



Extending International Terminology Systems to Enhance Communication Between Nursing Services

Clara Diesenreiter^{1,*}, Oliver Krauss¹ and Barbara Traxler¹

¹University of Applied Sciences Upper Austria, Softwarepark 11, Hagenberg i. M, 4232, Austria

*Corresponding author. Email address: clara.diesenreiter@fh-hagenberg.at

Abstract

Nursing care is a crucial part of health care, especially in our ageing society. Digitalization in this area is lacking when attempting to conduct a machine-readable, standardized, healthcare data exchange between different services.

To tackle this issue two standards, International Classification for Nursing Practice (ICNP) and Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT), identified as highly relevant code systems in this sector via expert interviews, were analysed. A competency catalogue of 241 terms was then mapped to both of these systems, in some case extending them with new concepts and terms.

The results show that neither code system was able to translate many of the terms without extension, with ICNP covering 12,03% and SNOMED CT covering 26,14%. However, both systems can be extended, with SNOMED CT showing a better capability to support data exchange in nursing care.

Keywords: Healthcare Data Exchange; Nursing Care; Code Systems;

1. Introduction

This work employs excerpts from the competency catalogue of the Arbeitsgemeinschaft (ARGE) mobile Dienste Oberösterreich (Bachinger-Thaller et al., 2019), which have been translated by the authors. In addition, clinical terms of terminology systems are utilized without any modifications by the authors, which may lead to variations in spelling due to differences between British and American English conventions.

As a consequence of demographic change towards an ageing society, more attention is being paid to the care sector (Braunisch et al., 2018; Statistik Austria, 2020, 2019). Due to population trends and socio-economic constraints, there is an increased specialization and concentration of resources in the healthcare system. To guarantee efficient high-quality healthcare, a continuous transfer of information between service providers is indispensable (J. Bauer, S. Rohner-Rojas, M. Holderried, 2020; Kubek et al., 2020).

Advancing digitalization facilitates the structured exchange of care data, through digital documents, across the boundaries of individual IT systems. To allow health-care providers to focus on care tasks, interoperability of communication channels and data is required (Rappold and Juraszovich, 2019; Weber and Heitmann, 2021; Glaser et al., 2018). International terminology systems are used to provide precise names and identifiers for clinically relevant data, such as diagnoses or actions. Nevertheless, there are still gaps in accurate definitions of care activities (Sellmann and Flemming, 2016; Endemann, 2014). Thus, uniform care concepts are needed to create a consistent database that can be transferred to suitable terminology systems and exchanged over institutional borders.

This work evaluates suitable communication standards and terminology systems and provides a concept to advance the digital documentation of mobile nursing services based on international standards.



The fields of action of mobile services are analysed and derived care acts are encoded using two terminology systems: ICNP and SNOMED CT. Findings are applied to the mobile care system in Upper Austria, since there are no harmonized nationwide specifications for care concepts and concepts and nursing services. Based on the coded care acts, an interoperable example document is created that corresponds to the Health Level 7 Clinical Document Architecture (HL7 CDA).

Nursing services are either encoded using pre-coordinated terms, i.e. terms already predefined by the terminology systems. Alternatively, care acts can be encoded by post-coordinated terms, i.e. proposed terms that comply with the rules of the respective terminology system and represent an extension of the terminology system. Thus, it is shown that both ICNP and SNOMED CT can be sufficiently extended to satisfy the needs of the applied nursing concept as well as the nursing services.

This work comprises several sections that collectively explore the findings and implementation of the study:

- Section 2 explores the established standards for health care data exchange that were implemented in this study. It also offers an overview of two domain-specific terminology systems, namely ICNP and SNOMED CT, which were utilized in the context of health care data exchange.
- Correspondingly section 3 explains the process of conducting an expert interview, outlines the composition and content the competency catalogue and details the procedure for encoding care tasks using either pre-coordinated or post-coordinated terms.
- In section 4 the outcomes and outputs derived from the analysis of the data gathered through the expert interview and the encoding processes are discussed. Additionally, an interoperable example document, based on the coded care tasks, is presented.
- Section 5 assesses the applicability of ICNP and SNOMED CT in encoding care tasks and effectively capturing nursing terminologies. It also delves into the challenges and benefits associated with defining extensions to accommodate additional care tasks within the terminology systems.
- Finally section 6 summarizes the key findings of this work and draws conclusions based on the results and discussions presented. It highlights the implications of the study and suggests potential areas for future research.

2. Background

Long-term care is a fairly recent part of the welfare system, bordering the social assistance system and the health care system. As a result of the distribution of competencies, mixed responsibility arises between the federal government and the individual provinces, which leads to mutual dependency in the regulation of care. Moreover, the lack of uniform definitions and conceptual models for care at the federal level poses a significant challenge. This results in an immense range of applied care concepts and leads to low transparency in service provision and quality assurance. Therefore, this work addresses the sector of mobile nursing care. (Rechnungshof-Österreich, 2020; Leichsenring et al., 2015)

Mobile nursing care is closely interlinked with the informal care field and supports family caregivers. This sector is multifaceted and not purely medical-oriented: it includes home nursing, home help, family help, meals on wheels as well as visiting and counselling services. Care provision involves three professions - certified nurses, social workers focused on geriatric care and residential care assistants - with varying areas of competence. (Rechnungshof-Österreich, 2020; Pichlbauer, 2018)

2.1. Standards for Health Care Data Exchange

In the health sector, communication between individual systems can be difficult due to the presence of varied communication structures. Standards for Health Care Data Exchange enable intra- and extramural data exchange and promote semantic interoperability across sectors.

To address these challenges, this work utilizes the Clinical Document Architecture (CDA), a Extensible Markup Language (XML)-based specification. The standard is of particular importance in Austria, where it is the primary standard for implementing electronic health records. CDA exchanges health data in the form of complete documents, which need to be human-readable and may be machine-readable. Ensuring recipients can view the clinical content requires the use of Extensible Stylesheet Language Transformations (XSLT) to render the document in a standard web browser. (Bärwolff et al., 2006; ELGA GmbH, 2022b; Benson, 2016; iEHR.eu, 2022)

Table 1. Definitions and technical terms of the 7-axis model (Ross-Kerr and J., 2014)

Axis	Definition	Example terms
Focus	The area of attention relevant to nursing	Elder abuse, Child Bearing, Arterial Ulcer, Fever
Judgment	Clinical opinion or determination related to the focus of nursing practice	High, Partial, Risk, Decreasing Level
Means	A manner or method of accomplishing an intervention	Wound Drainage Bag, Denture, Feeding, Bottle, Cast
Action	An intentional process applied to or performed by a patient	Assisting, Patient Advocating, Listening
Time	The point, period, interval. or duration of an occurrence	Always, Onset, Situation, Appointment, Afternoon
Location	Anatomical or spatial orientation of a diagnosis or intervention	Residential Building, Anterior, Intravenous route
Patient	Subject to which a diagnosis refers and who is the recipient of an intervention	Female-headed single family, Community, Elder

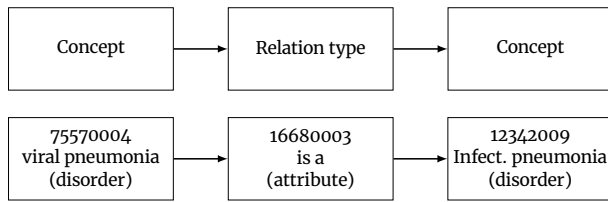


Figure 1. Use of relations in SNOMED CT (International Health Terminology Standards Development Organisation, 2017)

2.2. Terminology systems

Terminology systems are standardized sets of values that map universally available subject-specific terminologies. The use of standards aims to ensure semantic interoperability between distributed applications, enabling the involved systems to correctly interpret content. Such interoperability requires the communication participants to adopt the same nomenclatures and understand their codifications, as otherwise, misinterpretations may occur.

The present work considers two domain-specific terminologies, which are outlined below. (BMG Österreich et al., 2022; HL7 Austria, 2023)

2.2.1. ICNP

The terminology, managed by the International Council of Nurses (ICN), focuses on the classification of nursing phenomena (i.e. nursing diagnoses, nursing interventions, nursing outcomes), which serve to describe the practice of nursing. The central factors of nursing practice are globally congruent, but may differ based on locality and discipline. Therefore, to adequately represent the dynamic nature of nursing and any cultural differences, the system is broad, extensible, and partially translated.

The nomenclature consists of defined terms and encodings representing nursing diagnoses, nursing outcomes, and nursing interventions. Post-coordinated technical terms can be constructed using single keywords or primitive concepts. To facilitate its dynamic nature ICNP is based on two essential components, the International Organization for Standardization (ISO) Reference Terminology Model for Nursing and the 7-axis model, which serve as a foundation for constructing post-coordinated terms. The 7-axis model creates a navigation hierarchy that allows axes to be linked and therefore define additional technical terms. Table 1 shows the axes and their assigned definitions within the ICNP schema.

Newly generated terms do not represent valid instances of the terminology. They may be approved by the ICN and included in the nomenclature once submitted to the council. (International Council of Nurses, 2008; Coenen, 2003)

2.2.2. SNOMED CT

SNOMED CT emerged from Systematized Nomenclature of Medicine (SNOMED) and evolved into the standard with the most comprehensive medical vocabulary. The technical terms comprise clinically relevant concepts that do not merely relate to diagnoses or actions, but rather represent medical meanings. Given the broad spectrum of medical content covered, the vocabulary includes even unconventional terms such as colours.

The terminology contains pre-coordinated terms and their respective relationships to other concepts. Alternatively, if a single concept does not meet the required level of detail, concepts can be interrelated to define new terms. To that end, two underlying constructs, the logical data model and the conceptual model, are used. (ELGA GmbH, 2022c; International Health Terminology Standards Development Organisation, 2017; Benson, 2016)

3. Materials and Methods

An expert interview was conducted, to determine the needs of nursing care providers. Based on this interview and a competency catalogue care tasks were encoded, either by existing pre-defined expressions or by creating extensions to ICNP and SNOMED CT.

3.1. Expert Interview

No nationwide standardized nursing concepts or competency catalogues exist. To determine which terminology systems are suitable for encoding nursing services, a systematic expert interview was conducted, using an interview guide. The interviewee is a trained nurse in charge of nursing services at a major charitable organization. The following is a summarized content analysis and discussion of the most important insights.

A committee of experts developed a competence catalogue for mobile services in Upper Austria, which follows Monika Krohwinkel’s care model. (GmbH, 2019) The catalogue is provided by the expert and serves as the foundation for the coding process.

Electronic documentation may reduce the potential for errors, as the analogue documentation traditionally retained by the client may be altered by third parties.

No time savings are expected from a respective document, but a simplified exchange of information at the interfaces between care and other healthcare providers is hoped for.

Table 2. Examples for creating technical terms using the 7-axis model (International Council of Nurses, 2008)

	Action	Patient	Focus	Judgement	Location	Means	Time
Nursing diagnosis	-	-	Medication Non-adherence	Risk	-	-	-
Nursing intervention	Explaining	Family	-	-	-	Treatment Regime	-
Nursing outcome	-	-	Medication Adherence	Actual	-	-	-

Table 3. Notational rules of post coordinated expressions within SNOMED CT (International Health Terminology Standards Development Organisation, 2017)

Rule	Notation example
An identifier is the simplest form of a term.	80146002
An identifier can be followed by an optional term, which is indicated by vertical lines.	80146002 appendectomy
An identifier can be preceded by a specification, an attribute-value pair. A specification is preceded by a colon. Both attribute and value consist of an identifier and optional term. An attribute is separated from the value by an equal sign.	80146002 appendectomy : 260870009 priority = 25876001 emergency
If several attribute-value pairs succeed each other, they are separated by commas.	80146002 appendectomy : 260870009 priority = 25876001 emergency , 425391005 using access device = 86174004 laparoscope
Curly brackets are used to group attributes. In the following expression, a grouping is used to indicate that a method is applied to a specific anatomical location.	80146002 appendectomy : 260686004 method = 129304002 excision-action , 405813007 proceduresite-direct = 181255000 entire appendix
If the value of an attribute is to be specified, it is represented using round brackets.	161615003 history of surgery : 363589002 associated procedure = (80146002 appendectomy : 260870009 priority = priority emergency)

3.2. Competency Catalogue

The catalogue covers 241 nursing services provided by mobile services in Upper Austria and is defined as

"an excerpt of the possible activities and competences of the respective professional groups and not as a taxative (complete) list" (Bachinger-Thaller et al., 2019).

It is oriented towards organizational/administrative and therapeutic/diagnostic principles, as well as the Model of activating care, which is structured in 13 categories. The activities are performed by three professions and correspond to five areas of responsibility, which concern one profession or a combination of them. To enable the coding

of nursing services, it is necessary to translate them to English, as the catalogue is originally published in German. (Bachinger-Thaller et al., 2019)

3.3. Encoding care tasks using pre-defined expressions

Encoding of nursing services may be done using existing technical terms of ICNP and SNOMED CT, provided they offer a valid equivalent for the nursing service. Here, no concrete guidelines are given, so the accuracy of encodings is subject to the extent of domain knowledge. Both terminologies publish a browser that allows the respective termbase to be searched. (SNOMED International, 2023; International Council of Nurses, 2023)

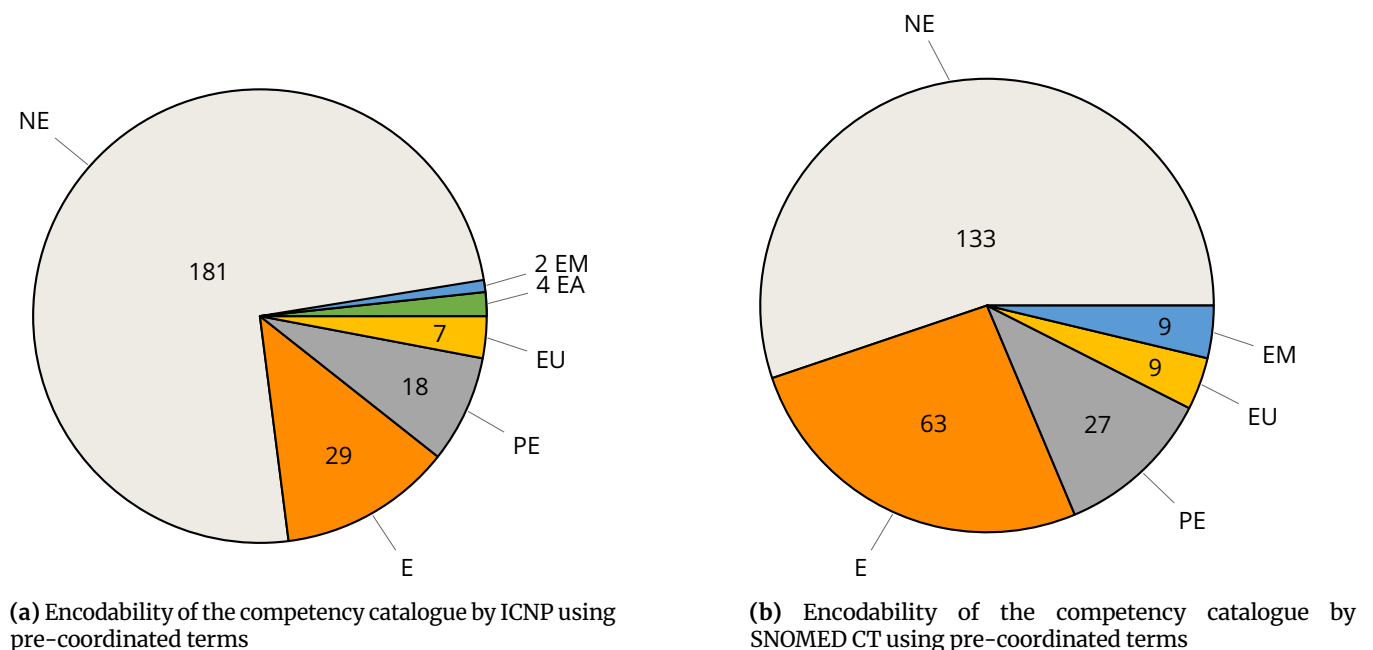


Figure 2. Illustration of the competency catalogue's encodability using predefined technical terms. The legends for both subfigures are as follows: NE - Not encodable, E- Encodable, PE - Partially encodable, EU - Encodable with contextual uncertainties, EM - Encodable using multiple pre-coordinated terms, EA - Encodable by terms of the action-axis

Table 4. Examples of concepts and their encodability levels in ICNP and SNOMED CT

ICNP			
Nursing service	Code	Term	Flag*
Suture removal	10032630	Removing Suture	E
Minor dressing change (e.g. dry dressing, plaster)	10045131	Wound Dressing Change	EU
Implementation of planning, evaluation	10035915, 10031252	Care Planning, Evaluating Care Plan	EM
Administration of drugs of the Addictive Substances Act (e.g. painkillers, oral patches, oral addictive drugs, etc.)	10023084	Administering Pain Medication	PE
Mobilisation according to care planning	10012120	Mobilising	EA
SNOMED CT			
Nursing service	Code	Term	Flag*
Minor dressing change (e.g. dry dressing, plaster)	18595004	Change of dressing, minor	E
Organize hot meals	183681001	Arrange meals on wheels	EU
Measure pulse and blood pressure according to doctor's order	65653002, 46973005	Pulse taking, Blood pressure taking	EM
Prepare tube nutrition, administer by tube and rinse	61420007	Tube feeding of patient	PE

* Abbreviations: E - Encodable, PE - Partially encodable, EU - Encodable with contextual uncertainties, EM - Encodable using multiple pre-coordinated terms, EA - Encodable by terms of the action-axis

3.4. Encoding care tasks by defining extensions

Forming new technical terms (representing nursing diagnoses, nursing interventions, and nursing outcomes) using ICNP, as shown in Table 2, requires the following (International Council of Nurses, 2008):

- A nursing diagnosis must include terms of the focus and judgment axes.
- A nursing outcome must include terms of the focus and assessment axes.
- A nursing intervention must include a term of the action axis as well as the term of any axes except the judgment axis.
- Any term may include terms of other axes if necessary.

As for SNOMED CT, the concept model defines the way technical terms are modelled by a combination of concepts, formal logic and editing rules, whereby interrelating concepts, as shown schematically in Figure 1, is a crucial aspect. Furthermore, the notation of a post-coordinated expression varies depending on its level of detail and follows the formal rules specified in Table 3.

4. Results

Numerous nursing services could not be encoded (NE - Not encodable) by either of the two terminology systems, as shown in Figure 2. However, SNOMED CT allowed to encode (E - Encodable) significantly more nursing services, namely more than twice as many as ICNP. In both terminology systems, uncertainties arose during the coding process. In these cases, it is uncertain whether a term sufficiently and correctly describes the nursing service (EU - Encodable with contextual uncertainties). Some nursing services can be encoded using multiple terms (EM - Encodable using multiple pre-coordinated terms). Therefore, interlinking of the individual terms is necessary, which can be done with SNOMED CT but not with ICNP. Conse-

quently, the ICNP encodings cannot be considered valid. Certain nursing services only allow for partial encoding (PE - Partially encodable), especially if they encompass a broad spectrum of actions, e.g. if multiple individual services are integrated into one. Within ICNP, several nursing services can be encoded using terms of the action axis (EA - Encodable by terms of the action-axis). However, these do not represent full technical and cannot be regarded as legitimate. Examples of encodable, or only partially encodable, concepts are shown in Table 4.

In order to demonstrate the feasibility of the terminology systems, we propose extensions for selected nursing actions of the competence catalogue. To encode nursing services using post-coordinated expressions, SNOMED CT requires compositional grammar. Examples of this can be found in Table 5. Furthermore, Table 5 contains basic elements that can be used to form a technical term within ICNP and correspond to the specifications of subsection 3.4.

Derived from the coded care acts, an interoperable example document is created that corresponds to the Clinical Document Architecture. It is based on the sample CDA documents provided by Elektronische Gesundheitsakte GmbH (ELGA GmbH), in particular, the care situation report. (ELGA GmbH, 2022a) The developed sample document corresponds to the ELGA Interoperabilitätsstufe (EIS) "FULL SUPPORT", a level of structuring that requires machine-readable medical content. Integrating the nursing service documentation is done within an existing section, which can contain various information on the nursing and care effort. (ELGA GmbH, 2021) To represent the human-readable part, the nursing services are incorporated into a table. The table is represented by the Extensible HyperText Markup Language (XHTML), as Listing 1 illustrates. A table entry contains the nursing service, a corresponding code and the name of the terminology system from which the code originates.

Each table entry (`<tr ID="pfleist1">`) and the nursing service it contains (`<tr ID="pfleist1_service">`) define a unique identifier. The identifier can subsequently be referenced by a machine-readable entry, which is shown in Listing 2.

Listing 1. XML-code of the human-readable representation of nursing services

```
<table>
  <thead>
    <tr>
      <th styleCode="xELGA_colw:70">
        Pflegeleistung
      </th>
      <th>
        Code/Terminologie
      </th>
    </tr>
  </thead>
  <tbody>
    <tr ID="pfleist1">
      <td ID="pfleist1_service">
        Assisting with personal hygiene
      </td>
      <td>
        225964003/SNOMED CT
      </td>
    </tr>
  </tbody>
</table>
```

Listing 2. XML-code of the machine-readable representation of nursing services

```
<entry typeCode="COMP">
  <act classCode="ACT" moodCode="EVN">
    <templateId root="1.2.3.4.5.6.7.8.9.10" />
    <id root="ff3efb1e-9ea1-479a-8909-9f6c88c9f851" />
    <code code="225964003" codeSystem="2.16.840.1.113883.6.96" displayName="Assisting with personal hygiene" codeSystemName="SNOMED-CT">
      <originalText>
        <reference value="#pfleist1_service" />
      </originalText>
    </code>
    <text>
      <reference value="#pfleist1" />
    </text>
    <statusCode code="completed" />
    <effectiveTime value="20150730130100+0200" />
  </act>
</entry>
```

The design decisions regarding the entry are justified as follows:

- `typeCode` serves to describe the relationship between the entry and the narrative text.
- The standard variant "COMP" is used because the entry and the continuous text do not have to correspond in terms of content.
- The nursing service itself is embedded in an `<act>`. Although the standard provides more detailed fields of action, none of them include nursing services. Therefore, the implementation is done by a generalized option.
- Similarly, the most general variant "ACT" is chosen for the `classCode`, as the other options are again too detailed.
- The `moodCode` shall provide an understanding of how an action is perceived Dolin et al. (205). Here the option "EVN" is used, because it is defined as "service that is actually performed" Dolin et al. (205) and can be both completed and ongoing.
- `<templateId/>` contains a dummy-OID.
- The `<code>` specifies the type of action. This is done by external terminology systems, which vary according to the field of action. For the `codeSystem` the existing OID is used for SNOMED CT.
- The `<originalText>` references the textual representation of the care action. This is a reference to exactly one field of the human-readable table, namely the nursing service, that is being coded. In contrast, the `<text>` refers to the overall description of the reference and thus to a complete row of the table.
- The elements `<statusCode>` and `<effectiveTime>` are necessary if the service entry represents a proof of execution. These elements can be used to record whether and when a service is to be performed or has been performed.

5. Discussion

The present work analysed the potential of digital and interoperable documentation regarding nursing services. The proposed concept demonstrates the possibility of documenting nursing services in a respective manner. The following conclusions are drawn.

5.1. Applicability of ICNP

Even though ICNP focuses on the care sector, the nomenclature remained beyond expectations as only 12,03% of nursing services could be encoded based on the layout and existing pre-coordinated terms.

The majority of activities, 75.10%, cannot be transferred to the terminology system. Additionally, it is shown that some services may be encoded using terms of the action axis, despite them not being permissible clinical terms. Furthermore, it became apparent that ICNP is inflexible in forming new clinical terms, as the terminology lacks a sufficient number of basic elements.

Table 5. Propositions for technical terms according to ICNP and post-coordinated terms following SNOMED CT

ICNP	
Nursing service	Basic elements for the pre-coordinated term
Planning prophylaxis (prevention of falls, thrombosis, contractures, pressure sores)	10014648 Planning, 10015838 Prophylactic
Perform partial washing at the washbasin	10020935 Washing, 10014132 Patient, 10004693 Commode
Mobilize according to the care plan	10012120 Mobilising, 10014132 Patient
Evaluation of the workplace	10007066 Evaluating, 10021145 Work Place
SNOMED CT	
Nursing service	Post-coordinated term
Medicinal inhalation according to doctors' orders	1366004 Inhalation therapy procedure : 363701004 Direct substance = 410942007 Drug or medication
Ear and nose care	225364005 Care of body sites : 363704007 Procedure site = 117590005 Ear , 363704007 Procedure site = 45206002 Nose
Conduct contracture prophylaxis according to care planning	169443000 Prophylaxis : 405816004 Procedure morphology = 57048009 Contracture
Change of urine bag	384728007 Replacement of device : 260686004 Method = 282089006 Replacement , 363699004 Direct device = 706499002 Wearable urine collection bag

5.2. Applicability of SNOMED CT

Although there is a mapping between ICNP and SNOMED CT, not all nursing services in ICNP can be derived using SNOMED CT. Nevertheless, SNOMED CT allows the encoding of a higher amount (26,14%) of nursing services, as was expected, given ICNP manages 1938 pre-coordinated expressions in comparison to 352 567 concepts in SNOMED CT. Although the encoding is not sufficient in SNOMED CT, it is possible to derive necessary encodings through the use of relations and description-logic notations. (International Council of Nurses (ICN), 2021; SNOMED International, 2022)

5.3. Defining extensions

Technical terms can be defined using both ICNP and SNOMED CT. On the one hand, ICNP leverages the use of an axis combination without further form criteria. Generated expressions must be approved by the ICN to be incorporated into the nomenclature. On the other hand, although SNOMED CT may seem more complex, the adherence to logic and notation rules allow (1) the use of post-coordinated expressions, without further approval and (2) for automated processing using certain parsing mechanisms. (International Council of Nurses, 2008; International Health Terminology Standards Development Organisation, 2017)

5.4. Encoding the competency catalogue

The competency catalogue comprises 241 services, divided into housekeeping, assistance activities, social services, and nursing care. (Bachinger-Thaller et al., 2019) Nursing services exceeding the healthcare scope, especially housekeeping activities, are not considered in the terminology systems. This proves the non-visibility of services outside the care spectrum mentioned by the expert in subsection 3.1. Services, which are a combination of single

actions, can be encoded either partially or by using several pre-coordinated expressions. Combining services reduces their codability, which is why they should be defined as fine-grained as possible. Uncertainties about the context emerged during the coding process when transferring certain services to the terminology systems. These uncertainties can be attributed, on one hand, to the authors' lack of domain knowledge, compared to a nursing healthcare professional. On the other hand, some activities possess a level of detail that cannot be adequately captured by existing nomenclatures. In such cases, it appears appropriate to formulate the activities more concisely or to include limitations in a description rather than directly in the action itself. For example, the activity "documentation in the proof of execution" can be reformulated as "nursing documentation", a term encodable by SNOMED CT.

The findings and methodology employed in this study are applicable to other nations care sector provided they possess a SNOMED CT licence.

Consequently, following the proposed sequential steps, it becomes feasible to encode nursing services tailored to the specific requirements of a community:

1. Establishing a comprehensive and standardized database, such as a competence catalogue, to ensure consistency and uniformity of data.
2. Employing pre-defined expressions for the purpose of coding nursing services.
3. Introducing extensions to address potential cultural variations, including nuances in language usage or divergent nursing practices, by formulating domain-specific expressions.
4. Validating the accuracy and appropriateness of the codifications through rigorous evaluation conducted by domain experts.

6. Conclusions

The proposed approach for documenting nursing services aims at the simplest possible integration into existing documents and structures, as shown by the reference implementation in section 4. The CDA document is valid within the CDA form regulations and the PDF/A standard and is also well-formed according to the XML standard. The validation result is based on the ELGA GmbH validation tool, which can be found at [Online-CDA-Validator · Elga Services](#).

The digital documentation of nursing services enables seamless information exchange across system and domain boundaries, playing a crucial role in upholding the quality of health care. In the field of nursing, efficient and continuous dissemination of nursing information fosters a robust flow of knowledge among all participants involved in the process. Given the inherent challenges of information sharing in everyday nursing practice, digital solutions offer the means to deliver real-time information, thereby enhancing decision-making confidence and ensuring a higher level of patient care. (J. Bauer, S. Rohner-Rojas, M. Holderried, 2020; Kubek et al., 2020)

Within the scope of this work, a further consultation of nursing experts to evaluate the reference implementation and encoding of the competency catalogue was not done. Intensive collaboration with nursing experts on encodings of nursing services poses a wide area of future research.

An additional challenge is the lack of uniform care concepts, therefore this work only addresses the mobile sector of the province of Upper Austria. Agreeing on competencies or nursing concepts appears to be a prerequisite for the introduction of digital care documentation. This does not only apply to Austria, but can be seen as globally valid, resulting in a need for further research.

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