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Mapping interRAI to SNOMED CT

Feasibility report

Acknowledgement

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Table of abbreviations

ADHA	Australian Digital Health Agency
ADL	Activities of Daily Living
AEHRC	Australian e-Health Research Centre
CDM	Common Data Model
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
EMR	Electronic Medical Record
HL7® FHIR®	Health Level Seven International (standards developing organization), Fast Healthcare Interoperability Resources (healthcare interoperability standard)
ICD	International Classification of Diseases (World Health Organisation)
ID	identifier
IEEE	Institute of Electrical and Electronics Engineers
interRAI	Brand/organisation name for international collaborative network; a joining of ‘international’ and Resident Assessment Instrument (RAI, the first assessment instrument in this family of instruments).
LTCF	Long-Term Care Facilities assessment system (interRAI)
OMOP	Observational Medical Outcomes Partnership
QDHeC	Queensland Digital Health Centre, The University of Queensland
SME	Subject Matter Experts
SNOMED CT	Brand name for a healthcare terminology (owned by SNOMED International); a joining of Systematized Nomenclature Of Medicine (United States origin) and Clinical Terms Version 3 (United Kingdom origin)
UQ	The University of Queensland

Executive summary

Background

- The lack of data integration between long-term residential care and other care settings is an untenable situation as care recipients move between settings with increasing frequency.
- interRAI systems are tools for comprehensive assessment of care recipients with complex needs, and are widely used in Europe, North America, and Asia. The original systems were designed for long-term residential and community care settings, but more recent systems have been designed to support assessment and management of functional and psycho-social needs within hospital settings.
- SNOMED CT, a standardised clinical terminology, has a substantial global footprint in acute care settings, but limited penetration in long-term residential aged care settings.
- interRAI and SNOMED CT systems serve different functions and are best viewed as complementary, however they utilise different terminologies, meaning that data does not readily transfer between them.
- Mapping interRAI data items to SNOMED CT will prepare interRAI assessments for interoperability with other digital health systems already encoding clinical data using SNOMED CT. This, in turn, will alleviate data collection burden for both care providers and recipients by reducing data duplication and will enhance care delivery through clinical decision support based on accurate, up-to-date data.

Project objective

To assess the feasibility of mapping a representative sample of interRAI clinical assessments, observations, findings, regimes and diagnoses to SNOMED CT International codes.

The scope of this feasibility study is to map from interRAI to SNOMED CT only; further significant work is required to integrate the SNOMED CT codes into electronic medical records (EMRs) for interoperability.

Key findings

It is feasible to map interRAI data to SNOMED CT International.

Based on the mapping and validation process described in this report, using a sample of 50 maps, comprising 6 assessments (Cognition, Communication, Functional), 1 diagnosis and 1 procedure, we found:

- All interRAI data in the sample had a feasible match in SNOMED CT.
- 46% (n=23) of maps required the use of qualifier values or situation qualifiers to obtain a more accurate match, which may create complexity for some interoperability use cases.
- 68% (n=34) of maps were considered an equivalent match, 26% (13) were broader, 4% (2) were inexact, and 2% (1) was a narrower match.

Key considerations in the mapping process:

- An initial large work-effort is necessary to create the maps, a smaller maintenance effort will remain.
- A large proportion of the data requires manual mapping, due to the complexity of interRAI system.
- Key expert personnel are necessary to ensure clinical accuracy of the mapping: interRAI and SNOMED CT subject matter experts (SME), clinicians, and clinical informaticians.
- Once mappings are complete and the mapping file is available, technical work is required to deploy it into software applications supporting interRAI assessments so that data is automatically mapped.

Benefits of mapping

Mapping interRAI data to SNOMED CT International will assist with:

- **Interoperability**: Mapping interRAI data items to SNOMED CT is the first step in enabling multi-system interoperability for software systems to communicate using a common language. This would enhance recipient care by ensuring accuracy of data and reducing duplication and inconsistencies during transfers across settings of the healthcare system.
- **Research**: Mapping interRAI items to SNOMED CT will facilitate translation of interRAI data to large scale research common data models (CDMs) such as the "Observational Medical Outcomes Partnership (OMOP)" CDM. Mapping to the OMOP CDM would allow for repeatable, large scale, multi-system and multinational research across different healthcare settings.
- **Regulation**: Regulation of care services, such as aged care services, may require periodic reporting to health regulation departments to ensure standards and quality of care. Embedding a standardised terminology may simplify reporting meeting regulatory requirements.
- **Expansion:** Potential for interRAI assessments to expand into markets where SNOMED CT is already in use (SNOMED CT is used in over 80 countries (1) while interRAI assessments are used over 40 countries (2)).

Financial considerations

The interRAI inventory has over 4,000 items and sub-items and therefore, the cost of mapping all interRAI clinical information to SNOMED CT is estimated to be in the range of several hundred thousand Australian dollars (at the date of this report). In addition to the mapping cost, the cost for technical implementation is additional, and there is a small ongoing cost for maintaining the maps that will need to be considered.

Despite these costs, the potential benefits described above make this financial investment worthwhile. Additionally, there are potential costs to care recipient safety of not undertaking the mapping, as non-interoperable data increases medication errors and adverse events (3, 4).

Recommendations

It is recommended that interRAI clinical information be mapped to SNOMED CT.

1. Consider the importance of the various use cases for the next stage of mapping, as this will impact the types of data and level of specificity required to be mapped.
2. Commence mapping with items from one interRAI assessment system with high clinical value.
    - The interRAI Acute Care system could be selected as it has a hospital audience, and contains around 60 items, totalling 200-300 maps, requiring a smaller initial investment.
3. Continue mapping other interRAI assessments to SNOMED CT (e.g. Long-Term Care Facility)
    - Consider iteratively mapping items based on frequency of use and clinical value.
4. Iteratively deploy mapping into interRAI systems:
    - Consider options for deploying the mapping file (the output of the mapping exercise). For example, the development of a reference table defining the mapped items source and target.
    - A look-up may potentially be built into interRAI system so that users can select SNOMED CT codes directly or be built in when developing new interRAI clinical assessment products.
5. Investigate the SNOMED CT licencing requirements in countries where interRAI assessment systems are deployed and may be mapped to SNOMED CT.

Introduction

interRAI Australia commissioned the Queensland Digital Health Centre (QDHeC), at The University of Queensland (UQ), to assess the feasibility of mapping a representative sample of interRAI clinical assessments, diagnoses and procedures to SNOMED CT codes. The sample was sourced from the interRAI Long-Term Care Facility (LTCF) system that is designed for use in residential aged care. The sample items were provided to QDHeC by interRAI Australia at the commencement of this feasibility project. The mapping and report preparation was conducted over a 9-week period at one day per week.

Background

The traditional separation between residential long-term care and other healthcare settings is no longer fit for purpose as care recipients are increasingly receiving services (sequentially or concurrently) from multiple care settings. Similarly, older persons in the community often are provided services from multiple agencies concurrently, where sharing of information real-time facilitates integrated care. Transitions between care settings are a time of high risk for care recipients and the existing model in which data does not flow easily between settings can have a negative impact on recipients' care (5). For information to flow effectively between clinical settings, interoperability is required. That is, the ability "to exchange information and to use the information that was exchanged" (6). An in-depth exploration is needed to determine if interRAI data items can be translated to SNOMED CT concepts, in an effort to create interoperable-ready data that would enable more informed care to be delivered as care recipients transition between care settings or receive care concurrently from multiple providers.

interRAI systems are designed to support clinical and administrative decision-making in settings where vulnerable individuals receive care. Internationally, the most common use is in aged care programs. interRAI systems comprise a schedule of clinical observations and an accompanying set of 'applications' that include risk and diagnostic screeners, care planning and treatment prompts, quality indicators, and case mix tools. The data elements focus on functional and psycho-social phenomena[1], with levels of granularity that are necessary for continuous care in programs such as aged care, mental health, disability services and palliative care. interRAI systems have a large international footprint across Europe, North America and locally in New Zealand and Singapore.

SNOMED CT is a controlled medical terminology system that aims to provide a common language for documentation of clinical and health data. SNOMED CT content is represented using concepts, descriptions, and relationships. Concepts represent a defined clinical meaning (e.g., clinical findings, observations, procedures, diagnoses, anatomical regions, pharmaceuticals, and substances, etc). The SNOMED CT terminology arranges concepts in a hierarchical order ranging from the general concepts to more granular concepts, enabling the use of clinical information at multiple levels of detail as needed. Each concept is assigned a permanent, unique, numeric, and computer-processable concept identifier. An identifier provides an unambiguous, unique reference to each concept and does not have any ascribed human interpretable meaning. Descriptions assign human readable terms to concepts and there two types: a preferred term or

[1] Includes psychological, social, and physiological/biological functioning. Considers availability/use of supports, living arrangements, finances, coping abilities, social history, family history, cultural factors, etc.

synonym. A preferred term is the default description of a concept's meaning (e.g., Myocardial infarction), whereas a synonym is an alternative term that can be used to refer to the same concept (e.g., heart attack, cardiac infarct, infarction of heart). Each concept can have only one preferred term in any language but can have several synonyms. Relationships link concepts that are related in some way. Like concepts, all descriptions and relationships have unique identifiers (7).

Like interRAI, SNOMED CT has a substantial global footprint, particularly in hospital care, but limited penetration into the settings where interRAI is prominent. Representatives from interRAI and SNOMED International (the organisation that owns SNOMED CT) have been in discussions regarding how these systems might relate in order to bridge this divide. A preliminary exploration revealed that the systems serve different functions and are best viewed as complementary. The parties agree that in-depth exploration is needed to determine how interRAI data items and outputs might translate to the SNOMED CT concepts and a data mapping exercise would help to inform discussions.

The mapping approach

Mapping a proprietary product and/or vocabulary to SNOMED CT is complex. In this particular context, for some interRAI items, the process is made even more complex as the map is not one terminology to another, but rather an interpretation of structured clinical assessment to multiple items in the SNOMED CT terminology and requiring multiple concept groups per item. This complexity reduces the utility of open-source tools (such as ‘Snapper’, developed by the Commonwealth Scientific and Industrial Research Organisation; CSIRO) that would typically automate such a mapping. This means the initial mapping processes are almost completely manual for all items (8). A commitment to implementation, associated tools, and ongoing management is necessary to deploy and maintain a quality map (9).

The Australian Digital Health Agency (ADHA) has published guidelines (SNOMED CT-AU Mapping Guidelines (9)) which outline best practice mapping: the mapping feasibility described here was assessed under those guidelines (see Figure 1). This feasibility report follows these guidelines, providing additional recommendations, tool suggestions, and guidance in the context of an interRAI to SNOMED CT map.

Licencing requirements

The use of SNOMED CT requires a licence. Affiliate licence to SNOMED CT is free for member countries, of which Australia is represented by the ADHA (10) and covers the use of the terminology in Australia. Similarly, the use of interRAI systems requires a licence, that may be secured by governments, other regulatory agencies, software vendors or provider agencies. If the interRAI-SNOMED CT mapping is to be used in other SNOMED member countries or jurisdictions using interRAI assessment systems, the SNOMED CT and interRAI licencing requirements in those countries/jurisdictions will need to be investigated to ensure compliance.

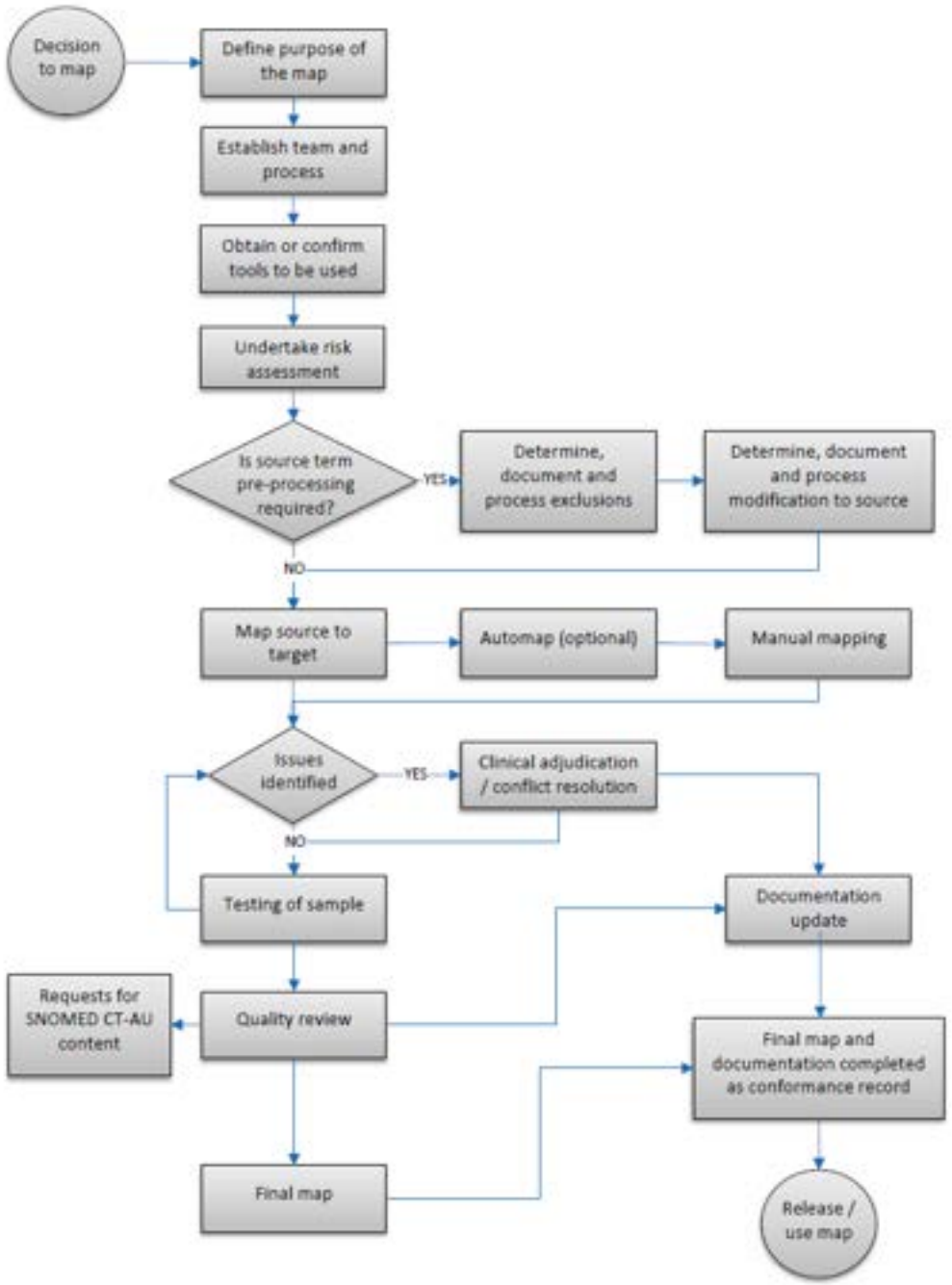


Figure 1 | Outline of the mapping Process (9)

Mapping via application of ADHA guidelines

The mapping of interRAI clinical assessment items to SNOMED CT – carried out via the application of ADHA guidelines to this scenario – is outlined below. Additional recommendations and processes have been described to align with the context.

The purpose of the map

Statement of purpose

The clinical translation of interRAI clinical assessments and findings to a standardised clinical vocabulary, within the residential long-term care facility context.

Use cases

Below are potential use cases for the standardisation of interRAI clinical assessment items using SNOMED CT.

Table 1 | Brief summary of potential use cases for the map

General use	Description
Research and population health	Support population health management and clinical research through the availability of comprehensive clinical data configured for analytics.
Interoperability	Ensure the communication between healthcare systems using a common language. Assigning standardised SNOMED CT codes to interRAI data items paves the way for their implementation in a data exchange standard such as HL7® FHIR®.
Data integration	Allow for the integration of data from and to multiple sources improving the comprehensiveness and interpretability of health records.
Regulatory compliance	If a regulatory framework were to be based off a common clinical terminology.

Team and process

Scope of the map

A typical interRAI assessment instrument is divided into multiple sections of clinical categories (e.g. cognition, function, and mood). Within each of these sections are multiple items. Multiple sub-items may then be associated with a single item, although there are also examples with no associated sub-item. For each item or sub-item, there is a pre-defined list of acceptable responses from which a clinician chooses when assessing a client. See Figure 2 for diagrammatic representation of interRAI clinical assessment document structure. All elements including ‘Item’, ‘Sub-item’, and ‘Answer’ will be mapped to SNOMED CT to provide context to interpret the clinical findings.

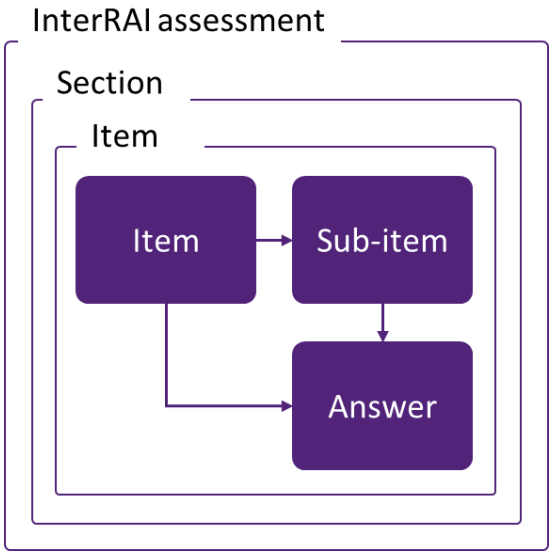


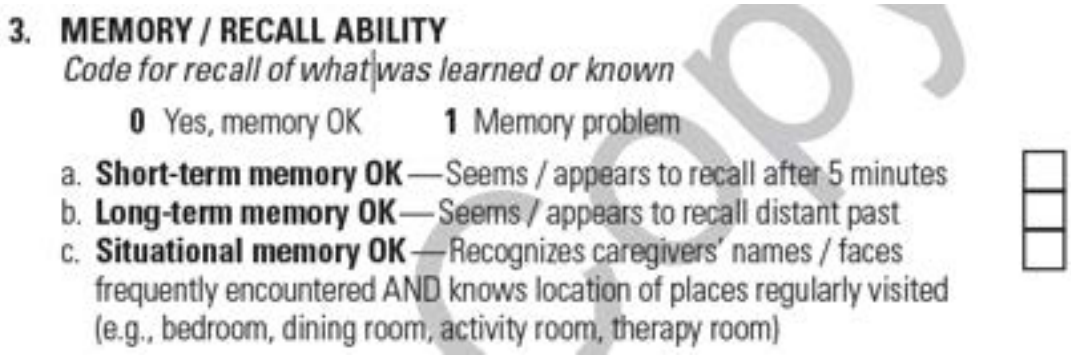
Figure 2 | interRAI item assessment relationship

For this feasibility study, a representative sample of items from the interRAI LTCF assessment system was chosen, including six assessments, one diagnosis, and one treatment/procedure:

1. Cognition (section C):
    a. Cognitive skills for daily decision-making (6 answer values)
    b. Memory/recall ability
        i. Short-term memory OK - Seems / Appears to recall after 5 minutes (2 answer values)
    c. Acute change in mental status from person's usual functioning (2 answer values)
2. Communication and Vision (section D):
    a. Making self understood (5 answer values)
    b. Hearing
        i. Ability to hear (with hearing appliance normally used) (5 answer values)
3. Functional Status (section H):
    a. Activities of daily living (ADL) self-performance:
        i. Walking - How walks between locations on same floor indoors (8 answer values)
4. Disease and Diagnosis (section J):
    a. Psychiatric
        i. Depression (4 answer values)
5. Treatments and Procedures (section O):
    a. Treatments and programs received or scheduled in the last 3 days
        i. Scheduled toileting program (5 answer values)

Mapping level

To demonstrate the level of mapping required, an example is provided. The example item is 'Memory/Recall ability'. When completing this form, it is assumed that any assessment is related to the last three days (a look-back period), unless otherwise specified. See Figure 3 for example of how the question appears in the form.


3. **MEMORY / RECALL ABILITY**
Code for recall of what was learned or known

0 Yes, memory OK **1** Memory problem

a. **Short-term memory OK** — Seems / appears to recall after 5 minutes
b. **Long-term memory OK** — Seems / appears to recall distant past
c. **Situational memory OK** — Recognizes caregivers' names / faces frequently encountered AND knows location of places regularly visited (e.g., bedroom, dining room, activity room, therapy room)

Figure 3 | Memory/Recall Ability LTCF assessment form

For this example, there are 10 mappable items:

1. '*Memory/Recall Ability*'
2. '*Short-term memory OK*'
3. '*Short-term memory OK*' **with response of** '*0 Yes, memory OK*'
4. '*Short-term memory OK*' **with response of** '*1 Memory problem*'
5. '*Long-term memory OK*'
6. '*Long-term memory OK*' **with response of** '*0 Yes, memory OK*'
7. '*Long-term memory OK*' **with response of** '*1 Memory problem*'
8. '*Situational memory OK*'
9. '*Situational memory OK*' **with response of** '*0 Yes, memory OK*'
10. '*Situational memory OK*' **with response of** '*1 Memory problem*'

Ideally, all items, sub-items, and answers are mapped to the same level of granularity as intended by the interRAI clinical assessment. Where this is not possible, the closest possible map was selected. It should be noted that the most appropriate match or level of detail required may depend on the specific use case. Mappings may be one to one, one to many, or many to one – depending on the clinical context of each clinical assessment and the use case.

Upon review of the subset provided for feasibility analysis, it appears that a 'typical' mapping logic for interRAI assessments may be:

1. Where an item, sub-item and answer are present:
    a. An item is mapped to a single procedure concept

i. Hierarchical relationship with Sub-Item is ‘Has focus’

b. A Sub-item is mapped to one or multiple observable entity concept/s

i. Hierarchical relationship with answer is ‘Interprets’

c. An answer is mapped to a single finding concept

2. Where only an item and answer are present:

a. An item is mapped to one or multiple observable entity concept/s

i. Hierarchical relationship with answer is ‘Interprets’

b. An answer is mapped to a single finding concept

Considering the extensive manual requirement of this mapping, it is likely there will be deviations from the above-mentioned mapping logic. See Figure 4 for diagrammatic representation of concepts and hierarchy for interRAI items.

The mapping logic will vary for diagnosis and procedure interRAI items. Instead of the Item level mapping to a Procedure or Observable entity, they will match to a Diagnosis or Regime/Therapy SNOMED CT concept.

The mapping may also require use of SNOMED CT qualifier values, which provide attributes that add context in relation to other concepts.

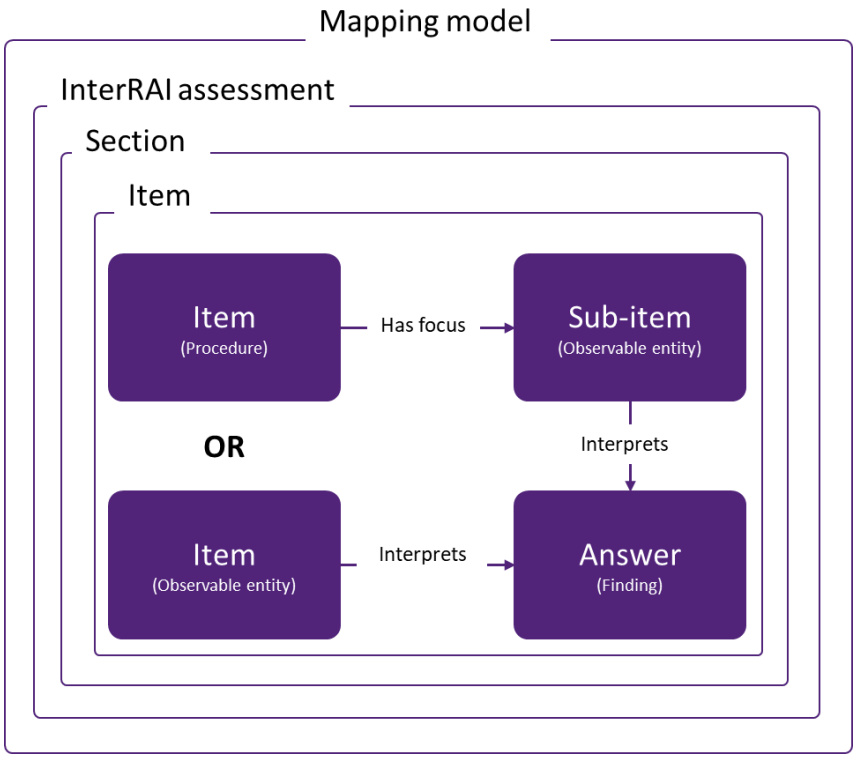


Figure 4 | Hierarchical relationships and associated SNOMED CT-AU concept

Relevant reference sets

In SNOMED CT, reference sets can be defined. A reference set can be employed to represent a subgroup of SNOMED components (concepts, descriptions or relationships) and a reference set may be used to associate the subgroup of components with additional information.

The interRAI clinical assessment mapping to SNOMED CT requirements do not fit within existing reference sets. The development of reference sets specific to the mapping of long-term care facilities may be beneficial if the mapping of associated clinical information is desired at scale.

Tools

Initial mapping

The primary tool used to assist with this mapping interRAI clinical assessments to SNOMED CT was the 'Shrimp/🔥' (Shrimp) solution, developed by the Australian e-Health Research Centre (AEHRC, CSIRO) (11), see Figure 5. The Shrimp tool provides the capability to search SNOMED CT codes in an edition (country-specific or international) and version of choice via a user interface. In this feasibility exploration we used the latest version available at the time (released November 2024) of the international edition. The interRAI to SNOMED CT 'mapper' reviewed the clinical assessment and all potential responses, then manually searched the SNOMED CT international edition catalogue for a corresponding response which aligns with the mapping logic.

Figure 5 | CSIRO's 'Shrimp/🔥' solution (11)

Mapping maintenance

Mapping maintenance was out of scope for this feasibility project, but once the map is implemented, 'Snapper/🔥' (Snapper), another tool developed by the AEHRC, would be the primary solution used to maintain maps (8). The Snapper tool can compare existing mapped SNOMED CT codes (from the initial map) to codes in the latest SNOMED CT version (a new version of SNOMED CT is typically released

monthly), allowing for the identification of newly inactivated codes and providing recommendations of new codes to map to.

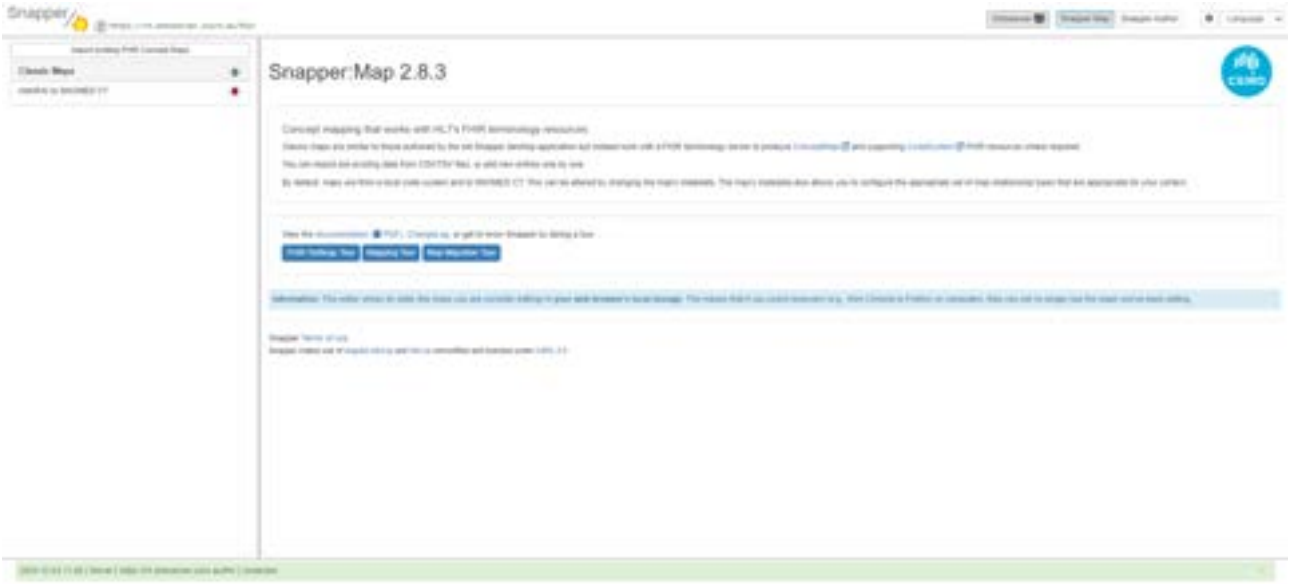


Figure 6 | CSIRO's 'Snapper/ 🔥 ' solution (8)

Risk management approach

If interRAI clinical assessment findings are mapped to SNOMED CT codes incorrectly, risk to care recipients is potentially introduced. It is necessary that a risk management approach is followed to minimise the occurrence of project or consumer harm. The scope of the risk management approach is any foreseeable safety or financial risk which is related to the implementation of interRAI to SNOMED CT mapping.

Risk management process

A common process for identifying and mitigating risks is briefly described below. A similar approach should be adopted to manage risks associated with a source to SNOMED CT mapping project.

1. Identify risks

- Subject matter experts (SME), and mappers, in the context of mapping interRAI to SNOMED CT and the potential use cases will need to brainstorm and note any risks associated with the mapping activity.

2. Assess risks

- The likelihood and impact of the risk occurring must be assessed against an applicable risk matrix. Local policy regarding risk management should be applied as appropriate.

3. Plan responses

- Leveraging the existing group of SME and mappers, obtain additional business context and plan mitigations to identified risks. Aim to reduce the likelihood and impact of the risk to within acceptable risk tolerance.

4. Implement responses

- Associate ownership and implementation responsibility to each identified risk for which mitigation is planned.

5. Communicate

- Ensure identified risks and planned responses are distributed to relevant project governance for endorsement and noting.

Roles and responsibilities

It is important that project management governance exists if a scaled interRAI to SNOMED CT project is to be established. Whilst establishing the governance process with clear escalation pathways, both the decision-making responsibility and roles should be described. This process should include the identification and management of risk.

Risk tolerance

Risk is always present, and rarely completely avoidable through mitigation. It is important to define the reasonable tolerance of risk within established governance processes related to the mapping exercise.

Many risk management scales exist. Ensuring likelihood and impact are measured is the primary requirement for a scale while the choice of scale is less important. Below is an example of a risk scoring matrix provided by the ADHA.

Risk scoring Risk score is obtained by multiplying the likelihood score by the consequence score.			Likelihood score				
			1	2	3	4	5
			Rare	Unlikely	Possible	Likely	Almost certain
Consequence/ impact score	5	Catastrophic	5	10	15	20	25
	4	Major	4	8	12	16	20
	3	Moderate	3	6	9	12	15
	2	Minor	2	4	6	8	10
	1	Negligible	1	2	3	4	5

Extreme risk	15 to 25
High risk	8 to 12
Moderate risk	4 to 6
Low risk	1 to 3

Figure 7 | ADHA example of risk scoring matrix (9)

Source preprocessing

Automated mapping was not an option for the provided subset for mapping of interRAI to SNOMED CT. Considering this, the requirement for preprocessing (i.e., modifying of local terms) was not necessary.

Automapping may be beneficial if other interRAI fields such as diagnosis where a ‘code to code’ map may be possible (i.e., ICD9/ICD10/local terminology to SNOMED CT).

For the feasibility subset, instead of preprocessing, interRAI data items require preparation in a way that facilitates manual mapping. As the hierarchy of data within an item is important when considering mapping, this needs to be represented in a data file to facilitate manual mapping of interRAI terms with context. For this exploration, this was done manually, however, we recommend an exploration of scripting (automating) this data preparation in the eventual scaling of mapping interRAI data items.

Source to target mapping and issue management

Any issues with mapping, including unclear targets and conflict resolution must be documented and clarification sought. Considering the mapping is nearly completely manual for the interRAI dataset, the QDHeC developed a prototype application (InterSeCT) to manage maps, issues, conflicts, and decisions (see Figure 8).

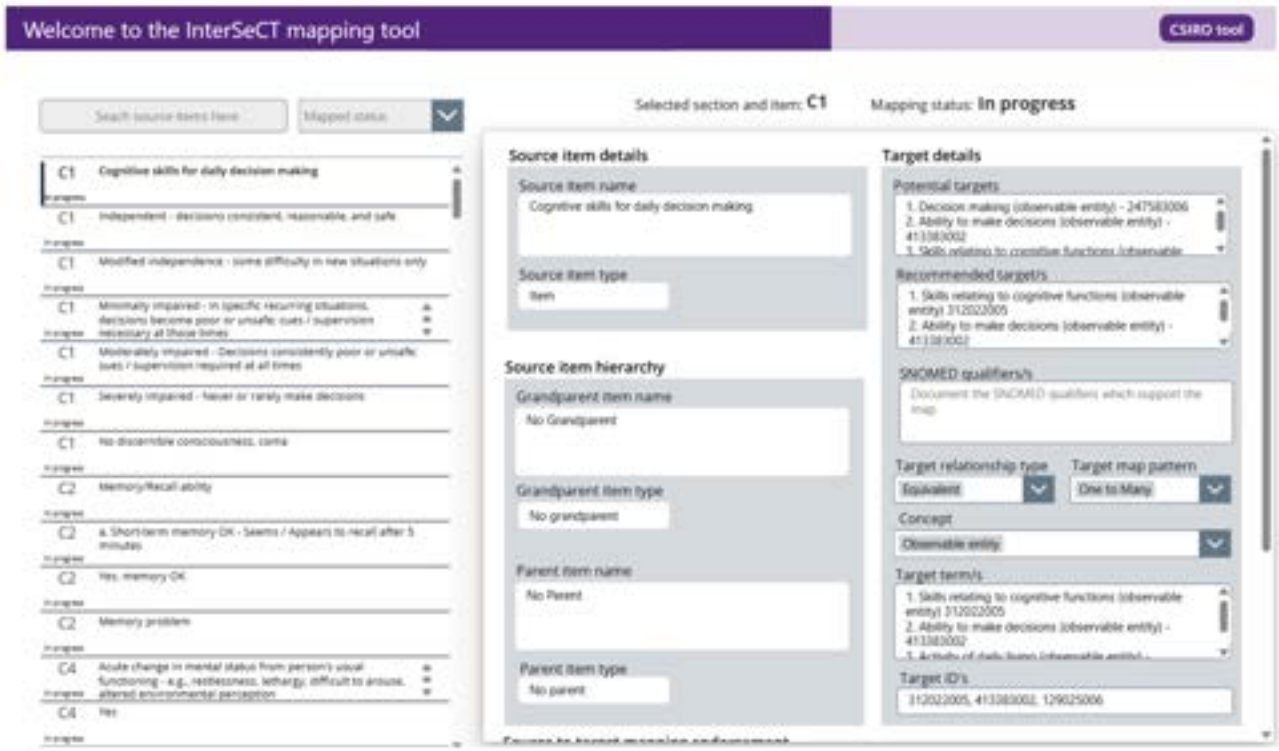


Figure 8 | QDHeC InterSeCT mapping tool

InterSeCT helps a human mapper visualise data which have been prepared as described in the *Source preprocessing* section above and allows each map to be enriched with information pertaining to the map. This ensures necessary data (as recommended by the ADHA guideline (9)) are entered and associated with the interRAI item. These data include:

1. Potential targets
    a. These are the SNOMED CT codes the mapper considered as potential targets for the map.
2. Recommended target(s)

    a. These are the SNOMED CT code/s the mapper is recommending the source be mapped to. Any issues regarding the map may be discussed in this field, including any clarifications which resulted in a recommended map.

3. SNOMED CT qualifier(s)
    a. These are qualifier values that provide context for the target terms.
4. Target relationship type
    a. Equivalent
    b. Broader
    c. Narrower
    d. Inexact
    e. No match/unmatched
5. Target map pattern
    a. One to one
    b. One to many
    c. Many to one
    d. One to none
6. Target Term(s) (the SNOMED CT term)
7. Target ID (the SNOMED CT ID)
8. Endorsing group
    a. This identifies to what extent governance was leveraged in the mapping decision making process i.e. (mapper, governance group, multiple mappers, etc).
9. Endorsement date
    a. This is the date the mapping decision was made.
10. Mapping status
    a. This field is used to monitor the completeness of the mapping exercise.
11. Comment field (within the ‘Source to target mapping endorsement’ section)
    a. This field is for any finalising comments regarding the endorsement of the map. See Figure 9 for example of the endorsement section of InterSeCT.

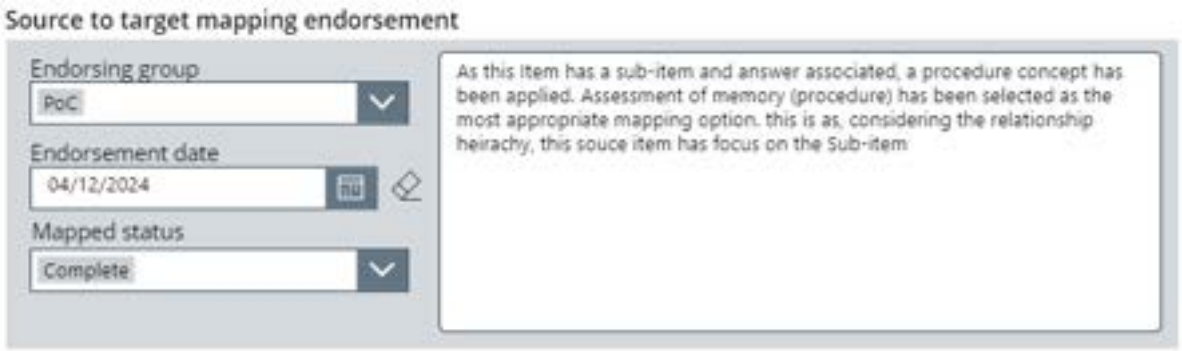


Figure 9 | InterSeCT mapping endorsement section

Considering risk identification, issue management and mapping requirements, a once off, high-level mapping process for the initial map is demonstrated in Figure 10.

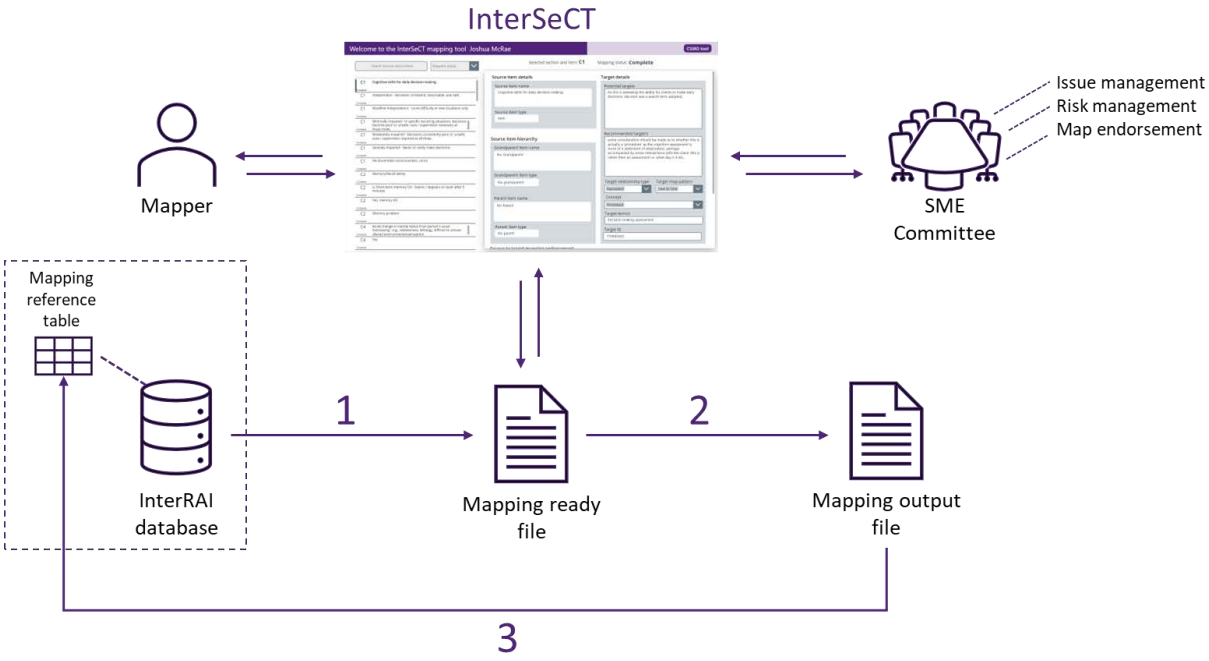


Figure 10 | High-level interRAI to SNOMED CT mapping process

Regarding mapping maintenance after implementation, the SNOMED CT international edition is typically updated monthly. Ideally, monthly releases are to be incorporated into the mapping reference table shortly after release. While this may not always be feasible or necessary for interRAI, a mapping maintenance schedule needs to be decided upon. The mapping maintenance process is demonstrated below for two scenarios – the introduction of a new interRAI field (Figure 11) and, assessing existing maps against a new SNOMED CT release (Figure 12). When a new interRAI item is introduced or an existing item is modified/updated, this field and all potential responses will need to be mapped to a SNOMED CT equivalent code as demonstrated in the initial mapping process. If, when comparing the latest SNOMED CT release against the most recent mapping file an inactive code is identified, an equivalent or similar active code will need to take the place of the now inactive code within the mapping reference table. To ensure data integrity

within the interRAI mapping reference table, inactive maps must be archived appropriately and managed to ensure identifiability and provenance of inactive maps to current active maps.

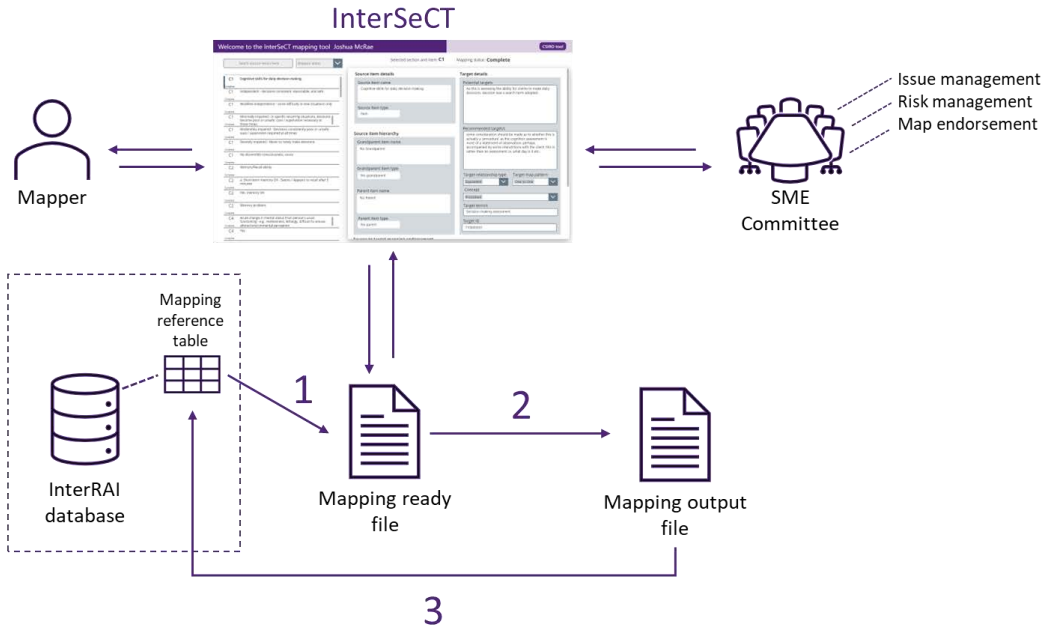


Figure 11 | High-level interRAI new item mapping process

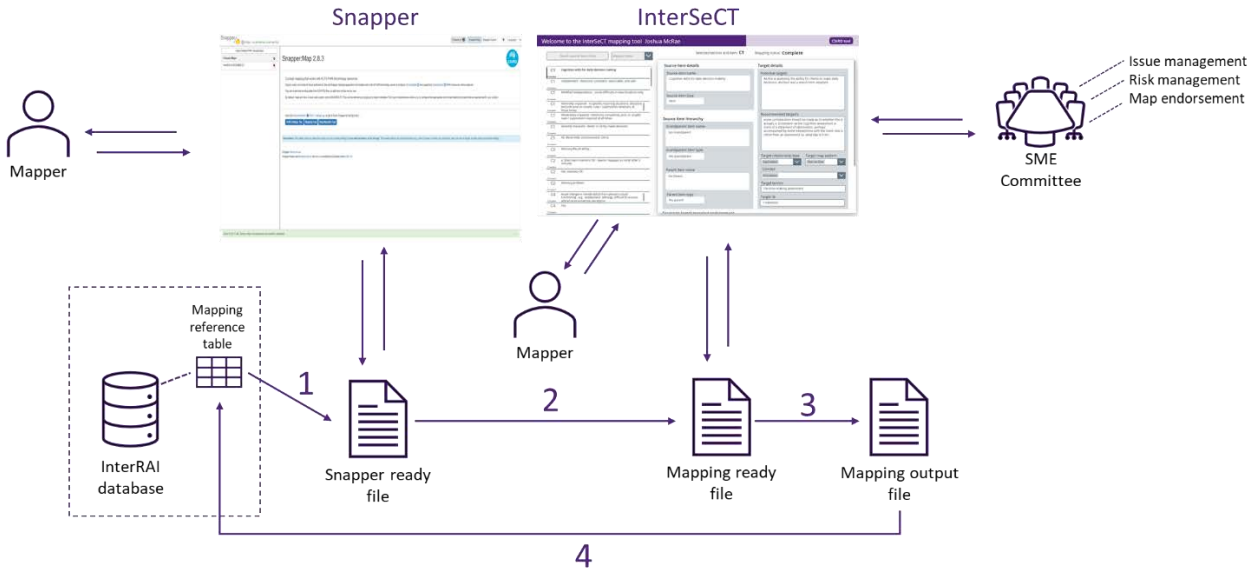


Figure 12 | High-level interRAI new SNOMED CT (International edition: November 2024) release maintenance

Validation

Clinical validation

For this feasibility project, a clinical validation of all maps was undertaken. The mapper met with two geriatricians experienced in long term-care, one with significant experience in developing and using interRAI

assessment systems. They discussed each map and recorded the outcome in InterSeCT. There are other potential methods for validation, described below - the appropriate method may depend on the use case.

Sampling

interRAI may decide to allow mapping to occur by the mappers alone, without review of a SME Committee although this is not recommended. This may be due to the apparent simplicity of some sub-sets of maps or the seemingly unnecessary review by the SME Committee for some items. This is especially likely when many items are required to be mapped due to extensive time commitment if all maps were to be reviewed.

Dual mapping approach

A more comprehensive approach to promote quality maps, which could remove the need for sampling, is to adopt a dual mapping approach. In this instance, two separate mappers will map the same items. Any maps which were not identical would be escalated to the SME Committee for resolution and decision. This option would require additional costs to resource an additional mapper.

Quality review

In practice, when implemented, a quality review will be conducted upon completion of the map ensuring all necessary items have been finalised. Key items for review can include:

1. Review of the clinical audit process
2. Audit of accuracy of the map
3. Documentation of lessons learnt
4. Ensuring mapping documentation is completed

This step is necessary to ensure ongoing improvement of the mapping process and mapping quality.

Findings

Based on the subset of interRAI data considered in this feasibility study and the recommendations and processes outlined above, it is feasible that interRAI data elements can be mapped to SNOMED CT.

In total, 50 maps were completed, comprising 6 assessments (across the areas of Cognition, Communication and Vision, Functional Status), 1 diagnosis and 1 procedure. Notably, we found that 68% of maps were considered an equivalent match, 26% were broader, 4% were inexact and 2% were narrower. The use of qualifier values was required in 46% of maps to obtain an accurate match.

A quantitative summary of the mapping outcomes is shown in Table 2. A descriptive summary of the mapping results for each interRAI item, reflecting the outcomes and relevant conversations had during the clinical validation process, is shown in Table 3. The full details of the recommended maps are available on request from Professor Len Gray (len.gray@uq.edu.au).

This feasibility study only included a selection of interRAI items and hence each mapping was bespoke, however the same answer values in interRAI are used across multiple sub-items creating efficiencies when mapping an entire form.

Table 2 | Quantitative summary of mapping findings

	N	%
interRAI level		
Item	8	16%
Sub-item	5	10%
Answers	37	74%
SNOMED CT qualifier values		
Not used	27	54%
Used	23	46%
Target relationship type		
Equivalent	34	68%
Broader	13	26%
Inexact	2	4%
Narrower	1	2%
Concept domain		
Procedure	3	6%
Observable entity	6	12%
Finding	28	56%
Disorder	6	12%
Regime/therapy	7	14%
Target map pattern		
One to One	43	86%
One to Many	4	8%
Many to One	3	6%

Table 3 | Descriptive summary of mapping findings for each interRAI item

interRAI source item	SNOMED CT mapping findings
C1 – Cognitive skills for daily decision making (6 answer values)	This interRAI Item captures three distinct ideas: (i) Cognitive function, (ii) to make decision, (iii) related to daily life; hence three 'observable entity' SNOMED CT codes were combined to capture this complexity. It is important that all Answer values are interpreted in the context of the Item mapping to capture that they relate to the combination of those three ideas. The level of specificity in the 6 answer values was maintained in the SNOMED CT mapping with the use of qualifier values, however one answer value was an inexact match.

C2 – Memory/recall ability: Short-term memory OK - Seems / Appears to recall after 5 minutes (2 answer values)	The Item, Sub-item and Answer maps for this Item were relatively straight forward one-to-one maps, without the use of qualifier values. However, the maps did not capture the 5-minute time element of the Sub-item.
ta	The Item level was mapped to a broader SNOMED CT code which reflected general mental state. There was an equivalent match to the Answer relating to presence of a change in mental status, utilising qualifier values. However, the Answer value relating to absence of a change was mapped to a broader SNOMED CT code.
D1 – Making self understood (5 answer values)	The Item level was mapped to an equivalent one-to-one match. However, some specificity was lost in the Answer values, as 3 of the source Answers were mapped to the same SNOMED CT code, meaning the 5 level of specificity in the source Answers was reduced to 3 levels of specificity in the SNOMED CT mapping.
D3 – Hearing: Ability to hear (with hearing appliance normally used) (5 answer values)	The Item and Sub-item maps were relatively straight forward one-to-one maps. The Answer values were all equivalent maps, maintaining the level of specificity in the source data with the use of qualifier values.
H1 – Activities of daily living (ADL) self-performance: Walking - How walks between locations on same floor indoors (8 answer values)	The Item and Sub-item maps were relatively straight forward one-to-one maps. The Answer value maps maintained the level of specificity in the source data with the use of qualifier values. However, most of them were broader level mappings.
J1 – Disease and diagnosis: Depression (4 answer values)	The Item and Sub-item maps were relatively straight forward one-to-one, equivalent level maps to Disorder SNOMED CT codes. All Answer values required combining the Disorder code with additional Regime/therapy codes or qualifier values. One map was a Narrower mapping.
O2 – Treatments and programs received or scheduled in the last 3 days: Scheduled toileting program (5 answer values)	The Item and Sub-item maps were relatively straight forward one-to-one maps to Regime/therapy SNOMED CT codes. All Answer values required combining the Regime/therapy code with qualifier values. One map was an Inexact mapping.

Considerations for mapping process

An initial large work-effort was necessary to create the maps. Almost all the interRAI data items in the sample required manual mapping, as the assessments and procedures within the interRAI system are complex and do not fit within existing SNOMED CT reference sets. While the initial mapping is resource intensive, maintenance of the map will require less time. Key expert personnel were necessary to ensure clinical accuracy of the mapping, in addition to the mapper who is a clinical informatician, SME in interRAI assessment systems, geriatric medicine and SNOMED CT jointly validated the mapping through discussion and consensus.

Considerations for interoperability

The scope of this feasibility study was to map from interRAI to SNOMED CT only, there is further significant work to determine how the SNOMED CT codes may be integrated into EMRs to achieve interoperability. If and how each of the SNOMED CT maps may be transmitted will depend on the use case. For example, the usefulness of transmitting the fact that the assessment itself was performed (rather than the findings) is debatable, as there is a lack of standardisation across systems and settings. However, this is dependent on the use case and how one would expect the other system to receive and use that information. Similarly, answer values which related to an absence of an assessment or diagnosis could not be mapped without the use of *qualifier values*. However, depending on the use case this may be less important, as it may not be useful to transmit information relating to absences. It should be noted that the use of qualifier values may create complexity for some interoperability use cases, as there is currently a lack of standardisation in how they are transmitted, and the interpretation is context dependent.

Note that exchange of data from SNOMED CT into interRAI was also outside of the scope for this project and would require further investigation and mapping.

Other considerations

SNOMED International does not directly incorporate licensed products, such as interRAI, into SNOMED CT. Hence, we do not foresee any threat to interRAI copyright or intellectual property (IP). The mapping logic to translate from interRAI to SNOMED CT, remains within the interRAI system. This means that in a typical data exchange, a healthcare provider organisation can receive and utilise the findings from an interRAI assessment conducted by a transmitting software but will not have access to the exact structure and details of the interRAI assessment system itself.

Conclusions

This report demonstrated that it is feasible to map interRAI data to the standardised clinical terminology, SNOMED CT. Based on the sample of 50 interRAI data fields, 68% of maps were considered equivalent, and 46% of maps required the use of SNOMED qualifier values to improve accuracy. Due to the complexity of interRAI systems, mapping was a manual process and resource intensive process. There are many potential benefits of mapping to SNOMED CT, including interoperability with other systems to improve care recipient safety, facilitating large scale research and complying with regulatory reporting requirements. It is recommended that a larger scale interRAI-to-SNOMED CT mapping be conducted, starting with a complete assessment system in the interRAI suit

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