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Documentation in Physical Therapy: Research How SNOMED CT Can Contribute to Improving the Quality of Documentation in Physical Therapy Services in Estonia

Master's thesis

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Dokumenteerimine füsioteraapias: Uuring kuidas SNOMED CT-d saab kasutada füsioteraapia dokumentatsiooni kvaliteedi parandamisesse

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Author’s Declaration of Originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

This research investigates the current state of documentation in physical therapy services in Estonia and the potential role of Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT) in enhancing the quality and efficiency of documentation.

Documentation plays a crucial role in healthcare in improving patient care, communication within the hospital, and research. Because of its importance and size, documentation occupies a significant role in the medical professional's work time, which decreases the amount of time spent with the patient. Standardized clinical terminologies (ST) help medical professionals by providing terms for documentation that are used in clinical management, assessment, and patient care. This enables a more meaningful exchange and processing of medical data. SNOMED CT is one of the most widely used STs in the world and provides a standardized way to represent entered and automatically interpreted clinical phrases through the use of clinically validated, semantically rich, and controlled vocabulary. Although beneficial, the use and opinions towards SNOMED CT and other STs among physical therapists are unknown.

A combination of a comprehensive literature review with a comparative analysis of the Estonian Edition of SNOMED CT against reference sets (REFSETS) developed by the Chartered Society of Physiotherapy (CSP) and a survey of practicing physical therapists in Estonia was conducted. The comparative analysis compared the newest edition of the Estonian Edition of SNOMED CT with CSP REFSETS developed for two initial use cases: Post Total Hip Replacement and Low Back Pain. A web-based survey gathered information from Estonian physical therapists (n=25) on their experiences and opinions on digital documentation.

The results show that the current version of the Estonian Edition of SNOMED CT is not ready to be used for documentation purposes by physical therapists. This is shown both by the comparison of the Estonian Edition of SNOMED CT and CSP REFSETS and the questionnaire results. The comparison showed that only one concept "Unable to move in bed" was present in both entities. The questionnaire showed that physical therapists tend

to favor free text documentation and feel positive toward the current Electronic Health Record systems (EHR) that they use. Opinions towards the need to implement STs into EHRs were also divided.

SNOMED CT, being the most comprehensive clinical terminologies in the world, is not yet ready to be enabled in the documentation of physical therapy services in Estonia. Although multiple barriers inhibit the use of SNOMED CT in the healthcare sector, there are already incentives implemented at the national level to improve the use and functionality of SNOMED CT. This includes the plan of action developed by The Health and Welfare Information Systems Centre (TEHIK) for the further improvement of the Estonian health info system, including the Estonian Edition of SNOMED CT.

This thesis is written in English and is 63 pages long, including 6 chapters and 16 figures.

Annotatsioon

Dokumenteerimine füsioteraapias: Uuring kuidas SNOMED CT saab panustada füsioteraapia teenuste kvaliteedi parandamisesse

Selle magistritöö eesmärk on uurida praegust dokumentatsiooni seisundit Eesti füsioterapaapia maastikul ja mis potentsiaalne roll võiks olla *Systematized Nomenclature of Medicine Clinincal Terms*-il (SNOMED CT) dokumentatsiooni kvaliteedi ja effektiivsuse parandamisel.

Dokumentatsioon mängib tervishoius olulist rolli, toetades haiglasisest suhtlust, patsiendi hooldust ja teadustööd. Dokumentatsiooni olulisuse ja mahukuse tõttu võtab see märkimisväärse osa meditsiinitöötaja tööajast, vähendades veelgi patsiendiga veedetud aega. Standardiseeritud kliinilised terminoloogiad (ST) aitavad meditsiinitöötajatel pakkuda dokumentatsiooniks termineid, mida kasutatakse kliinilises juhtimises, hindamises ja patsiendi hoolduses. See võimaldab sisukat andmevahetust ja -töötlust. SNOMED CT on üks maailmas laialdasemalt kasutatavaid ST-sid ja pakub standardiseeritud viisi kliiniliselt valideeritud, semantiliselt rikka ja kontrollitud sõnavara abil sisestatud ja automaatselt tõlgendatud kliiniliste fraaside esitamist. Kuigi SNOMED CT kasulikkust on pidevalt tõestatud, selle ja teiste ST-de kasutamine ja arvamused nende suhtes füsioterapeutide seas on teadmata.

Uurimistöö käigus sai läbiviidud ulatuslik kirjandusülevaade kombineeritud võrdleva analüüsiga Eesti SNOMED CT väljaande ning *Chartered Society of Physiotherapy* (CSP) poolt välja töötatud viidetekomplektide (REFSETS) vahel. Lisaks sai koostatud ning läbiviidud küsitlus Eestis praktiseerivate füsioterapeutide seas. Võrdlev analüüs võrdles Eesti SNOMED CT uusimat väljaannet SCP REFSET-idega, mis olid välja töötatud kahe haigusjuhu jaoks: puusaliigese endoprooteesimise järgne taastusravi ja alaseljavalu. Veebipõhine küsitlus kogus teavet Eesti füsioterapeutidelt (n=25) nende kogemuste ja arvamuste kohta digitaalse dokumentatsiooni osas.

Magistritöö tulemused näitavad, et viimane Eesti SNOMED CT versioon ei ole veel valmis kasutamiseks dokumenteerimiseks füsioterapeutide poolt. See ilmnes nii võrdlevast analüüsi ja küsitluse tulemustest. Eesti SNOMED CT väljaande ja CSP REFSET-ide võrdlus näitas, et ainult üks kontsept „Võimetu voodis liikuma“ oli mõlemas esindatud. Küsitlus näitas, et füsioterapeudid eelistavad vabateksti dokumenteerimisel ja suhtuvad suhteliselt positiivselt nende poolt kasutavatesse elektroonilistesse tervisesüsteemidesse (EHR). Arvamused ST-de rakendamise vajaduse kohta EHR-idesse oli samuti füsioterapeutide poolt pooleks jagunenud.

SNOMED CT, olles kõige põhjalikum kliinilise terminoloogia maailmas, ei ole veel täielikult Eestis valmis kasutamiseks füsioteraapia teenuste dokumenteerimiseks. Kuigi mõned takistused pärsivad SNOMED CT kasutamist tervisehoiusektoris, on mitmed meetmed riiklikul tasandil juba rakendatud stimuleerimaks SNOMED CT kasutamist ja funktsionaalsust. See hõlmab Tervise ja Heaolu Infosüsteemide Keskuse (TEHIK) poolt välja töötatud arengukava Eesti terviseinfosüsteemide arendamiseks, sealhulgaks ka Eesti SNOMED CT väljaande edasiseks täiustamiseks.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 63 leheküljel, 6 peatükki ja 16 joonist.

List of Abbreviations and Terms

CDSS	Clinical Decision Support System
CSP	The Chartered Society of Physiotherapy
EHR	Electronic Health Records
LOINC	Logical Observation Identifiers, Names, and Codes
REFSETS	Reference sets
SNOMED CT	The Systemized Nomenclature of Medicine Clinical Terms
ST	Standardized terminology
TAM	The Technology Acceptance Model
TEHIK	The Health and Welfare Information Systems Centre
	Clinical Decision Support System

Table of Contents

List of Figures

1 Introduction

1.1 Background

Every day vast amounts of sensitive health data is generated and with vast amounts of information, multiple challenges arise, one of the biggest being understanding the data and data-based decision-making [1]. To help medical professionals in meaningfully exchanging and processing data, multiple standardized clinical terminologies (ST) have been created over the decades. A standardized clinical terminology is a compilation of terms that are used in clinical management, assessment, and patient care [2]. STs include accepted definitions for these terms and accurately represent the knowledge behind them linking them with a standardized coding and classification system [2]. The Systemized Nomenclature of Medicine Clinical Terms (SNOMED CT) is one of the most widely used STs in the world and is considered to be the most comprehensive, multilingual, clinical healthcare terminology in the world [3]. SNOMED CT provides a standardized way to represent clinical phrases entered by healthcare professionals and automatically interprets them through the use of clinically validated, semantically rich, and controlled vocabulary [4].

Despite the importance of STs in healthcare, integration of them into different medical practices, including physical therapy, poses challenges. These include~~,~~ the absence of widespread acceptance among practitioners towards the use of STs, the difficulties in finding the right concepts through a huge list of STs and the complexity of the medical information just to name a few. Although the advantages of STs outweigh the major efforts required to combat the issue around unstructured data, the actual use of STs is in healthcare is still not totally known. [5]

Current paper focuses on the investigation of the usefulness of SNOMED CT in physical therapy practices in Estonia.

1.2 Statement of Problem

The lack of research on SNOMED CT use among physical therapists could be the cause of the lack of awareness and training of medical professionals towards Electronic Health Records (EHR) [6]. There is a need to investigate the current state of documentation and use of SNOMED CT in Estonian physical therapy practices to identify barriers and opportunities for improving documentation quality and efficiency.

1.3 Aim of the Study

This study aims to assess the current state of physical therapy documentation in Estonia and the current barriers that prevent the successful integration of SNOMED CT into the Estonian physical therapy sector.

1.4 Research Questions

This section states the research questions used to achieve the main aims of the study:

Q1: How can SNOMED CT or other STs contribute to improving the quality of physical therapy services in Estonia?

Q2: What is the current state of SNOMED CT in physical therapy documentation in Estonia?

Q3: What challenges and barriers exist in the implementation of SNOMED CT or other STs in the Estonian physical therapy sector?

Q4: What opinions and experiences have Estonian physical therapists towards documentation and STs?

2 Literature Overview

2.1 Documentation in Healthcare

2.1.1 Challenges of Documentation in Healthcare

Documentation plays an important role in healthcare by providing all information about patients' health status, procedures done by the hospital staff, and communication within the hospital [7], [8]. It is essential for the continuity of patient care, research, and legal defense, and can prevent avoidable medical errors [6]. Because of its importance and size, documentation nowadays occupies 20% to 50% of the medical professional's work time and has been found to actually increase the amount of time away from the patient and instead going through the patient's medical data [9]. Record keeping is generally seen as a complicated activity by healthcare workers and because of that is found to be associated with burnout, increased cognitive load, loss of information, and distractions [6], [10]. In addition to the lack of time, another big factor that impacts medical documentation is the lack of eHealth literacy. A 2014 study found that amongst a group of surveyed Estonian physicians, 57% had not received basic Electronic Medical Record training from the developers [6]. The same study also revealed that the more physicians received training on the same system, the more critical and dissatisfied they became with it [6].

2.1.2 Structured Documentation

Structured and or standardized clinical data can be captured using clinical terminologies, by retrieving concepts from sophisticated reference terminologies and assigning them a status [11]. This enables the creation of high-quality and reusable data, automation of reporting, and reliable data sharing between health systems [12]. Clinical terminologies currently are recognized as key resources for knowledge management, data integration, and decision support in medical institutions [13]. Among dozens of terminologies available SNOMED CT and Logical Observation Identifiers, Names, and Codes (LOINC) have been identified as having the highest impact in clinical practice, and thus becoming international standards [13].

Although structured documentation can make it easier to gather and reuse data, they can also be difficult to use during patient visits and may lack the expressivity and flexibility needed for medical practices [14]. This happens especially when clinical terminologies do not contain a needed item for thorough documentation, which in addition to the complexity of the used systems can slow the user down and increase documentation time [14].

2.1.3 Interoperability in Healthcare

Semantic interoperability aims to share data among information systems or organizations and ensure that the data is understood and interpreted correctly [15]. Well-established interoperability ensures effective patient care by facilitating a seamless exchange of information among multiple healthcare systems [16]. This can enhance overall decision-making in medical institutions and reduce the number of medical errors by providing credible information, updating data in real time, and preventing data duplication and loss [16], [17]. Additionally, advancements in blockchain and cloud technology, have been found to also improve interoperability between healthcare systems [18].

Despite the numerous benefits that semantic interoperability presents, implementation still remains challenging, mainly because usually each organization has an internal ecosystem in which patient records are stored [15]. In addition, economic challenges such as cost-benefit decisions and navigation through the complex landscape of healthcare regulations impact also investments and implementation of interoperable systems in the healthcare sector [19], [20].

2.2 SNOMED CT

2.2.1 Aim and Benefits

The aim of the nomenclature is to preserve the richness of expression of free text while enabling the processing of clinical data by using modern information technologies [21]. This creates possibilities for clinical research, self-directed learning, and improving the quality of care. Automated cross-mapping systems can drastically cut down the time needed to process statistics and billing information [21]. The use of SNOMED CT in

EHRs improves communication and increases the availability of relevant information [4]. It is found to be beneficial both on the individual and societal levels, by providing multiple useful functions ranging from increased opportunities for decision-support to more accurate retrospective reporting for both research and management [22].

When implemented, SNOMED CT can provide multiple features to represent clinically relevant information reliably, comprehensively, and consistently [4]. The features of SNOMED CT include a comprehensive scope covering clinical concepts in patient records, the ability to express varying levels of clinical detail through expressions with one or more concept identifiers, and concept relationships for consistent information retrieval [23]. Its extensible design supports the addition and evolution of content, while the reference set mechanism aids in representing mappings, language variants, and value sets [23].

One of the biggest benefits of SNOMED CT and its extensive set of concepts is its support of automated reasoning over clinical text [24]. This enables the development of advanced clinical decision support tools and facilitates the accurate translation of clinical terms into SNOMED CT concepts [24]. Clinical decision support systems aim to guide medical professionals' decision-making and actions, which can improve the quality of care and prevention of errors, save time, and reduce costs [25]. Trained algorithms and validated computerized tools in addition to efficiently interpreting complex data sets, enable monitoring individual's health status and alert healthcare providers of potential side effects or insufficient success in treatment [26]. This proves to be especially valuable in the field of chronic disease management, by allowing agile adaption strategies for patient care [26]. In addition, recent advancements in artificial intelligence in combination with SNOMED CT, have already been proven to be suitable for diagnostic purposes [27].

2.2.2 SNOMED CT Components

SNOMED CT content is represented using three types of components that are supplemented by reference sets (REFSETS), which offer more adaptable features and allow terminology to be configured to meet various needs and requirements. These components are [4]:

- Concepts- represent clinical meanings and formal logical-based definitions that are organized, from the general to more detailed, into hierarchies. A numeric concept

identifier is given to every concept. This makes it possible to record in-depth clinical data that can subsequently be accessed or aggregated at a more general level. [4]

- Descriptions- connect concepts to appropriate human-readable terms. Multiple descriptions can be associated with a concept, each of which serves as a synonym for the same clinical concept. An additional set of descriptions that connect terms in another language to the same SNOMED CT concepts is included in every translation of SNOMED CT. A distinct numerical description identifier is assigned to each description. [4]

- Relationships- connect related concepts. Formal definitions and additional characteristics of the concept are provided by these relationships. A relationship that relates a concept to more general concepts is called |is a| relationship. Other types of relationships illustrate aspects of the concept's meaning. [4]

These components are supplemented by REFSETS, which support a variety of requirements for the customization and enhancement of SNOMED CT. These include language preferences for the use of particular terms, mapping from or to other code systems, and subsets, which are sets of concepts or descriptions taken from wider sets of concepts or descriptions. Subsets serve as the extensibility mechanism in SNOMED CT, enabling both developers and users to tailor the content of SNOMED CT to meet specific use cases. This adaptability means that subsets of SNOMED CT can be initially created and then progressively refiner over time to align with the evolving requirements. [28]

All concepts in SNOMED CT, Estonian Edition included, are divided by their attributes and ranges amongst 19 different domains [29]. They are indicated by semantic tags, which are placed in parentheses at the end of the Fully Specified Name of the concept [29]. The whole list of concepts and semantic tags can be seen in Appendix 1.

2.2.3 SNOMED CT in Estonia

SNOMED International membership has been rapidly growing, consisting now of 49 member states and issuing licenses to over 30,000 individuals and organizations worldwide [30]. Estonia has been a member of SNOMED International since 2010 and since then SNOMED CT has been available for use in EHR, health research, and other applications [31]. The adoption of SNOMED CT has already improved data quality and

semantic interoperability in multiple healthcare fields like pathology, nursing, and laboratory [31]. The Health and Welfare Information Systems Centre (TEHIK) is SNOMED International's contact point and the administrator of the Estonian Edition of SNOMED CT [32]. The Estonian extension of SNOMED CT contains [31]:

- Estonian translations to the, continuously expanding, core set of concepts.
- Value sets, which are distributed as SNOMED CT REFSETS utilized in the data exchange with the national health information system.
- Content that has been nationally added and specific to Estonian use cases.
- Estonian translations of every concept found in national or cross-border value sets.

TEHIK also has developed a vision and a plan of action for 2030, for the improvement of the Estonian health info system [33]. Further development and wider adoption of STs like SNOMED CT into the healthcare sector is one of the main goals of this vision [33]. To achieve that multiple actions have been developed [33]:

- Further support of the development and usage of the Estonian Edition of SNOMED CT
- The creation of guide and training programs for STs
- Further development of terminology-based solutions that simplify data entry.
- Creation of sustainable terminology management based on a clear distribution of roles, responsibilities, and mandates

To ensure the flexibility of data exchange, additional information models have been agreed upon that are based on international standards and terminologies like SNOMED CT [33].

2.2.4 Use of SNOMED CT

Multiple reviews have been conducted internationally over the last decade that focus on the use of SNOMED CT. All studies show that both the interest and use of SNOMED CT have been steadily increasing over the last decade. This has been seen in the rising number of countries where papers about SNOMED CT have been published, increasing from 22

countries over the period of 2001 and 2012, to 43 countries between 2013 and 2020 [34]. In more practical settings, the use of SNOMED CT has also been found to be increasingly implemented. The most popular uses were natural language processing (NLP), use in population-based registries, and clinical decision support systems (CDSS) [34]. However, the number of papers that demonstrated the impact and merit of SNOMED CT use, was small [34]. In addition, the number of publications has been diminishing in recent years and few publications overall used advanced features of SNOMED CT, such as the polyhierarchy or post-coordination, mostly conceiving SNOMED CT only as a dictionary, terminology, or as a resource for synonyms [3].

When it comes to convenience of use, a few pieces of research were found on the direct benefits of SNOMED CT to physicians and other medical professionals. SNOMED CT's ability to compare individual patients with the whole cohort of similar patients in real time was found to be one of the benefits [35]. In addition, to reducing the amount of medical errors, the tool was also found to significantly reduce the time to locate and confirm the presence of multiple conditions for subsequent coding [36], [37]. When it comes to decision support in 2013, a successful CDSS was compiled, using SNOMED CT, aimed at supporting decisions surrounding low back pain [38].

In Estonia, there have been a couple of publications in the last 10 years that focus on the use of SNOMED CT in Estonian healthcare. In a 2013 paper, the author concluded that SNOMED CT terminology could be used as one of the main encoding systems, to reduce the amount of uncoded data. When in use, it can improve semantic interoperability at the national level or reduce the number of lists created to improve the semantic interoperability of international data exchange [39]. A functional prototype for SNOMED CT pre-release files was also developed for a 2021 diploma thesis. The prototype turned out to be useful in simplifying and speeding up the process of the file review process. Several aspects were found to be taken into consideration when developing this type of software [40]. Unfortunately, the software itself wasn't comprehensive enough in terms of functionality and documentation to give a clear idea of what the ready-made software should be and in what aspects should emphasis be placed during the development of the software [40].

2.3 Strategies for Improving eHealth Development and Acceptability of New Technologies

There are multiple theories and models to consider when implementing needed changes in medical technologies. The technology acceptance model (TAM), is one of the widely used models in assessing and explaining the acceptance and behaviour associated with information and communication technology [41]. At its simplest, the TAM presumes that perceived utility and ease of use have a mediating role between system characteristics and usage [41]. Since its publication in 1986, the TAM and its extensions have been successfully used widely in a variety of end-user technologies, including clinical technologies like EHR, telemedicine, and mobile applications [41], [42]. To improve the acceptance of new technology among healthcare professionals, the perceived usefulness of the system should be made clear to them [41]. In addition to perceived usefulness, other factors such as self-efficacy, system quality, information quality, security, and privacy concerns were also found to be important for adopting EHRs [41]. A unified Theory of Acceptance and Use of Technology has also been found to be effective in the healthcare setting and could be also used in promoting a better transition into the use of SNOMED CT in healthcare [43]. While developing the strategies using these theories, multiple additional aspects should also be considered, mainly because they are not covered in the models [44]. These include: socio-organizational, workflow, cultural or emotional aspects, and differences in healthcare user groups like different healthcare professionals and patients [44].

Integration of medical documentation into workflows is challenging, causing tension among busy healthcare providers [11]. Previous investigations have found that healthcare providers value documentation methods that promote the quality of expression in their documentation, mainly for their accuracy, reliability, and intelligibility [11]. The focus should be put on the further development of EHR systems [45]. Customization and standardization of terminologies to better suit specific medical circumstances can enable a more consistent and uniform usage among health workers [46]. This can promote better utilization of data for decision-making and improve patients' health outcomes [46]. By providing medical professionals with the tools to work smarter, not harder, previously described problems in documentation can be improved drastically [12].

To improve or enable the use of STs in clinical settings, strong cooperation between different stakeholders in medical institutions should be implemented, which especially includes professionals at the IT and administrative levels [47]. Unsuccessful implementation of STs into the workflows of medical professionals can hurt both the documentation and patient care in medical institutions, while successful implementation could enhance the quality of documentation and support decision-making in clinical care [47].

3 Methodology

This research was carried out in two phases. The first phase evaluates the readiness of the Estonian Edition of SNOMED CT for integration into local practices, answering the second and third research questions. The fourth research question was answered in the second phase of the research, where the assessment of effectiveness and current barriers to the integration of SNOMED CT into physical therapy practices in Estonia are evaluated.

3.1 Comparison of the Estonian Edition of SNOMED CT and Reference Sets Recommended by the Chartered Society of Physiotherapy

In the first phase, to achieve the overview of the Estonian Edition of SNOMED CT, a comparative analysis was carried out between all Estonian concepts available in the Estonian Edition of SNOMED CT and the proposed reference sets and concepts developed by The Chartered Society of Physiotherapy (CSP). Comparative analysis was chosen because of its integral part in medical research, allowing comparison between groups to validate hypotheses [48]. An ontology alignment technique is best suited for this research, as it consists of generating correspondences between different ontological entities [49].

CSP is a professional, educational, and trade union body for physical therapists in the United Kingdom. CSP developed a strategy in 2016 for SNOMED CT implementation in physical therapy with the guidance of SNOMED CT's Technical Implementation Guide and by leveraging CSP's prior experience with National Health Service systems. The main focus was on the development of needed REFSETS on two initial use cases: Post Total Hip Replacement and Low Back Pain. The REFSETS were developed as building blocks, which enabled users to have smaller, more focused, and more discrete REFSETS, with tighter definitions, to work with. This was done to improve interoperability, usability, and accuracy of the recording and consistency of information. [28]

CSP distributed developed REFSETS into 10 different groups [28]:

1. Deformity of spine findings- common deformities resulting from abnormal curvature of the spine
2. Joint movement findings- active and passive movements of major joints (excluding the spine)
3. Mobility findings- descriptions explaining an individual's physical movement
4. Musculoskeletal reflex findings- descriptions of the peripheral upper limb, lower limb, and trunk reflexes
5. Pain aggravating factors- common pain-related aggravating factors of the spine
6. Pain easing factors- common pain-related easing factors of the spine
7. Posture findings- common clinical visual observations of posture
8. Spine movement findings- active and passive physiological movements of different parts of the spine
9. Transfer ability findings- descriptions of the individual's ability to transfer between two surfaces or objects
10. Wound integrity findings- descriptions of the status of a wound postoperatively

A full list of concepts of the Estonian Edition of SNOMED CT was provided through cooperation with TEHIK. The author then compared CSP REFSETS with the ones available in the latest version of the Estonian Edition of SNOMED CT by searching for common concepts through SNOMED CT identifiers (SCTID), which are universal in all editions of SNOMED CT. A separate document was created by the author, which included all of the Estonian Extension concepts and CSP concepts. Some of the SCTIDs in the CSP document were not found in the current version of the International Edition of SNOMED CT, so they were updated to be in line with the newest version.

3.2 Questionnaire on Physical Therapists' Assessment of the Use of Electronic Health Information Systems

The second phase focused on gathering information from Estonian physical therapists on their thoughts, opinions, and proposals on the current state of health data collection, exchange, and management in their everyday work. A web-based questionnaire (Appendix 2) was designed which included questions about physical therapists' work, documentation platforms, and their experiences and opinions towards them. A questionnaire enables the evaluation of satisfaction, usability, acceptance, and quality outcomes of a certain technology while minimising bias and maximising the precision of research [50], [51].

The respondents were recruited through different medical institutions, and the request for participation in the questionnaire was sent to all Estonian hospitals and multiple private clinics. The questionnaire was sent on the 8th of April and the data was collected until the 19th of April. The questionnaire was created and shared using the Microsoft Forms platform. It included 15 questions, with some questions having additional questions where respondents could write their answers more thoroughly. Only an Estonian version of the questionnaire was shared, an English translation of the questionnaire can be found in Appendix 3. Because no similar questionnaires have been conducted previously, no template was used. The questionnaire was created through cooperation with industry professionals, including physical therapists and digital health experts. Before distributing the questionnaires to other medical institutions, a small sample group consisting of 4 physical therapists was conducted, who tested the questionnaire and gave necessary feedback.

4 Results

4.1 Overview of the Estonian Edition of SNOMED CT Concepts and Reference Sets Recommended by the Chartered Society of Physiotherapy

In cooperation with TEHIK, a full list of concepts that were translated into Estonian from the latest version of the Estonian Edition of SNOMED CT was obtained. The list contained all 19 953 Estonian concepts, found in the latest extension of the Estonian Edition of SNOMED CT. The latest version of the Estonian Edition of SNOMED CT was released on the 30th of November 2023, and included the Estonian extension with all translated concepts, plus all the other concepts found in the International Edition of SNOMED CT. All of the Estonian concepts were divided and categorized by the author of the current research into a list by their semantic tags and domains (Appendix 4).

The SNOMED CT domains represented in the Estonian Edition are presented in Figure 1:

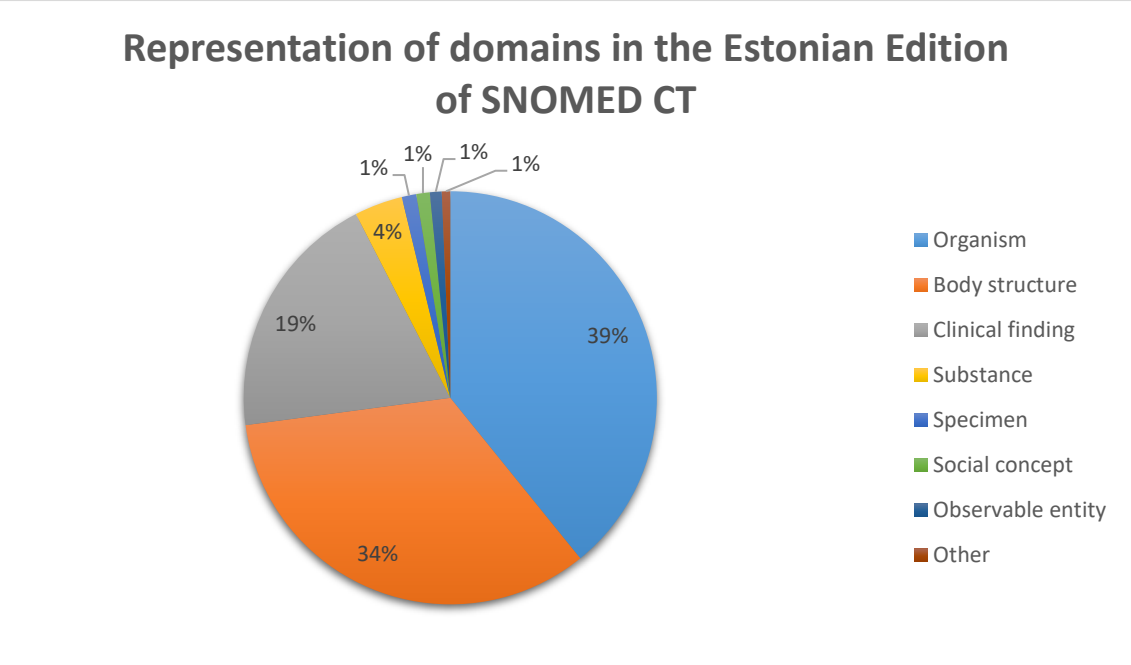

Figure 1 Representation of domains in the Estonian Edition of SNOMED CT.

Three of the most popular domains found in the Estonian extension of SNOMED CT are Organism, Body structure, and Clinical finding, collectively comprising approximately 92% of all concepts. The fourth largest domain is Substance which contains approximately 4% of all the concepts, meaning that all the other 15 domains collectively make for about 3% of all the concepts. The Organism domain consists of different concepts related to living organisms, mostly microorganisms and multicellular organisms like *Mycobacterium tuberculosis*, different types of human parainfluenza virus, and many more. The Body structure domain contains a thorough list of anatomical structures and different types of abnormalities of the human body. The Clinical finding domain contained descriptions of different findings and symptoms like blood types, dyspnoea, different types of allergies, etc. In addition to the findings, approximately 85% of the Clinical finding domain concepts consisted of different types of disorders and diseases.

The SCP REFSETS included 978 concepts and all of the concepts were linked with the Clinical finding domain, mainly because the proposed concepts either described the different types of mobility findings, pain, reflex, and wound integrity findings, or spine deformity findings. The majority of the concepts, 940 out of 978, were under the Finding semantic tag and mainly described different spine and joint movement and overall mobility findings. The rest of the concepts described different types of deformities and disorders of the spine and wound integrity findings.

When comparing the SCP document and translated concepts of the Estonian Edition of SNOMED CT only one common SCTID was found in both lists, which was linked to the concept “Unable to move in bed”.

4.2 Results of the Questionnaire

25 physical therapists answered the anonymous questionnaire and the results were then collected and summarized.

4.2.1 Professional Backgrounds and Descriptions of Provided Services

The majority of physical therapists (84%) were based in hospitals, with the largest segment of therapists (36%) boasting over a decade of expertise (Figures 2 and 3). More than half of the people document their entries after the provision of service and it is

indicated that the longer the service the more thorough the documentation of it is, at least at the initial assessment (Figures 4, 5, and 6).

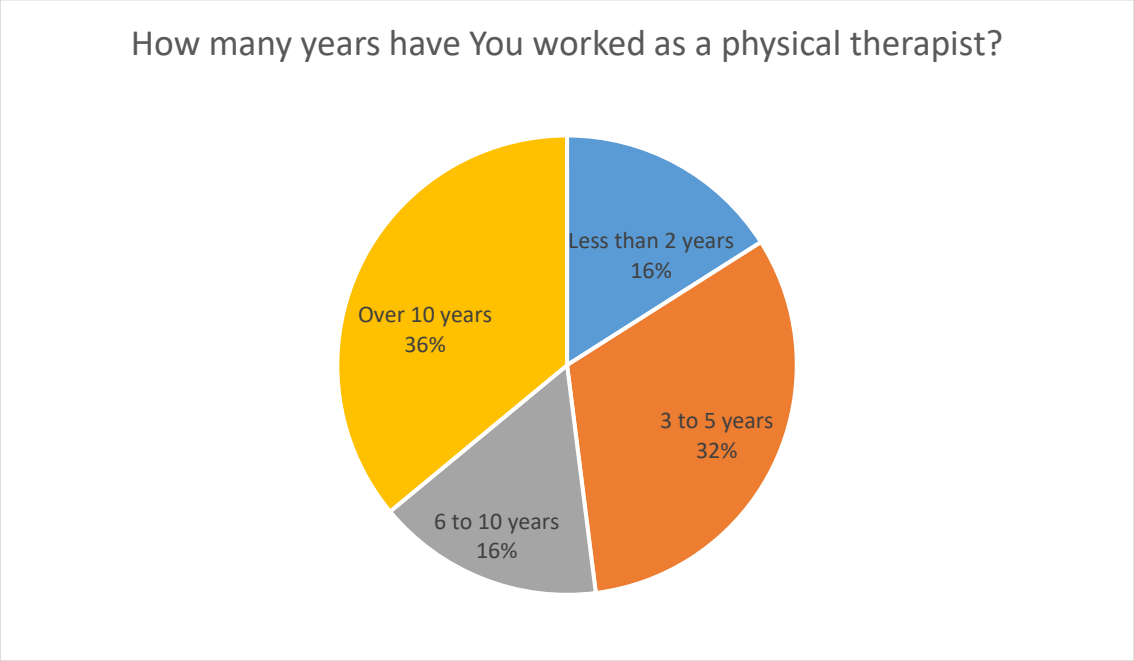

Figure 2 “How many years have You worked as a physical therapist?” results.

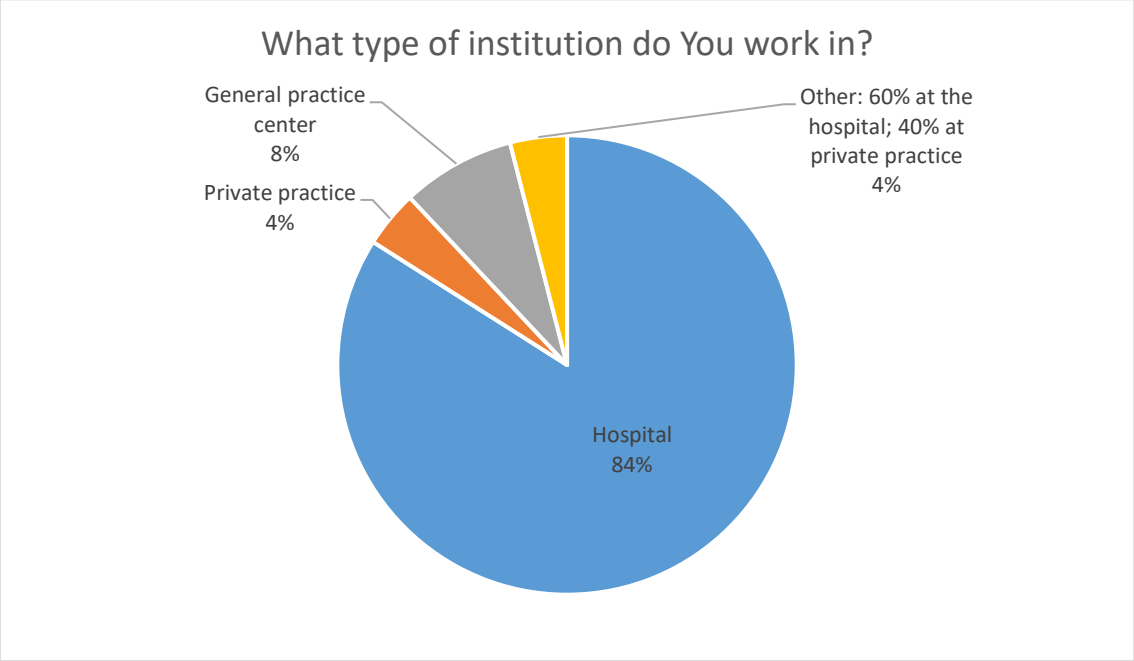

Figure 3 “What type of institution do You work in?” results.

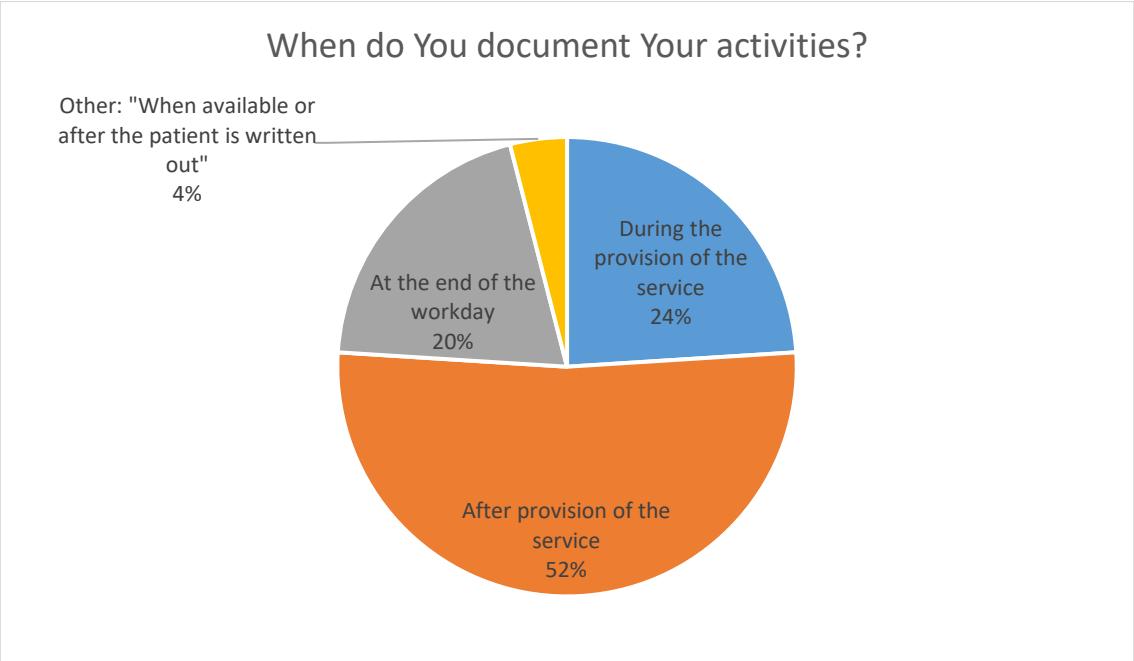

Figure 4 “When do You document Your activities” results.

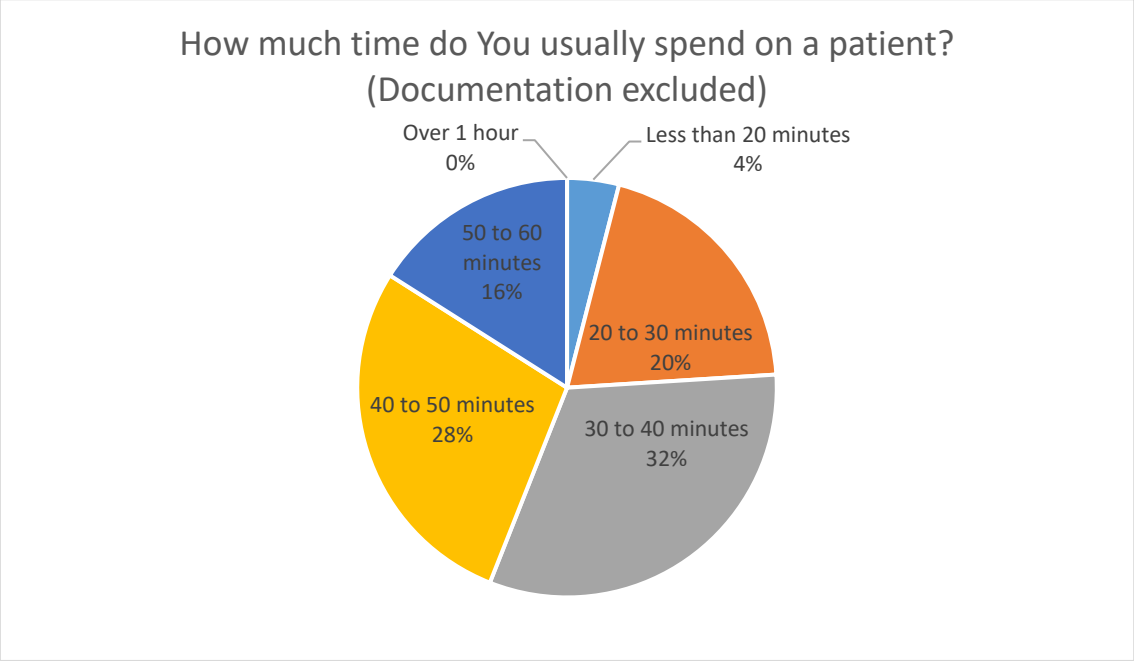

Figure 5 “How much time do You usually spend on a patient? (Documentation excluded)” results.

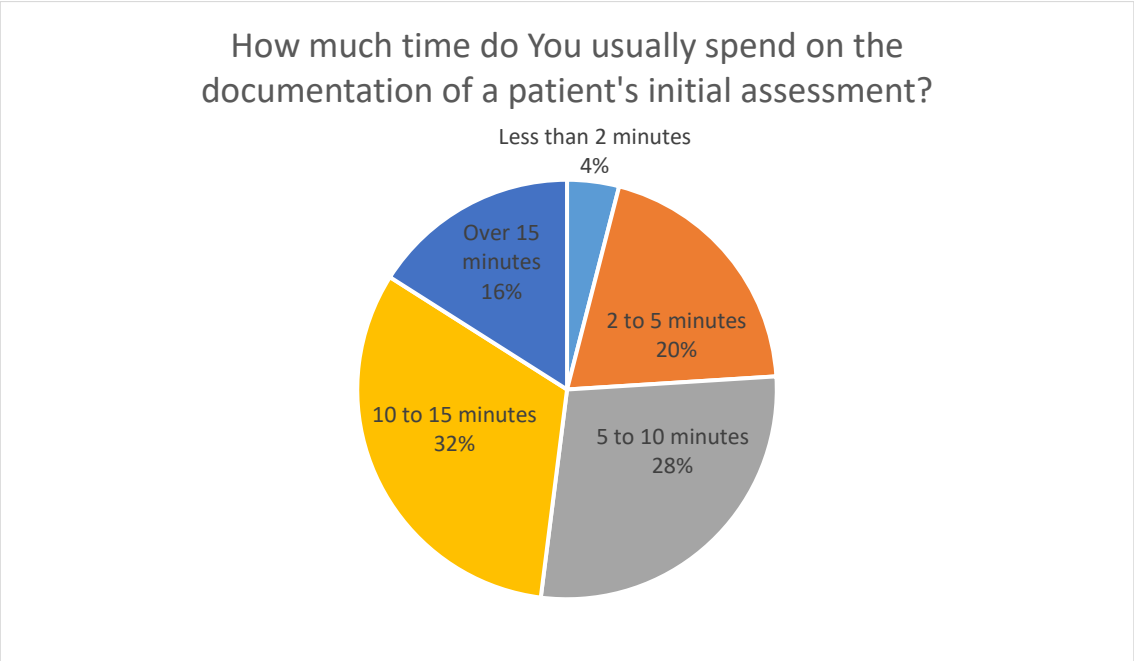

Figure 6 “How much time do You usually spend on the documentation of a patient's initial assessment?” results.

4.2.2 Experiences and Opinions Towards the Documentation and EHRs

The “Liisa” platform stands out as the most utilized information system, which is not surprising as it is used in 97 Estonian medical institutions such as West-Tallinn Central Hospital and Fertilitas Private Hospital (Figure 7) [52]. When it comes to the adequacy of the platforms used, the majority of therapists feel their systems sufficiently provide the necessary information about the patient for their work (84% combined “Yes” and “Rather yes”) (Figure 8). The biggest need for improvement in medical platforms is expressed through the absence of information concerning patients’ previous physical therapy-related medical history, being the only option where most physical therapists expressed that this information is unavailable in their platforms (Figure 9). The main problem that was expressed by that option was that information from other medical institutions was absent. In addition to that, the absence of patients’ information on prescription drugs, was also brought out by a third of therapists. The majority of physical therapists document their services in free text, either because of their preferences or limitations in the systems they use (Figure 10). Even though less than a quarter of therapists report having efficient search options for documentation and the majority of therapists find their platforms to be comfortably structured and user-friendly (Figures 11, 12, and 13).

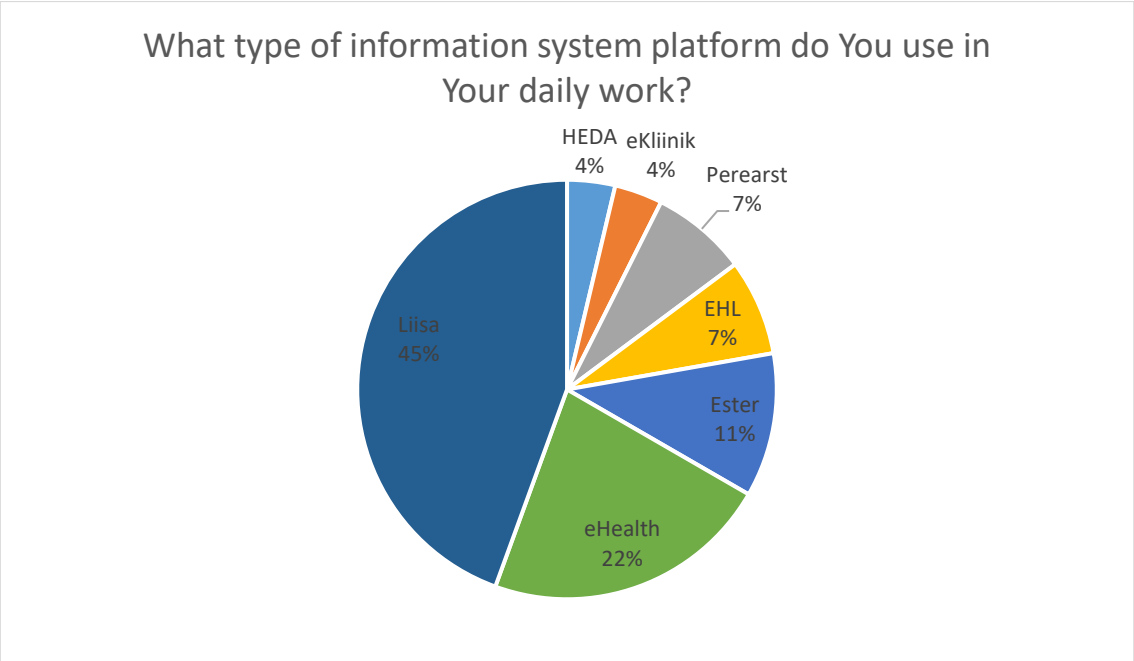

Figure 7 “What type of information system platform do You use in Your daily work?” results.

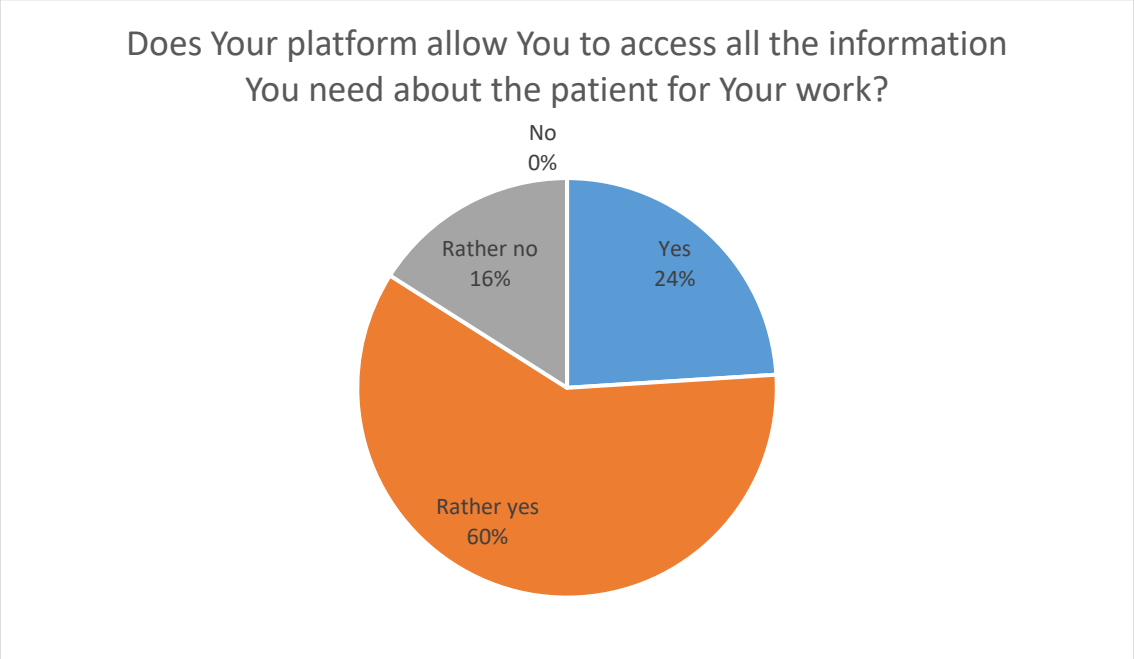

Figure 8 “Does Your platform allow You to access all the information You need about the patient for Your work?” results.

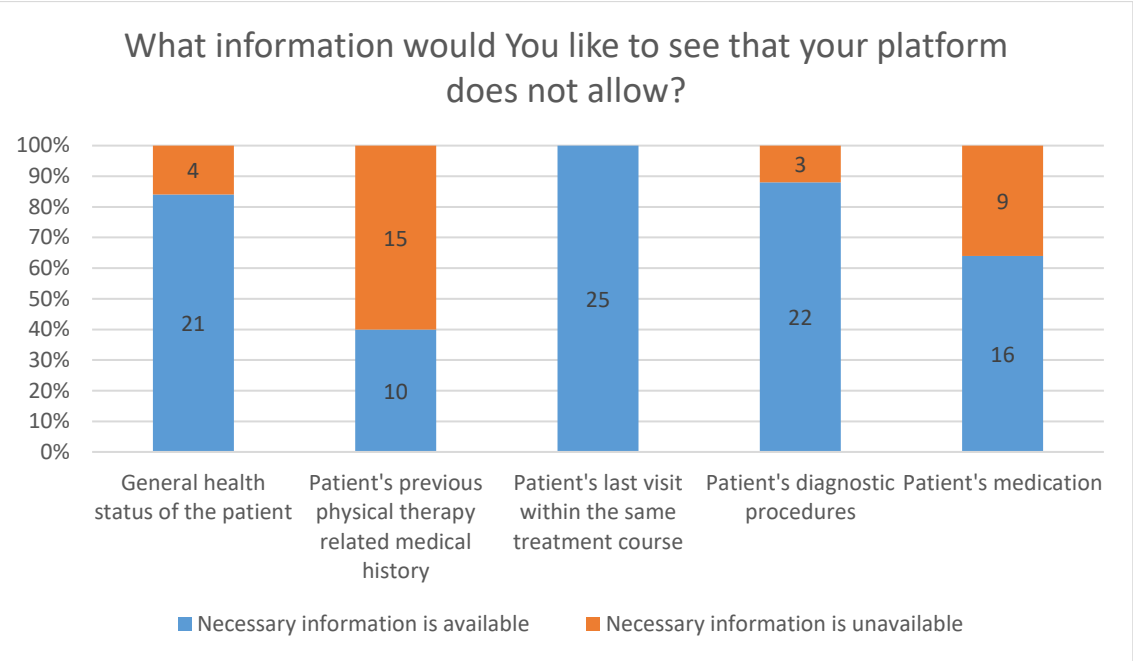

Figure 9 “What information would You like to see that Your platform does not allow?” results.

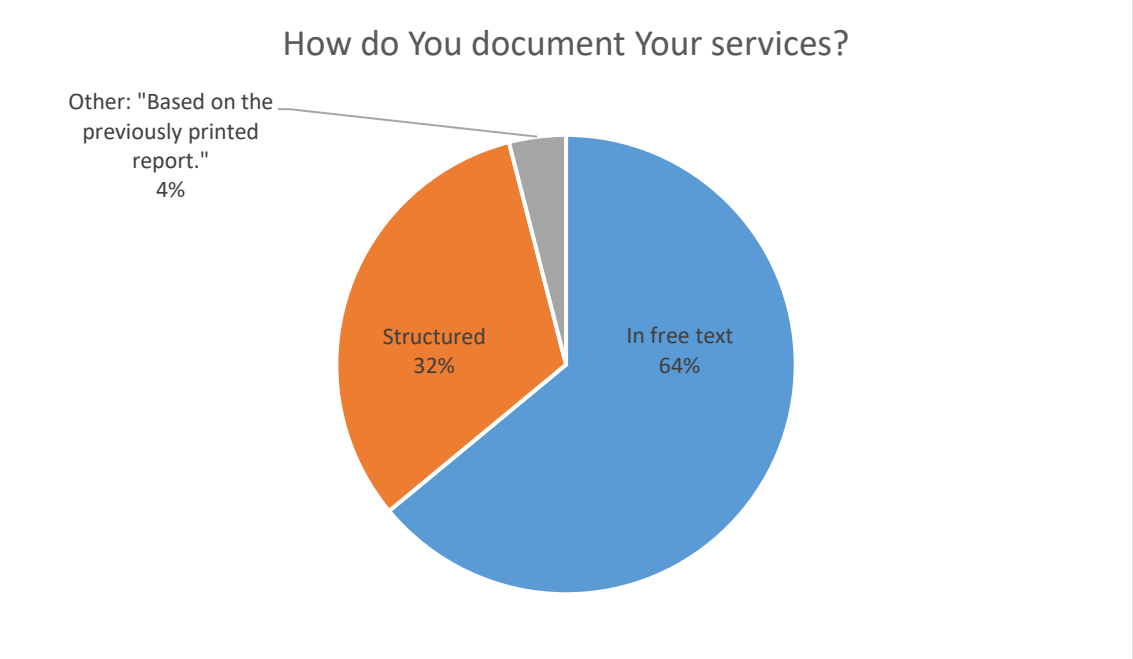

Figure 10 “How do You document Your services?” results.

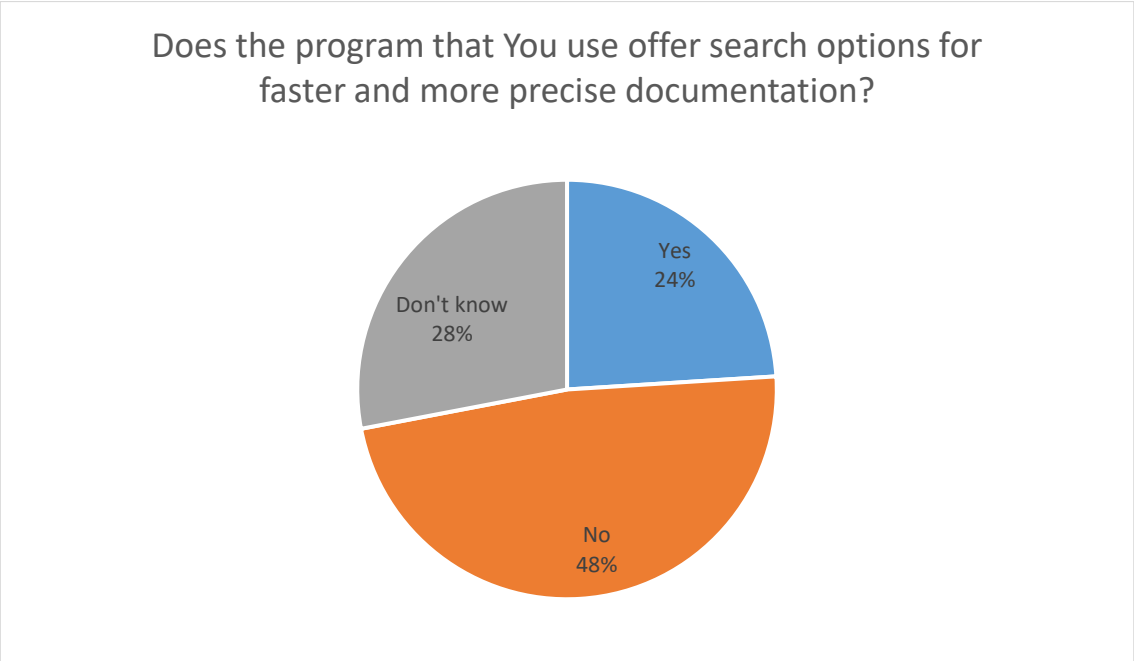

Figure 11 “Does the program that You use offer search options for faster and more precise documentation?” results.

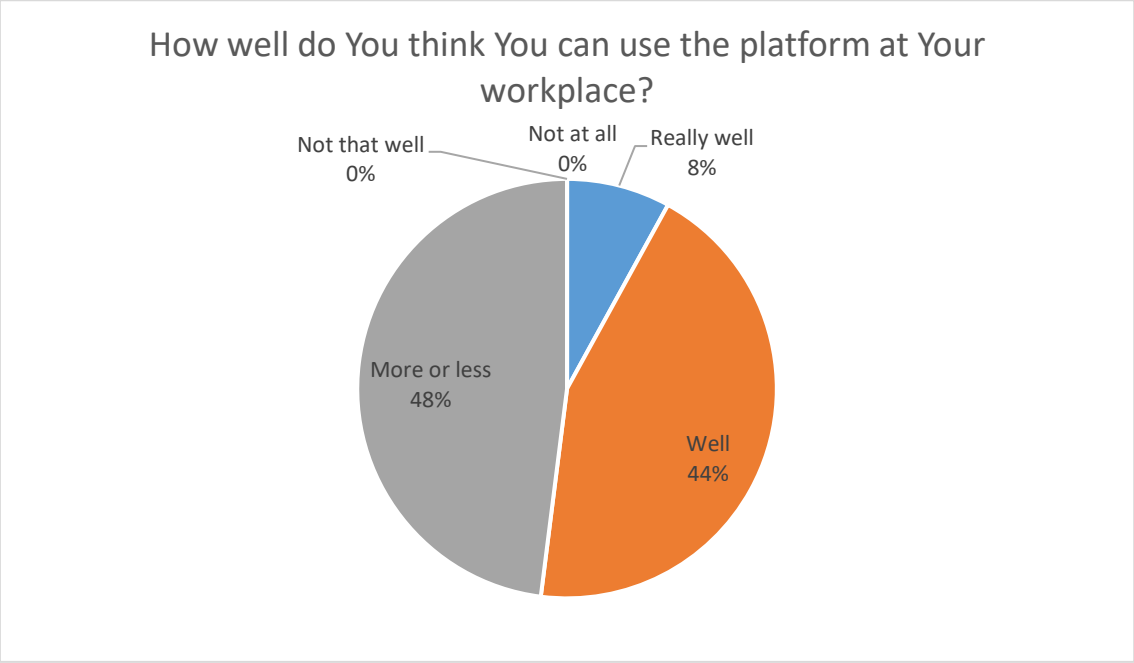

Figure 12 “How well do You think You can use the platform at Your workplace?” results.

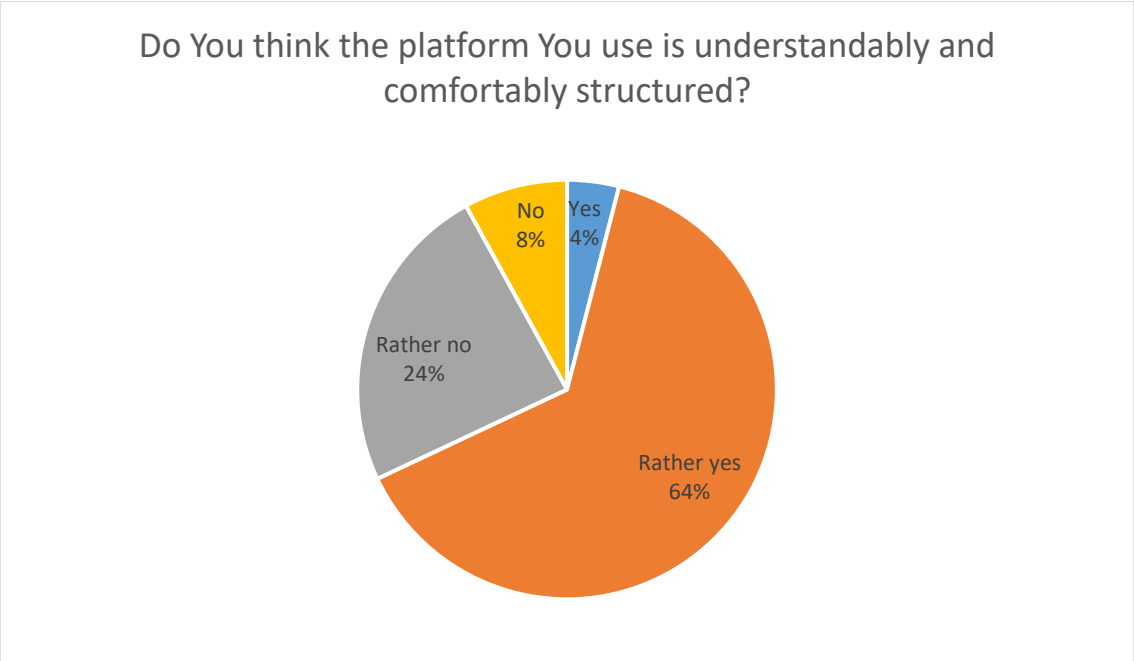

Figure 13 “Do You think the platform You use is understandably and comfortably structured?” results.

4.2.3 Experiences and Opinions Towards STs

Only 20% of respondents confirmed that the software they use enables the use of clinical terminology systems, and a significant 56% are unsure about its presence and functionality (Figures 14 and 15). The absence of needed patient information is also not seen in therapists' opinions on data re-entry, where 60% of the therapists do not see patient’s data being constantly re-entered (Figure 16).

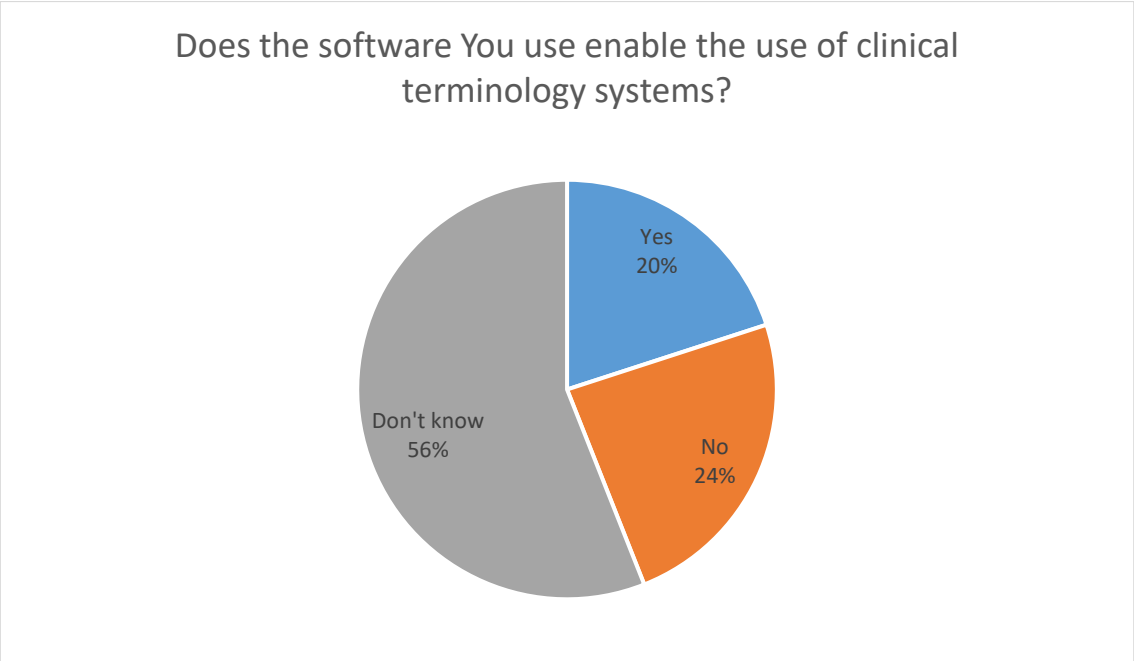

Figure 14 “Does the software You use enable the use of clinical terminology systems?” results.

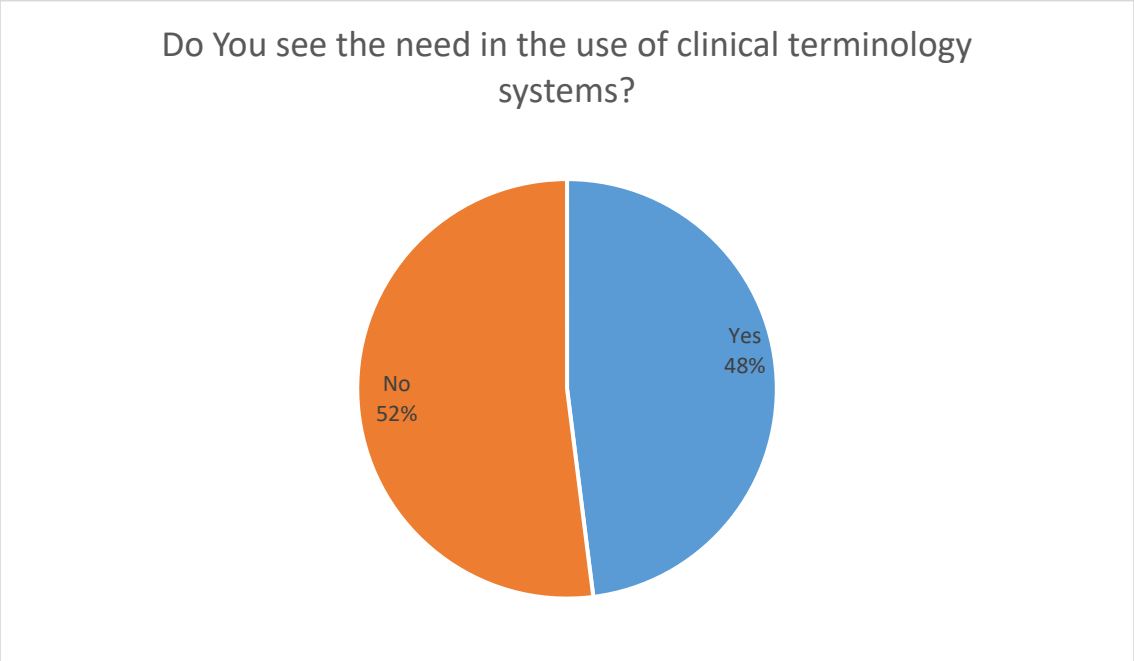

Figure 15 “Do You see the need in the use of clinical terminology systems?” results.

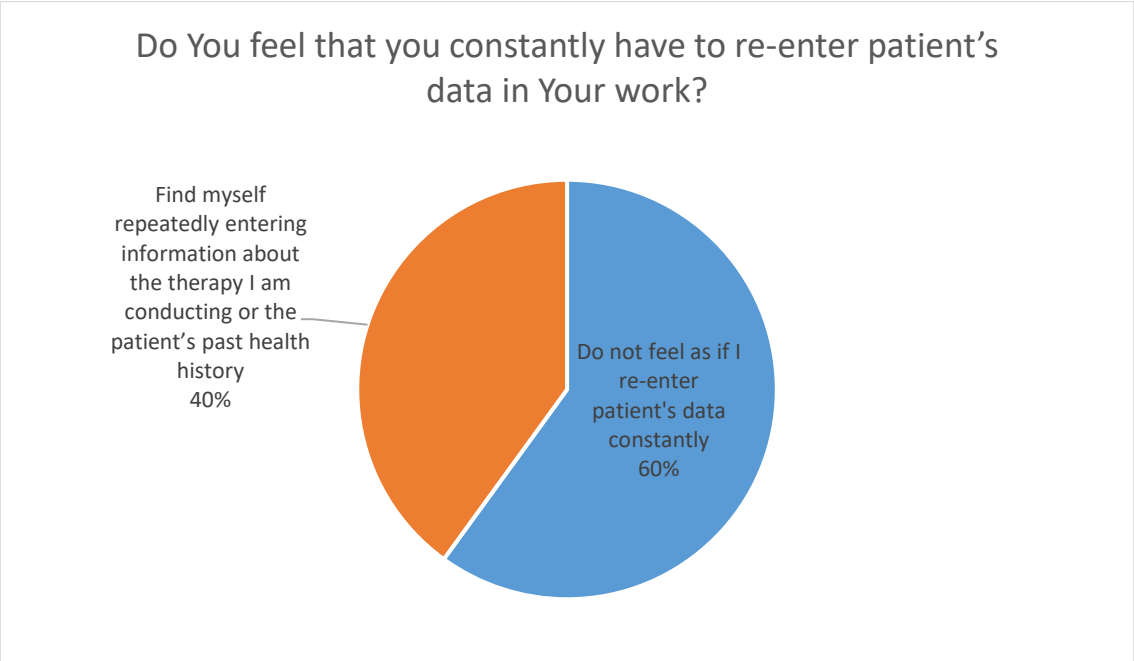

Figure 16 "Do You feel that you constantly have to re-enter patient's data in Your work?" results.

5 Discussion

The importance and benefits of STs like SNOMED CT have been widely acknowledged for decades. These benefits significantly enhance the quality of physical therapy and other medical services in several ways, two of the biggest being improved documentation quality, ensuring consistency in the entry of patient information, and efficient data exchange, facilitating better communication among healthcare providers. In addition, multiple other benefits like the support of CDSS, add to the value of SNOMED CT. Gradually, efforts have been made to provide medical systems with an improved means of recording and sharing patient data. Implementing needed changes in the Estonian healthcare sector has not been as smooth as wanted and multiple obstacles and challenges have occurred both from the technical and human aspects. Enabling the use of SNOMED CT in the documentation of physical therapy services has not been prioritized by TEHIK, which oversees the development of the Estonian Edition of SNOMED CT. This is mainly seen at the scarcity of concepts needed for physical therapy evaluation and documentation. Low interest in enabling SNOMED CT or other STs in the documentation of physical therapy services is seen by the physical therapists themselves as well. Physical therapists feel overall positive towards the health systems that they use and are comfortable with their use of free-text documentation. This proves that the current implementation of SNOMED CT and STs in general, into the documentation of physical therapy services, has not been successful, being inhibited both by the developers of the Estonian Edition of SNOMED CT and potential users themselves, i.e. physical therapists.

5.1 Current state of SNOMED CT in Estonian Physical Therapy

Out of almost twenty thousand translated concepts that are currently available in the Estonian edition of SNOMED CT, only one concept was found to be present in both the SCP list of concepts and the Estonian Edition of SNOMED CT: “Unable to move in bed”. When looking at how concepts are distributed amongst SNOMED CT domains, a clear picture emerges. The continuous development of the Estonian edition of SNOMED CT has been mainly pivoting more on the translation of concepts needed for laboratory analysis and the physician’s physical evaluation of the patient.

Although all of the needed concepts for physical therapy documentation are available in the Estonian Edition of SNOMED CT in English, it is highly unlikely that physiotherapists and other medical professionals will use them in their documentation. The absence of Estonian concepts needed for physical therapy evaluation makes it currently difficult to enable structured documentation amongst physical therapists and medical practices in general. This does not mean that SNOMED CT and other STs should not be promoted in medical institutions. Both the International and Estonian Editions of SNOMED CT are constantly being updated, and translating needed concepts can be just a matter of time, which could be sped up and prioritized when seen a need for these types of concepts among healthcare professionals.

5.2 Physical Therapists' Utilization and Perception of Electronic Health Information Systems and Standardised Terminologies

Attitudes toward EHRs are notably polarized. Although a majority of therapists express general satisfaction with the systems they employ, approximately half of these professionals report an absence of needed tools for better documentation and patient data analysis. Half of the respondents also expressed their uncertainty about their skills towards the medical systems they use. These statements contribute to the notion that currently there still remains a lack of needed knowledge and experience among healthcare workers towards EHRs.

The need and interest in structured documentation is not seen among Estonian physical therapists. The majority of respondents who participated in the questionnaire do not see the need to implement STs into their EHR systems. This again is depicted by participants' lack of knowledge of ST availability and functionality in their EHRs. In addition, only a third of respondents use some kind of structured style of documentation in their work, while others prefer the unstructured style of free-text documentation. Most people feel that information needed in their everyday work is available in the systems they use and do not feel as if they need to repeat and re-enter patient data constantly. This attitude towards digital documentation and EHRs in general, could be the result of insufficient training of medical staff towards the use and functionalities of EHRs and incomplete development of EHRs.

5.3 Strategies for Embedding SNOMED CT into Estonian Physical Therapy Practices

Implementing TAM and a Unified Theory of Acceptance and Use of Technology by TEHIK and other major healthcare stakeholders to the current plan of action could be beneficial in proving to different medical specialists, including physical therapists, the need and benefits of SNOMED CT in their work. The effect of these models could enable a faster and more efficient transition into the further development and wider use of SNOMED CT. To improve the use and attitude towards SNOMED CT and STs in general, in addition to the needed training towards the use of EHRs for all medical personnel, a strong cooperation between medical stakeholders should be implemented, especially from the IT and administrative levels. Further customization and standardisation of health systems and terminologies could enable a more consistent use of STs among healthcare workers and improve the state of documentation in general. Additionally, further development of the Estonian Edition of SNOMED CT can be beneficial in creating CDSSs that can be used both by physical therapists and physicians.

5.4 Limitations of the Study

The CSP REFSET provided a good overview of the current state of the Estonian Edition of SNOMED CT but consisted of concepts only related to Post Total Hip Replacement and Low Back Pain. The study population was relatively small and too hospital-centric. The questionnaire was structured more on documentation and did not provide physical therapists’ opinions on SNOMED CT. Although the questionnaire did not provide strong conclusions on physical therapists' opinions on SNOMED CT or other STs, it shows the overall opinions and experiences of physical therapists towards documentation.

5.5 Recommendations for Future Research

Further research on this topic is needed to understand the current landscape of digital documentation among physical therapy and other medical practices in Estonia. Opinions towards SNOMECT CT and other STs should be more closely analysed among physical therapists and other medical professionals to understand the current obstacles in the implementation of STs into different EHRs. Additionally, a closer analysis of the functionalities of different EHRs should also be researched, to get a better understanding

of how to enable a smoother and more successful transition of SNOMED CT or other STs into EHRs. A new questionnaire is recommended to be developed that focuses more on the knowledge amongst physical therapists of mechanisms for assuring data quality, interoperability, and reusability.

6 Summary

The aim of this study was to investigate the current state of physical therapy documentation in Estonia and barrierst that prevent the successful integration of SNOMED CT into the Estonian physical therapy sector. The research was conducted in two phases, to answer previously imposed research questions.

The first phase analysed the current state of the Estonian Edition of SNOMED CT and its usability in physical therapy practices. The second phase focused on gathering opinions and experiences among physical therapists in Estonia towards documentation and STs.

The findings of the first phase showed, that currently, the Estonian Edition of SNOMED CT is not optimised to be used by physical therapists in Estonia. Although the Estonian Edition of SNOMED CT includes concepts needed for physical therapy documentation, the majority of them are in English, which is still not useful for documentation in Estonian.

The survey, which included responses from 25 physical therapists working in different Estonian medical institutions showed that opinions of physical therapists tend to favor free text documentation over structured documentation. Therapists expressed also confidence in their ability to use their current EHRs effectively and overall feel that the platforms are structured understandably and comfortably. This is also seen by the absence of knowledge towards health systems' ST functionality and the divided opinions towards the need to implement STs into EHRs.

SNOMED CT and other STs have been proven to be effective in improving data exchange in the healthcare sector and even CDSS, but currently, the full functionality of SNOMED CT is not fully utilized. To enable the use of STs in EHRs, further development of health information systems and strong cooperation between different stakeholders in medical institutions should be established, especially at the IT and administrative levels. Although there are multiple barriers, that inhibit the use of SNOMED CT in the healthcare sector, there are already incentives implemented at the national level to improve the functionality of health information systems through SNOMED CT.

In conclusion, currently, there is not enough functionality of the Estonian Edition of SNOMED CT nor the popularity of STs among physical therapists to improve the use of SNOMED CT in physical therapy documentation. Future development of EHRs and strengthening the communication and cooperation between different healthcare stakeholder, should improve documentation among medical professionals and enable a better implementation and use of STs in the healthcare sector.

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Appendix 1 - List of SNOMED CT Domains and Semantic Tags

- Body structure (body structure)- anatomical structures, as well as morphological abnormalities [53]:
    - (morphologic abnormality)
    - (cell)
    - (cell structure)
- Clinical finding and disorder (finding)- information gathered from human observers, by using scientific instruments to record data or samples obtained from the source [54] :
    - (disorder)- abnormal clinical state
- Environment or geographical location [55]:
    - (environment)- information about the type of environment
    - (location)- named locations such as countries, states, or regions
- Event (event)-information about occurrences impacting health or healthcare [56]
- Observable entity (observable entity)- information about a quality, disposition, function or property to be observed and how it will be observed [57]
- Organism (organism)- information about organisms with significance to human medicine [58]
- Pharmaceutical / biologic product (product)- information used to clearly distinguish drug products from their chemical constituents [59]:

    - (clinical drug)
    - (medicinal product)
    - (medicinal product from)
    - (physical object)- only 1 concept

- Physical force (physical force)- information about the application of energy or effort to exert pressure, impact, or influence on an object or substance, resulting in a change of its overall condition [60]
- Physical object (physical object)- information on physical devices relevant to healthcare or injuries [61]
- Procedure (procedure)- represent activities performed in the provision of healthcare [62]
    - (regime/therapy)
- Qualifier value (qualifier value)- information that provide attribute values used in the definitions of other concepts or expressions to refine the meaning of concept [63]:
    - (administration method)
    - (basic dose form)
    - (disposition)
    - (dose form)
    - (intended site)
    - (number)
    - (product name)
    - (release characteristic)
    - (role)
    - (state of matter)
    - (transformation)
    - (supplier)
    - (unit of presentation)
- Record artifact (record artifact)- entity that provides information about events or states of affairs [64]

- Situation with explicit context (situation)- a subtype of the situation, with an attribute associating it with the relevant clinical finding or procedure [65]
- SNOMED CT Model Component (metadata)- attributes and concepts needed to organize and structure SNOMED CT terminology and its derivatives [66]:
    - (core metadata concept)
    - (foundation metadata concept)
    - (linkage concept)
    - (namespace concept)
    - (attribute)
    - (link assertion)
    - (OWL metadata concept)
- Social context (social concept)- represents social aspects affecting patient's treatment and overall health. Circumstances and conditions related to this hierarchy include [67]:
    - (ethnic group)
    - (lifestyle)
    - (occupation)
    - (person)
    - (racial group)
    - (religion/philosophy)
    - (social status)

- Special concept (special concept)- inactive concepts that are no longer active or supported in SNOMED CT [68]:
    - (inactive concept)
    - (navigational concept)
- Specimen (specimen)- information on entities obtained for examination or analysis [69]
- Staging and scales (staging scales)- concepts describing relevant stagin or grading systems used to either make a judgement about the patient, condition or the phase or progression of a disease [70]
    - (assessment scale)
    - (tumor staging)
- Substance (substance)- concepts that can be used for recording and modelling of medicinal and non- medicinal products, allergies, adverse reactions, poisoning, nursing and physicians orders laboratory reports and results [71]

Appendix 2 – Questionnaire for Physical Therapists in Estonian

KÜSIMUSTIK FÜSIOTERAPEUTIDE HINNANGUST ELEKTROONILISTE TERVISE INFOSÜSTEEMIDE KASUTAMISELE

Lugupeetud uuringust osaleja

Minu nimi on Anton Lossitski, olen Tallinna Tehnikaülikooli E-Tervise magistriõppekava tudeng ning kirjutan magistritöö teemal "Kvaliteedi tagamine füsioteraapias: Uuring kuidas SNOMED CT saab panustada füsioteraapia teenuste kvaliteedi parandamisesse". Küsimustiku esmärgiks on välja selgitada, Eestis kasutatavate elektrooniliste tervise infosüsteemide võimekustest füsioterapeutide perspektiivist ning füsioterapeutide kogemusi ja arvamusi nende poolt kasutatavate tervise infosüsteemide kohta.

1. Mitu aastat olete te töötanud füsioterapeudina?
    a. Vähem kui 2 aastat
    b. 3-5 aastat
    c. 6-10 aastat
    d. Üle 10 aasta
2. Mis tüüpi asutuses te töötate? (Valige koht kus te kõige enam töötate)
    a. Haigla (PERH, Ida-Tallinna Keskhaigla, Läänema Haigla, jne.)
    b. Erapraksis (Adeli, Confido, Meliva jne)
    c. Perearstikeskus
    d. Muu
3. Mis tüüpi tervise infosüsteemi platformi te kasutate oma igapäeva töös? (eHealth, Perearst3, Liisa, HEDA, EKliinik, jne.)
4. Millal te dokumenteerite?
    a. Teenuse osutamise ajal
    b. Peale teenuse osutamist
    c. Tööpäeva lõpus
    d. Muu

5. Kui palju aega kulub teil keskmiselt ühe patsiendi peale? (Dokumenteerimine ei lähe arvesse)
    a. Alla 20 min
    b. 20-30 min
    c. 30-40 min
    d. 40-50 min
    e. 50-60 min
    f. Üle 1 tunni
6. Kui suur osa vastuvõtu ajast kulub teil keskmiselt füsioterapeutilise alghindamise dokumenteerimisele?
    a. Alla 20 min
    b. 2-5 min
    c. 5-10 min
    d. 10-15 min
    e. Üle 15 min
7. Kas teie tarkvara pakub kogu teie tööks vajalikku informatsiooni patsiendist?
    a. Jah
    b. Pigem jah
    c. Pigem ei
    d. Ei
8. Mis informatsiooni teie sooviksite näha, mida teie poolt kasutatav platvorm ei võimalda?
    a. Patsiendi üldise terviseseisundi andmed:
    b. Patsiendi varasemad füsioteraapiaga seotud haigusjuhud:
    c. Patsiendi eelmine visiit sama ravikuuri käigus:
    d. Patsiendi diagnostiliste protseduuride (labor, radioloogilised uuringud) andmed:
    e. Patsiendi ravimid:
    f. Ei ole sellist
9. Kas teie poolt kasutatav tarkvara võimaldab kasutada meditsiinilisi loendeid? (ICD-10/RHK-10; SNOMED CT)
    a. Jah
    b. Ei
    c. Ei tea

10. Kas näete vajadust meditsiiniliste loendite kasutamisel?
    a. Jah
    b. Ei
11. Kas tunnete, et dokumenteerides sisestate mingeid andmeid korduvalt? (Võimalusel kirjeldage täpsemalt)
    a. Ei tunne, et sisestan andmeid korduvalt
    b. Tunnen, et sisestan enda poolt läbiviidava teraapia või patsiendi varasemate terviselugude andmeid korduvalt
12. Kuidas te oma teenuseid dokumenteerite?
    a. Vabatekstina
    b. Struktureeritult (Andmete sisestus toimub läbi erinevate klassifikatsioonide)
    c. Muu
13. Kas teie poolt kasutatav programm võimaldab pakub otisnguvõimalusi kiiremaks ja täpsemaks dokumenteerimiseks (kehaosade loend, kehaosade funktsioonide loend, protseduuride loend jm.)
    a. Jah
    b. Ei
    c. Ei tea
14. Kui hästi te enda arvates oskate enda töökohal kasutatavat platvormi kasutada?
    a. Väga hästi
    b. Hästi
    c. Pigem ei oska
    d. Ei oska üldse
    e. Ei oska üldse
15. Kas teie arvates on teie poolt kasutatav platvorm arusaadavalt ja mugavalt ülesehitatud?
    a. Jah
    b. Pigem jah
    c. Pigem ei
    d. Ei

Aitäh, uuringus osalemise eest.

Appendix 3 – Questionnaire for Physical Therapists in English

QUESTIONNAIRE ON PHYSICAL THERAPISTS' ASSESMENT ON ELECTRONICS HEALTH INFORMATION SYSTEMS

Dear research participant,

My name is Anton Lossitski, I am currently completing my master's program in Digital Health at Tallinn University of Technology. I am conducting a survey amongst Estonian physical therapists for my master's thesis "Quality Assurance in Physical Therapy: Research how SNOMED CT can contribute to improving the quality of physical therapy services in Estonia". The aim of this questionnaire is to find out about the capabilities of the health information systems used in Estonia from the perspective of physical therapists and learn about the experiences and opinions of physical therapists on about the health information systems they use.

1. How many years have You worked as a physical therapist?
    a. Less than 2 years
    b. 2 to 5 years
    c. 6 to 10 years
    d. Over 10 years
2. What type of institution do you work in? (Choose the place where You work the most)
    a. Hospital (PERH, East-Tallinn Central Hospital, Läänemaaa Hospital, etc.)
    b. Private practice (Adeli, Confido, Meliva, etc.)
    c. General practice center
    d. Other

3. What type of information system platform do you use in your daily work? (eHealth, Perearst3, Liisa, HEDA, EKliinik, etc.)

4. When do you document your activities?

    a. During the provision of service

    b. After the provision of service

    c. At the end of the workday

    d. Other

5. How much time do you usually spend on a patient? (Documentation excluded)

    a. Less than 20 minutes

    b. 20 to 30 minutes

    c. 30 to 40 minutes

    d. 40 to 50 minutes

    e. 50 to 60 minutes

    f. Over 1 hour

6. How much time do you usually spend on the documentation of a patient's initial assessment?

    a. Less than 2 minutes

    b. 2-5 minutes

    c. 5-10 minutes

    d. 10-15 minutes

    e. Over 15 minutes

7. Does your platform allow you to access all the information you need about the patient for your work?
    a. Yes
    b. Rather yes
    c. Rather no
    d. No
8. What information would you like to see that your platform does not allow?
    a. General health status of the patient:
    b. Patient’s previous physical therapy related medical history:
    c. Patient’s last visit within the same treatment course:
    d. Patient’s diagnostic procedures (lab, radiological examinations) data:
    e. Patient’s medication
    f. No need in any of them
9. Does the software you use enable the use of clinical terminology systems? (ICD-10, SNOMED CT)
    a. Yes
    b. No
    c. Don’t know
10. Do you see the need in the use of clinical terminology systems?
    a. Yes
    b. No
11. Do you feel that you constantly have to re-enter patient’s data in your work? (Please specify if possible)

a. Do not feel as if I re-enter patient's data constantly

b. Find myself repeatedly entering information about the therapy I am conducting or the patient’s past health history

12. How do you document your services?

a. In free text

b. Structured

c. Other

13. Does the program that you use offer search options for faster and more precise documentation (lists of anatomical parts, body functions, test etc.)

a. Yes

b. No

c. Don’t know

14. How well do you think you can use the platform at your workplace?

a. Very well

b. Well

c. More or less

d. Not that well

e. Not well at all

15. Do you think the platform you use is understandably and comfortably structured?

a. Yes

b. Rather yes

c. Rather no

d. No

Thank you for participating in the survey.

Appendix 4 – List of Domains and Semantic Tags Used in Estonian Edition of SNOMED CT

Body structure	
Semantic tag	Number of concepts
(body structure)	3296
(cell)	1
(cell structure)	0
(morphologic abnormality)	2021
Clinical finding	
(finding)	482
(disorder)	2602
Environment or geographical location	
(environment/location)	1
Event	
(event)	34
Observable entity	
(observable entity)	146
Organism	
(organism)	6177
Pharmaceutical / biologic product	

(clinical drug)	0
(medicinal product)	7
(medicinal product form)	0
(product)	5
Physical force	
(physical force)	2
Physical object	
(physical object)	222
Procedure	
(procedure)	3681
(regime/therapy)	131
Qualifier value	
(qualifier value)	135
(administration method)	0
(basic dose form)	0
(disposition)	0
(dose form)	0
(intended site)	0
(number)	0
(product name)	0
(release characteristic)	0

(role)	0
(state of matter)	0
(transformation)	0
(supplier)	0
(unit of presentation)	0
Record artifact	
(record artifact)	0
Situation	
(situation)	21
SNOMED CT Model Component	
(attribute)	1
(core metadata concept)	1
(foundation metadata concept)	36
(link assertion)	0
(linkage concept)	0
(namespace concept)	0
(OWL metadata concept)	0
Social concept	
(social concept)	3
(ethnic group)	0
(life style)	1

(occupation)	2
(person)	159
(racial group)	0
(religion/philosophy)	1
Special concept	
(inactive concept)	0
(navigational concept)	6
(special concept)	2
Specimen	
(specimen)	179
Staging and scales	
(staging scale)	1
(assessment scale)	1
(tumor staging)	0
Substance	
(substance)	596

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