TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies
Department of Health Technologies

Anni Männil 163300YVEM

# USING THE TIME AND MOTION STUDY METHOD TO INVESTIGATE ESTONIAN FAMILY PHYSICIANS’ TIME UTILIZATION DURING FACE-TO-FACE PATIENT VISITS

Master’s Thesis

Supervisor: Janek Metsallik

MSc, lecturer

Tallinn 2020

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond
Tervisetehnoloogiate instituut

Anni Männil 163300YVEM

# AJA JA TEGEVUSTE VAATLUSUURINGU MEETODI KASUTAMINE EESTI PEREARSTIDE AJAKASUTUSE JA ERINEVATE TÖÖPROTSESSIDE AJALISE JAOTUSE UURIMISEKS PATSIENDI VISIITIDEL

Magistritöö

Juhendaja: Janek Metsallik

MSc, lektor

Tallinn 2020

# 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.

Author: Anni Männil

20.05.2020

Supervisor: Janek Metsallik

# Abstract

Time is family physicians’ key resource and its use and distribution between different activities is crucial to study in order to see and address potential inefficiencies. The main aim of the Thesis was to study the feasibility and reliability of using direct time and motion study (TMS) method for collecting data about Estonian family physicians’ time utilization at physician-patient visits. More, the preliminary data on physicians’ time expenditure with an emphasis on time on the computer, and the physicians' opinions on their workload, computer use and e-solutions were also studied. The methods used to achieve the aims were direct TMS observations, self-reported diary and semi-structured interviews.

A TMS pilot study was carried out with 63 direct observations at seven family physicians showed that the visit duration as well as the time distribution between different activities across the visits varied greatly. Physicians spent a mean of 37% of the visit time on computer-based activities and 63% on non-computer tasks, where the most time consuming activities were counseling/teaching, taking anamnesis, documentation and searching patient history from the EHR/EMR. Together with the data from self-reported diaries, it was revealed that physicians spent almost half of their working time on the computer, out of which nearly one-third was spent on documentation and searching for patient information. This was also confirmed by the family physicians, who acknowledged that time-consuming data entry and queries increases their workload, causes stress and burnout. Physicians stated that one reason for that is that the clinical software they are using does not fully support fast and efficient operation of these work processes.

The present pilot study confirmed that the TMS method is a feasible and suitable method for studying the time utilization of Estonian family physicians as it provides quantitative information about the time expenditure and time distribution between different activities, as well as it enables to find patterns and relationships between different factors influencing the physicians’ time use. Recommendations for future TMS research in the Estonian healthcare field were provided as a conclusion for the TMS feasibility.

The Thesis is written in English and is 65 pages long, including 5 chapters, 10 figures and 6 tables.

# Annotatsioon

Käesoleva magistritöö peamine eesmärk oli uurida aja ja tegevuste vaatlusuuringu meetodi kasutamise teostatavust ja usaldusväärsust andmete kogumisel Eesti perearstide ajakasutuse kohta patsiendi visiitidel. Lisaks kirjeldada pilootuuringu tulemusi arstide ajakasutuse kohta ning anda ülevaade arstide arvamustest nende töökoormuse, arvuti- ning e-lahenduste kasutamise kohta. Eesmärkide saavutamiseks kasutati aja ja tegevuste vaatlusuuringuid, poolstruktureeritud intervjuusid ning arsti poolt täidetavat päevikut.

Aja ja tegevuste vaatlusuuringu piloodi käigus viidi seitsme perearsti juures läbi 63 patsiendi visiidi otsene vaatlus. Uuringutulemused näitasid, et visiitide kestus ja tegevuste ajaline jaotus varieerus visiitide vahel suuresti. Perearstidel kulutas keskmiselt 37% visiidiajast arvutipõhistele tegevustele ning 63% tegevustele, milles arvutit ei kasutatud. Kõige ajakulukamad tegevused visiidil olid patsiendi nõustamine, anamneesi võtmine, dokumenteerimine ja patsiendi kohta terviseinfo otsimine digiloost või perearsti tarkvarast. Koos arstide poolt täidetud päeviku andmetega selgus, et arstid veedavad ligi poole oma tööajast arvutis (s.o pea 4 tundi) ning sellest ligi kolmandik kulub dokumenteerimisele ning patsiendi info otsimisele. Seda kinnitasid ka perearstid tunnistades, et aeganõudev andmete sisestamine ja päringute tegemine suurendab töökoormust, tekitab stressi ja läbipõlemist. Põhjuseks toodi välja asjaolu, et perearstide poolt kasutatav tarkvara ei toeta täielikult arstide tööprotsesside läbiviimist.

Käesolev töö kinnitas, et aja ja tegevuste vaatlusuuring on Eesti perearstide ajakasutuse uurimiseks sobilik meetod, võimaldades saada kvantitatiivset infot ajakulu ja ajalise jaotuse kohta eri tegevuste vahel, lisaks leida mustreid ja seoseid erinevate ajakasutust mõjutavate faktorite vahel. Töö lõpus anti soovitused tulevaste aja ja tegevuste vaatlusuuringute läbiviimiseks.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 65 leheküljel, 5 peatükki, 10 joonist ja 6 tabelit.

# List of abbreviations

| | |
|---|---|
| EHIF | Estonian Health Insurance Fund |
| EHR | Electronic Health Record |
| EMR | Electronic Medical Record |
| ENHIS | Estonian Health Information System |
| TEHIK | Health and Welfare Information Systems Center |
| CPOE | Computerized physician order entry |
| UI | User interface |
| ICT | Information communication technology |
| IT | Information technology |
| NAO | National Audit Office |
| WOMBAT | Work Observational Method by Activity Timing |
| PC | Personal computer |

# List of figures

# List of tables

# Table of contents

# 1. Introduction

Family physicians have a highly important and responsible role in Estonian health care system – they work as gatekeepers, meaning that they are the patient's initial contact with the health system. They are obliged to assist the patients in matters within their competence and, when patient's health problems require it, refer them to a specialist. In other words, family physicians are the treatment process coordinators with the aim of reducing the number of visits to secondary care. Besides patient illness monitoring and treatment planning, the family physician's responsibilities include counseling, disease prevention activities and programs, vaccinating, taking samples for analysis, and even minor surgical procedures (EHIF, 2019b).

From the patient's point of view, family physician is like a trustee who can always be approached for health concerns, who knows their full health history, social and individual characteristics as well as their other family members and their interrelationships.

The role of a gatekeeper means a heavy workload. The patient list size per every family physician is set to 1200-2000, or 2001-2400 patients if there is at least one assistant physician providing care services together with the family physician (Tervishoiuteenuste korraldamise seaduse, majandustegevuse seadustiku üldosa seaduse ja surma põhjuse tuvastamise seaduse muutmise seadus, 2012) and every patient on the list wants personalized and high-quality care. The resulting responsibility and workload is a major challenge for the family physicians, which is not easy to cope with.

Time is family physicians' key resource in delivering health care services. Therefore, understanding how physicians spend their time at patient visits and outside that time is essential, giving the idea of work efficiency and time allocation. Through this, it can be deduced which activities take proportionately too much time while generating little value regarding the goal of family physician's work. Thinking ahead, efficient use of time is getting more and more important as the health care system faces many challenges – aging of the population, increasing number of people with multiple chronic illnesses and insufficient number of medical staff (EHIF, 2017). These changes are already here – for example, the number of visits to family physicians has increased significantly during the last years as there were 489 328 more visits in 2018 than was in 2014 (4 472 141 versus 4 961 469) (EHIF, 2018a). This change has and will continue to significantly and consistently increase the burden on the health care system and in particular, on primary care. This raises the importance of family physicians to have as supportive, functional and effective solutions and tools as possible available to be used in their daily work in order to enable efficient time utilization and to provide the best quality of care. To achieve this, the physicians' time utilization and the usability of used e-solutions, as well as the interrelationships between these two need to be constantly examined.

Health information technology plays an increasingly important role in the physician's work, significantly influencing their daily work and its efficiency. Today, there is limited objective data on how Estonian family physicians spend their time, both in general and during patient visits, and how the technological solutions on physicians' desktop have an impact on their work efficiency. There are some usability studies carried out in this area in Estonia, but have not led to big changes as family physicians' satisfaction with their workload and implemented solutions, mostly with clinical software, still remains low (NAO, 2019; NAO, 2011). Moreover, to date, there are no usability studies conducted in Estonian primary healthcare field that include an objective impact assessment on the family physician's work and time efficiency. Conversely, none of the family physicians' time utilization studies cover the impact of any specific solution on the (in)effectiveness of physician's work. The data on both usability and time utilization studies have been mostly collected through online questionnaires and interviews. Although these methods are convenient, inexpensive and relatively fast way to collect data from a large sample (in terms of questionnaires), it may not produce reliable results when investigating quantitative indicators like time utilization and effectiveness.

## 1.1 Previous studies on family physicians' time utilization and e-solutions' usability

Few studies have been made on the usability of the solutions and systems used by family physicians. In 2014, Evelin Vanker conducted a study to investigate the usability of physician's clinical software (Electronic Medical Record, EMR) among Estonian family physicians. Four methods were used: web-based questionnaire, interviews and two usability tests called Cognitive Walkthrough and Heuristic Evaluation. Although the overall impression of the EMR was unexpectedly high among family physicians, the biggest shortages reported were cognitive overload and lack of efficient interactions. Both of these gaps have a significant impact on the physicians' time utilization and work efficiency, but were not measured in the study. Yet, one important proposal was made – there is a great need for a usability framework for Estonian e-health systems to reduce the mismatches between physicians' needs and the functionality and usability of the e-solutions. This is a very important proposal, but in six years' time no apparent progress has been made in this direction whatsoever.

Another important finding emerged in the study – the more physicians had received IT training, the more critical and dissatisfied they became towards the EMR and the lower they rated the system. What makes it more interesting, and also worrying, is that 57% of the surveyed physicians said they had not even received the basic EMR training from the developers. As can be seen, there may be a discrepancy between user satisfaction and IT awareness/knowledge, and since the overall user satisfaction was found to be good, the developers do not find a significant need to improve the system.

The usability and family physician's satisfaction with the drug-drug interaction alert system was analyzed by Kerli Metsla in 2018. The drug-drug interaction service was released in 2016 with the aim of minimizing the potential for adverse drug interactions (EHIF, 2018b). Methods included data acquisition from the e-prescription centre and for qualitative data, a web-based survey was conducted among family physicians. Results showed that Estonian family physicians are mostly satisfied with the interaction system but some improvements in the functionality of the system should be made to reduce potential errors and improve the usability of the system. Again, the study did not investigate the impact of the service on the physician's work effectiveness and time utilization.

The Estonian National Audit Office (NAO) has been investigating the Estonian family physicians' time utilization. In 2011, NAO conducted an audit to observe whether the Estonian primary healthcare system is performing the tasks assigned to it. As part of the audit, an online questionnaire was used to gather information from family physicians about their daily work processes and time utilization. Among other tasks, family physicians had to evaluate their average working hours per week and the distribution of time between different activities. Under the results section it was highlighted that when interpreting the results of the physicians' time utilization, it must be borne in mind that it is their subjective assessment of the use of time, not objective documented data. This raises the question of the level of validity and reliability of the questionnaire results and whether any conclusions could be drawn from these outcomes.

As said above, although using questionnaire and interview as a research method is convenient, it is still a qualitative research method and therefore is not suitable for the collection of objectively measurable data. Additionally, the use of questionnaires and interviews can be affected by a number of biases. For example participation bias, as responses are often obtained from highly motivated people who are willing to participate in large surveys. This group of people are usually active in the communities, therefore it may not reflect the target population's true and general opinions. There is also risk of response bias (also known as survey bias), which means that respondents tend to give inaccurate or false answers, whether consciously or not. This may occur due to unclear structure or ambiguity of the question, but also because of the unwanted impact of the previous questions on the respondent (Wetzel et al., 2016).

## 1.2 Time and Motion Study

Time and motion studies (TMS) have been used in the healthcare sector to provide quantitative information on workflow and work practices, as well as the impact of information technology on clinical work efficiency. The method was first described in industrial engineering in the early 20th century as a quantitative data collection method in which an external observer collects detailed data on the duration and movements that are required to perform a specific task, together with a data analysis aimed at improving the efficiency of that task (Taylor, 1911). Taylor believed that the greatest loss from work inefficiency was not materialistic, but the waste of human resources. In 1914, Frank and Lilian Gilbreth began to apply the time and motion research method in the healthcare sciences, evaluating the inefficiencies of the healthcare services (Gilbreth, 1914). Since then, the method has been adopted by healthcare managers and researchers to study costs and inefficiencies in healthcare delivery, patient safety and quality of care, and recently, to study the adoption and impact of IT and technological solutions on time utilization and time allocation to different clinical and non-clinical tasks. This method is often favored by researchers as definite variables are used for data collection and therefore it is easier to compare the study results with standards, other similar studies as well as with future interventions. Today, the data collection is relatively easy as instead of measuring the time of different activities with a stopwatch as it was done in the past, it can now be done electronically using any TMS software downloaded to a personal computer (PC), tablet or smartphone device. Moreover, some of the TMS applications also perform automatic data transmission and analysis. Further, the data can be gathered, besides the external observer, also by the subject(s) that are being studied, or automatically by computerized systems (Lopetegui et al., 2014).

As there are many different ways to conduct a TMS and researchers are relatively free to use different technological solutions and techniques to carry out the study, the designs of the TMS-s are not always consistent and therefore the results may not be comparable. To address this issue, Zheng et al. (2011) developed a Suggested Time and Motion Procedures (STAMP) checklist to improve and maintain the quality of TMS methodology and reporting in order to be able to gain knowledge from across-study synthesis. The suggested STAMP outlines a minimum set of data that TMS researchers should collect and provide in their study (Table 1). The checklist consists of 29 items which are divided into nine main areas: 1) intervention; 2) empirical settings; 3) research design; 4) task category; 5) observer; 6) subject; 7) data recording; 8) data analysis, and; 9) ancillary data.

**Table 1** STAMP checklist (retrieved from Zheng et al., 2011)

| Area and element | Ref Code | Description |
|---|---|---|
| **Intervention** | | |
| Type | INT.1 | The system studied (intervention) |
| System genre | INT.2 | Origin or lineage of the system (eg, commercial product, homegrown system, open source software) |
| Maturity | INT.3 | Time elapsed since intervention, including the amount of time that study subjects have been exposed to the intervention |
| **Empirical setting** | | |
| | ES.1 | Type of the healthcare facility or facilities where empirical observations are conducted (eg, academic vs non-academic) |
| Care area | ES.2 | Area of patient care services (eg, inpatient, outpatient, emergency department) |
| Locale | ES.3 | Geographic characteristics (eg, urban vs rural) |
| **Research design** | | |
| Protocol | RD.1 | Research protocol (eg, RCT, before and after, after only) |

| | | |
|---|---|---|
| Duration | RD.2 | Length of fieldwork (eg, whether all observations are completed within a month, or occur sporadically over the course of a year) |
| Shift distribution | RD.3 | Clinical shifts observed (eg, morning, afternoon, night, if applicable) |
| Observation hours | RD.4 | Total number of direct observation hours, in addition to how the hours are distributed across study phases or RCT study arms (if applicable) |
| **Task category** | | |
| Definition and classification | TC.1 | Definition of tasks and description of all major and minor task categories |
| Acknowledgment of prior work | TC.2 | Acknowledgment of task classification schemas previously used in the same or similar settings, and justifications if modifications are made |
| New development | TC.3 | Development and validation of task definition and task classification, if no prior work can be leveraged |
| **Observer** | | |
| Size of field team | OBS.1 | Total number of independent human observers |
| Training | OBS.2 | Type and amount of training provided to human observers, including pre-study pilot observation sessions |
| Background | OBS.3 | Professional background of observers (eg, residents, nurses, industrial engineering students) and their prior experiences in conducting observational studies in clinical settings |
| Inter-observer uniformity | OBS.4 | If and how inter-observer agreements are calibrated |
| Continuity | OBS.5 | Continuity of observers across multiple study phases (if applicable) |
| Assignment | OBS.6 | How observers are assigned to shadow different research subjects and in particular, research subjects enrolled in different study phases or RCT study arms (if applicable) |
| **Subject** | | |
| Size | SUB.1 | Number of research subjects enrolled |

| | | |
|---|---|---|
| Recruitment and randomization | SUB.2 | How research subjects are recruited (and randomized, if applicable) |
| Continuity | SUB.3 | Continuity of subjects across multiple study phases (if applicable) |
| Background | SUB.4 | Background information about research subjects such as clinician type and level of training (eg, residents vs attending physicians); if conditions allow, other individual characteristics such as gender, age, and computer literacy |
| **Data recording** | | |
| Multitasking | DR.1 | If and how multitasking is taken into account; in particular, if only the primary task is recorded or all concurrent tasks are recorded |
| Non-observed periods | DR.2 | If there are periods of time not covered by independent observers |
| Between-task transition | DR.3 | If and how transition periods between consecutive tasks are handled |
| Collection tool | DR.4 | Device and software used to collect field data |
| **Data analysis** | | |
| Definition of key measures | DA.1 | Key measures used in analysis and results reporting, for example, average time spent on ordering activities vs on direct patient care, time on task, and average continuous time that assesses workflow fragmentation and task switching frequency |
| Analytical methods | DA.2 | Statistical or other types of analytical methods used to analyze the data |
| **Ancillary data** | | |
| Interruption | AD.1 | A descriptor specifying if a task represents an interruption to prior tasks |
| Interaction | AD.2 | Interpersonal interactions/communications necessary for task execution; for example, with whom and via what method (eg, in person, by telephone, via a computerized system) |

| | | |
|---|---|---|
| Location | AD.3 | The location where the activities take place (eg, in a patient ward, in a hallway, at computer workstations) |

To date, a number of TMS’s have been conducted in healthcare settings to examine physicians' use of time, with a particular focus on time spent on the computer. Sinsky et al. conducted a TMS in 2016 to study U.S. physician’s time expenditure in ambulatory practice. In total of 57 physicians in family medicine, internal medicine, cardiology, and orthopedics from 16 practices were observed for 430 hours using direct observational TMS during physician’s office hours using the Work Observational Method by Activity Timing (WOMBAT) tool. Additionally, self-reported diary method was used to study the time expenditure during after hours. The study found that physicians spend nearly half of the total workday on the computer and desk work, and less than one third on direct face-to-face time with the patients. Also, physicians spend on average 1.5 hours of personal time at home each night on work tasks. One interesting finding in the study was that physicians who used documentation support spent significantly more direct face-to-face time with the patients (31.4% for those who used dictation and 43.9% for those with a documentation assistant) than those without documentation support (23.1%). Similar results were obtained by Arndt et al. (2017), who found in their study that U.S family physicians spend more than half of their workday – nearly six hours – interacting with the Electronic Health Record (EHR). It must be explained that in this study context, EHR was defined as all activities performed on a computer, including e-mails, administrative tasks, security system etc. The most time consuming activities were documentation (accounting for 23.7% of total working time), emails (23.7%) and searching patient information from the clinical software (16.9% of the total time).

TMS method has also been used to compare the work and workflow changes in healthcare after the implementation of a new e-solution. Carayon et al. (2015) assessed ICU physicians and residents’ time utilization before and after clinical software implementation. After 289 hours of direct pre- and post-implementation observations, the results showed that the use of the software significantly changed physician's work, as, for example, the time spent on clinical review increased 40% and documentation 55%. Also, the implementation affected the frequency of switching between different activities, where in some cases the frequency increased and in some cases, decreased.

Similar study was carried out in primary care settings by Pizziferri et al. in 2005. In total of 20 physicians from five primary care practices were observed for a total of 167.2 hours. The results showed that using clinical software did not significantly change the time spent on direct patient care, however, the time spent on the computer carrying out indirect patient care activities (e.g. reading and documenting) increased from 0.95 minutes to 5.11 minutes per patient, which is a 538% increase. An online survey, which was a part of the study methodology, revealed that 71% of family physicians felt that it takes more time to carry out documentation on the new clinical software than in the old, paper-based system.

As far as known, no TMS has been conducted in Estonian primary healthcare settings to study Estonian family physician’s workflow and time utilization. Yet, due to the increasing workload and the frequent introduction of new technological solutions and services into family physician’s daily work, it is highly important to know how physicians spend their time and how it is affected by the implemented e-solutions. As described above, the studies conducted so far are mostly qualitative and based primarily on questionnaires and interviews. A more accurate assessment of physicians' workflow would give more objective data about the current situation, potential shortcomings and together with data analysis, ways to improve the efficiency and effectiveness of physicians work, reduce cognitive load, stress and burnout at personal, intra-organizational and inter-organizational levels. The results from TMS studies would also benefit software developers – knowledge of the exact needs of end-users will help to develop and improve solutions and services that significantly facilitate the workflow of physicians. Moreover, policymakers and healthcare payers (i.e. Estonian Health Insurance Fund, EHIF) would reap the benefits of this information to develop better funding models for Estonian primary healthcare system.

## 1.3 ICT solutions on Estonian family physicians’ desktop

Over the last few decades, the advent of health information and communication technology (ICT) has strongly influenced and restructured Estonian health care system and the provision of care. To date, most of the work processes of family physicians have been digitized, primarily to make their work easier and quicker, and therefore more time-efficient. The implementation of ICT may benefit care provision and healthcare system performance in several ways – it may increase the quality and efficiency of care; reduce the administrative costs as well as operating costs of healthcare services and; allow to create completely new and innovative care models (OECD, 2010).

Information systems are the cornerstones of healthcare. Boell and Cecez-Kecmanovic (2015) defines information systems as “complex systems which involve a variety of information technologies such as computers, software, databases, communication systems, the Internet, mobile devices and much more, to perform specific tasks, interact with and inform various actors in different organizational or social contexts.” According to the WHO (2008), health information system (HIS) has four key functions: 1) data generation; 2) compilation; 3) analysis and synthesis, and; 4) communication and use. These functions provide the necessary support for decision-making among various professionals, including healthcare providers.

In Estonia, the HIS forms the entire national e-health system called Estonian National Health Information System (ENHIS) which was established in 2008. The chief processor of the ENHIS is the Ministry of Social Affairs and the authorized processors are Estonian Health and Welfare Information Systems Center (TEHIK) and Estonian Medical Digital Image Bank. The ENHIS consists of three main parts: the central database of the information system, the medical digital image database and the data warehouse. The central database of the information system contains a large amount of health data generated by healthcare providers and other relevant persons (health records), by the data subjects (patients), and also of data retrieved from the national digital registry (Tervise infosüsteemi põhimäärus, 2016). The Estonian Medical Digital Image Bank is a central database where about 90% of the radiological images and films, including X-rays, CTs and MRIs are stored (SCOOP4C, n.d.). The third part of the EHNIS – data warehouse – collects pseudonymized personal data for national statistics in order to see the trends and plan the allocation of healthcare resources (TEHIK, n.d./a; e-Estonia, n.d.).

Using different data sets from the EHNIS and other national databases, several e-services and solutions have been created and implemented in Estonian primary care system, out of which the most common ones used by family physicians are:

- E-consultation – e-service that enables family physicians to quickly and conveniently consult with other healthcare specialists to clarify patient's diagnosis and prescribe appropriate treatment (EHIF, n.d./a);

- Digital referral – an e-service where standardized electronic document is filled by family physician in order to refer a patient to appropriate healthcare specialist (EHIF, 2019b);
- Medical digital image database – central database that stores almost all of the radiological images and films, as well as radiological study descriptions and makes them available and usable to every family physician (NAO, 2019);
- Working incapacity certificate – physician can issue an official confirmation of the patient's temporary inability to perform work tasks for health reasons. There are four types of working incapacity certificates: for sick leave, for maternity leave, for adoption leave and, for care leave (EHIF, n.d./b).
- E-prescription – a database established for prescribing and processing digital prescriptions and medical device cards (NAO, 2019);
- Drug-drug interaction service – a database that checks the patient's drug interactions at the time of prescription and informs the physician if there is an inappropriate interaction (EHIF, 2018b).

In addition to the services listed above, the most widely used service is the Electronic Health Record (EHR). EHR is the national health information exchange platform which functions as a central database, but it actually retrieves data from different healthcare providers. This enables family physicians to obtain comprehensive information about the patients – for example digital records, test results, out- and inpatient epicrisis, lab results, as well as links to images (e.g. MRIs or X-rays) located in the Picture Archiving and Communication System (PACS) – from a single electronic platform in a standardized format. Also, all Estonian family physicians are obliged to send the patient-generated data to the ENHIS via their clinical software (TEHIK, n.d./a). The exchange of data and information is enabled through a unique nationwide software-based data exchange layer called X-road, which ensures a secure data exchange through data encryption and hash-chained non-reputable logging (blockchain-like integrity protection) on outgoing and incoming data (RIA, 2019). It provides a good platform for seamless, efficient and secure data exchange between different services and systems.

Family physician’s clinical software, called EMR, is considered as the backbone of the primary care infrastructure as it supports the integration of various tools and services that simplify physician’s daily work and improve the use of evidence in medical decisions. EMR, which is also interfaced with the EHR, has many essential functionalities, e.g. patient reception, documentation, billing and reporting, patient's medical history search from both the EHR and EMR, communication with laboratories, as well as other solutions like e-consultation, e-prescription, digital referral, working incapacity certificates and other, as briefly described above on page 11-12 (TEHIK, n.d./b). EMR is a central program used by family physicians in their everyday work.

Physician's clinical software has been a major debate topic around the world. On one hand, it has seen to offer many advantages for physicians, for example improved work efficiency; better access to patient's information; improved retrieval, collection and analysis of data; as well as improved communication with patients, colleagues and other health care specialists (Kroth et al., 2018; Krenn and Schlossman, 2017; Campanella et al., 2016). On the other hand, clinical software has been associated with physician burnout and dissatisfaction with workload and work-life balance (Arndt et al., 2017; Robertson et al., 2017; Sinsky et al., 2016). Robertson et al. (2017) surveyed family physicians and residents from 24 primary care residency practices in the U.S. and found that out of 585 surveyed, 216 (37%) respondents reported one or more burnout symptoms, with 162 (75%) associating the burnout with after-hours work on the computer. More, slightly over a half (53%) of the respondents reported dissatisfaction with work-life balance. These negative effects have been linked to several reasons, for example excessive requirements for data entry, inefficient design of user interface, insufficient inter-institutional health information exchange, information overload, and disrupted communication with patients (Kroth et al., 2018; Robertson et al., 2017). This contradiction between the positive effects of physicians clinical software and its negative impact on physicians may be due to lack of collaboration between end-users and service developers in the solution development process, which eventually may lead to non-user-friendly and inefficient services that are inconvenient to the end-user.

There are different EMR-s used among Estonian family physicians. Approximately 80% of Estonian family physicians use clinical software called Perearst2, less used are Watson, Medicum (MIS), eKliinik, Arstiportaal+ and Perearst3 (NAO, 2019). All the different clinical softwares are functionally similar and offer more or less the same capabilities. Nevertheless, the National Audit Office of Estonia reported in their 2019 e-government summary document that the fragmentation of EMRs causes time and money expenditure, and as there is no comprehensive management, software developments do not always meet the needs of the end-users. This in turn leads to physicians' dissatisfaction and work overload.

To tackle this problem, European Regional Development Fund, together with state funding is supporting the Family Physicians Association of Estonia in the period 2019-2023 with 435 000 euros for the analysis and development of Estonian family medicine software. The aim is to achieve IT solutions that are more user-friendly and support family physicians in their daily work, also considering the nationwide health center project planned for 2023, which brings a number of changes in the organization and needs (for e-health solutions) of family physicians and other medical team members (Lehtla, 2019). Family physicians and nurses have long waited for this financial support, and finding and providing financial resources to investigate and solve the EMR software problem is proof that the current system is unsustainable and the problem needs to be addressed.

A prerequisite for improving e.g. an e-service or EMR software is the availability of basic information about the physician's work in order to know the existing inefficiencies and shortcomings. This Master's thesis is the first baseline study of the TMS method in Estonian primary healthcare settings to determine the feasibility and usability of this method in studying family physicians' work processes and time utilization at physician-patient visits. If successful, TMS could be a provider of high-quality data in the future, on the basis of which the necessary changes can be developed and implemented, thus improving the work of family physicians. More, this study can be a pioneer for future research on the effects of future interventions and technological solutions.

## 1.4 Aim of the research

The aim for the Master's Thesis is to assess the feasibility of direct time and motion observation method to collect data about Estonian family physicians' time utilization at physician-patient visits.

Sub-goals for the research are:

- to obtain preliminary data on the family physician's time expenditure and time distribution between different work processes during the patient visits;
- to get an initial overview of the average time physicians spend on the computer during the patient visits, outside the visits hours, as well as throughout the working day;
- to compare the observed time distribution and time expenditure with the family physicians' opinions on their workload, computer use and digital solutions.

## 1.5 Research questions

Based on the research objectives listed above, the study is aimed to answer the following questions:

1. Is using the direct time and motion observation method appropriate and reasonable to study Estonian family physicians' time utilization?
2. How is the time divided between different activities on patient visits and what are the most time-consuming tasks?
3. How much time and on what physicians spend their time on a computer outside the visit hours?
4. Do the opinions of family physicians coincide with the results of the time and motion study results regarding the time expenditure and burdensome activities?
5. What are the attitudes towards the EMR and other electronic solutions and services physicians currently use in their everyday work?

# 2. Materials and methods

This study investigates the usability of the TMS method for mapping the work processes and time utilization of family physicians. The method consists of three subsections: direct time and motion observations, self-reported diaries, and semi-structured interviews.

## 2.1 Direct time and motion observations

This study was a structured multi-site pilot TMS, which was carried out through direct observations on 63 face-to-face visits at seven family physicians across seven practice sites from different areas of Estonia. The TMS study was performed following the STAMP checklist developed by Zheng et al. (2011) to ensure proper structuring of the TMS and the comparability of results with the future studies. Because the checklist has been compiled primarily for studies examining the impact of newly introduced interventions on healthcare work efficiency, it is not possible to fully follow the STAMP checklist in current pilot study.

### 2.1.1 Recruitment of family physicians

A convenience sample of family physicians were recruited through the mailing list of the Family Physicians Association of Estonia. The author of this thesis sent an initial email to the mailing list, briefly introducing the content, methods and objectives of the study and inviting them to participate. In total of eight (8) family physicians responded to the email agreeing to participate in the study, after which a more detailed description of the study process and physician commitments was sent via email. The initial idea was to involve participants from different regions of Estonia, both rural and urban, in order to get more generalized view of the situation. Six of those interested were from Tallinn and its immediate vicinity, and the other three family physicians were from rural areas of Estonia.

Confidentiality agreements were signed with all family physicians to ensure data protection and to assure that recorded data is not used improperly and not accessed by third parties (Appendix 1). No sensitive personal data were recorded in the study process. All patients were provided with an information sheet containing all the necessary information on the content and setup of the study (Appendix 2). Each patient had the opportunity to refuse the investigator’s stay in the physician’s office during the visit. Due to the fact that there was no sensitive personal data recorded during the observations, the study was in compliance with data protection law and the consent of the Ethics Committee was not required.

### 2.1.2 Data collection

From November to December 2019, the observer stationed at each family physician practice for one working day's patient appointment session to observe the physicians' work processes on site. Observations were performed on 'usual' workday where appointments with scheduled adult patients were planned. The observations started with the first patient appointment and continued until the last scheduled patient left the physician's room. The observer was placed in a suitable location in the office to be unobtrusive, but at the same time be able to observe the physician's activities and see the computer screen.

The observer had no prior experiance in conducting observational studies in clinical settings. The basic training was acquired through preliminary work by the observer, i.e. researching previous studies and exploring the selected TMS data collection tool.

### 2.1.3 Data entry tool and pre-testing

The direct time and motion observations were performed using WorkStudy+ 6 Time Study Software application (Quetech Ltd., Canada), which was used on OnePlus 6T Android mobile phone (Figures 2-4). This particular software was selected because it had a free version available and several similar studies have been previously performed in the healthcare field using the same software (Arndt et al., 2017; Long et al., 2020). The activities were determined based on similar studies previously conducted (Young et al., 2018; Arndt et al., 2017; Sinsky et al., 2016; Mamykina et al., 2016) and adapted to the conditions and needs of Estonian primary healthcare system. This was done through literature review and consultation with one family physician.

To test the tool and to refine the activity list, pre-testing was carried out in August 2019 where two patient visits were observed at one family physician. An example of a statistical summary and details generated by the data collection tool after the observation is brought out in Figure 1. As a result of the pre-testing, "scheduling new appointment" was added to the activity list. Also, the activity named "other" was divided into two different activities: "other (c)", meaning that the activity was done on a computer and "other (non-c)", meaning that the activity was done not using a computer.

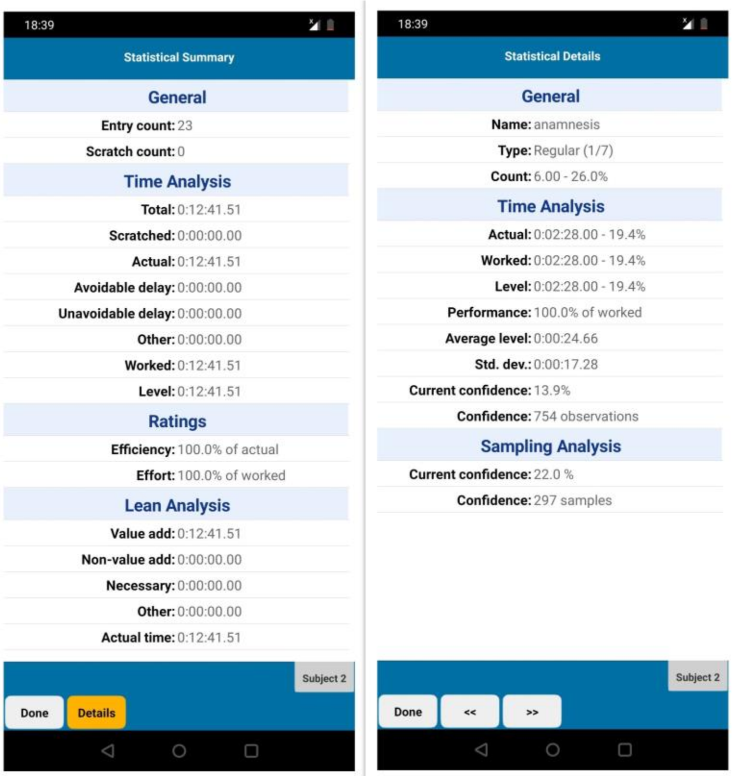



**Figure 1** Screenshot of the statistical summary (on the left) and statistical details (on the right) generated by the data collection tool. For every activity recorded during the visit, total time and the percentage of the total visit time were automatically calculated.

The final activity list consisted of 15 activities which were divided into two categories – computer-based activities and non-computer-based activities. The activities in the computer-based group were: history searching (EHR/EMR), security system (authentication and logging in/out), documentation, writing a referral, issuing digital prescription, ordering blood test, scheduling new appointment and other (c). The non-computer-based activities were: patient enter the room, anamnesis, physical examination, test/measurement, counseling/teaching, patient exit room, other (non-c). All activities are defined in Table 2.

**Table 2** Definitions of activities collected in the study

| Activity | Definition | Includes | Excludes |
|---|---|---|---|
| **Pt enter the room** | Patient entering the physician's room for appointment. | The time the patient enters the room and the physician has not yet started taking the anamnesis. Greetings. | Time when the patient is outside the appointment room. Time when the physician starts taking |

| | | | |
|---|---|---|---|
| | | | anamnesis or other visit-related activities. |
| **Anamnesis** | Gaining information from the patient by asking specific questions of the patient with the aim of obtaining information that is useful in formulating an accurate diagnosis and providing appropriate treatment to the patient. | Communication between the patient and the physician on patient's health and other relevant health-related topics. | Physician's communication with someone else (e.g with a colleague and other people). Greetings and goodbye, other introductory talk. |
| **Physical examination** | An examination of the bodily functions and condition of a patient carried out by the family physician through inspection, palpation, percussion and auscultation. | Inspection (visual examination) of patient's different body parts and systems, palpation (the act of feeling the surface of the body with the hands to determine the characteristics of the organs beneath the surface), percussion (tapping the body surface with short, sharp blows and evaluating the resulting sounds), auscultation (evaluating sounds produced by the heart, the lungs, the blood vessels, of the bowels using stethoscope). | All patient examination activities where any kind of measuring instrument is used by the physician. |
| **Test / measurement** | Objective measurements of bodily functions and condition of a patient carried out by the family physician using some kind of measuring instrument. | Anthropometric measurements (weight, height, perimeters, body fat percentage etc.), blood pressure, heart rate. | All patient examination activities where no measuring instruments are used and which do not provide objective measurement results. |

| | | | |
|---|---|---|---|
| **Security system** | The process or action of verifying the identity of the physician. | Logging onto the computer, EHR, EMR and e-mail account. Digital signing. | Other actions that are not logging in or logging out activities, or digital signing. |
| **Patient history search (EHR/EMR)** | Physician seeking information about the patient from previous medical records in both the EHR and the EMR. | Looking up past entries made by other health care professionals  (from the EHR) and by themselves (from the EMR); analysis results; teleconsultation results and other information about the patient that is available in the EHR and EMR. Writing search words to find the needed entries. | Other actions made in EMR and EHR. All writing activities. |
| **Documentation** | The creation of a digital record into the EMR describing the information about patient's health obtained during the visit (including anamnesis, the results of the physical examination and measurements, patient treatment/management plan, progress notes etc). | Typing free text into the EMR's digital record, inserting patient diagnosis code into EMR. | Issuing digital prescription, writing referral, ordering tests, scheduling new appointment time. |
| **Counseling/ teaching** | Oral counseling of a patient concerning his or her health. | Oral counseling on a patient's treatment plan, medication administration, healthy lifestyle and exercise recommendations, and other health-related counseling. Teaching the patient exercises. | Requesting information from the patient (anamnesis). Physician talk that is unrelated to patient health instruction and teaching. |
| **Issuing e-prescription** | Prescribing medication for the patient in the EMR. | Searching for the medication from the database, typing and | Any activity not related to issuing the digital prescription. |

| | | | |
|---|---|---|---|
| | | confirming the prescription medication in the EMR. | |
| **Referral writing** | Placing an order for a referral in the EMR. | Filling in the corresponding field in the EMR, looking up patient information for the completion and issuing of the referral. | Any activity not related to writing the referral. |
| **Blood test order** | Placing an order for a blood or laboratory test in the EMR. | Opening the blood test ordering page in the EMR, marking the blood markers to be analyzed, approving and sending the order. | Any activity not related to ordering the blood test. |
| **Scheduling new appointment** | Physician booking new appointment time for the patient in the EMR. | Finding a suitable time in the physician's appointment schedule, patient registration. | Any activity not related to scheduling new appointment to the patient. |
| **Pt exit room** | Patient leaving the physician's appointment room. | The time the patient leaves the room and health-related communication is no longer being held. | Time when other activities related to the visit are performed, including the time when physician talk about patient's health. |
| **Other (c)** | All the other activities the family physician does on the computer. | Googling, communicating via social networks (e.g. Skype), checking and writing emails, visiting websites. | Any other activity defined above; activities where the computer is not used. |
| **Other (non-c)** | All the other activities the family physician does which are not related to the computer. | Phone calls, communicating with colleagues, searching for the equipment, leaving the room, etc. | Any other activity defined above; activities where the computer is used. |

All the activities were inserted into the data collection tool WorkStudy+ 6. The process of adding a new activity to the application's activity list is shown in Figure 2 and the WorkStudy+ 6 TMS study dashboard with the final activity list is outlined in Figure 3.

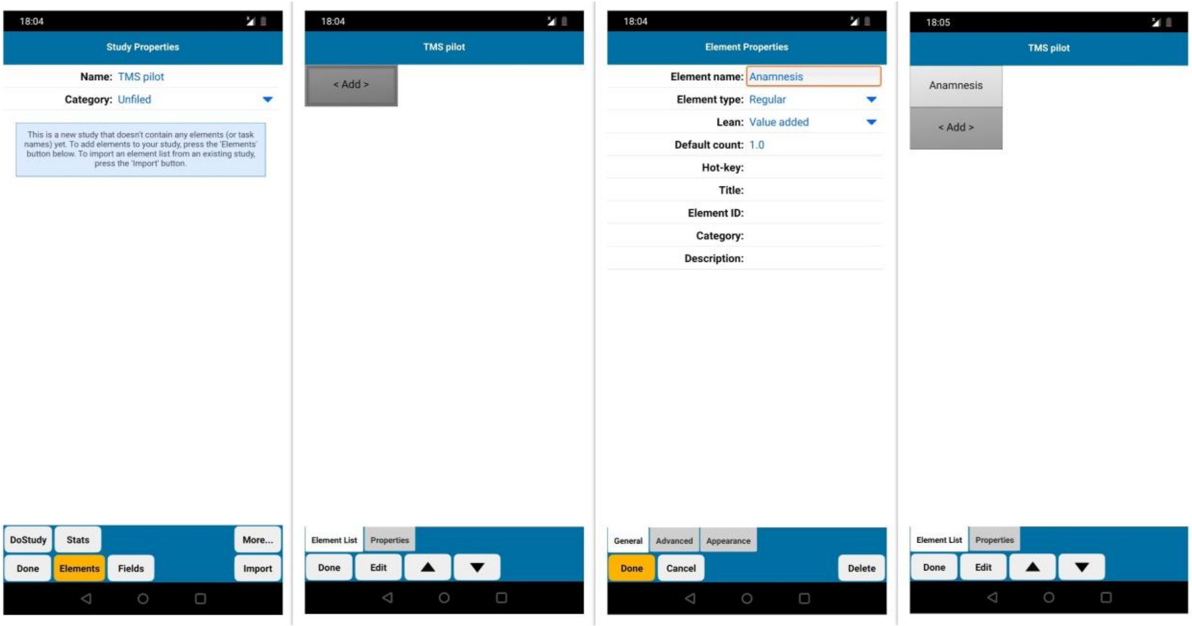



**Figure 2** Adding a new activity ("anamnesis") to the data collection tool's activity list

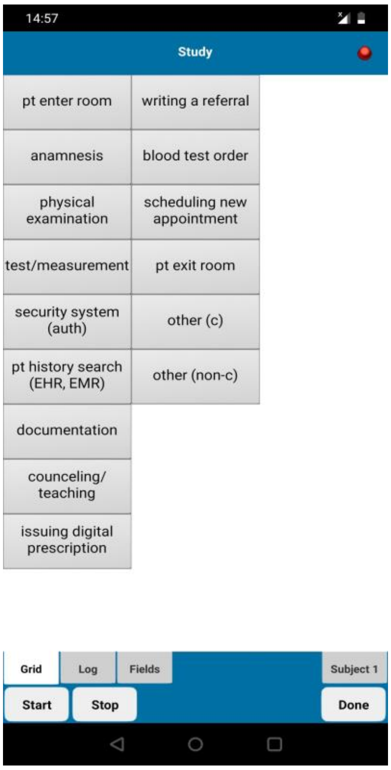



**Figure 3** Screenshot of TMS data entry tool WorkStudy+ 6 interface design with 15 listed activities

### 2.1.4 Data analysis

Data from WorkStudy+ 6 Time Study Software were extracted to Google Sheet for data processing and analysis. Descriptive statistics are provided to show how physicians utilized their time and distributed it between different activities. Mean visit time, average time distribution on visits (minutes and %), mean time per every process, minimum and maximum values of the activities, total computer time and total non-computer time were calculated for each visit, each practice sample, as well as for total sample.

## 2.2 Self-reported diaries

Due to the limited time on the patient visit, physicians are often unable to complete the necessary activities at the time of the visit, whether it is documentation, issuing a referral letter, or other. To get a complete picture of how much time family physicians spend working on a computer during their usual workday and what are the activities that take the most time, family physicians were asked to keep a digital diary throughout the observation day. The time intervals during which they worked on the computer together with the activities they performed during that time period were entered into the diary. A prepared Excel spreadsheet with the instructions for completion was sent to each physician via email prior to the observation day. By entering the starting and ending time of the activity, the spreadsheet automatically calculated the sum of time spent on the computer. A screenshot of the completed diary example is shown in Figure 4 to show what data and in what format were required from the physicians.

Self-reported diary

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

**Kuupäev:** 29.11.2019

**Tööpäeva algus (kellaeg):** 8:15

**Tööpäeva lõpp (kellaeg):** 16:00

**Patsientide vastuvõtt (ajavahemik, nt 13:00-17:00):** 09:00-13:00

**Tööpäeva kestus:** 7 h 45 min

| Algusaeg (nt 08:10) | Lõppaeg (nt 08:32) | Tegevus(ed) (nt dokumenteerimine, meilide lugemine ja vastamine, retseptide pikendamine, analüüside tellimine, patsiendi raviloo vm vaatamine/otsimine, meditsiinialase info otsimine Internetist; isiklikud tegevused jm) | Kestvus |
|---|---|---|---|
| 08:21 | 08:23 | uue patsiendi raviolooga tutvumine | 0:02:00 |
| 08:25 | 08:27 | eelmisel päeva tehtud visiidi täiendav dokumenteerimine, tõendi väljastamine | 0:02:00 |
| 09:15 | 09:17 | dokumenteerimine, TIS | 0:02:00 |
| 09:28 | 09:38 | dokumenteerimine, saatekiri e-konsultatsioonile, digiretsept | 0:10:00 |
| 09:39 | 09:58 | patsiendi meilidele vastamine, TIS | 0:19:00 |
| 10:15 | 10:21 | tervisetõend, TIS | 0:06:00 |
| 10:30 | 10:38 | meilidele vastamine | 0:08:00 |
| 10:51 | 10:53 | saatekiri, digiretsepti kinnitamine | 0:02:00 |
| 11:18 | 11:40 | digiretsept, dokumenteermine, arved, TIS | 0:22:00 |
| 12:43 | 12:46 | dokumenteerimine | 0:03:00 |
| 14:09 | 14:53 | analüüsi vastuste, uuringutulemuste vaatamine, interpreteerimine, dokumenteerimine, õdedele kirjalike korralduste andmine patsiendile info edastamiseks | 0:44:00 |
| 14:54 | 14:56 | TIS | 0:02:00 |
| 14:57 | 15:03 | Töövõimetuslehe paranduse avalduse tegemine ja meilimine haigekassasse | 0:06:00 |
| 15:04 | 15:49 | raviarvete lõpetamine | 0:45:00 |
| **Total:** | | | **2:53:00** |

Self-reported diary

**Figure 4** Screenshot of a completed self-reported diary example in an Excel spreadsheet

## 2.3 Semi-structured interviews

To obtain information to help to understand whether and to what extent the results of the direct observations and the opinions of family physicians coincide or differ, a semi-structured interview was carried out with each family physician who participated in the study. The focus was on finding out the physician’s subjective thoughts and attitudes in terms of their use of time and work efficiency, both on visits and overall, as well as exploring the satisfaction with the e-solutions used, particularly focusing on the EMR. All interviews were conducted straight after the direct time and motion observations were finished. In order to avoid bias, the family physicians were not given any information about the results of the observations prior to the interview.

Interviews were undertaken in November-December 2019 with seven family physicians. All the interviews were conducted face-to-face. An interview guide (Appendix 3) was used to keep the focus and all the interviews were audio-recorded using Voice recorder - Audio editor application (Green Apple Studio, Canada). Afterwards, anonymization, partial transcription and content analysis was done, and the results were divided into four main thematic areas: background information; workload and work organization; patient visits and; used e-solutions.

# 3. Results

This chapter provides an overview of the study results. It is divided into three main parts according to the methodology used in the study. First, the results of the TMS observations are given, covering both the description of the conduct of the study as well as the results of the preliminary TMS pilot observations. The second subchapter provides an overview of the data obtained from the self-reported diaries, describing how much and on what family physicians spend time on the computer during the working day. The third part of this chapter provides an overview of the information obtained during the interviews with the family physicians, describing their opinions and attitudes towards their work settings, workload, time use, and used e-solutions.

## 3.1 Results of the TMS

The following section is divided into two – the first part provides a detailed description of the conduct of the study and the second part presents the results of the TMS observation pilot.

### 3.1.1 Conduction of the TMS

**Study participants**

A total of seven family physicians from seven different practices participated in the study and a total of 63 face-to-face patient visits were directly observed and analyzed. One family physician who initially agreed to participate in the study was unable to join in due to inability of the observer and the physician to find a suitable time to carry out the observation. Out of seven practices, five were group practice with a mean of 3.6 family physicians and 4.8 family nurses; one was single practice with one physician and four nurses; and one was primary care centre with three physicians and five nurses. All participating family physicians were female (n=7), age ranged from 35-57 with a mean age of 48.3 years (SD 7.2). The mean work experience as a family physician was 20.3 years (ranging from 3 to 28 years), residency included. Six out of seven physicians were working full time (i.e. with workload 1.0) and one with 0.8 workload. The main characteristics of physicians are listed in Table 3 below.

**Table 3** Characteristics of participating family physicians

| Characteristic | Physicians, no. (%) (n=7) | Characteristic | Physicians, no. (%) (n=7) |
|---|---|---|---|
| **Practice type** | | **Work experience** | |
| Health centre | 1 (12.3%) | ≤9 | 1 (12.3%) |
| Group practice | 5 (71.4%) | 10-19 | 3 (42.9%) |
| Single practice | 1 (12.3%) | 20-29 | 3 (42.9%) |
| **Location** | | **Workload** | |
| Urban | 5 (71.4%) | 1.0 | 6 (85.7%) |
| Rural | 2 (28.6%) | 0.8 | 1 (12.3%) |
| **Sex** | | | |
| Female | 7 (100%) | | |

Seven practices from three different counties – Harju county, Saare county and Lääne-Viru county – participated in the study (Figure 5). Five practices were located in urban areas, of which four in Tallinn, and two in  rural areas.

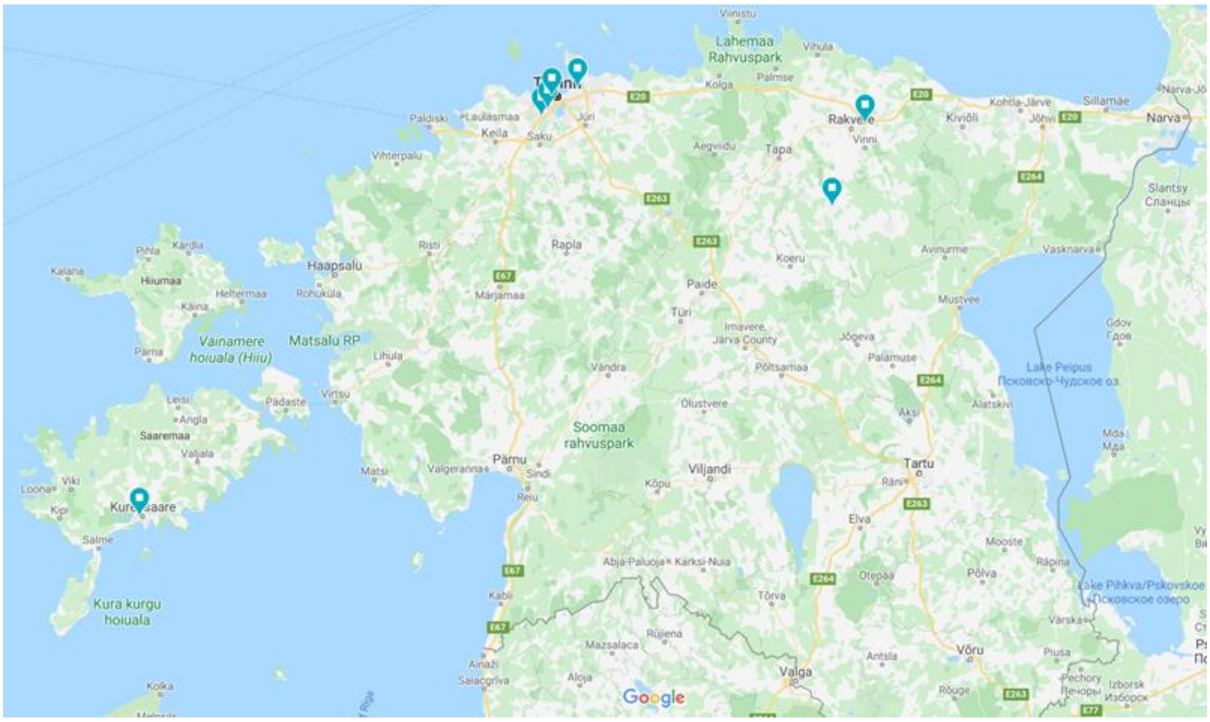



**Figure 5** Practice locations (source: Google Maps)

**Conduction of the TMS**

A total of 38.5 hours of observations and interviews was carried out (a mean of 5.5 hours per one family physician), during which a total of 63 face-to-face visits were directly observed and seven semi-structured face-to-face interviews were conducted.

The preparatory activities for the observations were (with approximate time expenditure):

- preparation of the necessary documents (confidentiality agreement and patient information sheet), 2 hours;
- background research for compiling the activity list, 6 hours;
- selection of a suitable TMS software solution and software setup, 5 hours;
- compiling and sending an email for the recruitment of study participants, 1 hour;
- pre-testing of the TMS software and the study settings, 5 hours;
- communicating with interested study participants (e.g. providing additional information and selecting suitable observation day), 4 hours.

The observer arrived at the study site approximately half an hour before the patient appointments started in order to get acquainted with the physician, to sign a confidentiality agreement, and to briefly repeat the study and observation processes. Patient information sheets were handed over to the administrator for distribution to incoming patients, or left in the waiting room for patients to read if there was no administrator. The observer chose a suitable place in the appointment room where she would be as unobtrusive as possible, but at the same time would be able to monitor the physician’s activities and see the physician's computer screen. It was important for the observer to remain as unnoticeable as possible to both the patient and the physician in order not to cause discomfort and behavioral changes. In most cases, the placement was done in such a way that a triangle was formed between the physician, the patient and the observer, so that the investigator remained out of sight in the case of physician-patient eye contact. To minimize the Hawthorne effect, i.e. the reactivity in which an individual modifies their behavior in response to their awareness of being observed (Adair, 1984), the observer did not initiate any conversation and avoided eye contact with the physician and patient during the visit.

In addition to the patient information sheet, each patient was individually notified by the physician. This was done in several ways, depending on the family physician. Three physicians out of seven explained the reason for the observer's presence while directing the patient to the appointment room so that the patient could refuse if having a third party in the room during the visit feels uncomfortable. Other four physicians did the same explanation when the patient was already in the appointment room. Also, every family physician emphasized to patients that the research subject is the physician, not the patient, and no personal data will be recorded during the visit. Of all seven physicians, only one patient refused to have the observer in the room due to delicate health concern.

The observer started the measurement by tapping the 'pt enter room' field on the TMS data entry tool's screen the moment the patient crossed the doorstep. From then on, activities were selected on the screen according to the physician's actions. As soon as the observer selected an activity, the application recorded the activity's start time to millisecond precision. The start time of each activity was the stop time of the immediately preceding activity. As the application did not allow to capture multiple activities simultaneously (multitasking), e.g. when a physician was viewing a patient's medical history from the EHR while taking anamnesis, the observer had to prioritize the activities. The observer always recorded the predominant activity to which the family physician paid the most attention to. Next, few examples are given to illustrate the choice of primary activities:

- Most commonly, the multitasking situation occurred when the physician took anamnesis and documented it simultaneously. In these cases, the time the physician was typing was recorded as 'documentation' and when the physician was talking or listening to the patient without typing, it was registered as 'anamnesis'. The same went for other similar activities where typing and reading on a computer occured, e.g. writing a referral, searching from EHR or EMR, prescribing drugs, ordering blood tests, etc.
- During the physical examination, it was common that the physician also asked health-related questions or counselled the patient at the same time. In these cases, the physician's dominant activity was communicating ('anamnesis' or 'counselling/teaching') whenever it occurred during the physical examination process.

In such multitasking situations as described above, there were usually many alternating entries between the two activities.

Every observation ended with 'pt exit room' which was the time when the patient got up from the chair and was preparing to leave the room, and relevant talk was no longer pursued between the physician and the patient. The observation measurement was stopped when the patient crossed the doorstep and left the room.

At the end of every observation day, the data was manually transferred from the TMS software to a personal computer for storage and analysis. The analysis was done using Excel spreadsheet. Data from all visits were summarized in a single table, where the duration and proportionality of all activities were presented, together with calculated total and mean visit time, total and mean computer time and non-computer time (both in minutes and in %). In addition, mean values of all above-mentioned parameters were calculated from the data of all visits of one family physician, and from the data of total visits observed.

The TMS data collection tool WorkStudy+ 6 Time Study Software used in the study was sufficiently functional and easy to use, and in general was suitable for this pilot. Looking back and analysing the software and its main features, the author of this Thesis brings out some pros and cons of the used software which, in one's opinion, are important and may affect the conduct of the TMS and the overall quality of the study (Table 4).

**Table 4** Pros and cons of the WorkStudy+ 6 data collection tool

| Pros | Cons |
|---|---|
| ● Compatibility – the application can be used on Android, iOS and Windows devices and is also available on Web<br>● Simple and clear application structure and in-app navigation<br>● Free of charge<br>● Runs without an Internet connection | ● No direct data import to the Excel and no automatically generated reports (free version)<br>● No multitasking – impossible to record two activities simultaneously<br>● One-dimensional activity capture<br>● Only eight measurements can be saved in the application at a time |

### 3.1.2 Results of the TMS pilot

A total of 63 face-to-face visits were directly observed for a total of 15.87 hours of direct visit time. The mean number of visits per physician was 9.14, ranging from 2 to 13 visits (SD 3.5). The mean duration of the visit was 14.48 minutes (median 14.45 minutes). The visit times varied greatly between family physicians, where the mean visit times ranged from 10.60 to 17.78 minutes (median 10.20 to 17.17 minutes), as well as between patients (range, 4.42 to 26.83 minutes). Similarly, the time allocation between different activities was highly variable across family physicians as well as across the visits carried out by one physician. Figure 6 shows the time variability of the activities recorded during the visits.

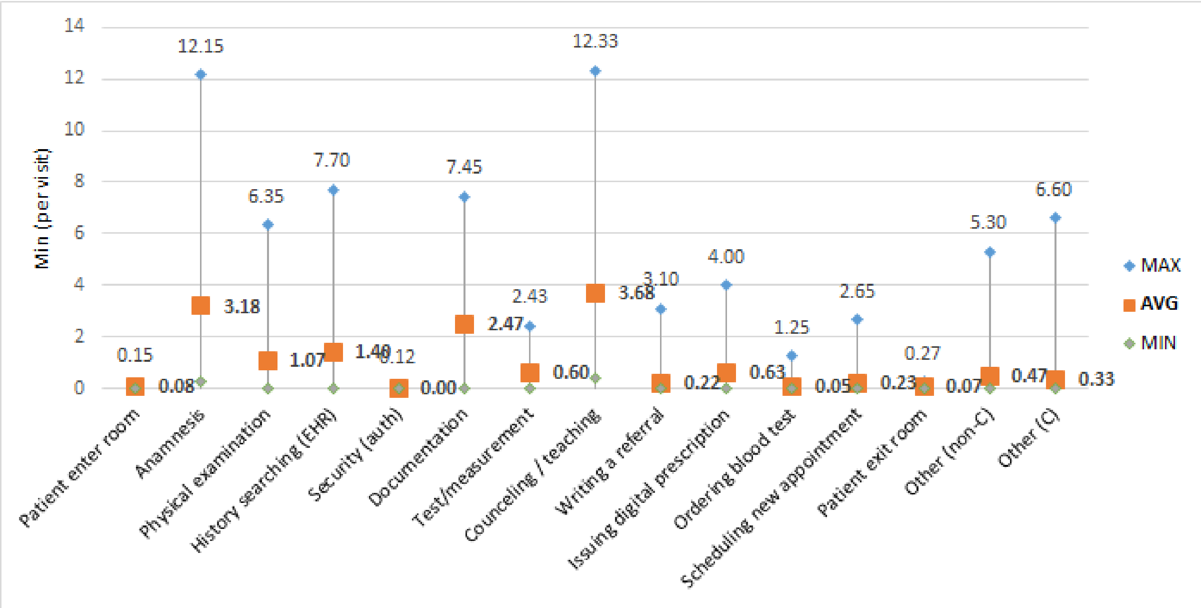



**Figure 6** Average time distribution on visits and minimum and maximum values of the activities

On average, 36.8% (5.33 minutes) out of the mean visit time was spent on computer-based tasks (including searching patient history from the EHR/EMR, authentication/security, clinical documentation, referral writing, issuing digital prescription, and scheduling new appointment) and 63.2% (9.15 minutes) on non-computer tasks (including anamnesis, physical examination, tests/measurements, and counseling/teaching). The most time consuming activity during the visits was counseling/teaching, which accounted for almost a quarter of the visit time (24.8%, or 3.68 min). This was followed by anamnesis with 22.4% (3.18 min), documentation with 16.9% (2.47 min) and patient history searching from the EHR/EMR with 9.9% (1.40 min). The least reported activity during the visits was "security" (authentication and login and logout), accounting for only 0.1% of the visit time. Moreover, security-related activities were registered on four visits in total, out of which three were carried out by one family physician. Other least reported activities were patient entering (0.8%) and leaving (0.5%) the appointment room, and physician ordering a blood test (0.4%). The latter was registered on six visits with an average duration of 0.62 minutes (4.3% of the average visit time). The mean time distribution between different activities is shown in Figure 7, where computer-based activities and non-computer activities are divided into yellow and blue undertones.

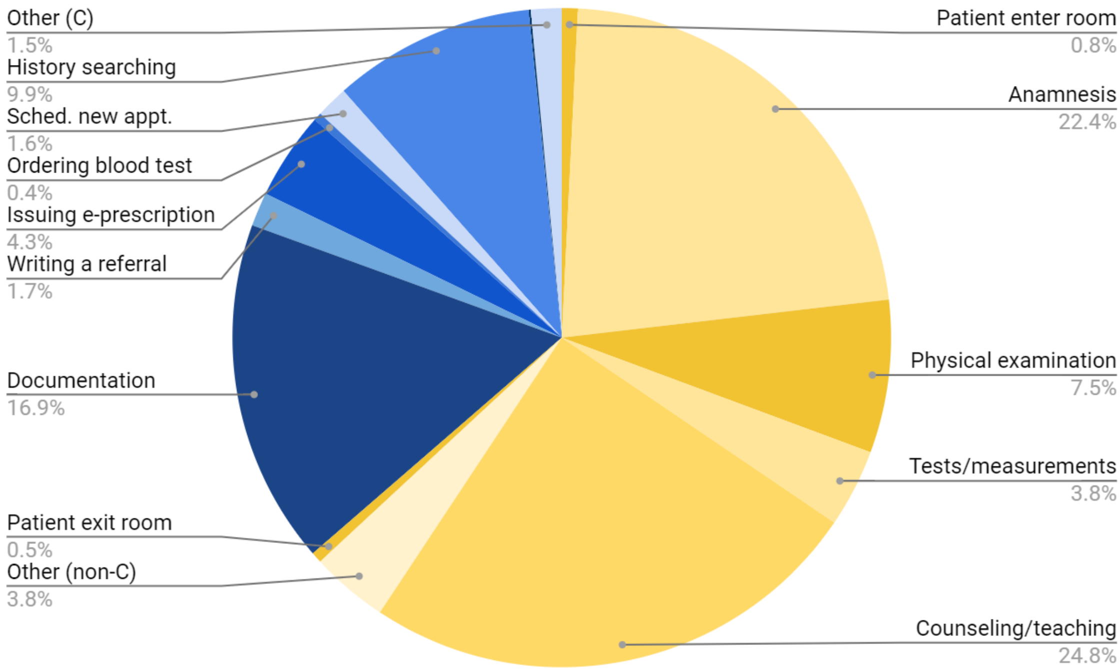



**Figure 7** Time distribution between different activities, mean (%). Blue colours show computer-based activities (36.8% of total visit time) and yellow colors show non-computer-based activities (63.2%).

Two activities in the activity list – “other (c)” and “other (non-c)” – included a number of different activities that were not covered by other tasks on the pre-set activity list. Under the "other (c)", the registered computer-based activities included googling, checking emails, visiting health-related websites and showing them to the patient, communicating with colleagues via Skype, and compiling a working incapacity assertion. The “other (non-c)” contained activities such as calling a colleague, calling the hospital patient to arrange a procedure time, searching and bringing equipment, leaving the appointment room, and physician watching a patient fulfilling a paper-based test. The “other (c)” activity was registered at 18 visits with a mean duration of 1.10 minutes (range, 0.27 to 5.30 minutes) and “other (non-c)” at seven visits with mean duration of 1.68 minutes (range, 0.17 to 6.60 minutes).

The structure of the visit depended largely on the patient's problem rather than the family physician’s work style and peculiarities. The health concern determines whether, for example, if there is a need for a physical examination or measurements, or whether just a consultation is sufficient enough to meet the objectives of the visit. Despite that, the differences in the time use of family physicians were evident, mainly due to differences in the habitual behaviours of using the computer during the visits. While some physicians had a normal practice of compiling the documentation as much as possible during the visit, other physicians limited themselves only to take notes with a view to completing the patient's health records later. Figure 8 brings out the time distribution of two observed family physicians, where pie charts show the contrast in physicians' time utilization based on the differences in time spent on the computer during the patient visit. The upper chart shows that the physician spent on average slightly more than a half (50.3%) of the visit time on the computer, mostly documenting and searching the EHR and/or EMR for patient health information (accounting for 37.9% of the total visit time). In contrast, the physician who spent the least time on a computer (22.5%) focused primarily on collecting the medical history and counseling the patient (accounting for 37.1% of the total visit time). For that physician, documentation and searching for patient information accounted for only 18.8% of the total average visit time.

Based on this example, the relationship between computer use during the visit and total visit time was also revealed, where the mean visit time of the physician who used the computer the most was 2.34 minutes longer than of the physician who spent the least time on a computer (14.72 and 12.38 minutes, respectively). More, by using data from self-reported diaries, it can be said that less computer time during visits can not be associated with more computer time outside of visit hours. In the present example, respectively 2.68 (more computer time) and 4.35 (less computer time) hours were spent on the computer during out-of-visit hours, which, on the one hand, seems to indicate that physician with more computer time spend less time on the computer outside the visit hours. However, looking at the percentage distribution of out-of-visit time, the physician who spent more time on a computer during the visits also spent a greater proportion of the time on a computer during the out of visit hours (80.9% vs 65.0%, respectively). This is a very good example to illustrate the difference in family physicians' work practices and working habits.

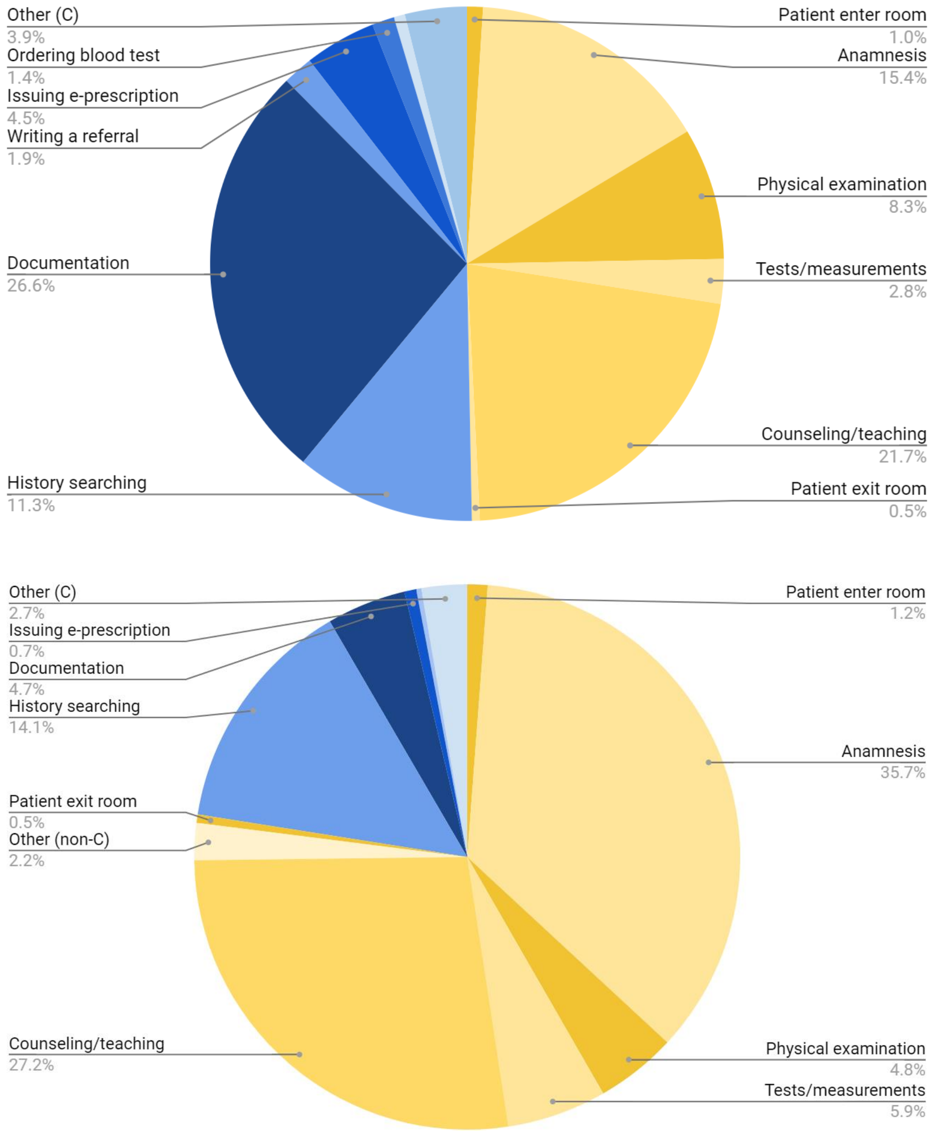



**Figure 8** Mean visit time distribution of two family physicians (upper chart pie - physician who spent the most time on the computer; the bottom chart pie - physician who spent the least time on the computer).

## 3.2 Results of the self-reported diaries

All seven physicians completed a self-reported diary on the same day as the TMS was carried out. The mean working day was 7.92 hours long, ranging from 6.50 to 8.75 hours between different family physicians. Every physician had four hours of scheduled patient appointments, when the time and motion observation was carried out. During that time, the self-reported diary was filled only at the time slots between the visits.

The mean time spent on the computer during the workday (excluding the patient appointments) was 3.08 hours, which is, on average, 56.2% of their working time (Table 5). The times ranged from 2.03 to 4.35 hours across physicians. The smallest share of working time spent on a computer was 42.6% and the largest was as high as 80.9%.

**Table 5** Physician’s time spent on a computer during the working day

| Physician ID | Total working time | Accountable time (excl. patient visits) | Computer time | Time spent on the computer (% of total) |
|---|---|---|---|---|
| **1** | 08:15 | 07:47 | 03:19 | **42.6** |
| **2** | 08:45 | 06:41 | 04:21 | **65.0** |
| **3** | 08:00 | 04:17 | 02:02 | **47.5** |
| **4** | 07:45 | 04:47 | 02:08 | **44.6** |
| **5** | 07:45 | 06:30 | 02:53 | **44.3** |
| **6** | 06:30 | 03:19 | 02:41 | **80.9** |
| **7** | 08:30 | 06:15 | 04:14 | **68.8** |
| **Mean** | **07:55** | **05:39** | **03:05** | **56.2** |

In total, 100 entries were made with a total of 158 activities registered, which makes the mean of 22.6 activities registered per one family physician (range, 12 to 33 activities) (Table 6). The most reported activity was documentation, which was mentioned 58 times (a mean of 8.3 times per physician), which is 36.7% of all reported activities. Two family physicians started their working day by finishing the documentation about the patients who visited the physician the previous day. The second most reported activity was searching for patient information from the EHR and EMR, which was mentioned 38 times, i.e 24% of all activity entries and was reported a mean of 5.4 times per physician. This activity group included searching for patient's medical history from the EHR and viewing test results and previous entries from the EMR program. Third most frequently registered activity was communication, which included emails and other communication channels, e.g Skype. Only one physician did not report viewing and replying to emails on the working day. Two physicians used Skype to communicate with coworkers during the working hours. Other reported activities were mainly related to filling in and sending various forms related to patients – digital referrals and digital prescriptions were mentioned 14 and 13 times, respectively, followed by blood test ordering, health certificates and working incapacity assertions. The latter three activities were mentioned a total of 11 times, which is an average of 1.6 times per physician. One family physician reported sending medical bills to the EHIF.

**Table 6** Self-reported diary activity entries

| Physician ID / Activity | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Sum of activity entries | Mean no. of entries per physician |
|---|---|---|---|---|---|---|---|---|---|
| **Documentation** | 9 | 10 | 5 | 9 | 6 | 8 | 11 | 58 | 8.3 |
| **EHR and EMR search** | 4 | 6 | 3 | 5 | 7 | 3 | 10 | 38 | 5.4 |
| **Mails and other communications** | 3 | 4 | - | 3 | 3 | 5 | 4 | 22 | 3.1 |
| **Prescriptions** | - | 4 | 1 | 3 | 3 | 1 | 2 | 14 | 2 |
| **Referral** | - | - | 3 | 3 | 2 | 2 | 3 | 13 | 1.9 |
| **Certificates / assertions** | 1 | - | - | - | 3 | - | 2 | 6 | 0.9 |
| **Blood test order** | - | 3 | - | 1 | - | - | 1 | 5 | 0.7 |
| **Medical bills** | - | - | - | - | 2 | - | - | 2 | 0.3 |
| **Sum of entries** | **17** | **27** | **12** | **24** | **26** | **19** | **33** | **158** | **22.6** |

## 3.3 Results of the semi-structured interviews

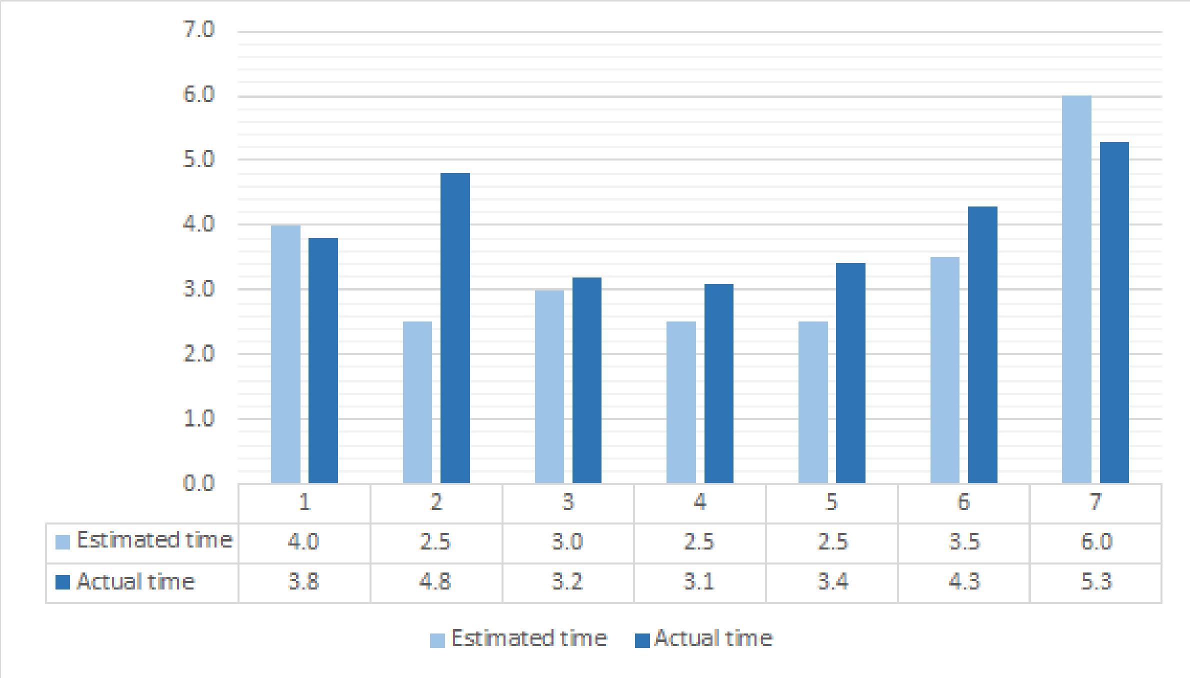
Seven interviews were conducted between November and December 2019. Interviews were held with each family physician who participated in the study directly after the end of time and motion observations. The background information collected on family physicians is described in section 3.1.

### 3.3.1 Workload and work organization

Six out of seven physicians were working full time (i.e. with workload 1.0) and one with 0.8 workload. Four (62.5%) physicians worked in more than one practice. Slightly more than half (57.1%) of the respondents rated their workload as normal, other 42.9% admitted to be overburdened. Family physicians see many problems in the current primary care system that contributes to overload and burnout. The problems brought out were: unreasonably large patients list size, too many mandatory services and responsibilities, shortages of labor and support specialists, and increasing (unjustified) demands on family physicians by the patients.

The majority of physicians (71.4%) thought that data entry, documentation and other bureaucratic activities take up too much of the family physician's working time and energy, and many of these time-consuming and burdensome activities are considered as an additional obligation, rather than a part of physicians' work. These include, for example, responding to EHIF audit inquiries, preparation and submission of different reports and documents to various organizations, e.g. to the Labor Inspectorate, Ministry of Social Affairs and EHIF, and also activities associated with the entrepreneurship, e.g. administrative tasks, practice management, personnel issues, etc. Physicians mentioned one good EMR function that really facilitates documentation process and helps to save time – "typical", which allows the physician to save prepared and unfilled text into the EMR that is easy to copy-paste and fill in when making a patient's medical record entry. This feature is mostly used for typical or specific medical conditions that require a specific course of action or patient assessment algorithm.

When asked to give an estimate of the average time spent on documentation and data entry on a usual working day (excluding the time spent on these activities during patient appointment period), there was a large variation between estimates. Four (57.1%) physicians responded that it takes about 3 hours a day, one said it takes 4 hours, one that it takes 5 hours, and one said that it takes on average 6 hours a day to deal with data entry and bureaucracy. Figure 9 shows the difference between the estimated computer time given by family physicians and the actual time spent on the computer (based on data from the TMS observations and self-reported diaries). For five physicians, the actual time spent on a computer was higher than estimated. The largest difference was 2.3 hours, i.e. 48% more than the initial estimate.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Estimated time | 4.0 | 2.5 | 3.0 | 2.5 | 2.5 | 3.5 | 6.0 |
| Actual time | 3.8 | 4.8 | 3.2 | 3.1 | 3.4 | 4.3 | 5.3 |

**Figure 9** A comparison of the estimated computer time and the actual computer time. Note: the top row of the table indicates the physician's IDs.

More than half (57.1%) of the physicians admitted that work affects their mental and physical health causing anxiety, depression, burnout, and physical inactivity due to fatigue and lack of time. One family physician admitted she has experienced severe burnout twice during his 20 years of service.

### Patient visits

The time set for the visit by the family physicians varied across practices. In four practices, the time set for the visit was 20 minutes, in two practices it was 15 minutes and in one it was 30 minutes. Opinions on the time set for the visit varied considerably. Although a 20-minute visit seemed to be optimal, one family physician considered it too long and thought it could be even 5 minutes less. An interesting and unexpected contrast of opinions occurred among physicians with a 15-minute visit, where one physician considered the time too long and the other considered it too short. It is also worth pointing out that both of the practices where the visit time was set to 15-minutes were located in Tallinn and the practice with 30-minute visit time was in the rural area. These results clearly demonstrate the large variation in the need for time resources between different family physicians, which may also indicate the differences in time and work efficiencies and time utilization.

All but one of the interviewees (n=6) said that there was enough or rather enough direct contact with the patient during the visit (Figure 10). Nevertheless, more than half of the physicians

(57.1%) admitted that using a computer during the visit influences communication with the patient, two physicians (28.6%) said it affects communication to some extent, and one physician said that computer use does not affect his interaction with the patient. The impact on communication was thought to be rather negative.

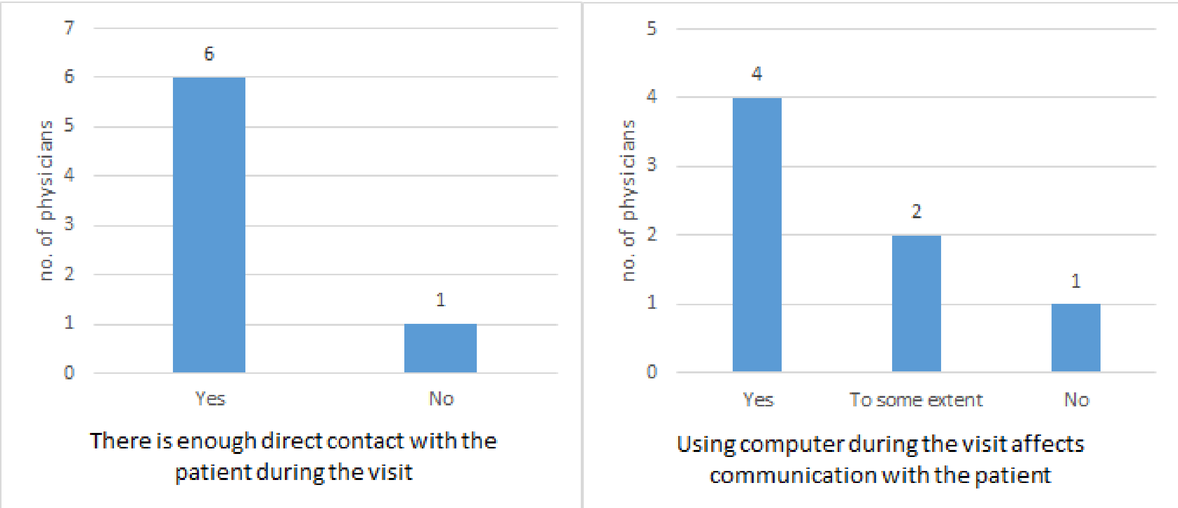



**Figure 10** Sufficiency of direct contact with the patient and computer's impact on physician-patient communication during the visits

The most time-consuming activities during the patient visits were mentioned to be documentation, making inquiries and seeking medical information about the patient from the EHR. One physician pointed out that the need to constantly repeat the same information to the patients is also very time consuming and exhausting. Four physicians out of seven try to document as much as possible during the visit, but as it is almost impossible to fully complete the patient record during the visit due to a lack of time, they must complete the documentation process afterwards. Thus, they estimate to complete approximately 70% of the documentation during the visit. One physician said she could complete about 50% of the documentation and two physicians said they only make notes during the visit and compile a medical record after the patient appointment session.

### Used e-solutions

The attitudes towards the e-solutions and services physicians use daily were positive – all the interviewees agreed that the solutions and services facilitate and ease their work processes, as well as improves the availability and dissemination of information. Two different EMR-s were used, where five physicians (71.4%) used Perearst2 software and two used Watson.

The first difference in attitudes towards these two softwares was evident in the assessment of software satisfaction among the physicians. While two Watson users were determined to be satisfied with the software they were using, Perearst2 users seemed rather hesitant in their answers, saying that they are rather satisfied because they have no experience with other programs. One physician was explicitly not satisfied with the Perearst2 software.

The most significant disadvantages of Perearst2 software were considered to be: slowness (n=3); non-user-friendly user interface (UI) as there is too much clicking and no more than one window can be opened at the same time; time-limited availability of customer support, and; inconvenient and time-consuming data retrieval. The pros of the Perearst2 set out by physicians were: auto save function; convenient preparation of referrals, digital prescriptions and similar documents, and; easily accessible patient diagnoses.

As a downside to the Watson software, users pointed out that, when making an entry about the patient, the software does not display the previously made entries about this patient (as it does in Perearst2). The positive aspects of the software presented by the physicians were that there is less clicking, many operations can be done with the keyboard which is more convenient; simple and logical UI design; appropriate home screen, and; fast and good customer support.

Last, physicians were asked to name changes and innovations they would like to see in the program in the future that would make their work more convenient and time efficient. The proposed changes were:

- Desktop notifications. These should appear on the screen when, for example, an e-consultation response is received, when there are anomalies in the patient's analysis answers, when the patient visits a specialist on the basis of a referral issued by a family physician, in case of drug purchase, etc. At the moment, physician have to make the inquiries about these issues from the EHR manually, having to guess the right time to make the inquiry, or make the inquiries frequently to check the process status.
- The patient's dashboard displayed in the EMR should additionally show a list of the patient’s most important diagnoses (e.g. chronic diseases, malignancies), time-critical information, summaries of inpatient epicrises, and the patient's current treatment regimen. Data changes in the home screen should be updated automatically.
- The results of the analyzes (e.g blood test markers, blood pressure and blood sugar readings) should be organized so that changes in readings over time can be easily

monitored. These data should also be displayed in tabular or graphical form for better overview and for monitoring the patient's condition over time.

- Data structuration and categorization in the ENHIS. This would make it more logical and easier to find the data needed. As several family physicians said, the ENHIS database is like a trashcan at the moment, where it is very difficult to find the necessary information due to the uncategorized data.
- Decision support that would provide alert-notifications about the patients in the risk group, e.g. when an influenza vaccine is needed to be done.
- Standardized structure of patient life anamnesis. This would make it easier for physicians to, for example, create a digital referral where the patient's basic health data could be copied from the patient’s dashboard to provide a brief overview to the specialist.
- More user-friendly UI. The navigation in the program should be easier and more logical. Improved program structure would also lead to a reduced number of clicks required to navigate the program.

# 4. Discussion

The main aim of this Thesis was to study the feasibility and reliability of using direct time and motion study method for collecting data about Estonian family physicians' time utilization at physician-patient visits. Also, to get the preliminary results from the TMS and together with diaries and interviews, give an overview of the average time physicians spend on the computer during their workday, and physicians' opinions on their use of time on the computer, overall workload, and attitudes towards the e-solutions used, with an emphasis on the EMR. The study was carried out due to lack of objective data on how Estonian family physicians' time is allocated in ambulatory care and how large is the proportion of the work that is done on the computer. Currently there is limited data available and the data has been mostly obtained through either questionnaires or interviews. The knowledge about time utilization, however, is highly important as it helps to identify and address potential work inefficiencies in family physician's daily work, as well as study the effects of newly implemented solutions, and therefore: 1) reduce physician's cognitive load, stress and burnout; 2) save time and reduce costs for the healthcare funders and primary care providers; 3) give opportunity for software developers to create innovative problem-solving solutions and services tailored exactly to the needs of family physicians.

Time and motion study was first described by Taylor (1911) in the early 20th century as a quantitative data collection method, where an external observer collects detailed data on the duration and movements that are required to perform a specific task, together with a data analysis focused on improving this task's efficiency. Three years later, in 1914, first TMSs on healthcare field were conducted and since then, the method has been widely used among healthcare managers and researchers to study costs and inefficiencies, quality of care and the adoption and impact of IT and technological solutions on time utilization. Today, there are many TMS software applications which can be used as data collection tools, which greatly simplifies the conduct of the study. Further, the data can be collected either by an external observer, as has been done in the classical way, but also by the subjects themselves, or by computerized systems. Due to the many different options for conducting the TMS, Zheng with colleagues (2011) developed a Suggested Time and Motion Procedures (STAMP) checklist, which  outlines a minimum set of data that TMS researchers should collect and provide. It's main purpose is to improve and maintain the quality of the methodology and reporting of TMS, therefore gaining better knowledge from across-study synthesis and improving the quality and provision of healthcare.

A structured multi-site pilot TMS was carried out through direct observations of 63 face-to-face visits at seven family physicians across seven practice sites from November to December 2019 to investigate the applicability and suitability of the method for use in Estonian primary healthcare field. The preparatory activities for TMS conduction took approximately 23 hours for the observer and included the preparation of documents, background research for compiling the activity list, selection of a suitable TMS software, software setup, recruitment of study participants, pilot pre-testing, and communicating with study participants. The time expenditure on these processes depend on different factors, including the scale of the study, the number of investigators, the way the sample is recruited, and how the appropriate software and activity list are selected and implemented. If the TMS is to be used more widely in Estonian (primary) healthcare, conducting a basic research to offer the best possible software options, analysis methods and activity list would be a reasonable next step. This would speed up the study preparation period and make the studies more standardized, comparable and thus on higher quality.

The data collection tool WorkStudy+ 6 Time Study Software application (Quetech Ltd., Canada) was sufficiently functional and easy to operate with, and in general was suitable for this pilot. It was chosen mainly because of two reasons – first, it has previously been used in similar studies in the healthcare field and second, the basic version of the application was available for free. In retrospect, alternative software options could also be considered for future TMS studies, as WorkStudy+ 6 has a number of features that may affect the quality of the survey. These features include, for example, the inability to measure multiple activities simultaneously (multitasking), software storage limitations, and the lack of automatic data transfer and initial analysis. For future research with funding, one alternative option could be the use of the Work Observation Method by Activity Timing (WOMBAT) tool as it is also used in similar studies and is more advanced when compared to WorkStudy+ 6 software, providing an initial automatic analysis and capturing activities in a multidimensional way, including what task, with whom, and with what is done (Sinsky et al., 2016, Westbrook and Ampt, 2009).

The activity list for the study was chosen and determined on the basis of previous similar studies, and was refined through literature review, consultation with a family physician and a pre-testing of the observation in August 2019. The final activity list consisted of 15 mutually exclusive activities which were divided into two main categories according to the study's field of interest – computer-based activities and non-computer-based activities. Overall, as the study carried out was a test pilot, the chosen list was relevant and covered all the most important activities that occurred during the physician-visits. The "other (c)" and "other (non-c)" elements were chosen to include all activities that were not covered by other tasks on the list. For future research with similar purposes, some activities could be singled out from the "other (c)" and "other (non-c)", e.g. reading and/or writing emails, googling, using communication channels (Skype, Facebook), issuing assertions and certificates, phone calls and physician leaving the appointment room, as these were the most common tasks that occurred under those two elements. The development of an appropriate list of activities, however, depends first and foremost on the purpose and scope of the study (Zheng et al., 2011). For example, when studying family physicians' time utilization on visits with diabetic patients, it is crucial to add specific activities like feet assessment and blood sugar measurement to the activity list, which in other cases are relatively insignificant activities that do not need to be singled out. Or, when measuring the impact of a new implemented e-solution on physician's work efficiency, the focus should be primarily on the activities affected by this solution. Nevertheless, regardless of the aims of the work, the key activities should always be represented. The list proposed in this study has been developed based on previous TMSs and adapted according to our conditions, therefore it should be an appropriate indicative list of key activities, which can be used with or without minor adjustments.

The results of the conducted TMS with 63 direct observations on physician-patient visits showed that the visit duration as well as the time distribution between different activities across the visits varied greatly. This diversity has been associated with different factors, such as the patient's health concern, the number of health concerns the patient comes to the appointment and how many of them are addressed by the physician, number of medications prescribed to the patient, and whether it's the patient's first appointment with a physician (Young et al., 2018). Patients were not differentiated in this study for two reasons: first, the sample size was too small and therefore unlikely to lead to reliable patterns and secondly, the investigator confirmed in the confidentiality agreement that no patient data will be recorded.

The mean duration of the visit was 14.48 minutes, out of which, a mean of 37% was spent on computer-based activities and 63% on non-computer tasks. The most time consuming activities were counseling/teaching (25%), taking anamnesis (22%), documentation (17%) and searching patient history from the EHR/EMR (10%). Sinsky et al. (2016) who also used TMS together with the self-reported diaries to observe 57 U.S. physicians reached the same result of 37% of computer time during the patient visits. The study also found that physicians spent slightly more than 49% of their working day on a computer, out of which 39% was spent on documentation and review tasks. These results correlate well with the results of this study – together with the results from the self-reported diaries, family physicians spent approximately half of their working day (50%, 3.97 hours) on a computer. The most time-consuming computer-based activities were also documentation and searching patient information, taking almost one third (31%) of the total physician’s working time. Arndt et al. (2017) and Young et al. (2018) who both used physician’s clinical software’s event log data analysis also found the similar results of physicians spending approximately half of their workday on the computer (45% and 52%, respectively).

The fact that similar results have been obtained while using different methods indicate that TMS can be a plausible method for studying physicians’ time utilization. Moreover, when comparing the results from the observations and the interviews, physicians seemed to underestimate the time they spend on the computer. Five out of seven physicians estimated their computer time during the usual working day to be less than it was confirmed by the study data – the average difference between the physician's estimation and the data obtained from the study was more than 22% (4.3 vs 3.1 hours), which means that physicians spent more than an hour more on the computer per day than they thought. Although this finding is not trustworthy enough because of the small sample size, it is still important as it shows that physicians' perception of time expenditure might not always be valid and therefore, other more reliable methodological approaches like TMS could be used to get more valid results instead of data from questionnaires and interviews, which has been the main data source so far.

As stated above, documentation and searching patient information from the EMR/EHR were far the most time consuming computer-based activities during the visits, accounting for 27% of the total visit time and as much as 73% of the overall computer-based activity time. These two tasks were also the most frequently reported in physician’s self-reported diaries, accounting for 61% of all registered activities (96 out of 158). Other reported activities were (in descending order): reading/writing emails, communication, issuing digital referrals, prescriptions, certificates and assertions, ordering tests and billing. The self-reported diaries, which physicians completed throughout the working day, revealed that there is a large difference between the times spent on the computer, ranging from 2.0 to 4.4 hours per physician, or proportionately 43% to 81% of the total working time.

The fact that the majority of physician’s time was spent on just a few activities should make us wonder whether there may be any inefficiencies or are these time-consuming activities not sufficiently supported. Interviews revealed that although all of the family physicians see the positive merits of the EMR and other e-solutions they are using, more than 71% of them thought that documentation, data entry and other bureaucratic activities take up too much of their working time, both during the visits and overall. This was also revealed by the observations and at this point, the findings of the TMS largely coincided with the physicians’ opinions. Physicians stated that documentation is too time consuming mostly because the EMR does not fully support fast and efficient performance of their work processes. The only facilitating function brought out was a feature called “typical”, which allows the physician to save prepared and unfilled text into the EMR that can then be copy-pasted to a patient's medical record. Although it saves the physician's documentation time and improves the quality of treatment as all the needed information is pre-written in the text, the documentation process is still not fast and convenient enough. While six out of seven physicians stated that they feel they have enough or rather enough direct contact with the patient on face-to-face visits, more than half of them (n=4) admitted that using a computer during the visit influences their communication with the patient, doing it in a rather negative sense. Moreover, burdensome activities affect the well-being of physicians – three physicians out of seven admitted being overburdened and four admitted that work affects their mental and physical health causing anxiety, depression, burnout, and physical inactivity due to fatigue and lack of time.

In order to reduce and prevent the stress, overload and time waste, physicians’ workflow needs to be transformed so that the e-solutions used support physician’s work as much as possible. Shanafelt et al (2016) studied the relationship between electronic environment and physician burnout and found that physicians are mostly dissatisfied with their clinical software that they use in their everyday work. Physicians consider the burden involved using these tools too high and only half of the physicians thought that using clinical software improves patient care. This is an important signal that shows the mismatch between physicians’ needs and the development of e-services. The same problem arose in the current study where, although the overall attitude towards the EMR was rather positive, family physicians claimed that their clinical software does not fully support their work – unstructured data, lack of necessary notifications, and non-user friendly UI are some examples that were brought out. Five interviewees used the Perearst2 program and two used Watson, where the attitudes towards Perearst2 were clearly more pessimistic. Criticism of the software may stem from physicians' technological awareness as evidenced by the study conducted by Vanker in 2014, where physicians who had received more IT training were more critical towards the EMR. In addition to the criticism, physicians made a number of suggestions for the development of EMRs, which largely coincided with the recommendations set out in the study by Vanker (2014).

To conclude, the quantitative time and motion study and analysis of 63 face-to-face visits is the first TMS pilot study conducted in Estonian primary care settings with the aim of evaluating the feasibility and reliability of the method in such studies. The pilot showed the feasibility of the study as TMS is relatively easy to carry out and, thanks to various available possibilities like different data collection softwares and analysis methods, it is also flexible and thus adaptable to different study settings. TMS is reliable in evaluating Estonan family physicians' work processes and time utilization as the results obtained coincide with the results obtained in other similar studies.

Finally, few important aspects are provided which should be taken into account when conducting a future TMS study:

- Activity list. An appropriate list of activities should be compiled based on the study settings and main objectives, in addition to which the use of a list of key/standard activities is recommended. Activities should be mutually exclusive and clearly defined.
- Data collection tool. The TMS software application should have advanced functionality (multitasking, automatic data transmission and initial analysis) and high level of user-friendliness. This ensures the convenience of data collection and high quality of the collected data and results. In the absence of multitasking function, the primary activities and the principles of deciding the primary activities must be clearly defined.
- Pre-testing. The pre-testing should be carried out to refine and improve the activity list, confirm the compliance of the selected data collection tool with the study settings, and to test the feasibility of the study using selected methodology.

- Appropriate data analysis methods should be used in order to obtain reliable and comparable results.
- STAMP checklist should be followed to simplify the conduct of the TMS and to ensure the reliability and comparability of the study performed.
- The Hawthorne effect can be minimized by placing the observer in the observation room so that he or she is out of sight of the physician and patient, and by moving and talking as little as possible during the observations. Another option is to use video recording of the visits instead of the presence of an observer. This, however, would require greater attention to the compliance with data protection law and ethics regulations.

The study had several limitations. The fact that study participants were recruited through the mailing list of the Family Physicians Association of Estonia on a voluntary basis may mean that only highly motivated physicians participated in the study and as they are usually more aware and active in Estonian primary healthcare field, the results may not represent the Estonian average. In addition, although the study participants were from both rural and urban areas, none of the family physicians from the southern part of Estonia participated. In future studies, data should be obtained from physicians with different characteristics, locations, and work organizations to get the 'average' and reliable results. The 63 observations as a sample size was too small to obtain reliable study results, but was sufficient to test the suitability of the TMS method.

The data collection tool did not have a multitasking function, and thus the observer had to choose a primary task if several activities occurred simultaneously. This increases the risk of observer bias, which in turn affects the accuracy of the results. More, the self-reported diary entries written by the physicians included several activities for one time period, due to which the time spent on specific activities could not be calculated. This problem was due to the fact that the observer had not given enough thought to this aspect and therefore insufficient instructions were given to the doctors.

Future studies should study physician’s time allocation under some specific criteria, either for different patient groups (e.g age, diagnosis, type of diagnosis – primary or recurring, etc), or physician groups (e.g age, work experience, type of practice, location, software used etc). Also, the future assessments of the impact on the effectiveness and efficiency of newly implemented e-solutions and services should be compiled using TMS as it has proven to be highly relevant for comparative studies (Carayon et al., 2015, Pizziferri et al., 2005, Young et al., 2018). For example, solutions like the clinical decision support system that was made available for Estonian family physicians in May 2020 would be ideal for the TMS to gather quantitative data about what effect and to what extent the solution has on family physician’s work efficiency. Studying the impact is important as, besides the functionality, every solution that is in everyday use subjectively and objectively affects the end user’s work performance and well-being. This is supported by the findings of previous studies that physicians' satisfaction with implemented e-solutions is generally low and is directly associated with physicians’ burnout (Robertson et al, 2017; Shanafelt et al, 2016). Therefore, by studying the effect of the solution in the initial phase of the implementation, or better yet, during the pilot study, it is easier and cheaper to eliminate shortcomings, improve the solution and increase the usability and satisfaction among the end-users.

# 5. Conclusion

The conducted quantitative time and motion pilot study confirmed that the TMS method is a feasible and suitable method for studying the time utilization of Estonian family physicians. The TMS provides quantitative information about the time expenditure and time distribution between different activities, as well as it enables to find patterns and relationships between different factors influencing the physicians' time use. The pilot showed that the TMS is relatively easy to carry out and, thanks to various available possibilities like different data collection softwares and analysis methods, it is also flexible, thus adaptable to different study settings. TMS is reliable in evaluating Estonan family physicians' work processes and time utilization as the results obtained coincide with the results obtained in other similar studies.

The knowledge and recommendations provided in this study could be the basis for future TMS research in Estonian healthcare field, both for general baseline research, as was this pilot, to get a reliable overview of the time use of family physicians, as well as for the assessments of the impact on the effectiveness and efficiency of newly implemented e-solutions and services. Gaining knowledge through such research helps to reduce the burden on physicians by finding and addressing work inefficiencies, and by providing appropriate solutions that support physicians' work. This in turn improves the quality of health care delivery and enhances the Estonian health care system as a whole.

# References


Adair JG. **The Hawthorne Effect: A reconsideration of the methodological artifact.** Journal of Applied Psychology 1984; 69(2): 334–345. doi:10.1037/0021-9010.69.2.334

Arndt BG, Beasley JW, Watkinson MD, Temte JL, Tuan W-J et al. **Tethered to the EHR: primary care physician workload assessment using EHR event log data and time-motion observations**. Annals of Family Medicine 2017; 15(5):419–426.

Boell SK and Cecez-Kecmanovic D. **What is an Information System?** 2015. In 48th Hawaii International Conference on System Sciences (HICSS), ieeexplore.ieee.org, pp. 4959–4968.

Campanella P, Lovato E, Marone C, Fallacara L, Mancuso A et al. **The impact of electronic health records on healthcare quality: A systematic review and meta-analysis.** European Journal of Public Health 2016, 26(1): 6064.

Carayon P, Wetterneck TB, Alyousef B, Brown RL, Cartmill RS, McGuire K, et al. **Impact of electronic health record technology on the work and workflow of physicians in the intensive care unit.** International Journal of Medical Informatics 2015; 84(8): 578–94. doi: 10.1016/j.ijmedinf.2015.04.002.

e-Estonia. **E-health records.** n.d. Used 15.11.2019 from https://e-estonia.com/solutions/healthcare/e-health-record/

Estonian Health insurance Fund (EHIF). **2018. aasta majandusaasta aruanne.** 2018a. Used 10.11.2019 from https://www.haigekassa.ee/sites/default/files/uuringud_aruanded/2018_majandusaasta_aruanne.pdf

Estonian Health Insurance Fund (EHIF). **Eesti Haigekassa aastaraamat 2017.** 2017. Used 09.11.2019 from https://www.haigekassa.ee/

Estonian Health Insurance Fund (EHIF). **E-konsultatsioon tervise infosüsteemi vahendusel.** n.d./a. Used 15.11.2019 from https://www.haigekassa.ee/partnerile/raviasutusele/perearstile/e-konsultatsioon

Estonian Health Insurance Fund (EHIF). **Haigekassa tegi arstidele kättesaadavaks ravimite koostoimete hindamise andmebaasi.** 2016. Used 17.11.2019 from https://www.haigekassa.ee/uudised/haigekassa-tegi-arstidele-kattesaadavaks-ravimite-koostoimete-hindamise-andmebaasi

Estonian Health Insurance Fund (EHIF). **Practical Information for Foreigners on Estonia's Healthcare Services.** 2019b. Used 16.11.2019 from https://www.haigekassa.ee/sites/default/files/2019-07/tervishoid_infomaterjal_eng_web.pdf

Estonian Health Insurance Fund (EHIF). **The introduction of the Drug Interaction Database has received international recognition.** 2018b. Used 17.11.2019 from https://www.haigekassa.ee/en/uudised/introduction-drug-interaction-database-has-received-international-recognition

Estonian Health Insurance Fund (EHIF). **Töövõimetushüvitised.** n.d./b. Used 11.05.2020 from https://www.haigekassa.ee/inimesele/haigekassa-huvitised/toovoimetushuvitised

Gilbreth FB. **Scientific management in the hospital.** Modern Hospital, 1914, 3, 321–24.

Google Maps. n.d. Google. Accessed 28.12.2019 from maps.google.com.

Health and Welfare Information Systems Center (TEHIK). **Tarkvara meditsiiniasutustele.** n.d./b. Used 15.11.2019 from https://www.tehik.ee/tervis/liidestumine-tervise-infosuesteemiga/tarkvara-andmevahetuseks-tervise-infosuesteemiga/

Health and Welfare Information Systems Center (TEHIK). **Tervise Infosüsteemi võimalused.** n.d./a. Used 15.11.2019 from https://www.tehik.ee/tervis/tervise-infosusteemi-voimalused/

Information System Authority of Republic of Estonia (RIA). **Data Exchange Layer X-tee.** 2019 (last modified). Used 15.11.2019 from https://www.ria.ee/en/state-information-system/x-tee.html

Krenn L, Schlossman D. **Have Electronic Health Records Improved the Quality of Patient Care?** PM&R 2017; 9(5): S41–S50.

Kroth PJ, Morioka-Douglas N, Veres S, Pollock K, Babbott S, et al. **The electronic elephant in the room: Physicians and the electronic health record.** Journal of the American Medical Infomatics Association 2018, 1(1), 49–56. https://doi.org/10.1093/jamiaopen/ooy016

Lehtla E. **Eesti Perearstide Selts saab 435 000 eurot peremeditsiini tarkvaravajaduste analüüsiks.** Estonian Ministry of Social Affairs, 2019. Used 14.10.2019 from https://www.sm.ee/et/uudised/eesti-perearstide-selts-saab-435-000-eurot-peremeditsiini-tarkvaravajaduste-analuusiks?fbclid=IwAR3KJH3prYuOWPi3JwIoz_IhmBx5c3tdGf_YmfgqN42g-M9JySay4LzkX6o

Long JT, Neogi S, Vidonish W, Badylak J, Reder RD. **Therapy Workloads in Pediatric Health: Preliminary Findings and Relevance for Defining Practice.** Pediatric Physical Therapy 2020; 32(1), 52–59. doi:10.1097/pep.0000000000000665

Lopetegui M, Yen PY, Lai A, Jeffries J, Embi P, Payne P. **Time motion studies in healthcare: what are we talking about?** Journal of Biomedical Informatics 2014; 49: 292–299.

Mamykina L, Vawdrey DK, Hripcsak G. **How Do Residents Spend Their Shift Time? A Time and Motion Study With a Particular Focus on the Use of Computers.** Academic Medicine 2016; 91(6):827-32.

Metsla K. **Estonian family physicians usage and satisfaction with drug-drug interaction alert system.** 2018. Master’s Thesis, Tallinn University of Technology.

National Audit Office of Estonia (NAO). **#e-riik: Riigikontrolöri kokkuvõte e-riigiga seotud tähelepanekutest.** 2019. Used 02.04.2020 from https://www.riigikontroll.ee/LinkClick.aspx?fileticket=iN6L1b9sFoM%3D&language=et-EE&forcedownload=true

National Audit Office of Estonia (NAO). **Perearstiabi korraldus: Kas süsteem täidab sellele pandud ülesandeid?** 2011. Used 12.07.2019 from http://rahvatervis.ut.ee/bitstream/1/4741/1/Riigikontroll2011_2.pdf

OECD. **Improving Health Sector Efficiency – The Role of Information and Communication Technologies.** 2010. Used 17.11.2019 from https://ec.europa.eu/health//sites/health/files/eu_world/docs/oecd_ict_en.pdf

Pizziferri L, Kittler AF, Volk LA, Honour MM, Gupta S, Wang S, et al. **Primary care physician time utilization before and after implementation of an electronic health record: a time-motion study.** Journal of Biomedical Informatics 2005; 38: 17688.

Robertson SL, Robinson MD, Reid A. **Electronic Health Record Effects on Work-Life Balance and Burnout Within the I(3) Population Collaborative.** Journal of Graduate Medical Education 2017; 9(4):479–84.

SCOOP4C. **Estonian Medical Digital Image Bank.** n.d. Used 16.11.2019 from https://scoop4c.eu/cases/estonian-medical-digital-image-bank

Shanafelt TD, Dyrbye LN, Sinsky C, Hasan O, Satele D et al. **Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction.** Mayo Clinic Proceedings 2016; 91(7): 836-848.

Sinsky C, Colligan L, Li L, Prgomet M, Reynolds S et al. **Allocation of Physician Time in Ambulatory Practice: A Time and Motion Study in 4 Specialties**. Annals of Internal Medicine 2016; 165:753-60. doi:10.7326/M16-0961

Zheng K, Guo M, Hanauer D. **Using the time and motion method to study clinical work processes and workflow: methodological inconsistencies and a call for standardized research.** Journal of American Medical Informatics Association 2011; 18: 704–10.

Taylor FW. **The Principles of Scientific Management.** New York and London: Harper & Brothers Publishers 1911. Used 23.03.2020 from https://archive.org/details/principlesofscie00taylrich/mode/2up

**Tervise infosüsteemi põhimäärus.** RT I, 06.12.2016. Used 22.03.2020 from https://www.riigiteataja.ee/akt/106122016011?leiaKehtiv

**Tervishoiuteenuste korraldamise seaduse, majandustegevuse seadustiku üldosa seaduse ja surma põhjuse tuvastamise seaduse muutmise seadus.** RT I, 06.06.2012. Used 08.11.2019 from https://www.riigiteataja.ee/akt/129062012004

Vanker E. **Evaluation of estonian primary healthcare electronic health records usability.** 2014. Master’s Thesis, Tallinn University of Technology.

Westbrook J, Ampt A. **Design, application and testing of the Work Observation Method by Activity Timing (WOMBAT) to measure clinicians' patterns of work and communication.** International Journal of Medical Informatics 2009; 78S: S25-S33.

Wetzel E, Böhnke JR, Brown A. **Response biases.** 2016. In: Leong, Frederick T.L. and Iliescu, Dragos, eds. The ITC International Handbook of Testing and Assessment. Oxford University Press, New York, pp. 349-363. Used 22.04.2020 from https://kar.kent.ac.uk/49093/1/Response_biases_Final_accepted_version.pdf

World Health Organization (WHO). **Health Metrics Network Framework and Standards for Country Health Information Systems. - 2nd ed.** WHO: Geneva, Switzerland 2008.

Young R, Burge S, Kumar K, Wilson JM, Ortiz DF. **A time-motion study of primary care physicians work in the electronic health record era.** Journal of Family Medicine 2018; 50 (2): 91–99.

# Appendix 1 – Confidentiality agreement

**KONFIDENTSIAALSUSLEPING nr _____**

Leping on sõlmitud ___ . __________ 2019.a.

Osapooled ___________________ (perearst) ja **Anni Männil** (uuringu läbiviija)**,** edaspidi ka: lepingupool või koos: lepingupooled, sõlmisid konfidentsiaalsuslepingu (edaspidi: leping) alljärgnevas:

**1. Lepingu eesmärk ja objekt**

1.1. Lepingu eesmärgiks on sätestada uuringu läbiviijale perearstikekuses (edaspidi PAK) õppeotstarbelise uurimistöö tegemise ajal teatavaks saanud andmete igakülgne kaitse mittesihipärase kasutamise ning kolmandate isikute valdusesse sattumise eest.

1.2. Lepingu objektiks on uuringu läbiviija kohustus tagada PAK-is viibimisega seoses temale teatavaks saanud andmete konfidentsiaalsus, vältides kolmandate isikute juurdepääsu andmetele. Andmete all mõistetakse delikaatseid isikuandmeid ja muid PAK-i tööd puudutavaid andmeid, nt andmeid, mis on seotud PAK-i patsientide või infosüsteemidega jmt ja mida ei ole antud üldiseks kasutamiseks.

1.3. Uuringu läbiviija viibimise aluseks PAK-is on TalTech Tervishoiutehnoloogia eriala magistritöö jaoks andmete kogumine perearsti tööprotsesside kohta.

**2. Lepingu kehtivus**

Leping jõustub sõlmimisel ja kehtib 5 (viis) aastat sõlmimisest.

**3. Uurija kohustused**

3.1. Hoida temale PAK-is viibimisega seoses teatavaks saanud andmed saladuses ning mitte edastada andmeid kolmandatele isikutele ja mitte võimaldada kolmandatele isikutele juurdepääsu andmetele;

3.2. Kahtluse korral, enne igasugustele PAK-i puudutavatele andmetele juurdepääsu võimaldamist kolmandatele isikutele, täpsustada PAK-i kaudu kas tegemist on konfidentsiaalse infoga.

**4. Muud tingimused**

4.1. Lepingupool, kes rikub seadusest või lepingust tulenevaid andmete töötlemise (andmete kasutamise jmt) nõudeid, vastutab rikkumise eest õigusaktidega sätestatud korras ning on kohustatud hüvitama teisele poolele rikkumisega tekitatud igasuguse kahju.

4.2. Uuringu läbiviija Anni Männil kontaktandmete – e-post: _______@gmail.com ja tel _________ – kaudu saab uuringu läbiviijaga kontakti lepingu või uuringuga seotud küsimustes.

4.3. Perearst __________________ kontaktandmed on: telefon: _________, e-post: ____________________.

Leping on koostatud kahes identses eestikeelses eksemplaris, millest kumbki lepingupool saab ühe eksemplari.

________________ ________________

perearst (allkiri) uuringu läbviija (allkiri)

# Appendix 2 – Patient information sheet

**PATSIENDI TEAVITUSLEHT**

4.4. Uuringu läbiviija viibimise aluseks perearst-patsient visiidil on TalTech Tervishoiutehnoloogia eriala magistritöö jaoks **andmete kogumine perearsti tööprotsesside kohta** perearst-patsiendi visiidil.

4.5. Visiidi käigus registreerib uuringu läbiviija spetsiaalse mobiilirakendusega perearsti tööprotsesse (näiteks arvutis dokumenteerimine, saatekirja koostamine, anamneesi küsimine jm). **Registreeritavad ja mõõdetavad andmed ei sisalda mingil määral patsiendi ega perearsti isikuandmeid.**

4.6. Andmete kaitseks on perearst ja uuringu läbiviija allkirjastanud konfidentsiaalsuslepingu.

4.7. Konfidentsiaalsuslepingu kohaselt tagab uuringu läbiviija visiidil andmete kogumise ajal teatavaks saanud andmete igakülgse kaitse, kaitstes neid mittesihipärase kasutamise ning kolmandate isikute valdusesse sattumise eest. Andmete all mõistetakse delikaatseid isikuandmeid ja muid perearstikeskuse tööd puudutavaid andmeid.

4.8. Patsiendil on õigus keelduda tema visiidi ajal uuringu teostamisest. Keeldumiseks pöörduda perearsti või uuringu läbiviija poole.

# Appendix 3 - Interview guide

1. **Baasandmed**
   1.1. Sugu ja vanus
   1.2. Töökogemus perearstina (aastates)
   1.3. Töökoormus (0.5, 1.0, ..)
   1.4. Üksikpraksis, grupipraksis või tervisekeskus? Mitu perearsti ja pereõde on praksises?

2. **Töökoormus**
   2.1. Kuidas hindate oma praegust töökoormust? (väike, norm, koormav)
   2.2. Nimetage (mittevajalikud) tegevused, mis Teie arvates takistavad Teil igapäevaseid vajalikke tööülesandeid täita.
   2.3. Mis on Teie arvates hetkel perearstina töötamisel kõige olulisemad probleemid?
   2.4. Kas tunnete, et teie töö perearstina on mõjutanud teie tervist ja vaimset heaolu?

3. **Visiidid**
   3.1. Kuidas hindate visiidile kehtestatud aega - kas Teie arvates on aeg liiga lühike, et teha patsiendiga kõik vajalikud toimingud?
   3.2. Nimetage tegevused ja toimingud, mis Teie arvates võtavad visiidil liiga kaua aega.
   3.3. Kas arvate, et Teil on visiidi ajal patsiendiga piisavalt otsest kontakti?
   3.4. Kas tunnete, et arvuti kasutamine visiidi ajal mõjutab Teie suhtlust patsiendiga? Kuidas?
   3.5. Kas pakute patsientidele suhtusvõimalusi ka töövälisel ajal?
   3.6. Kui vastasite "Jah", siis läbi mis kanalite?
   3.7. Kas enamasti dokumenteerite visiidil toimunut visiidi ajal või pärast seda?
   3.8. Kui kaua kulub Teil päevas keskmiselt bürokraatiale / dokumenteerimisele?
   3.9. Kas tunnete, et perearsti töös on liiga suur osakaal andmete sisestamisel / dokumenteerimisel ja bürokraatial?
   3.10. Kas arvate, et arsti töölaual olevad e-lahendused (e-konsultatsioon, digiretsept jm) on teie töös pigem positiivse või negatiivse mõjuga - kas pigem kiirendavad ja lihtsustavad protsesse või vastupidi?
   3.11. Millist perearsti tarkvara Te kasutate?
   3.12. Kas ja kui rahul olete praegu kasutatava tarkvaraga?
   3.13. Millised on Teie poolt kasutusel oleva tarkvara plussid/tugevad küljed?
   3.14. Millised on Teie arvates tarkvara suurimad puudused ja/või probleemid?
   3.15. Milliseid andmeid peaks tarkvara kuvama praegusest erinevalt/lisaks, et visiidi läbiviimine oleks tõhusam?