at a higher level.

The model is being further extended to incorporate the roles and impact on other stakeholders. The combined effect of solutions with mixed capabilities in supporting SNOMED-CT, combined with disparate purchasers, timetables, political, economic and clinical imperatives, results in a complex picture. However, building on the model will enable understanding of the interplay, and interaction of each stakeholder's issues.

Conclusion

Going forward, care is required by all stakeholders when, in the future, local and national solutions comprise a mix of Level 1 and 2 solutions. Level 1 solutions cannot interoperate with messages from Level 2 solutions unless the Level 2 solutions comply with the restrictions imposed by each of the Level 1 solutions. As a result, only when all solutions are Level 2 will the full benefits of SNOMED-CT be realised. At this stage solutions will be built around SNOMED-CT and will likely provide sophisticated native SNOMED-CT terminology services. At this point, external (standalone) terminology services are likely to be limited to the distribution/syndication of maintenance releases for clinical content.

The Solution Capability Model has value in enabling understanding of the complexity of the environment in which implementation is to take place, so that careful planning can be undertaken, and a successful outcome achieved. The Solution Capability Model also makes it clear that this will not be achieved overnight.

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