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USER SATISFACTION OF USING SPEECH RECOGNITION IN HEALTH CARE CENTERS

Author: Atte Nieminen

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Abstract

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Author(s) Atte Nieminen			
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Supervisor(s) Pirjo Turunen			
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Abstract

Solutions to various rising healthcare costs have long been sought in a variety of technologies. The technologies are designed to ease the workload of professionals to allow more time to perform other tasks. Making an entry into the patient information system is one of the most important tasks in the work of professionals and often also the most time-consuming. Constantly evolving technology offers new and powerful applications that allow professionals to develop their own work efficiency and pace. Artificial intelligence technology in particular has been paid attention to the past 10 years. The speech recognition system utilizes an artificial intelligence-based cloud service in which a professional's speech is immediately converted to text, either directly to the patient information system or to another destination from where it can be transferred to the patient information system.

The aim of the study was to find out how satisfied the users of speech recognition were and what factors influence user satisfaction. In addition, users were asked to provide suggestions for improvements to increase user satisfaction. Previous surveys on user satisfaction with speech recognition were hardly found, especially in Finland. Other parts of the world, research on speech recognition in healthcare has focused mainly on error-sensitivity and usability, which is one component of user satisfaction. The study in the thesis was conducted using a quantitative questionnaire electronically, which was sent to speech recognition users in the Saarikka and Wiitaunioni area.

Based on the results, the users were generally satisfied with the use of speech recognition. The respondents were particularly satisfied with the orientation and the logic and ease of use. Satisfaction was explicitly emphasized in the use of the software itself. Based on the results, the facilitation of speech recognition for other work and especially for patient recording was felt to a lesser extent. As development ideas, the users wanted integration back between the patient information system and speech recognition software. In addition, regular refresher training and better accuracy in identifying non-medical vocabulary were desired.

The cost-effectiveness of the use of speech recognition was identified as a topic for further research, and a more detailed study of the time spent by professionals on recording would be needed in order to better understand the benefits of using speech recognition.

Keywords
User satisfaction, Speech recognition, Health care

CONTENTS

Introduction

Speech recognition has been studied in health care for nearly three decades. However, research has mainly focused on the main market areas for speech recognition applications in the United States and Australia. In addition, studies have mainly focused on radiology and pathology. To date, the main research topics in previous studies have been the error sensitivity of speech recognition, the effects on documentation efficiency and time use, and the comparison between traditional documentation and speech recognition. There has been little research on user satisfaction. In addition, more research information on the use of speech recognition in Finland is needed. (Blackley & co 2019)

The history of speech recognition dates back to the 1950s hand in hand with the development of computers (Juang & Lawrence 2004). The need for speech recognition was identified as early as the mid-20th century and was intended to replace some of the man-made mechanical movements or actions that a machine could automatically perform with certain voice commands. At the time, speech recognition was the prerogative of certain special groups (army, healthcare, etc.), but today some sort of speech recognition solution can be found in the pocket (cell phone) of almost every citizen. (O'Shaughnessy 2008)

Healthcare costs have continued to rise steadily during the 21st century in Finland. Expenditures in 2019 increased by 3% from the previous year and the ratio of health care expenditures to GDP increased by 0.2%, raising the overall ratio to 9.2%. As the population ages, health care costs are expected to continue to rise. (Matveinen 2021)

Curbing the rise in costs is expected, in particular, from the reform of social and health care and the related artificial intelligence and technology solutions directly to the field, which can make work more efficient. (Neittaanmäki & Kaasalainen 2018)

1 Speech recognition

Speech recognition is based on the sound characteristics calculated from the audio signal and the statistical models formed from them. In addition, the detector uses a large amount of text storage in which statistical vocabulary and language models are stored. These allow the program to select the most likely option from the same-sounding word. (Kurimo 2008)

1.1 History of speech recognition

The history of speech recognition dates back to the 1950s. At the time, the American computer company Bell developed a technology that recognized individual numbers spoken aloud. 10 years later, IBM introduced a technology that recognized 16 different words and was able to respond using the same words. At the time, hardware placed many constraints on technological development and research work was developed and continued globally. (Juang & Lawrence 2004)

In the 1970s, the U.S. Department of Defense and DARPA created the most advanced speech recognition system to date, allowing applications to recognize up to over a thousand different words and multiple voices. A significant turning point was the proliferation of personal computers (PCs) in the 1990s, which significantly accelerated hardware manufacturing. Thus, it was possible to create new features and goals for speech recognition as well. These processes also gave rise to the Dragon Speech Recognition System, which is still in use today. Dragon's strengths were continuous speech recognition and simple and powerful algorithms. (Huang & Baker 2014)

By the turn of the 21st century, speech recognition had already achieved significant vocabulary and recognition accuracy (80%). In a small backwater phase of development, Google’s search engine speech recognition and later also Apple’s own speech recognition features were disconnected from smart devices. The data on speech recognition currently in use is particularly significant. For these reasons, the development of speech recognition has been really tremendous in recent years. (O’Shaughnessy 2008)

1.2 Speech recognition technology

Converting spoken audio to text on a computer requires several different steps. The first step is to record and digitize the sound propagating as a wave motion in air. The challenge here is often to separate the desired sound from other background sounds, such as engine hum. Speech is cut into several sections of only about 10 milliseconds from which the frequency spectrum is calculated. This is the best way to separate background noise. (Salminen 2015)

In the second step, each section is formed into a feature vector containing numerical values intended to describe content relevant to speech recognition. A statistical model of sounds is formed by defining for each sound a probability distribution that describes the occurrence of that sound in the corresponding part of the recording. On the basis of the probability distribution of one sound, the

probability with which the feature vector in question could be derived from this distribution can be calculated. (Salminen 2015)

In the next step, the phonemes are selected. The phonemes create their own sets of patterns, on the basis of which the system seeks to identify the correct sounds and group them in the correct order. Different phonemes may occur at different stages of speech. Thus, several different distribution patterns and durations have to be created for phonemes. (Salminen 2015)

Next, a statistical model of the language is developed based on large textual data and this is taken into account when the signal is applied to sound models. First, a glossary is compiled and the probability of occurrence of each word and the most probable pronunciation pattern are determined. The larger the pronunciation dictionary, the greater the probability of error recognition. Therefore, one should choose only the most common pronunciation model. In many different languages, such as Finnish, the vocabulary size can be really large for speech recognition to work properly. This is affected by the different inflections of words, prefixes, and conjunctions. Recognition can be greatly facilitated by teaching the system to recognize the relationship of words to each other and the dependencies between them. Speech recognition is part of linguistics and is better known as speech processing and speech research. From the point of view of a functioning speech technology, it is important that the built solution works on four levels: 1) speech synthesis, 2) speech recognition, and 3) a speaker recognition application, and 4) interaction research. By using these four different areas, it is possible to achieve more functional entities in speech technology. (Salminen 2015)

In the last step, the word sequence is defined on the basis of the previously presented speech signal and the available sound and language patterns. Direct search cannot be used for continuous speech recognition even if powerful algorithms are used. However, with algorithm optimizations, it is possible to achieve real-time speech recognition. In this case, unnecessary calculations are omitted from the algorithms and they know how to remove the most unlikely alternatives from the word strings at the earliest possible stage. The operation of the algorithm can be facilitated by creating a list of the next best hypotheses or a compact word diagram from which a set of best hypotheses can be easily distinguished. (Salminen 2015)

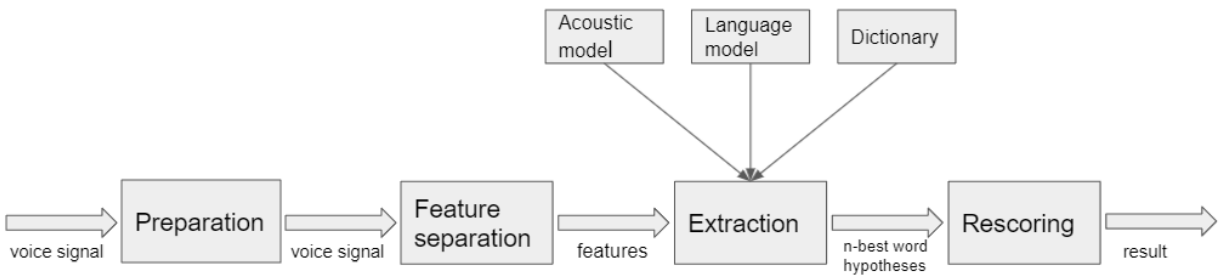


Figure 1. Typical speech recognition process (Gruhn 2008)

1.3 Hidden Markov model (HMM)

The hidden Markov model is one of the most common models on which current speech recognition systems are based. The HMM is a statistical model that seeks to infer transition probabilities based on observable outcomes. In practice, this means trying to deduce whole words and sentence structures from parts of words with the help of a dictionary and language model using probabilities. (Gales & Young 2007)

The hidden Markov model requires extensive training data with which the acoustic models are formed. However, the problem with speech recognition is that there are constantly more speakers and no ready-made acoustic model can be found for all speakers or their speech is poorly represented in the training data. The solution to this is an adaptation in which a small portion of the data from each different speaker is used to form an acoustic model. This data can be used in addition to the training data or directly as part of the recognition data to reduce the number of errors and increase the accuracy of the identification. (Gales & Young 2007)

1.4 Speech recognition in healthcare

The healthcare system is undergoing constant change and is being significantly affected by technological innovations in the environment. Over the last 30 years, technological development has been rapid and although some innovations arrive in the healthcare field with a delay, healthcare has had difficulty keeping up with developments and adapting to change quickly. Public and efficient health care has been seen as one sign of a functioning society and thus easy access to good care has been valued. Today, the emphasis on nursing has shifted in part to prevention and cost-effectiveness. Support for achieving these goals is sought in artificial intelligence and technical solutions based on it, of which speech recognition is one. (Parente, Kock & Sonsini 2004)

When, in the early 1990s, speech recognition was no longer constrained by computer performance, the use of speech recognition also progressed to areas other than industrial use alone. The first experiments with speech recognition in health care date back to 1994. At the time, the setup was still one where the user (= physician) had to learn to speak to the computer in the right way so that the machine understood what the user was saying. In addition, the interface of the application was not very user-friendly and the vocabularies were narrow and could not understand medical terminology. (Parente, Kock & Sonsini 2004)

In addition to speech comprehension, there were also challenges in the timing and accuracy of speech recognition processing. The 486-architecture of that time could not distinguish background noise from the speech produced. In addition, as an investment, a speech recognition workstation was relatively very expensive. Because of the challenges mentioned above, there was significant opposition to speech recognition in health care at the time. (Parente, Kock & Sonsini 2004)

Traditionally, digital dictation is used in healthcare in Finland, where text dictated by a doctor is transferred as a digital recording to a handler's workstation. I will demonstrate this process in figure 2.

The handler listens to the dictation and writes it as text and sends the finished text digitally to the doctor for approval. The doctor reviews and approves the text, after which it enters the patient's data into the patient information system. (Vogel & co 2015)

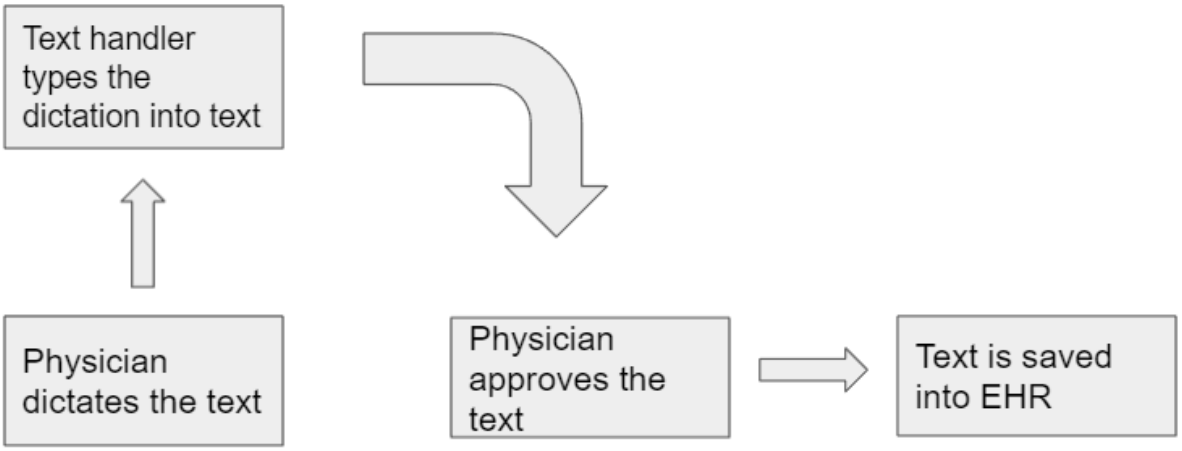


Figure 2. Traditional model of health record dictation and conversion to text.

With automatic speech recognition, patient texts can be completed in two different ways. In both ways, the physician first dictates the text and automatic speech recognition converts the speech to text. At this point, there is an option to choose between two different options. In the first option, the text generated by the automatic speech recognition goes to a text handler for review, which compares the dictation and the typed text and corrects any errors if necessary. The text handler then returns the text to the physician. Another option is to omit the word processor step altogether. In this option, the physician dictates the text and receives it as ready-made text directly on his own screen, where the physician himself approves the text and saves it directly in the patient information system. In the first option, the process is no different from traditional digital dictation from a physician’s perspective. In the second option, the physician himself prepares the text from start to finish. (Vogel & co 2015)

I will give an example where word processing is omitted in Figure 3.

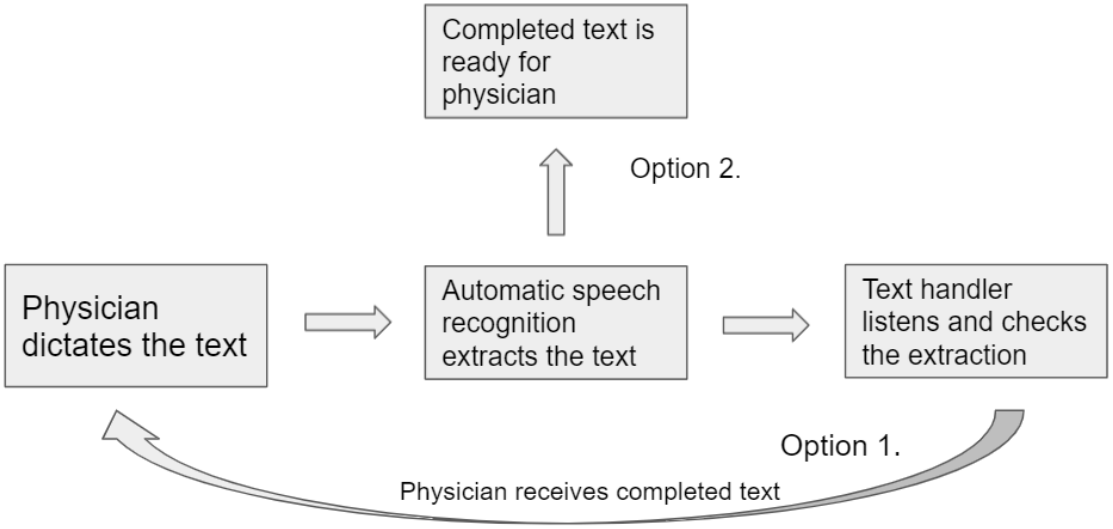


Figure 3. Automatic speech recognition in making patient texts

2 Cost efficiency from technology

Healthcare consists of health care systems and actions to improve an individual's health and / or well-being. These actions are implemented within health care systems. It is important to distinguish the structure of health care from its providers and the resulting outcomes. The quality of care can be thought of as a caricature from the perspective of an individual or a population. It is important that the quality of care is not measured by a single metric, but that the effects on both the individual and the population are taken into account when measuring quality. (Campbell & co 2000)

Healthcare costs in Finland increased by 3% in 2019 compared to the previous year. In total, health care expenditure was around € 22 billion. About half of this expenditure was for specialist care and primary health care. The ratio of health care expenditure to GDP was 9.2%, which was 0.2% higher than in 2018. In comparison with other OECD countries, Finland ranks slightly lower than the average (8.8%). Of the Nordic countries, only Iceland's expenditure was lower than Finland's. (Matveinen 2021)

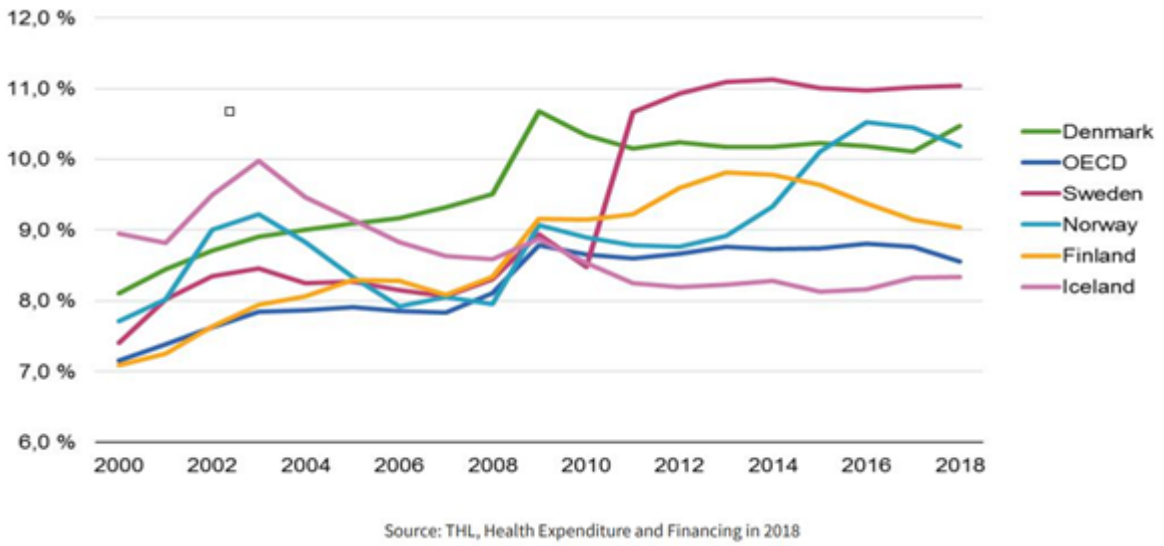


Figure 4. Health expenditure as a share of GDP.

In the same comparisons, the largest expenditures in relation to GDP in OECD countries were in the USA (17%), Switzerland (12.1%) and France (11.2%). The same report of the Finnish Institute for Health and Welfare states that in Finland, most health care expenditure is financed from public funds, which covers 76.8% of the financing. This is the lowest in the Nordic countries, but above the average for other OECD countries (73.9%). (Matveinen 2021)

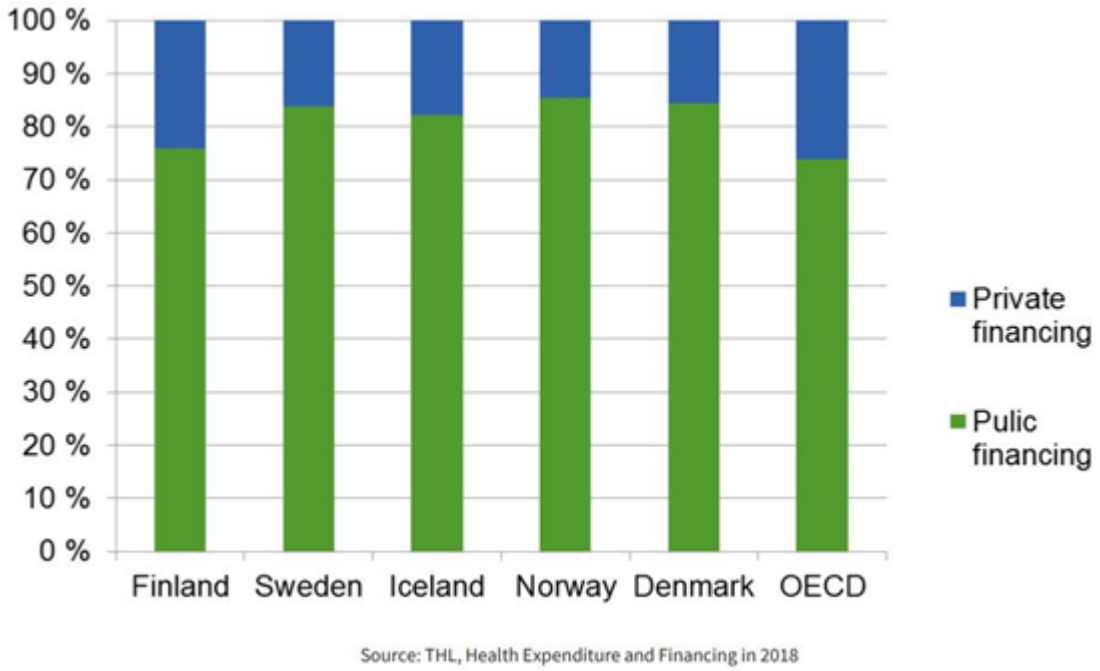


Figure 5. Contributions to health expenditure by country and by financing

Globally, health care costs have continued to rise. Between 2010 and 2017, health care costs grew by an average of 3.9% per year while GDP grew by only 3% per year. However, rising spending on health care does not guarantee better quality of care. The rise in health care costs occurred globally, regardless of countries 'income levels. The lower the income level of the country, the less money was spent on healthcare per capita on average. In higher-income countries, the government's share of the payer of healthcare is also significantly higher than in lower-income countries. However, it is important to note that costs have risen since before the corona pandemic. (Eissa 2020)

Finland has long been undergoing a restructuring of social and health services, the SOTE reform. The purpose of the reform is to transfer the responsibility for the production of services from the municipalities to the provinces, which will be established in connection with the reform. This would allow for greater uniformity in access to services and aims to increase the focus of care on primary health care rather than expensive specialist care. This is also intended to curb ever-increasing healthcare costs. (STM 2020)

With SOTE, healthcare IT solutions will play a key role in increasing efficiency and finding cost savings. Key areas for future development will be improving the usability of IT systems, developing management practices, and developing staff IT skills and utilization. More user-friendly systems save working time and improve patient safety. Artificial intelligence-based solutions are seen as a facilitator for information management and decision making. In addition, they are believed to speed up work processes in several different areas. (Neittaanmäki & Kaasalainen 2018)

Artificial intelligence in healthcare usually refers to a computer or system that is able to draw conclusions from available data and both to support a professional in decision making and in some

cases even to make decisions independently. The best-known manifestations of artificial intelligence are deep learning, machine learning, and natural language processing. In practice, artificial intelligence solutions in healthcare focus on decision support, big data processing and the automation of several different processes (appointment booking, word processing, etc.). Artificial intelligence in healthcare is still a relatively new acquaintance for healthcare professionals. There is a need to invest in effective investment in artificial intelligence solutions that simultaneously improve access to healthcare and reduce costs. More research is needed on the impact of artificial intelligence solutions on costs and employee attitudes. (Shinners & co 2020)

Speech recognition is an artificial intelligence-based solution that can bring efficiency and cost savings to the work of healthcare professionals. Some studies have found that it has led to significant economic savings in certain healthcare environments. In the past, speech recognition has been used mainly in radiology and pathology, but its use has become more common in other specialties due to more advanced speech recognition technology. Therefore, the effectiveness of speech recognition, and thus its economy, depends on the operating environment and the methods and practices used in the past. It should also be noted that there is relatively little research evidence on the economic benefits and that further research is needed. (Hogdson & Coiera 2015).

3 Previous studies about speech recognition

In her 2011 research, Ruotsalo showed that there was opposition to the use of speech recognition, especially among doctors and secretaries. These two occupational groups are the ones whose work is most affected by speech recognition. The responses to the survey show that many opposed speech recognition even without actual experience of using the program itself. From this it can be concluded that the resistance was mainly based on imagination. For example, in the case of secretaries, the opposition was partly related to fear for their jobs, and for doctors, the fear was suspected by concern about the increasing workload. (Ruotsalo 2011)

It can also be seen from the results of Ruotsalo's thesis that physicians in particular recognized to some extent the potential benefits of speech recognition, such as faster data flow. The main concern of physicians was that their workload would increase and there would be less time to treat patients. (Ruotsalo 2011)

In a review carried out in 2017, the National Institute for Health and Welfare in Finland surveyed the utilization rate of information and communication technology in health services. The results showed that more than 80% of hospital districts had a speech recognition system in place. At the time of the previous survey, the corresponding figure in 2014 was about 50%. The largest specialty in which a speech recognition system was used was radiology. In about half of the hospital districts, speech recognition was used in other specialties as well. These were mainly pathology, psychiatry, pediatrics and geriatrics. (Reponen & co 2017)

In primary health care, the speech recognition system was used in about one in three health centers (n = 121). In 2014, the corresponding figure was 10%. A significant group of users in health centers were radiologists and doctors working in the reception area. The survey also identified nurses, physiotherapists and psychologists as individual users in these health centers. (Reponen & co 2017)

In the private sector, speech recognition was used by six organizations, all of which used it in radiology, with the exception of one organization that identified that it also uses it in reception activities. The survey clearly states that the use of speech recognition has increased significantly in Finnish healthcare, but it is still mainly used only in radiology and special medical care. (Reponen & co 2017)

One of the potentials of speech recognition has been seen to be its speed compared to traditional mouse and keyboard use. However, a 2017 study in Australia found that patient documentation with speech recognition was, on average, 18% slower than with a mouse-keyboard combination, and the margin of error was higher when using speech recognition (Hodgson & co 2017).
It is good to note that in Finland, for example, doctors record text as digital dictation instead of the traditional mouse-keyboard combination.

In 2019, a survey of a few American hospitals found that the majority of physicians who use speech recognition were satisfied with its use (78%). Satisfaction largely consisted of experiences that the use of speech recognition increased efficiency and time savings. Slightly more than half felt that speech recognition also reduced the workload of administrative work. Almost all respondents had attended user training, but almost half of them felt the need for additional training. The study found that although speech recognition has developed a lot, there are still concerns about patient safety, efficiency and errors, among other things. (Goss & co 2019)

In her study, Kati Tuovinen mapped the use of technologies utilizing artificial intelligence in hospital districts in Finland. As part of the survey, the future plans of hospital districts and preparations for the introduction of technologies utilizing artificial intelligence were investigated. The responses revealed that the most potential uses of AI were related to performing repetitive daily routines, image and speech recognition, and diagnostics. The same survey also revealed that hospital districts have funding for artificial intelligence technology in their budgets in the near future. The vast majority of hospital districts said their budgets were around 80,000e / year set aside for artificial intelligence technology. However, the state of mind proved to be very cautious and anticipatory with respect to the development of technologies. (Tuovinen 2019)

Author(s) & Year	**Article**	**Research method**	**Objective**	**Results / Discussion**
RUOTSALO, Sharlotta. 2011	The Implementation of the Speech Recognition System in Finnish Healthcare - from Doctors' and Secretaries' Perspective	Qvalitative research Survey	To find out prejudices what physicians and secretaries would have towards automatic speech recognition system	There was opposition towards ASR. Prejudices were mainly expressed about concerns about increasing workload (doctors) and concerns about losing their jobs (secretaries)
REPONEN, Jarmo; KANGAS, Maarit; HÄMÄLÄINEN, Päivi; KERÄNEN, Niina & HAVERINEN, Jari. 2018. Current situation and trends. National Institute for Health and Welfare (THL).	Use of information and communications technology in Finnish health care in 2017	Quantitative research Survey	The purpose was to map the utilization rate of information and communication technology in health care organizations.	The amount of organisations using SR had increased to 80% from 50%. Radiology was the most common speciality where SR was in use.

HODGSON, Tobias; MAGRABI, Farah & COIERA, Enrico. 2017	Efficiency and safety of speech recognition for documentation in the electronic health record	Practical test and analysis of results	To compare the efficiency and safety of using speech recognition (SR) assisted clinical documentation within an electronic health record (EHR) system with use of keyboard and mouse (KBM).	Speech recognition usage was about 18% slower on average than a mouse keyboard combination.
GOSS, Foster; BLACKLEY, Suzanne; ORTEGA, Carlos; KOWALSKI, Adam; LIN, Chen-Tan; METEER, Marie; BAKES, Samantha; GRADWOHL, Stephen; BATES, David & ZHOU, Li. 2019	Efficiency and safety of speech recognition for documentation in the electronic health record	Survey	To assess the role of speech recognition (SR) technology in clinicians' documentation workflows by examining use of, experience with and opinions about this technology.	75.5% of respondents estimated seeing 10 or fewer errors per dictation, but 19.6% estimated half or more of errors were clinically significant. Although 29.4% of respondents did not include SR among their preferred documentation methods, 78.8% were satisfied with SR, and 77.2% agreed that SR improves efficiency.
TUOVINEN, Kati. 2019	Artificial intelligence technology - a next step towards productivity.	Survey	The aim of the robotics project was to find out the current situation of Finnish hospital districts with regard to the use of artificial intelligence solutions.	Most of the current artificial intelligence solutions were procured to facilitate daily routines. These include the use of speech recognition. In addition, hospital districts had budgeted for the coming years money for artificial intelligence solutions. The responses showed that the attitude towards the new solutions was very cautious and prejudiced.

Table 1. Related research table

4 Research goals and problems

4.1 Goals

The aim of the study is to map the user satisfaction of Dragon Speech Recognition program users. With the help of the answers and feedback received with the questionnaire, it is possible to develop the user satisfaction and implementation of speech recognition. Feedback from responses provides information to software developers about software experiences and problem areas. In addition, the goal is to provide feedback to organizations about the implementation process.

User satisfaction is part of the usability and utilization package. Other components in this entity are user expectations as well as user characteristics, task characteristics, and also technology characteristics. These form a usability context to which user satisfaction is a part. This study focuses on assessing and measuring user satisfaction. Usability consists of the efficiency, effectiveness and satisfaction that users achieve when they perform certain tasks in a particular environment in pursuit of certain goals. (Dawson & co 2014)

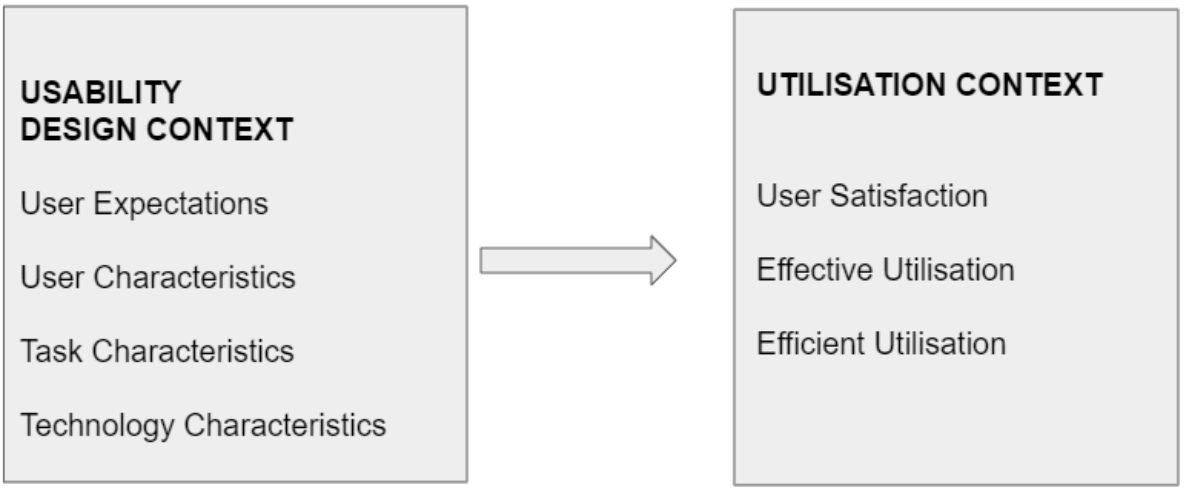


Figure 6. Usability and utilization contexts (Dawson & co 2014)

User satisfaction is primarily measured as a different subset of beliefs about specific systems, information, and other related characteristics. User satisfaction is based on object-related attitudes, while technology acceptance is based on behavioral and operational attitudes. Attitudes towards the system also influence beliefs about the usefulness of systematicity. (Wixom & Todd 2005) Thus, it can be stated that there is a connection between these two attitudes. The most important factor influencing user satisfaction is the attitude towards the quality of the system and the information it produces. I present a combined research model for user satisfaction and technological acceptance in figure 7.

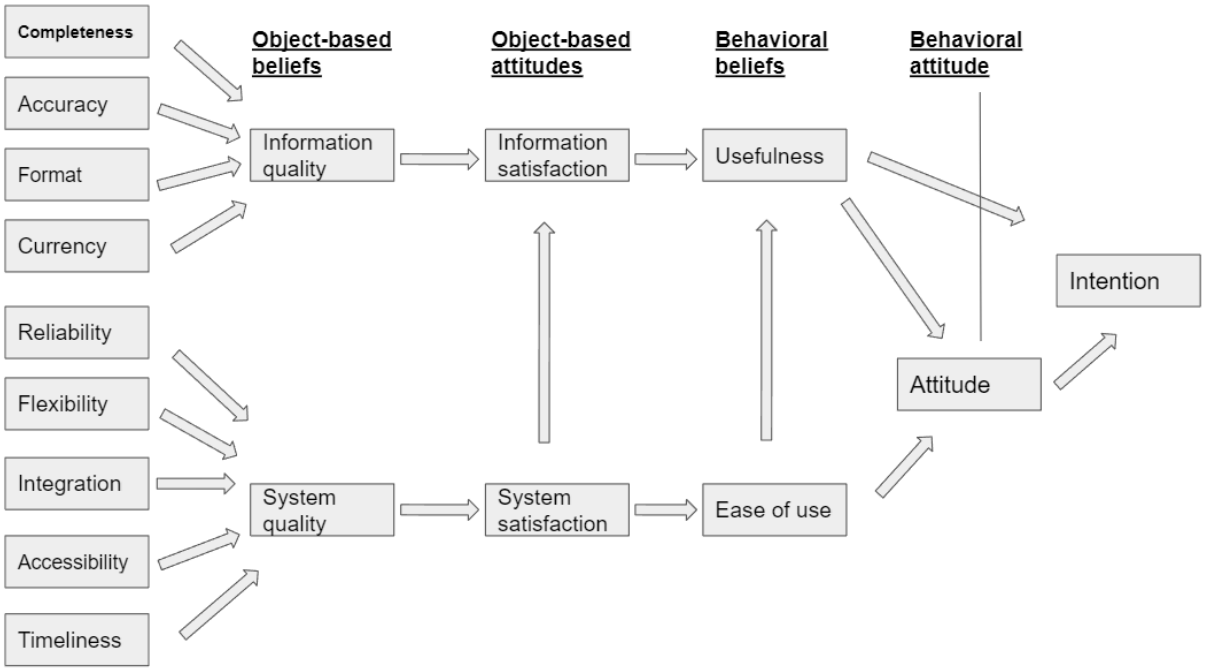


Figure 7. Combined research model for user satisfaction and technological acceptance

4.2 Research problems

Research problems refer to those issues, situations, or findings that guide the need for research. In general, a research problem can be formulated in one or more sentences. From a research perspective, it is important to formulate the research problem correctly and as accurately as possible, as this sets the direction for the entire research and how it will be conducted. It is also important to distinguish the research topic, purpose, and research questions from each other and the research problem. (Creswell & Gutterman 2021)

The topic of this thesis is to map user experiences of the use of speech recognition in healthcare. The research problem was formulated as follows: The use of speech recognition is not common among healthcare professionals. Research questions limit the purpose to specific questions that the research seeks to answer. In this thesis, the research questions are:

1) How satisfied Dragon users are with the software?
2) What factors affect user satisfaction?
3) What factors could be used to increase user satisfaction?

The speech recognition system in question is Dragon, developed by Nuance and used in conjunction with the Pegasos patient information system produced by CGI in Saarikka and Wiitaunioni. Dragon runs as a standalone application and is not integrated with Pegasos. The introduction of Dragon has been aimed at speeding up the safe completion of patient texts, increasing job satisfaction and reducing the workload of word processors.

Saarikka is a federation of five different municipalities; Saarijärvi, Kannonkoski, Kivijärvi, Kyyjärvi and Karstula. It is located in the northwest part of middle Finland. The total population is around 17000 people in which Saarijärvi alone has over 9000 residents. Saarikka produces most of the healthcare and social services in the area. (Saarikka 2021)

Viitasaari´s website states the Wiitaunioni organization's activities as follows: "The organizational structure of Wiitaunioni, formed by the city of Viitasaari and the municipality of Pihtipudas, consists of the co-operation of the administration and service production of both municipalities. At the core of the organizational structure are customer-oriented service entities. The Basic Security Committee acts as a joint committee of the municipalities of Kinnula and Pihtipudas and the city of Viitasaari." (Viitasaari 2021)

Both municipalities have their own independent decision-making bodies, i.e. city and municipal councils and governments. The population base in the area of both municipalities in 2016 was a total of 10,809 inhabitants (Viitasaari 6607 / Pihtipudas 4202). (Laine-Rissanen 2018)

5 Research method and process

The research strategy used in this thesis is survey research. This refers to a survey of a group of people conducted in a standardized format. Typically, the material is collected through a questionnaire or interviews. The aim is to describe, compare and explain different phenomena. (Hirsjärvi & co 2004)

The purpose of the study is to highlight the experiences of speech recognition program users in using the software. The aim is to highlight both positive and negative experiences of using the software compared to digital dictation and the production of computer text written by the computer itself. The results could make it possible to develop the process of introducing a speech recognition system in various public actors, especially in terms of user experience.

A combination of quantitative and qualitative research is used as the research method. Typically, these two different methods have been seen as opposites, but in the light of current research, this is not the case. According to the researchers, refining and clarifying the terminology of both methods removes the boundaries between these methods and current terms may not best describe the methods of all. Proper use of both methods supports the collection of data in the most accurate and descriptive way possible, allowing the most accurate and relevant results to be obtained. (Hirsjärvi 2004)

The basic idea of quantitative research is to describe things numerically and answer questions about how many, how much, and how often. The results are usually obtained numerically or are compiled into a single numerical format and presented numerically. In presenting the results, the essential numerical way is worn verbally by the researcher. (Vilkka 2014)

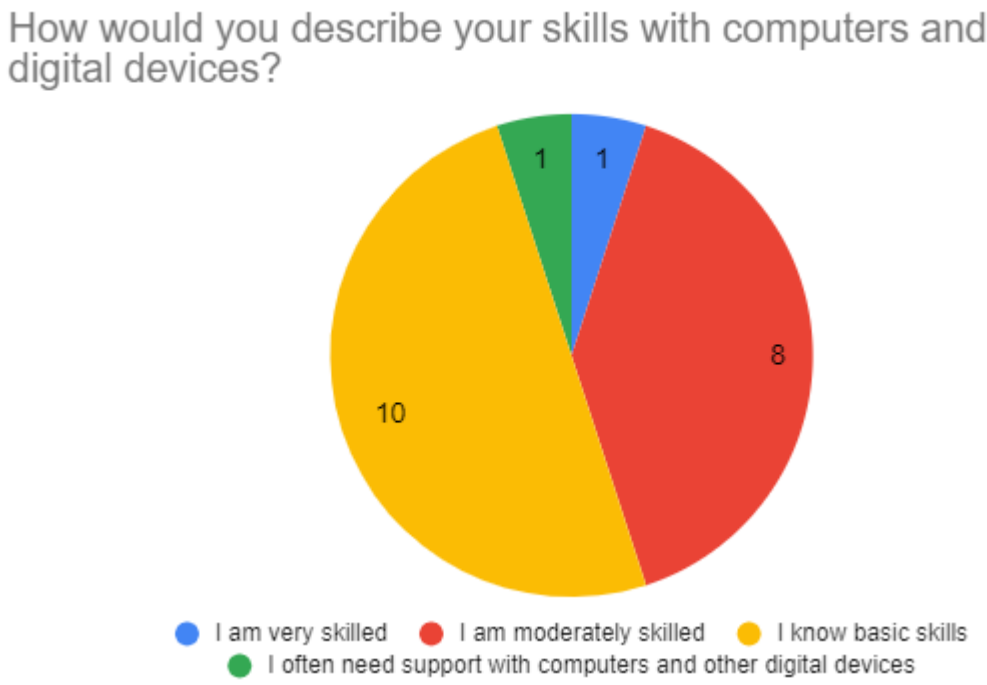
In order to study issues concerning natural phenomena and persons through quantitative research, the issues to be studied must be operationalized. This means transforming theoretical and conceptual matters into such a form that the subject can understand the matter in his or her everyday life. In practice, this means forming questions and answer options that describe the conceptual things you want to measure. (Vilkka 2014)

6. Results

6.1 Background information

The questionnaire was sent to the participants at the end of november 2021 via email. Total number of speech recognition users was 32 and 20 of them answered the questionnaire. Response rate was just under 63%.

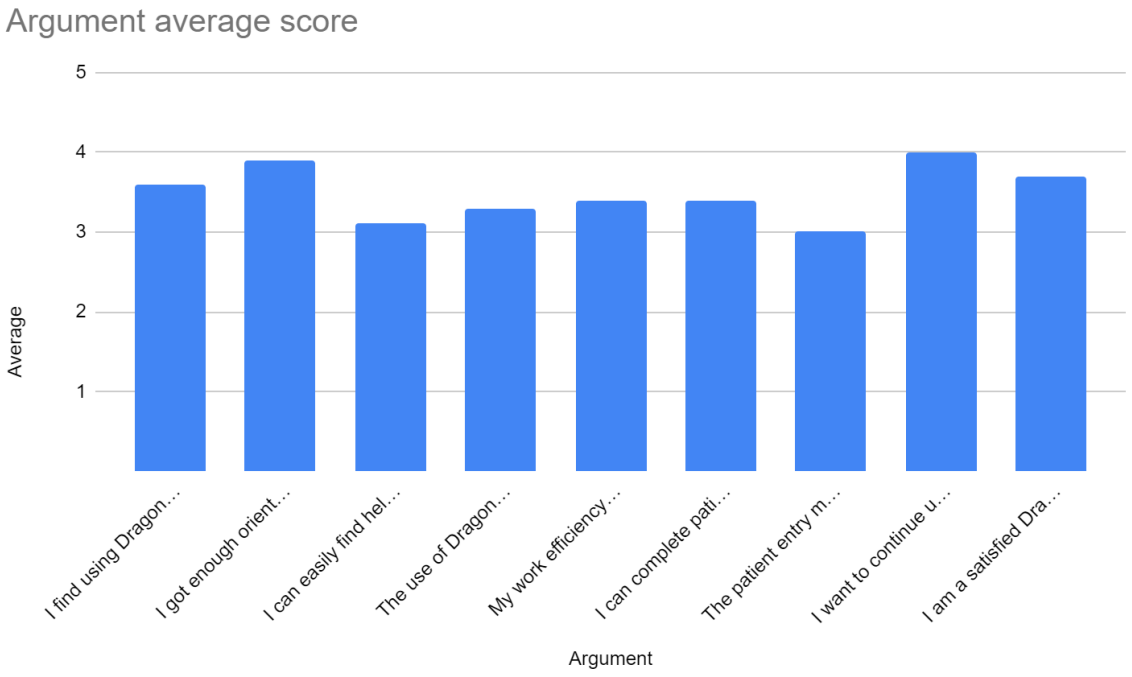
Most of the answers were from Wiitaunioni (n=13) and the rest from Saarikka (n=7). Twelve of the participants were doctors and eight were other health care professionals, for example nurses or psychologists. Almost all respondents felt that they had basic skills or were moderately proficient with computers or other digital devices. One third of the respondents had used speech recognition for 3-6 months. When asked about the previous way of making patient record entries, the answers were evenly divided between 50-50% of digital dictation and self-writing.



Regarding the experience of using a speech recognition program, the answers are moderately divided. However, the majority of users had used the program for more than 6 months. One respondent reported no longer using the program and the rest of the respondents had used the program for less than 6 months. When asked about the previous way of recording patient records, the answers were evenly divided between digital recitation and self-writing.

6.2 User satisfaction with Dragon

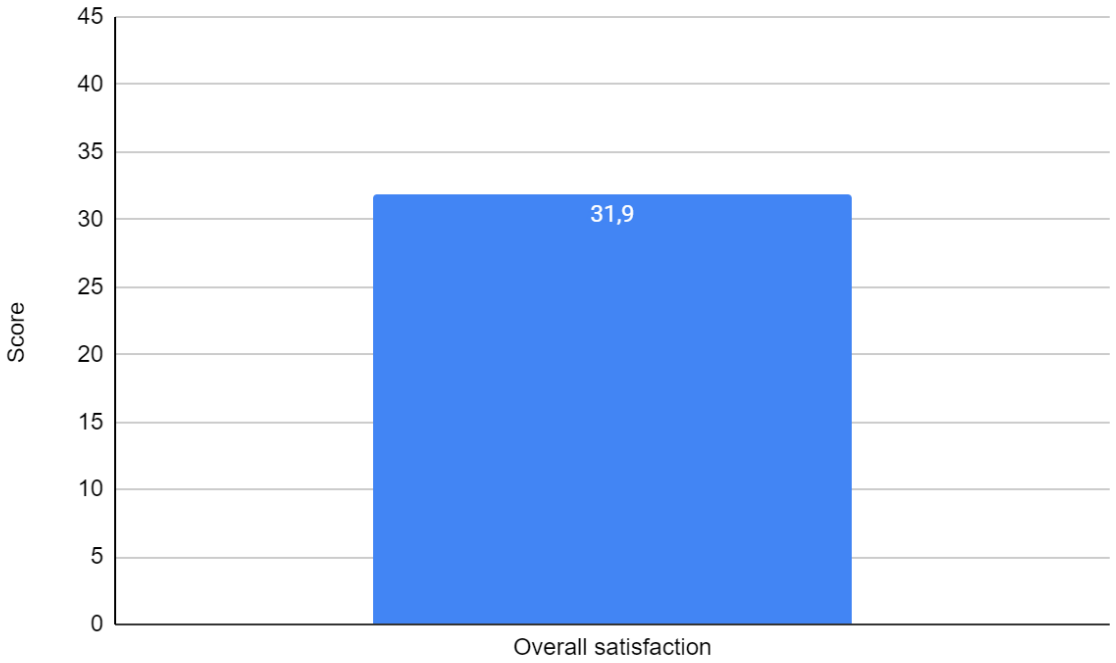
Questions 6-14 were statements to be answered according to the most appropriate option. The options were on a scale of 1 to 5, describing how much the respondent agrees with the statement, meaning that option 1 is "completely disagree" and option 5 is "strongly agree". The arguments are summarized in the table and the average score obtained by the arguments is presented in the same context.



Based on the responses received, user satisfaction was increased by statements with an average response of more than three. Such claims were all other claims except number 12 "The patient entry

made with the Dragon is clearer and more structured than the entry made in the previous way". In this statement, the average was exactly 3.0, which means that the respondents did not substantially disagree or agree with this statement.

Based on the values of the responses, users were generally satisfied rather than dissatisfied with the use of Dragon. The maximum number of points was 45 points and the total result of the answers was 31.9 points.



6.3 Factors in user satisfaction

The weakest scores came for claims that addressed Dragon's in-service support (3.1) and the claim for clarity and structure in patient labeling when using Dragon (3.0). The statements that wanted to continue using Dragon (4.0) and that the introduction was felt to be sufficient (3.9) received the most points. The maximum value of a single statement is 5. Thus, the common maximum value of statements 6-14 is 45. The total value realized in the survey was 31.9, with an average on a scale of 1-5 to 3.48. The lowest response value in a single statement was 3 and the highest value was 4. In addition, the average of the responses in statement 14 "I am a satisfied Dragon user" was 4, which was the highest of all the statements. Statement 13 "I want to continue using Dragon in the future" also had an average of 4.This illustrates that respondents are more satisfied than dissatisfied with the use of Dragon.

Based on the responses, good familiarity (statement 7) and ease of use and logic (statement 6) increased user satisfaction the most. Work efficiency was also felt to increase with the use of Dragon, and patient records were also felt to be completed more quickly.

In Question 15, "What do you think could be improved about using Dragon?" respondents were asked to report developments to the software. The answers can be divided into those factors that describe the current problems and to those areas for development in which solutions are desired in the future. Thirteen of the 20 respondents answered the question. In the current situation, the respondents found Dragon's error sensitivity and lack of integration into the patient information system difficult to use. The responses indicate that there has been integration in the past, which has been removed during the upgrade of the patient information system. Lack of user training and inadequate instructions were also currently hampered by the use of Dragon. In the Wiitaunioni organization in particular, Dragon jamming problems as well as the sudden disappearance of dictated texts from the patient information system had also been observed. No similar remarks were made by Saarika's organization from the responses.

As development ideas, respondents wanted integration back between the patient information system and Dragon. In addition, a correction to the error sensitivity and a more detailed specialty-specific vocabulary were desired. Some respondents also wanted regular user training and clearer instructions for using the program. For example, “teaching” the program was perceived as challenging by a few respondents due to a lack of guidance.

As a rule, professionals other than doctors found themselves moderately proficient with computers and other digital devices. Physicians had more dispersion in answering the argument, and more than half of the responding physicians felt they had basic skills. The experience of using speech recognition was clearly focused on the employees of the Saarikka. Five of Saarika’s respondents (n=7) said they had used Dragon for more than a year, while for Wiitaunioni, a clear majority had used it for less than a year.

7 Conclusions

7.1 The study process and research method

The aim of this thesis was to find out how satisfied the users of Dragon speech recognition software were with the use of the program. In addition, there was a desire to find out the factors that affect user satisfaction and which factors could increase user satisfaction. The need to investigate the issue arose within organizations and from the researcher's personal interest in speech recognition user satisfaction. From an ethical point of view, it is necessary to state that the author of the study works in Saarikka and his duties included being involved in Dragon's deployment project.

The respondents to the study consisted of users of Dragon's speech recognition software. Contact information was obtained from organizations and users were approached via email and they had 3 weeks to answer the survey. Users were identified based on the usernames issued. Admittedly, not everyone who has an account may be using the software actively or at all. However, the response rate was comprehensive.

As a research method, quantitative research proved to be a viable option and the layout of the questions supported the objectives of the research questions. The background questions sought to highlight possible differences between the professional groups, the organization, and the skill levels of users. The arguments sought to measure satisfaction in various areas that affect user satisfaction. One open-ended supplementary question at the end gave the research results versatility and the opportunity to examine the answers to the research questions in more detail. The answers to the open-ended question provided by the respondents helped to interpret the answers to the other questions and to draw conclusions.

7.2 Reflecting the results

The results obtained responded well to the research questions. In particular, the survey provided a clear answer to the research question "how satisfied are Dragon users with the use of the software". The majority of respondents felt satisfied with the use of Dragon and there was not much dispersion in the responses. There was no significant difference in satisfaction with Dragon's use between organizations. The responses also showed that users who had used Dragon for more than 6 months were slightly more satisfied than users who had used Dragon for less than 6 months. The results support a study conducted in 2019 in American hospitals where the majority of physicians were satisfied with the use of speech recognition (Goss & co 2019).

Based on the responses, user satisfaction was clearly more affected by issues related to the use and fluency of the software itself and familiarization than by other benefits. Other benefits mentioned in the claims include effects on patient safety, the effectiveness of one's own work flow and the

structure of patient texts. On the other hand, the claim concerning the subsidy for use was answered with the second lowest score in the whole survey. This section is supported by research data that user satisfaction is most affected by user attitudes to the quality of information as well as the quality of the system (Wixom & Todd 2005). It can be concluded that the issues related to the use of the software itself were not a problem in terms of user satisfaction. At the same time, based on the results, it appears that the benefits offered by Dragon compared to previous methods did not provide a significant increase in user satisfaction. This result is partly inconsistent with a study conducted in 2019 in which physicians specifically considered increased work efficiency and reduced workload to be positive factors in introducing speech recognition (Goss & co 2019).

When asked about suggestions for improvement, several respondents pointed out that the integration between the patient information system itself and Dragon had stopped working. Several respondents also raised the view that Dragon does not recognize words accurately enough, which affected user satisfaction negatively. Other developmental aspirations included more accurate non-medical vocabulary. Respondents felt that Dragon recognized the medical vocabulary well but the basic vocabulary was not comprehensive enough. From the responses, it can be interpreted that the errors that occurred in Dragon's speech recognition were largely related to non-medical vocabulary.

The answers also showed that compared to digital dictation, some of the respondents felt that the negative factor was that they had to read their own text at the same time to see that there would be no errors. When writing texts via digital dictation, the professional is also responsible for "acknowledging" the transcribed text, which means reviewing and approving it. In this context, the question arises as to whether the digital dictation process is being implemented as it should be. Based on those responses, it's surprising that the review process for making a text on Dragon is perceived as cumbersome when the dictation process in the review process comes later as its own separate step.

To summarize the results of the study, it can be said that the professionals were for the most part satisfied rather than dissatisfied with the use of Dragon. Factors related to the usability of the software itself added to the satisfaction. The other benefits of use were not generally considered to be so significant. Speech recognition has mainly been used in Finland in the field of radiology. Now, the study involved mainly health care professionals from the health center. The upward trend seems to be that artificial intelligence would take care of some of the day-to-day tasks, including text-based speech recognition (Tuovinen 2019). In the future, research is needed on the use of speech recognition in different medical specialties and its suitability.

7.3 Future research subjects

Although speech recognition has been the subject of much research, it turned out that there is little research data with the use of existing patient information systems, especially in Finland. Some of the research data was so old that the systems have evolved over several generations. The cost impact of using speech recognition comes to mind in particular as a future research topic. In the public sector in particular, it will be difficult to finance new acquisitions if they do not have the potential to have an economic impact.

In addition, it would be important to look more closely at the use of working time by professionals compared to both traditional digital dictation or self-writing and speech recognition. This would better highlight the effects on work efficiency. Error sensitivity was also mentioned in this study as one of the factors limiting user satisfaction. It may be necessary to examine in more detail the aspects, for example in the glossary, where exactly this error sensitivity occurs.

The spoken audio clip travels through network connections on Dragon's software developer's server where the text formatting itself is done. Related data security issues could also be explored further.

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APPENDIX 1: Survey Letter

Dear Receiver

In connection with my studies, I am doing a thesis on user satisfaction in speech recognition in Saarika and Wiitaunion. According to the information I received, you are one of the users of speech recognition in Saarika or Wiitaunion. For a survey to be successful, it is important that users respond to the survey. Please also answer the survey in the event that you no longer actively use speech recognition in your work. The survey is carried out in cooperation with Saarika, Wiitaunion and Savonia University of Applied Sciences.

Confidentiality

All data that allows the identification of an individual respondent will be deleted before the results are analyzed and published. The data are processed using statistical methods, and the responses of an individual cannot be separated from the results.

Participation in the survey

Please answer the survey on Webropol. It takes about 5 minutes to answer. You can answer the survey from this link. https://link.webropolsurveys.com/S/89B8C1BA940A8CB6

Please reply by 10:59/2012 at 11:59 PM. For more information, contact Atte Nieminen, 0406328133, atte.nieminen@saarikka.fi

Thank you!

APPENDIX 2: QUESTIONNAIRE

Questionnaire

Occupational Group: Doctor, Other health care person (nurse, psychologist, etc.)

Organization: Saarikka, Wiitaunioni

How would you describe your digital skills? I am very skilled, I am moderately skilled, I'm not particularly skilled, I am not skilled at all.

How long have you been using Dragon ?: less than 3 months, 3-6 months, 6-12 months, more than 12 months, I don't use Dragon anymore.

How did you write patient texts in the past? Digital dictation / typing directly into the patient health record.

Evaluate the following statements. Mark the appropriate answer according to your own views.

1, Completely disagree; 2, partially disagree; 3, I do not differ and do not agree; 4, partially agree; 5, Strongly agree.

1) I find using Dragon easy and logical
2) I got enough orientation with the use of the Dragon
3) I can easily find help and support with questions related to using Dragon
4) The use of Dragon improves patient safety
5) My work efficiency has improved with the help of Dragon
6) I can complete the patient text faster with Dragon
7) The patient text produced with Dragon is more structured and clearer
8) I want to continue using Dragon in my work in the future
9) I am a satisfied Dragon user

Open question: What could be developed in the use of Dragon?