




UMEÅ UNIVERSITY

An abstract, textured background image with vibrant green, blue, and orange colors, resembling a close-up of a biological or natural surface.

Digital care pathway for type 2 diabetes patients

The experiences and opinions of diabetes specialist nurses

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Abstract

Introduction: Type 2 diabetes (T2D) is a chronic disease with a complex treatment. Treatment often includes polypharmacy, and it is often accompanied by complications and comorbidities. There is a need for strong patient involvement in the treatment. Diabetes specialized nurses (DSNs) play a key role in the treatment. The prevalence of T2D is increasing. At the same time there is a lack of healthcare providers and resources. Patients are not getting the care they ought to get and the results in health outcomes are not satisfactory.

Digital care pathways (DCPs) offer patients and DSNs digital tools in the care of T2D. Data can be collected and analyzed, use of resources optimized, treatment outcomes estimated, and continuous communication improved, and patients be supported in a secure environment. DCPs as a part of treatment may improve medication adherence and medication safety. Utilizing pharmacists' services in DCPs might be beneficial. Current DCPs and other platforms are often not integrated to current workflows and the development lacks user-friendliness. It is important that patients and DSNs participate in the planning process to make the pathways more usable.

Objective: To investigate experiences and opinions of Finnish and Swedish DSNs on usability and extent of utilization of DCPs and, on the possibility to improve medication adherence and medication safety when using DCPs. In addition, the possible utilization of pharmacists' services in DCPs/platforms was investigated.

Method: A web-based structured survey including ready-made statement opinions and qualitative open-ended questions was used in this descriptive quantitative study.

Results: DSNs both from Finland and Sweden participated in the study. Many respondents treat type 2 diabetics every day or weekly and they often work in health care centers, in primary care and in the public health care. Respondents felt that DCPs offer useful functions in their work treating type 2 diabetics, and they thought that DCPs can improve medication adherence and medication safety. Utilizing pharmacists' services was felt to be the least utilizable part of the five sections in the study.

Many respondents felt that DCPs should be utilized more. Nevertheless, they did not feel that DCPs always make their work easier. There were concerns about availability and willingness of older people to use DCPs. DSNs wished for more user-friendly digital healthcare (DHC) services. Lack of time was found to be an obstacle in implementation of DCPs and, many tools and terms for DHC were found confusing. Results between Finnish and Swedish respondents were found to be similar. DSNs with previous experience on DHC services evaluated the functions in DCPs higher than the respondents with no previous experience evaluated such services.

Discussion: Unfamiliar ways of working and fear for increased workload can contribute to unwillingness to implement DCPs. Lack of integration of DCPs to workflows increases the workload of DSNs. The fear for unfamiliar ways of working is supported by differences in results between DSNs with previous experience of DHCs and DSNs with no previous experience of DHCs. Many T2D patients are old, and they are not used to digital tools. They can find DHCs inconvenient, and they often prefer traditional face-to-face appointments. Knowing the specific needs of older T2D patients may improve the commitment to use of DCPs. Nevertheless, it is important to remember that all patients cannot be treated digitally. The number of different pathways adds inequality in the care of T2D patients, national coordination could improve the situation. Pharmaceutical skills might be unfamiliar for DSNs which can contribute low willingness to utilize pharmacist services.

Conclusions: DCPs offer useful functions for DSNs in the treatment of T2D. To increase the usefulness of DCPs, it is important to integrate them to the current workflows of DSNs. More time and support are needed to increase the implementation of DCPs in DSNs' work. There is a need for national criteria and coordination of DCPs. To offer national common DCPs for several diseases or to unify the existing DCPs might be beneficial in the future. T2D patients might benefit from pharmaceutical services as a part of their treatment.

Key words: type 2 diabetes, digital care pathway, diabetes specialist nurse, pharmacist

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List of Abbreviations

Adverse drug events (ADE)

Diabetes specialist nurses (DSNs)

Digital care pathway (DCP)

Digital healthcare (DHC)

Health Care Provider (HCP)

Standard deviation (SD)

Type 2 Diabetes (T2D)

World Health Organization (WHO)

1. Introduction

1.1. Type 2 diabetes

Type 2 diabetes (T2D) is a long-term illness. Treatment of T2D is complicated and patients need to cope with multiple medical assignments continuously [1]. Patients suffer from chronic hyperglycemia. High blood glucose levels can be caused by a lack of insulin or by the impaired effect of insulin or both reasons [2]. Unhealthy lifestyle or a genetic predisposition are examples of reasons behind the changes in insulin release and effect [3]. T2D is associated with the possibility of acute and chronic complications and premature death as well as comorbidities. Ketoacidosis is an example of an acute complication. Chronic complications can be micro- and macrovascular. Retinopathy, kidney diseases, and renal diseases are microvascular complications and heart attack or stroke are examples of macrovascular complications. Comorbidities associated with T2D are for instance high blood pressure or hypercholesterolemia meaning that the patients suffer from metabolic syndrome [2-5]. There are several risk factors for T2D. Obesity and overweight are a major risk factor [2, 3]. Other risk factors are some medications (diuretics, non-selective beta-blockers, statins), advanced age, smoking, nutrition rich in saturated fats, limited physical activity in work and at leisure time, and some psychosocial factors like continuous stress, too little sleep, or depression [2, 4, 6].

The goal of treatment for T2D is to maintain steady blood glucose levels, prevent complications and treat comorbidities [2]. If risk factors are being recognized more effectively, macro- and microvascular complications can be reduced [7]. Lifestyle modifications play a key role in the care of T2D patients in terms of nutrition, weight control, smoking cessation, and exercise [4]. Life-style interventions are also of great importance in the prevention of T2D since effectively proceeding counselling can decrease diabetes incidence [8]. If life-style modifications do not gain optimal results, treatment with blood sugar lowering medication should be considered [2, 4].

The treatment of T2D should be supported and monitored by a multi-professional team of healthcare providers (HCPs) [2]. Diabetes specialist nurses (DSNs) play an essential role in guiding the care of T2D patients [9, 10]. Treatment should be based on local, national, and international recommendations. Patients should be offered patient-centered care and treatment goals are to be set individually [11]. Patients should be aware of the treatment goals [2, 4]. It is of great importance to support the continuity of care and to offer patients safe medication regimens. Active patient involvement and self-management lay an essential role in the treatment [5]. Self-management can be explained as one's capacity to succeed in accomplishing the therapy and decreasing symptoms as well as life-style modifications that exist in the situation with a long-term illness [12]. Both in Finland and in Sweden, diagnosing T2D is based on the criterion of World Health Organization (WHO). The diagnosis for T2D is based on symptoms, comorbidities, patients' plasma glucose levels, clinical status and on family history of the disease (figure 1) [2, 4].

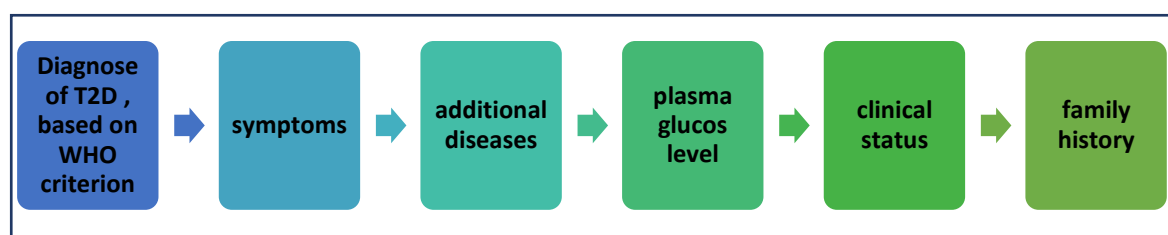


Figure 1. WHO criterion for diagnosing T2D [2, 4].

1.1.1. Incidence and prevalence

The rising incidence and prevalence numbers of T2D have become a global issue [3]. T2D patients are usually diagnosed at around 60 years of age, but it is not an exception that

younger adults also get diagnosed [13, 14]. It is estimated that there are around 463 million people worldwide with diabetes and 90% of these patients have T2D. This makes the global prevalence of T2D 9.3% of adults aged from 20 to 79 years [3]. It is also estimated that there are a great many adults who have undiagnosed T2D [3, 13]. It is predicted that the number of T2D patients will increase up to 700 million patients in the year 2045 [15].

In Finland it has been estimated that there are 375 000 T2D patients [2]. In 2020, 364 411 people were treated with diabetes medication (both type 1 and type 2 diabetes) [15]. The largest increase in the number of T2D patients is among patients 70 or older [2]. In Sweden, it is estimated that there are approximately 500 000 patients with diabetes [16]. Approximately 90% of diabetes patients in Sweden have T2D [14]. Of the Swedish population, 20 to 25% is estimated to have a genetic risk for T2D [4].

1.1.2. Costs of type 2 diabetes

Along with the increased prevalence and as a highly priced treatment, T2D has become one of the most expensive long-term illnesses in Europe and as well as worldwide [3, 5, 14]. About 9% of total health care costs in Finland originate from treating T2D [3]. The costs are expected to become even higher in the future [3]. Complications can double the expenses of the treatment, and the unbalanced care of T2D results in more expenses in form of decreased productivity at work and in society [3].

1.1.3. Lack of healthcare providers and resources

In the current situation healthcare systems are facing the challenges of limited resources. The care systems need optimization and rationalization [17]. Treatment of T2D patients is teamwork which involves several HCPs [2]. Especially DSNs face the problem with limited resources since the care of T2D patients is often organized by them [14]. The need for care is constant since the treatment requires continuous monitoring and support from the healthcare professionals [2]. There is a shortage of HCPs, too little time to undertake the care needing to be offered according to the guidelines, and a great amount of work and limited economic resources. The limited resources and expectations do not meet in the care of T2D patients [18, 19]. T2D patients also find that they are not getting the care they ought to get according to the guidelines [16]. The care is inadequate even though the newest technology and variety of blood glucose lowering medications are available [17].

1.2. Digital healthcare

1.2.1. Definition of digital healthcare

The term digital health is a broader concept, and it includes several similar terms such as mobile health, eHealth, telehealth, telemedicine, and health information technology [20, 21]. Digital health is a form of communication or delivering information between patients and HCPs that are placed physically apart from each other [22]. In addition, digital healthcare (DHC) is a way of improving health and well-being in the care of patients [21]. In this report the concept of DHC will be used as a common term for all the sub terms mentioned here.

1.2.2. Digital healthcare and its benefits for type 2 diabetes

DHC offers solutions to the current situation where the increasing group of T2D patients cannot be offered the care they ought to get because of the lack of HCPs [17]. DHC have shown a positive effect on the care of T2D patients [23]. Both patients and HCPs can utilize DHC tools in the care of the disease. Computers, tablets, mobile applications, video calls and digital platforms are examples of DHC tools that are available. DHC enables a wide range of functions to be carried out in the work of HCPs and in patients' self-management of the long-term disease [24, 25]. Different DHC functions are listed in table 1.

There are several benefits if DHC is involved in the treatment of T2D patients. Health care costs and resources can be utilized more effectively [26], and care processes can be better organized [5, 27]. More patients can be reached easily, and health care can be provided independent of patients' geographical location [24]. In addition, digital appointments can save HCPs time and their work can be better organized [27], and hospital care can be focused to the patients in the greatest need of it [28]. It is also possible to reduce the incidence numbers of complications by utilizing DHC tools in the treatment [26]. Patients can store and access their own medical data, they can more easily be in continuous contact with the HCPs, they can reach adequate information in one place as well as receive complementary treatment instructions from HCPs and they can receive patient-centered care [29]. DHC enables HCPs easily to contact patients and receive information from patients even before an appointment [27]. Additionally, medication adherence and medication safety in the treatment of T2D may be improved when DHC platforms are involved in the care [29, 30].

In a care pathway treatment is supported by evidence and it follows the best available treatment methods for a group of patients. Decision-making can be supported, and communication promoted in a multi professional team as well as with patients and their relatives. It enables data collection, observing results and estimating the effectivity of treatment. A care pathway offers a possibility to utilize more effectively the available resources, improve patients' well-being and increase patients' security [31]. A digital care pathway (DCP) includes similar functions that a care pathway does, but the treatment is organized in a digital form [27, 28]. DCPs have shown to rationalize care processes [27]. However, all healthcare services cannot be offered digitally [27, 32]. Face-to-face appointment and physical examination need to be offered if DHC cannot be provided satisfactorily and safely and, if enough information of a patient cannot be provided in an on-line meeting with HCPs [32, 33]. For some patients and with some conditions a combined care of digital and face-to-face appointments might be beneficial [34]. For instance, skin diseases or acute situations are not suitable conditions to be taken care of digitally [35].

Table 1. Examples of available DHC functions [24, 25, 27].

SERVICES	SUPPORT AND REMINDERS	ACCESS TO INFORMATION
<ul style="list-style-type: none"> • Website and smartphone coaching • Online counseling • Online appointments • Clinical reviews • Receive individual based and UpToDate treatment regimen • Remote monitoring e.g. blood glucose monitoring • Booking and managing appointments • Continuous communication with HCP: Ask questions, get answers, receive feedback • Chat groups 	<ul style="list-style-type: none"> • Mental support • Support for medication adherence • Support for lifestyle modifications • Support for self-care • Receive test results • Tools to manage symptoms • Medication reminders 	<ul style="list-style-type: none"> • Links to health associated information • Access to relevant and reliable information in one place • Links to databases • Access to patients' own medical records • Share data with HCPs • Receive health- related questionnaires • An online notebook • Assessment of treatment effects • Get an overall picture of the treatment and disease: DCPs

1.2.3. Challenges of digital healthcare

During the Covid-19 pandemic physical visits to health care had to be restricted due to infection risk, and the use of DHC increased. Increased use of DHC brought a lot of positive experiences to healthcare, but there are still some challenges that needs to be solved [36]. Variation in the ability of patients to access DHC due to e.g., advanced age or deficient computer skills and patients who are not willing to adapt to DHC as a part of their treatment are challenges in the use of DHC. Some of the patients are not finding DHC confidential and safe. Limited effectiveness has also been found in some of the studies. And additionally, low usability can be an obstacle for the use of the DHC [24, 25]. Lack of integrated criteria and recommendations for DHC are one of the current challenges with digitalization. To be able to offer equal healthcare services to all citizens, DHC should be coordinated nationally and organized so that also those who need multiple healthcare services could be treated in equally [36]. National care pathways would offer equal treatment for all patients [37].

1.2.4. Strategy for digital healthcare

The Finnish and Swedish strategies for DHC are quite similar. In both countries, endorsement of health and well-being are at the center of the strategy. Strategies aim at involving individuals to participate actively and independently in society. The focus is on person-centered and individualized care. In the development of DHC the current workflows should be considered. The secure and safe management of information needs to be guaranteed and the development of DHC needs to be supported by offering citizens and HCPs education and skills so that they can adapt to DHC [38, 39].

1.3. **Medication adherence**

1.3.1. Definition of medication adherence

The WHO defines adherence as how well an individual follows the instructions on taking medication and life-style modifications that are given by HCPs [40].

1.3.2. Medication adherence and type 2 diabetes

Low medication adherence is a global public health problem [30]. T2D patients often have a poor adherence to medication [41]. There are several reasons behind the low medication adherence. Both longevity and complexity of the disease can contribute to nonadherence [30]. Demanding self-management, polypharmacy, adverse drug reactions (ADR), difficulties in administering the medication, inconvenience in insulin use, drug interactions [41], and high costs of treatment are treatment-based factors that can have a negative effect on medication adherence [30]. The relationship between HCPs and patients is of great importance [30], and inaccurate communication and lack of support from HCPs can lead to nonadherence [1]. Also, patients' own beliefs [42] and inaccurate knowledge about the medication regimen and complication prevention can contribute to low medication adherence [41]. T2D patients' poor commitment to medication often leads to lowered health outcomes like imbalance of blood glucose levels, higher morbidity, and mortality, to extra expenditures, and to an increased number of hospital visits and complications [42].

1.4. **Medication safety**

1.4.1. Definition of medication safety

Schepel et al. explain in their article medication safety as safety which is associated with the use of medicines. Additionally, it includes the principles and activities that are used to protect patients from being harmed in healthcare entities and organizations. Medication safety also includes arrangements that are used to prevent, avoid, and correct adverse reactions from the use of medicines [43].

1.4.2. Medication safety and type 2 diabetes

Medication errors affect medication safety [44]. T2D patients' chance of medication errors is particularly high [45] and they often lack the information about safe medication use [29]. Complex treatment and polypharmacy contribute to medication errors [45]. In addition, complex medication regimens and polypharmacy generate challenges from frequently changing prescriptions, drug interactions, and ADRs and it requires multitasking ability from T2D patients when they take care of the continuous organization and scheduling the correct intake of medicines [41]. Insulin, but also other blood glucose lowering medications, belong to high-alert medications. The possibility of medication errors and worsened medication safety is high when using this group of medicines [45]. Critical side-effects like severe hypoglycemia are possible with use of blood glucose lowering medication such as sulfonylureas and glinides [5]. Comorbidities and the complexity and longevity of the disease [45] as well as lack of knowledge about the disease and medications are additional reasons for the occurrence of medication errors [46].

1.5. **Pharmacists' role in the care of type 2 diabetes**

The work provided by pharmacists can improve the care of diabetes and its comorbidities, and this is well-known around the world [44]. Pharmacists enhance pharmaceutical care, add adherence to medication [44], and support the continuity of treatment [30]. When pharmacists work as a part of a medical healthcare team a positive impact on medication safety can be seen. Pharmacists can in their work handle drug-related problems such as controlling correct doses, choosing appropriate choice of the drug, and for instance, observing ADRs [44]. They can take part in medication training and education, do medication reviews for T2D patients. The advantage of pharmacists' role has been seen especially when pharmacists are able offer their services directly to patients [41].

When pharmacists have been involved in DHC, similar effects of improved adherence to medication have been seen [47]. Additionally, with DHC communication and exchange of information can be improved and this can result in improved teamwork between pharmacists and physicians. And the improved teamwork can lead to patients' better-balanced care and increased medication safety [29].

1.6. **Usability of current digital healthcare tools**

The integration of DHC tools to the current workflows of HCPs has not been very successful [17, 48, 49]. Lack of integration reduces the usability of DHC functions and increases the workload of HCPs in diabetes patient care [48, 17]. When DHC tools are integrated into the workflows of HCPs, patient engagement can be improved and motivation to use DHC increased. This can lead to reduced workload of HCPs, improved self-management of diabetes, to a good relationship between patients and HCPs and finally to beneficial care of diabetes [48, 50].

DSNs are in the center of diabetes care. Engagement of both patients and DSNs will only take place if the DHC platforms are developed so that their content fulfills the needs of both these groups. Additionally, support for the use of DHC systems like platforms is needed so that the benefits of the platforms can more easily be utilized by HCPs [14]. The future development should concentrate on coordinated systems from a patient and team-based point of view [41]. When the DCP for T2D is more usable, DSNs can be better adapted to use of it and T2D patients can benefit more from the care provided in the care pathway.

2. Objective

The aim of this study is to explore the experiences and opinions of DSNs to be able to develop and improve the usability of DCPs or other integrated digital platforms in the treatment of type 2 diabetes patients in the future.

In this study answers are sought for the following six study questions:

1. How useful diabetes specialist nurses in Finland and in Sweden are finding digital care pathways or other integrated platforms in their work treating type 2 diabetes patients and which functions they find important?
2. According to their experiences and opinions, do diabetes specialist nurses think that T2D patients' medication adherence can be improved when using digital care pathways or other integrated platforms?
3. According to their experiences and opinions, do diabetes specialist nurses think that T2D patients' medication safety can be improved when using digital care pathways or other integrated platforms?
4. Do diabetes specialist nurses think that digital care pathways or other integrated platforms should be utilized to a larger extent in the treatment of type 2 diabetes?
5. Do diabetes specialist nurses think that pharmacist services should be utilized in digital care pathways or other integrated platforms in the treatment of type 2 diabetes, and in which functions should be utilized?
6. Are there differences in the opinions and experiences of diabetes specialist nurses between Finland and Sweden?

3. Method

This study is a descriptive quantitative study with a web-based structured survey. As a platform for the questionnaire, Survey Pal was used. This study was conducted as a part of the Finnish MASSE (Personalized Care with Mass Production Efficiency) – project, which aims at building a virtual care operator concept for chronic patients who need more intense care and guidance.

3.1. Literature search

Due to the limited time for the literature search, the use of search engines was limited to the library in Umeå University and PubMed. Exploring the literature started with the search engines of the library in Umeå University and was followed by PubMed. Additionally, Finnish webpages of Ministry of Health and Social Affairs and Duodecim current care guidelines and Swedish webpages of Swedish medical product agency and Government offices of Sweden were used among others to gather background information like the strategy of DHC. Diabetes barometers made by Finnish and Swedish associations for diabetes patients were used to find information about the implementation of T2D treatment in Finland and in Sweden. The FinDM study was used to find information about the prevalence and incidence of T2D.

These search words were the most used words in literature search: type 2 diabetes, diabetes mellitus, type 2 diabetes mellitus, digital healthcare, eHealth, medication adherence, medication safety, medication errors, pharmacists, clinical pharmacists, workload, workflow, digital care pathways, diabetes nurses, diabetes specialist nurses, integrated platforms. English was used as the main search language. Some additional searches were also conducted in Swedish and in Finnish. Words AND and OR were used in the search to

optimize search results [51]. Chain, and random search were used in the literature search [52]. In chain search the references of the useful articles were used to find more information for the study.

The literature search was completed during the time interval of 2022-10-10 – 2022-12-31. In the search only open access articles were included and most of the articles were Peer Reviewed. Articles and documents older than 10 years were excluded from the study except for the articles that were used to define use of Likert scale and terms self-management and adherence as well as two of the books that were used as background information in the methodological part of the study.

3.2. The survey

The respondents were contacted via Association for DSNs both in Finland and in Sweden. The survey and the cover letters were sent to potential respondents via email. There were three language versions of the survey and of the cover letter. The knowledge of voluntary activity was indicated in the cover letter. Participation in the survey was taken as consent. The length of the survey period was 2022-10-14 – 2022-11-02. The survey period was five days shorter in Sweden due to technical issues. Two reminders were sent in Finland and one reminder in Sweden. In Finland, the survey was also marketed in social media (Facebook) of Association for DSNs.

It was possible to answer the survey in Swedish, Finnish, or English. There were both qualitative open-ended questions and quantitative statements with ready-made response options in the survey. A four-point Likert scale was used in the quantitative questions. The answer alternatives for the Likert scale can be seen in the figure 2. The number of questions with ready-made response options in the survey was 55 and the number of open-ended questions were four. In addition, there were eleven demographic questions in the survey.



Figure 2. The answer alternatives the four-point Likert scale that was used in the survey.

The survey was divided into six parts including demographic information and sections based on the study questions:

1. Demographic information
2. Usability of DCPs in the work of DSNs
3. The impact of DCPs on medication adherence
4. The impact of DCPs on medication safety
5. The opinions of DSNs on the extent of utilization of DCPs
6. The possibility of utilizing pharmacist services in DCPs

A pilot test was conducted after the survey was formulated. It was sent to a pilot test group consisting of eight participants totally in Sweden and in Finland. Two of the participants were pharmacists and the rest of the participants were nurses who did not belong to the group of potential study respondents. Seven people out of eight participated in the test. The group tested all three language versions of the survey. The participants were chosen to test the survey written either in Finnish, Swedish or English based on their mother tongue. Additionally, the survey was checked and approved by Umeå University. The surveys were

completed and corrected based on suggestions that were received from Umeå University and based on the comments received from the pilot group.

The survey was formulated, checked, sent out to the potential respondents, and closed according to the time scale in figure 3.

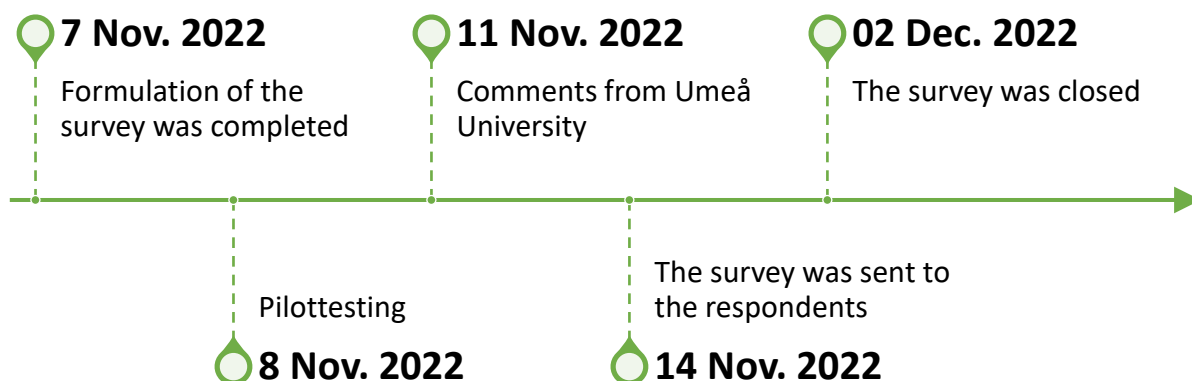


Figure 3. Timescale for the survey

3.2. Study population

The study population consisted of DSNs that are involved in the care of T2D patients in primary care and specialized care who work in hospitals and health-care centers as well in care homes, in home medical care and in emergency medical care in Finland and in Sweden. The term DSNs was used in this study for all the nurses or health care nurses that are involved in the care of T2D patients, and it was applied to them whether they had specialized as diabetes nurses or not. The goal of this study was at least 100 respondents. In Finland the survey was sent to Association members who had given permission for receiving surveys like this. This group of members consisted of 299 potential respondents. Three of the respondents informed that they are not participating in the study (lived not in Finland or in Sweden, no longer worked or did not work with T2D patients) additionally 10 of the potential respondents could not be reached because of the mail delivery problem (n of potential respondents in Finland 286). In Sweden the survey was sent to 410 members. 13 of the potential respondents could not be reached because of the mail delivery problem (n of potential respondents in Sweden 397).

3.3. Statistical analysis and data collection

A questionnaire was formed, and data was collected on a platform called Survey Pal. In Survey Pal data was obtained in excel formats. Survey Pal does not include a data analysis function. Data was moved electronically from the platform to data a processing software. In this study the SPSS 28.01 for IBM (Statistical Package for Social Science) data processing software was used. In SPSS calculations and analyses of the data were performed.

For the demographic information frequencies, and percentages were calculated. Means, standard deviation (SD), frequencies, and percentages were also calculated for the results received from ready-made answers options measured with Likert-scale. The smaller the mean was the more useful the function, the more the medication adherence and medication safety was thought to be able to be improved and the more there was seen a need for the utilization of DCPs and for pharmacist services in the DCP or other platforms for T2D patients.

The Chi square test can be used to measure if there is an association between two variables [53]. The Chi-square test is a suitable analysis for categorical variables with ordinal or nominal scale [54]. The Chi square test was used to find out if there is an association between answers and the age of respondents and between answers and the length of working experience the respondents have.

The T-test can be used to compare means between different subgroups. The T-test is a suitable statistical analysis for a quantitative study when the population is large ($n > 20-30$), the variable is normally distributed and when an interval scale is used [53]. The T-test can also be used when the population is not normally distributed, but the n is large [54]. With the t-test the means of two groups can be compared and the significance of the difference in answers can be determined [54]. The 0.05-significance level was used. The results below the p-value of 0.05 were found to be statistically significant. The Independent sample t-test was used to compare the results between Finland and Sweden and the results between DSNs who had used DHC tools in their work and DSNs who had not used DHC tools in their work.

The results of the open-ended questions were analyzed with a content analysis. In the content analysis the answers were read several times so that the content was well known for the researcher. Afterwards the answers were categorised to groups of similar answers, described, and quantified [53]. The results of the study were presented using bar and pie charts, tables, and text. Bar charts are suitable diagrams for low number of discrete categorical variables [55].

3.4. Sum variables

Five sum variables were formed of five different parts in the survey to find out how important DSNs found each part of the survey. The different parts were based on the different study questions. A mean value was calculated for each statement and further on a mean value for the sum variable. The lower the mean was the more the DSNs agreed on the benefits of the section. In table 2 can be seen the sum variables that were formed, number of statements that are included in each sum variable, the part of the study and the study question on which the sum variable is based on.

Table 2. Sum variables formed from five sections in the survey.

Number of statements in a sum variable	Sum variable	Study question and part of the survey
12 statements	Usability of DCPs in the work of DSNs	number one
16 statements	Medication adherence	number two
15 statements	Medication safety	number three
2 statements	Utilization of DCP for T2D	number four
8 statements	Utilizing pharmacist services	number five

3.5. Reliability

Reliability tells about a questionnaire's accuracy. It is about how similarly a repeated survey can be answered when a test person answers the questionnaire twice [52]. Questions that include words that are difficult to understand, or which include negations can reduce reliability since they increase chance for misunderstanding [55]. The more similar the answers are for both times the questionnaire is answered the better the reliability is. This

is called a test-retest method. The results of a test of this kind can be estimated with a kappa value or with percentage compliance [55]. In this study, the reliability was counted with percentage compliance.

3.6. Validity

Validity in a survey study is about how well, effectively, and comprehensively the survey measures the subjects it is expected to measure [52, 56]. The validity is based on study questions and to the objectives in the study [55]. Correct use of a survey, right timing and right target are in addition part of validity [56].

4. Results

The total number of respondents in the study was 52 out of 683. The response rate in the study was 7.6%. The survey was answered 31 times in Swedish and 21 times in Finnish. In Finland the survey was answered two times in Swedish and 21 times in Finnish. Nobody answered the survey in English.

The Chi square test was not used to analyse the results. The criteria for data for Chi-square test was not fulfilled. The number of participants was large enough, but the frequencies on certain answer alternatives became too low for the test to be completed. For that reason, the association between answers and the age of respondents and between answers and the length of working experience the respondents have could not be tested. The Independent sample t-test was used to compare the results between Finland and Sweden and the results between DSNs who had used DHC tools in their work and DSNs who had not used DHC tools in their work.

There were 5 missing answers in the demographic questions from different respondents. The missing answers can be seen in table 3. Respondents whose results included missing data were included in the study. There were no missing answers in the other parts of the survey. All the four open-ended questions were answered and altogether 22 answers were received to these questions.

Table 3. The type and number of missing data in the survey.

Demographic question where the missing data was seen	Number of missing data
Length of professional experience	2
Primary area	1
Primary sector	1
Type of primary organization	1

4.1. Demographic information

There were 11 demographic questions in the survey in total. In table 4 can be seen frequencies and percentage values calculated for each answer alternative of these questions.

Table 4. The results of demographic questions in the survey (n = 52).

Statement	Options	n	(%)
Gender	Woman	52	100
	Man	0	0
	Other	0	0
Age	20 – 30 years	2	4
	31 – 40 years	3	6
	41 – 50 years	12	24
	51 – 60 years	22	43
	Over 60 years	12	24
Country	Finland	23	44
	Sweden	29	56
Training	Nurse	26	51
	Health care nurse	22	37
	Other	3	12
Specialization	Diabetes nurse	41	79
	No specialization	5	10
	Other	6	12
Length of professional Experience	Under 5 years	0	0
	5 – 10 years	3	6
	11 – 20 years	11	22
	21 – 30 years	14	28
	Over 30 years	22	44
Primary area	Primary health care	42	84
	Specialized care	7	12
	Other	2	4
Primary sector	Public health care	46	90
	Private sector	5	10
Type of primary organization	Hospital	9	18
	Health care center	39	75
	Home health care	0	0
	Ambulance or similar	0	0
	Other	3	8
I treat patients who have sought care due to type II diabetes	Every day	30	58
	A couple of times a week	15	29
	A couple of times a month	4	8
	More seldom than a couple of times a month	3	6
In my work I utilize (possibility to choose several)	A digital care pathway for type II diabetes (e.g., Health village in Finland)	13	
	Maisa customer portal (in Finland)	3	
	Digital chat with patients	5	
	A video conference with patients	9	
	Other digital patient tools; what?	12	
	I don't utilize digital patient tools	21	

n = number of answers (frequency), % = answer distribution in percentage.

All the respondents were women (n=52). More of the respondents lived in Sweden (56%) than in Finland (44%). Most of the respondents were aged between 51 and 60 years (43%), and nearly one fourth of the respondents were over 60 years old (24%) (table 4).

Most of the respondents (79%) were specialized as diabetes nurses and 12% were specialized among others as a teacher, an ambulance nurse, and an occupational health nurse (table 4). The Swedish respondents (87%) were more often specialized as diabetes nurses than the Finnish respondents (61%) (Figure 4).

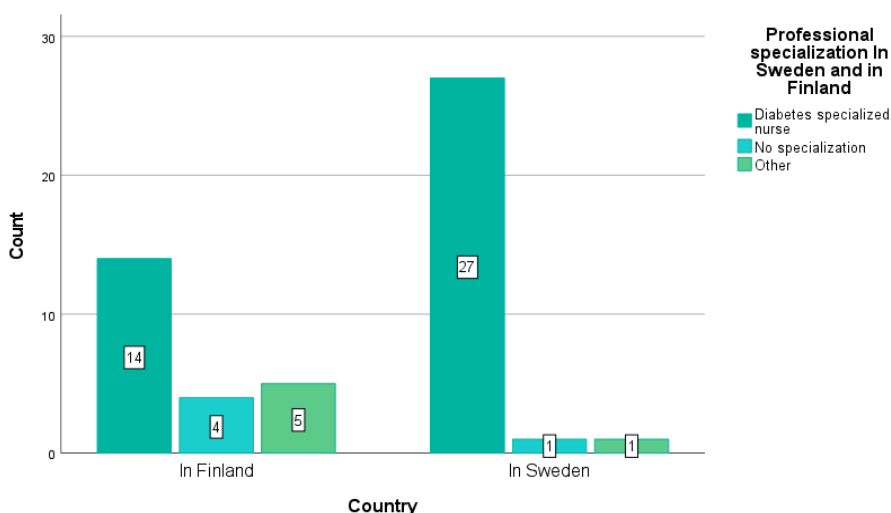


Figure 4. Specialization of the respondents, frequency distribution in Finland and in Sweden.

Most of the respondents worked in the public sector (90%) and more often in primary care (84%) than in specialized care (12%). Many respondents (44%) had over 30 years of professional experience and 87% of them treat T2D patients every day or weekly. Over half of the respondents (n = 31) utilize DHC tools in their work. Finnish DSNs (83%) use DHC tools in their work in a larger extent than Swedish DSNs (41%). DCP for T2D was used by 13 respondents, nine respondents use video conferences and five use chat. Several respondents (n =12) use some other kind of DHC tools and nine of the respondents use more than one DHC tool (table 4).

4.2. Usability of digital care pathways in the work of diabetes specialist nurses

There were 12 statements about the usefulness of DCPs/platforms in the survey. In table 5 can be seen calculated values of means and SD for each statement and frequencies, and percentages for each answer alternative. The smaller the mean value the more useful the function was found to be. The smaller the SD value the more the nurses agreed on the subject.

Table 5. Results for part one in the survey (n=52) (answer alternatives on Likert scale from one to four). The most useful functions in the DCPs/platform are written in bolded text.

Statement	Mean	SD	n (%)	n (%)	n (%)	n (%)
Answer alternatives			1	2	3	4
Unifying care processes	1.81	0.793	20 (38)	24 (46)	6 (12)	2 (4)
Making scheduling of patient work more efficient	2.02	0.804	14 (27)	25 (48)	11 (21)	2 (4)
Automatic medication reminders*	2.04	0.989	18 (35)	20 (38)	8 (15)	6 (12)
Supporting self-care*	1.69	0.940	28 (54)	17 (33)	2 (4)	5 (10)
Scheduling appointments	1.77	0.921	25 (48)	18 (35)	5 (10)	4 (8)
Versatile communication *	1.77	0.921	25 (48)	18 (35)	5 (10)	4 (8)
Giving medication advice	1.83	0.923	22 (42)	22 (42)	3 (6)	5 (10)
Medication training *	1.60	0.693	26 (50)	22 (42)	3 (6)	1 (2)
Answering patients' questions	1.77	0.921	25 (48)	18 (35)	5 (10)	4 (8)
Giving feedback to patients	1.85	0.916	22 (42)	20 (38)	6 (12)	4 (8)
Monitoring laboratory results*	1.83	0.985	24 (46)	19 (37)	3 (6)	6 (12)
Online meetings with patients*	1.92	0.882	19 (37)	21 (40)	9 (17)	3 (6)

SD = standard deviation, n=number of answers, %= answers in percentage. Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 = disagree completely. Statements marked with an asterisk (*) are shortened and the entire statement can be seen in Appendix 1, part 1.

The respondents felt that medication training for patients (mean 1.60) and supporting patients' self-care (mean 1.69) are the most useful functions in the DCP for T2D patients (table 5). Most of the respondents (92%) (agreed completely or somewhat) found medication training as useful function in DCP. The answer distribution is visualized in figure 5.

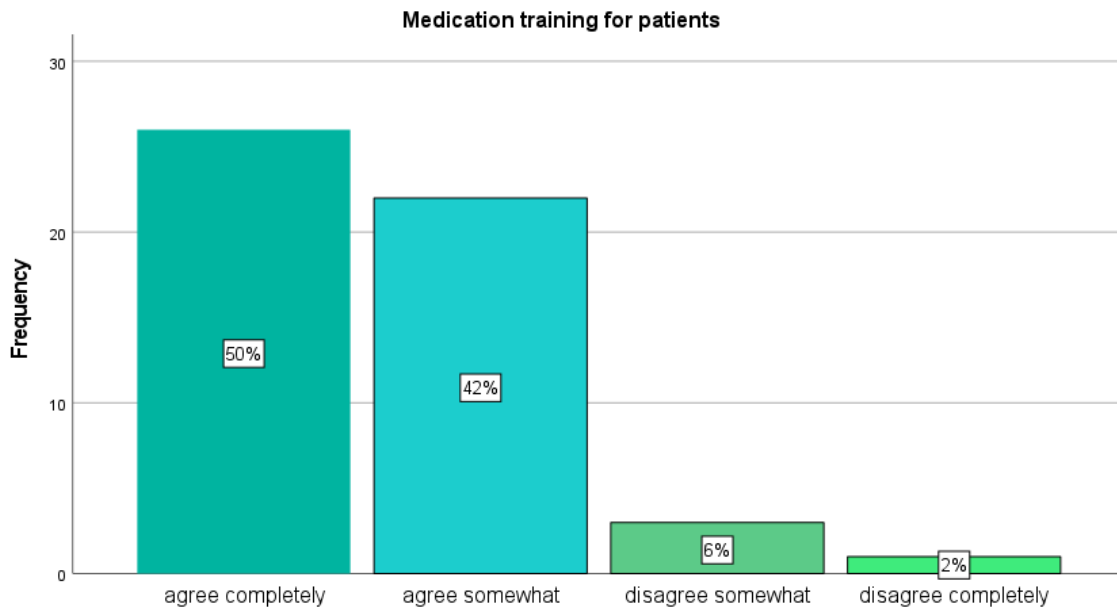


Figure 5. Medication training for patients, answer distribution in percentage for the statement

Supporting patients self-care was found (agreed completely or somewhat) as one of the most useful functions in DCP by 87% of the respondents. The answer distribution is visualized in figure 6.

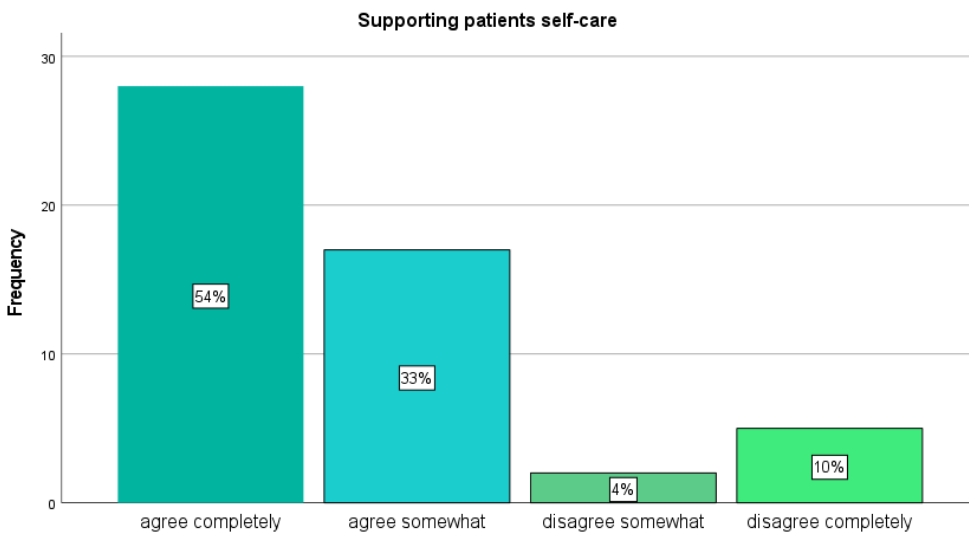


Figure 6. Supporting patients' self-care, answer distribution in percentage for the statement.

In addition, 83% of respondents found (agreed completely or somewhat) scheduling appointments, versatile communication with patients, and answering patients' questions as useful functions in DCPs for T2D patients (table 5).

Sending automatic medication reminders to patients were found to be the least useful function in DCP (mean 2.04) and it had the largest variation on answers (SD 0.989). The

respondents disagreed also on the usefulness of monitoring patients' laboratory results in DCP (SD 0.985) (table 5).

Seven answers, in average one sentence long, was received in the open-ended questions about other possible functions that DSNs wished to include in future DCPs. They wished for a function in DCPs that could quickly give a general view of laboratory values, of diagnosis and of treatment goals. One respondent wished to have a chat function that would enable the patients to be directed to the right health care service. When it came to the information systems, user-friendliness and compatibility were functions that were wished.

There was concern about the adequacy of time to complete the digital tasks:

“Time to do, not during other tasks, not at coffee or lunch”

and concerns about the skills of older people to use digital services:

“There is a challenge for older people, who are the patients that most often visit the nurse’s reception.”

The Swedish DSNs (mean 1.79) found the function of sending automatic medication reminders to patients more useful than DSNs in Finland (mean 2.35) ($p = 0.043$). This was the only statistically significant difference ($p < 0.05$) in results between Finnish and Swedish DSNs.

Respondents who use DHC tools in their work found the statements making scheduling for patient work more efficient, supporting patients' self-care, versatile communication with patients and giving medication advice in DCPs more useful than those respondents who do not use DHC tools. These were the only statistically significant ($p < 0.05$) differences in results between respondent with earlier experience and with no experience on DHC tools. The mean values for the statements and p-values for the differences can be seen in table 6.

Table 6. Results for the different statements of the section compared between DSNs with earlier experience on DHC tools and DSNs without such experience. The mean values for the statements and the p-values for the statistically significant differences ($p < 0.05$) are presented in the table.

Statement	DSNs with no experience on DHC, mean value	DSNs with experience on DHC, mean value	p-value
Making scheduling for patient work more efficient	2,29	1,84	0,048
Supporting patients' self-care	2,05	1,45	0,023
Versatile communication with patients	2,14	1,52	0,014
Giving medication advice	2,14	1,61	0,034

4.3. The impact of digital care pathways on medication adherence

There were 16 statements about the impact of DCPs/platforms on medication adherence in the survey. In table 7 can be seen calculated values of means and SD for each statement and frequencies, and percentages for each answer alternative. The smaller the mean value the more impact on medication adherence functions in DCP/platform have according to the respondents. The smaller the SD value the more the nurses agreed on the subject.

Table 7. Results for part two in the survey (n=52) (answer alternatives on Likert scale from one to four). Functions that have the largest impact on medication adherence in DCP are written in bolded text.

Statement	Mean	SD	n (%)	n (%)	n (%)	n (%)
Answer alternatives			1	2	3	4
Increase in the versatility of patient medication counselling (e.g., medication support materials like instruction videos)	1.79	0.696	18 (35)	28 (54)	5 (10)	1 (2)
Making patient medication counselling clearer and more unified	1.71	0.776	24 (46)	20 (38)	7 (14)	1 (2)
Making reliable information more easily available in one place	1.63	0.793	27 (52)	19 (37)	4 (8)	2 (4)
Medication reminders to patients	1.94	0.826	17 (32)	23 (44)	10 (19)	2 (4)
Scheduling the dosing times of medications	1.85	0.894	22 (42)	19 (37)	8 (15)	3 (6)
Automatic reminders to patients to get medications from the pharmacy	2.02	0.960	19 (37)	17 (33)	12 (23)	4 (8)
Supporting the appropriate use of medications	1.75	0.813	23 (44)	21 (40)	6 (12)	2 (4)
The use of versatile counselling methods (e.g., videos, patient instructions, peer groups, chats)	1.62	0.796	28 (54)	18 (35)	4 (8)	2 (4)
The availability of patient counselling is increased by 24-h-service (e.g., leaving a message to the nurse)	1.88	0.855	20 (38)	20 (38)	10 (19)	2 (4)
Increase patient empowerment regarding their illness and medication	1.81	0.841	22 (42)	20 (38)	8 (15)	2 (4)
The interaction between patient and healthcare professional can be strengthened (e.g., via digital chat function)	1.94	0.895	19 (37)	20 (38)	10 (19)	3 (6)
The availability of multidisciplinary team services is increased (e.g., nutritional therapist, pharmacist, nurse, doctor)	1.75	0.860	24 (46)	20 (38)	5 (10)	3 (6)
The information flow between groups of health care professionals is increased	1.79	0.871	23 (44)	20 (38)	6 (12)	3 (6)
The monitoring of information saved by patients and health care professionals is easier	1.77	0.921	25 (48)	18 (35)	5 (10)	4 (8)
The care of comorbidities is possible in the same place	2.06	0.998	17 (33)	22 (42)	6 (12)	7 (14)
Support of patient's independent activity in taking care of their medication	1.77	0.854	23 (44)	21 (40)	5 (10)	3 (6)

SD = standard deviation, n=number of answers, %= answers in percentage.

Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 =disagree completely.

The use of versatile counselling methods (mean 1.62) was found to be a function that improves medication adherence in DCP/platform for T2D patients (table 7). Majority of the respondents (89%) found (agreed completely or somewhat) that with this function medication adherence can be improved. The answer distribution is visualized in figure 7.

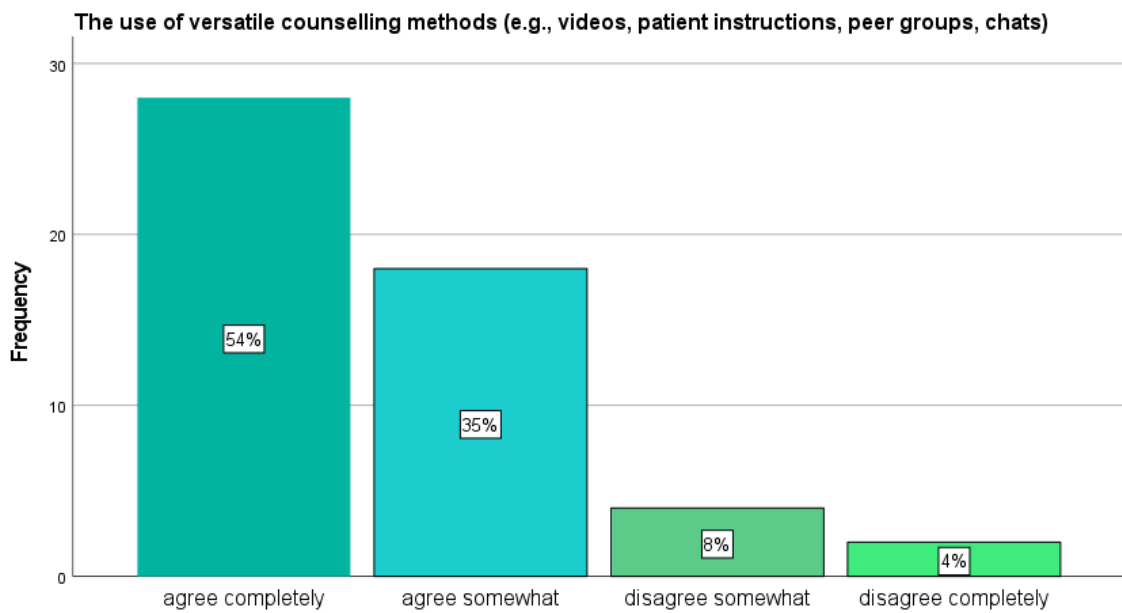


Figure 7. Versatile counselling methods, answer distribution in percentage for the statement.

Many of the respondents (89%) felt additionally (agreed completely or somewhat) that making reliable information more easily available in one place (mean 1.63) is a function in DCP /platform for type 2 diabetics that has an impact on medication adherence. The answer distribution is visualized in figure 8.

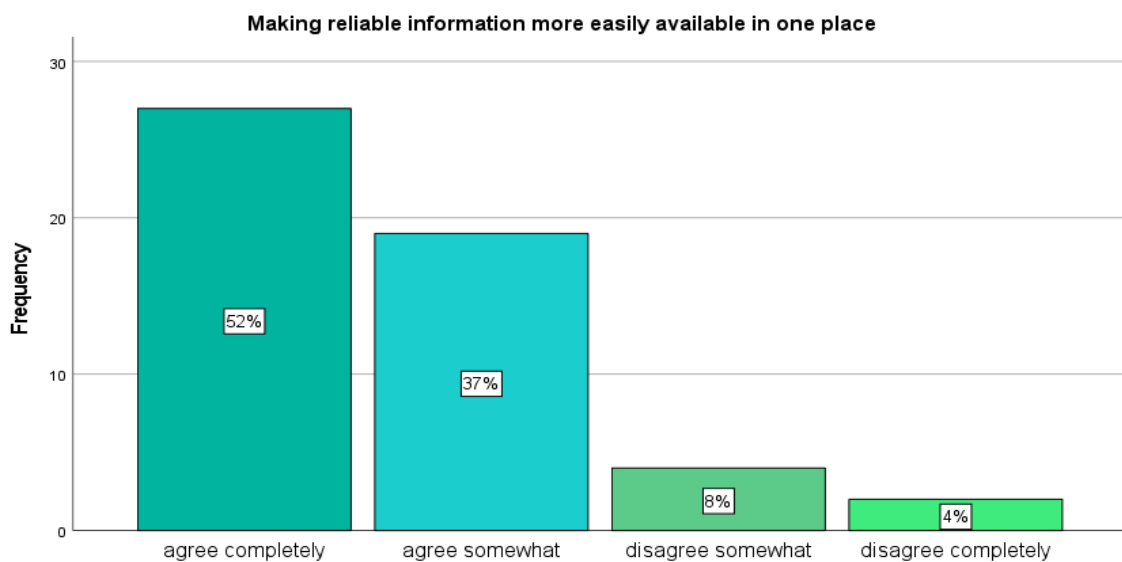


Figure 8. Making reliable information more easily available in one place, answer distribution in percentage for the statement.

In addition, many respondents found (agreed completely or somewhat) that medication adherence can be improved by offering an easier way of monitoring information saved by patients and health care professionals (83%), by offering more versatile patient medication counselling (89%), by making patient medication counselling clearer and more unified (84%) and by offering multidisciplinary team services (84%) in DCPs/platforms (table 7).

The possibility of caring for comorbidities in the same place (mean 2.06) and sending automatic medication reminders to patients to get medications from the pharmacy (mean 2.02) were found to be functions in DCP/platforms that have the least impact on improving medication adherence. There was additionally the largest variation on answers on these functions (table 7).

Four responses were received to the open-ended question of other ways of supporting medication adherence in DCPs/platforms. In one of the answers, it was believed that if information was readily available and accessible, medication adherence would be improved. Automatic reminders of medicines were considered useful, but their long-term effectiveness was questioned. The ability of both healthcare professionals and patients to access patient data was felt to support medication adherence. In addition, the opportunity of both calling the clinic and sending a digital message was felt to support medication adherence. The inadequacy of time was perceived as a challenge for supporting medication adherence:

“It still has the same problem at the healthcare center, there should be time, not in addition to other tasks.”

DSNs in Sweden (mean 1.62) found DCPs to improve medication adherence by increasing patient’s empowerment regarding their illnesses and medication more than DSNs in Finland (mean 2.04). P-value for the difference was 0.071. Since p-value was higher than 0.05, the difference was not statistically significant.

Respondents in Finland (mean 1.87) found the increased information flow between groups of healthcare professionals to be more important in improving medication adherence than respondents in Sweden (mean 1.72). P-value for the difference was 0.077. Since p-value was higher than 0.05, the difference was not statistically significant.

There were no statistically significant differences in answers between Finnish and Swedish respondents about improving medication safety with DCPs or platforms.

Respondents who use DHC tools in their work (mean 1.81) found the possibility to care for comorbidities in the same DCP/platform to have more impact on medication adherence than respondents who do not use DHC tools in their work (mean 2.43) ($p = 0.026$). This was the only statistically significant ($p < 0.05$) difference in results between respondent with earlier experience and no experience on DHC tools.

4.4. The impact of digital care pathways on medication safety

There were 15 statements about the impact of DCPs/platforms on medication safety in the survey. In table 8 can be seen calculated values of means and SD for each statement and frequencies, and percentages for each answer alternative. The smaller the mean value the more impact on medication safety functions in DCP/platform have according to answers of DSNs. The smaller the SD value the more the nurses agreed on the subject.

Table 8. Results for part three in the survey (n=52) (answer alternatives on Likert scale from one to four). Functions that have the largest impact on medication safety in DCP are written in bolded text.

Statement	Mean	SD	n (%)	n (%)	n (%)	n (%)
Answer alternatives			1	2	3	4
Correcting patients' mistaken ideas about their medication	1.88	0.758	16 (31)	28(54)	6 (12)	2 (4)
Decreasing the incidence of adverse effects through better guidance	1.88	0.758	17 (33)	25 (48)	9 (17)	1 (2)
Increasing awareness of how diabetes medications act in the body	1.58	0.723	28 (54)	19 (37)	4 (8)	1 (2)
Increasing awareness of the adverse effects of diabetes medications	1.65	0.738	25 (48)	21 (40)	5 (10)	1 (2)
Strengthening patients' ability to use injectable medicines independently	1.58	0.750	29 (56)	17 (33)	5 (10)	1 (2)
Supporting appropriate medication by automatic transfer of blood glucose measurements to the health care professional	1.63	0.980	32 (62)	9 (17)	9 (17)	2 (4)
Supporting the continuity of treatment	1.71	0.800	24 (46)	21 (40)	5 (10)	2 (4)
Supporting the patient when their medication changes by clarifying differences between old and new medicines	1.79	0.825	23 (44)	18 (35)	10 (19)	1 (2)
Offering information on how medication adverse effects (e.g., hypoglycemia) can be prevented	1.62	0.718	26 (50)	21 (40)	4 (8)	1 (2)
Decreasing dosage errors when products are switched	1.85	0.872	22 (42)	18 (35)	10 (19)	2 (4)
Clarifying information about the dosage and safe use of medications	1.63	0.742	26 (50)	20 (39)	5 (10)	1 (2)
Supporting the implementation of complex medication	1.88	0.855	21 (40)	17 (33)	13 (25)	1 (2)
Decreasing missed medication doses by medication reminders	1.81	0.908	24 (46)	17 (33)	8 (15)	3 (6)
Giving clear instructions regarding dosage, adverse effects and daily use of medicines	1.71	0.800	25 (48)	18 (35)	8 (15)	1 (2)
Helping patients to reach a comprehensive view of their medication	1.77	0.807	22 (42)	22 (42)	6 (12)	2 (4)

SD = standard deviation, n=number of answers, %= answers in percentage. Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 = disagree completely. Statements marked with an asterisk () are shortened and the entire statement can be seen in Appendix 1, part 3.*

Increasing awareness of how diabetes medications act in the body (mean 1.58) and strengthening patients' ability to use injectable medicines independently (mean 1.58) were found to be functions that improve medication safety in DCPs or platforms the most (table 8). Only 10% of the respondents disagreed on the fact that medication safety can be improved by increasing the awareness of how medications act in the body. The answer distribution is visualized in figure 9.

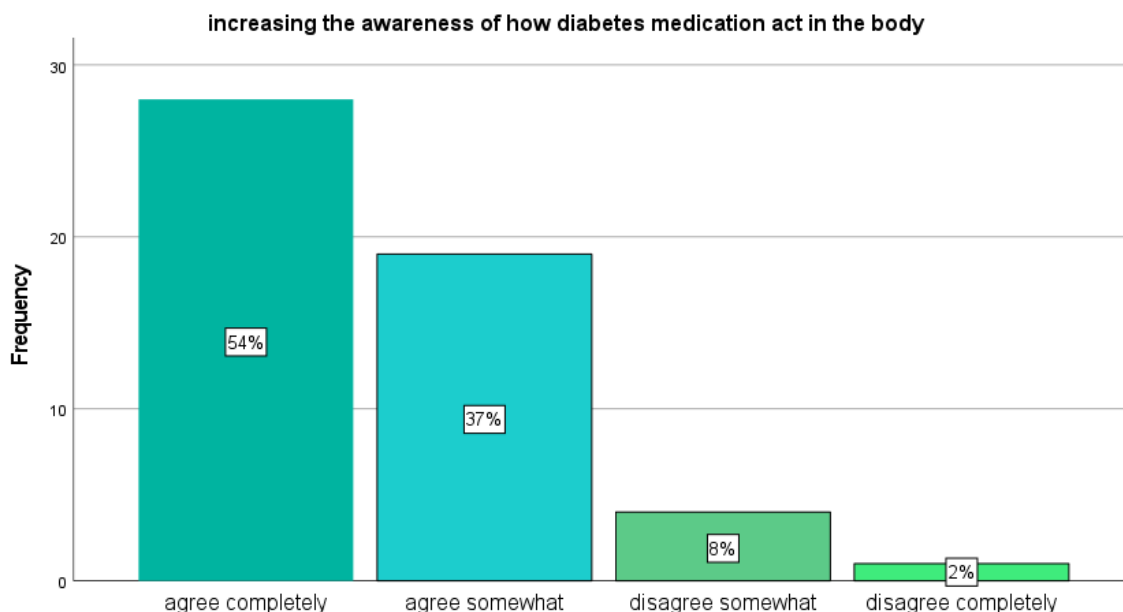


Figure 9. Increasing awareness of how diabetes medications act in the body, answer distribution in percentage for the statement.

In addition, the respondents found (agreed completely or somewhat) that it is possible to improve medication safety by supporting the appropriate medication by automatic transfer of blood glucose measurements to the healthcare professionals (79%), by clarifying information about the dosage and safe use of complex medication (89%) and by offering information on how medication adverse effects (e.g., hypoglycemia) can be prevented (90%) (table 8).

The least impact on medications safety was found to have with functions of correcting patients' mistaken ideas about their medication, decreasing the incidence of adverse effects through better guidance and supporting the implementation of complex medication. Nevertheless, these functions were found to improve somewhat medication safety (mean 1.88) (table 8). There was most variation in answers with functions of supporting appropriate medication by automatic transfer of blood glucose measurements to the health care professional (SD = 0.980) and decreasing missed medication doses by medication reminders (SD = 0.908) (table 7).

Respondents that had used DHC tools earlier (mean 1.45) found the statement supporting appropriate medication by automatic transfer of blood glucose measurements to the healthcare professionals to have more impact on medication safety than respondents who had not used DHC tools earlier (mean 1.90). P-value for the difference was 0.077. Since p-value was higher than 0.05, the difference was not statistically significant.

There were no statistically significant differences in answers between Finnish and Swedish respondents about improving medication safety.

4.5. The extent of utilization of digital care pathways

There were two statements in the survey about the extent utilization of DCPs/platforms in the work of DSNs. In table 9 can be seen calculated values of means and SD for each statement and frequencies, and percentages for each answer alternative. The smaller the mean value the more respondents thought DCPs should be utilized. The smaller the SD value the more the nurses agreed on the subject.

Table 9. Results for part four in the survey (n=52) (answer alternatives on Likert scale from one to four). The extent of utilization of DCPs/platforms.

Statement	Mean	SD	n (%)	n (%)	n (%)	n (%)
Answer alternatives			1	2	3	4
Digital care pathways or other digital platforms should be utilized more in treating type II diabetes	1.50	0.642	30 (58)	18 (35)	4 (8)	0 (0)
Digital care pathways or other digital care platforms make my work with type II diabetes patients easier	1.87	0.864	21 (40)	19 (37)	10 (19)	2 (4)

SD = standard deviation, n=number of answers, %= answers in percentage. Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 = disagree completely.

Most of the of respondents (93%) thought (agreed completely or somewhat) that DCPs should be utilized more (mean 1.50). The variation in the answer was the lowest of all the statements in the survey (SD=0.642) (table 9).

Some respondents (8%) thought that DCPs should not be used more (disagreed somewhat). These respondents thought that it is confusing with so many DHC tools available. There were additionally concerns about older patients and their commitment to the use of DHC tools, and one respondent wrote that:

“Those who are in greatest need of care do not use DHC tools.”

Several respondents (77%) found that DCPs help their work (agreed completely or somewhat) and 23% of the respondents felt that they do not help their work (disagreed completely or somewhat). There was more variation in opinions of DSNs on helpfulness of DCPs in work (SD = 0.864) than on the willingness to utilize them (SD =0.642) (table 9).

Respondents who found that DCPs do not help their work (disagreed somewhat or completely) wrote that lack of interest and experience in DHC tools as well as shortage of time and of resources limits the use of DHC tools. Several respondents found that DHC tools would be helpful in work with most of the patient groups, but not with all patients. One respondent believed in the use DHC tools in the future even though she was still lacking the experience in them:

“I have not yet started with these, but I strongly believe in them.”

Respondents (n = 28) had received feedback from patients on DCPs. Some of these respondents (n = 8) had received negative feedback. Answer frequencies can be seen in table 10.

Table 10. Frequencies for results on questions about feedback from patients.

I have received patient feedback about digital care pathways or other digital care platforms	Yes	No
Number of answers	28	24
The feedback I have received has been positive	Yes	No
Number of answers	20	8

Older patients' inability to use DHC tools (n = 4) was the biggest concern among the received negative feedback. Additionally, it was mentioned that patients prefer the traditional face-to-face meeting to digital meetings and one respondent had received negative feedback on limited availability of information in Swedish in DCP for T2D patients in Health village in Finland. It was also written that there are still patients who have not seen the positive impact of DCPs as a complement care to the traditional care:

“There are still patients who have not yet seen the positive impact DHC tools have as a complement to the face-to-face meetings.”

4.6. Utilization of pharmacists' services in digital care pathways

There were 8 statements about the possibility of utilizing pharmacist services in DCPs /platforms in the survey. In table 11 can be seen calculated values of means and SD for each statement and frequencies, and percentages for each answer alternative. The smaller the mean value the more useful respondents found pharmacist services would be in DCP/platform. The smaller the SD value the more the nurses agreed on the subject.

Table 11. Results for part five in the survey (n=52) (answer alternatives on Likert scale from one to four). Functions that respondents thought would be the most useful pharmacist services in DCP are written in bolded text.

Statement	Mean	SD	n (%)	n (%)	n (%)	n (%)
Answer alternatives			1	2	3	4
Medication review of patient's home medication	1.88	0.943	21 (40)	21(40)	5 (10)	5 (10)
Scheduling the timing of home medication	1.88	0.900	20 (39)	22 (42)	6 (12)	4 (8)
Taking notice of adverse effects	1.75	0.860	24 (46)	20 (39)	5 (10)	3 (6)
Checking medication interactions	1.69	0.853	26 (50)	19 (37)	4 (8)	3 (6)
Counselling concerning switching between products	1.83	0.923	23 (44)	19 (37)	6 (12)	14 (8)
Ascertaining the correct dose and dosing time of medication	1.92	0.882	19 (37)	21 (40)	9 (17)	3 (6)
Choosing the most suitable medication	2.25	0.905	11 (21)	22 (42)	14 (27)	5 (10)
Pharmacist reception at the pharmacy	2.02	0.874	16 (31)	22 (42)	11 (21)	3 (6)

SD = standard deviation, n=number of answers, %= answers in percentage. Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 = disagree completely.

Respondents found checking the medication interactions (mean 1.69) and taking notice of adverse effects (1.75) as the most important possible functions of pharmacist services in DCPs (table 11).

The least useful pharmacist service in DCPs was found to be choosing the most suitable medication (mean 2.25). 37% of respondents (disagreed completely or somewhat) found that this function should not be utilized by pharmacist in DCP. The highest variation among the answers was found in utilizing pharmacist services by doing medication review of patient's home medication (SD=0.943) (table 11).

Three responses were received to the open-ended questions of the utilizing pharmacist services in DCPs. No need for additional pharmaceutical services in a DCP was mentioned

by the respondents. Respondents wrote that they would consult a physician with any questions if necessary and that the need for pharmaceutical services varies with different patients. One respondent wrote:

” Sometimes I feel that pharmacists are unable to keep up and they meddle in the treatment.”

Chat was found to be the most utilizable way of contacting pharmacists in DCPs (40%). The least favorable way of contacting pharmacist in DCPs was found to be email (6%). Nevertheless, no wish for other ways of contacting pharmacists were mentioned. The percentages for the result distribution can be seen in figure 10.

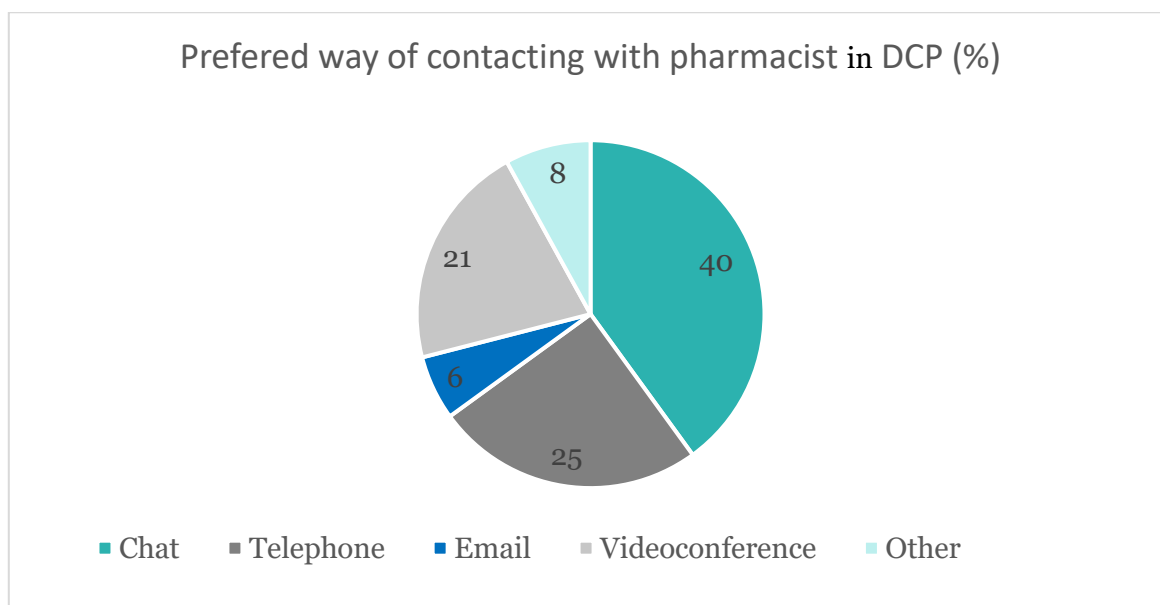


Figure 10. Respondents’ choice for the way of contacting pharmacist in DCPs/platforms, percentage (%) distribution.

There was no statistically significant difference when comparing the results of Finnish and Swedish respondents in this part of the survey.

Answers to all eight statements (pharmacist services) in this section were compared between respondents with earlier experience of DHC tools in their work and respondents with no previous experience of such tools. Respondents with experience of DHC tools found scheduling the timing of home medication and ascertaining the correct dose and dosing time of medication as more useful pharmacist services of DCP than respondents with no experience of DHC tools found these functions. These were the only statistically significant differences ($p < 0.05$) in results. The mean values for the statements and p-values for the differences can be seen in table 12.

Table 12. Results for the different statements of the section compared between DSNs with earlier experience on digital healthcare tools and DSNs without such experience. The mean values for the statements and the p-values for the statistically significant differences ($p < 0.05$) are presented in the table.

Statement	Mean value for DSNs with no experience on DHC	Mean value for DSNs with experience on DHC	p-value
Scheduling the timing of home medication	2.19	1.68	$p = 0.042$
Ascertaining the correct dose and dosing time of medication	2.24	1.71	$p = 0.033$

Respondents were asked if they wanted to tell something else about DCPs. Eight answers were received to this question. The answers were approximately once sentence long. Respondents mentioned the challenge of limited time for using digital services, the number of available forms of communication were found stressful and there were concerns that shy patients might not be in contact with nurse. Additional concerns included the possible obstacles for older people to use digital services and the challenge of motivating and committing patients to the digital world. Digital services were considered important in the management and support of self-care, but it was also mentioned that it is important to avoid making excessive fuss over patients:

”Even if remote counselling is increased, one should not fuss excessively over the patients. In self-care the patients themselves have the responsibility, although information should of course be given.”

4.7. Sum variables

The survey was divided into five different parts excluding demographics questions. Five different sum variables were formed of these sections. The lower the mean value for the sum variable was found to be the higher the respondents evaluated the section in DCP for T2D patients. In figure 11 can be seen the sum variables with mean values.

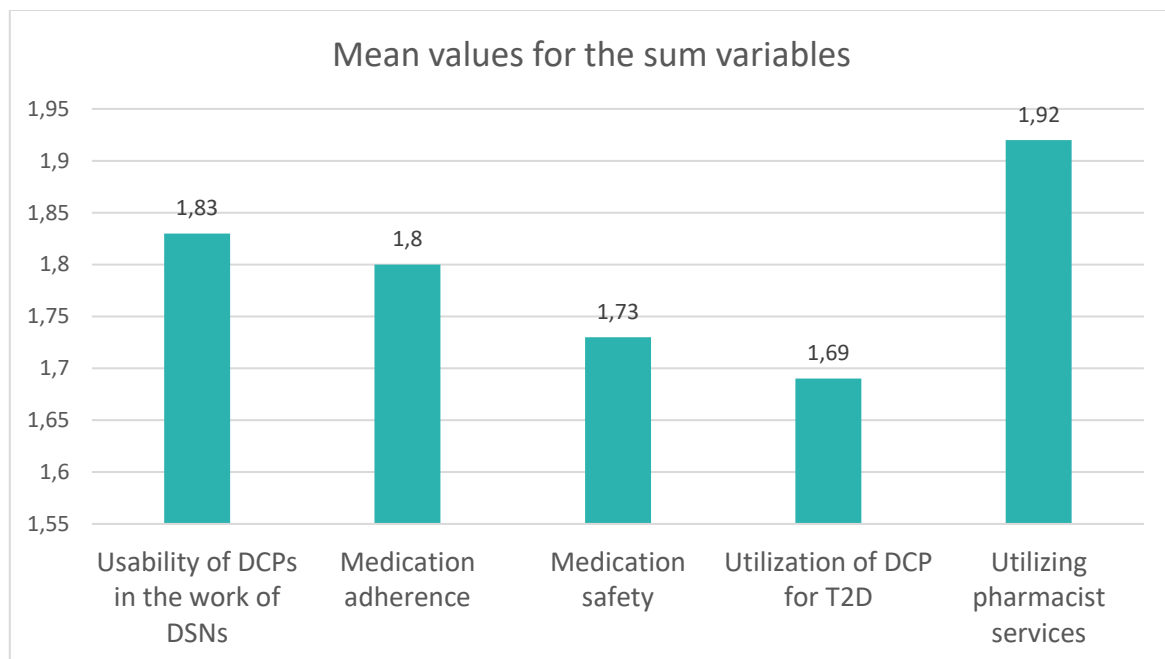


Figure 11. Sum variables with calculated mean values. Answer alternatives 1 = agree completely, 2 = agree somewhat, 3 = disagree completely, 4 = disagree completely.

5. Discussion

The objective in this study was to explore the experiences and opinions of DSNs to be able to further develop DCPs in the future. The aim was to find out how useful DSNs find DCPs, which digital functions they find important, and do DSNs find that medication adherence and medication safety can be improved when DCPs are used. Additionally, the objective was to find out if DSNs think DCPs should be utilized more and should pharmacist services be utilized in DCPs. And finally, the aim was to find out if there are differences between results in Finland and in Sweden.

In the study participated 52 DSNs. Most of the respondents had a long professional experience, they were over 50 years old, worked in primary care, in public health care and most often in health care centers. Most of the nurses took care of T2D patients every day or several times a week.

A four-point Likert scale was used in the survey (figure 2). According to the results DSNs found DCPs somewhat useful in their work (figure 11). They found medication training for patients and supporting patients' self-care the most useful functions in the DCPs (table 5). The possibility to improve medication adherence by using DCPs was found somewhat good (figure 11). The respondents found that the best way to improve medication adherence was by offering versatile counselling methods and making reliable information easily available in DCPs (table 7). According to the results, DCPs would have the best impact on medication safety of all the sections in the survey (figure 11). Medication safety would be improved most if the awareness of how diabetes medications act in the body would be increased and if patients' ability to use injectable medicines independently would be strengthened with help of DCPs (table 8). Most of the respondents thought that DCPs should be utilized more, but current care pathways were not found to help DSNs' work equally much (table 9). Utilizing pharmacist services in DCPs was found as the least useful section of all the five sections (figure 11). The most important pharmacist functions in DCPs would be checking the medication interactions and taking notice of adverse effects (table 11). Results between Finnish and Swedish respondents were found to be similar.

5.1. Method discussion

5.1.1. Choice of method

An interview study would have been an option to study the subject, but since we wanted reach DSNs in a wide area and since we wanted to know how many of DSNs have certain opinions and experiences a web-based survey was chosen to be used in this study. Combining an observational study with the survey study would have been beneficial. Following the work of the DSNs would have given the researcher a better idea of the content of the DSNs' work. However, due to lack of time, this was not possible.

The goal was to reach DSNs both in Sweden and in Finland. For that reason, a quantitative study with a web-based survey was an appropriate choice of method for the study since it is possible to reach a larger group of individuals in a geographically wide area this way [55]. With economical use of resources in the study, a web-based survey study offered a possibility to reach the respondents more easily and possibly faster and without high costs [55]. The goal of this study was at least 100 respondents, but the lower-than-expected response activity of DSNs produced a lower number of respondents than the original target was. A quantitative study may produce results that are generalizable, if the study sample is representative of the whole population [55]. Our goal was additionally to find out how many DSNs believe DCPs facilitate their work with T2D patients and how many of them believe that medication safety and medication adherence can be improved by using DCPs. These types of study questions are appropriate questions for a quantitative study [52]. Open-ended questions were included in the survey to get a deeper insight into the study topic. This way it was possible to get more information about the thoughts, ideas and concerns our respondents have on the subject [52, 55]. Structured questions and ready-made answer options do not give detailed information on the study subject [55].

To improve response activity in the study, the survey was written in three different languages. It enabled most of the responders to have the opportunity to respond in their mother tongue. This also makes it easier to respond to the survey and reduces opportunities for misinterpretation [55]. However, a multilingual survey can also be a limitation to the study. Inaccurate translation which includes different words and nuances may lead to surveys that are not equal in the content and that do not measure the same issues. Reminders were sent to the respondents to increase the response activity. This is a method that is often used in studies with questionnaires [52]. In this study a four-point Likert scale

was used to measure the opinions and experiences of DSNs. Likert scale is often used to measure different kinds of characteristics and a scale with four points or more usually gives results with variation [53]. Independent t-test was used for analyzing the results. Likert scale is often categorized as an ordinal scale even though its variables can be seen as good interval scale variables and for that reason the received numeric variables can be utilized in analyses that have been developed for interval scale variables [53, 57, 58].

5.1.2. Study population

Our goal was to reach DSNs that treat T2D patients. We wanted to reach both DSNs that use DHC tools and who do not use DHC tools to learn more about their experiences and opinions on DCPs/platforms. In the study participated 52 respondents. The participation activity was very low being only 7,6%. Low participation activity is typical in survey studies [55]. The target group in the study was DSNs that treat T2D patients. Many of the DSNs (87%) in the study treated T2D patients daily or a couple of times a week (Table 4). Most of the Swedish and 89% of the Finnish T2D patients are treated in primary care [15, 59]. DSNs who participated in the study worked most often in primary healthcare (84%) (table 4). In Finland, 83% of the nurses work in public healthcare [60]. In our study, 90% of the respondents worked in public healthcare (Table 4). The age distribution of the older DSNs was also quite similar to the age distribution of Finnish nurses in year 2020 [60]. Nevertheless, we did not reach the group of the youngest DSNs in our study. We may say that we have reached the right target group, but the population is not representative of the whole population [52], and thus we cannot generalize our results.

The response activity could have been improved by lengthening the survey time. Additionally, more respondents could have been reached if it had been possible to send the survey to hospitals and health care centers. The ethical permission processes in health care organizations can be quite lengthy and are often not best suited to student surveys with specific schedules. A cover letter and reminders were sent to respondents and there was active communication with the contact persons in both the associations. These factors often contribute to higher response activity [52, 55]. A longer survey period could have made it possible to send out several reminders and to market the survey more in the social media of the associations which could have improved the response activity [53]. The survey was sent before Christmas time to avoid the public holidays, but quite many of the respondents were on holidays when the survey was sent out and this could have affected the activity. The survey could have been sent out earlier, but it took a lot of time to formulate three language versions of the survey.

5.1.3. Strengths and limitations in the study

The usefulness of DCPs is currently a particularly interesting topic due to several reasons: the DCPs themselves are a relatively recent innovation that is being implemented in the treatment of many chronic illnesses, and these are the years when the first experiences about effectiveness of the pathways is being gathered. The covid -19 pandemic increased both need for digital solutions as well as the willingness of both health care professionals and patients to use them. Our study takes the first steps towards finding out how DCPs are being used in the treatment of T2D and points the way for more research to come in this topic. Particularly the approach of comparing two countries may bring future possibilities to combine best practices on the Nordic level. It is positive that we have reached our target group and received answers both from Finnish and Swedish DSNs.

There are some limitations in the study. A limited number of statistical analyses could be completed due to low response activity. Results from the Likert scale may be used in analyses that are made for interval scale variables [53, 57, 58]. Nevertheless, data gained from the Likert scale limits the variety of analyses that can be used. As a limitation for a Likert scale with only four answer alternatives can be seen that it might offer too few options for the respondents to choose from. A respondent might be forced to choose an

answer alternative that do not represent her opinions, or one might decide not to answer if there isn't a suitable answer alternative. Additionally, it was not possible to analyze the results with a Chi square test since the criterion was not fulfilled. The researcher's limited knowledge about statistical analyses can also be seen as a limitation in the study since some analyses might have been left undone by oversight. The researcher's knowledge about current Swedish DHC tools can be seen as an additional limitation and it was seen in the demographic question about use of DHC tools (table 4): only Finnish tools were mentioned in the question. This might have led to false results when comparing how many of the respondents in each country utilize DHC tools in their work. Additionally, it cannot be made sure with a web-based survey if the respondents actually were DSNs since no identification was required when answering the survey. It can neither be secured if someone answered the survey several times. The fact that survey was sent only for the members associations of DSNs can have led to selection bias since it is possible that nurses with a certain type of interest and opinions are members in associations.

5.1.4. Reliability

Test-retest method was used to measure the consistency of the survey. This method tells if the test gives same results when same person answers a survey twice. The limitation for this test can be seen that it does not consider the random effect of answers [55]. A value of 1.0 can be seen as high reliability and 0 as low reliability [53]. The survey was sent two times to two nurses that were not possible respondents in the study. The percentage compliance value for the test was calculated to be 0.64. It can be seen as a better than mediate reliability. However, a group consisting of two people does not give a sufficiently broad and reliable result from the test and therefore the result of the test-retest should be interpreted with caution [55].

5.1.5. Validity

To ascertain that the questionnaire measured the facts that we wanted it to measure a lot of effort was put on the formulation of the survey. The study area was divided into different sections and different statements were formulated to cover the subjects. After the survey was formulated a pilot test was conducted with a test group consisting of nurses who have experience on treating T2D patients and pharmacists to find out if the survey was readable, and if it functions as it was wished to function and if the statements and sections were logical. Some changes were made in the layout, in the order of the statements, one demographic question was added, and some language changes were made based on the comments received from the test group. The language in the surveys was tested by nurses and pharmacists who speak the language in the survey as their mother tongue. The three language versions were compared to each other, and the content and the order of the questions was made equal. The results received from the pilot group were used to improve the functionality of the survey. The survey was checked additionally at Umeå University. Additional corrections on language and in the content were made after that.

5.2. **Result discussion**

Results between Finnish and Swedish respondents were found to be similar. Similarities in Finnish and Swedish healthcare systems, patient material, and treatment recommendations may have contributed to the similar answers in both countries. Additionally, many of the respondents had quite similar backgrounds. Many of them worked in primary healthcare and in healthcare centers, they had a long professional working experience, they were over 51 years old, and they treated often T2D patients. For that reason, they might have answered in a similar way.

DCPs enable a wide range of functions in care pathways that may facilitate the work of healthcare professionals [23, 27]. Respondents of this study felt that the functions of DCPs mentioned in the part one of the survey would be useful in their work treating T2D patients (table 5). Active patient involvement and self-management are key factors in ensuring successful treatment in T2D [5]. DSNs also considered supporting patients' self-care to be

one of the most useful functions in the DCPs for T2D patients (table 5). The respondents found additionally the opportunity provided by DCPs to organize a wide range of trainings on, for example, diabetes medicines and comorbidities equally useful. The results of Tuomikoski's research support the beneficial results of versatile guidance in DCPs [27].

In digital platforms HCPs and patients have an opportunity to communicate in a variety of ways, have on-line appointments, and it is possible to answer patients' questions [27, 29, 41]. DSNs felt that these functions are also useful in the DCPs for the treatment of T2D patients (table 5). Unlike previous results [5, 27], a quarter of the DSNs did not find that DCPs would make the organization of patient work much more efficient (table 5). The open-ended questions raised the wish for a chat service that would assist in the work of a nurse by referring the patient to the right professional service. However, the respondents felt that treatment processes could be unified with the help of DCPs (table 5) in a similar manner with an earlier study [5].

Digital monitoring of laboratory values is possible [24, 25]. This function has been found useful in treatment of T2D in an earlier study [29]. However, the respondents of this study rather disagreed on the usefulness of this function in the treatment of type two diabetics (table 5). 18% of the respondents did not find this function very useful, but on the other hand, the open-ended responses specifically called for a function that would allow them to quickly see the results of the patient's laboratory values through the DCPs.

To improve willingness to implement different functions of DCPs into DSNs work with T2D patients, it is important to carefully plan the implementation and it might be beneficial to start the implementations for instance with patients who are more interested in DHC and perhaps with a small group of patients. It might also be beneficial to learn more about reasons why DSNs are unwilling to implement different functions in DCPs into their work.

Respondents with previous experience on DHC tools in their work found several functions in DCPs more useful than those respondents who had not used DHC tools. Positive experiences of DCPs have also been obtained in the previous study that examined the experiences on DCPs among healthcare professionals in specialized care hospitals in Finland [27]. It can be difficult to understand the benefits of DCPs before it has been implemented into one's workflow. Lack of time can contribute to negative attitudes towards unfamiliar ways of working. In the open-ended questions lack of time was mentioned as an obstacle to implement DCPs. In addition, earlier studies have pointed out that the digital function should be compatible with the current workflows [48] and with other available digital services [17], the functions should serve the needs of the HCPs [14], the workload should not be increased [17], and the implementation of the DCP should be supported [27, 41] to make the advantages of DHC tools. Insufficient attention to these requirements can be an obstacle for the use of DCPs. In open ended questions patients' advanced age was additionally seen as an obstacle to the implementation and use of DCPs. This result is in line with the findings of earlier studies [29, 24].

It has been proven in earlier studies that medication adherence in the treatment of T2D may be improved when DHC platforms have been involved in the care [29, 30]. Respondents of this study found also that it is possible to increase medication adherence if the functions of DCPs mentioned in the survey are being used (figure 11).

The respondents felt that the availability of diverse training methods in DCPs was the most effective function in improving medication adherence (table 7). There is often only a short time at an appointment to go through the information and patients can miss a lot of information that has been given. It is beneficial that information is available in various formats (video, text, audiobook, etc.). Once they have returned home, patients can go through the information again (in written, audio or video format) if any uncertainties remain to them. This function could also be supported by the possibility of round-the-clock communication in DCPs for instance via messaging availability. The respondents participating in the survey felt that patients' possibility of sending message to HCPs round-

the-clock would improve medication adherence (table 7). This fact is also supported by a previous study [1]. The need for different contact methods was also raised in open ended questions. Medication adherence was felt to be improved when the patient could choose the way of contacting HCPs.

It has been shown in earlier studies that lack of information for instance on medication can lead to lowered medication adherence [41]. Also, DSNs found that when patients can be offered reliable information and that it is easily available in one place medication adherence can be improved (table 7). Today, there is so much information available that it is difficult for patients to choose the right and reliable information for themselves. Therefore, this function in the DCP is especially important in supporting adequate self-management and treatment of T2D.

Digital healthcare services may improve communication between different professional groups [31]. Respondents believed also that improved communication in a multidisciplinary team increases medication adherence (table 7). However, DSNs did not believe as strongly that adherence to medication would improve if comorbidities could be treated in DCPs (table 7). At this point, however, the difference in responses was clear between respondents who had previously used DHC tools and those who had no previous experience on DHC tools. Those who used DHC services in their work felt more strongly that this function can have a positive impact on medication adherence than those DSNs that had not previously used DHC tools. The reason is perhaps the respondents' fear that their own already large workload will increase if comorbidities must be taken care of as well.

However, the treatment of comorbidities is a key part of the treatment of T2D [2]. The diversity and incompatibility of care pathways and DHC services is a challenge in the current situation [17, 36]. The fragmentation of DHC tools was also highlighted in open ended questions in this survey and was perceived as confusing. Treatment of comorbidities and treating patients with multiple diseases through the same DCP, however, could make it easier for patients to be involved in the treatment. One common DCP would also make it easier for the HCPs to access patients' medication data in one place. The DCP could direct the patient with a chat function to the right professional according to their needs and symptoms. The idea of common care pathways is also supported in an earlier article [37]. A common DCP for several diseases could be beneficial. Many chronic diseases have similar characteristics, and a DCP suitable for different diseases might be useful. In the future, the survey prepared for this study could also be used to investigate the needs and wishes of HCPs treating other chronic diseases.

Earlier studies have shown signs of improved medication safety with DHC [29, 30]. Respondents in this study found also that when DCPs are being used medication safety can be improved (figure 11). In addition, they estimated functions of DCPs to have a slightly greater impact on medication safety than on medication adherence (figure 11).

High alert medications are part of the treatment of T2D. Use of high alert medication increases the risk for medication errors and the risk for reduced medication safety [45]. Correct use of medication including self-injectable medicines is an essential part of the treatment for T2D patients. DSNs estimated the function of supporting patients' ability to use injectable medicines as one of the most important functions in DCPs that improves medication safety (table 8). Safe use of medication is important since lack of knowledge about disease and medications can increase the occurrence of medication errors [46]. The results of this study also show that DSNs believe that medication safety can be improved if more information on how medications act in body can be offered and if clarified information on safe use of medication is available in DCPs (table 8).

One of the central goals of treatment for T2D is to maintain steady blood glucose levels. Monitoring blood glucose levels of T2D patients is an important part of care [2]. In digital platforms, blood glucose measurements could be transferred automatically to health care

professionals [24, 25]. Almost all the DSNs in this study found that this kind of possibility to monitor patients' blood glucose levels in DCP would improve medication safety (table 8).

Most of the respondents found that DCPs should be utilized more (table 9). Respondents who felt that DCPs should not be utilized in a larger extent found that there are already so many DHC tools available and that is confusing. In this study 12 other DHC tools besides DCPs were mentioned in demographic questions (table 4). It has been shown in an earlier study that lack of integration between DHC tools reduces their usefulness [48]. Additionally, the lack of national coordination as well as of criteria and recommendations can contribute to confusion among DHC users [36]. There are several terms that are being used for DHC which have been shown to increase the confusion among users of DHC [20, 21].

In the future, it would be beneficial to study more the functionality and utilization of DCPs. Instead of constantly urging the implementation of new DCPs, it would be beneficial to find ways of integrating and developing current DCPs for the use of a larger group of patients and HCPs. Alongside with these studies it would be useful to investigate other professionals' wishes and experiences on DCPs for T2D.

Another subject that was raised in the survey by respondents in feedback that they have received from patients is the concern about older patients' ability to cope with and ability to use DCPs. This is something that should be taken into consideration since most of T2D patients are older people [13, 14]. However, it is important to remember that there might be individual differences in willingness to use DCPs among older patients. Are older people willing to use DCPs, and in which ways, is there a possibility to motivate, teach and support the use of DCPs to this group of patients? It would be beneficial to study these subjects in the future.

Many of the respondents found that DHC tools can help their work. Similar results have been shown for instance in Tuomikoski's study [27]. Nevertheless, there were also respondents who found that DCPs are not helping their work in the current situation. Behind the thoughts there are the same reasons that are common in the treatment of T2D patients, which are the lack of time and resources [18]. Respondents of the study found that they do not have time to learn how to use DCPs. To motivate the DSNs to use DCPs it is essential to consider their opinions when developing DCPs in the future. When implementing the DCPs individualized support should be available, it should be made sure that DCPs suit the current workflows and that there is enough time to learn to use DCPs. The use should be coordinated at the national and organizational level.

All diseases, symptoms and situations cannot be taken care of digitally [27, 32]. An option could be integrated care with both digital and traditional face-to-face care [34]. In the open-ended questions of the survey some respondents told though that there are still patients that have not seen the positive impact on DCPs as a complement to their care. This might be improved if the patients would participate in the development of DCPs and this might lead to increased number of motivated patients. Additionally, it is necessary to let DSNs to participate in the planning process of DCPs to better motivate and to increase their involvement in the use of DCPs. Like Scimmer et al write in their study it is essential to include both patients and HCPs in the development of DHC tools [14]. In the future, it would be beneficial to study also T2D patients' opinions on DCPs so that their needs would be taken into consideration.

Patients should have an equal right to receive care, and they should be able to choose how and where they are treated [36]. This has been pointed out also in the feedback that has been received from T2D patients. Patients are willing to use DCPs, but they wish also to have a possibility to reach HCPs by phone if necessary. National coordination and pathways would support equality in care [37].

The role of pharmacists in clinical work was considered important in a previous study [44, 61], but the competence of clinical pharmacists was not always sufficiently well-known according to the study made in Sweden [62]. The implementation of more clinical work assignments for pharmacists has not been fast in Finland [63, 64]. In this study, the use of pharmacist services in DCPs was rated as the least useful section of the study (figure 11). The respondents agreed somewhat that pharmacist knowledge should be utilized as part of DCPs. The reasons for DSNs' unwillingness to utilize pharmacist services in DCPs for T2D might be the unawareness of skills that pharmacists have and services that they can offer to improve safe and rational use of medication. Going through the interactions and identifying the ADRs are functions that it is traditionally customary for pharmacists to perform. These functions were also perceived as most useful pharmacist services in this study (table 11).

Clinical pharmaceutical services like making medication reviews, scheduling the timing of home medication, and ascertaining the correct dose and dosing time are pharmaceutical services that are perhaps not known so well and not made the most advantage of yet in Sweden and in Finland [62, 64]. These functions were found also in this study to be less useful pharmacist services in DCPs (table 11). Part of the reason why these activities were not perceived as equally important as part of DCPs may be a lack of awareness that pharmacists can perform these activities. Pharmacists are also often not considered as a part of the patient's treatment chain even though they have a great potential to increase medication safety and optimize medication care [64]. In this study the respondents would rather contact physicians than pharmacists when in need of medical consultation. If pharmacists were to be considered as part of the treatment chain as other health care professionals, their expertise could be better utilized, for example, in the treatment of T2D diabetics. There is a need for a greater number of health care professionals to be included in the treatment of increasing number of T2D patients. Community pharmacists as well as pharmacist in hospitals have the knowledge and potential to be involved in the medical care of T2D patients. In the future it would be beneficial to investigate the opinions of pharmacists on the subject and more about the possibility to include pharmacists in the multidisciplinary team treating T2D patients.

5.3. Possible future research subjects

- DSNs' opinions and experiences on DCP for T2D – DSNs reached via hospitals and healthcare centers
- Other HCPs' needs and expectations on DCP for T2D
- T2D patients' needs and expectations on DCPs
- Older T2D patients' special needs and expectations on DCPs
- Possible ways of increasing the utilization of pharmacist skills in the treatment of T2D patients
- Pharmacists' opinions on utilizing pharmacist services in DCPs
- HCPs treating other chronic diseases - Needs and expectations on DCPs
- Possibility of developing a common DCP for several diseases

6. Conclusion

T2D is a complex disease, and its treatment requires active involvement from patients and a strong support from DSNs. Along with the increasing number of T2D patients and with limited resources there is a need to optimize and rationalize the traditional care so that T2D patients receive the person-centered individualized treatment they ought to receive according to the guidelines.

DSNs in Finland and Sweden had similar opinions and experiences on DCPs according to the results. They found that DCPs offer several functions that are useful in the care of T2D patients. They found also that DCPs should be utilized more. Supporting self-management of T2D, offering versatile training methods as well as improved communication between patients and HCPs are functions that DSNs found as the most useful ones. DSNs believe that medication adherence and medication safety can be improved when DCPs offer certain services.

DSNs did not find the pharmacist services as the most important functions in DCPs. However, both community pharmacists and pharmacists in hospitals have skills that could be utilized in the treatment of T2D patients who have complex medication regimen. The positive effect of the work provided by pharmacists is not so well known in Finland and in Sweden as it is elsewhere in the world. If other HCPs knew better the pharmacists' skills, it might lead to increased willingness to utilize pharmacists' services as a part of a multidisciplinary team in DCPs also in Finland and in Sweden, and the increasing number of T2D patients might well benefit from these services in the future.

DSNs found that DCPs should be utilized more. However, all diseases and symptoms cannot be treated digitally and DCPs can be challenging for a subgroup of patients like patients with advanced age. Additionally, there should be enough time and support for the implementation of DCPs into DSNs work and DCPs should suit the current workflows to avoid increased workload. A national common DCP for several diseases including treatment of comorbidities or unification of existing DCPs might increase the usability/usefulness of DCPs in the future. National criteria, recommendations, and coordination on DCPs could contribute to increased utilization of DCPs. The results of this study could be used in the future in the further development of DCPs.

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9. Appendix

9.1. The survey

Appendix 1, the survey, demographic information

1	Gender	Woman Man Other
2	Age	20–30 years 31–40 years 41–50 years 51–60 years Over 60 years
3	Country	Finland Sweden
4	Training	Nurse Health care nurse Other; what?
5	Specialization	Diabetes nurse No specialization Other; what?
6	Length of professional experience	Under 5 years 5–10 years 11–20 years 21–30 years over 30 years
7	Primary area	Primary health care Specialized medical care Other; what?
8	Primary sector	Public healthcare Private sector
9	Type of primary organization	Hospital Health care center Care home Home health care Ambulance or similar Other; what?
10	I treat patients who have sought care due to type II diabetes	Every day A couple of times a week A couple of times a month More seldom than a couple of times a month
11	In my work Utilize (You can choose several opinions)	A digital care pathway for type II diabetes (e.g., Health village in Finland) Maisa customer portal (in Finland) Digital chat with patients Another digital patient tool, what?

Appendix 1, the survey, part 1/5: Usability of digital care pathways/platforms in the work of DSNs

In my opinion the below feature of a digital pathway is or would be useful in my work:	1	2	3	4
1. Unifying care processes				
2. Making scheduling or patient work more efficient				
3. Sending medication reminders to patients automatically				
4. Supporting patients' self-care				
5. Scheduling appointments				
6. Versatile communication with patients				
7. Giving medication advice				
8. Medication training for patients, e.g., on diabetes medication or the care of comorbidities				
9. Answering patients' questions				
10. Giving feedback to patients				
11. Monitoring patients' laboratory results				
12. Online meetings with patients, e.g., a chat service				
13. What other kinds of functions in a digital care pathway or other digital platform would support your work?				

1 = agree completely, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree completely

Appendix 1, the survey, part 2/5 Medication adherence

In my opinion a digital care pathway or other digital care platform increases medication adherence due to this reason:	1	2	3	4
1. Increase in the versatility of patient medication counselling (e.g., medication support materials like instruction videos)				
2. Making patient medication counselling clearer and more unified				
3. Making reliable information more easily available in one place				
4. Medication reminders to patients				
5. Scheduling the dosing times of medications				
6. Automatic reminders to patients to get to get medications from the pharmacy				
7. Supporting the appropriate use of medications				
8. The use of versatile counselling methods (e.g., videos, patient instructions, peer groups, chats)				
9. The availability of patient counselling is increased by 24-h-service (e.g., leaving a message to the nurse)				
10. Increasing patient's empowerment regarding their illnesses and medication				
11. The interaction between patient and healthcare professionals can be strengthened (e.g., via digital chat function)				
12. The availability of multidisciplinary team services is increased (e.g., nutritional therapist, pharmacist, nurse, doctor)				
13. The information flow between groups of healthcare professionals is increased				
14. The monitoring of information saved by patients and healthcare professionals is easier				
15. The care of comorbidities is possible in the same place				
16. Support of patient's independent activity in taking care of their medication				

1 = agree completely, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree completely

Appendix 1, the survey, part 3/5. Medication safety.

In my opinion a digital care pathway or other digital care platform strengthens medication safety due to this reason:	1	2	3	4
1 Correcting patients' (possible) mistaken ideas about their medication				
2 Decreasing the incidence of adverse effects through better guidance				
3 Increasing awareness of how diabetes medications act in the body				
4 Increasing awareness of the adverse effects of diabetes medications				
5 Strengthening patients' ability to use injectable medicines independently				
6 Supporting appropriate medication by automatic transfer of blood glucose measurements to the healthcare professionals				
7 Supporting the continuity of treatment				
8 Supporting the patient when their medication changes by clarifying differences between old and new medicines				
9 Offering information on how medication adverse effects (e.g., hypoglycemia) can be prevented				
10 Decreasing dosage errors when products are switched				
11 Clarifying information about the dosage and safe use of medications				
12 Supporting the implementation of complex medication				
13 Decreasing missed medication doses by medication reminders				
14 Giving clear instructions regarding dosage, adverse effects, and daily use of medicines				
15 Helping patients to reach a comprehensive view of their medication				

1 = agree completely, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree completely

Appendix 1, the survey, part 4/5: Utilizing digital care pathways and other digital platforms.

	1	2	3	4
Digital care pathways or other digital platforms should be utilized more in treating T2D				
If you answered, “Disagree somewhat” or “disagree completely”, you may justify your answer below				
Digital care pathways or other digital care platforms make my work with T2D patients easier.	1	2	3	4
If you answered, “Disagree somewhat” or “disagree completely”, you may justify your answer below				
I have received patient feedback about digital care pathways or other digital care platforms	Yes		No	
If I have received patient feedback about digital care pathways or other digital care platforms, the feedback has been positive.	1	2	3	4
If you answered, “Disagree somewhat” or “disagree completely”, you may justify your answer below				

1 = agree completely, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree completely

Appendix 1, the survey, part 5/5. Utilizing pharmacist services in a digital care pathway or other digital care platform.

Currently pharmacist services are not used in digital care pathways. In my opinion the medication knowledge of pharmacists could be utilized in digital care pathways or other platforms in the following way:	1	2	3	4
1 Medication review of patients' home medication				
2 Scheduling the timing of home medication				
3 Taking notice of adverse effects				
4 Checking medication interactions				
5 Counselling concerning switching between products				
6 Ascertaining the correct dose and dosing time of medication				
7 Choosing the most suitable medication				
8 Pharmacist reception at the pharmacy				
In what other way could pharmacists' knowledge about medications be utilized in digital care pathways or other digital care platforms?				
In a digital care pathway, the consultation of pharmacists would work best in Digital chat Phone call Email Video conference Other; what?				

1 = agree completely, 2 = agree somewhat, 3 = disagree somewhat, 4 = disagree completely

Is there something else you like to tell us about digital care pathways or other digital care platforms in your work?

9.2. The cover letter

Appendix 2, the cover letter

Digital care pathway for type two diabetes – experiences and opinions of healthcare professionals/ diabetes nurses

The number of diabetes patients is increasing, and the resources of healthcare professionals and of healthcare are limited. Digital care pathways and other digital care platforms are topical and possible future solutions of healthcare. The role of nurses is essential in the care of type II-diabetes patients and this role could be supported by using digital care pathways. Utilizing the medication knowledge of pharmacists as a part of a multi professional team have shown positive effects on medication safety.

The aim of the study

This study aims to investigate the usability of digital care pathways in the care of type II-diabetes patients. This study aims to reach both nurses that have used digital care pathways or other digital platforms earlier (experiences) and nurses that have not used these services formats yet (opinions). The objective of the study is to investigate what kind of digital tools would facilitate the work of nurses, what kind of effect digital care pathways would have on medication adherence and on medication safety and what kind of role pharmacists could have as a part of the multi professional team of digital care pathways.

The data collection and the timescale

The target group of this study is nurses and other care providers that are involved in the care of type II-diabetes patients and that are members of the associations for the diabetes specialist nurses both in Finland and in Sweden. Participating in the study is voluntary. No personal data or patient data of the respondents will be collected in the study. The study respondents cannot be identified from the answers. The data will be collected with a platform called Survey Pal by Lääketietokeskus (Pharmaceutical Information Centre). Participation in the survey is taken as consent. Your response is valuable for our study. We hope that you will answer the survey as soon as possible but the latest on November 28, 2022.

You will find the links for the survey in the email. You may answer the survey in English, Swedish or Finnish.

Research person and supervisors

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Results

The results will be reported as a Master's thesis of pharmacy and they may also be utilized as a part of the MASSE-project in Lääketietokeskus (Pharmaceutical Information Centre) (<https://www.aalto.fi/en/departments-of-industrial-engineering-and-management/masse-personalized-care-with-mass-production>).

Thank you for your participation in the study!

Parainen, Finland, November 2022
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