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General practitioners' user experience of the nationwide digital decision support system in primary care

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Riikliku otsustustoe süsteemi perearstide kasutuskogemus esmatasandil

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Author’s declaration of originality

I hereby certify that I am the sole author of this work. All the used materials, references to the literature and the work of others have been referred to. This work submitted for thesis defence is based on the scientific article which is and original work and has not been published before presenting to the publisher.

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Abstract

Digital decision support systems have the potential to improve the quality and safety of medical services by supporting clinical decision-making with evidence-based recommendations. Due to a lack of knowledge, it is difficult to assess whether DDSSs are fulfilling their purpose. In Estonia, a nationwide DDSS for general practitioners (GPs) was implemented in 2020. To understand the impact of DDSS on the quality of care in the Estonian context and meet the demands of healthcare, it is necessary to gather information about the experiences of the users. The aim of the study is to describe the user experiences of a nationwide digital decision support system. This is the first study that examines the experiences of GPs of the nationwide DDSS.

A qualitative descriptive study was conducted based on snowball sampling. Semi-structured interviews were performed in February–March 2022 with nine GPs. Data were analyzed by thematic analysis. A total of six themes and 16 subthemes emerged from the data.

The following themes were identified: user-friendliness, DDSS use in clinical practice, benefits, and the impact of the DDSS on GPs' work, barriers to using the DDSS, and suggestions for improving the user experience. DDSS used in various clinical settings and found that it is generally a useful solution, although the system needs improvements.

To meet the demands of healthcare, there is a need for software solutions that facilitate clinical work. Certain developments of the DDSS are required. Future research should evaluate the functioning of the DDSS and the quality of the decisions it provides by observing and evaluating patients´ records.

This thesis is written in English and is 42 pages long, 1 figure and 1 table.

Keywords: digital decision support system, evidence-based personalized medicine, user experience, primary care, qualitative study

Annotatsioon

Digitaalsete otsustustoe süsteemidel on potentsiaal parandada meditsiiniteenuste kvaliteeti ja ohutust, toetades kliiniliste otsuste tegemist tõenduspõhiste soovitustega. Vähese tõenduspõhisuse tõttu on raske hinnata, kas DDSS-id tegelikult täidavad oma eesmärki või mitte. Eestis võeti 2020. aastal kasutusele üleriigiline otsustustoe süsteem esmatasandis. Selleks, et mõista DDSS-i mõju ravikvaliteedile Eesti kontekstis ja vastata tervishoiu nõudlusele, on vajadus kasutuskogemuste järele. Sellest tulenevalt on uuringu eesmärk kirjeldada üleriigilise digitaalse otsustustoetussüsteemi kasutuskogemusi. Tegemist on esimese uuringuga, mis uurib üleriigilise otsustustoe süsteemi kasutuskogemusi perearstide seas.

Lumepalli meetodi abil viidi läbi kvalitatiivne kirjeldav uuring. Poolstruktureeritud intervjuud viidi läbi 2022. aasta veebruaris-märtsis üheksa perearstiga. Andmeid analüüsiti temaatilise analüüsiga. Tulemusena moodustusid kuus põhiteemat ja 16 alamteemat.

Põhiteemadena selgusid: kasutajasõbralikkus, DDSS-i kasutamine kliinilises praktikas, DDSS-i eelised ja mõju perearstide tööle, DDSS-i kasutamise takistused ja soovitused kasutuskogemuse parandamiseks. DDSS-i kasutati erinevates kliinilistes tingimustes ja leiti, et see on üldiselt kasulik lahendus, kuigi süsteem vajab täiustamist.

Tervishoiu vajaduste rahuldamiseks on vaja tarkvaralahendusi, mis hõlbustavad tervishoiutöötajate kliinilist tööd. Kasutusel olev üleriigiline otsustustoe süsteem vajad arendusi. Tulevased uuringud peaksid hindama DDSS-i toimimist ja selle pakutavate otsuste kvaliteeti, jälgides ja hinnates patsientide andmeid.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 42 leheküljel, 1 joonis, 1 tabel.

Võtmesõnad: digitaalne otsustust;e süsteem, tõenduspõhine personaalmeditsiin, kasutuskogemus, esmatasand, kvalitatiivne uurimus

List of abbreviations and terms

DDSS	Digital Decision Support System
EBMeDS	Evidence-Based Medicine electronic Decision Support system
EHR	Electronic Health Record
EMR	Electronic Medical Record
EPR	Electronic Patient Report
GP	General practitioner
HIS	Health Information System
ICD-10	International Classification of Diseases 10th Revision
UX	User Experience

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Extension of the article

Jekaterina Šteinmiller (2024). General Practitioners' User Experience Of The National Digital Decision Support System In Primary Care. Extensions of research article as master thesis. Tallinn University of Technology, Digital Health.

Introduction

Current study describes the user experiences of a nationwide digital decision support system, which has been used since 2020. To the best of the author´s knowledge there is no one certain DDSS software that would solve all specific scenarios from the personalised medicine implementation perspective. To understand the impact of DDSS on the quality of care in the Estonian context and meet the demands of healthcare, it is necessary to gather information about the experiences of the users. This is the first study that examines the user experiences of GPs of the nationwide DDSS.

In this article, we created a pool of data which was collected from general practitioners and performed a data analysis to identify individual UX of DDSS in everyday clinical practise. Received findings are unique, because it is a unique nationwide solution, which is not limited with one healthcare provider, and can be used both by healthcare professionals and individuals and aimed for use for health promotion and disease management.

While the clinical software is not comprehensive (meaning used in different stages of the process) and rather focusing on one healthcare provider, the results of this study are valuable input for the clinical software presenting the opportunity for integration the health data from different sources into one unique solution and support of the clinical decision-making.

The results cannot be generalized to all clinical software's and/or DDSSs, as this study mapped UX to a specific DDSS. However, the involvement of users in development process and in the systematic evaluation of usability are important inputs for the implementation and sustainable usage of the software.

Therefore, we believe that currents study would be in the interest of researchers from various clinical and non-clinical fields as well for policy makers in the area of primary care and healthcare technology / digital health internationally.

Background

The main subject of the research is GPs user experience of the digital decision support system in primary care. Estonia ranks first in the world in the use of digital health and related solutions. According to the Population Health Development Plan 2020-2030, as one of the priority interventions for the improving the health care quality and patient safety, there is a need for development appropriate health technologies and related evidence-based e-services [1].

In Estonia primary care is the first contact for accessing health care and specialist care. GPs lists consist of the different age patients, with different health issues both urgent and chronical conditions, as well as regular health examination. Estonia has a large proportion of patients with chronic diseases, which burden the healthcare system. There are agreed pathways for GPs and nurses to follow based on the patient's condition [1]. In order to ensure the quality of care there is a need for innovative solutions that facilitate clinical decision-making by GPs [2], [3].

According to the register of the Health Board Republic of Estonia a total of 1,195 GPs are registered in Estonia [4]. Most Estonian GPs (80%) use the DDSS in daily practice, and for 95% of GPs, the DDSS is available on their desktop [5].

DDSSs are software solutions developed to facilitate clinical decision-making, where patients' health data are matched with computerized clinical knowledge or a machine learning algorithm, and then personalized recommendations are presented to inform decision-making [6], [7]. Different types of DDSSs are widely used at different levels within the healthcare system to support specific processes of care and health issues, both in medical and nursing care. A DDSS is a crucial tool that primarily deals with health and medical data, and recently, genome data as well [6]–[12].

A DDSS is used to support the clinician's decision-making process in several ways. It can improve the treatment process by influencing the quality of treatment, reduce treatment errors, increase healthcare professionals' adherence to treatment instructions,

and improve patient outcomes/health outcomes involving patients' data assessment, which is adjusted based on the evidence-based clinical knowledge provided by the DDSS [11]–[16].

There are knowledge-based and non-knowledge-based DDSSs [14]. Knowledge-based systems are based on rules (IF–THEN statements), and the system retrieves data to evaluate each rule and produce an action or output. (Figure 1, Appendix 1). Non-knowledge-based DDSSs produce recommendations based on different AI methods, such as ML, or statistical design, rather than evidence-based knowledge.

Decision-making support can allow healthcare professionals to work easier and faster. However, there is no international consensus regarding approved methods of measuring the results of clinical decision support tools and their presentation, leading to contradictory research conclusions [5], [16]–[21]. Therefore, it is difficult to confirm whether the decision support systems are effective (i.e. whether they fulfill their purpose).

Evidence shows that alerts, reminders, or feedback provided by decision support systems can influence patient care (e.g., diabetes care) [17]. Koskela et al. [20], investigated individually perceived barriers and enabling factors affecting the implementation and use of a DDSS by healthcare professionals. Their study revealed that the reminders transmitted by the system are effective in shaping the treatment management behaviors of doctors [20].

It is assumed that the entry of the GP in the health record affects the rules/suggestions offered by the decision support system, which in turn affects the quality of treatment. Marcolino et al. [3], evaluated the perceived feasibility, usability, and usefulness of a decision support system and the satisfaction of healthcare workers six months after the implementation of the system. In addition, two focus group interviews were conducted with users: GPs and nurses [3], [19]. In terms of feasibility, both GPs and nurses agreed that decision support can be used in primary care. Regarding ease of use, they stated that the decision support decisions were simple to use and particularly useful in carrying out preventive activities and promoting the treatment process [3].

The Evidence-Based Medicine Electronic Decision Support system (EBMeDS) is a unique, simple, and structured software solution, which was developed by the Finnish publisher Duodecim Medical Publications and has been implemented in Estonia since

2020. EBMeDS supports qualitatively new primary care service by speeding up the decision-making process and improving patient safety by supporting GPs and nurses through patient-specific recommendations and entries both in real-time and for special groups of patients. EBMeDS is registered as a medical device in Estonia and belongs to the group of knowledge-based DDSSs [23]–[24].

The uniqueness of the Estonian setup is that the system is a nationwide solution, and all patients' health data across the country are considered. Likewise, EBMeDS uses a patient-oriented Estonian Nationwide Health Information System (EHIS) as an EHR service, in which healthcare providers at different healthcare levels have exchanged patients' health data since 2008. EHIS includes a medical overview of visits, anamnesis, diagnoses, received treatment, and recommendations, which is visible to all healthcare professionals taking care of the patient [25].

All healthcare service providers in Estonia are obliged to send certain data and documents defined by law to the EHIS. The data in the EHIS are also visible to the patient through the patient portal. EBMeDS is connected to all electronic medical records (EMRs) used by GPs and to the Prescription Center, which is a central service. Both the medical data and data exchange standards are matched to ensure that decision algorithms receive information in a structured and standardized format [23].

EBMeDS analyzes patient data, compares the patient's status to criteria based on clinical guidelines, or looks for any inconsistencies in the data. Based on the analysis, reminders or alerts are created and sent to the GP's desktop. The system provides links to relevant guidelines used by the software. EBMeDS can also prefill interactive electronic forms with patient data, such as calculators, recommendations, or algorithms [23]–[24].

Patients' information is run through decision support scripts in 27 specialities, focusing on a specific clinical layout, based on evidence-based knowledge. Scripts (N=797) are compressed guidelines that have been translated into a computer-interpretable form, containing a brief summary describing the functionality of the data. Additionally, appropriate links to the evidence are provided, along with summaries from evidence-based guidelines and references, Cochrane reviews, and the decision rule messages. Potential harms are presented separately [22].

The short versions of the outputs (reminders) of the decision rules are available in 12 languages. Several structured databases have been developed by Duodecim and other institutions to support the creation of decision rules for drug treatment. It is important to note that EBMeDS is a source of information for healthcare professionals, supporting their clinical performance [22], [23].

In addition to the EBMeDS, the drug interaction database and clinical decision support INXBASE has been available in Estonia nationally since 2016. It is connected to the e-prescription system and is available for all EMRs used in Estonia. The platform contains evidence-based information on up to 26,000 pharmacokinetic interactions, based on the active ingredient and dosage. Interactions in the database are classified based on clinical significance and are evidence based [26].

There are several advantages of the DDSS, including reducing medication errors, improving patients' safety, clinical management, and documentation, and supporting diagnostics. The following risks are associated with the DDSS: disrupted workflow, unnecessary alerts and notifications, interoperability issues, data content and quality, lack of standardized metrics, affordability, and other concerns [14].

Despite the benefits, little is known about the experiences of users, patient health outcomes and associated costs, and/or evaluation of the quality of care, as well as factors affecting implementation of DDSS [20]. Thus, the results of this research will be helpful for improving the implementation of the DDSS by GPs and nurses and the quality of treatment at the primary care level when using technology to support clinical decision-making. To understand the quality of decision support in the Estonian context, it is necessary to evaluate both the functioning of the system as a whole and the experiences of the users. This was the first study to evaluate the user experience of a DDSS, response to the expectations of healthcare providers. Accordingly, the aim of the study was to describe the user experiences of the DDSS and gain a sense of the underlying patterns and reasons GPs have for interacting with it.

Methodology

A qualitative descriptive study was conducted, with snowball sampling used to recruit the interviewees. Initially, the plan was to conduct 10 interviews or to collect data until the

database became saturated, that is, when no new information was added during the interviews and the answers began to repeat [27]. For this purpose, the Estonian Society of General Practitioners was approached with a request to distribute an invitation to participate in the study. The GPs who agreed were then asked to recommend other contacts who fit the research criteria and who might be willing to participate, and in turn, who could also recommend other potential participants. The reason for utilizing a qualitative study design and snowball sampling was that it is difficult to objectively calculate the actual accuracy and impact of the DDSS. Due to a lack of research data, it is unclear whether the DDSS is fulfilling its purpose or the quality of the decisions, alerts, and reminders it provides. Moreover, from a data protection perspective, it is difficult to access sensitive personal data to evaluate the results of the DDSS [28].

Informed consent was obtained from all participants [29]. Since all the GPs preferred video interviews (using MS Teams), digital signing of the informed consent form was used, as electronic signing allows document files to be signed without paper and saves time. Semi-structured interview questions (8) adapted from Koskela et al. [20] were used for the interview (after translation into the Estonian language) to clarify user-perceived barriers and enabling factors that influence the implementation and use of a decision support system by healthcare professionals. During the interviews, the respondents were directed to delve more into the topics with guiding questions: "*Please give an example, how exactly it was, can you add something else, what it meant to you, how it affected you*." At the end of each interview, the interviewee was given the opportunity to add something if desired.

The data were analyzed based on a six-step thematic analysis framework, which is a qualitative data analysis method for identifying themes within qualitative data [30]–[32]. In the first step, the researcher became familiar with the data, and important notes were recorded. Step two included the generation of the initial codes. Open coding was used, meaning that codes were developed during the coding process. In the third step, a search for themes was conducted. Descriptive initial themes describing patterns in the data relevant to the research questions were identified. In step four, the initial themes were reviewed and modified. In step five, the final refinement of the themes was conducted. The process ended with a write-up in step six [30]–[32]. The result was based on 26 codes, which were categorized into six themes and 16 subthemes (see Table 1). The presentation of the findings is based on the themes, subthemes, and quotations.

Data Analysis

Recruiting interviewees was challenging. Two reminder letters were sent to the EPS. Data were collected in February–March 2022. A total of nine GPs were interviewed. GPs who agreed to participate in the interview contacted the researcher using the contact details listed in the invitation, and then a suitable time and place for the interview (on-site or online/MS Teams, Zoom, Skype) were agreed upon.

The duration of the interviews was 30–45 minutes, which were conducted as video meetings. All the interviews were recorded and transcribed into text by the lead author after the interview was finished. All interviews were then listened to and read over, avoiding the loss of text, and then the audio recordings were deleted from the recorder. No personally identifiable information was transcribed during the interviews [30]–[32].

Results

Conducted research fulfilled the aim of the study and six main themes revealed: *user-friendliness*, *DDSS use in clinical practice*, *benefits of the DDSS*, *the impact of the DDSS on GPs' work*, *barriers to using the DDSS*, *and user experience improvement suggestions.* (Table 1, Appendix 1).

The first identified theme was "*user friendliness*," based on GPs' shared user experience of the DDSS. There were both positive and negative experiences shared by GPs, who reported that the DDSS was "*convenient to use*" and "*simple*." As with any innovation, the users expressed some initial bias: "*At first it seemed complicated, and I was confused. I needed time to learn how to use it*." It was also reported that the DDSS operates "*...slowly, wastes the time of the visit*...." (Table 1, Appendix 1).

The second identified theme, "*DDSS use in clinical practice*," referred to the use of the system in daily practice with the patient. The majority of patients GPs encounter in their daily work have several diseases (multimorbidity), and some of the GPs shared that DDSS was used for "*...working with chronically ill patient*...." One of the interviewees used the DDSS with a "… *regular patient arrived for a visit*…" and found the system to be "…*time-saving*." The system was also used for adult patients who required a license for "…*driving a motor vehicle*." (Table 1, Appendix 1).

Third, the "*benefits of the DDSS*" were supported by subthemes like "*modern solution*," which "*supports clinical decision-making*" and is "*convenient to use*" because it is a "*digital solution*" that is "*integrated with GPs' desktop*." Based on the interviewees, the DDSS "*supports GPs' work*" by giving "*suggestions based on the current treatment guidelines, no need for search anything else*" as well as providing "*instructions, etc. that I would not have thought of immediately*" and recommendations for "*consider making diagnostics and lab tests*." The participants stated that the current DDSS is "*modern and convenient because of* [its] *integration with the GPs' dashboard.*" (Table 1, Appendix 1).

The fourth identified theme was "*impact of the DDSS on GPs' work*," which was supported by subthemes like "*time-saving*" *and* "*improved both communication and documentation*." Using the DDSS "*enables GPs to spend more time on the patient.*" Moreover, the GPs stated that "*documentation improved*" as well as "*communication among other specialists.*" (Table 1, Appendix 1).

The theme "*barriers to using DDSS*" were mainly related to "*mismatched input data*." GPs noticed reported that "*When opening new patients health record recommendations related to the previous patient displayed*," which in turn raises doubts about trustworthiness and the quality. The DDSS might "*display an empty cell, but when clicking on it, it shows the EBMEDS treatment recommendations*." (Table 1, Appendix 1).

GPs also made suggestions related to "*user experience improvement*." Several subthemes were identified, including "*warning when entering wrong information*," "*warning if data differ from reference values*," "*compliance of data with system recommendations*," "d*ata exchange when changing the patient*," and "*timing of alerts/warnings*." When inserting incorrect clinical data, an exception should be generated and displayed, which does not allow the system to proceed further: "*If there is any error in the values of the blood tests or a repetition, ex-high cholesterol values are over the reference value, then appropriate warnings or recommendations should be given/displayed*" and "*While viewing the health record there is no entry in the health record about whether the doctor followed recommendations or not*." This is because is not possible to assess whether the decision/recommendation of the decision support system was taken into account by other GPs: "*The DDSS shows the recommendations given to the previous patient. Therefore, the reliability/relevance of the offered recommendation is questionable*." In this case, the

warning is incomprehensible because the recommendation/warning was made already. (Table 1, Appendix 1).

Discussion

The results of this study are based on user experiences of the nationwide DDSSs, the first time that GPs' opinions of the DDSS have been examined in Estonia. To the best of our knowledge, Estonia is the first country in which clinical a DDSS is used nationwide. DDSSs are used worldwide in various clinical situations, and they are considered a way to improve healthcare delivery [6]–[10]. However, the use of a DDSS is limited to the EMRs of a healthcare provider or EHRs of a specific region. The results of our study also confirmed that the DDSS in Estonia is used in dealing with various health issues due to its benefits. GPs are the gatekeepers of the healthcare system, and patients with various problems need to be effectively assessed during the limited visit time and treated appropriately. It is crucial to provide appropriate conditions at the primary level to assist and support GPs in achieving their clinical goals to improve patients' health outcomes.

Based on the study conducted by the Estonian Health Insurance Fund [5], only 80% of GPs use the EBMeDS, which is surprising since the DDSS has been enabled for several years. Similar results were reported in the study of Kortteisto et al [33]. On the one hand, this may be due to the fact that GPs in Estonia have no unified EMR, and technical issues may affect the acceptance and usage of the DDSS. Fragmented digital systems may be a problem and may affect patients' safety [6]. However, on the other hand, it may be due to GPs' lack of knowledge or previous experience regarding using the DDSS, or it may be assumed that the DDSS itself lacks a user-friendly design. Users' digital competency, previous experience with similar digital solutions, and appropriate training all facilitate proper usage and interaction with the DDSS [35]–[35]. There is a need for clear and concise training that supports GPs in the use of the system. The motivation of GPs to use the system could also be increased by confirming the evidence that informs the system, which does not replace the clinical intuition of several specialists. Since the priority of GPs' clinical work is patients' well-being, it would be unreasonable to waste this valuable professional resource on poor development. However, as long as the use of the system is not fully accepted by GPs and is voluntary, it cannot be ensured that the target group will use it appropriately despite its benefits. Moreover, GPs reported the "*impact of the DDSS*" on their work, saving time and enhancing communication at all levels as well as

improving documentation. These results offer valuable insights regarding quality-of-care coordination, which can improve long-term patient outcomes. Casey et al. [11], reported similar findings, as the majority of physicians who participated in their study agreed that the DDSS improves patient outcomes and saves time. In a recent study by Meunier et al. [7], physicians stated that using DDSS increases their self-confidence and improves care, ensuring patients receive appropriate care, including patient education.

The availability of medical care may be affected by a lack of healthcare personnel and insufficient time for patient visits, making it difficult to identify needs, make decisions, and provide documentation at the same time. Patients seeking medical help at primary care health centers may have several conditions simultaneously and may use different healthcare services in various healthcare institutions. It may also be the case that patient data are not available to all parties, although all relevant health data should be transferred to the central system in the Estonian case. Users prefer DDSSs that are simply designed, save time, and are easy to learn and install if needed [11]. It is an important benefit for GPs that EMBeDS is integrated with their desktop. This saves time for dealing with data and, at the same time, harmonizes the available data and offers relevant recommendations. Despite the assumptions, it is important for clinicians that the DDSS recommendations encourage them rather than oblige them to interact. One recent study highlighted the importance of accessing the DDSS from different locations of the EHR [11].

There were several barriers affecting the use of the DDSS, such as non-relevant recommendations, alert fatigue, a lack of user friendliness, slow and poor integration with the EHR, and information overload [7]. Barriers revealed from the study included technical and content-related obstacles, while non-relevant recommendations and information explosion can be considered an experts' habit phenomenon. GPs have their own professional behavior based on individual clinical intuition, expertise and beliefs that are not in alignment with the organizational changes, which in turn leads to difficulties in accepting and effectively making evidence-based clinical decisions. One possible explanation for not adopting and accepting the DDSS could be that the system does not meet the needs or support the current way of clinical working, meaning that it simply is not serving its purpose.

In recent studies, several barriers have been reported related to DDSS use, such as poor digital competence, limited access to EHRs, lack of timely technical support, overloaded

work environments, and poor interaction with other software solutions [11]. In a recent study conducted by Horwood et al. [16], the participants suggested that alerts could be displayed when incorrect data are inserted by the GP into the DDSS or if the values do not match the reference values. In this study, the GPs reported that the DDSS displays recommendations related to the previous patient, not the next patient who is visiting the GP. This could be explained by the fact that the software system is running slowly, which does not allow the comparison and alignment of data. Since the DDSS does not analyze or match free, narrative text, it is important for GPs and nurses to insert data in a structured way into the appropriate data fields, to use the correct ICD-10 codes, and to insert the correct prescription type and treatment plan when writing a prescription.

It is vital that the software solution is not distracting and provides evident value. When developing technical solutions, specialists working in this field should be involved in the development process, and their opinions should be considered [6]. Ineffective care coordination and the underlying suboptimal teamwork processes are healthcare organization issues. To provide safe and quality care, accurate and effective teamwork-related interventions as well as collaboration at different levels are required [34], [35], [36].

The key takeaways from the article are the following:

- To meet the demand for healthcare, there is a need for software solutions that facilitate the clinical work of GPs and do not interfere with their working process.
- DDSS has the potential to serve this purpose, despite several developmental issues.
- Systematic user experiences need to be collected and examined to ensure the usability and sustainability of the DDSS.
- Future studies are needed to examine systematic user experiences and evaluate the functioning of the system and the quality of the decisions provided by the DDSS. This should involve observing and evaluating EPR as well as focusing on the pros and cons of using the DDSS.

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Appendix 1 – Submitted journal information, submissioncorrespondence and article

This study was formed as a scientific research article and was submitted to Digital Health on 28/12/2023. Impact Factor: 3.9 and 5-year impact factor is 4.4. Digital Health is a "*peer reviewed open access journal which focuses on healthcare in the digital world, bridging the evolution of advances in informatics and technology in medicine, health and all aspects of health care*."

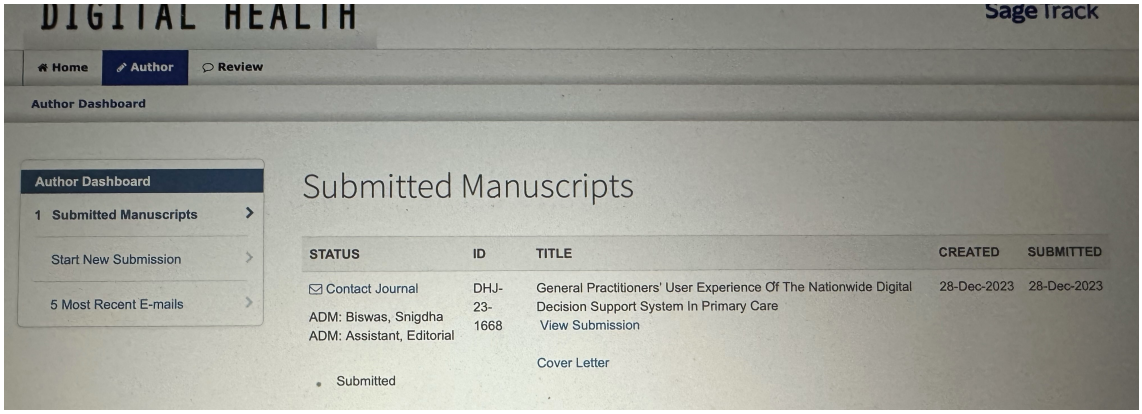
Article was structured according to the requirements of journal and consists of 4123 words, 1 figure, 1 table and 36 references.

DIGITAL HEALTH

General Practitioners' User Experience Of The Nationwide Digital Decision Support System In Primary Care

Journal:	*Digital Health*
Manuscript ID	DHJ-23-1668
Manuscript Type:	Original Research Article
Date Submitted by the Author:	28-Dec-2023
Complete List of Authors:	Šteinmiller, Jekaterina; Tallinn University of Technology, Infotechnology Ross, Peeter; Tallinn University of Technology
Keywords:	Digital decision support system, Evidence-based personalized medicine, User experience, Primary care, Qualitative study

Abstract:	Objectives: The aim of the study is to describe the user experiences of a nationwide digital decision support system (DDSS). Summary of background data: DDSSs have the potential to improve the quality and safety of medical services by supporting clinical decision-making with evidence-based recommendations. Due to a lack of knowledge, it is difficult to assess whether DDSSs are fulfilling their purpose. In Estonia, a nationwide DDSS for general practitioners (GPs) was implemented in 2020. To understand the impact of DDSS on the quality of care in the Estonian context and meet the demands of healthcare, it is necessary to gather information about the experiences of the users. This is the first study that examines the experiences of GPs of the nationwide DDSS. Methods: A qualitative descriptive study was conducted based on snowball sampling. Semi-structured interviews were performed in February–March 2022 with nine GPs. Data were analyzed by thematic analysis. A total of six themes and 16 subthemes emerged from the data. Results: The following themes were identified: user-friendliness, DDSS use in clinical practice, benefits, and the impact of the DDSS on GPs' work, barriers to using the DDSS, and suggestions for improving the user experience. DDSS used in various clinical settings and found that it is generally a useful solution, although the system needs improvements. Conclusion: To meet the demands of healthcare, there is a need for software solutions that facilitate clinical work. Certain developments of the DDSS are required. Future research should evaluate the functioning of the DDSS and the quality of the decisions it provides by observing and evaluating patients´ records.



Digital Health
Digital Health DHJ-23-1668
To: shteinmiller@gmail.com, Peeter Ross,
Reply-To: digitalhealth@sagepub.co.uk

Inbox - Google 28. December 2023, 15:12

28-Dec-2023

Dear Dr. Šteinmiller:

Your manuscript entitled "General Practitioners' User Experience Of The Nationwide Digital Decision Support System In Primary Care" has been successfully submitted online and is presently being given full consideration for publication in Digital Health.

Your manuscript ID is DHJ-23-1668.

You have listed the following individuals as authors of this manuscript:
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Thank you for submitting your manuscript to Digital Health.

Sincerely,
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Introduction

Digital decision support systems (DDSSs) are software solutions developed to facilitate clinical decision-making, where patients' health data are matched with computerized clinical knowledge or a machine learning algorithm, and then personalized recommendations are presented to inform decision-making.[1-2] Different types of DDSSs are widely used at different levels within the healthcare system to support specific processes of care and health issues, both in medical and nursing care. A DDSS is a crucial tool that primarily deals with health and medical data, and recently, genome data as well.[1-7]

A DDSS is used to support the clinician's decision-making process in several ways. It can improve the treatment process by influencing the quality of treatment, reduce treatment errors, increase healthcare professionals' adherence to treatment instructions, and improve patient outcomes/health outcomes involving patients' data assessment, which is adjusted based on the evidence-based clinical knowledge provided by the DDSS.[6-11]

There are knowledge-based and non-knowledge-based DDSSs.[9] Knowledge-based systems are based on rules (IF–THEN statements), and the system retrieves data to evaluate each rule and produce an action or output (Figure 1). Non-knowledge-based DDSSs produce recommendations based on different artificial intelligence (AI) methods, such as machine learning (ML), or statistical design, rather than evidence-based (EB) knowledge.

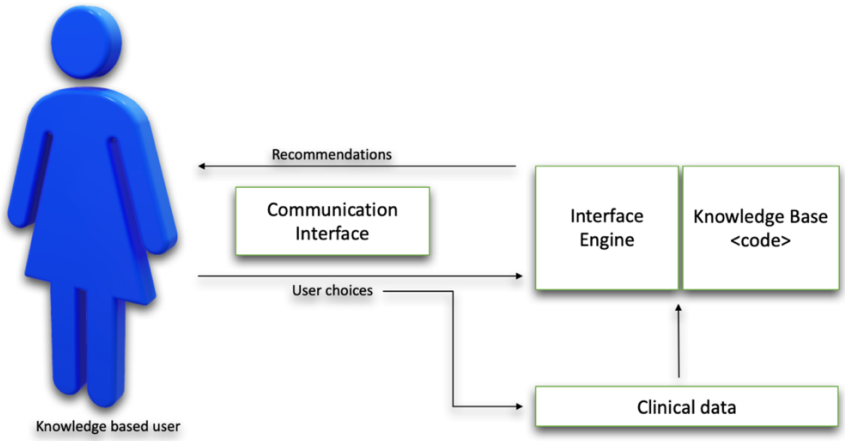

Figure 1. Key interactions in a knowledge-based DDSS.[9]

Decision-making support can allow healthcare professionals to work easier and faster. However, there is no international consensus regarding approved methods of measuring the results of clinical decision support tools and their presentation, leading to contradictory research conclusions.[11-17] Therefore, it is difficult to confirm whether the decision support systems are effective (i.e. whether they fulfill their purpose).

Evidence shows that alerts, reminders, or feedback provided by decision support systems can influence patient care (e.g., diabetes care).[12] Koskela et al.[16] investigated individually perceived barriers and enabling factors affecting the implementation and use of a DDSS by healthcare professionals. Their study revealed that the reminders transmitted by the system are effective in shaping the treatment management behaviors of doctors.[16]

It is assumed that the entry of the general practitioner (GP) in the health record affects the rules/suggestions offered by the decision support system, which in turn affects the quality of treatment. Marcolino et al.[13] evaluated the perceived feasibility, usability, and usefulness of a decision support system and the satisfaction of healthcare workers six months after the implementation of the system. In addition, two focus group interviews were conducted with users: GPs and nurses.[13,15] In terms of feasibility, both GPs and nurses agreed that decision support can be used in primary care. Regarding ease of use, they stated that the decision support decisions were simple to use and particularly useful in carrying out preventive activities and promoting the treatment process.[13]

Implementation of DDSSs in the Estonian Nationwide Health Information System

Primary care is a gatekeeper of patient journey in the Estonian healthcare system, which is based on the solidarity-based principle, meaning that all insured people in Estonia are entitled to the same quality health care. There are agreed pathways for GPs and nurses to follow based on the patient's condition.[19] The Evidence-Based Medicine Electronic Decision Support system (EBMeDS) is a unique, simple, and structured software solution, which was developed by the Finnish publisher Duodecim Medical Publications and has been implemented in Estonia since 2020. EBMeDS supports qualitatively new primary care service by speeding up the decision-making process and improving patient safety by supporting GPs and nurses through patient-specific recommendations and entries both in real-time and for special groups of patients. EBMeDS is registered as a medical device in Estonia and belongs to the group of knowledge-based DDSSs.[20-21]

The uniqueness of the Estonian setup is that the system is a nationwide solution, and all patients' health data across the country are considered. Likewise, EBMeDS uses a patient-oriented Estonian Nationwide Health Information System (EHIS) as an EHR service, in which healthcare providers at different healthcare levels have exchanged patients' health data since 2008. EHIS includes a medical overview of visits, anamnesis, diagnoses, received treatment, and recommendations, which is visible to all healthcare professionals taking care of the patient.[19]

All healthcare service providers in Estonia are obliged to send certain data and documents defined by law to the EHIS. The data in the EHIS are also visible to the patient through the patient portal. EBMeDS is connected to all electronic medical records (EMRs) used by GPs and to the Prescription Center, which is a central service. There are five different EMRs for GPs in use in Estonia. EBMeDS automatically queries and analyses the data from EHIS, the Prescription Center, and the EMR of the GP and presents reminders, therapeutic suggestions, and links to patient-specific guidelines through the EMR user interface. The aim is to offer users the most recent medical information relevant to the present treatment context. Both the medical data and data exchange standards are matched to ensure that decision algorithms receive information in a structured and standardized format.[22]

EBMeDS analyzes patient data, compares the patient's status to criteria based on clinical guidelines, or looks for any inconsistencies in the data. Based on the analysis, reminders or alerts are created and sent to the GP's desktop. The system provides links to relevant guidelines used by the software. EBMeDS can also prefill interactive electronic forms with patient data, such as calculators, recommendations, or algorithms.[20-21]

Patients' information is run through decision support scripts, focusing on a specific clinical layout, based on evidence-based knowledge. Scripts (N=797) are compressed guidelines that have been translated into a computer-interpretable form, containing a brief summary describing the functionality of the data. Additionally, appropriate links to the evidence are provided, along with summaries from evidence-based guidelines and references, Cochrane reviews, and the decision rule messages. Potential harms are presented separately. EBMeDS supports decision-making in 27 specialities.[20]

The short versions of the outputs (reminders) of the decision rules are available in 12 languages. However, more decision rules are being developed. Several structured databases have been developed by Duodecim and other institutions to support the creation

of decision rules for drug treatment. It is important to note that EBMeDS is a source of information for healthcare professionals, supporting their clinical performance.[20-21]

In addition to the EBMeDS, the drug interaction database and clinical decision support INXBASE has been available in Estonia nationally since 2016. It is connected to the e-prescription system and is available for all EMRs used in Estonia. The database was developed by Celsius Healthcare in cooperation with the Estonian Health Insurance Fund. The platform contains evidence-based information on up to 26,000 pharmacokinetic interactions, based on the active ingredient and dosage. Interactions in the database are classified based on clinical significance and are evidence based. The database has five subsections: Clinical Implication of the Interaction, Recommendation, Mechanism, Background, and References. This system was developed to improve patients' safety'.[23]

According to the register of the Health Board Republic of Estonia a total of 1,195 GPs are registered in Estonia.[26] Most Estonian GPs (80%) use the DDSS in daily practice, and for 95% of GPs, the DDSS is available on their desktop.[27]

There are several advantages of the DDSS, including reducing medication errors, improving patients' safety, clinical management, and documentation, and supporting diagnostics. The following risks are associated with the DDSS: disrupted workflow, unnecessary alerts and notifications, interoperability issues, data content and quality, lack of standardized metrics, affordability, and other concerns.[9]

Despite the benefits, little is known about the perceptions/experiences of users, patient health outcomes and associated costs, and/or evaluation of the quality of care. Thus, the results of this research will be helpful for improving the implementation of the DDSS by GPs and nurses and the quality of treatment at the primary care level when using technology to support clinical decision-making. To understand the quality of decision support in the Estonian context, it is necessary to evaluate both the functioning of the system as a whole and the experiences of the users. This was the first study to evaluate the user experience of a DDSS, response to the expectations of healthcare providers. Accordingly, the aim of the study was to describe the user experiences of the DDSS and gain a sense of the underlying patterns and reasons GPs have for interacting with it.

Methods

A qualitative descriptive study was conducted, with snowball sampling used to recruit the interviewees. Initially, the plan was to conduct 10 interviews or to collect data until the database became saturated, that is, when no new information was added during the interviews and the answers began to repeat.[24] For this purpose, the Estonian Society of General Practitioners (EPS) was approached with a request to distribute an invitation to participate in the study. The GPs who agreed were then asked to recommend other contacts who fit the research criteria and who might be willing to participate, and in turn, who could also recommend other potential participants. The reason for utilizing a qualitative study design and snowball sampling was that it is difficult to objectively calculate the actual accuracy and impact of the DDSS. Due to a lack of research data, it is unclear whether the DDSS is fulfilling its purpose or the quality of the decisions, alerts, and reminders it provides. Moreover, from a data protection perspective, it is difficult to access sensitive personal data to evaluate the results of the DDSS.[25]

Informed consent was obtained from all participants.[28] Since all the GPs preferred video interviews (using MS Teams), digital signing of the informed consent form was used, as electronic signing allows document files to be signed without paper and saves time.[29] Semi-structured interview questions (8) adapted from Koskela et al.[16] were used for the interview (after translation into the Estonian language) to clarify user-perceived barriers and enabling factors that influence the implementation and use of a decision support system by healthcare professionals. During the interviews, the respondents were directed to delve more into the topics with guiding questions: "*Please give an example, how exactly it was, can you add something else, what it meant to you, how it affected you*." At the end of each interview, the interviewee was given the opportunity to add something if desired. The interview questions were as follows:

1. Please share the user experience of the DDSS?

2. In which clinical situation did you use decision support? How much time did it take? What was the consequence of this?

3. What do you think are the best elements of this decision support?

4. What impact has decision support had on your work or collaboration between other professionals and patients? Has it affected the way you work?

5. Which decision support elements have you paid attention to? Which ones have you not?

6. Have you encountered obstacles when using decision support?

7. What ideas/suggestions do you have for improving decision support?

8. Is there anything else about the decision support system that we haven't mentioned yet?

The data were analyzed based on a six-step thematic analysis framework, which is a qualitative data analysis method for identifying themes within qualitative data.[30-32] In the first step, the researcher became familiar with the data, and important notes were recorded. Step two included the generation of the initial codes. Open coding was used, meaning that codes were developed during the coding process. In the third step, a search for themes was conducted. Descriptive initial themes describing patterns in the data relevant to the research questions were identified. In step four, the initial themes were reviewed and modified. In step five, the final refinement of the themes was conducted. The process ended with a write-up in step six.[30-32] The result was based on 26 codes, which were categorized into six themes and 16 subthemes (see Table 1). The presentation of the findings is based on the themes, subthemes, and quotations.

Data Analysis

Recruiting interviewees was challenging. Two reminder letters were sent to the EPS. Data were collected in February–March 2022. A total of nine GPs were interviewed. GPs who agreed to participate in the interview contacted the researcher using the contact details listed in the invitation, and then a suitable time and place for the interview (on-site or online/MS Teams, Zoom, Skype) were agreed upon.

The duration of the interviews was 30–45 minutes, which were conducted as video meetings. All the interviews were recorded and transcribed into text by the lead author after the interview was finished. All interviews were then listened to and read over, avoiding the loss of text, and then the audio recordings were deleted from the recorder. No personally identifiable information was transcribed during the interviews.

Results

The analysis revealed six main themes: *user-friendliness*, *DDSS use in clinical practice*, *benefits of the DDSS*, *the impact of the DDSS on GPs' work*, *barriers to using the DDSS*, *and user experience improvement suggestions* (Table 1).

Themes	**Subthemes**
User friendliness	Positive and negative user experiences
DDSS use in clinical practice	Patient with multimorbidity Adult health examination
Benefits of the DDSS	Modern solution Supports clinical decision-making Digital solution integrated with GPs dashboard Convenient to use
Impact of the DDSS on GPs' work	Time saving Improved communication Improved documentation
Barriers to using the DDSS	Mismatched input data
Suggestions for improving the user experience	Warning when entering wrong information Warning if data differs from reference values Compliance of data with system recommendations Data exchange when changing the patient Timing of alerts/warnings

Table 1. Main themes and subthemes identified.

The first identified theme was "***user friendliness***," based on GPs' shared user experience of the DDSS. There were both positive and negative experiences shared by GPs, who reported that the DDSS was "*convenient to use*" and "*simple*." As with any innovation, the users expressed some initial bias: "*At first it seemed complicated, and I was confused. I needed time to learn how to use it*." It was also reported that the DDSS operates "*…slowly, wastes the time of the visit….*"

The second identified theme, "***DDSS use in clinical practice***," referred to the use of the system in daily practice with the patient. The majority of patients GPs encounter in their daily work have several diseases (multimorbidity), and some of the GPs shared that DDSS was used for "*…working with chronically ill patient….*" One of the interviewees used the DDSS with a "… *regular patient arrived for a visit*…" and found the system to be "…*time-saving.*" The system was also used for adult patients who required a license for "…*driving a motor vehicle*."

Third, the "***benefits of the DDSS***" were supported by subthemes like "*modern solution*," which "*supports clinical decision-making*" and is "*convenient to use*" because it is a "*digital solution*" that is "*integrated with GPs' desktop*." Based on the interviewees, the DDSS "*supports GPs' work*" by giving "*suggestions based on the current treatment guidelines, no need for search anything else*" as well as providing "*instructions, etc. that I would not have thought of immediately*" and recommendations for "*consider making diagnostics and lab tests*." The participants stated that the current DDSS is "*modern and convenient because of* [its] *integration with the GPs' dashboard.*"

The fourth identified theme was "***impact of the DDSS on GPs' work***," which was supported by subthemes like "*time-saving*" *and* "*improved both communication and documentation*." Using the DDSS "*enables GPs to spend more time on the patient.*" Moreover, the GPs stated that "*documentation improved*" as well as "*communication among other specialists.*"

The theme "***barriers to using DDSS***" were mainly related to "*mismatched input data*." GPs noticed reported that "*When opening new patients health record recommendations related to the previous patient displayed*," which in turn raises doubts about trustworthiness and the quality. The DDSS might "*display an empty cell, but when clicking on it, it shows the EBMEDS treatment recommendations*."

GPs also made suggestions related to "***user experience improvement***." Several subthemes were identified, including "*warning when entering wrong information*," "*warning if data differ from reference values*," "*compliance of data with system recommendations*," "d*ata exchange when changing the patient*," and "*timing of alerts/warnings*." When inserting incorrect clinical data, an exception should be generated and displayed, which does not allow the system to proceed further: "*If there is any error in the values of the blood tests or a repetition, ex-high cholesterol values are over the reference value, then appropriate warnings or recommendations should be given/displayed*" and "*While viewing the health record there is no entry in the health record about whether the doctor followed recommendations or not*." This is because is not possible to assess whether the decision/recommendation of the decision support system was taken into account by other GPs: "*The DDSS shows the recommendations given to the previous patient. Therefore, the reliability/relevance of the offered recommendation is questionable*." In this case, the warning is incomprehensible because the recommendation/warning was made already.

Discussion

The results of this study are based on user experiences of the nationwide DDSSs, the first time that GPs' opinions of the DDSS have been examined in Estonia. To the best of our knowledge, Estonia is the first country in which clinical a DDSS is used nationwide. DDSSs are used worldwide in various clinical situations, and they are considered a way to improve healthcare delivery.[1-5] However, the use of a DDSS is limited to the EMRs of a healthcare provider or EHRs of a specific region. The results of our study also confirmed that the DDSS in Estonia is used in dealing with various health issues due to its benefits. GPs are the gatekeepers of the healthcare system, and patients with various problems need to be effectively assessed during the limited visit time and treated appropriately. It is crucial to provide appropriate conditions at the primary level to assist and support GPs in achieving their clinical goals to improve patients' health outcomes.

Based on the study conducted by the Estonian Health Insurance Fund,[27] only 80% of GPs use the EBMeDS, which is surprising since the DDSS has been enabled for several years. Similar results were reported in the study of Kortteisto et al.[33] On the one hand, this may be due to the fact that GPs in Estonia have no unified EMR, and technical issues may affect the acceptance and usage of the DDSS. Fragmented digital systems may be a problem and may affect patients' safety.[1] However, on the other hand, it may be due to GPs' lack of knowledge or previous experience regarding using the DDSS, or it may be assumed that the DDSS itself lacks a user-friendly design. Users' digital competency, previous experience with similar digital solutions, and appropriate training all facilitate proper usage and interaction with the DDSS.[34-35] There is a need for clear and concise training that supports GPs in the use of the system. The motivation of GPs to use the system could also be increased by confirming the evidence that informs the system, which does not replace the clinical intuition of several specialists. Since the priority of GPs' clinical work is patients' well-being, it would be unreasonable to waste this valuable professional resource on poor development. However, as long as the use of the system is not fully accepted by GPs and is voluntary, it cannot be ensured that the target group will use it appropriately despite its benefits. Moreover, GPs reported the "*impact of the DDSS*" on their work, saving time and enhancing communication at all levels as well as improving documentation. These results offer valuable insights regarding quality-of-care coordination, which can improve long-term patient outcomes. Casey et al.[6] reported

similar findings, as the majority of physicians who participated in their study agreed that the DDSS improves patient outcomes and saves time. In a recent study by Meunier et al.,[2] physicians stated that using DDSS increases their self-confidence and improves care, ensuring patients receive appropriate care, including patient education.

The availability of medical care may be affected by a lack of healthcare personnel and insufficient time for patient visits, making it difficult to identify needs, make decisions, and provide documentation at the same time. Patients seeking medical help at primary care health centers may have several conditions simultaneously and may use different healthcare services in various healthcare institutions. It may also be the case that patient data are not available to all parties, although all relevant health data should be transferred to the central system in the Estonian case. Users prefer DDSSs that are simply designed, save time, and are easy to learn and install if needed.[6] It is an important benefit for GPs that EMBeDS is integrated with their desktop. This saves time for dealing with data and, at the same time, harmonizes the available data and offers relevant recommendations. Despite the assumptions, it is important for clinicians that the DDSS recommendations encourage them rather than oblige them to interact. One recent study highlighted the importance of accessing the DDSS from different locations of the EHR.[6]

There were several barriers affecting the use of the DDSS, such as non-relevant recommendations, alert fatigue, a lack of user friendliness, slow and poor integration with the EHR, and information overload.[2] Barriers revealed from the study included technical and content-related obstacles, while non-relevant recommendations and information explosion can be considered an experts' habit phenomenon. GPs have their own professional behavior based on individual clinical intuition, expertise and beliefs that are not in alignment with the organizational changes, which in turn leads to difficulties in accepting and effectively making evidence-based clinical decisions. One possible explanation for not adopting and accepting the DDSS could be that the system does not meet the needs or support the current way of clinical working, meaning that it simply is not serving its purpose.

In recent studies, several barriers have been reported related to DDSS use, such as poor digital competence, limited access to EHRs, lack of timely technical support, overloaded work environments, and poor interaction with other software solutions.[6] In a recent study conducted by Horwood et al. (2023),[11] the participants suggested that alerts could be

displayed when incorrect data are inserted by the GP into the DDSS or if the values do not match the reference values. In this study, the GPs reported that the DDSS displays recommendations related to the previous patient, not the next patient who is visiting the GP. This could be explained by the fact that the software system is running slowly, which does not allow the comparison and alignment of data. Since the DDSS does not analyze or match free, narrative text, it is important for GPs and nurses to insert data in a structured way into the appropriate data fields, to use the correct International Classification of Diseases 10th Revision (ICD-10) codes, and to insert the correct prescription type and treatment plan when writing a prescription.

It is vital that the software solution is not distracting and provides evident value. When developing technical solutions, specialists working in this field should be involved in the development process, and their opinions should be considered.[1] Ineffective care coordination and the underlying suboptimal teamwork processes are healthcare organization issues. To provide safe and quality care, accurate and effective teamwork-related interventions as well as collaboration at different levels are required.[34,36]

Conclusion

To meet the demand for healthcare, there is a need for software solutions that facilitate the clinical work of GPs and do not interfere with their working process. Based on the study results, the DDSS has the potential to serve this purpose, despite several developmental issues. Systematic user experiences need to be collected and examined to ensure the usability and sustainability of the DDSS.

The study showed that certain improvements are required, and user experiences and opinions should be considered in making those improvements. In particular, future studies are needed to examine systematic user experiences and evaluate the functioning of the system and the quality of the decisions provided by the DDSS. This should involve observing and evaluating EPR as well as focusing on the pros and cons of using the DDSS.

DECLARATIONS

Declaration of Conflicting interests

The authors have no conflicts of interest to declare. All authors have seen and agree with the contents of the manuscript, and there is no financial interest to report.

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Ethical Approval

The ethics committee of the National Institute of Health Development approved this study (decision no 1001, issued 29.12.2021).

Guarantor: JS

Contributorship: JS researched the literature and conceived the study. JS and PR were involved in gaining ethical approval and agreement from the Association of Estonian General Practitioners. JS collected data and interviewed GPs. JS wrote the first draft of the manuscript. Both authors, JS and PR, critically reviewed and edited the manuscript and approved the final version of the manuscript to be published. Both authors participated sufficiently in the work.

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Appendix 2 - Ethics board acceptance response

Tervise Arengu Instituut

Tervise Arengu Instituudi inimuuringute eetikakomitee

Otsus nr 1001

Tervise Arengu Instituudi inimuuringute eetikakomitee (TAIEK) koosseisus Kristi Rüütel, Kaire Innos, Marje Liibek, Adik Levin, Avo-Rein Tereping, Vahur Valvere, Anne Kull, Ants Kask, Toomas Pruunsild arutas oma koosolekul 16. detsembril 2021 ja otsustas lugeda kooskõlastatuks uuringuprojekti 2326 **„Üleriigilise otsustustoe süsteemi otsuste kvaliteedi hindamine“**, mille vastutav uurija on **PhD Peeter Ross** (Tallinna Tehnikaülikool) ning põhitäitja on **PhD Jekaterina Šteinmiller** (Tallinna Tehnikaülikool, magistrant).

TAIEK koosoleku protokoll nr 35. Otsus nr 1001 on väljastatud 29.12.2021.

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TAIEK esimees /allkirjastatud digitaalselt/

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