Medical Technology and eHealth for Prevention against Lifestyle Related Diseases

A survey of attitudes among health center personnel and patients prescribed with physical activity on prescription (PAP)

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Medicinsk Teknik och eHälsa för Prevention mot Livsstilsrelaterade Sjukdomar

En undersökning av attityder hos primärvårdspersonal och patienter förskrivna med FaR

Cecilia Fornstedt

Degree Project in Technology and Health
Advanced level (second cycle), 30 credits
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TRITA-STH, EX 2017:96

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Abstract

With an aging population that suffers from comorbidity, healthcare is facing grand challenges. In order to meet the demand, digitalization is thought to be an opportunity. Digitalization of curative care, such as diagnostics and treatment, have been initiated and is today used and appreciated. Preventative care, on the other hand, has not been included in the digital adaptations to the same extent and there are few scientific studies within the area. Nonetheless, a further proactive care that meets patients and healthcare personnel are of interest to several actors. The Swedish Government has a vision that Sweden, in 2025, will be world leading within eHealth. For that to be possible, digital preventative care have to support and complete the preventative work that is performed today.

The present study has investigated the attitude towards Connected Medical Devices for Prevention (CMDfP) within the primary care. By a mixed-methodology including questionnaires, the opinions of 24 health center personnel and 17 patients prescribed with Physical Activity on Prescription (PAP) were collected and analyzed. The results show that health center personnel are willing to prescribe connected eHealth devices for prevention and patients are willing to use the devices prescribed. Additionally, among the respondents there is a belief that CMDfP could facilitate in order to increase the adherence to PAP without any major impact on the personnel’s workload.

By digitalizing preventative care, it is possible that people will be able to live healthier and therefore not require care to the same extent as today. Reasons to the possible results are that digital tools within curative care have been shown to generate positive outcomes to chronically ill patients that utilize home care. Additionally, studies of preventative care have generated positive outcomes to the health of the population in several countries. It is therefore likely that the combination, digital preventative care, would be rapidly relished. These thoughts align with the positive results on attitudes of this study.

Before CMDfP could be prescribed to patients, pilot studies have to be performed and new work routines including reimbursement models, have to be established within healthcare. These are all areas of future work within medical engineering.

Key words: preventative care, digitalization, eHealth, mHealth, virtual care, medical engineering, medical technology, connected care, Physical Activity on Prescription, primary care, cardiovascular diseases

1 CMDfP is a stipulative definition regarding the concept of Connected Medical Devices for Prevention that was constructed by the author during the project
Sammanfattning


Denna studie har undersökt attityderna till Uppkopplade Medicinsktekniska Hjälpmedel för Prevention (UMHIP\textsuperscript{2}) bland primärvården. Genom en metod som inkluderat enkätundersökningar, inhämtades och analyserades attityden av 24 personer från personalen på vårcentraler och 17 patienter med Fysisk Aktivitet på Recept (FaR). Resultaten visade att primärvårdspersonal är villiga att förskriva UMHIP och att patienter vill använda de hjälpmedlen som förskrivs. Dessutom har respondenterna tro att UMHIP kan underlätta att förbättra följsamheten till FaR utan att påverka personalens arbetsbördas nämnvärt.


Innan UMHIP kan förskrivs till patienter måste pilotstudier genomföras och nya arbetssätt inklusive betalningsmodeller måste införas i hälso- och sjukvården. Detta är kommande arbeten inom medicinsk teknik.

Nyckelord: förebyggande vård, preventiv, digitalisering, eHälsa, mHälsa, virtuell vård, medicinsk teknik, uppkopplad vård, Fysisk Aktivitet på Recept (FaR), primärvård, hjärt- och kårhsjukdomar

\textsuperscript{2}UMHIP är en stipulativ förkortning av konceptet Uppkopplade Medicinsktekniska Hjälpmedel för Prevention som initierades av författaren under detta projekt.
Acknowledgements

This master thesis has been performed at the Royal Institute of Technology, KTH, at the School of Technology and Health, STH, within the area of technology and health. The master thesis is the closing remark of my studies within Master of Science in Medical Engineering.

I would like to thank everyone that has supported me during this master thesis and studies at KTH. A thank you to the personnel at Täby Centrum Doktorn, Banérgatans Husläkarmottagning and Hjärt- och Kärlcentrum Nord vid Danderyds Sjukhus as well as the patients from Feelgood, Itrim and Hjärt- och Kärlcentrum Nord vid Danderyds Sjukhus that participated in my data collection. Special appreciations to Anne-Lise Venseth, who, as a subject matter provided feedback during my thesis. For allowing me to carry through this project, I would like to thank the personnel at Philips Healthcare and Matilda Åberg-Wennerholm at Philips Personal Health.

Both Peta Sjölander, who has been my supervisor at KTH, as well as Sebastian Mejier, the course examiner, which have provided continuous feedback on my work and developed my analytic and scientific skills, should be thanked.

I am exceptionally thankful to my supervisor and mentor Emelie Håkansson, at Philips Healthcare Transformation Services, who has supported me and provided feedback both before and after the master thesis.

Last but not least, I would like to give my fullest gratitude to my beloved family, who has encouraged me during my life and especially through my five years at KTH.

Sincerely,
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May 2017
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Nomenclature

BP Blood Pressure

**CMDfp** Connected Medical Devices for Prevention (stipulative definition)

**Connected care** Uses devices that could sample data from the user and store it in a cloud-based solution where it would be possible to analyze later on

**CVD** Cardiovascular Diseases

**eHealth** The usage of information- and communication technology (ICT) in care

**HRQoL** Health Related Quality of Life

**Lifestyle Related Diseases** Collection of cardiovascular diseases, diabetes, obesity for instance

**mHealth** The usage of mobile devices and solutions within care

**MI** Motivational Interviews

**PAP** Physical Activity on Prescription, Fysisk Aktivitet på Recept (FaR)

**Patient** Person in the risk zone of develop a cardiovascular or other lifestyle related disease

**Virtual care** Care that is performed over a video link or with other connected devices
“In 10 years, we will have changed the attitude to what the primary care is and the culture we work. The patient will be part of a team, more actors will be involved and work preventative”

- Daniel Forsslund. Innovation County Council, Stockholm County Council, SLL

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Värden av digital teknik i den svenska vården, McKinsey, 2016 (translated from Swedish to English by the author)
1 Introduction

The Swedish healthcare is regarded as one of the most superior in the world [1]. Every citizen can visit a doctor and receive the help that is needed. Due to the available care, the aging and increased population seeks care to an extended level. They demand a high availability and flexibility, which in hand increases the demand on healthcare. The waiting times, especially to the health centers (HC, vårdcentraler), are extremely long. Additional actions must be taken and a recently highlighted area in focus is to increase the efficiency of the primary care [2]. The primary care’s HCs are not only responsible for diagnosing and treating patients, but should also encourage healthy living and work preventative.

For the 1.8 million Swedish people that suffer from cardiovascular diseases (CVD), the evolution of the primary care and the desire of it to focus on preventative care to a greater extent, is of special interest [3]. The most prevalent risk factors for CVD are correlated to both or either lifestyle and lack of physical activity [4, 5]. By encouraging a person to be more physically active, many of the risk factors for CVD would decrease. When a person is at risk of CVD, it is possible for them to receive Physical Activity on Prescription (PAP) instead of, or before, medication. PAP is a justified prescription to write in order to increase the Health Related Quality of Life (HRQoL) for non-active people [6]. Unfortunately, studies have shown that the adherence to PAP is inadequate both from the care providers’ and the patients’ perspectives. That the health checks takes much administrative work at the HCs and that the motivation of the patients decrease as time passes, are thought to be reasons for the decrement adherence [7, 8]. That people live unhealthier today compared to years ago, have lead to an increased risks for CVD as well as diabetes in the world. Not only people’s health are in danger but also the waiting times and costs of healthcare [9, 10]. By increasing the adherence to PAP from both the personnel’s and the patients’ perspectives, the health of people at risk of developing CVD are thought to be improved. The long-term demand on healthcare would likely decrease if people live healthier. An aim for healthcare should certainly be to decrease the costs while improving health among the citizens.

During the last decades, medical technology including tools and devices with an aim to favor both patients and healthcare personnel, have been introduced. As stated by the Swedish Authority for eHealth (eHälsomyndigheten) healthcare has gone from focusing on organizations to focusing on individuals. From categorizing patients in terms of disease and diagnosis to value health and holism. From work routines based on hierarchies to team-ship. From a split care with different responsible to a coherent care. And from steering with focus on cost and production towards focusing on equality and patient-centered care\textsuperscript{4}. The outline is that healthcare is currently undergoing grand developments going from driven by profit to driven by delivery. Healthcare providers have been forced to adapt to the new solutions and strategies. The adoption is still under implementation but until today three steps have been taken in the direction towards healthcare digitalization. First, healthcare has implemented Health Information Systems (HIS) that have proved to

\textsuperscript{4}https://www.ehalsomyndigheten.se/globalassets/dokument/pwc_digitala_patienten_2016_vfinal.pdf
ease the healthcare personnel’s administrative work [11]. Secondly, the introduction
of wearable sensors carried by hospitalized patients as well as ways for quick diag-
nosis have been proven to offer a more personalized care to patients and strengthen
the patient-physician relationship [12]. Finally, the recent development of digital
clouds, health clouds, that are able to store patient data and make it accessible to
different care providers, are being utilized by multiple actors [13].

In order to minimize the number of hospitalizations, make care more patient-
centered and further available, healthcare has started a digital development. After
a tenacious initiation, it has been discovered that new implementations and inno-
vations could favor healthcare personnel and patients [13]. This far, curative care,
communication and information as well as home care have been in focus during
the digitalization. The outcomes from these implementations are positive [11]. Not
only have the tools and devices reduced costs and increased efficiency at hospitals,
but also improved the precision and enabled a further patient-engaged care [12].
Several studies confirm that the healthcare personnel and patients want to use the
tools and devices that are now available and will be, in the future [14, 15, 16]. The
requirements on an up-to-date healthcare demand a digital development of preven-
tative care as well. For the future implementation of digital equipment to go as
persuasive as possible and thereby meet the increasing demand on healthcare while
improving quality to lower expenditures, it is important that an increased number
of studies related to medical technology are performed. Healthcare origins from a
value-based society and therefore medical technology must prove to help, and not
harm, patients and personnel in order to be accepted.

The preventative work that is driven by HCs is both time- and economically con-
suming [10]. Additionally, it is tedious to measure the effects of preventative work
since there seldom are stand-alone indicators of the health. It is of great importance
to people’s general health to encourage healthy living. Digitalization of the primary
care is thought to be a solution to the time- and financial limits of the primary care’s
work. Similar to curative care, new technologies and tools that could reduce costs
and waiting times while increasing the availability could be favorable in preventative
care. That could be a development of a further patient-centered care with an
opportunity for engaging the patient in its own improvements. Connected care and
cloud-based storage of monitored vital parameters have revealed new opportuni-
ties within curative care [17]. Digitalization is a requirement by countries around
the world and worldwide medical technological companies are developing solutions.
More specifically, digitalizing a grand part of the HC’s preventative work, is an
aim of the Swedish Government and Sweden’s Municipalities and County Councils
(Sveriges Kommuner och Landsting, SKL) [18]. The HC’s preventative work, and
especially in combination with the solutions that digitalization can and will be able
to, provide has been diminutive explored. There are reasons to believe that there is
a great potential of introducing medical technological solutions to HCs [14, 15, 16].
Since the attitudes of the potential users are of great importance regarding how
successful an implementation would be, it is at today’s stage of research relevant to
investigate the attitudes towards using Connected Medical Devices for Prevention
by HC personnel as well as the patients. It has been shown that the attitude towards using digital equipment and solutions in curative care is positive, but since preventative work often is regarded secondarily and difficult to measure, there is no evidence that the attitude towards CMDfP would be regarded with a similar tuning. Previously this study, either the attitude to prescribing CMDfP among the HC personnel or the contemplation that the CMDfP could help the patients live healthier, has been widely explored. By investigating the willingness of the HC doctors and nurses to prescribe CMDfP to patients at risk of lifestyle related diseases, such as CVD, diabetes and obesity, and to evaluate the patients’ inclination to use the CMDfP prescribed, the digitalization of the primary care will be able to proceed further expedient. By using digital tools, the primary care could be more efficient and favor healthcare in its development towards a further patient-centered, available and modern community.

1.1 Aim

The aim of this master thesis project is to investigate the willingness of HC doctors and nurses to prescribe CMDfP to patients at risk of lifestyle related diseases and to evaluate the patients’ inclination to use the CMDfP prescribed. The attitudes to CMDfP includes the believes towards the possibility of increased adherence to PAP as well as the probable effects on the workload and work routine of the personnel.

In order to reach the aim of the study, three research questions were developed:

- Are general health center personnel willing to prescribe and are patients prescribed with Physical Activity on Prescription (PAP) willing to use Connected Medical Devices for Prevention (CMDfP)?

- Do health center personnel as well as patients prescribed with Physical Activity on Prescription (PAP) believe that Connected Medical Devices for Prevention (CMDfP) could improve the adherence to PAP?

- If Connected Medical Devices for Prevention (CMDfP) were prescribed to patients with Physical Activity on Prescription (PAP), what effect on the health center personnel’s work routine is it likely to have?

1.2 Limitations

In order for the project to be exploratory and to fit the time limit of 20 weeks, the following limitations had to be made:

- The possible prescription of CMDfP was investigated as a complement to PAP and not instead of PAP.

- A selection of respondents to the patient questionnaire was made and only patients with PAP were included in the results of the study.

- The CMDfP were theoretically considered by the respondents.

CMDfP is a stipulative definition regarding the concept of Connected Medical Devices for Prevention that was constructed by the author during the project.
• The theoretical patient that was in focus in the questionnaire to the personnel was at risk of developing CVD.

• The focus of the project origins from Swedish healthcare and its structure but the results of the project can likely be applied to other countries as well.
2 Background

2.1 Healthcare

Sweden is divided into 21 county councils, each one responsible to offer healthcare, both in- and outpatient care, to the citizens\(^6\). The inpatient care, that handles hospitalized patients, is often further specialized and more complex compared to the outpatient care. The outpatient care regards patients that are not hospitalized but can rather go home in between the visits\(^7\). The primary care and it’s associated health centers (HC, vårdcentraler) constitutes the greatest part of the outpatient care, but included in the the outpatient care are also specialized hospital clinics and in recent times the patients’ homes. The emergency clinics (ER) at hospitals are clinics that are open around-the-clock, every day of the week and that can treat acute disorders. The ERs as well as the HCs can refer a patient to a specialist located either in the in- or outpatient care.

![Figure 1: The structure of the Swedish Healthcare](image)

The different care providers collaborate with, affect and exchange patients with one another (see Figure 1). For instance, a high pressure on a HC will likely generate a high pressure on the emergency clinics in the region and vice verse [2]. Even if the different county councils are responsible for their own healthcare they can support one another. This most often occurs in the inpatient care when hospitals are overcrowded while people are in need for hospitalization. Moreover, HCs from different county councils can exchange experiences and in some cases patients as well. In 2009, a policy was initiated by professors in Health Science at the University of Copenhagen. The policy aims for a stronger collaboration between the primary- and secondary care [19]. The authors Wadman et al. seek to clarify the areas of responsibility between the different categories of care in the countries but also suggests that collaboration across organizational borders should be improved. The policy was initiated since the pressure on the available care continually increases and the demand cannot be managed without an united vision.

Today, the waiting times to healthcare are extremely long and must decrease in order for the increasing population to be offered care when needed [20]. How the

\(^6\)http://www.lansstyrelsen.se:80/Sv/Pages/default.aspx  
\(^7\)http://www.1177.se/Regler-och-rattigheter/Hitta-ratt-i-sjukvarden/
waiting times should be decreased and patient queues shortened is still not revealed. Though, in the long-term, the efficiency of healthcare is probable to increase if the care providers focus on prevention to a greater extent, according to the Swedish State’s Official Investigations (Statens Offentliga Utredningar) [2]. By focusing on prevention, people are likely to be encouraged to live healthier and understand the risk of unhealthy living. Thereby, it is possible that people would not need healthcare as voluminously as today.

2.2 Primary Care

The HCs of the primary care are situated throughout the country and patients are free to choose between different centers in their county council. Approximately 50% of the HCs are in the ownership of the county councils themselves and the remain are private. The HCs should be able to diagnose and treat less acute diseases, recommend the patient on further help as well as send referrals to specialists. The HCs should also work preventative and counteract development of diseases by supporting patients to live healthier as well as offer solutions to home treatment [21]. Therefore, the primary care has a holistic responsibility of the populations’ wellness. At the HCs there are different professions working with each other. Specialized doctors and nurses as well as physiotherapists, curators and psychologists are the most common professions. There are most often opportunities for drop-in appointments in the morning and bookings during the day. There are great variations of issues and diseases that people seek care for at the HCs. Anything from pregnancy controls and depression counseling to children with streptococci and elderly that need rehabilitation after a stroke, are common issues. One can understand that there is a grand responsibility to coordinate, treat and prevent all these people with different issues and in addition to that handle the administrative work that is required. Offer home care to patients, or provide similar measures that could move people from the hospital and HCs or be more efficient, without any somatic risk, should therefore be encouraged [2]. Regarding similar circumstances, if there is a possibility for self-treatment of a patient instead of surplus time from the HC personnel, this should be fortified.

The overall responsibility that the primary care has is certainly a bottle neck and stress factor for the HC personnel. Multiple studies have shown that the staff feel that they lack time and that the first thing that is dismissed during time constrains is preventative work [22, 23]. Both Yarnall et al. and Konrad et al. have shown in their studies that the HC personnel desired that they had more time to work preventive. Konrad et al. further describe that the HC personnel understand the importance of preventative work and that they believe that additional and other resources are needed in order for the preventative care to function. By additional resources, HCs could involve patients in preventative work and therefore decrease the patients’ risk of becoming ill while reducing the demand on the available time of healthcare.
2.3 Lifestyle Related Diseases

Lifestyle related diseases is a generic term of diseases including as cardiovascular diseases (CVD), diabetes and obesity. 1 of 5 (1.8 million) Swedes are currently living with a decreased cardiovascular function. It is the most widespread illness among the citizens and high blood pressure (BP) is the furthermost common affliction [3]. Between 1980 and 2008 the number of patients with raised BP arose from 600 million to 1 billion people, according to the World Health Organization, WHO\textsuperscript{8}. A reason to the increase is thought to be the lack of daily physical activity and the sedentary habits among the population. In 2010 a study was published in USA that compared the physical activity of 45 year old women living in 1965 with similar aged women living in 2010. The study showed that the women living in 2010 exercised 1.2 hours more per week than women living in 1965 but that the amount of daily physical activity, such as housework, had decreased from 26 hours to 13 hours per week. On the other hand, the time spent in front of a computer or a TV had increased from 8 to 17 hours per week [24]. In Sweden, the cost to deliver care to overweight and obese people is estimated to 16 billion SEK per year and if no radical measures are rapidly implemented, lifestyle related diseases are likely to triple until 2050\textsuperscript{9}. If healthcare were to focus more on preventative care, lifestyle- and chronic diseases could be reduced. By such actions, not only would the cost for care diminish but it is even likely to decrease [25, 26].

High BP is not a standalone medical diagnosis but people that have an increased BP are at great risk of developing lifestyle related diseases, especially CVD. To help people discover their cardiovascular issues and give them tools to improve their health and Health Related Quality of Life (HRQoL), healthcare research ought to focus on directing healthcare into a more personalized and preventive delegate that could meet and support a person. The support needs to be available at the correct time, at the correct place in the correct way, according to Swedish Heart- and Lung Society (Hjärt- och Lundfonden) [3]. Again, by making healthcare more patient-centered and encouraging patients to live healthier and take care of themselves, healthcare is thought to save money, time and lives [25, 26].

2.3.1 Risk Factors for Lifestyle Related Diseases

The most prevalent risk factors for lifestyle related diseases such as CVD and diabetes are correlated to both a lack of physical activity or daily habits. Lack of sleep or bad sleep quality, a high amount of stress, an unhealthy diet, smoking and a high alcohol consumption as well as heredity are factors that can contribute to a high risk [5]. When diagnosed with high BP, the motivational factor and the willingness of a person to change can be insufficient and could thereby be problematic during the improvement [8]. If enough support is provided to the person, a decrement of the risk factors and improvement of HRQoL is possible.

\textsuperscript{8}http://www.who.int/gho/ncd/risk_factors/blood_pressure/relevance/ext/en/

\textsuperscript{9}http://www.gp.se/nyheter/debatt/var-skattefinansierade-sjukvard-riskerar-kollaps-1.252631


2.3.2 Prevention Against Lifestyle Related Diseases

It is common that people at risk of developing lifestyle related diseases are in regular contact with HCs to check their BP, waist circumference, body mass index (BMI) and pulse. People that have been diagnosed with high BP have a tendency to increase their awareness of their own health and avoid situations that they know can raise their BP, like physical activity [27]. HC personnel should offer coaching to help patients motivate themselves to a change and live healthier. The preventative work at the HCs that are done in order to support a person, should follow national guidelines [28]. The guidelines suggest that the patient at risk should visit the HC at least once a month for approximately 30 minutes. Since these procedures are done on multiple patients, one can imagine that the time spent on these routines has a great impact on the total time and cost available at the HCs. Despite, the time that is spent on the follow-up checks is most often not enough and people at risk do not receive the help and support that they need [7, 8]. In a randomized controlled intervention trial it was shown that the support and encouragement towards a lifestyle change that was done by the HC nurses, was the most important input for the patient to succeed in improving its health [29]. The more frequent these meetings were held, the more favorable it was for the patients to take empowerment and responsibility for their improvement. A study that describes the important work that is done by the Primary Care Specialized Nurse (distriktsjuksköterska) showed that the most efficient preventative care was given when the HC nurse and the patient met once a month and were in contact over phone between the meetings [30]. An engaged and understanding patient is likely to be further motivated to a change compared to a patient that feel a lack of control.

The importance of working preventative in order to minimize lifestyle related diseases has been highlighted by the Social Board in Sweden (Socialstyrelsen). In their national guidelines from 2014 it is suggested that healthcare should focus on support healthy living, favor non-pharmaceutical prevention and focus on widespread diseases of which a general improvement could have an impact on society [31]. In 2009 the Swedish Institute for Public Health (Statens Folkhälsoinstitut) launched a survey to educate healthcare personnel about motivational interviews (MI), which are guidelines on how to motivate patients to a lifestyle- and behavioral change [32]. In order to meet the patient at different stages during the change, it is suggested that MIs should be held regularly along the patient’s journey [33, 34]. Vindahl and Carlson discussed, in their study, that it would probably be preferable if a patient at risk could receive a long-term medical contact at the HC since a patient’s social environment often adapts more lingering than the person is able to change its habits. The social environment often has a grand impact on a person’s life and could impede the change by a person [5].

It is often highlighted that there is a lack of time at the HCs and unfortunately there is a tendency to post-phone preventative work in a broader range compared to curative work, like diagnostics or treatment [35]. Reducing the need for a patient to visit a HC and decreasing the time that the HC needs to spend on physical meetings is therefore thought to be a solution to improve care. A meta-analysis
done by the nurse faculty in Alberta, Canada compared the benefits, disadvantages and effects on costs of home-based programs with center-based programs for both cardiac rehabilitation and secondary prevention [36]. The analysis showed that home-based programs for stable patients was superior concerning efficiency and also relatively low-cost compared to hospital-based services. Regarding the difference in quality of care between home-based and center-based rehabilitation programs, a study on home-based cardiac care done by Jolly et al. states that neither option can be favored [37]. Therefore, it seems that home-based prevention could be a more efficient, less expensive and more flexible approach to help patients.

Two studies that have calculated the theoretical cost effect on healthcare if more preventative care was implemented, highlights that it is probable that the costs of healthcare could decrease [25, 26]. Additionally, Olsen et al. and Cohen et al. highlights that cost is important but that people’s health should be foremost important when investing in preventative work.

2.3.3 Physical Activity on Prescription, PAP

A decade ago a new form of prescriptions were introduced to healthcare, and have especially been written in the primary care. These are Physical Activity on Prescription (PAP) and in 2010 approximately 49 000 prescriptions were written in Sweden\(^\text{10}\). The aim of PAP is to encourage moderate physical activity to people at risk of developing CVD, diabetes or that suffer from light depression. By encouraging a person to increase its physical activity many of the risk factors for the diseases would decrease [5]. PAP covers a period of four to six months and suggests that during five times a week, a patient should do 30 minutes of cardiovascular exercise with moderate intensity. Patients with the ordination can often buy gym memberships at certain fitness centers for a decreased deposit. At the gym, the staff can sign the patients’ certificate which ensures that the patient have performed their activity [38]. From a financial perspective, healthcare professors Sallis et al. explained that promotion of physical activity is a cost effective preventative tool against CVD, diabetes, obesity and depression. The reason to this is that a fit person have a lower risk to develop a disease, has increased chance to live longer and can thereby contribute to the societies wellness for a longer period of time. Also, unhealthy people tend to suffer from chronic diseases that costs in medication and treatment the remaining of their lives. Therefore, introducing physical activity in a person’s life can minimize the risk of a variety of diseases. Sallis et al. are also unique in their field of research by suggesting that an introduction of medical devices in combination with promotion of physical activity could be a solution that would attract people to be more active [39]. In multiple studies it has been shown that an addition of physical activity can increase the time of rehabilitation of men at stage of post myocardial infarction and that physical activity can help decrease the risk of a person to develop CVD [40]. Additionally, an increased intake of fruit and vegetables have positive effects on the prevention of an infarction [41]. Hence, it is likely that if a person is at risk of developing any cardiovascular disease, an improvement of its physical activity in combination with a nutritious diet are likely

\(^{10}\)\url{http://fyss.se/wp-content/uploads/2011/04/Läkartidningen-PAP-1251s234833501.pdf}
to be crucial.

To people in the risk zone of developing CVD, PAP is an alternative to a prescription of BP decreasing medicines. Receiving pharmaceutics is a solution that have been shown to have moderate benefits. An investigation showed that only 20-30% of the patients prescribed with pharmaceutics against their increased BP decreased their BP [42]. An explanation could be that only 50% of the patients that are prescribed with BP reducing medicines take the medicine as according to the prescription [27]. The region Västra Götaland in Sweden have highlighted that men and women diagnosed with high BP do not get the equal prescriptions of medicines and are therefore given unequal care [43]\(^{11}\). Hence, giving pharmaceutics to decrease a person’s BP that in turn would decrease their risk of developing CVD does not have the scientific support that is required.

Even though, PAP has credibility of being an important tool to prescribe, it is not used to the extent that one might expect [44]. One of the main reasons for its low appearance is likely that the adherence to the prescription is inadequate among patients and that the time-effort for the health checks are too extensive from healthcare’s perspective [7]. From a patient self-reporting test regarding the adherence to PAP, Kallings et al. showed that after six months the adherence was good (62%). Though, other studies have shown that the adherence to PAP, as to most medicines, is high within a limited time and decreases as time pass [45]. The main reasons to why patients do not adhere PAP are lack of time and motivation [45]. An intervention study by Venseth, explained that since the HC personnel lack time for follow-ups of patients with PAP, the personnel sometimes even avoid prescribing physical activity since their responsibility for follow-ups cannot be fulfilled [8]. It is therefore important to develop new ways and alternatives for the health-checks in order to encourage a person to adhere PAP, without any extension in time for the health centers.

2.4 Digitalization

The greatest part of the medical technological devices that are available on the market today are for curative purposes like diagnostics or treatment. Though, the scope of health is much broader than primarily diagnosing and treating. For instance, health includes healthy living and prevention from getting ill. Healthcare and medical technological devices should cover all stages of health but most importantly, offer solutions of how these can be connected without any entanglement between the interventions (see Figure 2).

As previously stated, healthcare has lately undergone great reorganizations and developed towards a more modern community. Though, there are still obstacles to overcome until it could be regarded as stable and reliable to offer qualitative care to the entire population. In order to increase the efficiency, Sweden’s Municipalities and County Councils (Sveriges Kommuner och Landsting, SKL), have decided to develop new methods and techniques towards patient-centered care and also aim for a stronger collaboration between all stakeholders [ätt]. In focus for the project is the everyday work routine of the HC personnel. By implementing digital tools and involving the citizens before they become ill, SKL hope to decrease the number of patient visits, improve quality of care and also decrease the workload and stress of the HC personnel. One of the main steps for SKL and the primary care is to encourage teaching, condone development and implementing innovation within the primary care. Obviously, the digitalization lays in focus but also moving hospital to home would be a mission that suits well with SKL’s vision.

During the last decades, more tools and devices with an aim to favour both patients and healthcare personnel, have been introduced. Though, it has been accepted by healthcare providers with various attitudes. The attitudes are some of the many evidences of that healthcare has not yet discovered what the capacity of digital medical technology is and that healthcare is more medical than technological compliant at the moment. Besides the doubtful attitudes, healthcare has slowly started to adapt. Implementing healthcare information systems (HIS), introducing wearable sensors and developing digital health clouds are areas that are now positively accepted around the world [11, 12, 12, 13]. Within digital healthcare there are two major categories. Electronic health (eHealth) that is defined as the usage of digital tools and information systems aimed to improve health. And mobile health (mHealth) that utilizes mobile devices for the possibility of portable care. Due to the availability e- and mHealth have offered within curative care, it is now accepted with a positive attitude by healthcare personnel and patients [14]. Especially chronically ill patients in different age groups are willing to use eHealth and most preferably the usage should be complemented with physical meetings and checks according to them.

As revealed, digitalization of healthcare has mainly regarded curative care [46]. Studies that have investigated the usage of digital tools indicate that there are time- and financial winnings of the usage [14]. Contradictory, at the beginning of healthcare digitalization there was skepticism from both patients and healthcare personnel [15]. Unlike medicines and other methods used in healthcare, medical devices have not been validated in as long-term perspective and thus has difficulty to receive the justification that the evidence-based healthcare is demanding. Additionally, there have been a difficulty developing reimbursement models and pro-
curement procedures for digital care. Today, healthcare have ought to adapt and rely on equipment for diagnostics and treatment and several studies show positive outcomes. Both patients and healthcare personnel are positive to use devices for curative care and are willing to replace physical meetings to virtual [14]. Preventative care on the other hand, have always been difficult to measure and validate. Consequently, preventative care have not been in focus for digitalization as extensively as curative care has. There are extremely few studies within the area of digital preventative medical technology and the attitudes towards it.

2.4.1 Connected Care

The current step of healthcare digitalization is the implementation of connected and virtual care, thus performing care outside of the hospital and transferring data from patient to different healthcare providers. Similar to other medical devices, connected and virtual solutions are currently primarily oriented to diagnostics and treatment [46]. Besides, the introduction of fitness bracelets as well as apps have made it possible for the general public to track and measure their activity, food intake and several different health parameters in a way that has previously not been possible [17]. The bracelets are often connected to a smartphone app and a community where the consumers are able to analyze and discuss their health with other users. Since the bracelets are not medically validated or classed, they are of no use to healthcare. Nonetheless, the data that could be measured and stored by the bracelets could provide information, such as big data, to the Internet of Things (IoT). The belief behind IoT is that by using data collected from different individuals, healthcare and the pharmaceutical market could be able to develop new solutions and medicines in an economically favorable way [47]. Additionally research on software solutions indicates that wearable sensors and devices could help people in general to be more engage in their health and detect abnormal parameters before the people become patients [48, 49].

Recently the development of smartphone-based rehabilitation programs are shown to be a possible tool for patients during rehabilitation after cardiac diseases [50]. The programs are thought to be a more accessible solution for patients during their rehabilitation and a solution that could decrease the demand of having physiotherapists available to the same extent as today. The awareness of medical technology was highlighted in 2016’s issue of The Future Health Index report. The aim of the report was to investigate to what extent the citizens and the healthcare personnel were aware of healthcare digitalization and connected care. The results highlight that citizens, including the healthcare personnel, are less aware of the different tools and solutions available than what was expected13. Therefore, the potentials of e- and mHealth and the benefits they could provide to patients and healthcare personnel, would need to be further promoted.

An opportunity to collect even more accurate data and to help both people at risk of a disease and the HC personnel to save time, would be to let people at risk wear connected devices. These could be connected to an app on the patient’s

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smartphone and also to the HCs IT-systems and thereby make the data visible to all actors. For instance, by virtually monitor patients prescribed with PAP and reporting the results in a surveying interface to both to the patients and to the HC personnel, it is likely that the time requirements for MIs and health checks would decrease and thereby the number PAPs to increase. If the prescriptions of PAP would increase the overall health of the population would likely improve [44]. Moreover, by an improved adherence to PAP, preventative work would be further driven and the cost and time of healthcare could decrease. This is an availability of connected care that has not been researched until this day.

2.4.2 Medical Technology for Preventative Care

Today, the research of Connected Medical Devices for Prevention (CMDfP) and their potential benefits are unexplored. Since there is a demand to streamline preventative care, world wide medical technological companies are developing CMDfP. The overall aim of healthcare is to offer solutions throughout the different stages of care (see Figure 2). Today, devices for curative care exists and are used while connected solutions for healthy living and prevention are being developed in order to manage the demand on healthcare. The CMDfP are supposed to be prescribed to patients at risk of lifestyle related diseases and should, unlike the fitness bracelets, be connected to the hospitals’ and HCs’ IT- and journal systems since they would be medically validated. The CMDfP should focus on helping people in the risk zone of lifestyle related diseases to improve their HRQoL by reminding a person of physical activity, facilitate to make healthier choices and thereby decrease the risk for illness. Pulse, BP, oxygen saturation, physical activity and sleep efficiency are examples of values that would be of interest in order to determine a person’s health. Since the CMDfP are aimed for preventative usage it is important with an informative overview of a person’s health. A possibility to add information including food and beverage to understand nutrition levels and have personalized coaching programs available is of importance. The data collected by the CMDfP should be stored in a digital cloud-based solution that would be available to the patient itself from a smartphone app but also to the care provider via the patient’s journal and occasionally, a patient’s relatives[^14][^15]. In addition to the physical meetings between patients and HC personnel that are held today, the holistic solution of CMDfP could provide information and patterns to healthcare personnel that have not been available before.

An important consideration during the research and developmental process of CMDfP is that they ought to be clinically validated, CE-marked or MDD classified. If the patient data was tracked automatically, the need for the patient to visit the HC would decrease and HCs could spare time on standardized procedures. Both the HCs and the patients would therefore be able to focus on valuable actions. Moreover, if integrated in the healthcare’s IT-systems, the different solutions could offer the healthcare personnel to be at the right place, at the right time, with the correct patient and help and support them just when needed. The solutions would prob-

[^14]: http://www.usa.philips.com/c-m-hs/health-programs
[^15]: http://www.usa.philips.com/healthcare/innovation/about-health-suite
ably ease during the development of healthcare towards a more patient-centered manner, deliver a further flexible and available care for patients as well as probably reduce the number of hospitalizations. Digitalization and CMDfP are thought to be steps towards solving healthcare’s problems related to time and cost [51]. Preventative work that utilizes technology could, in 2025, contribute to savings of up to 2 billion SEK whereof 1 billion SEK of these would be savings in the primary care, according to the Swedish Government [18]. CMDfP constitute a step towards a more patient-centred, personalized digital and efficient care which in turn aligns with the Swedish Government’s goal within eHealth in 2025 [18].

There are great opportunities within healthcare digitalization and especially in the primary care [51]. People understand the benefits of and are willing to use medical technology in curative care. Though, neither the attitude of HC personnel nor the attitude of the patients that would use the CMDfP have been investigated. A study of their approach to the possibility of prescribing and using e- and mHealth is required in order for the development to proceed. Therefore, the attitudes and willingness of the primary care to prescribe CMDfP to patients in the risk zone of CVD ought to be researched. An investigation if the patients prescribed with PAP would use CMDfP and if they believe that the they could benefit from using the devices, is required. Digitalization of curative care is today reality, but preventative care is lagging. By regarding the opportunities that preventative care in combination with digital devices have, the development of healthcare could advance and people could receive the care that they need.

### 2.5 Questionnaire Design

There are different kinds of questionnaire designs among which cross-sectional are recommended to use when the investigation is performed during one single time [52]. The name cross-sectional refers to that the study aims at exploring the characteristics of the sampling group and it also enables the possibility to draw inductive conclusions and understand correlations.

When investigating attitudes it is justified to provide statements that the participants can take a stand on [53]. By using a Likert scale, the strength of the consent of the respondents on a statement can be revealed e.g. how much of agreeing or disagreeing. A forced scale with yes or no answers, only reveals if a person agrees or disagrees. Most often, three different versions of the Likert scale are used. The three point scale investigates the strength of consent to a minor degree and therefore only provides minor results but does not require much time to answer. The five point scale that measures the degree to a great extent while providing a moderate number of different alternatives to the respondents. And the seven point scale that investigates the strength of the consent to a greater degree than the others but can sometimes be too extensive for the respondents to differentiate the alternatives from one another [53]. Studies have shown that when providing a “no opinion”-alternative as a choice of response, the response frequency of that particular response has been naturally higher than the actual attitudes [54]. Hence, there is no change in either reliability or validity if the “no opinion”-alternative is
included or not [54]. Therefore, when desiring to collect as much relevant data as possible, it makes sense to force the respondents to take action by excluding the "no opinion" alternative but not have a forced choice scale that simply suggests a number of alternatives.

In addition to statements in a questionnaire, if an extensive literature review on the subject of interest has been done, it is possible to add closed-end questions with different alternatives [52]. To be able to capture the attitudes of the respondents and assure that as little information as possible is excluded, the ability for the respondents to comment at the end of the questionnaire, could be suitable [52]. By such design of the questionnaire one should be able to gather much information about the question of issue including qualitative information. Adding qualitative information to a quantitative method is meaningful according to the mixed-method methodology. The additional data facilitates in order to gathered much information and a further workable solution could thereby be received, compared to choosing one of the methods [55]. Both reliability and validity of a questionnaire increases if a literature study of the area of interest has been done and straightforward and relevant questions and statements are conducted [54].
3 Method

3.1 Questionnaire Methodology

To explore the question of issue an exploratory mixed-method was selected [56]. By collecting qualitative and quantitative data, the method aims at exploring an uncharted area that previously lacks of investigations. Further theories and hypothesis can be developed after an exploratory investigation has been performed [57].

A flowchart of the method of this study is summarized in Figure 3 below. The blue boxes represent key milestones towards this finalized report while the gray boxes are sources of information that are likely to have increased the validity and reliability of the results. The different steps are further explained in this section.

![Flowchart of method](image)

The study was initiated with a literature review centered on the three research questions that were established in the beginning of the study. The review was mainly done in the database KTH Primo, that can be retrieved from the KTH Library’s web page, as well as the databases PubMed and Google Scholar 16. Mesh-terms that generated valuable information was connected care* AND adherence* as well as cloud-based solutions* AND medical technology* while the terms medical technology* AND preventative* and cardiovascular diseases* AND physical activity* engender too narrow and too broad results respectively.

Connected Medical Devices for Prevention (CMDfP) is a newly developed area, and therefore few scientific articles on the subject could be found. In order to receive more information within the subject, semi-structured interviews were held. Since the interviews were semi-structured, no transcription was done. The aim of the interviews was to collect information of healthcare, connected care and investigations within similar areas in curative care, that had been done.

During the literature review, deeper knowledge about questionnaire methodology and how to construct questionnaires, in order to capture the research questions, was retrieved. Also the researcher attended a seminar with the topic of interviews and questionnaire methodology. Recommended there was the book *Enkäten i praktiken: 16https://www.kth.se/kthb*
3.2 Questionnaires

Two different questionnaires, one aimed for the health center (HC, vårdcentraler) personnel and one for patients prescribed with Physical Activity on Prescription (PAP), were constructed (see appendices A.2 and A.3). The five point Likert scale was used to explore the attitudes towards the different statements. To minimize the risk of misunderstanding of the participants, a covering letter was attached to all questionnaires (see appendix A.1). The covering letter also contained the informed consent that is critical from an ethical point of view. To increase the respondent frequency, the questionnaires were kept relatively short 13 and 20 questions respectively. It is more likely to generate multiple respondents on a shorter questionnaire than a longer [52]. The questionnaires followed general guidelines. For instance they were initiated with general questions like age and sex, followed by statements regarding the research questions and completed with ability for the respondents to comment [52]. The difference between the two questionnaires was the range of statements regarding the different research questions. In the questionnaire to the personnel, question 7 and statements 8-10 regarded research question 1. Question 6 and statements 12-14 considered research question 2. Lastly, question 5 and statements 11 and 15-20 in the questionnaire to the personnel covered research question 3. In comparison, question 4 and statement 5 in the questionnaire to the patients with PAP, concerned research question 1. Question 3 and statements 12-14 considered research question 2. While statements 10-13 regarded the preferred contact frequency with the HC, which can be important when regarding research questions 3.

To further increase the validity of the questionnaires, a HC physician provided feedback and information on the formulations of the statements and questions before the finalized versions. The questionnaires were printed and also made digital by using the web-based tool Survey Monkey17.

3.3 Data Collection

To recruit respondents, a random selection of HCs, rehab centers and wellness organizations, both private and government-owned, in the Stockholm area, Sweden, were contacted by the researcher via phone. Multiple centers wanted to participate but their lack of time was an issue to make that possible. Three HCs and two prevention- and rehab centers participated. The data collection was done during a period of six weeks in February and Mars 2017. The distribution between the different clinics is found in Table 1 in the results section (4).

Two different approaches were taken during the data collection. The patients’ questionnaires were allocated at different centers and the personnel distributed the questionnaires to patients prescribed with PAP. Instructions to the personnel that they should ask for a patient’s participation and give them the questionnaires with-

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17https://sv.surveymonkey.com/
out any additional information apart from the covering letter, were given. For the patients there was also a digital copy made and distributed through an email to the members of the rehab center. The data collection of the personnel was approached differently. 30 minutes of the HCs staff meetings at the three health centers were dedicated to the data collection. Initially, a short background including general information and the aim of the project was given. Thereafter, the questionnaires were distributed to the personnel that accepted to participate. Any questions that the personnel had about definitions or similar were clarified but without any intend to bias. The reason to the different distributions was because the centers have, like the majority of centers, a limited amount of patients with PAP each day and to be able to received attitudes of as many patients as possible this way of distribution was considered as the most beneficial.

3.4 Data Analysis

When the data had been collected, the answers to the questionnaires had to be structured and analyzed in order to retrieve workable results. All respondents were indexed with a number ranging from 1-24 for personnel and 25-41 for the patients. The indexing made it possible to track patterns and correlations between the respondents, such as age, technical experience and attitude to use CMDfP, for instance. The data analysis regarded the three research questions and therefore different statements and questions from the two different questionnaires were input to an analysis.

3.4.1 Analysis of Statements

When a questionnaire measuring grading with a Likert scale, which is most often regarded as an ordinal scale, the median or percentage of the responses can be calculated [53], [54]. Statements 8-15 in the personnel questionnaire and statements 5-10 in the questionnaire to the patients were constructed according to the Likert scale and could therefore be analyzed by calculating in the mentioned way.

3.4.2 Analysis of Closed-Questions

The closed-ended questions with alternatives, were analyzed by calculating the percentage of the responses of each specific answer. In the personnel questionnaire questions 1-7 and 16-20 as well as question 1-4 and 11-13 in the patient questionnaire were approached this way.

3.4.3 Analysis of Comments

The respondents were able to make comments at the end of the questionnaires. The comments were translated from Swedish to English by the researcher and presented in the results section (4), Table 2 and Table 3. In contrast to the quantitative statements and questions, the comments contributed with qualitative information as intended by the mixed-methodology.
3.5 Validation

After the data had been collected and further analyzed, the results were validated. The validation was done with both the subject matters including a HC physician and personnel from worldwide medical technological companies. During a workshop (WS) the data was presented to the participants, who provided input, their view on the results as well as feedback.

3.6 Ethical Considerations

All respondents were given oral or written information about the aim of the study, why it was regarded as important, how they could find information about the study and contact information to the researcher. Participation in the study was, of course, voluntary and the answers were anonymous. No information about the respondents except from sex, age and profession was collected. An informed consent was distributed to the participants in the covering letter (appendix A.1).
4 Results

Totally, 24 health center (HC, vårdcentraler) personnel and 17 patients prescribed with Physical Activity on Prescription (PAP), participated in the study. Table 1 represents the distribution of respondents among the clinics. In total, 4 personnel did not manage to answer the entire questionnaires, which explains the varying number of responses to certain statements below. If the attitudes of all respondents would have been gathered, hence a zero internal loss, it could have impacted the results moderately. All patients managed to answer the entire questionnaires.

<table>
<thead>
<tr>
<th>Clinic</th>
<th>Number of participant personnel</th>
<th>Number of participant patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic 1</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Clinic 2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Clinic 3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Clinic 4</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Clinic 5</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1: Distribution of participants between the clinics

The results presented in this section is a selection of the questions and statements from the different questionnaires. The selection was made by the researcher based on the different questions’ and statements’ connected to the three research questions.

4.1 Personnel

When referring to questions and statement in the questionnaire to the personnel, please see appendix A.2 for more specific information.

4.1.1 Characteristics of personnel

Related to the characteristics of the personnel, the questions 1 - 3 in the questionnaire to the personnel were relevant. From the different HCs, 24 healthcare personnel participated in the study. Of these, 2 (8%) were men of which both were physicians, 22 (92%) were women with 7 (32%) physicians, 13 (55%) nurses and 2 (10%) Primary Care Specialized Nurses (distriktsjuksköterskor) assigned as “others” in the diagrams below. Since the distribution of sexes is dominantly women, it would be unrepresentative to compare the attitudes between men and women.

The personnel belonged to 4 different age groups: 18-29, 40-49, 50-59 and 60-69. The median age of the personnel was 50-59 years. The age distribution between the different professions is presented in Figure 4 below.
4.1.2 Attitude to the concept of Connected Medical Devices for Prevention (CMDfP)

Experience of eHealth was a characteristic of interest in the study since the theoretical connected devices for prevention are located in the research area of eHealth. It was revealed by question 7 in the questionnaire to the personnel. 6 (25%) of the personnel had experience of eHealth, which is shown in Figure 5 below. Of the personnel that had experience of eHealth, the most common was personal experience.

By the answers to statement 8 in the questionnaire to the personnel, the majority
of the personnel would prescribe a health app to patients at risk for CVD. 10 (42%) people were respectively absolutely or probably willing to prescribe. 4 (17%) people partly agreed on the statement and no personnel was unwilling to prescribe an app. See Figure 6.

**Figure 6:** Willingness to prescribe a health app to patients at risk of CVD among personnel

Similar to statement 8 and prescribing a health app, in statement 9, the majority, 6 (26%) and 13 (57%) people, were positive, absolutely or probably willing, to prescribe CMDfP to their patients at risk for CVD as a complement to Physical Activity on Prescription (PAP). See Figure 7.
4.1.3 Adherence to Physical Activity on Prescription (PAP)

Since CMDfP are supposed to be used for a preventative manner, it is important to understand the effect it could have on the adherence to PAP. The experience and attitude to PAP was therefore investigated in question 6 in the questionnaire to the personnel. 14 (64%) of the personnel, had positive experience of PAP. 2 (1%) personnel had experience of PAP but were negative towards it and 1 (0.5%) person was negative even though she did not have experience of PAP. This is presented in Figure 8.

Figure 7: Willingness to prescribe connected medical devices for prevention to patients with PAP among personnel
In Figure 9, 10 and 11, the personnel’s belief that their patients would be motivated to a lifestyle change, increase their physical activity and choose healthier food and beverage, if prescribed with connected eHealth devices, are presented. This was revealed by statements 14, 12 and 13 in the questionnaire. Towards the fact of an increased motivation to a change in lifestyle, the personnel were uncertain and 12 (50%) persons partly agreed to the fact. To statements regarding increased physical activity and healthier choices of food and beverage, the majority, 11 (48% and 46%) persons, thought that an improvement is probable. 8 (35%) and 10 (42%) of the personnel partly believed that an improvements were possible.
Figure 9: The belief of the personnel of a lifestyle improvement among patients if prescribed with CMDfP

Figure 10: The belief of the personnel of an increase of physical activity among patients if prescribed with CMDfP
4.1.4 Effect on Work Routine

It is of importance to include the probable effect on work routine and workload within the attitudes to CMDfP. This was investigated by statement 15 in the questionnaire. As stated in Figure 12, 10 (43%) of the personnel do not believe that their workload would decrease if CMDfP would be able to be prescribed. 8 (35%) people partly agreed to the opportunity.

Figure 12: Attitude towards probable decrease in workload by the personnel

The personnel had different views towards replacing physical meetings to virtual,
which statement 11 in the questionnaire aimed to investigate. 8 (33%) people contradicted a replacement while 9 (38%) persons were likely to replace at least one physical meetings, see Figure 13.

![Figure 13: Willingness of the personnel to replace at least one of their physical meetings if their patients were prescribed with CMDfP](image)

If CMDfP were prescribed, 11 (52%) of the personnel would prefer a physical meeting frequency that is similar to the one today or every second time compared to today, according to 8 (38%) people. See Figure 14 that presents the answers to question 16 in the questionnaire. The frequency of virtual meetings would be, as presented in Figure 15, more frequent, according to 5 (25%) people, every second time was suggested by 6 (30%) persons or only when necessary, according to 7 (35%) from the personnel, compared to today. This was the distribution of answers to question 17 in the questionnaire.
4.1.5 Personnel’s additional comments

The additional comments are overall positive to prescription of CMDfP as a complement to PAP. There are some concerns of the target patient groups.
An up-to-date and good way to go

I think that the motivation of the patient to be physically active is very important and I don’t think that an app would provide that

Will not work for all patient groups but maybe for some

Will favor motivated patients and those that have an interest in technology. Difficult to reach the unmotivated patients

Positive attitude. We let the patients book their revisits by themselves and they would be responsible to do that even in this case. I believe that the patients will have a greater control over their health without extra work for me

Might be difficult for older patients

Positive! The patient will be more anxious to understand and care about their health

Good with clear and robust tools in addition to motivational interviews

Too much technique! Won’t solve problems!

Very positive. An opportunity for gains in order of illness prevention

<table>
<thead>
<tr>
<th>Physician</th>
<th>Nurse</th>
</tr>
</thead>
<tbody>
<tr>
<td>An up-to-date and good way to go</td>
<td>Might be difficult for older patients</td>
</tr>
<tr>
<td>I think that the motivation of the patient to be physically active is very important and I don’t think that an app would provide that</td>
<td>Positive! The patient will be more anxious to understand and care about their health</td>
</tr>
<tr>
<td>Will not work for all patient groups but maybe for some</td>
<td>Good with clear and robust tools in addition to motivational interviews</td>
</tr>
<tr>
<td>Will favor motivated patients and those that have an interest in technology. Difficult to reach the unmotivated patients</td>
<td>Too much technique! Won’t solve problems!</td>
</tr>
<tr>
<td>Positive attitude. We let the patients book their revisits by themselves and they would be responsible to do that even in this case. I believe that the patients will have a greater control over their health without extra work for me</td>
<td>Very positive. An opportunity for gains in order of illness prevention</td>
</tr>
</tbody>
</table>

Table 2: Personnel additional comments (one person per column)

4.2 Patients

When referring to questions and statement in the questionnaire to the patients, please see appendix A.3 for specific information.

4.2.1 Characteristics of patients

The characteristics of the patients were investigated by questions 1 and 2 in the questionnaire to the patients. Of the 17 patients that were prescribed with PAP, 3 (18%) were men and 14 (82%) were women. The patients belonged to 5 different age groups; 30-39, 40-49, 50-59, 60-69, 70+ years and their median age was 50-59 years, which was the same as the personnel’s. The age and sex distribution is presented below in Figure 16.
4.2.2 Attitude to the concept of Connected Medical Devices for Prevention (CMDfP)

Similar to the personnel, it was relevant to investigate the experience of eHealth of the patients. This was done by question 4 in the questionnaire. The patients had slightly more experience of eHealth compared to the personnel. 7 (41%) patients answered that they had experience of eHealth in any kind and most often personal experience. This is presented in Figure 17.

Figure 16: Age distribution of patients

Figure 17: Experience of eHealth among patients

In the questionnaire to the patients, statement 5 concerned the willingness to use a health app. 5 (29%) and 8 (47%) respectively patients would absolutely or probably use a health app if it was recommended to them from the health center. 1 (6%)
patient would absolutely not use an app. Unfortunately, this patient did not leave any comment regarding the reason why. See Figure 18.

![Figure 18: Patients’ willingness to use health app recommended by health center](image)

### 4.2.3 Adherence to PAP

Since it is the patients that would use the CMDIP, their attitude towards a probable increase in motivation to a change ought to be investigated. Results to statement 6 from the questionnaire is presented Figure 19 and shows that 9 (53%) patients believed that it is probable that their motivation towards a change in lifestyle would increased if they used CMDIP. The patients were therefore more positive to the possible adherence to PAP than the personnel were.
Towards the statements 8 and 9 in the questionnaire, that regarded the increase of physical activity as well as healthier choices of food and beverage, the majority of the patients, 13 (76%), considered it as certain or probable that the CMDfP would facilitate. This is presented in Figures 20 and 21.

**Figure 19:** Patients’ belief of a motivation to lifestyle change if prescribed with CMDfP

**Figure 20:** Patients’ belief of an increased of physical activity if prescribed with CMDfP
4.2.4 Effect on Work Routine

Statement 10 in the patients’ questionnaire concerned the attitude towards replacing all physical meetings with the HCs if the patients were prescribed with CMDfP as a complement to PAP. The patients were doubtful to replace all of their physical meetings, see Figure 22. 7 (41%) patients partly agreed to the fact of only having virtual check-ups with their HC.
On the other hand, by question 11 in the questionnaire, as shown in Figure 23, 16 (88%) patients were willing to have physical meetings every second time or only when necessary, if they were prescribed with the CMDfP.

![Figure 23: Patients’ preference of physical meetings if prescribed with CMDfP](image)

The preferred frequency of virtual meetings should be the same, according to 6 (35%) patients, or less often, according to 10 (50%) patients, compared to today’s frequency of physical meetings. This is presented in Figure 24 and was revealed by question 12 in the questionnaire.

![Figure 24: Patients’ preference of virtual meetings if prescribed with CMDfP](image)
4.2.5 Patients’ additional comments

The additional comments are overall positive towards a prescription of CMDfP as a measure to increase the adherence to PAP.

<table>
<thead>
<tr>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>For me that received PAP after a cancer treatment, the motivation to move could surely have been received through an app. Maybe I would have been eager to move sooner if I had virtual follow-ups since I was unsure how hard I could push myself since I was in pain and my body had been through a lot.</td>
</tr>
</tbody>
</table>

| Might motivate to increased adherence. Otherwise the physical meeting is of great importance when one suffers from mental diseases - in that case it would be preposterous to replace physical meetings with virtual. |

| Suits well with the reason to why I have PAP |

| I believe in PAP if it is done under controlled circumstances and regularly |

**Table 3:** Patients’ additional comments (one person per column)
5 Discussion

The opportunities of healthcare innovation were described by Rehnquist, et al. in an article in the Swedish newspaper Svenska Dagbladet from the 8th of January 2017. By offering additional innovative medical technology and thereby further centering the care around the patient, healthcare could develop in an advantageous direction both from an economical and social perspective [58]. The authors are positive that healthcare, in the long-term, will be improved if it adapted to new technologies and new work routines were established. The results of the present study align with the thoughts that Rehnquist et al. have. The aim of the study was to investigate the attitudes of health center (HC, v¨ardcentral) personnel and patients towards using Connected Medical Devices for Prevention (CMDfP). The aim was determined since there are extremely few studies of the possibilities regarding medical technology within preventative care. Of special interest in the study were the attitudes towards whether or not the respondents believe that usage of CMDfP could facilitate an increased adherence to Physical Activity on Prescription (PAP).

The results show that both patients and HC personnel were positive to the theoretical implementation of CMDfP. The respondents believe that CMDfP could be used in order to increase the adherence to PAP and improve the Health Related Quality of Life (HRQoL) for patients at risk of developing cardiovascular diseases (CVD). This is one of the first steps towards the implementation and further development of a modernized, adaptive and patient-centered preventative healthcare. Since the respondents are positive to prescribed medical devices as a complement to PAP, the credible PAPs have an opportunity to develop in a further advantageous direction and help people increase their physical activity. Before the actual implementation of the prescriptions of devices included in CMDfP can begin, healthcare has to make adaptations.

5.1 Discussion of Method

Questionnaire methodology is credible to use when one aims to gather as much quantitative information as possible [53, 54]. By using the method in this study, it was possible to generate relevant information since the patient respondents constituted of the target users of CMDfP. A mixed-method approach was considered as suitable since the number of patients prescribed with PAP, and therefore the number of possible respondents was relatively small. The methodology that provided both quantitative and qualitative information regarding the three research questions, was the most relevant method at the current stage of research [56]. A qualitative methodology would have been difficult to construct since the question of issue is not extensively explored. Qualitative methods gather less and more subjective results, which would not have been of as much interest as a more general approach [57]. On the other hand, a quantitative method often generates more objective results and trends, which would have been suitable if the number of participants in the study had been greater. Due to the limited amount of participants within the unexplored area, the results were subjective though concerning predefined and objective statements. A HC physician and developers of CMDfP indicated that the method was applicable and regarded the results afterwards, which increased the validity and reliability of the study.
A risk when exploring people’s attitudes using a Likert scale is the acquiescence bias that both agrees and disagrees on a statement. These respondents often agree with the statements in order to ‘please’ the constructor [54]. When investigating attitudes, it is important to keep in mind that the respondents are likely to be more positive when answering a questionnaire, compared to what they are in reality. In this study a reason to this might be that, during the answering procedure, the respondents had to reflect about theoretical scenarios. The respondents’ full sets of influences were not present, as it would have been if the respondents were in the specific situation during the time of response. Consequently, consistency in the questionnaires is of importance. As mentioned, the Likert scale usually appears in three versions; a three-point, five-point and seven-point. The five point Likert scale was used in this study, since it was of interest to understand the strength of the respondents’ attitudes to some degree but without a too demanding investigation. The questionnaires regarded theoretical concepts and an aim was to collect as many respondents as possible and that was considered as more probable if the investigation was kept in an exploratory phase and thereby did not use the seven point Likert scale. It is probable that slightly different results would have been retrieved if another scale was used. For instance, a four-point scale may have forced the respondents to take side on a statement, whereas a questionnaire that used questions instead of statements might have provided other, likely more subjective, results.

Attitudes are subjective and for future usage of the questionnaires, it should also be possible for the respondents to comment on each different statement. Especially since a few respondents answered rather contradictory to correlated statements. Interviews in addition to the questionnaires would have been beneficial in order to retrieve more information related to the subjectivity. In the presence of more time the health- and rehab centers that participated in the data collection would also have been able to provide feedback during the validation.

The study aimed for at least 10 patients and 20 HC workers to participate, in order to retrieve workable results. If the goal of participants would not have been reached, the data collection period would have been extended and more facilities would have been contacted. If the number of respondents had been greater, further pattern-tracking and statistical analysis would have been an opportunity. Examples of analysis that would have been of interest are the difference in attitudes between professions, age groups and sexes.

5.1.1 Personnel Questionnaire

The majority of the respondents were able to take a stand on all statements and answer all questions. One can therefore understand that the questions and statements were straightforward and simple to understand. During the analysis it was revealed that statement number 10. *There is no medical difference between prescribing medical technology for prevention (to people in the risk zone) compared to for curative (to already diseased people)* was confusing since the attitudes to the statement deviated
from attitudes to similar statements by the very same respondents. Therefore, this statement should have been reformulated to *Medical devices for prevention are as important to prescribe as medical devices for curative care*, in order for an enhanced connection to the Likert scale. Also, when analyzing the responses to question 19, *Who would check the patients’ monitored parameters?* some respondents answered with multiple responses to the question. For future usage it should therefore be stated that each question only should be provided one answer.

5.1.2 Patient Questionnaire

As mentioned in the method section, the data collection of the patients was done by letting the HC personnel distribute questionnaires to the patients or send the digital questionnaire to them. Since there are few people prescribed with PAP, this way of distribution was beneficial in order to receive as many participants as possible within the time limit. The disadvantage was that no information regarding the collection could be gathered. The procedures could have been varying between different HCs and different personnel. For future usage of the methodology and the associated questionnaires, one should aim for manual distribution of all of questionnaires. If respondents have questions, the researcher would have been able to answer them in such case. Nonetheless, all patients were able to answer the entire questionnaires. Statement number 10. *I would replace all my physical meetings with the health center to virtual* should have been replaced with *I would replace at least one of my physical meetings with the health center to a virtual one* to better understand the willingness of the patients to have virtual meetings and also to be comparable to similar the statement in personnel’s questionnaire.

5.2 Attitudes to the concept of Connected Medical Devices for Prevention (CMDfP)

Medical devices have been available for several centuries and in recent years connected medical devices have been developed. The connected devices are primarily located at hospitals for an availability to monitor in-patients. Thus, the devices are primarily used within curative care such as diagnostics and treatment [46]. Healthcare, as it is structured today, will not be able to meet the future needs of the increased age and comorbidity of the population. Reports and studies on how healthcare will become more efficient, highlights the importance of preventative care [2, 20]. The benefits of preventative care are not least that patients never have to become patients as lexically defined. Rather they can remain in the risk zone of a disease and is supported to prevent this disease from affecting them. Preventative work is often breached compared to curative care since there is a lack of time at HCs to manage both. It is therefore important to make preventative work less demanding. To be able to give the primary care and HC personnel additional time to work with prevention it is likely that an implementation of wearables and connected eHealth devices for preventative care could be a solution. Studies have shown that digital medical devices have facilitated in curative care and are therefore likely to ease the pressure on preventative care as well [47]. The Swedish Government has a vision that Sweden, in 2025, will be ranked as number one on eHealth [18]. Thus, if there is a willingness within the primary care to prescribe CMDfP and the patients
in need of preventative care are likely to use CMDfP, it could be the origin for preventative care to develop in a favorable direction.

The results of this study concern the attitude towards CMDfP and align with the positive attitudes towards curative medical technology that other studies have found. One can therefore argue that digitalization of curative care have unleashed people’s minds and provided insight to what healthcare could offer with new tools and eHealth solutions. The first research questions *Are general health center personnel willing to prescribe and are patients prescribed with Physical Activity on Prescription (PAP) willing to use Connected Medical Devices for Prevention (CMDfP)?* was examined by question 7 and statement 8-10 in the personnel’s questionnaire and question 4 as well as statement 5 in the patient questionnaire. The results show that the personnel are positive to prescribe both health apps and CMDfP and the patients are positive to use the tools. That personnel and patients are willing to use medical technology within curative care have previously been highlighted, but never has the usage of CMDfP been examined. Devices for curative care as well as the non-medically validated fitness bracelets have revealed new opportunities for increased flexibility of treatments and further patient-centered care [17].

The previous experience of eHealth was low among both personnel and patients in this study. Of the personnel, 83% were positive to prescribe CMDfP to patients at risk of CVD. Of these, 25% and 32% respectively had experience within eHealth, which means that the majority had not. Even though the personnel did not have experience of eHealth, they are willing to prescribe the tools. Probably because they understand the benefits of digitization in combination with preventative work. No respondent in this study was negative towards prescribing and only one patient was negative to using the connected devices that are aimed for preventative care. Contradictory, the person that was negative to use eHealth for prevention thought that she would be more physically active and choose healthier food and beverages if she was prescribed with the devices. She was also willing to replace physical meetings to virtual if she used CMDfP. Comparative to the initial digitalization within curative care, the positive attitudes are an opportunity that society should take into account. It is likely that if further and larger studies within the area of digital preventative care generate similar results, the development, implementation and acceptance of CMDfP will proceed favorably.

The attitudes towards medical technological devices for curative care were at the beginning of its introduction doubtfully regarded. Unlike medicines and methods, medical devices have not been validated in as long-term perspective and are therefore sometimes not regarded as evidenced-based as healthcare requires. As positive results from scientific studies regarding medical technology have been generated, digital tools for curative care are now accepted, and sometimes even preferred over medicines. If the positive outcomes that could result from working further preventative in combination with the benefits that medical technology for curative care have proven to have, could be combined into CMDfP, healthcare would develop further and probably meet the requirements of tomorrow.
Comparative with curative digital tools, it is important that connected eHealth devices for preventative care are provided at least the same amount of resources, if not more, to develop. Even if preventative care is not as straightforward to measure the benefits of as curative care, people would remain healthier if they were provided with preventative tools. In order for the attitudes towards eHealth regarding preventative care to be even more positive, it is important that connected eHealth devices for preventative care become available for usage shortly and that both healthcare personnel and patients reveal the benefits of working further digital.

If preventative care could progress in at least the same manner as curative care has, the health of the population and Health Related Quality of Life (HRQoL) could be improved while the demand on the availability of HCs and their time could be reduced. Further, if vital parameters and data were collected from patients at risk and stored in digital health clouds, it could contribute to big data and the Internet of Things (IoT). The big data and IoT could be used for further developments of devices, medicines and methods to prevent and cure people.

By utilizing connected eHealth devices for preventative care it is possible for healthcare to save time and money. The Swedish Management Association (Vårdförbundet) and the Swedish eHealth Authority (eHälsomyndigheten) have calculated that if 1 out of 5 Swedes chose to make half of their meetings with the primary care virtually, instead of physically, healthcare could save 1.4 billion SEK per year\cite{18}. Techniques for a more proactive, digital and distant monitored care have a possibility to make healthcare more efficient since it would retrieve new opportunities for delivering care. Even though the transformation may cost money and time in the short-term, one should keep in mind that these are investments that are done for an improved future and that the benefits will be visible in the long-term. The financial improvement is also something that Castillo et al. highlights. Their study showed that in curative care, connected devices have revealed to save time and money and that the big data collected when monitoring patients could be used for further developments that could contribute to further savings in healthcare \cite{47}.

By working further connected, there are great benefits for the patients and healthcare personnel. If the patients that are in need for preventative care are not forced to visit the HCs, their risk of getting infected by other people is minimized. There is also an opportunity to reach out to more people. When patients’ days are controlled by meetings at the HCs, which today sometimes require time off work for them, some people neglect the visits instead. With a more available care there is a chance that more people will consider using preventative care and thereby improving their health. Additionally, if patients’ vital parameters were checked digitally there is an opportunity for retired physicians and nurses to work and for healthcare personnel to perform the patient checks from other locations than the HCs.

In the beginning of the implementation of medical technology and healthcare digitalization, people feared the healthcare development and doubted that virtual meetings would be as meaningful as meeting face to face. There is still a hesitation that

\cite{18}https://www.ehalsomyndigheten.se/globalassets/dokument/pwc\_digitala\_patienten\_2016\_v\_final.pdf
connected care is safe and reliable. Though, one has to remember that the main reasons to why healthcare digitalization is taking time is due to the fact that it is developing with small and secure steps to make sure that every one concerned are in line and up to date. Related to the development of healthcare, could be the developments of other businesses that have undergone similar adaptions. By extremely secure systems, today’s bank sector mainly consists of e-banking. A decade ago the majority of bank errands were done at bank offices and today, people are able to pay bills and transfer money at the subway, with the help of a smartphone. Similar developments apply for the music industry. 30 years ago the LP was the biggest trend, then came the CD along with a Walkman or freestyle that developed to an mp3 and now, music is available by streaming services, such as Spotify, on almost any connected device. The steps that these industries have taken are similar to the steps that healthcare needs to take in order for the future needs to be met.

It is of importance that the healthcare personnel, both those working at the HCs and other departments at the in- and outpatient care, receive education of the CMDfP, solutions and new approaches. Healthcare and HCs are not used to work virtually and therefore need guidelines to implement new work routines to optimize their care flow. If connected eHealth devices for preventative care are proven to function properly, they could be used as a patient’s private storage of data. For instance, if an unconscious person comes to the emergency clinic (ER) the personnel working at the ER could look either in the person’s journal or smartphone to receive the patient’s updated vital parameters and also understand what the patient’s normal values are and thereby detect deviations.

If and when CMDfP are implemented in the primary care, it is important to secure that the care provided is equal to all patient groups. In this and other studies it has been revealed that CMDfP are not suitable to all patient groups. The HC personnel see a risk that the care provided could become further unequal if digital tools were implemented since not all patient groups will be equally familiar to use digital tools in general and not all people can afford the equipment. An unequal care is a risk when implementing new modern solutions to healthcare, though if patients that want CMDfP are provided with them and thereby can decrease the pressure on healthcare, the people without the CMDfP could be given additional time at their HCs. On the other hand, within curative care, personnel believe that patients will experience an improvement in care if digital tools would be further provided [16]. Results have found that chronically ill patients are positive to have meetings with physicians through an app and willing to be virtually monitored in their home [16]. The chronically ill patients as well as patients in palliative care highlights a safety factor that is provided to them during constant monitoring. The positivity towards digital tools in curative care is correlated to the results found in this study and indicates that the concept of CMDfP is something that needs to be further evaluated. From this perspective, healthcare can be seen like any other business that continuously adapts, benchmarks and finds new solutions to meet the needs and requirements.
5.3 Adherence to Physical Activity on Prescription (PAP)

It has been stated that preventative work will improve healthcare and be beneficial from both a health and a financial perspective. Therefore the Swedish Social Board (Socialstyrelsen) has made the decision to implement new guidelines, especially in the primary care, towards working further preventative [25, 26]. The guidelines suggest to focus the development of preventative care on widely spread diseases of which lifestyle related diseases, such as CVD, are targets. The most dominant areas of improvement for prevention against lifestyle related diseases are increased physical activity, consumption of healthier food and beverages and an improved lifestyle in terms of less stress and enriched sleep quality [5]. PAP was implemented as a tool during lifestyle changes, but the adherence to it has shown to be low [8].

In this study the attitudes to CMDfP were further revealed by investigating the belief of an increased adherence to PAP by research question two Do health center personnel as well as patients prescribed with Physical Activity on Prescription (PAP) believe that Connected Medical Devices for Prevention (CMDfP) could improve the adherence to PAP? This was done by question 6 and statements 12-14 in the questionnaire to the personnel and in the questionnaire to the patients, by question 3 and statements 12-14. 48% of the personnel, were convinced that the patients’ adherence to PAP would be increased if they were prescribed with CMDfP. The majority of the personnel were positive to PAP and the possibility it has in general. Hence, they understand the importance of preventative work against lifestyle related diseases. The personnel believe that there would be improvements in physical activity and that the patients’ choices of food and beverage would be healthier. If physical activity and the consumption of food and beverage were healthier, a person would improve several of the risk factors of lifestyle related diseases. It can also be argued that an improvement of physical activity and consumption healthier food and beverage are correlated with an improved lifestyle and HRQoL. Though, in the study the personnel were not convinced that the lifestyle changes of the patients with PAP would be improved if they were prescribed with CMDfP. A reason to this can be that the term ”lifestyle change” is vague. The attitudes towards statements regarding physical activity and food and beverage, should be dominantly considered regarding the attitude towards the adherence to PAP. Compared to the personnel, the patients with PAP in the study were more positive to the belief of further motivation to a lifestyle change, and especially that their physical activity and choices of food and beverage would be improved. The positivity aligns with results from studies within medical technological devices for curative care and rehabilitation [14]. Hence, the patients believe that CMDfP is something that could help them and that is essential. The new opportunities can allow a patient to be in further control of its own health, understand it’s needs and therefore be more engaged and motivated to improvement.

In this study the view towards the adherence to PAP is that the three personnel that were negative to PAP as it is constructed today, believe that their patients would be more motivated to a lifestyle change, increase their physical activity and choose healthier food and beverage. Certainly, the number of respondents are too
minor to draw any grand conclusion but the results of the study indicates that personnel that are negative to PAP could consider prescribing a combination of PAP and CMDfP to their patients at risk for lifestyle related diseases. Therefore, the credible PAPs are, in combination with CMDfP, both likely to increase in number and receive enhanced adherence. Again, an additional opportunity to healthcare that ought to be embraced.

Within curative care, rehabilitation and secondary prevention, studies indicate that home-based programs in combination with physical meetings and phone calls between HC nurses and patients have generated positive outcomes and are considered as flexible ways of healthcare [30, 36]. Home care instead of center-based care has also been seen to be the preferred choice if the patient could decide [36]. Reasons to this might be that people feel less sick if they do not have to visit healthcare environments. Further, it has been shown that purely smartphone-based cardiac rehabilitation programs have resulted in increased health among patients [50].

Physical activity is an important contributor during an improvement of health and can function both as treatment and as a prevention [40]. Today when a patient is prescribed with PAP, the patient is recommended to perform 30 minutes of moderate activity five to six times a week [38]. The definition of moderate intensity is ambiguous. If a patient is less active then what is intended with the prescription, the effect of PAP could be reduced. By using connected eHealth devices for preventative care that tracks pulse and calories burned, the patient is allowed to understand how much they ought to move. The degree of physical activity is an important input and a cross-sectional study on people that underwent secondary prevention for CVD showed that the more vigorous the activity is, the more the heart muscle needs to work, which is beneficial to decrease the risk for developing CVD [59, 4]. If a patient understands how healthy living impact on vital parameters it is also likely that there will be positive side effects. For instance, if a parent implements a healthy behavior the children and friends are likely to live healthier as well. In turn, that could have positive effects for the entire society.

The daily activity and interrupted sedentary occupation is an important aspect regarding health, as stated by Archer et al. [24]. Unlike PAP, that promotes physical activity as exercise, the CMDfP could remind a person to stand up and move when he or she has been sitting down for an elongated period of time. This opportunity is something that the participants in the present study might have reflected upon since they were confident that the devices would increase the physical activity.

A valuable opportunity for a person with increased blood pressure (BP) during prevention for CVD is the ability to undergo lifestyle changes instead of receiving medicines [31]. Patients that have high BP and that are prescribed with BP decreasing medicines tend to forget to take their medicines [27]. If a patient instead was prescribed with CMDfP, the HC personnel could detect if a patient forgets to use CMDfP and thereby remind the patient. The patient would also understand the value of the CMDfP and hopefully feel that the devices support him or her and therefore be more keen to use them.
5.4 Effect on Work Routine

The personnel at HCs lack time, which often results in that preventative care is postponed or excluded. The neglect is a serious issue since preventative care is important, not least from a health perspective of the citizens. An important view regarding the attitude to CMDfP is the probable impact on the HC’s daily work.

In the questionnaire to the personnel of the present study, question 5 and statements 11 and 15-20 covered the last research question. While statements 10-13 in the questionnaire to the patients regarded the preferred meeting frequency. In addition to the willingness to prescribe and use CMDfP, the personnel were positive to replace at least one physical meeting to a virtual, if the patients were prescribed with CMDfP. In an extensive study by the Swedish eHealth Authority (eHälsomyndigheten), 66% of the responding healthcare personnel thought that virtual meetings would be able to replace physical\textsuperscript{19}. Only 18% of patients in the present study were willing to replace all of their physical meetings. Though, 41% of the patients partly agreed to the fact of having all their physical meetings replaced. One can therefore imagine that the patients were positive to have at least one meeting replaced.

If patients were prescribed with connected eHealth devices for preventative care it would be an additional alternative to care available for them, compared to today. In an early stage of implementation the opportunity to have physical meetings should not be excluded, rather should the patients be offered another, more holistic and up to date, alternative to support them in their lifestyle change. A study regarding the usage of eHealth of chronically ill patients highlighted exactly this, that especially older people wanted eHealth to replace a part of the physical meetings and checks but not entirely [16]. Several studies have shown that devices in combination with motivational interviews (MI) at HCs have generated positive results during rehabilitation and could therefore likely apply for preventative care as well [39].

The patients with PAP in this study, suggest that the physical meetings with the HCs should be held more seldom, if the they were prescribed with CMDfP. The virtual meetings should be held with a similar frequency as the physical meetings are held today, according to the patients. Contradictory, the personnel would prefer to meet the patients physically as regular as today, if the patients were prescribed with CMDfP. This is rather contradictory to the personnel’s willingness of replacing at least one physical meeting. 52% of the HC personnel in this study do not believe that their workload would decrease if the patients were prescribed with CMDfP. Surely, an unchanged or even increased workload could be the short-term effects when implementing connected eHealth devices for preventative care but the likelihood is that it will decrease. Within curative care, new work routines have been developed and adaptions have been made in order for the benefits, including the time reduction, of the technology to be revealed. The same is applicable to preventative care and the HC’s work routine. Since the preferred frequency of meetings,

\textsuperscript{19}https://www.ehalsomyndigheten.se/nyheter/2016/den-digitala-patienten-ar-har-men-ar-varden-redo/
physically and virtually, diverged between the personnel and the patients, two important actions must be taken. First, the personnel should be presented the results of the patients’ preferred meeting frequency to understand that they, at least in this study, are positive to meet less frequent. Lastly, developments of HC’s work routine must be performed together with the profession to secure them that the less frequent physical meetings, which are of preference to the patients, are a benefit towards their workload.

In the long-term, several studies indicate that the workload of healthcare personnel will be decreased and time saved if preventative care received further resources [48, 49]. Separately, digital devices within curative care and preventative care have been proved to unleash time to healthcare personnel and minimize the cost of healthcare while being further available to the patients. Thus, combining the two to digital preventative care would certainly be affirmative. During physical meetings, there is always a source of inefficient time. For instance, when the patient arrives, shake hands with the HC personnel, takes of its jacket etc. Such time could be considered as waste of time that could be decreased if less physical meetings were held. If multiple virtual meetings or connected health-checks were performed, the time that is expected to be saved could be spent on more valuable work. For a minimal increase of workload at the beginning of the implementation, a suggestion is to have a staff member that works full time with the connected preventative care. Such person could have responsibility over the incoming patient data, could call or video chat with the patients and schedule both to virtual and physical meetings with the HC. The current physicians and nurses working at HCs could in such case have a non-interrupted workday, where time is spent on valuable sessions. Also, if the patient data was automatically transferred from the patient to the HC, it would be possible for the HC personnel to regard this data at a time and place that suits them. It is in such case likely that the personnel would feel less stressed and at the end of their day feel confident that they have accomplished the work intended. In order for this to work, education on CMDiP and new work routines of the personnel have to be performed.

5.5 Future Work

Three major steps ought to be taken before an implementation of CMDiP could be reality. First, the developers of the technology and connected eHealth devices for preventative care have to understand healthcare and the related problems regarding connected and preventative care. This is crucial for the CMDiP to be developed as required and adapt to the surrounding environment. Secondly, the connected eHealth devices for preventative care have to be secure and medically validated according to the international systems; CE, Medical Digital Devices and ISO for instance. This is required in order for the equipment to be reliable and the work of the primary care to become optimal. In addition, connected eHealth devices for preventative care should be, as revealed by the definition, connected to healthcare’s different IT- and journal systems. This could be the greatest barrier since the firewalls of the hospitals are extremely safe and it would be challenging to connect devices from outside the hospital. Finally, in comparison to rather complex
interfaces of devices for diagnostics and treatment, the connected eHealth devices for preventative care ought to be intuitive to use. Medical engineers must therefore develop devices and solutions that are understandable to the users and healthcare personnel as well as reliable and that meet the demands and requirements.

A valuable investigation regarding the future steps of digitalization of preventative care would be to examine which patient groups that would benefit from CMDfP and how they would utilize the devices. It might be so that immigrants that have not yet learned the local language would benefit the most. Also caregivers that foster patients suffering from hyperactivity or eating disorders might receive advantage of the devices since they would be able to track the vital parameters and physical activity of their patients. Therefore, CMDfP could work in multiple ways outside hospitals with regards to improved health and wellness.

Before any major conclusions of the attitude to CMDfP can be drawn, the CMDfP have to be experienced by the intended users and the HCs need to develop adapted work routines. The collaboration between different stakeholders within healthcare has to be improved as the policy that was suggested by Wadman et al. aimed for [19]. Digitalization of healthcare will not happen over night and not unless dedicated people commit to it. Business companies, the state and government, county councils, municipalities and the citizens have to make their contribution. Before the first patient can be prescribed with CMDfP, the IT-systems of healthcare have to be in connection with the platforms and health cloud solutions that should store the data collected. Business- and payment models including how the distribution of CMDfP should be conclude and paid for are necessary. Models for reimbursement of the checks and virtual meetings must also be developed. The primary care must be given a budget for the intended usage of CMDfP in order to start. These are steps of future work in research within medical engineering. If CMDfP are introduced as positively as regarded in this study, Daniel Forslund’s vision of a new, preventative care in 10 years is definitely possible\textsuperscript{20}.

\textsuperscript{20}Värdet av digital teknik i den svenska vården, McKinsey, 2016
6 Conclusion

Healthcare has recently undergone major developments in order to meet the demands of an aging population, unhealthier living and a stagnant widespread of cardiovascular diseases. The digitalization of the primary care and the preventative care are currently being highlighted. Few studies within digital preventative care are today available but definitely needed. This study has examined the attitudes of health center physicians and nurses to prescribe Connected Medical Devices for Prevention (CMDfP) as well as the attitudes of patients prescribed with Physical Activity on Prescription (PAP) to use CMDfP. Personnel and patients from five different health- and rehab centers in Stockholm, Sweden, believe that connected eHealth devices for preventative care is a tool that could motivate, support and streamline preventative care. The respondents of the study were willing to use eHealth for prevention, both apps and wearables. They believe that the devices could facilitate to an improved adherence to PAP, especially to increased physical activity and choices of healthier food and beverage. The personnel that were negative to PAP as it is used today, are positive to combine PAP with eHealth and believe the effects will be positive. The work routine of the health center personnel has to be adapted. The workload is likely to decrease in the long-term, since the preferred meeting frequency of physical meetings should be less seldom, according to the patients. The personnel were also willing to replace physical meetings to virtual if their patients were prescribed with the devices. Therefore, the positive results that medical devices within curative care have generated, such as reduced cost, improved time management and increased availability, are likely to correlate with what the future of connected eHealth devices for preventative care holds. Instantly, healthcare and developers of connected eHealth devices should align in order to help the patients help themselves and meet the future needs of healthcare.
References


[38] “FaR – fysisk aktivitet på recept,” [Online; accessed 09-Feb-17].


A Appendices

A.1 Covering Letter
Följebrev till deltagande i enkätundersökning gällande preventiv medicinsk teknik

Tack på förhand för Din medverkan!


Syftet med arbetet är att undersöka primärvårdens attityd till att förskriva preventiv medicinsk teknik till personer i riskzonen för att utveckla hjärt- och kärlsjukdomar i ett syfte att öka följsamheten till FaR (Fysisk aktivitet på recept). Detta anses vara en viktig frågeställning eftersom insikter i ämnet krävs för att gynna individers hälsa, förebygga ohälsa samt minska trycket på primärvården.

Enkäten behandlar Din attityd till preventiv medicinsk teknik och om Du tror att det skulle kunna öka motivationen till en livsstilsförändring. Svara därför efter Din egen erfarenhet och inställning.

All data och svar kommer att behandlas anonymt och konfidentiellt.

I enkäten finns följande definitioner:
- **Värden:** puls, syremättnad, sömnkvalitet, aktivitetsnivå, återhämtning, blodtryck, temperatur, vikt, BMI (body mass index) och fettporcent.
- **Tekniska hjälpmedel:** Våg, hälsoklocka, termometer och blodtrycksmätare
- **Patient:** person i riskzonen för att utveckla hjärt- och kärlsjukdom.
  - De tekniska hjälpmedlen är över bluetooth uppkopplade till en molnbaserad tjänst som kan vara tillgänglig för både sjukvården, patienten själv och patientens anhöriga.

Om Du önskar ta del av slutresultatet av arbetet vänligen skicka ett mail till fornst@kth.se så skickas rapporten till er i slutet av juni då den beräknas vara sammanställd. Mailadressen kan även användas om Du har frågor eller kommentarer kring arbetet.

Återigen, tack för Ditt deltagande!

Varma hälsningar,
Cecilia
A.2 Questionnaire to Health Center Personnel
Frågeformulär till anställda i primärvården

Introduktion
1. Kön:  ○ Man  ○ Kvinna  ○ Vill ej ange
2. Arbetsroll:  ○ Läkare  ○ Sjuksköterska  ○ Annat:________________________
3. Ålder:  ○ 8-29 år  ○ 30-39 år  ○ 40-49 år  ○ 50-59 år  ○ 60-69 år  ○ 70 + år  ○ Vill ej ange
4. Arbetsfarenhet inom primärvården:___________ år

Dagligt arbete
5. Under den senaste månaden, hur stor del av Dina patienter har legat i riskzonen för att utveckla hjärt- och kärlsjukdomar (tex har blodtryck i övre gränsskikt eller har övervikt)?
   ○ < 25%  ○ 25% - 50%  ○ 50% - 75%  ○ > 75%  ○ Ingen uppfattning
6. Har Du någon gång ordinerat FaR (fysisk aktivitet på recept) och vad är Din inställning till det?
   ○ Ja, positivt inställd  ○ Nej, men är positivt inställd
   ○ Ja, och är negativt inställd  ○ Nej, och är negativt inställd

Teknik
7. Har Du någon erfarenhet av aktivitetsarmband eller app-baserade hjälpmedel rörande hälsa?
   ○ Ja, mina patienter använder detta  ○ Ja, jag använder detta  ○ Nej, ingen alls

eHälsa (påståenden för gradering av Din inställning)
8. Om det fanns en medicintekniskt klassad app som skulle kunna hjälpa mina patienter att få bättre kontroll på sin hälsa så skulle jag rekommendera den.
   ○ Absolut  ○ Troligen  ○ Håller delvis med  ○ Antagligen inte  ○ Absolut inte
9. Om det fanns medicintekniskt klassade hjälpmedel som kan förebygga att patienter som ligger i riskzonen utvecklar hjärt- och kärlsjukdomar skulle jag förskriva det.
   ○ Absolut  ○ Troligen  ○ Håller delvis med  ○ Antagligen inte  ○ Absolut inte
10. Det är ingen medicinsk skillnad att ordina teknik i preventivt (till patienter i riskzonen) jämfört med ett behandlande syfte (till redan sjuka patienter).
    ○ Absolut  ○ Troligen  ○ Håller delvis med  ○ Antagligen inte  ○ Absolut inte
11. Jag skulle kunna tänka mig att ersätta minst ett av mina fysiska möten med patienter i riskzonen för att utveckla hjärt- och kärlsjukdomar mot ett virtuellt möte genom en molnbaserad tjänst.
    ○ Absolut  ○ Troligen  ○ Håller delvis med  ○ Antagligen inte  ○ Absolut inte

VAR GOD VÄND!
12. De tekniska hjälpmedlen skulle motivera mina patienter till att bli mer fysiskt aktiva i sin vardag.

- Absolut
- Troligen
- Håller delvis med
- Antagligen inte
- Absolut inte

13. De tekniska hjälpmedlen skulle hjälpa mina patienter att fatta sundare beslut kring sina kostvanor.

- Absolut
- Troligen
- Håller delvis med
- Antagligen inte
- Absolut inte

14. De tekniska hjälpmedlen skulle i högre utsträckning kunna motivera mina patienter till livsstilsändring än vad fysiska samtal kan göra.

- Absolut
- Troligen
- Håller delvis med
- Antagligen inte
- Absolut inte

15. Att förskriva medicinsk teknik till patienter i riskzonen att utveckla hjärt- och kärlsjukdomar skulle minska min arbetsbörda.

- Absolut
- Troligen
- Håller delvis med
- Antagligen inte
- Absolut inte

Arbetssätt

16. Om patienterna ordinerades tekniken, hur ofta skulle Du ha fysiska möten med patienterna jämfört med idag?

- Mer ofta än idag
- Lika ofta
- Varannan gång mot idag
- Endast vid behov

17. Om patienterna ordinerades tekniken, hur ofta skulle Du ha virtuella möten över den molnbaserade tjänsten med patienterna jämfört med idag?

- Mer ofta än idag
- Lika ofta
- Varannan gång mot idag
- Endast vid behov

18. Hur ofta skulle patientens värden behöva ses över digitalt?

- Varje vecka
- Varje månad
- Varje år
- Endast inför besök
- Annat:_________________________

19. Vem skulle titta på patientens monitorerade värden?

- Läkare
- Sjuksköterska
- Administratör
- Annat:_________________________

20. Vem skulle kontakta vem vid uppföljning (oavsett digital eller fysisk)?

- Patienten kontaktar vårdcentral
- Vårdcentral kontaktar patienten
- Annat:_________________________

Övrigt
Kommentarer rörande Din inställning till förskrivning av preventiv medicinsk teknik:

__________________________________________________________________________________________________

__________________________________________________________________________________________________

TACK FÖR DIN MEDVERKAN!
Vid frågor, kontakta Cecilia Fornstedt, fornst@kth.se

Detta är ett del av en datainsamling till ett masterexamensarbete som utförs på KTH Skolan för Teknik och Hälsa i samarbete med Philips Healthcare
Questionnaire to primary care personnel

Introduction

1. **Sex:**
   - [ ] Man
   - [ ] Women
   - [ ] Do not want to say

2. **Profession:**
   - [ ] Physician
   - [ ] Nurse
   - [ ] Other: __________________________

3. **Age:**
   - [ ] 18-29 years
   - [ ] 30-39 years
   - [ ] 40-49 years
   - [ ] 50-59 years
   - [ ] 60-69 years
   - [ ] 70+ years
   - [ ] Do not want to say

4. **Work experience within the primary care:** ___________ years

Daily work

5. During the last month, how big share of your patients are have been in the risk zone of cardiovascular diseases (has increased blood pressure or have been overweight)?
   - [ ] < 25%
   - [ ] 25% - 50%
   - [ ] 50% - 75%
   - [ ] > 75%
   - [ ] Don’t know

6. Have you prescribed PAP (Physical Activity on Prescription) and what is your attitude to it?
   - [ ] Yes, positive attitude
   - [ ] Yes, negative attitude
   - [ ] No, positive attitude
   - [ ] No, negative attitude

Technology

7. Do you have any experience of fitness bracelets or health apps?
   - [ ] Yes, my patients use this
   - [ ] Yes, I use this
   - [ ] No, not at all

EHealth (statements regarding your attitude)

8. If there was a medically classed app that could help my patients to have more control of their health, I would recommend it.
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not

9. If there were connected medically classed devices that could help my patients to have more control of their health, I would prescribe them.
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not

10. There is no difference prescribing medical technology for prevention (to people in the risk zone) compared to for curative (to already diseased people).
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not

11. I would replace at least one of physical meetings with patients in the risk zone for cardiovascular diseases to a virtual meeting through a cloud-based service.
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not

12. The technical devices would motivate my patients to be more physically active during their day.
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not

13. The technical devices would help my patients to be choice healthier food and beverages.
   - [ ] Absolutely
   - [ ] Probably
   - [ ] Partly agree
   - [ ] Probably not
   - [ ] Absolutely not
14. The technical devices could motivate my patients to a lifestyle change, more than physical meetings could do.

- Absolutely
- Probably
- Partly agree
- Probably not
- Absolutely not

15. Prescribing medical devices to patients in the riskzone for cardiovascular diseases would decrease my workload.

- Absolutely
- Probably
- Partly agree
- Probably not
- Absolutely not

Work routine

16. If patients were prescribed with medical devices, how often would you want to have physical meetings with the patients compared to today?

- More frequent
- As frequent as today
- Every second time
- Only when necessary

17. If patients were prescribed with medical devices, how often would you want to have virtual meetings with the patients compared to today?

- More frequent
- As frequent as today
- Every second time
- Only when necessary

18. How often would the patient data be reviewed?

- Every week
- Every month
- Every year
- Before appointment
- Other: _______________

19. Who would check the patient monitored parameters?

- Physician
- Nurse
- Administrator
- Other: _______________

20. Who would contact who for check-ups (physical or virtual)?

- Patient contacts health center
- Health center contacts patient
- Other: _______________

Additional comments

Comments regarding you attitude to prescriptions of connected medical technology:

_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________
_________________________________________________________________________________________________________________________
A.3 Questionnaire to Patients with PAP
Frågor till personer med FaR – Om attityd kring preventiv medicinsk teknik

Introduktion

1. Kön: ○ Man ○ Kvinnan ○ Vill ej ange

2. Ålder: ○ 18-29 år ○ 30-39 år ○ 40-49 år ○ 50-59 år ○ 60-69 år ○ 70 + år ○ Vill ej ange

3. Har Du FaR (Fysisk aktivitet på Recept)? ○ Ja ○ Nej

Teknik

4. Har Du någon erfarenhet av aktivitetsarmband eller app-baserade hjälpmedel rörande hälsa?
   ○ Ja, jag använder digitala hjälpmedel
   ○ Endast genom personer i min närhet använder digitala hjälpmedel
   ○ Nej, ingen alls

eHälsa (påståenden för gradering av Din inställning)

5. Om min vårdgivare rekommenderade mig att använda en hälso-app så skulle jag använda den.
   ○ Absolut
   ○ Troligen
   ○ Håller delvis med
   ○ Antagligen inte
   ○ Absolut inte

6. Användningen av tekniska hjälpmedel och tillgången till mina värden i en molnbaserad tjänst skulle göra att jag blev mer motiverad att genomföra en livsstilsförändring.
   ○ Absolut
   ○ Troligen
   ○ Håller delvis med
   ○ Antagligen inte
   ○ Absolut inte

7. Jag skulle se över mina värden flera gånger om dagen och följa de rekommendationer som mitt personliga elektroniska coachningsprogram gav mig.
   ○ Absolut
   ○ Troligen
   ○ Håller delvis med
   ○ Antagligen inte
   ○ Absolut inte

8. Om min fysiska aktivitet registrerades skulle jag bli mer angelägen om att röra på mig till den nivå jag vet att jag behöver.
   ○ Absolut
   ○ Troligen
   ○ Håller delvis med
   ○ Antagligen inte
   ○ Absolut inte

9. Mina aktiva val av mat och dryck skulle bli sundare om jag kunde registrera vad jag konsumerade och fick en överblick av detta.
   ○ Absolut
   ○ Troligen
   ○ Håller delvis med
   ○ Antagligen inte
   ○ Absolut inte

10. Jag skulle kunna tänka mig att ersätta alla mina fysiska motiverande samtal med vårcentralen till virtuella.
    ○ Absolut
    ○ Troligen
    ○ Håller delvis med
    ○ Antagligen inte
    ○ Absolut inte

VAR GOD VÄND!
Vårdkontakt

11. Om Du använde de tekniska hjälpmedlen, hur ofta jämfört med idag, skulle Du vilja träffa vårdpersonalen
fysiskt?
- Mer ofta än idag
- Lika ofta
- Varannan gång mot idag
- Endast vid behov

12. Om Du använde de tekniska hjälpmedlen, hur ofta jämfört med idag, skulle Du vilja träffa vårdpersonalen
virtuellt?
- Mer ofta än idag
- Lika ofta
- Varannan gång mot idag
- Endast vid behov

13. Vem skulle kontakta vem vid uppföljning (oavsett digital eller fysisk)?
- Jag skulle kontakta vårdcentral
- Vårdcentral skulle kontakta mig
- Annat: __________________________

Övrigt

Kommentarer rörande Din tro att medicinsk teknik kan öka följsamheten till FaR:

__________________________________________________________________________________________________

__________________________________________________________________________________________________
Questionnaire to patients with PAP

Introduction
1. **Sex:**  ○ Man  ○ Women  ○ Do not want to say

2. **Age:**  ○ 18-29 years  ○ 30-39 years  ○ 40-49 years  ○ 50-59 years  ○ 60-69 years  ○ 70 + years  ○ Do not want to say

3. **Are you prescribed with physical activity?**  ○ Yes  ○ No

Technology
4. **Do you have any experience of fitness bracelets or health apps?**  ○ Yes, I use this  ○ Yes, people in my vicinity use this  ○ No, not at all

eHealth (statements regarding your attitude)
5. **If my care provider recommended a health app, I would use it.**
   ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not

6. **The usage of medical technological devices and the access to my parameters, would make me more motivated to a lifestyle change.**
   ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not

7. **I would regard my parameter multiple times every day and follow the personalized coaching programs that were available through the medical devices.**
   ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not

8. **If my physical activity was tracked, I would be more eager to more.**
   ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not

9. **My choice of food and beverage would be healthier if a registered what I consumed and received an overview of it.**
   ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not

10. **I would replace all of my physical meetings with the health center to virtual.**
    ○ Absolutely  ○ Probably  ○ Partly agree  ○ Probably not  ○ Absolutely not
Healthcare contact

11. If you used the medical devices, how often would you want to have physical meetings with the health center compared to today?
   - More frequent
   - As frequent as today
   - Every second time
   - Only when necessary

12. If you used the medical devices, how often would you want to have virtual meetings with the health center compared to today?
   - More frequent
   - As frequent as today
   - Every second time
   - Only when necessary

13. Who would contact who for check-ups (physical or virtual)?
   - Patient contacts health center
   - Health center contacts patient
   - Other: ____________________

Additional comments
Comments regarding you attitude to prescriptions of connected medical technology:

________________________________________________________________________________________________________________________