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Digital health literacy among Estonian adult citizens: a mixed methods study

Master's thesis

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Digitaalne terviseteadlikkus Eesti täiskasvanud elanike seas: segameetodiline uuring

Magistritöö

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Author’s declaration of originality

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

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Abstract

Today it is essential to know how digitally health literate patients are. In Estonia, however, the digital health literacy of patients has not been studied much, and the last study was nine years ago. This master's thesis aims to study the digital health literacy of Estonian adult citizens, how often health information is sought, on which topics information is mainly sought, which sources are used for this, and which technological aids are used to monitor one's health. The aim is also to investigate whether patients are ready to be more digitally health literate and how the digital health literacy of patients could be increased by public sector organizations, healthcare workers and patients themselves.

First, the author familiarized herself with the literature on this topic. To find answers to the research questions, the author surveyed Estonian adults to find out what and how often they use and whether the digital information found has also helped them to solve health problems. After conducting the survey, the author interviewed doctors and healthcare support specialist to get their input on which sources patients bring up the most in their work and to which reliable sources health professionals themselves mainly refer patients.

As a result of the master's thesis, it becomes clear what health-related information citizens mainly seek and which sources they use for this. It also becomes clear what thematic mobile applications people are using and how active people are in collecting health data using smart watches. The results of this work could be helpful for healthcare workers and support specialists working in healthcare, healthcare providers, and patients. The Ministry of Social Affairs, the Health Board, the Health Insurance Fund and the National Institute for Health Development could also be interested in the results of this work.

This thesis is written in English and is 79 pages long, including 7 chapters, 9 figures and 8 tables.

Annotatsioon

Digitaalne terviseteadlikkus Eesti täiskasvanud elanike seas: segameetodiline uuring

Tänapäeval on väga oluline, et oleks teada, kui digitaalselt terviseteadlikud elanikud on. Eestis ei ole kodanike digitaalset terviseteadlikkust palju uuritud ning viimane uurimus jääb üheksa aasta tagusesse aega. Antud magistritöö eesmärgiks on uurida Eesti kodanike digitaalset terviseteadlikkust, kui tihti otsitakse tervisealast infot, millistel teemadel peamiselt infot otsitakse, milliseid allikaid selleks kasutatakse ning milliseid tehnoloogilisi abivahendeid kasutatakse oma tervise jälgimiseks. Samuti on eesmärgiks uurida, kas patsiendid on valmis olema rohkem digitaalset terviseteadlikumad ning kuidas võiks patsientide digitaalset terviseteadlikkust tõsta nii avaliku sektori organisatsioonide, tervishoiutöötajate kui ka patsientide enda poolt.

Kõigepealt tutvus autor antud teemal kirjandusega. Uurimisküsimustele vastuste leidmiseks viis autor läbi küsitluse Eesti täiskasvanud elanike seas, et uurida, mida ja kui tihti nad kasutavad, ning kas leitud digitaalne info on neid aidanud terviseprobleemide lahendamisel. Pärast küsimustiku läbi viimist viis autor läbi intervjuud arstide ja tervishoius töötava tugispetsialistiga, et saada nende sisendit selle kohta, milliseid allikaid patsiendid nende töös enim välja toovad ja millistele usaldusväärsetele allikatele tervishoiutöötajad ise patsiente peamiselt suunavad.

Magistritöö tulemusena selgub, millist laadi tervisealast infot kodanikud peamiselt otsivad ning milliseid allikaid nad selleks kasutavad. Samuti saab selgeks, mis teemalisi mobiilirakendusi kasutatakse ning kui aktiivsed ollakse nutikellade abil terviseandmete kogumisel. Antud töö tulemused võiksid olla kasulikud nii tervishoiutöötajatele ja tervishoius töötavatele tugispetsialistidele, tervishoiuteenuse osutajatele kui ka patsientidele endale. Samuti võiksid antud töö tulemustest olla huvitatud ka Sotsiaalministeerium, Tervisekassa, Terviseamet ja Tervise Arengu Instituut.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 79 leheküljel, 7 peatükki, 9 joonist, 8 tabelit.

List of abbreviations and terms

DHLI	Digital Health Literacy Instrument
GP	General practitioner
HIS	Health information system
ICT	Information communication technology

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1 Introduction

With the development of Internet technologies, digital health literacy is becoming one of the main factors influencing a healthy lifestyle and health-related decision-making [1]. Digital health literacy is an important topic that has not studied in Estonia recently. The last available survey is from year 2014 when Eurobarometer 2014 European citizens' digital health survey was conducted. According to this survey 56% of people used the Internet to search for health-related information online [2].

The purpose of the research is to find out more about the digital health literacy of Estonian adults, which sources are used to search for digital health information, how often information is searched for, what problems citizens experience when searching for digital information, how satisfied citizens are with the information found, etc. In addition, find out which factors affect the digital health literacy of Estonian adults. The last goal is to find out how the digital health literacy of Estonian citizens could be improved.

For this research author selected the convergent parallel mixed methods design. In convergent parallel mixed methods design author collected quantitative and qualitative data and analysed them separately. Quantitative data were collected by using survey. The author put together a questionnaire to gather data. Qualitative data were mainly collected during semi-structured interviews with healthcare workers and a specialist working in healthcare. Qualitative data were analysed using thematic analysis. Firstly, the author presented the quantitative statistical results, then author discussed the qualitative findings that either disconfirmed or confirmed the quantitative analysis.

Main chapters of the thesis are following Research Methods, Overview, Data Collection and Analysis, Findings and Discussion.

1.1 Problem statement

The topic of digital health literacy in Estonia needs research because it has not been assessed lately. The last data are available from the year 2014. These data are taken from Eurobarometer survey, which is a collection of cross-country public opinion surveys conducted regularly on behalf of the European Union Institutions. According to Eurobarometer 2014 European citizens' digital health literacy survey, 56% of people in Estonia used Internet to search for health-related information within the last 12 months [2]. Current Statistics Estonia data show that in 2022 91.5% of citizens aged 16 -74 use Internet. According to Statistics Estonia the percentage of 16- to 74-year-old Internet users who searched for health-related information in year 2022 is 65.0%. 45.2% of 16- to 74-year-old Internet users used webpages to book a doctor's appointment. 58.7% of Internet users used public sector webpages to look for information [3].

Statistics show that over 91% of people use Internet in Estonia, but the percentage of people who use the Internet to search for health-related data or to book a doctor's appointment is much lower. This research aims to determine factors influencing how much people search for health-related info online. Also, what sources do people who search Internet for health-related information in Estonia use. This thesis proposes suggestions for what doctors and ministries need to do to improve the situation and encourage citizens to use National Patient Portal and other digital solutions more to improve their health.

The primary outcome of this research will be recommendations for citizens, the Ministry of Social Affairs and doctors on improving digital health literacy in Estonia and encouraging people to use digital health solutions more.

A possible outcome of this research could be suggestions and material for information leaflet for patients on where to find their personal health data on the Internet and how to access it. If this information leaflet is created based on this research, then it could be shared out by general practitioners or other specialist doctors.

Suppose the survey reveals that people do not use the National Patient Portal due to its complexity or inaccessibility. In this case, the outcomes of the study can be recommendations for making the patient portal more user-friendly.

The outcomes of this study can also be recommendations for large hospitals to make information aimed at their patients more accessible and understandable, for example making information on their websites more understandable.

Adding a digital health literacy module to various patient trainings, which hospitals organize. These trainings could also teach how to find reliable sources on the Internet.

In Estonia, different parties could benefit from this research. For example, Ministry of Social Affairs, The National Institute for Health Development, Estonian Health Board and Estonian Health Insurance Fund. Also, healthcare provides (doctors, nurses, specialists working in healthcare, pharmacists, etc) and patients. The results of this master's thesis can be added to medical doctors' curricula to encourage young doctors to pay attention to their patients' competences in accessing their own digital health data and other necessary health-related information from reliable sources.

1.2 The motivation for research

Idea for this research paper emerged during the e-health event *Tervisekogukonna kärajad* 2022 in Estonia, where the importance of digital health literacy was mentioned. It was stated that this topic had not been researched in Estonia lately.

The author of the thesis is from Estonia and has worked in her career with different e-health services for over seven years. Most of the time author has been working with doctors who submit health data to National Health Information System. The author has not been working with citizens who access their health data so much, so it would be enlightening to learn more about their perspectives, concerns, and goals.

Increasing awareness about digital health literacy is essential because people who are digitally health literate can have a more active role in their health management. This will result in improved prevention, healthier lifestyle behaviours, and overall improved health outcomes. Also, according to the National Health Plan 2020-2030 by the Ministry of Social Affairs (*Sotsiaalministeeriumi Rahvastiku tervise arengukava 2020-2030*) it is important that inequality in health, between genders, regions, and education levels, would decrease in coming years. Digital solutions can reduce socio-economical and geographical inequalities; therefore, it is crucial to focus on digital health [4]. The swift

progress of digital health can decrease the time and cost of medical treatment, bringing cost-effective advantages [5].

Health-supporting choices are those citizens should be able to make independently. These choices are significantly influenced by what products and services are easily available in everyday life, what choices are favoured and enabled by the environment, and what attitudes are common in society. In the information and digital age, the importance of digital media and its influence on people's behaviour and decision-making is becoming increasingly visible. Choices that support health reduce person's risk behaviours and help to shape a healthy lifestyle and healthy habits. The desired result for the future in Estonia is that health-supporting options are readily available for all Estonian citizens. Health-supporting choices should be readily available, regardless of income, education level and region of residence [4].

1.3 Research questions

The main goal of this research paper is to understand what digital sources and applications citizens with ICT skills and regular Internet access use to find information about their health on the Internet. The goal is to analyse the main factors influencing how digitally health literate citizens are and what would encourage them to use the Internet more to access health information.

Another research goal is understanding people's readiness to understand digital health data. Also, to understand how general practitioners and maybe other specialist doctors can contribute so that people will be more interested in health data online and use digital tools to help to improve their quality of life.

Research Question 1. How is patients' digital health literacy in Estonia?

> **Sub Question 1.1.** What kind of information do the adults in Estonia want to access?
>
> **Sub Question 1.2.** How often do individuals interact with digital health information?
>
> **Sub Question 1.3.** What sources do Estonian people visit for health information?

Sub Question 1.4. Which tools are citizens using to manage their health?

Research Question 2. How is patients' digital health literacy in Estonia regarding the National Patient Portal?

Research Question 3. How can digital health literacy be improved in Estonia?

Next, the author described the research tasks.

Research Task 1. Literature review about e-health in Estonia and analysing digital health literacy in Estonia and how it is possible to improve citizens' digital health literacy.

Research Task 2. To evaluate citizens' level of digital health literacy via qualitative and quantitative methods by distributing surveys among the citizens that represent different age groups, education levels, and geography.

Research Task 3. Analyse information from general practitioners, specialist doctor and healthcare support specialist, by conducting interviews with them on patients' digital health literacy.

Research Task 4. Propose recommendations for enhancing digital health literacy in Estonia and increasing citizens' knowledge on digital health literacy.

2 Research methodology

This chapter introduces the research methods that were used in this study to gather and analyse data. Short explanation of why these methods were chosen will also be added.

2.1 Convergent parallel mixed methods design

For this research author selected the convergent parallel mixed methods design. This research method was chosen because mixing qualitative and quantitative data can give stronger understanding of the research problem. In the convergent parallel mixed methods design author collected quantitative and qualitative data and analysed them separately. After that author of the thesis compared the results to get more comprehensive understanding and see if the findings support each other (see Figure 1). Firstly, the author presented the quantitative statistical results, then discussed the qualitative findings that either disconfirmed or confirmed the quantitative analysis [6].

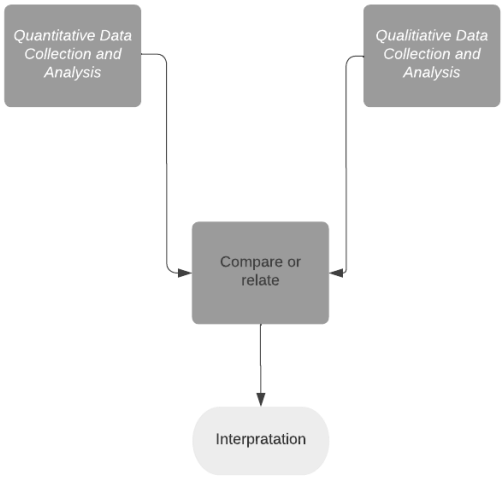

Figure 1. Convergent parallel mixed methods design

2.1.1 Quantitative research

The quantitative research method used in this thesis is a survey. A survey design is used because it provides a numeric description of a population's attitudes, trends, and opinions of a population. To gather data for quantitative research, the author put together a questionnaire. Internet questionnaire was shared out via social media and e-mail lists. Web questionnaire was used because it allowed having a geographically dispersed sample and because web questionnaire allowed respondents to complete it in their free time. The questionnaire was self-completed questionnaire. The author also at first considered using delivery and collection of questionnaires, which general practitioners would have shared on paper, but general practitioners thought that this was not necessary because this would give people who do not have access to the Internet at all a possibility to answer the questions, and this would not give any valuable information for this thesis but is unnecessary noise [7] [8] [6].

The sampling for the survey was convenience sampling. The author collected data from the conveniently available pool of respondents. Convenience sampling was used because it is the most efficient and economical method. The author liked to cover as broad age groups as possible, in the range of 18 to 65+ years old. The aim was also to cover different geographical locations, from the capital Tallinn to rural areas, and also to cover people with different levels of education. All respondents were informed before answering the survey that their answers would be anonymous.

Examples of quantitative data that was asked in the questionnaire was following: age, time spent in the National Patient Portal per visit, etc.

Quantitative data analysis methods such as descriptive statistics and inferential statistics (hypothesis testing) were used to analyse survey results. Descriptive statistics provided simple summaries about the sample and simple-to-understand graphs. Inferential statistics (hypothesis testing) was used to make up hypotheses and try to prove them with data.

Deductive reasoning was used in this thesis, because deductive inferences are the strongest because they guarantee the truth. The author formulated a hypothesis, collected data, analysed data, and then rejected or did not reject the hypothesis.

In this quantitative research, the point is to take the sample author has collected and make inferences about the rest of the population based on that sample [8]. Because of time and money, the author could not study all the population, so the goal was to get at least 80 responses to the author's questionnaire. If the author receives funding in the future, then the author is willing to expand the sample.

2.1.2 Qualitative research

Qualitative research methods such as literature review, interviews, and questionnaire with open-ended questions were used to gather data.

Firstly, a literature review of available literature was presented in the thesis. Secondary data produced by previous researchers was used to answer research questions. Types of secondary data, which were beneficial for this research include following: European Union publications, journals, and government publications. One of the advantages of analysing previously written documents is that it is time convenient for the author. Using the literature allows us to summarize the literature findings, identify central issues, and allows combining what other researchers have done before. Available literature was also used as a basis for hypotheses in this thesis [7], [6].

Secondly, a questionnaire was used to get citizens' answers on their digital health literacy. The questionnaire consisted of open-ended questions also to get some qualitative data. The advantage of using questionnaires is being able to collect data from a large number on respondents and collect questionnaire responses over the Internet. The questionnaire was put together in Estonian [9].

Thirdly, semi-structured interviews with general practitioners, specialist doctor, and healthcare support specialist were conducted to get their perspectives on Estonian citizens' digital health literacy. Interviews were used to get in-depth and qualitative data. Interviews were one to one interviews, and some were e-mail-based-interviews. Interviews were held in Estonian. One to one interviews were audio recorded to fully transcribe these after the interview and re-listen during data analysis. Semi-structured interviews were used because this option allowed the interviewer to vary some questions from interview to interview. Some advantages of interviews as a data collection method are that interviews give the researcher control over the line of questioning, help to gain more in-depth understanding of a topic and that interviewees can provide historical info.

Also, to get healthcare workers' personal opinions. Other advantages of interviews are that these allow the interviewer to clarify responses and to get a shared understanding [7], [6].

Thematic analysis was used to analyse qualitative data from interviews and open-ended survey responses to discover recurring patterns and themes. Qualitative data analysis software was used for thematic analysis. The qualitative data analysis program helped to keep the author's collected data organized and count the frequency of developed codes. Also, it helped to organize the codes into themes, search all text that relates to a code, and locate materials. Qualitative data analysis software also helped search and recapture sentences useful for quotations. Thematic analysis was used because it is easy to learn for a starter who is new to qualitative research, flexible, it can highlight similarities but also differences across database and can be handled by a single individual. The process started with familiarising with data. The author coded the data using qualitative data analysis software. After coding, the author looked for themes, patterns, and relationships. The author refined the themes and relationships between them as a last step. When author presented her findings, a concept map was also used. A concept map is a map of links and connections [10], [11], [12].

3 Overview

This chapter introduces the literature background of digital health literacy and e-health in Estonia. What is digital health literacy, why e-health literacy is important, what are the consequences when citizens have poor digital health literacy, and what can the ministry and doctors do to improve citizens' health literacy. This chapter also introduces e-health in Estonia and the primary sources where Estonian people can get health information digitally.

3.1 Existing body of knowledge

Norman and Skinner (2006) define e-health literacy as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem". E-health literacy combines different literacy skills, which are following: computer literacy, traditional literacy, health literacy, information literacy, scientific literacy, and media literacy. The concept of computer literacy refers to an individual's ability to use computers for problem-solving purposes. Traditional literacy is having the ability to read, understand, speak, and write a language. Health literate are patients who can read, understand, and act on healthcare information. An individual who possesses information literacy knows how to identify relevant resources, can use effective search strategies, and apply filtering to obtain needed information. Scientific literacy involves a systematic comprehension of the characteristics, methods, applications, and limitations associated with creating knowledge. Media literacy is ability to access and analyse media messages [13].

Digital health literacy focuses on empowering citizens and enables them to participate in management of their own health and make health decisions informed by e-health resources [13].

If a country wants to realise the potential of e-health in improving public health, then the gap between what is offered to citizens and what they can access must be recognized and corrected [13].

When talking about patients' access to their health data, for example, through patient portals, then possible benefits of patients having access to their health records are

understanding their care plans better and enhanced opportunities to manage their own health better. Patient empowerment requires access to information and competences and tools to make informed decisions. Such empowerment is essential in a health crisis, and it has become even more apparent during COVID-19 pandemic. The use of patient portals increased rapidly during the pandemic [14].

Some studies show that patients with lower education and lower socio-economic status are less likely to read their health records. However, these are also the patients who could benefit the most from having access to health records. Lower socio-economic status and older age are correlate with lower digital literacy [14], [15].

Citizens with poor digital health literacy are expected to struggle to make the most of digital tools to access relevant info about health-related topics, such as available news and data. Limited digital health literacy prevents people from fully adhering to guidelines communicated by healthcare professionals through digital platforms, to promote individual and public health. People with low digital health literacy are likely to make inconsistent health decisions, which can have negative impact on their health status [16].

The spread of information and communication technology tools in healthcare makes digital health literacy crucial for healthcare organizations and, more broadly, for the effective functioning of healthcare systems [16].

Ensuring trust in the utilization of digital health technologies is crucial for both patients and healthcare workers. It is especially important that any form of exclusion is avoided. This is important considering the growing role that technology will play in healthcare in the future [17].

Some challenges with patients' access to health records are a need for better digital literacy and better usability of patient portals. Education of patients and healthcare professionals is needed. Online access to health records must be designed that way, it is helpful for patients, but also without overburdening healthcare professionals [14].

Searching for digital health information online has also changed medical consultations. Patients turn to doctors' appointment having prepared on the Internet before and they want to discuss and validate this information found with their doctor. Doctors will likely encounter more and more Internet-educated patients in the future [18].

3.1.1 Factors that influence digital health literacy

Many factors influence digital health literacy.

Some of the factors, that can influence person's digital health literacy are demographic factors such as age and gender. Also, socioeconomical status (whether person is employed or unemployed or what is persons' education level) is also affecting e-health literacy [19], [13]. Living in urban or rural area is also a factor, that could influence e-health literacy [20].

Language barrier and lack of language proficiency are also factors that influence e-health literacy [21].

Also, a factor influencing e-health literacy is prior Internet experience and more frequent Internet use [20].

One factor influencing e-health literacy is the technology used [13].

Another influencer, that is affecting individual's digital health literacy is health status at the moment or whether a person is suffering from a chronic disease [19], [13].

Perceived usefulness of Internet health information is also one factor that could influence person's digital health literacy [22].

3.1.2 Raising digital health literacy

Literature offers many recommendations to raise citizens' digital health literacy, and some things have been done in the past in Estonia to raise digital health awareness.

The Regional Digital Health Action Plan for the WHO European Region 2023-2030 identifies four strategic priorities, one of which is to increase the country's capacity to better promote digital health literacy. The first key focus area for this strategic priority is to strengthen the digital literacy skills of population, putting special attention on the health workers. This is especially needed for digital health services [23]. So, it is also important to promote the education of healthcare workers as well. As new technologies develop, training is also needed for healthcare workers. By introducing this topic into the curriculum of healthcare students, healthcare professionals will be better equipped to promote patients' digital health awareness [24], [25].

More than five years ago, a brochure about the National Patient Portal was published in Estonia. The brochure in question is attached in Appendix 2. The brochure explains what the National Patient Portal is, outlines the main features of the National Patient Portal, and describes who can use the National Patient Portal. In addition, they also talk about what a person can do to protect their health data and explain the transparency of the health information system. All the requests made can be seen in the logbook of the National Patient Portal.

Community health workers and health coaches are one way to raise people's digital health literacy [26], [27]. Singapore also uses volunteers to bring digital health literacy to citizens. In Singapore, volunteers show elderly people how to use technologies to manage their health and are encouraging them to practice using digital health tools. For example, elderly people are shown how to use HealthHub [28]. HealthHub provides one-stop access to the citizens of Singapore personal medical records, links to healthcare organizations and services, etc [29].

Using the example of Singapore, one possibility would be to create targeted training programs for specific groups (for example, the elderly, people with low health literacy, etc).

Healthcare organizations could partner with local libraries. In local libraries there are librarians, who are experts in research and who have the knowledge advise citizens on how to find reliable information sources [26], [27].

Healthcare providers could help patients by assisting them with online research, helping patients navigate different websites, and helping them to verify the credibility of online sources [27].

Healthcare professionals who recommend a digital tool (such as a Patient Portal) to a patient must mention how this tool will help improve their health and how to use it. If a healthcare professional recommends them to a patient, they are more likely to adopt it because they trust their healthcare professional [27].

Using simple and comprehensible language when communicating health-related information to patients is considered one of the most important topics for health education practice. In a study conducted at the University of Tartu, it was thought that the possibilities of the National Patient Portal could also be used for consulting patients more widely than now. For example, National Patient Portal could include recommendations

for lifestyle changes and science-based information corresponding to a person's specific health condition. It is also possible to offer the patient decision support, for example, recommendations on what to do in case of a change in condition, for example, where to go, and how to behave if blood sugar rises. This would make possible to share health-related information with people on a more personal level [30].

Search engines are not only sources patients can use to look for health-related information and healthcare providers should remind that to patients [27].

Create e-health learning materials to educate citizens [31]. Global strategy on Digital Health 2020-2025 by World Health Organization also proposes to offer online courses to improve digital health literacy [32].

One option is to offer citizens incentives for learning and completing courses. These incentives could be for example financial compensations for participating in (online) courses [31].

In March 2023, after the parliamentary elections, the Estonian Association of General Practitioners made proposals to the new Parliament of Estonia and the government to overcome the healthcare crisis. The systematic development of e-services was also among the proposals of family doctors. General practitioners considered it essential to have a patient-centred movement of health information, where the patient owns his data, has access to all health data through the HIS, and can add their own health data there. Increasing health literacy was also considered necessary. According to family doctors, the creation of science-based decision support systems, which are based on a person's own health data, and which can be used to get answers to persons questions and advice for solving simple health concerns, is necessary for patient empowerment [33].

3.1.3 Digital health in Estonia

According to Eurobarometer 2014 European citizens' digital health literacy survey, 56% of people in Estonia used the Internet to search for health-related information within the last 12 months. In 2014 the percentage of citizens who used Internet was 84%. Current Statistics Estonia data shows that in 2022 91.5% of citizens aged 16 -74 use Internet. According to Statistics Estonia the percentage of 16- to 74-year-old Internet users who searched for health-related information in 2022 is 65.0%. 45.2% of 16- to 74-year-old Internet users used webpages to book doctor appointments. 58.7% of Internet users used public sector webpages to look for information. These numbers show that there is room

for improvement, that more people have access to Internet, and can use ICT tools to access their health information [2], [3].

In Estonia, the health care service provider is obliged to document the provision of health care services to the patient [34]. National Health Information System (HIS) in Estonia has been operating since year 2008. As of April 2023, there are approximately 144 million health documents in the HIS. Almost all patients (approximately 1.3 million) have a countrywide digital record. Doctors and other healthcare workers make 4 million queries to HIS every month. Almost all prescriptions in Estonia are e-prescriptions. E-prescription is an electronic drug prescription or a digital medical device prescription that a doctor or a nurse with prescription rights, who can prescribe repeat prescription, prescribes for a patient on a computer [35], [36].

National Patient Portal launched in Estonia in year 2008. National Patient Portal in Estonia http://www.digilugu.ee includes full online access to health records from primary and secondary care, including case summaries and laboratory results, appointment booking, prescription data, immunisations, digital referral letters, dental care charts, COVID-19 related laboratory results and immunisations, organ donation will, body donation will, and blood transfusion will. National Patient Portal allows the patient to appoint a representative(s) with different rights. National Patient Portal is accessible using national authentication service different methods such as ID-card, Mobile ID and Smart-ID. Every query about the patient in health information system is logged, which makes the system traceable [37], [38].

In Estonia health records are typically available to doctors on an opt-out basis. Patients have the right to control how their health information is used and shared. However, their information is typically assumed to be available to health professionals unless they specifically opt-out of sharing.

The websites of various hospitals also have their own web registration systems, through which appointments can be booked both without a referral and with a referral [39], [40], [41]. There are also web registration systems on the websites of various private clinics [42]. Veebiregistrautur.ee offers an online registration solution for healthcare facilities, which is also compatible with several family doctor software and hospital software. Veebiregistrautur.ee users can also interface with the National e-Booking System [43].

National e-Booking System (*Üleriigiline Digiregistratuur*) was launched in 2019. National e-Booking System is an online application where a person can book, cancel and change appointment times in all interfaced medical facilities. As of April 2023, approximately 277 healthcare facilities have interfaced with National e-Booking System. Among them are hospitals, specialist doctor facilities, general practitioner centres, and dental care facilities [44], [45].

From State Portal Eesti.ee person can see information about one's prescriptions, health insurance information, details of issued European Health Insurance card, information about medical care and treatment abroad, information about receiving sickness benefits, information about temporary incapacity for work, information about permanent incapacity for work, information about Poisoning Information Centre and information about vaccination [46].

In Estonia, the websites of most major hospitals have information materials for patients about various diseases, examinations, procedures, and operations. North Estonia Medical Centre, Tartu University Hospital, East-Tallinn Central Hospital, Ida-Viru Central Hospital and West-Tallinn Central Hospital all have those on their website. Information about procedures and operations can also be found on some private clinics' websites, for example Fertilitas. Also, some general practitioner centres websites have links to reliable information sources [47], [48], [49], [50], [51], [52], [53].

Two platforms offer a secure and intelligent means of communication between the patient and his/her registered general practitioner. Both applications LEIA and *E-perearstikeskus* offer logging in with safe identification methods, such as Mobile-ID, ID card and Smart-ID. LEIA functions include following: requesting prescription renewal, requesting health certificate, requesting and terminating sick leave or carer's leave, contacting your general practitioner about vaccination, overall questions, health inspection or health problem. Application E-*perearstikeskus* application functions include following: requesting prescription renewal, terminating sick leave, requesting appointment with GP, opportunity to contact your doctor, requesting health certificate, video visits and health diary. *E-perearstikeskus* also lets you connect Fitbit application to exchange data. Fitbit devices can monitor the number of steps, heart rate and sleep. The data are usually synced to the Fitbit mobile app, where users can track their statistics and set goals. Application *E-perearstikeskus* allows many actions to be performed on the behalf of the representable

also (for example, asking for a repeat prescription, etc). *E-perearstikeskus* also offers a mobile application. Often, on the website of the centres that use these applications, there is a request that please do not send your health concerns via e-mail, and if you want to write about your health concerns, open or terminate sick leave, order a prescription renewal, please use the corresponding application [54], [55].

Much useful health information can also be found on the websites of various public institutions. For example, the Health Board, the National Institute for Health Development, the Medicines Board and Estonian Health Insurance Fund [56], [57], [58], [59].

Kliinik.ee is Estonia’s most visited health counselling environment, where patients' questions and doctors' answers can be found [60].

Health-related information can also be found on the websites of pharmacies, medical device manufacturers, and distributors. For example, pharmacies like Apotheka and Benu and medical device distributors Semetron and Meditsiinigrupp [61], [62], [63], [64].

4 Data collection and analysis

The survey process started with identifying the general topic area, which came from author's selected thesis topic. Secondly the author researched literature to familiarize with the context and background. Thirdly, the author established the aims and objectives of the study and possible hypotheses. As a next step, the suitable population was identified. The population for the survey was adult Estonian citizens, who can use computer, have access to Internet, and understand Estonian language. Data were gathered from a sample of adult Estonian citizens, and the findings generalized to the entire population. Then author applied an appropriate sampling technique, which was convenience sampling, because of financial and time constraints. After that, author designed survey and did pilot testing. Pilot testing was done to ensure that questions did not need any clarification. After the questionnaire was finished author collected the data [8].

After the survey was conducted, the author interviewed general practitioners, specialist doctor and clinical psychologist, to get their perspectives on Estonian citizens' digital health literacy. The interviews aimed to collect qualitative data.

4.1 Questionnaire design

Survey data are normally obtained by using a questionnaire. A questionnaire is a series of pre-determined questions. Different types of questions were used in the designed questionnaire because it is important to keep the questionnaire interesting. The designed questionnaire consisted of closed questions (dichotomous questions, multiple select questions), scale items for measuring attitudes (Likert scale) and open-ended questions to get more detailed responses and details to the closed questions. Likert scale is a technique that allows respondents to select the option that best demonstrates their agreement level. The author used five-point Likert scales in the questionnaire. Five-point Likert scale provides five possible answers to a question to indicate the respondent's level of satisfaction or agreement. Dichotomous questions were also used in the questionnaire. Dichotomous questions can have two possible answers. Author used "Yes" or "No" answers in the questionnaire. Multiple select options were also used, allowing respondents to choose all options from the list that apply. Also, open-ended questions

were used to get respondents' complete knowledge and not limit their response options [8].

Data from citizens were collected using questionnaire, which was designed in Google Forms. The questionnaire was in Estonian. The questionnaire started with an introduction about the author, the questionnaire's objectives, and author's contact information. In the introduction part, it was also mentioned that all answers are anonymous. The questionnaire contained four parts. The parts were the following: general information, health-related information, internet usage habits and digital health literacy information. The designed questionnaire can be found in Appendix 3.

4.2 Implementation of the questionnaire

After the questionnaire was developed, an online questionnaire in Google Forms was made available online of 21 March 2023 to 11 April 2023. Google Forms was used because it is well-know, user-friendly, and only requires a little technical expertise. The author of the thesis shared the questionnaire link via her social media.

The number of questionnaires received online was 89. All received questionnaires were valid.

4.3 Interview design

Author put together interview questions for general practitioners, for specialist doctor, and for clinical psychologist, to get their perspectives on Estonian citizens' digital health literacy. Interviews consisted of more than 25 questions (see Appendix 4).

The first set of interview questions were made for general practitioners. For specialist doctor and clinical psychologist, the same questions were used, but some were left out.

4.4 Implementation of interviews

Face-to-face, telephone and e-mail interviews were carried out with two general practitioners (one working in Tallinn and one in rural area), one specialist doctor (otorhinolaryngologist) and one healthcare support specialist (clinical psychologist). See Appendix 5 for the professions and names of the interviewees. All interviewees were asked whether they wished to appear by name or remain anonymous. All interviews were held in Estonian. Interviews lasted for 1-1.5 hours. Interviews were audio recorded to be able to transcribe these later fully.

4.5 Questionnaire analysis

After the data from 89 respondents was collected author started to analyse the data. Before that author had done the preparations for analysing, by choosing the statistical software package IBM SPSS Statistics. This statistical software program was chosen because there is enough support material and manuals available for it [65]. Other option which author considered was STATA 17. STATA was considered because it was free for Tallinn University of Technology students. After analysing the data, the author presented the findings and conclusions [8].

4.6 Interview analysis

Qualitative analyse was done to analyse data and to get an understanding of the topic under investigation. Interviews were fully transcribed using Tekstiks.ee, a public speech recognition service of Tallinn University of Technology speech technology laboratory. Transcriptions were entered into Taguette software. Taguette was used for qualitative data analysis. This software helps to organize and analyse interviews and open-ended survey responses [66]. Thematic analysis was used to draw conclusions from collected data, because thematic analysis is a flexible method for various types of research. When the author presented her findings, she used a concept map to organize information and shop connections between different ideas and connections. Lucidchart software was used to create concept maps [67], [68], [69].

5 Findings

The findings chapter presents the descriptive statistics results of the questionnaire responses, the results of statistical tests, and the results of the qualitative data analysis. Tables and graphs are used to present findings.

5.1 Descriptive statistics

Descriptive statistics were used in the thesis to summarize the information received via completed surveys.

Gender and age distribution of respondents

The number of completed surveys was 89 (n=89). All completed surveys were valid. 66% of answers came from women and 34% came from men. The average age was 43,25. The median age was 40. The oldest respondent was 89 years old and the youngest 18 years old. See Figure 2 for the gender and age distribution of the respondents.

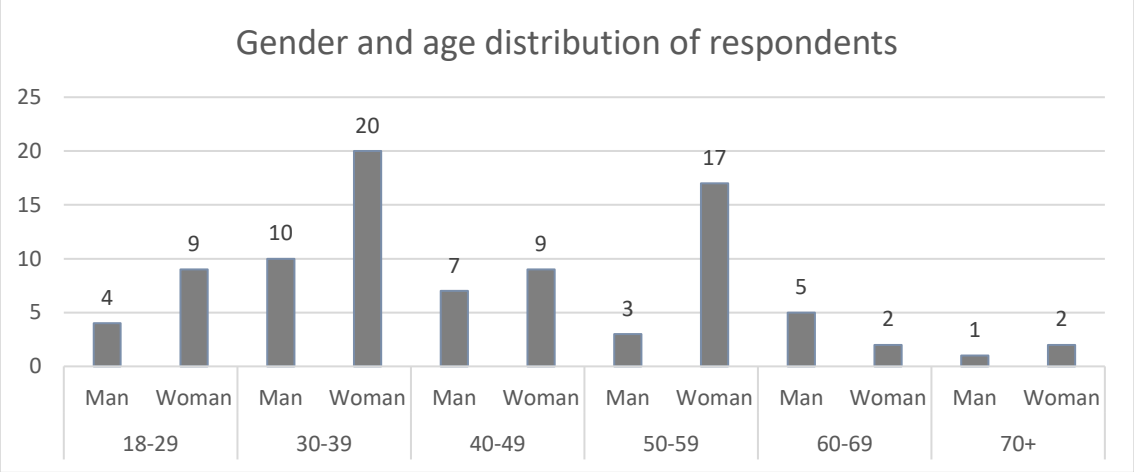

Figure 2. Gender and age distribution of respondents

Place of residence

89.9% of respondents lived in city. 10.1% lived in rural areas.

Education

The educational distribution of the respondents is showed in Table 1.

Table 1. Educational distribution of respondents

Highest acquired education	Number	Percentage
no education	0	0,0%
basic education	1	1,1%
vocational education based on basic education	5	5,6%
secondary education	8	9,0%
vocational secondary education	2	2,2%
vocational education based on secondary education	7	7,9%
bachelor's degree or applied higher education	25	28,1%
master's degree	37	41,6%
Doctorate	4	4,5%

Mainly occupied

72 out of 89 responded that they are mainly working, engaged in business or on temporarily sick leave from work. 9 respondents out of 89 were disability or old-age pensioners. 4 respondents were mainly occupied with studying. Three respondents were home with children. One person was not working. See Table 2 for information on how respondents are occupied.

Table 2. How are respondents occupied

Mainly occupied	Number	Percentage
Working	72	80,9%
Pensioner	9	10,1%
Studying	4	4,5%
Home with child	3	3,4%
Not working	1	1,1%

Connection to healthcare

21% were connected to healthcare (worked in healthcare or have been studying healthcare). 79% of respondents were not connected to healthcare.

Suffering from a chronic disease

58% of respondents did not have any chronic diseases. 42% were suffering from a chronic disease.

Regularly taking medication or using medical devices

60% of respondents were not regularly using medications or medical devices. 40% were regularly using medications (including the use of medical devices).

Designated disability for work

11% had a designated disability for work. 89% did not have designated disability for work.

Exercising regularly

61% of respondents were regularly exercising. 39% were not regularly exercising.

Self-reported health score

To get some insight into individual's perception of their own health status self-reported health assessment on a scale of 0 to 10 was asked. Mode self-reported health score was 8. 45 people out of 89 reported their self-reported health with scores 8 to 10, which can be interpreted as excellent health status. 40 people reported their health assessment with a score 5-7, which can be interpreted as average health status. Four people reported their health assessment with a score 0-4, which can be interpreted as poor health status (see Figure 3).

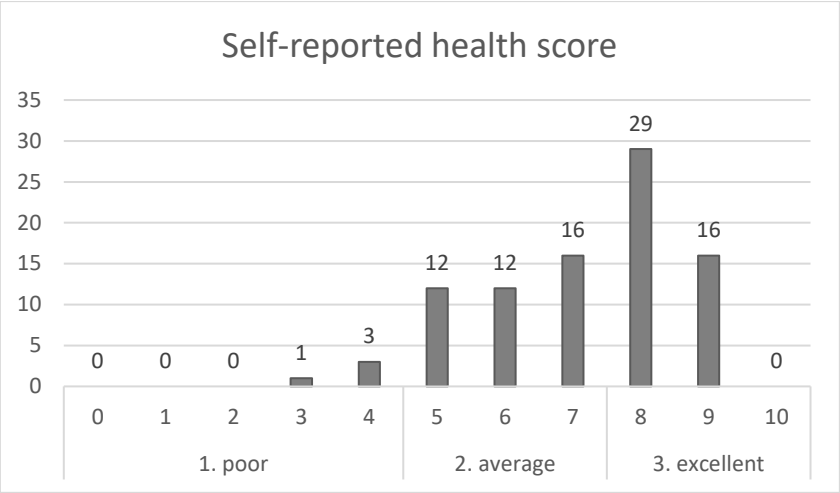

Figure 3. Self-reported health score

Internet usage habits

77 respondents out of 89 responded that they always use Internet. 11 people responded that they often use the Internet. One person responded that he/she never uses the Internet.

There were different types of devices that respondents used to consume the Internet. These devices and their popularity are described in Table 3. The Internet is mostly consumed via mobile phones.

Table 3. Device type distribution

Type of device	Number	Percentage
Mobile phone	86	96,6%
Personal computer or laptop	76	85,4%
Work computer or laptop	55	61,8%
Smart watch	21	23,6%
Tablet computer	19	21,3%
Somebody else's computer	1	1,1%
Computer at a public Internet point	0	0,0%

Self-reported digital literacy score

To get some insight into individual's perception of their digital skills and abilities self-reported digital literacy assessment on a scale of 0 to 10 was asked. Altogether, there were 89 respondents. The minimum self-reported digital literacy score was 0, the maximum

was 10. The median self-reported digital literacy score was 8. Mode self-reported score was also 8 (see Figure 4).

58 respondents answered with scores 8 to 10, which can be interpreted as having high digital literacy skills. 29 respondents answered with a score of 5-7. Scores in the range of 5-7 indicate having average digital abilities and skills. 2 people responded with scores 0-4. Scores in the range of 0-4 indicate having poor digital literacy.

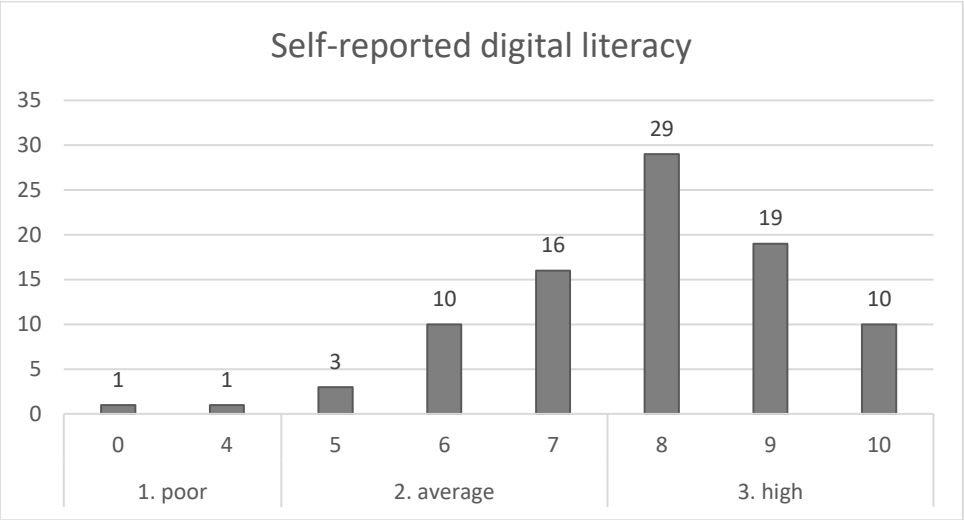

Figure 4. Self-reported digital literacy

People who have searched for health-related information online

82 out of 89 people answered that they have been searching for health-related information online. This means 92% of respondents have been looking for health-related information online.

Types of health information citizens have searched for

Table 4 shows the different types of health-related data they have searched for and how popular each type is.

Table 4. Different types of health information citizens have searched for

Information type	Number	Percantage
Specific information about a particular disease	67	81,7%
Information about my symptoms	64	78,0%
Drug information/information about medical devices	63	76,8%
Information about my own appointments	60	73,2%
General health information	53	64,6%
Specific information about a particular study, service or a procedure	52	63,4%
Information about vaccination	43	52,4%
Information after a doctor's visit to get a second opinion	14	17,1%

Sources used to search for health-related information

People use different sources to look for health-related information online. Table 5 shows different sources and their popularity among 82 respondents who responded that they have been looking for health-related information online.

Table 5. Sources that respondents have used to search for health info

Sources used to search for health-related data	Number	Percentage
Internet search	75	91,5%
Websites of the Health Insurance Fund, Medicines Board, Health Board, Health Development Institute	49	59,8%
Homepages of major hospitals and other healthcare facilities	46	56,1%
Websites of pharmacies	44	53,7%
Research articles, scientific medical journals	34	41,5%
State portal www.eesti.ee	30	36,6%
Medical device information from the manufacturers' websites	20	24,4%
Online communities, forums, groups on social media	19	23,2%
Digital mass media	18	22,0%
Youtube	15	18,3%
Online conferences organized by hospitals for a population suffering from a specific disease	6	7,3%

Problems with online health-related information

29% of respondents have experienced problems when searching online for health-related information. These problems were the following: there was no specific information available (68% of responses), info was not trustworthy (43% of people), information was difficult to understand (31% of responses), info was not personal (22% of responses). Other responses included the following: incompletely documented by the doctor, and information was contradictory.

Used languages to search for health-related data

81 out of 82 people have been searching for health-related information in Estonian language. 66 people out of 82 have used English language. 13 people used Russian language. Other languages used included Finnish (10 people), German (2 people), Swedish (1 person).

Problems with information not being available in their preferred language

29% of people answered that there had been occasions where health-related information was not available in their preferred language. 71% of respondents had not experienced problems that information was unavailable in their preferred language.

Frequency of searching for health information using digital sources

34 respondents out of 82 who answered that they search for health information online responded they often or almost always search for health information using digital sources (41.5% of respondents). 45% of respondents answered that they sometimes search for health information using digital sources. 13.4% stated that they rarely search for health information online.

Discussing health information found on the Internet with a healthcare professional

8.5% of respondents out of 82 responded that they almost always or often have discussed health information found on the Internet with a healthcare professional. 39% of people answered that they sometimes do it. 34.1% of respondents replied that they rarely do it. 18.3% of people responded that they have never discussed health information found on the Internet with a healthcare worker.

Satisfaction with digital health information found on the Internet

53.7% of 82 respondents were satisfied or very satisfied with digital health information on the Internet. 42.7% of people where neutral, whether they were satisfied or dissatisfied. 3.7% of people were dissatisfied with digital health information found (see Figure 5).

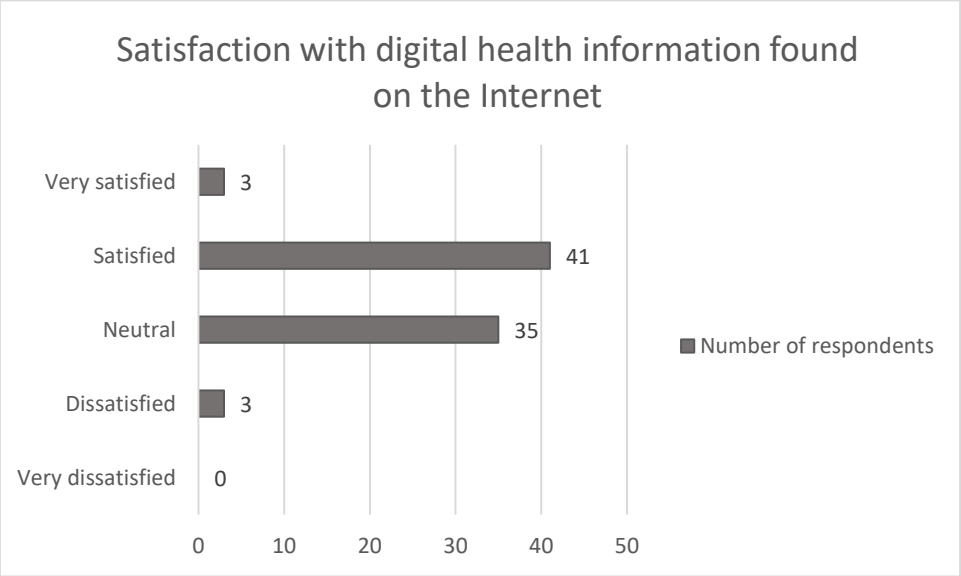

Figure 5. Satisfaction with digital health info found on the Internet

Usefulness of digital health information found on the Internet

62.2% of 82 respondents, who answered that they have searched for health-related information digitally agreed or strongly agreed that digital health information on the Internet has helped them to solve health-related problems. 34.1% of people where neutral whether information on the Internet has helped them to solve health-related problems. 3.7% of respondents disagreed or strongly disagreed that digital health information has helped them (see Figure 6).

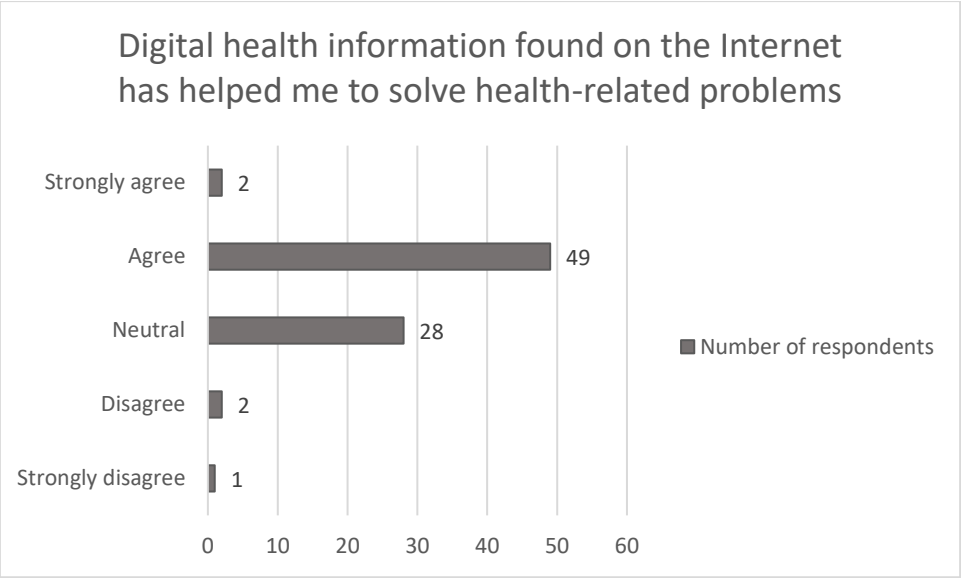

Figure 6. Usefulness of digital health information found on the Internet

Using National Patient Portal

87 out of 89 respondents answered that they have been using National Patient Portal to look for their health data. This is approximately 98% of all respondents.

74 out of 87 spend approximately 0-9 minutes in National Patient Portal per visit. Remaining 13 people spend more than 10 minutes per visit in National Patient Portal.

The most popular National Patient Portal service was case summaries (83.9% of responses). Followed by referral letters or answers to referral letters with 82.8% of responses. Next were laboratory results with 78.2% of responses. Fourth was prescriptions with 69% of responses. Fifth was information about vaccination (59.8% of responses). Sixth was COVID-19 related information (52.9% of responses). Seventh was health-declaration (44.8% of responses).

Usefulness of information found on National Patient Portal

46% of people agree or completely agreed that information found on National Patient Portal has helped them to solve health problems. 43% of people where neutral about whether information found on National Patient Portal has helped them or not. 11% disagreed or completely disagreed that information found on National Patient Portal has helped them (see Figure 7).

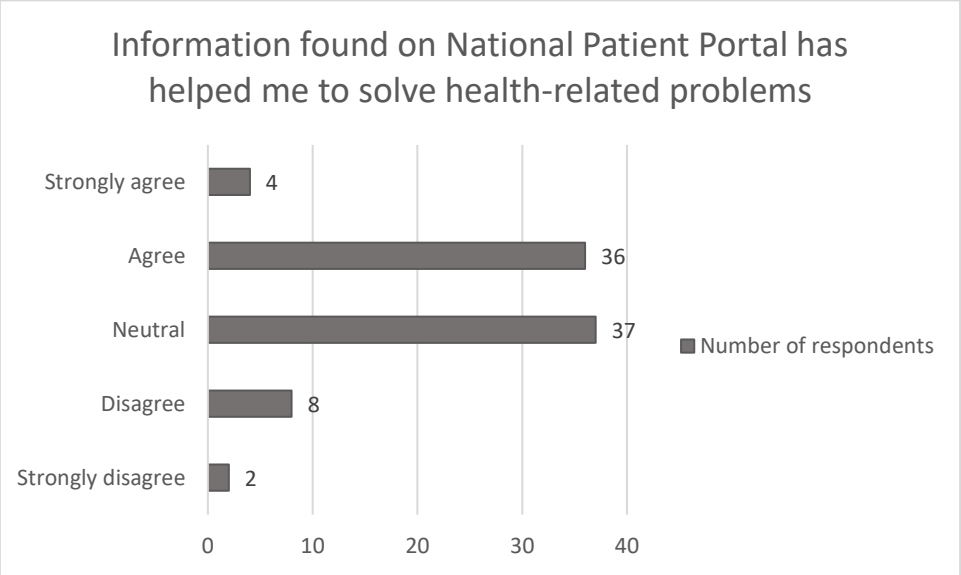

Figure 7. Usefulness of information found on National Patient Portal

Booking an appointment for a doctor's visit or examination

The most popular way of making appointment for a doctor's visit was by telephone (90% of respondents answered that over the past 12 months, they had made an appointment by phone). Using the National e-Booking System was the second most popular way of booking an appointment (53% of respondents). The third most popular way of booking an appointment was using online booking system on the healthcare facility's website (47% of respondents). Fourth was booking appointment by e-mail (38% of respondents). 12.4% of respondents had made an appointment with general practitioner using application *E-perearstikeskus*. 10.1% of respondents have made an appointment by attending the healthcare facility. 7.9% of people responded that they had not made any appointments for a doctor's visit in last 12 months.

Using smart watch

39% of respondents (35 people) reported using smart watch to track their health. 31 of them reported that they use smart watch to track activity. Also, 31 people reported that they track pulse. Tracking sleep was in third place, 22 respondents reported tracking sleep. Other health indicators that people track using smart watch included blood oxygen level (8 respondents), blood pressure (4 respondents), and electrocardiogram (4 respondents).

Using mobile applications

72% of respondents have not been using mobile applications to track their health. 28% of respondents (25 people) answered that they use mobile applications to track their health. Exercise and fitness was the most popular type of mobile application used (21 responses out of 25). The second most popular type of application was women's health (14 responses out of 25). Other responses included the following: sleep tracking (11 responses), nutrition (10 responses), mental health (5 responses), health management and chronic disease management (5 responses), application for communication between the patient and general practitioner *E-perearstikeskus* (2 responses).

91% of respondents will use mobile applications to track their health if necessary. 9% responded that they are unwilling to use mobile applications to track their health.

Using telemedicine services

22.5% of respondents answered that they have used telemedicine services, 77.5% of respondents said that they have not used telemedicine services like video consultations. 71% of respondents are willing to use telemedicine services if necessary. 29% of respondents are not willing to use telemedicine services.

Self-reported digital health literacy score

To get some insight into individuals' perception of their digital health literacy skills and abilities self-reported digital health literacy assessment on a scale of 0 to 10 was asked.

All together there were 89 respondents. The minimum score used was 1, and the maximum score used was 10. The median score was 8. Mode self-reported score was also 8 (see Figure 8).

49 people out of all 89 respondents responded with scores 8-10. These scores can be interpreted as having high digital health literacy. These people have good knowledge of health-related topics and can access and evaluate health information found online. They are probably able to use digital applications and technologies to manage their health. 36 respondents answered with score 5-7. Scores in the range of 5-7 indicate average digital health literacy. These people probably have some knowledge on health-related topics and they are probably able to access and evaluate digital health information to some extent. They may require assistance using digital applications and technologies to manage their health. 4 people responded with scores 0-4. Scores in the range of 0-4 indicate poor digital health literacy. These people may have little knowledge about health topics and these people can struggle to access digital health information. They may also experience difficulties using digital applications to manage their health. These people can also have low confidence in their abilities to use digital resources for health purposes.

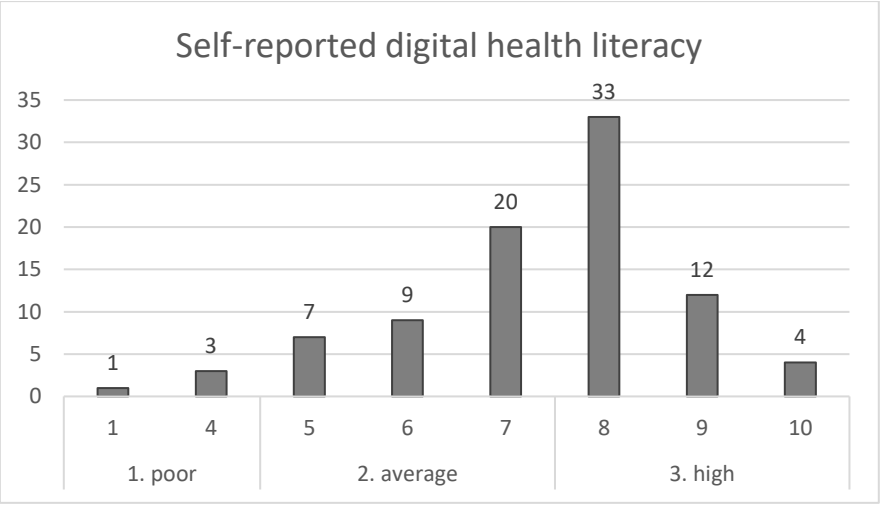

Figure 8. Self-reported digital health literacy

Citizen's willingness to be more digitally health literate

66% of people said that they would like to be more digitally health literate. 34% of respondents said that they would not like to be.

60% of all respondents (53 out of 89 people) are willing to participate in courses or online courses to be more digitally health literate. 40% of respondents are unwilling to participate in courses to be more digitally health literate.

5.2 Inferential statistics

Inferential statistics was used to make inferences and draw conclusions about a population based on a sample data. Inferential statistics was used to test hypotheses and make decisions about the validity of research statements. Author formulated null hypotheses and alternative hypotheses, collected data, and analysed data using appropriate statistical tests to determine whether the results support or reject the null hypothesis. Statistical tests used were for example Mann-Whitney U test and Kruskal-Wallis test.

H_0: Women's self-reported digital literacy scores do not differ from men's.

H_1: Women's self-reported digital literacy scores are higher than men's.

In author's comparison of women and men, author found that women's self-reported digital health literacy score (mean=7,64) was significantly higher than men's (mean=6,77), with an average difference of 0,87 points ($p = 0{,}009$ which means $p < 0.01$).

H_0: Self-reported digital health literacy scores are the same between people with a medical background and people without a medical background.

H_1: People with a medical background have higher self-reported digital health literacy scores than people without a medical background.

In author's comparison of people with medical background and people without medical background, author found that people with medical background (mean=8,16) was significantly higher self-reported digital health literacy scores than people without medical background (mean=7,13), with an average difference of 1,03 points ($p = 0{,}006$ which means $p < 0.01$).

H_0: People who have searched for health information using digital sources and people who have not searched for health information using digital sources do not differ in their self-reported scores of digital health literacy.

H_1: People who have searched for health information using digital sources self-reported scores for digital health literacy are higher than people who have not searched for health information using digital sources.

In author's comparison of people who have looked for digital health information and people who have not looked for digital health information, author found that people have looked for digital health information (mean=7,52) have significantly higher self-reported digital health literacy scores than people who have not looked for digital health info (mean=5,29), with an average difference of 2,23 points ($p = 0,006$ which means $p < 0.01$).

H_0: There is no relationship between the frequency of internet use and digital health awareness.

H_1: People who use the Internet more often have different self-reported digital health literacy scores than those who use the Internet less frequently.

In author's comparison of people who use Internet almost always and people who do not use it all the time, author found that people who use Internet always (mean=7,53) have significantly higher self-reported digital health literacy scores than people who are often using Internet (mean=6,64) or people who never use internet (mean=1), which means there are differences between those groups ($p = 0,032$ which means $p < 0.05$).

The author of the thesis also tested other hypotheses but found no statistical differences there. Other hypotheses that the author tested were following:

- the difference in self-reported digital health literacy scores of people living in rural areas and in the city;
- the difference in self-reported digital health literacy scores between people with and without chronic diseases;
- the difference in self-reported digital health literacy scores between people who exercise regularly and people who do not;
- the difference in self-reported digital health literacy scores between people with and without defined incapacity to work or disability;
- the difference in self-reported digital health literacy scores between people who regularly take drugs and who do not;
- the difference in self-reported digital health literacy scores of different age groups.

5.3 Qualitative data analysis results

Qualitative data analysis was used to gain a deeper understanding of the topic. Qualitative data analysis was also used to either confirm or reject the results of the quantitative data analysis.

Qualitative data for this research came from interviews with two general practitioners, one specialist doctor and with one clinical psychologist. The remaining qualitative data came from open-ended survey questions.

5.3.1 Problems with Patient portal

Problem, which was most mentioned regarding the National Patient Portal was the ease of use. There were 16 mentions of this in survey responses. Different topics emerged: the need for mobile application, information is difficult to find and the used language is too difficult.

Need for mobile application or better mobile version. The author will not discuss this topic in this thesis anymore, because the new Health Portal (*Terviseportaal*) which will launch in autumn 2023, has considered this non-functional requirement. New portal will first be created as a responsive web, allowing users to use it comfortably on mobile devices. Development of separate mobile application is not planned [70], [71].

The answers to the survey revealed that it is difficult to find information in the current National Patient Portal. This problem has also been considered when creating the new Health Portal (*Terviseportaal*). The new Health Portal will have a search function [72].

One topic that was mentioned was difficult language used in National Patient Portal. Author of this thesis will not discuss this problem anymore, because this has also considered in new Health Portal. Many services have been renamed for new Health Portal. For example, case summaries have been renamed in the new portal as held appointments and hospital treatment summaries, passport of immunization has been renamed as vaccinations and time-critical data has been renamed as my health overview [71].

With laboratory analysis results references would be good, if you could read about the explanations of the blood sample indicators. Now, it is pointed out that they must be searched for separately and, for example, that Synlab’s webpage has these explanations.

Also, there should be explanations for when blood indicators are outside reference values, what that means. and what patient needs to do (whether to contact your general practitioner, etc). One respondent pointed out that it would be good to see the change of laboratory results over time, for example, the ability to see all the haemoglobin results taken and how they have changed.

National Booking System *Üleriigiline Digiregistratuur* does not have all the organizations available for booking. The history of doctor visits there does not include all appointments.

Notifications when there is a need for renewing vaccine or notification about new document in health information system. Notifications are not planned in new Health Portal (*Terviseportaal*) when it launches in 2023. These will be a later development [71].

Patients also wanted to see x-ray recordings. At first new Health Portal (*Terviseportaal*) will not have image references or x-ray recordings visible as images in new portal [71].

Possibility to see sick leave information was also one thing that was mentioned in questionnaire answers. This has also been analysed with new Health Portal and according to the documents it is feasible. Analysis states that it is reasonable to develop the content of health services in the patient portal and this information should be in Health Portal rather than in State Portal Eesti.ee [71].

The answers to the survey also expressed the desire to see more detailed information about the diagnosis description. In the future, more general health information should also be available in the new *Terviseportaal*. Citizens and healthcare providers expect that in the future the new portal will bring together the instructions and information materials related to diagnoses that are currently distributed to patients [72].

Other topics mentioned also included possibility to chat with your general practitioner or specialist doctor in National Patient Portal and no information in health information system about some doctor’s appointments.

As a result of the survey, problems with the current National Patient Portal were revealed, see Figure 9 to see map of them.

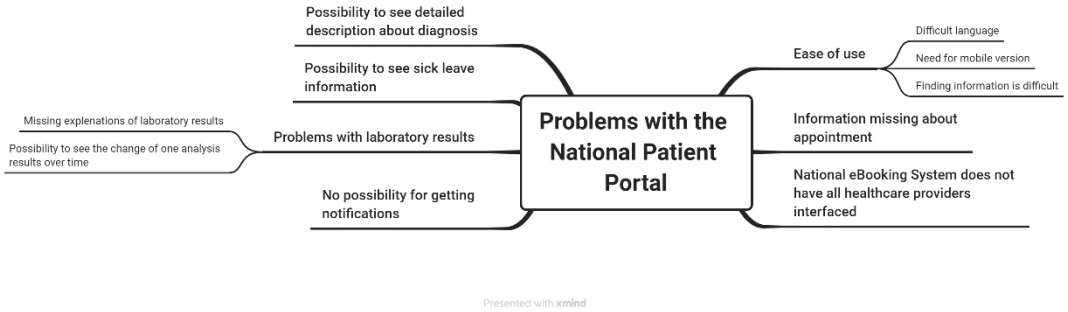

Figure 9. Concept map - Problems with National Patient Portal

5.3.2 Benefits of digital health information

The benefits of the availability of digital information also emerge from the interviews.

For example, a clinical psychologist notes that the availability of digital information benefits the patient in psychoeducation. If earlier the same information had to be repeated from books in addition to the reception room, now it is more easily available on the Internet.

General practitioner notes that after the launch of the National Patient Portal people are more aware of their health. Patients can view the results of their own laboratory tests; if there are no abnormalities, repeat consultations with the family doctor will decrease.

The availability of health-related information on the Internet has also helped because person sometimes gets an answer to his/her problem or question already on the Internet. And then he/she does not come to the reception to ask it. And if he/she does, then it can be discussed further in the appointment. The groundwork is already done and doctor can do a better job with a patient who has done groundwork online before appointment. Fewer people come to the general practitioner’s appointment out of boredom.

Documenting case summaries on the computer has allowed doctors to do it much faster and more precisely than on paper, because standard answers can be used and specified with additional details if necessary. Since the doctor's notes are visible to others, it also makes the doctor document the treatment history more clearly.

5.3.3 Types of resources patients use

The tool that healthcare professionals see patients using the most in their daily work is searching for information on search engines (especially Google). Websites of healthcare institutions and websites of public sector institutions were also mentioned. These interview responses also confirm the survey results. Survey had the same TOP 3 regarding sources used for looking health-related information.

In addition, social media was noted.

5.3.4 Data collected by smartwatches

All interviewees answered that patients have expressed a desire or referred to health data collected by smartwatches. Sleep tracking on smartwatches was mentioned most by interviewees. However, they also mentioned blood oxygen level, electrocardiogram, blood pressure and stress level assessments. This also matches the survey results to some extent, according to survey answers, sleep tracking was in the third place.

One GP mentioned that approximately 20% of his patients mention use of smartwatches for gathering health data.

5.3.5 Using telemedicine services

Information emerged from interviews that people like to use telemedicine services such as video consultations since COVID-19 pandemic. The clinical psychologist mentioned that right now approximately 20% of her appointments are video consultations. Reasons why people want to use telemedicine services were the following: the possibility to do consultations even when suffering from virus diseases, the possibility to do consultations in the middle of workday without the need to commute to doctor and the possibility to do doctors' appointments even if you live far from the clinic or if the availability of services is low in the area you live.

The answers to the survey also revealed that telemedicine could be used more, especially in mental health.

According to the general practitioner, conducting video consultations with patients only happens sometimes in his work, but it does happen with patients living abroad. The

specialist doctor mentioned that in her case, video consultations were rather remained during the COVID-19 pandemic.

5.3.6 Misinformation and overabundance of digital information

In the interviews with healthcare workers, it was also revealed that the spread of misinformation about health is a problem. Mainly it came out in an interview with a clinical psychologist, who said this is a problem. For example, she pointed out therapists who do not have mental health training and science-based therapy training but are still allowed to call themselves therapists, because the laws of the Republic of Estonia do not regulate this. Such therapists are featured in mainstream media, social media, and television, and are easily found on search engines.

Other interviewees also mentioned Telegram website, anti-vaccine news and nutritional misinformation.

Most of the interviews revealed that the problem is also the overabundance of digital information. People may expend excessive resources such as time on working on their hypothesis and confirming that they have some disease and may become anxious and stressed. Similar symptoms can be signs of other diseases or medical disorders.

5.3.7 Asking second opinion from a healthcare worker about information found online

Interviews with general practitioners and clinical psychologist stated that patients had asked them for a second opinion regarding health information found on the Internet. Asking for a second opinion regarding health-related information found on the Internet came out more from the answers of family doctors and clinical psychologist. According to the specialist doctor, her patients do not do it. This probably stems from the Estonian healthcare system and the fact that the answers to all kinds of questions have probably already been answered by the family doctor, without whose referral you cannot see a specialist doctor. And by the time you get to the specialist, the diagnosis is probably relatively clear.

One of the family doctors stated that about half of the patients had done groundwork with materials found on the Internet before coming to the appointment.

5.3.8 Referral of patients to adequate resources

All the interviews revealed that, to a greater or lesser extent, healthcare professionals refer patients to adequate digital sources in their practice.

Website peaasi.ee, which focuses on mental health topics, and the homepage of the Health Insurance Fund https://tervisekassa.ee/ were mentioned the most.

Among other responses were public sector websites such as information website about vaccination vaktsineeri.ee, National Institute for Health Development www.tai.ee/ and Health Board terviseamet.ee.

More adequate online sources to which healthcare professionals refer patients: trainings and consultations to get rid of disturbing emotions meelerahu.ee, how to be good parent to your child tarkvanem.ee, information about the effects of alcohol and reducing alcohol consumption alkoinfo.ee and vaikuseminutid.ee/ website, which teaches evidence-based skills for coping with stress and emotions.

5.3.9 Promoting use of National Patient Portal

As a result of the interviews and the questionnaire, different variants of how to promote the National Patient Portal were revealed.

One way to promote the use of National Patient Portal is during doctor’s visit. At the doctor's appointment, the doctor could tell the patient every time that he is sending his case summary to the health information system, where it is visible to the patient through the Patient Portal and that the patient can calmly read it at home. One interview revealed that this raising of digital health literacy could somehow be treated as a family nurse service.

Pharmacists can also promote National Patient Portal. Pharmacist can tell person, if he/she sees that the person has duplicate prescriptions, not to call the doctor every time to order a new prescription. Instead, before asking the doctor for a new prescription, check the National Patient Portal and check if you already have a prescription that is not sold yet.

The interviews also revealed that training could be offered to the population. Patients would certainly need videos on how to use National Patient Portal and how to find exactly what you need there (with screen recordings).

You could also advertise in mass media and television. For example, in popular television shows.

Possibility to use social media marketing and influencer marketing to promote National Patient Portal were also mentioned in survey responses.

One family doctor also mentioned in the interview that sending mass notifications could be used to promote National Patient Portal. These notifications can be sent via various channels such as email or text messaging. The content could be something like, please check your health data in the National Patient Portal. E-mail notifications could also include all necessary links.

The National Institute for Health Development has also done all kinds of campaigns in the form of posters on the streets. This would be one option to raise awareness.

The survey revealed that pamphlets in general practitioner's office are also one way to promote National Patient Portal.

5.3.10 Educating healthcare workers

General practitioner from rural area, stated,

"When we talk about the digital capabilities of patients, we must not forget that of the healthcare workers as well." (General practitioner Madis Veskimägi, semi-structured interview)

Most interviewees agreed that the digital health literacy of healthcare workers should also be raised. This general practitioner, who thought that awareness is already enough, agreed that healthcare workers should be exposed to the topics of digital health literacy since university.

Respondents pointed out, for example, additional training and training days in hospitals as ways to increase the digital health literacy of healthcare workers.

It was also pointed out that knowledge could be brought to healthcare workers, for example, through professional associations in Estonia. For example, we have professional associations of family doctors, family nurses, dentists, pharmacists, etc.

6 Discussion

In this chapter author will discuss the findings concerning research questions and objectives. The author will discuss the limitations of the findings and will also propose recommendations for future research.

6.1 Recommendations on how to raise digital health literacy in Estonia

The author proposes the following recommendations to raise Estonian adult citizens digital health literacy. The recommendations are divided into three groups: for citizens' (see Table 6), for healthcare professionals and healthcare institutions (see Table 7), and for government institutions (see Table 8).

For citizens

The author proposes the following recommendations for citizens on how to improve their digital health literacy.

Table 6. Recommendations for citizens

Number	Recommendation
1	Find information from reliable sources such as healthcare organisations' websites or government institutions' websites. Search engines should not be primary source for information.
2	Use critical and source-critical thinking.
3	Participate in (online) trainings on digital health literacy.
4	Consult results with healthcare worker. Ask recommendations or validate your online findings with a healthcare professional.
5	Take an interest in your own health and how to improve it by being digitally health literate.

For healthcare professionals and healthcare institutions

The author proposes the following recommendations for healthcare professionals and healthcare institutions on how to improve citizens' digital health literacy.

Table 7. Recommendations for healthcare professionals and healthcare institutions

Number	Recommendation
1	Reliable health-related information must be available via digital sources.
2	Refer patients to trusted sources and explain to patients that search engines are not only sources for health-related information. Help patients to navigate trusted websites.
3	When communicating health-related information use simple and understandable language. The use of simple and understandable language plays an essential role in the practice of health education.
4	Refer patients to digital tools that match their skills to improve their health and explain how a digital tool can help improve their health.
5	Healthcare workers should also educate themselves in digital health literacy, and they should be offered opportunities for this in the form of training.

For government institutions

The author proposes the following recommendations for government institutions on how to improve citizens' digital health literacy.

Table 8. Recommendations for government institutions

Number	Recommendation
1	Offer life-long learning and (online) training for citizens on digital health literacy and partner with local libraries to offer digital health literacy training programs. Trainings should also be offered to healthcare workers.
2	Community health workers could bring information about digital health literacy closer to citizens. Volunteers could also be used.
3	Create promotional material (such as brochures) about national health solutions and digital health literacy that can be distributed in clinics, GP centres and elsewhere.
4	National portals should be designed to be user-friendly and accessible to all, which means that they should be user-friendly for mobile use, use understandable language and be available in three languages (Estonian, Russian, and English).
5	Use different channels for promoting digital health solutions: mass text messages and e-mails, television and mass media, social media marketing, etc.

6.2 Answering research questions

In this chapter, the author answers the research questions.

Research Question 1. How is patients' digital health literacy in Estonia?

Sub Question 1.1. What kind of information do the adults in Estonia want to access?

Most searched by people is specific information about disease. This is followed by information about their symptoms. In third place is information about medicines or medical devices. This is immediately followed by information about your appointments. There is also much searching for general health-related information or information about a specific study, service, or procedure.

Sub Question 1.2. How often do individuals interact with digital health information?

92% of respondents answered that they have searched for health-related information using digital tools. 41.5% answered that they do it often or almost always. 45.1% of them answered that they do it sometimes and 13.4% stated they do it rarely.

Sub Question 1.3. What sources do Estonian people visit for health information?

The most popular source for digital health information was search engines (especially Google). This was followed by searching for health information on the pages of public institutions, searching information on the pages of hospitals and other healthcare institutions, and the websites of pharmacies.

Sub Question 1.4. Which tools are citizens using to manage their health?

72% of survey respondents answered that they are using health-related mobile applications. Exercise and fitness applications proved to be the most popular. In second place were apps related to women's health. Women's health applications were followed by sleep tracking and nutrition applications.

39% of survey responses revealed that people use smartwatches to gather health-related data. The most popular data collected was data about activity and heart rate data. These were followed by sleep monitoring. To a lesser extent, some

respondents monitored blood oxygen levels, blood pressure, and electrocardiogram.

Research Question 2. How is patients' digital health literacy in Estonia in regard of National Patient Portal?

98% of respondents answered that they have used National Patient Portal in last 12 months. Most popular National Patient Portal service was case summaries. These were followed by referral letters or answers to referral letters, laboratory results, and information about vaccination.

46% of people or completely agreed that information found on National Patient Portal has helped them solve health problems. 43% of people where neutral about whether information found on National Patient Portal has helped them or not. 11% disagreed or completely disagreed that information found on National Patient Portal has helped them.

Using the National e-Booking System in National Patient Portal was the second most popular way of booking a doctor's appointment after the telephone.

Research Question 3. How can digital health literacy be improved in Estonia?

Author of the thesis proposed a set of recommendations on improving digital health literacy among Estonian adult citizens. Author divided those recommendations into three groups: recommendations for citizens, recommendations for healthcare professionals and healthcare institutions, and recommendations for government institutions. These recommendations can be found in chapter 6.1 Recommendations on how to improve digital health literacy.

6.3 Limitations

The assessment of digital health literacy relies on individuals' self-reported status rather than an objective measure, potentially leading to the introduction of bias. The limitations of this research are also related to the subjectivity of interviewees. This study's limitation is that the survey was only available in Estonian, and not in Russian or English.

The sample is also not representative of all Estonian adult citizens, because the percentage of people with higher education is much higher than in Estonia overall. Also, the percentage of people living in cities, is much higher in this sample than in Estonia overall. Ratio of men and women living in Estonia is also not the same as in this sample. Actual proportion of men and women in Estonia is more or less equal.

All data from citizens were collected using online tool potentially excluding any citizens that did not have access to the Internet. However, as 91% of 16- to 74-year-old people in Estonia use Internet this may not be a serious limitation.

6.4 Future research

Future research could expand this given sample; it would help to create more comprehensive results. Find more people from lower socio-economic backgrounds, people living in rural areas, and even more elderly people.

Estonians' digital health literacy could also be measured on a scale that measures a person's real skills, knowledge, and abilities. The Digital Health Literacy Instrument (DHLI) is an example of such scale. DHLI has performance-based items indicating real-world abilities and practical skills [73]. There are also other scales available which assess digital health literacy, surpassing self-reported measures and integrating objective evaluations.

Future qualitative studies could include other people working in health care, for example, pharmacists, nurses, dentists, midwives, specialists working in health care in addition to clinical psychologists (for example physiotherapists, emergency technicians, occupational therapists), social workers, etc.

Also, a questionnaire about citizen's readiness for genetic testing and using genetic information for medical assistance and everyday health decisions. Future research could also examine people's attitudes towards personalized medicine and the first services that will become public to Estonians in 2024 in connection with the following projects: breast cancer prevention and pharmacogenetics.

In the future, more research could be done on the example of other countries and what have been done to raise digital health literacy. Through this, it would be possible to generate new ideas and recommendations for raising Estonians’ digital health literacy.

7 Summary

The main goal of the mixed methods study was to learn more about adult Estonians' digital health literacy and the factors that influence it. The aim was also to give recommendations on how to increase the digital health literacy of Estonians.

During the research, the author discovered that search engines, especially Google, are used the most to search for health-related information. The lack of specific information, the unreliability of the information, and the difficulty of understanding the information came out as the main problems related to digital health. Interviews with healthcare workers revealed that, to some extent, the problem is also the overabundance of health-related information and the spread of misinformation. Also, 29% of survey respondents had problems with digital health information not being available in a language suitable for them. Overall, 62.2% respondents agreed or strongly agreed that digital health information on the Internet has helped them to solve health-related problems. 34.1% of people where neutral on whether information on the Internet has helped them to solve health-related problems.

Almost all respondents (98% of respondents) used the National Patient Portal to view their health data in the last 12 months. 46% of people agreed or completely agreed that information found there helped them to solve health-related problems. 43% of people where neutral on whether information found on the National Patient Portal has helped them or not.

Different factors influence how digitally health literate Estonians are. These factors are the following: gender, medical background, frequency of Internet usage, etc.

The author proposed recommendations for citizens; healthcare workers and healthcare institutions; and ministries to raise adult citizens' digital health literacy.

It is crucial to know about the digital health literacy of patients because patients need to take active roles in managing their health. Digital health literacy is also crucial for the state because it is helping to avoid medical expenses.

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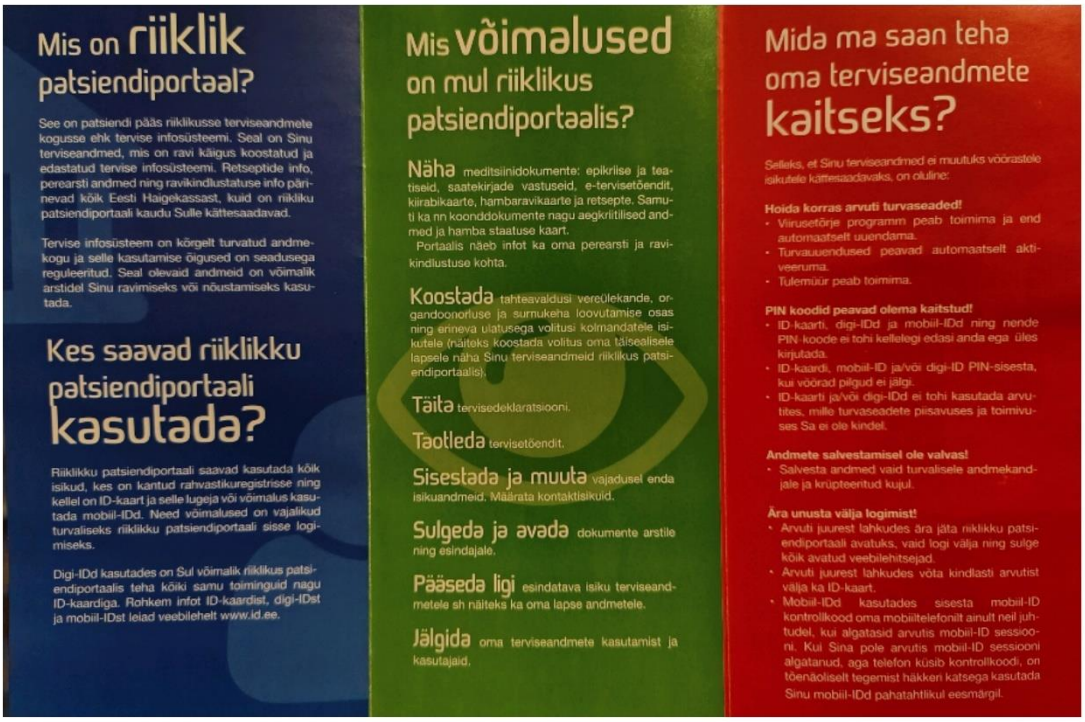
Appendix 2 – Pamphlet introducing National Patient Portal



Mis on riiklik patsiendiportaal?

See on patsiendi pääs riiklikusse terviseandmete kogusse ehk tervise infosüsteemi. Seal on Sinu terviseandmed, mis on ravi käigus koostatud ja edastatud tervise infosüsteemi. Retseptide info, perearsti andmed ning ravikindlustatuse info pärinevad kõik Eesti Haigekassast, kuid on riikliku patsiendiportaali kaudu Sulle kättesaadavad.

Tervise infosüsteem on kõrgelt turvatud andmekogu ja selle kasutamise õigused on seadusega reguleeritud. Seal olevaid andmeid on võimalik arstidel Sinu ravimiseks või nõustamiseks kasutada.

Kes saavad riiklikku patsiendiportaali kasutada?

Riiklikku patsiendiportaali saavad kasutada kõik isikud, kes on kantud rahvastikuregistrisse ning kellel on ID-kaart ja selle lugeja või võimalus kasutada mobiil-IDd. Need võimalused on vajalikud turvaliseks riiklikku patsiendiportaali sisse logimiseks.

Digi-IDd kasutades on Sul võimalik riiklikus patsiendiportaalis teha kõiki samu toiminguid nagu ID-kaardiga. Rohkem infot ID-kaardist, digi-IDst ja mobiil-IDst leiad veebilehelt www.id.ee.

Mis võimalused on mul riiklikus patsiendiportaalis?

Näha meditsiinidokumente: epikriise ja teatiseid, saatekirjade vastuseid, e-tervisetõendit, kiirabikaarte, hambaravikaarte ja retsepte. Samuti ka nn koonddokumente nagu aegkriitilised andmed ja hamba staatuse kaart.
Portaalis näeb infot ka oma perearsti ja ravikindlustuse kohta.

Koostada tahteavaldusi vereülekande, organdoonorluse ja surnukeha loovutamise osas ning enneva ulatusega volitusi kolmandatele isikutele (näiteks koostada volitus oma täisealisele lapsele näha Sinu terviseandmeid riiklikus patsiendiportaalis).

Täita tervisedeklaratsiooni.

Taotleda tervisetõendit.

Sisestada ja muuta vajadusel enda isikuandmeid. Määrata kontaktisikuid.

Sulgeda ja avada dokumente arstile ning esindajale.

Pääseda ligi esindatava isiku terviseandmetele sh näiteks ka oma lapse andmetele.

Jälgida oma terviseandmete kasutamist ja kasutajaid.

Mida ma saan teha oma terviseandmete kaitseks?

Selleks, et Sinu terviseandmed ei muutuks võõrastele isikutele kättesaadavaks, on oluline:

Hoida korras arvuti turvaseaded!
- Viirusetõrje programm peab toimima ja end automaatselt uuendama.
- Turvauuendused peavad automaatselt aktiveeruma.
- Tulemüür peab toimima.

PIN koodid peavad olema kaitstud!
- ID-kaarti, digi-IDd ja mobiil-IDd ning nende PIN-koode ei tohi kellelegi edasi anda ega üles kirjutada.
- ID-kaardi, mobiil-ID ja/või digi-ID PIN-sisesta, kui võõrad pilgud ei jälgi.
- ID-kaarti ja/või digi-IDd ei tohi kasutada arvutites, mille turvaseadete piisavuses ja toimivuses Sa ei ole kindel.

Andmete salvestamisel ole valvas!
- Salvesta andmed vaid turvalisele andmekandjale ja krüpteeritud kujul.

Ära unusta välja logimist!
- Arvuti juurest lahkudes ära jäta riiklikku patsiendiportaali avatuks, vaid logi välja ning sulge kõik avatud veebilehitsejad.
- Arvuti juurest lahkudes võta kindlasti arvutist välja ka ID-kaart.
- Mobiil-IDd kasutades sisesta mobiil-ID kontrollkood oma mobiiltelefonilt ainult neil juhtudel, kui algatasid arvutis mobiil-ID sessiooni. Kui Sina pole arvutis mobiil-ID sessiooni algatanud, aga telefon küsib kontrollkoodi, on tõenäoliselt tegemist häkkeri katsega kasutada Sinu mobiil-IDd pahatahtlikul eesmärgil.

Kes on andmeid vaadanud?

Lisaks oma terviseandmetele näed riiklikust patsiendiportaalist ka oma andmete **kasutuslogi**, infot selle kohta, kes ja millal on Sinu terviseandmeid vaadanud. Kui märkad ebaköla, võta ühendust Andmekaitse Inspektsiooni või Terviseametiga.

Terviseandmete ja andmekaitsega seotud aktuaalseid teemasid ning selle teemaga seotud küsimusi ja vastuseid saad lugeda terviseandmete kaitse foorumist.

www.terviseandmetekaitse.ee

Terviseandmete kaitse foorum

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Riiklik patsiendi-portaal

Pääs tervise infosüsteemi

www.digilugu.ee

Appendix 3 – Questionnaire

General Information

The questions in the "General Information" part are about your general information.

Question	Possible answer
Gender	(Male, Female)
Age	(Number)
Place of residence	(City, rural area)
Highest acquired education	(no education, basic education, vocational education based on basic education, secondary education, vocational secondary education, vocational education based on secondary education, bachelor's degree or applied higher education, master's degree, doctorate)
How are you mainly occupied?	(Working, studying, unemployed, retired person, Something else)
Are you involved in medicine? (Studied or worked in a profession related to medicine)	(No, Yes)

Health-related information

The questions in the "Health Information" part are about your general health condition.

Question	**Possible answer**
Do you suffer from any chronic disease? **(A chronic illness is a medical condition that is permanent or long-term and lasts at least three months or more.)**	(No, Yes)
Do you regularly take (prescription) medication? (Including the use of medical devices)	(No, Yes)
Do you have a disability or designated incapacity for work?	(No, Yes)
Do you exercise regularly?	(No, Yes)
How would you rate your health on a scale of 0 to 10? **(0 - very poor, 10 - excellent)**	(0-10)
How well do you rate your health literacy? (0 - very poor, 10 - excellent)	(0-10)

Internet usage habits

The questions in the "Internet usage habits" part are about your internet usage habits and overall digital literacy.

Question	**Possible answer**
How often do you use the internet?	(never, rarely, sometimes, often, always)
What tools do you use to use the internet? (Please tick all suitable options)	(Personal computer or personal laptop, work computer or work laptop, smartphone, tablet computer, computer in public internet point, smartwatch, something else)
How well do you rate your digital literacy? (0 - very poor, 10 - excellent)	(0-10)

Digital health literacy

The questions in the "Digital Health Literacy" part are about your digital health behaviour data for the past 12 months.

Question	Possible answer
Have you searched for health information using digital sources?	(No, Yes)
Which of the following languages do you use to search and find digital health information? (Please tick all that apply)	(Estonian, Russian, English, Finnish, Something else)
Has it caused you problems that the desired health-related material is not digitally available in the language that suits you?	(No, Yes)
How often do you search for health information using digital sources?	(never, rarely, sometimes, often, always)
What health information have you searched for using digital sources? (Please check all that apply.)	(Information about my own appointments, general health information, information about my symptoms, specific information about a particular disease, specific information about a particular study, service or procedure, information after a doctor's visit to get a second opinion, drug information, time for a doctor's visit or health examination, information about vaccination, Something else)
Which of the following digital sources do you use to search for health	(Homepages of major hospitals and other healthcare institutions, Internet search,

information? (Please tick all that apply.)	Research articles/scientific medical journals, Patient portal digilugu.ee or other patient portals, Health-related mobile applications, State portal eesti.ee, Digital mass media, Online conferences organized by hospitals for a population suffering from a specific disease, Youtube, Online Communities/Forums/Groups on Social Media, The websites of the Health Insurance Fund/Medicines Board/Health Board/National Institute for Health Development, Pharmacy websites, Medical device information from the manufacturers' websites, Something Else)
How satisfied are you with the information you received from these sources?	(very dissatisfied, dissatisfied, neither dissatisfied or satisfied, satisfied, very satisfied)
If there have been situations when you have not been satisfied with digital health information, what are the reasons? (Please check all that apply.)	(The information was not reliable, The required specific information was not found, It was difficult to understand the information, The information was not personal, Something else)
How well do you rate your ability to assess the reliability of the digital health information you find? (0 - very poor, 10 - excellent)	(0-10)

How often have you discussed health information found on the Internet with a healthcare professional? (with your family or specialist doctor or another healthcare professional)	(never, rarely, sometimes, often, (almost) always)
The digital health-related information I found on the Internet has helped me in solving health problems	(strongly disagree, disagree, neutral, agree, strongly agree)
Have you used the Patient Portal digilugu.ee to view your health data?	(No, Yes)
On average, how much time do you spend on digilugu.ee Patient Portal per visit?	(Less than 5 minutes, 5-9 minutes, 10-15 minutes, 16-30 minutes, more than 30 minutes)
How often do you use the Patient Portal digilugu.ee to view your health data?	(never, rarely, sometimes, often, always)
What options have you used in the Patient Portal digilugu.ee? (Please check all that apply.)	(Viewing case summaries, Viewing referrals and referral responses, Viewing laboratory test results, Viewing vaccination information, COVID-19 information, Prescriptions, Requesting/viewing the driver's health certificate, View Children's School Health Notices, Work capacity assessment information, Dental records, Time-critical data, Viewing emergency cards, Submission of vaccine injury data, Family doctor's information, Declarations of intent, Bills submitted to the Estonian Health Insurance Fund, Something else)

Information received from the National Patient Portal digilugu.ee helped me to solve health-related problems	(strongly disagree, disagree, neutral, agree, strongly agree)
What information do you miss in the National Patient Portal digilugu.ee?	(Free text paragraph)
In your opinion, what would be the possibilities to direct people to use National Patient Portal digilugu.ee more?	(Free text paragraph)
How have you made appointments for medical appointments? (Please check all that apply.)	(Going to a healthcare facility, By telephone, By e-mail, Using the online registration directly on the website of the desired healthcare institution, Using the National Appointment Booking System digiregistratuur.ee, Using application E-perearstikeskus, Have not made bookings in the last 12 months, Something else)
Have you used health-related mobile applications?	(No, Yes)
What kinds of health-related mobile applications have you used? (Please check all that apply.)	(Monitoring of chronic diseases, Mental health, Exercise and fitness, Nutrition, Sleep monitoring, Women's health, Health monitoring, Something else)
Would you be willing to use health-related mobile apps if necessary?	(No, Yes)
Do you use a smartwatch to monitor your sleep or any medical indicators? (For example, pulse, blood pressure,	(No, Yes)

blood oxygen level, electrocardiogram, body temperature.)	
Have you used telemedicine services?	(No, Yes)
Would you be interested in using telemedicine services, should you need it?	(No, Yes)
How good do you rate your overall digital health literacy? (0 - very bad, 10 - excellent)	(0-10)
Would you like to be more digitally health literate?	(No, Yes)
Would you be willing to take (online) courses or read educational materials to be more digitally health literate?	(No, Yes)

Appendix 4 – Interview questions for general practitioner

Interview questions for general practitioners were following.

General

1. Does your GP centre use any software for secure communication with the patient? *E-perearstikeskus* https://eperearstikeskus.ee/patient/welcome, LEIA https://leia.ai/, etc.

   If "No" then:

   Why is your GP centre not using such applications?

   If "Yes" then:

   Which?

   How many patients use it to get in touch with the GP Centre?

   Do you promote it during visits?

2. What are the main ways of communication that patients want to interact with the GP Centre?

3. What are the digital tools and sources that you see patients using in your work?

   What do you feel is used the most?

4. Do patients often ask you for advice or a second opinion about digital health information found on the Internet?

5. In your work, do you direct patients to relevant websites where they can get adequate health information?

   If "Yes" then:

   To which websites you refer patients to?

6. Do you refer patients to mobile applications in your daily practice? (For example, topics like Mental Health, Medicines, Monitoring and Treatment of Chronic Diseases, Women's Health, Exercise and Fitness, etc.)

   If “Yes” then:

   What are the main topics of mobile applications you refer patients to?

7. Have the various digital tools (For example National Patient Portal and other patient portals, online appointment booking systems, health-related mobile applications, availability of information on the Internet) helped You in your job?

8. Have patients been interested in using telemedicine services? (Services such as video consultation and voice consultation; remote monitoring of (chronic) diseases)

   If “Yes” then:

   How many patients have expressed interest?

   Against what services?

9. Have the patients who use a smart watch to monitor their health indicators expressed a desire to share the data they have collected with you or have they done so?

   If “Yes” then:

   What health indicators have patients expressed a desire to share with the doctor?

10. In your work, do you encounter the problem that there is a lot of misinformation about health digitally?

    If “Yes” then:

    How often?

    How big of a problem do you think this is today?

What are your exposures to which channels do people get the most misinformation from?

Have you done anything yourself to combat misinformation? (E.g. corrected patients if they have brought out false information during the appointment; referred patients to adequate sources)

11. In your work, do you come across the problem that patients have problems with the overabundance of health information on the internet?

    If "Yes" then:

    How often?

    How big of a problem do you think this is today?

    Have you referred patients to adequate resources?

About National Patient Portal

1. What proportion of your patients use the Patient Portal?
2. Who are the patients who prefer to use the Patient Portal (their profile (age, gender, education, health status, etc))?
3. How has the arrival of the Patient Portal changed your work as a doctor? Before the National Patient Portal, when medical records were not accessible to the patient, versus now. (The National Patient Portal came in 2008)
4. Has the arrival of the Patient Portal made the life of doctors easier?
5. Has the arrival of the Patient Portal made the life of doctors harder?
6. Have you taught patients to use the Patient Portal yourself?
7. Do you see the need for patient training to use the Patient Portal?
8. In your opinion, through what channels and in what way could the Patient Portal be brought to more people so that they would use it more?

About doctor's digital health awareness

1. Do you systematically use digital information to improve your knowledge and search for health-related information on the Internet?

2. How would you rate your digital health literacy on a scale of 0-10 (0 - very poor, 10 - excellent)?

3. Should e-health in general and digital health literacy be more integrated into the curriculum of medical students?

In conclusion

1. What should the state do (Ministry of Social Affairs, Health Insurance Fund, National Institute for Health Development, etc.) to raise patients' digital health literacy?

2. What do you think patients themselves need to do to raise their own digital health literacy?

3. What do you think should be done by doctors, healthcare workers, specialists working in healthcare, pharmacists to raise patients' digital health literacy?

4. Do you think it would also be necessary to raise the digital health awareness of healthcare workers, pharmacists, and support specialists working in healthcare?

5. In what way could the digital health awareness of healthcare workers, pharmacists and support professionals working in healthcare be increased?

6. What else would you like to add on the topic of digital health literacy among Estonian adults?

Appendix 5 – List of interviewees

Number	Name	Speciality	Comments
1	Aivi Reiman	clinical psychologist	specialist working in healthcare
2	Kristel Kalling	otorhinolaryngologist	specialist doctor
3	Signe Alliksoo	general practitioner	GP working in Tallinn
4	Madis Veskimägi	general practitioner	GP working in the rural area