Expressiveness of SNOMED CT for wound Care – Mapping a Standardised item Set for Leg Ulcers to SNOMED CT

Jens Hüsers (j.huesers@hs-osnabrueck.de)
Hochschule Osnabrück
Mareike Przysucha
Hochschule Osnabrück
Lisa Nolte
Hochschule Osnabrück
Anne Paul
Hochschule Osnabrück
Philipp Matysek
Hochschule Osnabrück
Swen John
Osnabrück University
Ursula Hübner
Hochschule Osnabrück

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Abstract

Background: Chronic health conditions are on the rise and are putting high economic pressure on health systems as they require well-coordinated prevention and treatment. Among chronic conditions, chronic wounds such as cardiovascular leg ulcers have a high prevalence. The interdisciplinary and multiorganisational character of wound care demands interoperable information exchange that can be achieved by using international semantic standards such as SNOMED CT. This study, therefore, aimed to investigate the expressiveness of SNOMED CT in this medical domain, and thereby its clinical usefulness and the potential need for its extension.

Methods: In this study, a consented wound care item set, the National Consensus for the Documentation of Leg Wounds (NKDUC), was mapped to the international reference terminology SNOMED CT. In order to derive the relevant items of the wound domain, an information model was developed that served as the foundation for the mapping. The mapping itself was guided by the procedural formalism of ISO TR 12300. As a result, the reliability, equivalence and coverage rate were determined.

Results: The developed information model revealed 268 items to be mapped. Conducted by three health care professionals, the mapping resulted in “moderate” reliability (K=0.512). Regarding a symmetric match, the coverage rate of SNOMED CT was 67.2% overall, and 64.3% specifically for wounds.

Conclusion: The results show acceptable reliability values. The overall coverage rate shows that two-thirds of the items found a symmetric map, which is a substantial portion of the source item set. As the differences in the coverage rates between different wound care sections demonstrate, some areas, such as “general medical condition” and “wound assessment”, in particular, were covered better than other areas (“wound status”, “diagnostics” and “therapy”). These deficiencies can be mitigated either by post-coordination or the inclusion of new terms in SNOMED CT. In general, this study adds another puzzle piece to the general knowledge about SNOMED CT in terms of its clinical usefulness and its need for further extensions.

Introduction

Wound care and interoperability

Chronic health conditions are on the rise, constituting long-lasting disease burden for patients [1, 2], and posing high economic pressure for health systems [3, 4] as they require well-coordinated prevention and treatment. Among the chronic conditions, diabetes as well as vascular diseases causing chronic wounds are common [5], and the prevalence of chronic wounds is estimated to be 2.21 per 1,000 people worldwide [6]. There are different types of chronic wounds depending on the primary diseases and the site, e.g. leg ulcers that constitute the most common chronic wound [6]. Also known as ulcus cruris or chronic leg wound, a leg ulcer is a skin defect located on the lower leg or the foot that fails to heal automatically. The leg ulcer is caused by underlying cardiovascular diseases, most often peripheral arterial occlusive disease (PAD) or venous insufficiency [7]. Furthermore, they are linked to severe complications, such as pain as well as local and systemic infections [8].

As with most chronic diseases, an interdisciplinary regimen promises to be an effective clinical therapy strategy for chronic leg wounds [9, 10]. To obtain the optimal treatment results for patients, physicians from multiple medical fields such as dermatology, cardiology and surgery, specialised wound care nurses and physical therapists are all part of an interdisciplinary team [11]. As leg ulcer patients are most often treated in the ambulatory setting, multiple organisations and providers are involved [2]. The characteristics of chronic wound care as well as its interdisciplinary and multiorganisational aspect demand information exchange about the patients between the attending medical professionals to coordinate and manage care. The healing time and disease burden can thereby be curtailed [12].

In order to standardise and thus improve the documentation and communication process, various data sets were defined, among them the minimum data set (MDS) for generic wound assessment [13], the electronic wound summary [14] and the National Consensus for the Documentation of Leg Ulcer (NKDUC) [15, 16]. The MDS is a Canadian, regionally used item set and the electronic wound summary is a German national standard under development that describes the structure and content of information exchange at patient discharge. The NKDUC item set was published by the Institute for Health Services Research Dermatology, and Nursing at the University Medical Centre Hamburg-Eppendorf Germany. It was developed as a consented, national standard for the assessment of chronic leg wound, taking into account the international literature and medical guidelines [15] and it is, therefore, also applicable outside of Germany.

To foster communication and exchange in this setting, health information technology (HIT) applications offer solutions like electronic health records, personal health records and portals for recording and sharing data across professionals and organisations as well as with the patient [17]. However, a crucial prerequisite for clinical information sharing is the semantic interoperability of HIT applications. Aiming for such semantic interoperability in health care, the International Health Terminology Standards Development Organisation (IHTSDO) publishes and maintains the Systematized Nomenclature of Medicine - Clinical Terms (SNOMED CT). SNOMED CT promises to be the leading reference terminology on an international scale which supports the goal of semantic interoperability and enables health care professionals to exchange the semantics of data, i.e. the clinical meaning. Besides communication and record-keeping, standardised and interoperable clinical documentation from multiple clinical sites constitute the backbone of data-driven clinical decision support systems that may further improve the treatment outcome [18].

Increasingly more countries are adopting SNOMED CT on a national level, including Switzerland and Austria, which joined IHTSDO in 2016 and 2018, respectively. Germany is also following suit [19].

SNOMED CT has proved its usefulness in different areas of health care, e.g. trauma information in emergency medicine records [20], cancer registries [21] and cardiology [22] and, therefore, lends itself to be tested for chronic wounds as well. It may, therefore, provide solutions to foster interdisciplinary leg wound care [23]. However, there is limited research on chronic wounds and SNOMED CT in general, so that studying the expressiveness of SNOMED CT in this clinical field promises to be rewarding in terms of revealing the potentials and limits of SNOMED CT. Such studies also provide evidence and valuable insights for stakeholders on the use of SNOMED CT and on realising interoperability in wound care. In addition, they might motivate clinicians in the discovery of SNOMED CT and its usability in their specific domain.

Objective and Research Questions

Thus, the principal purpose of this study is to investigate the rate with which SNOMED CT covers the medically relevant expressions and terms used in the care of people with chronic wounds in particular with chronic leg wounds. This procedure should give evidence on the expressiveness of SNOMED CT in this medical domain and, therefore, its clinical usefulness and the potential need for its extension. Accordingly, the study followed three research questions:

1. Which leg ulcer concepts should be matched with SNOMED CT?
2. What is the reliability of the matching process?
3. What is the coverage rate of SNOMED CT for the leg wound terms and expressions, i.e. how many items are present in SNOMED CT?

Methods

Wound care item set and general methodology

In order to test the expressiveness and clinical usability of SNOMED CT in the care of patients with chronic wounds and with chronic leg wounds, in particular, a wound care item set based on international medical guidelines and standards with a high degree of clinical acceptance is needed. It was thus decided to use the National Consensus for the Documentation of Leg Wounds (NKDUC) to map the content. The decision was made on the ground that it is a standardised data set drawing on international recommendations and thus features the necessary validity. Furthermore, it embraces a rich set of terms mirroring the wound assessment and status, diagnostic measures and treatments.

In order to meet the research objective and answer the research questions, the present study comprises three main consecutive methodological blocks: First, a formal information model based on NKDUC was designed. Second, a mapping was conducted according to the Technical Report 12300:2014 of the International Organization for Standardization (ISO) [24]. Its 21 mapping principles were followed throughout this process (Appendix 1). Finally, in the third block, the coverage rate was determined.

Information Model

The mapping of a wound dataset to SNOMED CT was based on an information model. This model was developed using the NKDUC dataset. Focusing on chronic leg wounds, the NKDUC overlaps in large portions with other wound related sets, such as the electronic wound summary. The information model was developed including all NKDUC items of the sections “patient demographics”, “general medical condition”, “wound assessment”, “wound status”, “diagnostics” and “therapy”. Thus, only NKDUC items were used that were consented by the NKDUC consortium in a Delphi-based process [15], and other sections were excluded, i.e. “Patient-Related Outcomes”, “Patient Education” and “Nutritional Status”, as they exclusively referred to external sources, such as questionnaires, and assessment instruments, e.g. the Wound-QoL [25].

Designed for clinical purposes, the NKDUC has a flat tabular structure, from which the classes and class attributes were derived. We also modelled value sets consented by the NKDUC as enumerations in the class diagram.

The information model derived uses the UML class diagram notation. Based on this model, all its items (i.e. class names, attributes and value sets) constitute the set of items that are then mapped with SNOMED CT.

Wherever possible, we aimed to reduce the redundant information of the NKDUC that was introduced through its hierarchical structure, e.g. diabetes mellitus and hyperuricemia are both part of the sub-section metabolic disorders. SNOMED CT concepts already contain this information through its relationship, governed by the concepts model [26].

Mapping

In the second methodological block, the NKDUC items represented in the information model were mapped to the target terminology SNOMED CT. This mapping can be considered as what the ISO/TR 12300 defines as a one-time map because the NKDUC clinical content was translated into this terminology through the mapping [24].

The mapping of the items was performed as a non-automatic mapping. As such, it was manually conducted by three clinicians (AP, PM, LN), i.e. nurses experienced in wound care, with a master's degree in health management and a major in health informatics. Before the mapping process started, all three nurses were trained to work with SNOMED CT. The training mainly focused on the logical model, which provides the fundamental structure of SNOMED CT, and the concept model, which specifies, on the one hand, the top-level concepts (i.e. hierarchies) and, on the other hand, the arrangement of concepts within and between these hierarchies. The mapping was conducted in 2018 and 2019 using the International SNOMED CT Version and the IHTSDO SNOMED CT Browser.

Each mapper translated each NKDUC source item into English. Then, for each source item, each mapper was advised to select one concept from the target terminology to create a one-to-one relationship between the NKDUC and SNOMED CT. The result of such a one-to-one relationship is what is called a simple reference set [24].

In this study, only pre-coordinated SNOMED CT concepts were used for the mapping to scrutinise the coverage rate by the existing SNOMED CT concepts. Each concept represents a clinical idea by a single SNOMED CT entity, i.e. a concept that has a unique SNOMED CT identifier (SCTID).

In order to answer the second research question, the inter-rater reliability of the mapping was assessed by computing the Fleiss-Kappa statistic. This statistic quantifies the concordance between the three mappers expressing the reliability with a number ranging within the open interval from zero to one ($0 \leq K \leq 1$) [27, 28] with high kappa values reflecting the high agreement between the mappers. The advantage of this statistic is that it acknowledges that agreement occurs randomly and accounts for it so that its estimate is more robust

than the proportional agreement [29]. This assessment was performed for the overall mapping and the six distinct sections of the NKDUC.

Equivalence Rating and Coverage Rate

In the third methodological block, (i) the semantic equivalence of the previously created maps was rated, (ii) the final concept was chosen and (iii) the coverage rate of the mapping was calculated, as requested in the third research question.

The equivalence rating was conducted according to the scheme described by the ISO/TR 12300. According to this scheme, the semantic equivalence of the map, and thus its quality, was categorised through five degrees (see Appendix 1). The first degree describes the semantic equivalence of meaning (lexical as well as conceptual) and the second degree does too but with synonymy. The third and fourth degrees indicate that both concepts share meaning, but the former describes a broader meaning of the source concept while the latter has a narrower meaning of the source concept. The fifth degree indicates that a map is impossible as there are no concepts that share meaning in the target terminology.

The equivalence rating was independently conducted by two assessors (JH, MP). Both researchers are experienced in health informatics and health care interoperability in wound care. Again, the reliability of both assessors was evaluated using the Fleiss-Kappa statistic. Then, both assessors selected the final concept in a joint discussion. For this final map, the coverage rate for the final map and each NKDUC section was calculated.

The mapping and equivalence rating, in which the coverage calculation roots, was conducted by experts in two distinct processes with a minimal overlap of experts.

The data were entered and stored in MS Excel. Data processing and analysis were performed using the programming language Python and additional open source packages. The data and the Python script are available online. This study neither included human subjects nor personal clinical data so that an ethical vote was unnecessary.

Results

Information model

The information model derived from NKDUC, which was designed in the first methodological block, revealed 268 distinct items for the mapping. It included 25 classes, 66 attributes, 23 value sets and 23 relations. Figure 1 shows an overview of the information model; the complete model is shown in Appendix 2.

Mapping and Reliability Analysis

In the second methodological block, first, the previously identified 268 items were mapped and, second, the reliability thereof was analysed (Table 1).

Regarding the overall reliability, the Fleiss-Kappa value was K = 0.512, which is considered a “moderate” agreement on a scale from 0.41–0.60 [30]. In addition, we analysed the reliability of the mapping for each section of the NKDUC. In this context, the three mappers were the most concordant for the items of the section “general medical condition” with K = 0.754, which is considered a “substantial” agreement. The reliability of “patient demographics” and “wound assessment” was K = 0.575 and, respectively, K = 0.568, both considered as a “moderate” agreement. The raters were the most discordant for the sections “wound status” (K = 0.366), “therapy” (K = 0.367) and “diagnostics” (K = 0.280), considered as “fair” agreement.

Table 1
Inter-rater reliability of the three mappers that conducted the mapping

	Reliability	Number of Items
	Fleiss-Kappa	
By Section		
01 Patient demographics	0.575	34
02 General medical condition	0.754	66
03 Wound assessment	0.568	24
04 Wound status	0.366	57
05 Diagnostics	0.280	14
06 Therapy	0.367	73
Overall	0.512	268

Equivalence Rating and Coverage Rate

In the third methodological block, the map was finalised based on the equivalence rating methodology. According to the Fleiss-Kapp value of K = 0.702, the reliability of the equivalence rating of two assessors can be considered as a “substantial” agreement. The reliability values of the equivalence rating per sections are found in the appendix (Appendix 3).

Based on the equivalence rating, 212 out of the 268 NKDUC items (78.1%) had a match in the target terminology SNOMED CT (Table 2). Among these 212 items, 117 NKDUC items shared lexical and conceptual meaning (degree 1), 63 items shared meaning through synonyms (degree 2) yielding a total of 180 items in the two best categories. 32 NKDUC items matched to SNOMED CT with semantic asymmetry combining degrees 3 and 4, among which six items had a broader (degree 3), and 26 items had a narrower (degree 4) meaning than SNOMED CT. Last, 56 (20.9%) out of the 268 items remained unmatched, described as degree 5 in the ISO TR 12300 equivalence scheme. Table 2 breaks down the coverage rates according to equivalence categories, and Table 3 shows examples for each equivalence category.

The overall coverage rate (which covers the degrees 1 and 2) amounts to 67.25%. When considering the semantic equivalence for each section distinctly, the items of the sections “general medical condition”, “wound assessment” and “wound status” had the highest coverage rate, i.e. 83.3%, 75% and 64.9%, respectively. In contrast, the section “patient demographics” had the lowest coverage rate (50%) and the highest number of unmatched items (35.3%) (Table 2). Regarding wound specific information covered according to the two best degrees (1 and 2), wound assessment ranked first (75.0%) and wound diagnostics last (57.1%), with wound status and therapy ranking in between. The overall wound specific coverage rate amounted to 64.3%. When considering symmetric and asymmetric coverage (degrees 1–4), the wound specific overall rate increased to 72%.

Table 2
Coverage rate of the mapping presented using ISO TR 12300 equivalence categories for the complete NKDUC and each of its sections.

Equivalence Categories	Overall (n = 268)	Section					
		01 Patient demographics (n = 34)	02 General medical condition (n = 66)	03 Wound assessment (n = 24)	04 Wound status (n = 57)	05 Diagnostics (n = 14)	06 Therapy (n = 73)
Semantic Match present (Degree 1 and 2)	67.2% (n = 180)	50.0% (n = 17)	83.3% (n = 55)	75.0% (n = 18)	64.9% (n = 37)	57.1% (n = 8)	61.6% (n = 45)
Semantic Asymmetry present (Degree 3 and 4)	11.9% (n = 32)	14.7% (n = 5)	6.1% (n = 4)	4.2% (n = 1)	12.3% (n = 7)	21.4% (n = 3)	16.4% (n = 12)
Semantic Match absent (Degree 5)	20.9% (n = 56)	35.3% (n = 12)	10.6% (n = 7)	20.8% (n = 5)	22.8% (n = 13)	21.4% (n = 3)	21.9% (n = 16)

Table 3
Examples of the Equivalence Rating

	Source	Target	
Degree of Equivalence (ISO 12300)	**NKDUC**	**SNOMED CT (descriptor)**	**SCTID**
Equivalence of meaning; lexical, as well as conceptual	Ankle-brachial pressure index	Ankle-brachial pressure index (observable entity)	446841001
Equivalence of meaning, but with synonymy.	Ulcus Cruris Arteriosum	Arteritic leg ulcer (disorder)	402862000
Source concept is broader and has a less specific meaning than the target concept	Skin Condition	Periwound skin condition (observable entity)	700149001
Source concept is narrower and has a more specific meaning than the target concept	Wound infection	Infection status (observable entity)	405009004
No map is possible	Extent of wound area		

Discussion

Summary

This study investigated the expressiveness of SNOMED CT in the domain of chronic wounds. It presents a mapping of a documentation standard for chronic wounds, the NKDUC, which is a nationally consented collection of items relevant for leg wound care, to SNOMED CT. Based on the NKDUC, the developed information model revealed 268 items to be mapped. Conducted by three health care professionals, the mapping had “moderate” reliability (K = 0.512). The coverage rate of SNOMED CT was 67.2% (symmetric match) overall and 64.3% specifically for wounds.

Coverage Rate

The achieved coverage rate can be regarded as “satisfactory” as there is a direct, symmetric match in SNOMED CT for two-thirds of all the mapped items (67.2%). An additional 14.6% of the mapped items found an asymmetric match, which adds to a total of 81.8% coverage. Regarding wound specific information, wound assessment ranked first (75%) and wound diagnostics last (57.1%).

In comparison, the overall coverage rates based on pre-coordinated concepts in other clinical domains, e.g. emergency medicine (89%) [19], were higher, but could also be as low as 30% in case of the Human Phenotype Ontology [31], which allows these results to be classified.

Considering the NKDUC sections, heterogeneous coverage rates became apparent. At the end of both extremes, the section “general medical condition” - with over 80% coverage for the first both degrees - had the highest, and the section “patient demographics” had the lowest coverage with 50% combing degree 1 and 2

only. “General medical condition” mainly contains a list of ulcer-relevant conditions also found in the ICD-10 classification. Past ICD-10 mappings with SNOMED CT showed that SNOMED CT covers those items generally well [32], which explains the high coverage rate of this section.

Although the wound specific sections (i.e. “wound status”, “wound assessment”, “diagnostics” and “therapy”) showed a fair to reasonable coverage rate, the mappings thereof remained incomplete. In particular, only a bit more than 55% of the items in the “diagnostics” sections could be mapped literally to the same term or a synonym.

The section “patient demographics” contains items specific to the German system: Its contents include the educational, marital, professional and health insurance status for whose items few identical concepts were identified in SNOMED CT. The reduced coverage rate of this section reflects the fact that the mapping was performed using the international SNOMED CT version for German specific items. Our findings support the need to fill these gaps for a national German SNOMED CT version.

There are no comparable studies in the wound domain to validate our findings. However, an attempt to link a small nursing-specific data set for chronic wound care with SNOMED CT concepts yielded a value to be used as a hint. This value of 50.8% [13] was smaller than the 67.2% in our study.

In any case, our investigation revealed a gap of expressing information specific for chronic wound care in SNOMED CT. Clinical, interdisciplinary datasets that are based on the literature and consented by medical experts, such as the NKDUC, provide valuable insights to identify and fill these gaps.

One approach to doing so is post-coordination to express meaning by composing the existing concepts following SNOMED CT’s compositional grammar. Post-coordination seems especially promising when the target concepts had a broader meaning (degree 4) and the meaning can possibly be narrowed down using post-coordination. Even for missing matches (degree 5), post-coordination can offer a solution. For example, post-coordination would lead to a SNOMED CT expression to code a “leg ulcer smear procedure ”

(16314007 |Microbial smear examination (procedure)|: {363700003 |Direct morphology (attribute)| = 56208002 |Ulcer (morphologic abnormality)|, 363704007 |Procedure site (attribute)| = 416077002 |Skin and/or subcutaneous tissue structure of lower limb (body structure)|}).

In addition, post-coordination requires a consensus building process to be established, as there are various solutions to post-coordinate expressions.

However, if post-coordination fails, missing concepts should be added to SNOMED CT. In this context, the wound-specific sections “diagnostics” and “wound status” may benefit the most because they showed the lowest coverage rates. New concepts to describe the progress of epithelisation and granulation to record wound healing would be good examples to illustrate this need.

Both of the approaches, post-coordination and adding missing concepts, promise to close the semantic gaps identified in SNOMED CT and would allow NKDUC, and probably other documentation standards in wound care, to reach semantic interoperability.

In summary, the findings show that SNOMED CT is not fully ready to be used for wound care documentation and, therefore, further measures need to be taken.

Reliability

The strength of these findings highly depends on the reliability of the mapping. The overall reliability of K = 0.512 is what the reference literature describes as a “moderate” agreement between the mappers. Thus, the findings of the mapping stand on solid ground. However, in this mapping process, rather than selecting items from a small set of options, the raters had to choose from a vast range of SNOMED CT concepts, as it provides over 350,000 pre-coordinated concepts. This circumstance makes it generally harder to find consensus. This conclusion is supported by the fact that the Kappa statistic tends to decrease as the number of categories grow [33].

Comparing NKDUC sections, they showed heterogeneous reliability values. For example, mappers were more discordant for concepts concerning “diagnostics” compared to “general medical condition”. This situation may imply that sections showing low reliability are challenging to map, either because there are many similar SNOMED CT concepts, the NKDUC items are ambiguous or both cases hold true. Reliability values and coverages rates seem to not be uncorrelated as the lower Kappa values for wound status (0.366), diagnostics (0.280) and therapy (0.367) tend to correspond with lower coverages rates of 64.9%, 57.1% and 61.6%, respectively. Alike, higher reliability values for general medical condition (0.754) and wound assessment (0.568) vary with higher coverage rates of 83.3% and 75%. Therefore, in either case, the mapped SNOMED CT concepts in the sections with lower reliability have to be validated carefully prior to its use in clinical practice.

Information Model

Although the information model that was derived from the NKDUC served primarily as a source for identifying the items to be mapped, it also allows statements to be made about the general validity of NKDUC by comparing this information model with others. For example, the openEHR templates “wound assessment panel” and “wound presence assertions” [34], which partly represent wound phenomena, embrace similar content as the corresponding parts of the NKDUC information model. This overlap hints at the validity of this information model as well as the mapping and implications for SNOMED CT. Furthermore, it seems promising to integrate the identified SNOMED CT concepts into wound-specific openEHR archetypes and templates to enhance interoperability in the domain of chronic wound care [35].

Limitations

There are some limitations to be considered when interpreting the results. Most importantly, as mentioned herein above, this study did not make use of post-coordination, which most likely limited a higher coverage rate, as post-coordination usually extends the content of SNOMED CT through compositional expressions [36]. However, this study was conducted to investigate the predefined content and its coverage rate in the ulcer care domain using the NKDUC as an example of a national consented collection of ulcer-relevant items.

We plan to implement post-coordination for an upcoming mapping of the NKDUC to SNOMED CT to further fill semantic gaps and to improve the coverage rate, which is required for actual implementation in systems used in clinical care. Furthermore, as the NKDUC focuses on cardiovascular leg wounds, the coverage rate for items of further wound types, e.g. pressure ulcers, have to be investigated.

Another limitation of this study is the absence of a German SNOMED CT version resulting in the necessity of a translation by each mapper, which may have introduced bias. However, while a national licence is unavailable, at least until 2021, an upcoming German translation is unlikely, especially as German-speaking countries with a SNOMED CT licence, i.e. Austria and Switzerland, do not plan to release a German SNOMED CT version soon [37]. Thus, a translation of the German terms and items was required in this initiative and will remain so in the upcoming German mapping initiatives. In turn, those initiatives may guide and support the future development of a German SNOMED CT version.

Conclusion

This study is the first to investigate the expressiveness of SNOMED CT in the domain of wound care. To this end, a mapping between a standardised wound care data set and the international version of SNOMED CT was performed. The mapping follows the instructions of a fully formalised procedure according to ISO Technical Report 12300:2014 to determine the reliability as well as the equivalence and coverage rate. The results demonstrate varying, but generally acceptable, reliability values. The overall coverage rate shows that two thirds of the items found a symmetric map, for wound specific items the rate was 64.3%. As the differences in the coverage rates between different wound care sections demonstrate, some areas in particular “general medical condition” and “wound assessment” were covered better than other areas (“wound status”, “diagnostics” and “therapy”). These deficiencies can be mitigated by post-coordination or the inclusion of new terms in SNOMED CT. The latter seems advisable particularly for the areas of wound-healing.

Standardised datasets are not an end in itself but contribute to improved information exchange and can serve as a multicenter data source for building clinical decision support systems that make use of routinely recorded information [38].

This study thus adds another puzzle piece to the general knowledge about SNOMED CT in terms of its clinical usefulness and its need for further extensions. Semantic interoperability through SNOMED CT becomes the most powerful in interdisciplinary and interprofessional scenarios across care settings of which wound care is an excellent example.

Abbreviations

SNOMED CT – Systematized Nomenclature of Medicine – Clinical Terms

NKDUC - National Consensus for the Documentation of Leg Wounds

Wound-QoL – Questionnaire on quality of life with chronic wounds

SCTID – SNOMED CT Identifier

IHTSDO - International Health Terminology Standards Development Organisation

PAD – Peripheral Arterial Disease

Declarations

Ethics Approval

This study neither included human subjects nor personal clinical data so that an ethical vote was unnecessary.

Consent for publication

Not applicable.

Availability of data and materials

The dataset generated during the current study are available in the github repository, at https://jnshsrs.github.io/snomed-nkduc/

The python script and additional information are available at https://jnshsrs.github.io/snomed-nkduc/

Competing Interests

The authors declare that they have no competing interests.

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Author contributions

This paper is the result of the close collaboration between all the authors. UH and JH were the first to initiate the project. Subsequently, all the authors planned the study and general concept. AP, PM and LN conducted the SNOMED CT mapping to the NKDUC. MP and JH conducted the equivalence rating. JH was primarily responsible for the content components, statistical analysis and writing the manuscript with large

contributions from UH and SMJ throughout the paper. All of the authors were involved in the interpretation and discussion of the results.

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Corresponding Author

Jens Hüsers Health Informatics Research Group, University of Applied Sciences Osnabrück, Osnabrück, Germany, j.huesers@hs-osnabrueck.de

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