Digital Health in General Practice: User Experience, Virtual Visits, and Cardiovascular Prevention

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Digital Health in General Practice

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User Experience, Virtual Visits, and Cardiovascular Prevention

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LUND
UNIVERSITY

DOCTORAL DISSERTATION

Doctoral dissertation for the degree of Doctor of Philosophy (PhD) at the Faculty of Medicine at Lund University to be publicly defended on the 28th of May 2025 at 09.00 in Lilla Aulan, Jan Waldenströms gata 5, Malmö

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Abstract:

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Paper 1 explored primary care physicians' experience of digital health through qualitative content analysis of free-text questionnaire responses. A barrier to use was the loss of face-to-face patient contact. There were concerns regarding risks for patient harm and an increased workload due to a rising number of patient access routes and a deficient technological infrastructure.

Paper 2 studied one of the new patient access routes – text-based virtual visits to public primary care. The patients were comparably young, and the most common group of diagnoses was skin conditions. Most patients did not require subsequent face-to-face health care contact, and of those who did the majority remained in primary care.

Paper 3 explored the patient experience of a digital intervention in the form of health-promoting text messages to primary care patients with hypertension. Participant interviews were analyzed using systematic text condensation. We concluded that the text messages were perceived as useful reminders, but that increased individualization could facilitate lifestyle change.

Paper 4 analyzed the effects on lifestyle of health-promoting text messages. Compared to the group that was randomized to treatment as usual, the text message group reported decreased alcohol use and increased physical activity.

The overall conclusion is that staff and patients should be included early in the development of new digital tools, that the effects on health equity of virtual visits need to be considered, and that a simple intervention such as health-promoting text messages can be effective but may be further improved by increased patient involvement.

Keywords: telemedicine, eHealth, digital health, general practice, primary health care, attitude of health personnel, e-visit, virtual visit, remote consultation, access to primary care, health care use, text messaging, hypertension, lifestyle, health behavior, theory of planned behavior

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Carpe diem

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Preface

The prelude of this thesis was my scientific project as a resident physician in general practice. My idea was to do some kind of intervention study to increase physical activity – and maybe social connectedness as a side effect – among patients at my primary health care center. So, I approached a researcher and general practitioner, Moa Wolff, who had done a yoga intervention for her thesis, as I thought that she would be a good match as a supervisor. However, a residency project in general practice is a total of 10 weeks which is a short time to plan, perform, and report an intervention study. So, wisely enough, my supervisor suggested taking part in a project that was starting up regarding an evaluation of digital tools in primary care in our region. I was quick to say yes, as I thought that would be a meaningful and manageable project. From clinical experience and conversations with colleagues, I could state that we obviously need more useful digital tools in primary care.

That residency project opened the door to a PhD project on digital tools in primary care. The suggested project included a randomized controlled trial for lifestyle change and the application of behavioral theory. In other words, it united the areas that I had first expressed interest in with the field of digital health that I had begun to learn more about and found intriguing. So, I decided to continue the journey and now invite you to read the result.

As a side note, where I was first inspired to do research was during my years as an undergraduate in Environmental Studies at the University of Montana, Missoula, USA. That is another story, but maybe one to build on for future research endeavors.

Context of this thesis

Digitalization is the answer – but what was the question? A bit simplified, but so it sometimes seems when you listen to certain stakeholders in media, politics, or health care: “New digital tools can greatly increase health care efficiency and could make just about everything better” (constructed quote). That is not necessarily incorrect. However, it may not have been the experience of the average Swedish health care professional during recent decades.

In evidence-based medicine, we do not introduce radically new ways of doing surgery or new medications without a scientific basis. But something akin to introducing new pills without sufficient knowledge of usefulness or side effects appears to be a recurring issue regarding new digital tools in health care. There are at least four interconnected problems with this relative lack of evaluation. First, it poses a risk to patients. Second, it poses a risk to the work environment. Third, it may waste health care resources. Fourth, it risks making health care professionals more negatively inclined towards digitalization, thus reducing our ability to use digital health to its full potential.

Of course, there are useful digital health technologies being developed, evaluated, and introduced. Furthermore, there is high-quality research being conducted nationally and internationally. However, digital health is a comparably new and rapidly evolving field where much is not known or insufficiently studied. From a Swedish perspective, there are many areas in need of more knowledge.

At the conception of this thesis, there were several new digital health technologies being introduced in primary care, mainly for virtual patient contacts but also in terms of the electronic health record. In addition, my supervisors had started a randomized controlled trial where health-promoting text messages were sent to patients with hypertension in primary care. All potentially useful new technologies, but in need of evaluation.

The idea of this thesis project was thus to contribute to the scientific evidence base regarding digital tools in Swedish primary care. Digitalization may or may not be the answer, but we need to ask more and better questions about it. To that end, we need more knowledge. And that is what I wanted to contribute to with this thesis.

Abstract

Digital tools are sometimes introduced in primary care with little end user involvement and without sufficient evaluation, which may decrease usefulness. Therefore, this thesis project analyzed the end user experience and effects of different digital tools in primary care in southern Sweden. The overarching aim was to contribute to increased patient benefit of digitalization.

Paper 1 explored primary care physicians' experience of digital health through qualitative content analysis of free-text questionnaire responses. A barrier to use was the loss of face-to-face patient contact. There were concerns regarding risks for patient harm and an increased workload due to a rising number of patient access routes and a deficient technological infrastructure.

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The overall conclusion is that staff and patients should be included early in the development of new digital tools, that the effects on health equity of virtual visits need to be considered, and that a simple intervention such as health-promoting text messages can be effective but may be further improved by increased patient involvement.

List of papers

1. Glock H, Milos Nymberg V, Borgström Bolmsjö B, Holm J, Calling S, Wolff M, Pikkemaat M. Attitudes, barriers, and concerns regarding telemedicine among Swedish primary care physicians: a qualitative study. Int J Gen Med. 2021;14:9237-46. doi:10.2147/IJGM.S334782.
2. Glock H, Jakobsson U, Borgström Bolmsjö B, Milos Nymberg V, Wolff M, Calling S. eVisits to primary care and subsequent health care contacts: a register-based study. BMC Prim Care. 2024;25(1):297. doi:10.1186/s12875-024-02541-y.
3. Glock H, Borgström Bolmsjö B, Milos Nymberg V, Wolff M, Calling S. 'In the end, I'm the one who has to do the job': participant experience of a lifestyle intervention for patients with hypertension. Scand J Prim Health Care. 2023;41(4):457-68. doi:10.1080/02813432.2023.2271042.
4. Glock H, Björk Javanshiri A, Borgström Bolmsjö B, Jakobsson U, Milos Nymberg V, Wolff M, Calling S. Promoting lifestyle change through text messages to patients with hypertension: a randomized controlled trial in Swedish primary care. Prev Med Rep. 2025;51:103009. doi:10.1016/j.pmedr.2025.103009.

Abbreviations

AI	Artificial intelligence
BMI	Body mass index
CI	Confidence interval
COVID-19	Coronavirus disease 2019
CVD	Cardiovascular disease
DALY	Disability-adjusted life year
DASH	Dietary Approaches to Stop Hypertension
eHealth	Electronic health
GBD	Global Burden of Disease (study)
GP	General practitioner
ICD-10	International Classification of Diseases 10th Revision
mHealth	Mobile health
NCD	Non-communicable disease
OR	Odds ratio
PHC Online	Primary Health Care Skåne Online
PUSHME	Primary Care Usage of Health Promoting Messages (trial)
RCT	Randomized controlled trial
REDCap	Research Electronic Data Capture
SD	Standard deviation
TEXT ME	Tobacco, Exercise and Diet Messages (trial)
TPB	Theory of planned behavior
UK	United Kingdom of Great Britain and Northern Ireland
US	United States of America
UTAUT	Unified theory of acceptance and use of technology
WHO	World Health Organization
WONCA	World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians (also called the World Organization of Family Doctors)

Terminology

World Health Organization (WHO) definitions are used when available.

AI	Artificial intelligence. An area of computer science that emphasizes the simulation of human intelligence processes by machines that work and react like human beings (1, 2).
DALY	Disability-adjusted life year. One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost due to premature mortality and the years lived with a disability due to prevalent cases of the disease or health condition in a population (3).
Digital health	The field of knowledge and practice associated with the development and use of digital technologies to improve health (1). Digital health expands the concept of eHealth to include digital consumers and emerging areas such as artificial intelligence (1, 4).
Digital health technologies	Any digital technology used to improve health or health care delivery (1, 5).
Digital (health) tools	Another term for digital health technologies (5, 6).
Digitalization	The ongoing integration of digital technologies and digitized data across the economy and society (1, 7).
eHealth	The use of information and communications technologies in support of health and health-related fields (1, 4).
eVisit	In this thesis: A text-based virtual visit, through synchronous or asynchronous two-way communication via a digital platform (app- or web-based) (8).
mHealth	The use of mobile devices for medical and public health practice (9).

Telemedicine	The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communications technologies (1). Note that the term telemedicine is also used synonymously with eHealth or digital health, including in Paper 1 of this thesis.
Virtual visit	In this thesis: A health care visit between patient and health care professional conducted via video, or via synchronous or asynchronous text (8, 10). Note that definitions vary and sometimes include audio-only or telephone contacts (11, 12).

Introduction

General background

General introduction to this thesis

With an aging population, the rise in lifestyle-related diseases, and an increased political focus on person-centered primary care, the demands on Swedish primary care are increasing (13-15). Decision makers in health care have put forth digitalization as a way to improve access, efficiency, and quality of care (16). However, concerns have also been raised regarding increased health care disparities, the workload of health care staff, and patient security issues related to digitalization (17, 18). To address some of these issues, this thesis will explore different aspects of digitalization in health care from a Swedish primary care perspective.

Digitalization in health care - terminology and a very brief history

Health care has undergone several revolutions in recent decades. A major one is the introduction and rapidly increasing use of digital tools (19, 20).

Digitalization in health care is often referred to by the term electronic health (eHealth) or, more recently, digital health (1, 16). The World Health Organization (WHO) defines digital health as "the field of knowledge and practice associated with the development and use of digital technologies to improve health" (1). Digital health thus includes all types of digital technologies used in health care, from the electronic medical record to tools employing artificial intelligence (AI), as well as remote contacts (telemedicine) and mobile devices (mHealth) (1).

Digitalization in health care began in the late 1950s with early attempts at computerized medical history taking and diagnosis, and the development of medical health records (21, 22). After at times comparably slow development in contrast to other sectors of society, digitalization has picked up pace in the last decades in many health care systems (19, 20). In Sweden, the 2000s saw the introduction of digital health tools such as internet-based cognitive behavioral therapy, and computerized clinical decision support systems in telephone triage (23, 24). In the early 2010s, video consultations between patients, general practitioners (GPs), and secondary care physicians were initiated in rural Sweden (25). In the latter half of the decade,

commercial primary care providers began to offer virtual visits through video or text (10). The same type of visits were initiated by Swedish public primary care providers some years later (26). Development in other high-income countries appears to be similar and rapidly evolving (19, 20).

To complicate and nuance the picture of this rapid development, it should be noted that the use of fax machines is still widespread in Swedish health care in this digital age, with a total of more than 4000 fax machines in use across the country (27). It should also be noted that new digital tools are often not sufficiently and transparently validated, which may result in risks for patients and mistrust from health care providers (28).

Primary care challenges and digital health

What is primary care?

To discuss primary care challenges, it is pertinent to first define what we mean by primary care. This may seem straightforward. However, there are differing and continuously evolving professional definitions, popular views, and political interpretations. I will briefly describe this under the following three subheadings.

Primary health care and primary care

The definition of primary health care goes back to the *Declaration of Alma-Ata* at the International Conference on Primary Health Care in 1978, which in essence posed that primary health care is key to attaining the universal human right of health and well-being (29). However, interpretations and uses of the term have varied since. Forty years later, in 2018, there was a new Global Conference on Primary Health Care which agreed upon a comparably simple definition of primary health care (30):

> Primary health care is a whole-of-society approach to health that aims to ensure the highest possible level of health and well-being and their equitable distribution by focusing on people's needs and preferences (as individuals, families, and communities) as early as possible along the continuum from health promotion and disease prevention to treatment, rehabilitation and palliative care, and as close as feasible to people's everyday environment. (30)

The components of primary health care were further visualized in a picture (Figure 1).

Figure 1 The components of primary health care
As defined and illustrated by the World Health Organization and the United Nations Children's Fund at the Global Conference of Primary Health Care in Astana, Kazakhstan, 2018 (30). Provided under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; https://creativecommons.org/licenses/by-nc-sa/3.0/igo). No changes have been made to the original figure.

As illustrated in Figure 1, primary care is a part of the concept of primary health care. Primary care is defined by the WHO as "a key process in the health system that supports first-contact, accessible, continuous, comprehensive and coordinated person-focused care" (31, 32). The World Organization of National Colleges, Academies and Academic Associations of General Practitioners/Family Physicians (WONCA, also called the World Organization of Family Doctors) defines primary care as "the setting within a health care system, usually in the patient's own community, in which the first contact with a health professional occurs" (33). Put simply, primary care is health care provided close to the community. However, it is important not to lose sight of the whole-of-society approach and the equitable health aims of primary health care.

General practice and family medicine

As defined in the preceding paragraphs, "primary care" is a relatively broad term. However, it is often used interchangeably with the more specific terms general practice or family medicine (34).

First, a note on the dual terminology. In the United Kingdom of Great Britain and Northern Ireland (UK), physicians specialized in primary care are called general

practitioners (GPs), and the medical specialty is termed general practice (35). In the United States of America (US), the equivalent terms are family physicians and family medicine (36). The professional Swedish term can be translated to "specialist in general practice" (37). Therefore, in this thesis, I will use the terms GP and general practice.

By definition, general practice is primary care provided by specialized medical doctors and/or other health care professionals (32). It is further described and summarized by the WONCA tree (Figure 2) (33, 38).

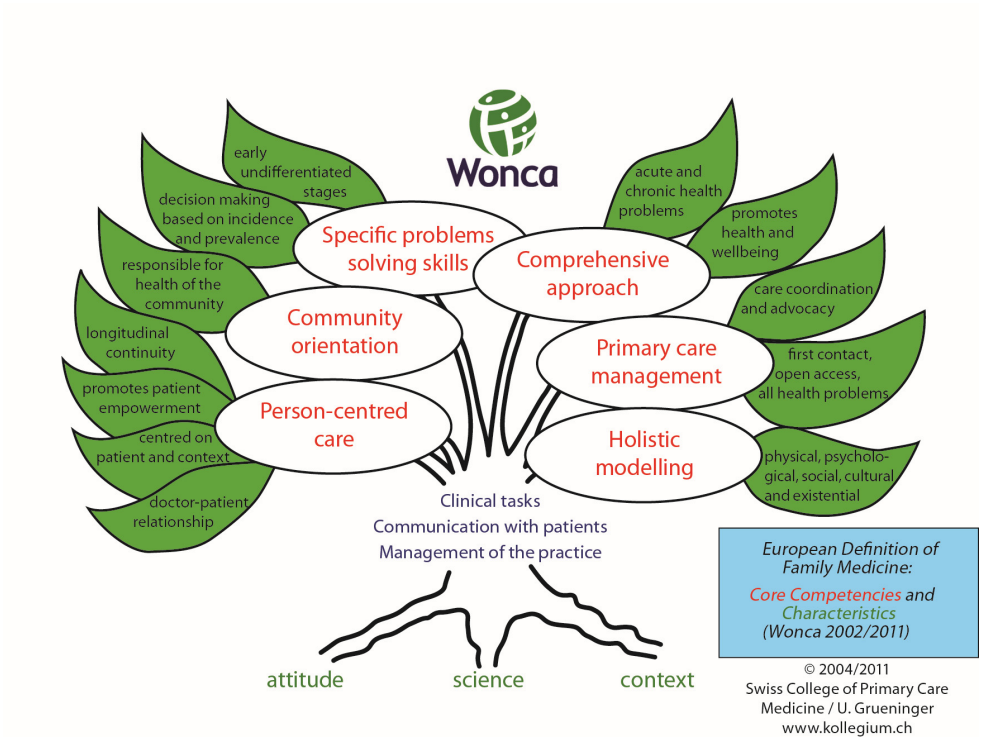

Figure 2 The WONCA tree as produced by the Swiss College of Primary Care Medicine
A visualization of the complexity and interrelationships of the discipline and specialty of general practice/family medicine (38). Reprinted with permission from the copyright holder.

Primary care defined by society and politics

In Sweden, inhabitants in need of non-emergency care usually contact their primary health care center, which is staffed by physicians (mainly GPs and GPs in training), registered nurses, assistant nurses, medical secretaries, and often also psychologists, dieticians, physiotherapists and/or occupational therapists. Accordingly, in everyday Swedish language, the term "primary care" is usually used to signify the services carried out at primary health care centers. Consequently, due to popular

Swedish and academic use, I will use the term “primary care” interchangeably with “general practice” (33, 34, 39).

Health care in Sweden is predominately publicly financed (39). General regulations, goals, and financial boundaries are thus set by elected officials. Administrative regions and municipalities are responsible for the provision of primary care to the population (39, 40). Current laws and regulations state that the basic commitment for regions and municipalities with regard to primary care include:

1. Provide the health care services that are required to satisfy common health care needs.

2. Make sure that health care is easily accessible.

3. Provide preventive efforts depending on population needs and the patient’s individual needs and conditions. (40)

In summary, primary health care, primary care, and general practice are not easily delimited. The expectations put on general practice and primary care are extensive. The expectations of primary health care could be described as infinite. However, the possibilities of primary health care to improve the human condition are also potentially enormous.

Primary health care potential and challenges: non-communicable diseases

Primary health care has contributed substantially to global health improvements over the past half-century (30). Maternal and child mortality, and deaths from infectious diseases, have decreased dramatically in low- and middle-income countries partially thanks to primary health care (41, 42). It has been repeatedly shown that focusing on primary health care is an efficient way to improve population health in high-income as well as low- and middle-income countries (43).

Disability-adjusted life year (DALY)

One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost due to premature mortality and the years lived with a disability due to prevalent cases of the disease or health condition in a population (3).

Over recent decades, there has been a global rise in non-communicable diseases (NCDs) (14, 30). The most important NCDs are cardiovascular diseases (CVDs), cancers, chronic respiratory diseases, and diabetes (44). From 1990 to 2016, the

percentage of disability-adjusted life years (DALYs) attributed to NCDs rose from 44% to 61% (30). The rise was most notable in low- and middle-income countries (30). However, from 2010 to 2021, the age-standardized number of DALYs attributed to NCDs decreased by 6%, indicating that the absolute rise was also caused by population growth and aging (14).

Part of the rise in NCDs can thus be attributed to an increased life expectancy as mortality, especially from infectious diseases, has decreased (45). However, another, and substantial, reason for the rise in NCDs is changes in lifestyle habits (30). Tobacco use and alcohol use are long-known risk factors for several NCDs (46, 47). More recently, unhealthy diets and physical inactivity have risen as increasingly important risk factors. Such unhealthy lifestyle habits have also spread from high-income to low-income countries as a new type of epidemic (46, 47).

The potential of digital health

The global rise in NCDs is a major challenge for primary health care in the 21st century (30, 46, 48). The amount of resources that can be spent on health care is limited even in high-income countries. Consequently, there is a constant need to make health care more efficient.

Increased use of digital health technologies has been put forth by political as well as scientific and global health authorities as a way to improve access, efficiency, and quality of care (16, 19, 49). The potential of digital health has also been addressed in national policies such as Sweden's *Vision for eHealth*, stating that:

> In 2025, Sweden will be best in the world at using the opportunities offered by digitisation and eHealth to make it easier for people to achieve good and equal health and welfare. (16)

The European Commission's *Communication on the Transformation of Digital Health and Care* similarly describes the promise – and some caveats (50):

> Digital solutions for health and care can increase the well-being of millions of citizens and radically change the way health and care services are delivered to patients, if designed purposefully and implemented in a cost-effective way. (50)

Scientific authorities such as the US National Academy of Medicine have also discussed digital health, describing the potential for rewards from scientific investments in digital health as enormous (19). Areas of importance included diagnosis and treatment, care continuity, telemedicine, self-management, health behavior, and use of big data for knowledge generation and public health (19).

In summary, the reach of digital health is vast, and the potential is immense. A simple question, though, is how these promising visions translate into work "on the floor" of everyday health care delivery (51).

Concerns regarding digital health

Several concerns have been raised regarding digitalization and the use of digital tools in health care. Important areas where caution has been warranted include effects on health care disparities, health care quality and efficiency, patient security issues, and the workload of health care staff (17-20, 52, 53).

The possible effects of digital health on health care disparities are important from a primary care perspective, as the equitable distribution of health is an outspoken goal of primary health care (30). A major problem is that of health care access (19). Vulnerable or underserved populations are often also digitally under-resourced (54). Except for an actual lack of technology, they may also have low digital literacy and health literacy levels (18, 52). Thus, there is a risk that improvements in digital health reach those already comparably affluent and healthy, but not those in more need of health care. That is an illustration of the "inverse care law" (people in most need of health care receive the least of it) and is also called the digital divide (19, 53, 54).

Another important area of concern regarding digital health is the quality and efficiency of new digital tools (17, 19, 20, 28, 52, 53). As the development of new digital health technology is rapid, regulations and standards have problems keeping pace (19). The accountability of commercial developers is often unclear and validation can be limited (28, 52). Evaluation with regard to clinical quality, health outcomes, and effectiveness is usually not required before a new digital health tool is put to use (17, 28, 52). Furthermore, the involvement of end users in development varies (19). Taken together, this risks providing health care with digital tools that do not improve the quality or efficiency of care, and also causes concern regarding patient safety (20, 52).

Alleviating the workload of health care professionals is one reason to increase the use of digital health technologies. However, the effect of digital health on staff workload is also an area of concern (17-20). The interoperability between systems, and the incorporation of digital tools into workflow, obviously affects the work environment. Furthermore, as for patients, the digital literacy of health care professionals varies and will have consequences for the real-world usefulness of digital health technologies (18, 19).

State of the scientific evidence base

As outlined above, an important area of concern regarding digital health is the need for evaluation of new digital health technologies (20, 52). Evaluation can be done through validation by a commercial vendor or as part of an implementation process, but it can also be conducted through scientific study (28).

Reviewing the literature when this thesis was conceived indicated a need for further research on several areas of digital health. A rather substantial amount of scientific evidence has been added thereafter. That new evidence will primarily be covered in

the Discussion. However, the overall impression of the scientific evidence base of digital health remains.

By 2020-2021, telemedicine, or in other words the use of digital health technologies where patient and provider are separated geographically, had been indicated to produce outcomes at least equivalent to face-to-face care (2, 17, 18, 55-57). Studies concerned different types of tools, conditions, and areas of health care including general practice. It had also been shown that clinical decision support tools could contribute to the improved performance of health care staff (58). Furthermore, digital medical history taking had been demonstrated to provide relevant information (59). However, all studied areas of digital health required evidence of higher quality (2, 17, 18, 55-59). In addition, generalizability between different contexts was a concern (60, 61).

Thus, there was ample need for continuing scientific study of digital health. Areas of importance that were of current interest in the southern Swedish primary care context (where this thesis was conducted) included end user experience, virtual visits, and the use of digital tools in the treatment and prevention of NCDs. The remainder of the Introduction will, therefore, be attributed specifically to these areas.

Background of papers included in this thesis

Health care professionals' experience of digital health

Health care professionals' experience of using new digital tools has been rather extensively studied, especially in secondary care but also in primary care (17, 55, 62, 63). The results have been mixed with regard to the overall question of whether digitalization and digital tools are perceived as a positive addition or a burden. Practitioners' acceptance has generally been more tentative than that of patients, with more focus being put on the challenges and risks of digital health (17, 55, 62, 63). Key areas for acceptance that have emerged include ease of use, perceived usefulness, effects on patient safety, and consequences for workflow (58, 63-65). Research focusing on primary care has reached similar conclusions (17, 66). In light of increasing digital patient contacts during the coronavirus disease 2019 (COVID-19) pandemic, GP experience and acceptance showed more positive tendencies but still included the same areas of concern (67, 68).

Focusing on health care professionals' experience of digital health in Scandinavian general practice, most studies have investigated GP experience of patient contacts conducted via text or video (69-73). As in international research, there were positives and negatives. Positives included improved efficiency and more specific

communication. Negatives included overuse by patients, too high inflow of information, and misunderstandings (69-73).

Most studies concern health care professionals' experience with specific digital tools. Few studies concern the general experience of digitalization in health care, and there were no such studies to be found in a Swedish general practice context. Therefore, in 2019, some colleagues initiated a study exploring primary care physicians' general attitudes toward digital health (74). A web-based questionnaire was sent to primary care physicians in southern Sweden, employing Likert items based on the theory of planned behavior (TPB, further described under the subheading "Theories of health behavior"). Analysis showed that attitudes toward digital health, and perceived behavioral control in the use of digital health, strongly predicted behavioral intention to use digital health technologies (74).

In this theoretical context, "attitudes" can be understood as what the respondent thinks that the behavior will result in (75). "Perceived behavioral control" can be understood as the respondent's estimate of their possibilities to use digital health technologies (76, 77). These ratings are thus in line with the importance of usefulness and ease of use, and the considerations regarding workflow, which have been reported in other studies on health care professionals' experience of digital health (58, 63-65, 74, 76, 77). An interesting additional finding of the questionnaire was that the primary care physicians reported a high intention to use digital health, but low actual use.

Virtual visits and health care use

An area of digital health of obvious importance to health care in general, and general practice in particular, is that of virtual visits. Primary care is the first point of health care contact for most patients, and the patient consultation is an essential part of general practice (30, 33, 78). Consequently, virtual visits have the potential to substantially affect overall care-seeking behavior and health care use, and general practice workflow. The circumstance that Scandinavian studies on GPs' experience of digital health primarily cover virtual visits may indicate the perceived importance among Scandinavian clinicians and researchers (69, 71-73).

Most studies on virtual visits have been carried out in the United States (17, 56, 79, 80). In the US, as in Sweden, asynchronous text-based contacts via patient portals have been possible for more than a decade (81). However, the type of virtual visit that seems to have been most studied is video visits (71, 79, 80). Text-based virtual visits, where provider and patient communicate via text through a web-based platform or an app (comparable to a chat), is a less studied field (17, 56). This type of visit can also be termed as an eVisit.

Existing research has indicated that the clinical outcomes of virtual visits are comparable to face-to-face visits, even if more studies have been called for (17, 55,

56, 80). More research has been specifically requested regarding what conditions are suitable for eVisits (56).

Another important concern to address is the risk of overuse related to virtual visits (11, 17, 18, 67, 70). An ongoing public debate in Sweden, and other countries, is whether virtual visits cause increased health care consumption and negatively affect health equity (11, 82). This has been indicated by research that shows that patients who seek virtual care are generally healthier, younger, and more urban than patients who seek face-to-face care (10, 17, 83). Furthermore, studies on health care use related to virtual visits have yielded inconclusive results (17, 56, 80).

Health care use could serve as an indicator of efficiency (17, 56, 80, 84-86). It is often approximated with follow-up rates. Focusing on eVisits, according to prior research, follow-up rates vary between 5% and 25% depending on context (17, 56, 83, 87-95). Studies have also indicated that follow-up rates after eVisits are comparable to those of face-to-face visits (87-92). However, those studies mainly covered urinary tract infections and respiratory tract infections through register-based comparisons.

By 2023, most primary care providers in Sweden offered virtual visits (85). More than half of the providers had an option for eVisits or were initiating this (96). Nevertheless, published research on eVisits was rather sparse.

Patient experience of digital health

Patient experience and acceptance of digital health have generally been reported as more positive than that of health care professionals (2, 17, 55, 86, 97, 98). This includes virtual health care contacts, where specific areas of patient appreciation were accessibility and time savings (17, 86). Acceptability was most evident for patients with long-term conditions and those living in remote areas, but was generally high (17). Likewise, remote monitoring has been shown to yield high patient acceptance and satisfaction scores (2). Digital health interventions, such as app-based support or text messages for lifestyle change in chronic conditions, have also rendered positive patient experiences including perceptions of usefulness, motivation, and support (2, 97-101). In summary, from a patient perspective, digital health has the potential to increase access, convenience, and empowerment. It is thus a promising tool for the supported self-management that will be needed as chronic conditions continue to increase (102). Nonetheless, digital health interventions have to be used with caution, also from a patient perspective, as side effects such as decreased well-being may occur (103).

Even if the reported patient experience of digital health is generally positive, there are some concerns (17, 55, 104, 105). Patients do express worries regarding the privacy and security of their data (17, 105). In addition, acceptance has been indicated to vary depending on socioeconomic status, with the socioeconomically

disadvantaged showing less interest and ability to use digital health (17, 55). Finally, age has been repeatedly described as a limiting factor with the older population showing lower digital health literacy and use – and expressing more concern regarding the use of digital health technologies (17, 55, 104, 105).

Studies of patient experience of digital health technologies have rendered some recommendations regarding design. Tools that are personalized or tailored to the specific user, especially taking the needs of older and disadvantaged groups into account, and that support self-management and patient empowerment, have been indicated to contribute the most to patient uptake (97, 100, 104, 105).

Disease prevention and digital health interventions

An interconnected world

A major consequence of digitalization is the increased interconnectedness of the world, and thus the possibility to rapidly reach a large number of people. Mass media and social media are the most obvious ways. However, it is also possible on a more individualized basis via e-mail, text messages, and more recently via smartphone applications.

As previously described, NCDs are increasing across the world (14, 30). Many of these diseases, such as CVD, can to a considerable extent be prevented through improved lifestyle habits (106-108). One mode of delivery for lifestyle interventions is through digital health. Therefore, this thesis includes a digital lifestyle intervention directed at primary care patients. The intervention aims at the number one modifiable risk factor for CVD: hypertension (109). Accordingly, in this section, background information on lifestyle, hypertension, and CVD will be provided.

Essentials of hypertension

Blood pressure is the pressure that blood exerts on the systemic artery walls. Hypertension is defined by the European Society of Cardiology, and by the WHO, as a confirmed clinic systolic blood pressure of ≥140 mmHg or diastolic blood pressure of ≥90 mmHg (110-112). According to Swedish guidelines, diagnosis can also be made using home blood pressure monitoring or 24-hour ambulatory blood pressure monitoring (110). The development of hypertension is complex, involving environment, behavior, heredity, and an interaction of hormonal, renal, cardiovascular, and neural mechanisms (111). Most patients are diagnosed with essential hypertension, meaning that we do not know exactly why they have persistently high blood pressure. For about 10% of patients, a specific pathophysiological cause can be identified, and this is termed secondary hypertension (111).

Over time, high blood pressure causes organ damage which can result in disease (111). Observational studies from the early 1900s and onwards, and subsequent clinical trials, have established that hypertension is a risk factor for coronary heart disease, stroke, other CVDs, chronic kidney disease, and dementia (107, 113). For each 20 mmHg increase in systolic blood pressure from 120 mmHg, the relative risk of ischemic heart disease and stroke has been indicated to roughly double (107, 114). Conversely, lowering systolic blood pressure to <120 mmHg has been shown to continuously reduce the risk for cardiovascular events (115). Consequently, there is an ongoing scientific and professional discussion regarding lowering the limits for the diagnosis and treatment of hypertension. The term elevated blood pressure has been proposed for clinic blood pressure of 120-139/70-89 mmHg (111). There have also been suggestions for addressing hypertension in the context of overall cardiovascular risk rather than as a separate disease (116).

The global burden of hypertension and cardiovascular disease

High systolic blood pressure ≥140 mmHg is the leading modifiable risk factor globally for disability, disease, and premature death (106). It was the second most important of all risk factors in 2021, causing 7.8% of global DALYs and surpassed only by particulate matter air pollution at 8.0% (117). It is also the top attributable risk factor of DALYs due to NCDs (Figure 3) (118). High systolic blood pressure was estimated to cause 10.9 million deaths in 2021 (119).

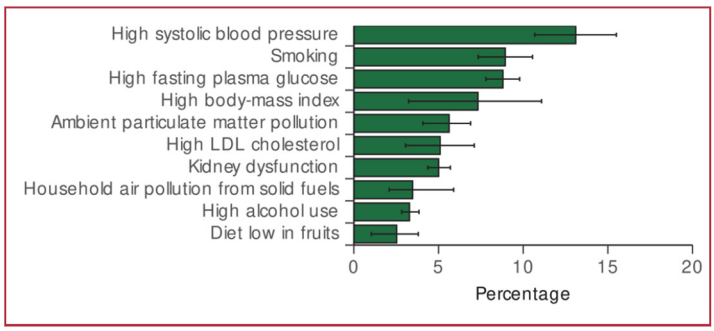

Figure 3 Percentage of disability-adjusted life years due to non-communicable diseases attributable to top risk factors in 2021

Figure from the Global Burden of Disease study fact sheet (118). Provided under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0 (https://creativecommons.org/licenses/by-nc-nd/4.0/). No changes have been made to the original figure.

As analyzed by the Global Burden of Disease (GBD) study, disability and death due to high systolic blood pressure occurs almost exclusively through CVD, but also through chronic kidney disease (106, 107, 119). High systolic blood pressure

contributes approximately half of all DALYs attributable to CVD and is thus the number one risk factor for CVD (Figure 4) (109, 120).

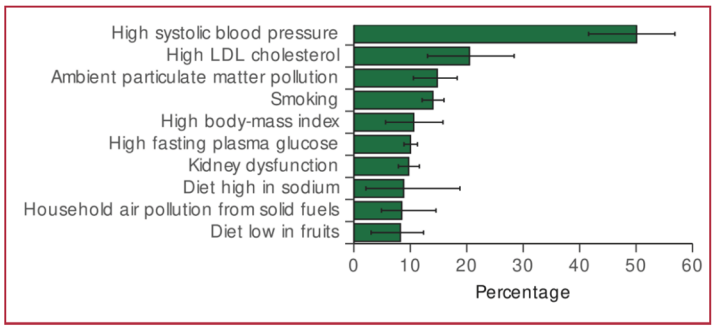

Figure 4 Percentage of disability-adjusted life years due to cardiovascular disease attributable to top risk factors in 2021

Figure from the Global Burden of Disease study fact sheet (109). Provided under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0 (https://creativecommons.org/licenses/by-nc-nd/4.0/). No changes have been made to the original figure.

When studying the GBD risk factor hierarchy, one needs to keep in mind that it does not define risk factors primarily from a pathophysiological viewpoint but from a global health and data-driven viewpoint (106, 117). The purpose is to find modifiable and important drivers of disease (106, 117, 121). As high systolic blood pressure is analyzed as a risk factor and not a disease, the GBD study does not report risk factors for hypertension. Mediation pathways are to some extent accounted for in the analysis, but not in the presentation of the data (117). Hence, even if diet is a risk factor for hypertension, due to the GBD risk factor hierarchy it is visualized as a separate risk factor for CVD at the same level as hypertension.

An additional aspect is that the GBD combines data from studies with varying methodologies and may have an underrepresentation of data from low- and middle income countries (120). However, a multinational prospective cohort study examining modifiable risk factors for CVD found similar associations as the GBD study, with some differences in magnitude (120). More than 70% of CVD morbidity and mortality could be attributed to modifiable risk factors, with metabolic risk factors at 41% of the population attributable fraction and hypertension being the most important at 22% (120). The hierarchy of subsequent attributable risk factors was similar to that of the GBD study, underlining the importance of modifiable risk factors, especially blood pressure, tobacco use, and diet, when it comes to CVD prevention (109, 120).

From 1990 to 2019, in the age group 30-79 years, the number of individuals worldwide with hypertension doubled from approximately 650 million to almost 1.3

billion (122). However, the age-standardized prevalence did not change significantly. In 1990, the figure was 32% for both sexes, and in 2019 it was 32% in women and 34% in men. Within these numbers, there was a decrease in the age-standardized prevalence of hypertension in high-income countries and an increase in low-income countries. Treatment and control rates improved significantly in high-income countries, and in some middle-income countries, during the period. In Canada, Iceland, and South Korea, more than 70% of those with hypertension were treated, and more than 50% were controlled. In Sweden, in 2019, the age-standardized prevalence was 25% for women and 36% for men. For both sexes, approximately 54% were detected, 40% were treated, and 20% were controlled. Those rates were rather close to the global average, indicating that Sweden as a high-income country with universal health coverage has significant room for improvement (122).

There is ample evidence that pharmacological treatment of hypertension is cost-effective and safe (107). Drugs in standard dose on average lower systolic blood pressure with 9.1 mmHg and diastolic blood pressure with 5.5 mmHg (123). Such decreases have been shown to result in significant relative risk reductions of cardiovascular events, including 40% in heart failure, 35% in stroke, and 20% in cardiovascular mortality (107, 124).

Hypertension, lifestyle, and cardiovascular disease

For the purpose of this thesis, now that hypertension has been put into context, the question of interest centers around the role of lifestyle habits in hypertension and CVD.

In their respective guidelines on high blood pressure, the American College of Cardiology, the American Heart Association, and the European Society of Cardiology summarize and evaluate the available scientific evidence (111, 125). Furthermore, the Lancet Commission on Hypertension has summarized the evidence and contextualized hypertension with global health aspects and resources (113). Those are the main sources that I have used for the summary of the connection between hypertension, lifestyle habits, and CVD. These guidelines are also consistent with other international guidelines of good rigor with regard to the non-pharmacological management of hypertension (126).

It has been shown in epidemiological studies and randomized controlled trials (RCTs) that lifestyle habits affect blood pressure. The most important habits are diet including salt intake (sodium chloride), physical activity, and alcohol use (111, 113, 125). A dietary approach has been indicated to be most effective, followed by exercise (127). The approximate effects of the best-proven lifestyle or non-pharmacological efforts to lower blood pressure are summarized in Table 1 (111, 113, 125).

Table 1 Non-pharmacological intervention effects on blood pressure
A summary of effects shown in meta-analyses of randomized controlled trials or large randomized controlled trials. Table inspired by (125) and (111). Abbreviations: DASH, Dietary Approaches to Stop Hypertension; SBP, systolic blood pressure; BMI, body mass index.

Factor	Intervention	Approximate effect on SBP		References
		Normotensive	Hypertensive	
Diet	DASH: Diet rich in fruit, vegetables, whole grains, and low-fat dairy foods, with reduced saturated and total fat.	-3 mmHg	-11 mmHg	(128-130)
Sodium intake	Reduction, optimally to <2 g/day (2 g sodium = 5 g salt = 1 teaspoon).	-2/3 mmHg	-5/6 mmHg	(131-133)
Aerobic physical activity	150 min/week of aerobic moderate-intensity, or 75 min/week of aerobic vigorous-intensity physical activity.	-2/4 mmHg	-5/8 mmHg	(134-136)
Resistance training	2-3 times/week. Dynamic (6 exercises x 3 sets x 10 repetitions) or isometric (4 x 2 min hand grip).	-2/4 mmHg	-4/5 mmHg	(134, 137, 138)
Alcohol intake	Reduction, optimally to <100 g/week (<2 standard drinks/day).	-3 mmHg	-4 mmHg	(139-142)
Weight	Reduction, optimally to a BMI of 20-25 kg/m^2. Expect about -1 mmHg for every 1-kg weight reduction.	-2/3 mmHg	-5 mmHg	(143)

The Dietary Approaches to Stop Hypertension (DASH) diet has been shown to have an additive effect on blood pressure reduction if combined with other lifestyle changes (physical activity and weight reduction, and reduced sodium intake) (130, 144, 145). Emerging evidence also indicates that combined lifestyle interventions can be effective and that diet and physical activity may be the most important combination to reach maximum blood pressure reductions (127, 146, 147).

The main reason for preventing and treating high blood pressure is to decrease the risk of CVD (107, 111, 113, 116, 125). In other words, death or disability from CVD are in essence the final endpoint of interventions to improve blood pressure. The European Society of Cardiology specifically addresses this in their 2024 guideline on hypertension, requiring pharmacological blood pressure treatments to have RCT evidence of effect not only on blood pressure reductions but also on cardiovascular events to receive the highest class of recommendation (111).

For lifestyle interventions and other low-risk non-pharmacological interventions, however, the European Society of Cardiology reasons differently (111). Here, it is deemed sufficient with RCT evidence on blood pressure lowering together with evidence of lower level of cardiovascular events. The consistent connection between blood pressure reduction and reduction in risk for CVD that has been shown in meta-analyses of blood pressure lowering RCTs is thus accepted as supporting proof (107,

115, 124). This “special status” is motivated in several ways. Firstly, in addition to lowering blood pressure, a healthy lifestyle has a number of other positive health effects. Secondly, the risks of negative side effects of lifestyle interventions are low compared to medications. Thirdly, it is harder to finance RCTs of lifestyle interventions as pharmaceutical companies would have no greater interest in this (111). The American College of Cardiology/American Heart Association guidelines articulate a similar perspective on lifestyle habits, blood pressure, and CVD, saying that it is vital to correct the lifestyle behaviors that cause high blood pressure to reduce the risk for CVD (125). Finally, the Lancet Commission on Hypertension exhibits a corresponding viewpoint by stating that scientific evidence shows that healthy lifestyle behaviors can lower blood pressure and decrease cardiovascular events (113).

Evidence on lifestyle approaches to hypertension and cardiovascular disease

Major considerations regarding lifestyle, hypertension, and CVD have been outlined in the preceding subchapter. Below, I summarize the scientific evidence with regard to the effects of different lifestyle approaches to hypertension and CVD in more detail.

Considering diet, the DASH diet seems to have more RCT evidence of efficiency in lowering blood pressure, while a Mediterranean diet has been shown to result in a lower incidence of CVD in primary and secondary prevention (148, 149). Reduced dietary sodium intake has also been shown to decrease cardiovascular events and death in an RCT of patients with hypertension and/or prior stroke (150). In addition, there is convincing observational evidence on the connection between lower sodium intake and a decreased risk for CVD and all-cause mortality (151).

For physical activity, a systematic review of longitudinal studies concluded that patients with hypertension who regularly engaged in physical activity had a lower cardiovascular and all-cause mortality than those who were sedentary (152). There does not seem to be RCT evidence regarding this relationship. However, there is extensive RCT evidence on the effect of physical activity on blood pressure in healthy and hypertensive individuals (111, 113, 125, 134, 135). Aerobic physical activity is the most studied, but there is also evidence concerning the benefits of resistance training on blood pressure (135, 137, 138). The overall interpretation of the scientific evidence is thus that physical activity is beneficial for decreasing blood pressure and the risk for CVD in primary and secondary prevention (111, 113, 125).

Considering alcohol, it has been established in RCTs that high-dose consumption raises blood pressure in men after 13-24 hours (153). A meta-analysis of cohort studies has further established that alcohol use increases the risk for hypertension in men, starting at a low-dose consumption with a 14% relative risk increase at 10 g/day (141). For women, data are more sparse but have shown no protective effect of alcohol on the risk for hypertension (111, 141, 153).

There is a long-standing discussion regarding the cardioprotective effects of light to moderate alcohol consumption (111, 125, 154). RCT evidence is unlikely for ethical and also for methodological reasons (154). Epidemiological studies and meta-analyses have indicated that, compared to no intake of alcohol, a light to moderate consumption of <100 g of pure alcohol/week or <2 standard drinks/day is associated with a decrease in CVD and cardiovascular death, and in all-cause mortality (125, 155, 156). However, a recent meta-analysis found no protective effect of low to moderate alcohol consumption on all-cause mortality (157). It should also be noted that the total health effects of alcohol suggest that avoiding alcohol is best from a general health perspective (111, 158).

Regarding body weight, a Cochrane review on dietary weight interventions for patients with hypertension reported reductions in body weight and blood pressure, but insufficient evidence on long-term effects (159). However, for adults with obesity (body mass index [BMI] ≥30 kg/m^2), a meta-analysis of RCTs showed a positive effect on all-cause mortality of dietary weight loss interventions, with or without physical activity (160). Positive effects on several cardiovascular risk factors have also been shown for weight reductions starting at 5-10% of initial body weight in a meta-analysis of RCTs including lifestyle and/or drug interventions for weight loss (161). That is, meta-analyses of RCTs indicate that lifestyle interventions for weight loss have a positive effect on cardiovascular risk, but some uncertainty remains regarding the effects of reduced body weight specifically for patients with hypertension.

Regarding tobacco use, smoking causes an immediate increase in blood pressure, and heavy smoking increases daytime blood pressure (162). However, smoking does not appear to affect long-term blood pressure (163). Nonetheless, smoking cessation is likely the most important measure to prevent CVD events and substantially affects all-cause mortality and morbidity (164, 165). Thus, smoking has well-proven negative effects on general and cardiovascular health, but not primarily through affecting long-term blood pressure.

In summary, there is scientific evidence in support of healthy lifestyle habits to prevent and treat hypertension and CVD (111, 113, 125).

The prevalence of unhealthy lifestyle habits

So, we know about the relative importance of healthy lifestyle habits and have done so to some extent for several decades (107, 108). But what does it look like in the population in terms of actual (or reported) lifestyle behavior?

More than a decade ago, the WHO pointed out the increase in unhealthy diets and physical inactivity, resulting in overweight, obesity, high blood glucose and cholesterol, and high blood pressure, as global health risks that had surpassed undernutrition in terms of number of deaths caused (166). In low- and middle-income countries, the burden of disease from these unhealthy lifestyle habits was

equal to that caused by HIV/AIDS and tuberculosis (166). Since then, the increase in unhealthy habits has continued (30, 106, 108, 167).

This trend has also been described in European patients with cardiovascular risk factors. From 1999 to 2013, the prescriptions of cardioprotective medications to coronary patients increased significantly (168). Blood pressure and cholesterol levels were improved if not by a corresponding magnitude, but the prevalence of obesity and diabetes increased (168). At the European primary care level, in 2016-2018, patients at high cardiovascular risk (without known atherosclerotic disease but with blood pressure drugs, lipid-lowering drugs, or diabetes treatment) showed poor risk factor control (169). Slightly less than half of the patients (47%) met the blood pressure target of <140/90 mmHg. Almost half of the patients were obese (BMI ≥30 kg/m^2), and two-thirds had central obesity (waist circumference ≥88 cm for women and ≥102 cm for men). One-third of the patients with obesity reported that they had not received dietary advice. Approximately one-third of the patients were physically active (≥30 minutes on average five times/week), while 39% were not physically active at all nor planned to be. More than half of the patients (55%) reported that they had not been advised to increase their physical activity (169). A similar picture has been found in a recent survey specifically in British general practice (170).

In a Swedish cohort material on women, it has been shown that a low-risk lifestyle (regarding diet, physical activity, alcohol, smoking, and BMI) substantially reduces the risk of ischemic stroke, with relative risks from 0.72 for one controlled risk factor down to 0.38 for full risk factor control compared to none. However, only 1.9% of the cohort (589/31,696) reported a low-risk lifestyle on all five factors (171).

In summary, there is a significant prevalence of unhealthy lifestyle habits from a global health perspective. Prevalence is also significant in Europe with regard to primary as well as secondary cardiovascular prevention. Furthermore, it is evident that prevention is challenging, including at the general practice level.

Regarding prevention of disease through lifestyle interventions

It is generally agreed that healthy lifestyle habits are an important part of the prevention and treatment of lifestyle-related diseases (108). However, there is a professional and scientific discussion regarding in what way lifestyle interventions are best carried out (172-174). Therefore, I will briefly describe the different levels of prevention, and some evidence and viewpoints on this theme.

Primordial prevention aims to avoid the development of risk factors for disease, e.g., to prevent development of hypertension and subsequent CVD through interventions regarding diet (113, 175). Primary prevention refers to treating risk factors. This includes interventions regarding an unhealthy diet as well as high blood pressure, as these are risk factors for CVD (113, 175). Secondary prevention refers to risk

factor optimization after disease has become evident, such as after a heart attack or a stroke, aiming to avoid further damage, disability, and death (113).

Preventive efforts can be undertaken at the population level and/or at the individual level (113, 125). At the population level, the goal is generally a small improvement for many people which would result in substantial health benefits by sheer numbers (113). At the individual level, the aim is to reach the part of the population at greatest risk with more intensive interventions, producing more effect per person. An example would be lifestyle interventions for those with a high risk of CVD related to high blood pressure as primary prevention or for coronary patients as secondary prevention. This can also be termed a "targeted approach" (125). Modeling studies indicate that population-based and targeted approaches regarding cardiovascular risk factor control may have similar effects on the occurrence of cardiovascular events (176, 177). For population-based approaches, however, even small side effects need to be carefully considered as these can affect many people (176). For targeted approaches, on the other hand, total resource use needs to be considered (177).

There is scientific evidence that public health interventions can be cost-effective (108, 178). Examples of public health interventions affecting lifestyle habits are tobacco and alcohol taxes, regulations, and information drives. Information campaigns regarding diet and physical activity have also been shown to be effective and are recommended by the WHO (108, 178). The Lancet Commission on Hypertension advocates a focus on population-based strategies when it comes to lifestyle but also notes that some individual-based strategies could be of value (113).

From another perspective, the relatively new field of lifestyle medicine has grown during recent decades (179). Lifestyle medicine emphasizes the importance of efficient lifestyle interventions to prevent and treat chronic diseases. An example is cardiac rehabilitation programs, a structured lifestyle intervention after myocardial infarction and similar events, which has significantly reduced mortality from all causes. Lifestyle medicine also includes lifestyle interventions through clinical counseling and motivational interviewing (179). There is scientific evidence indicating that brief counseling interventions delivered in a health care setting can be effective for smoking cessation, alcohol use, physical activity, and diet (180-184). Some studies also reported cost-effectiveness (180, 184). Considering hypertension, a meta-analysis of RCTs of individual consultations by health care professionals for lifestyle modification showed a reduction of 4.4 mmHg in systolic blood pressure (185). Specifically, nurse-led interventions to manage hypertension have also been found to be effective in terms of lowering blood pressure (mean differences -5/2 mmHg), improving diet, and increasing physical activity (186).

However, the adequacy of recommendations regarding individually oriented lifestyle interventions in clinical practice guidelines has been questioned (172, 174). Critiques concern insufficient scientific evidence for the actual effects of the

recommended interventions as well as the impossibility of providing such interventions to all eligible persons, which for the UK has been calculated to require more physicians and nurses than currently employed by the National Health and Services (172-174, 187).

Regarding strength of evidence, an approach where RCT evidence can be complemented by observational studies on long-term effects has been suggested from the viewpoint of lifestyle medicine and is similar to that put forth in recent guidelines on blood pressure management (111, 188). However, the fact remains that primary care professionals in general and GPs in particular have limited time to provide individual lifestyle advice to patients. Furthermore, guidelines serve to provide information on which habits are healthy – but not as much on how to specifically attain them in clinical practice.

Consequently, more efficient and applicable lifestyle interventions are needed. There is no obvious reason that targeted individual approaches and population-based efforts should be mutually exclusive. Rather, the most efficient efforts should be selected and distributed. Here, digital health interventions have been repeatedly suggested (30, 111, 113, 125).

Digital health interventions for cardiovascular prevention

A pertinent use of the increased opportunities for digital mass communication is thus to provide lifestyle interventions to patients with cardiovascular risk factors or CVD. The large group of patients with hypertension is an obvious target population, which also contains numerous subpopulations. Several studies have investigated such uses of digital health technologies.

Briefly widening the scope to different types of digital health for patients with hypertension, home blood pressure monitoring has been used with some success for over a decade (189). Decreases in systolic/diastolic blood pressure of -5/2 mmHg have been shown, if initially more costly compared to usual care (189). Turning to mobile health (mHealth), it has been shown that text messages can significantly improve medication intake in chronic disease, approximately doubling the odds of adherence (190).

Considering digital health for lifestyle counseling in hypertension, a 2013 meta-analysis showed that the reduction of systolic blood pressure (mean of -3.8 mmHg) was similar to face-to-face lifestyle advice (191). Furthermore, it was indicated that interventions with a duration of at least six months, those employing at least five behavioral change techniques, and those that were proactive (sending out messages instead of waiting for patients to log on) were more effective (191).

A somewhat later review of mHealth for the prevention of CVD through risk factor modification reported that existing evidence indicated that mHealth was effective, but that there was a need to discern which type of mHealth was more effective (57).

In addition, it was suggested to study to what extent personalization and interactivity was needed (57). A meta-analysis of text messages for CVD prevention, compiling studies that could affect at least two risk factors, found that there was a weighted mean difference in systolic blood pressure of -4 mmHg, and in diastolic blood pressure of -1 mmHg (192). A systematic review specifically regarding the effects of text messages on blood pressure in patients with hypertension reported that systolic blood pressure was reduced, and that the odds of uncontrolled blood pressure were halved in six months (193).

Finally, a relatively recent meta-analysis compared different modalities of digital health interventions for self-management, including lifestyle change, in patients with hypertension (98). There was an improvement in blood pressure levels with overall reductions of -4/2 mmHg, but no significant difference between delivery by text message, application, or website. The effect was larger for those with higher blood pressure. The review put forth a need to detail further the mediators and moderators of the effect of the interventions (98).

All reviews and meta-analyses concluded that digital health could be of use but that there was substantial heterogeneity between studies, that methodological quality and risk of bias varied, and that more research was needed (57, 98, 189-193).

In summary, digital health interventions seem to have the potential to facilitate a change in lifestyle habits and to improve clinical outcomes in patients with hypertension and CVD. Small but statistically and clinically significant effects have emerged regardless of the mode of delivery.

TEXT ME and PUSHME

From a primary health care perspective, text messaging has the advantage of being simple, cheap, and accessible at almost all levels of society. Thus, text messaging could be an efficient and scalable way to improve lifestyle habits in the growing group of patients with NCDs, including those with hypertension and CVD.

A relatively early RCT of text messages for cardiovascular prevention was the Tobacco, Exercise and Diet Messages (TEXT ME) trial. The trial was carried out involving patients with verified coronary heart disease in a tertiary hospital in Australia (194). In addition to usual care, the intervention group were sent four text messages per week for six months. The messages aimed to provide advice, motivation, and support for lifestyle change. After six months, the intervention group had increased their physical activity and decreased smoking. The text message recipients also exhibited significantly lower levels of low-density lipoprotein cholesterol, systolic blood pressure, and BMI compared to the control group (194).

To investigate if a similar intervention could be beneficial for Swedish primary care patients with hypertension, i.e., in a mainly primary preventive context in a different

country, the Primary care Usage of Health Promoting Messages (PUSHME) trial was initiated in 2018 (195). The pilot trial showed the feasibility of the study protocol and also indicated positive trends regarding blood pressure, BMI, glycated hemoglobin, and cholesterol levels (195). Papers 3 and 4 of this thesis are part of the PUSHME project.

Theories of health behavior

A brief overview of behavioral theories used in health care

Behavioral theories have been developed in the social and behavioral sciences and are also used in the health and medical sciences to understand health behaviors and to design and evaluate behavioral change interventions (196, 197). As lifestyle-related diseases are an important and increasing contributor to global disability and death, this interdisciplinary approach appears logical and much needed (117, 196).

Evidence indicates that public health and individual health-promoting interventions that are based on behavioral theory are more effective than those that are not (196). However, it has not been possible to provide decisive evidence on the issue due to methodological problems primarily in terms of possible confounding, difficulties in reliably quantifying the use of theory, and mixing up of models and theories (198). At any rate, a large number of behavioral theories have been used with the aim of providing more effective interventions regarding health behaviors, but a smaller number have been frequently used. The latter include the health belief model, the transtheoretical model, social cognitive theory, the social ecological model, and the theory of planned behavior (TPB) (196). I will briefly describe these theories, with some more detail regarding the TPB as that theory has been used in several of the papers included in this thesis.

It should be noted that there seems to be no one theory that is predominant (196). Also, theories can center around similar ideas and pathways using different terminology. Some theories and models focus on explaining behavior and some on changing it, but there is not a clearcut line between the two types of theory as understanding and change are interrelated (196).

Developed in the 1950s, the *health belief model* is one of the first and still most used theories of health behavior (196). The health belief model primarily aimed to understand participation in specific public screening programs but has since been extended to include other preventive programs (e.g., vaccination), and lifestyle behaviors. The model poses that what affects whether a person takes action to prevent a disease is their perceptions regarding susceptibility and severity, the perceived benefits and barriers of taking action, and cues to action (196). The concept of self-efficacy has also been added to the model (199). Self-efficacy is a person's perceptions regarding their ability to change (e.g., adopt a new habit) and

to persist with the change (200). It has been found to be particularly important in health behaviors (200).

The *transtheoretical model* of behavior change centers around readiness for change (196). A key concept is stages of change. To change a behavior, a person moves through different stages: precontemplation, contemplation (e.g., thinking about a new habit), preparation, action (adoption of a new habit), and maintenance (keeping the habit) (196).

Social cognitive theory poses that there is continuous interaction between personal factors, environmental influences, and behavior (196, 200). Key concepts include observational learning, self-control, reinforcement, and self-efficacy (196). *Social ecological models* contain elements of social cognitive theory. These models focus on the importance of the environment, and the individual's interplay with the environment (196).

In public health and health promotion, focus on the individual or ecological perspective has varied over decades (196). Up until the 1970s, the importance of social determinants of health and a community view on prevention were prevalent. The following two decades saw more of an individual emphasis, focusing on each person's ideas and ability to change. Thereafter, the pendulum has been turning back towards proposing an ecological perspective as a more effective way to attain behavioral change in matters of public health, but programs to reduce risk factors often retain an individual focus (196).

The theory of planned behavior and the reasoned action approach

In three out of the four papers of this thesis, I have used the *theory of planned behavior* (TPB) and the *reasoned action approach to predicting and changing behavior*. As we have seen under the preceding subheading, there are several models to understand and predict human behavior. These may not primarily have essential differences but rather more superficial variations. The TPB thus contains elements of the other theories. It has been suggested by its creators, Ajzen and Fishbein, to be a comprehensive model to understand and predict human social behaviors, and also to design interventions to change behavior (77).

The foundations of the theory were laid in the 1960s-1970s, based on prior theory which proposed that intention was the antecedent of behavior (77). Intention, in turn, was a function of beliefs about what the behavior would lead to and about the expectations placed on the individual to perform the behavior (77). An early version was named the theory of reasoned action. This was followed by the TPB in the early 1990s (76). The TPB has since been extensively tested, adjusted, and found useful in many different contexts including health behaviors (77, 197, 201, 202). Measures of the predictors of behavior are generally elicited through questionnaires with Likert items that are adapted to the specific behavior being studied, and analyzed through regression analysis (75, 76).

The TPB is illustrated in Figure 5 (203). In short, for behavior that an individual has the possibility to affect, the intention to perform the behavior is the most important direct predictor (77). Intention, in turn, is to a large extent formed by three factors: attitude toward the behavior, subjective norms, and perceived behavioral control. Whether an individual takes a positive or a negative stance on these factors depends on behavioral beliefs (what one thinks will be the consequences of the behavior), normative beliefs (perceptions of what others think and do), and control beliefs (how one assesses barriers and facilitators to the behavior, similar to self-efficacy). Finally, these beliefs are grounded in individual background factors such as age and knowledge but also social background factors including interventions (77, 203). Thus, according to the TPB, an individual's behavior is most affected by an intervention targeting the beliefs underlying the predictor that has the greatest influence on intention. For example, if attitude toward the behavior is of most importance for exercise, an intervention should focus on positive feelings and health consequences after exercise.

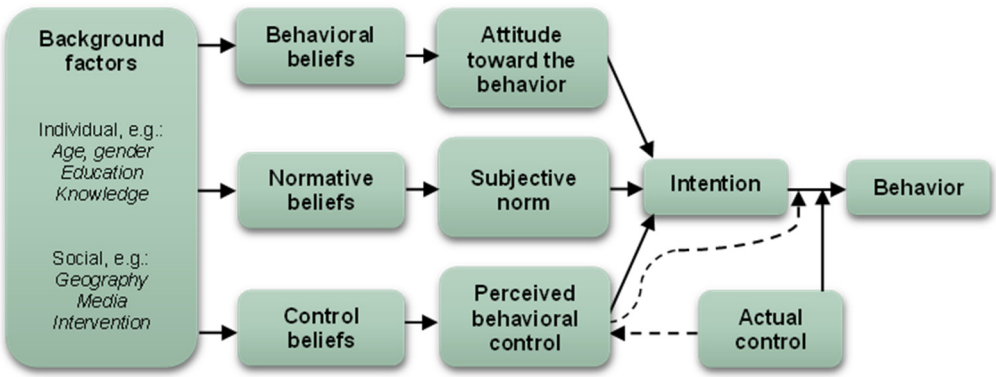

Figure 5 The theory of planned behavior with background factors
Schematic presentation adapted from Ajzen and Fishbein (76, 77, 203).

In their 2010 book *Predicting and changing behavior: The reasoned action approach*, Fishbein and Ajzen further discussed and elaborated on the theory (77). A comparably novel development was the dual aspects of the behavioral predictors (77). Several studies have found that each predictor can be divided into two components. Attitude toward the behavior may be divided into experiential attitude (if the behavior will bring a positive or negative experience) and instrumental attitude (if the behavior will bring positive or negative effects). Subjective norm can be divided into injunctive norm (what others think) and descriptive norm (what others do). Finally, perceived behavioral control may be divided into capacity (one's perceived ability to perform a behavior) and autonomy (perception that the decision is up to oneself) (77).

The full framework and all its developments are referred to by Fishbein and Ajzen as “a reasoned action approach” (77). However, “the reasoned action approach” is also a term that is used in the scientific literature to refer to the TPB with its latest refinements based on the 2010 book. It is in the latter significance that I use the term “the reasoned action approach” in Paper 3. However, in keeping with the terminology of the creators of the theory as far as possible, in this thesis summary I will use the term “the theory of planned behavior” and the corresponding acronym “TPB” to refer to the theory including its latest refinements.

Contrasting the TPB with other theoretical models as described under the preceding subheading, one may note that the TPB contains elements of the social ecological model in the form of environmental factors, social cognitive theory in terms of self-efficacy, and the health belief model with similarities in the predictors of behavior. There will be no one theory to address all questions of health behaviors and promotion. However, the TPB appears to be a good and well-founded option if one is searching for a model to encompass several different behaviors – and levels to affect behaviors (77, 196, 202).

Behavioral theories and digital health

Behavioral theories have also been applied with regard to digital health technologies. Some theories specifically concern the use of technology with the best known arguably being the technology acceptance model, and the unified theory of acceptance and use of technology (UTAUT) (204, 205). The UTAUT united eight different models, which had been used in technology acceptance research into one model, thus explaining 70% of the variance in intention to use new technology (compared to 17% to 53% for the original models). The original models included the theory of reasoned action, the TPB, social cognitive theory, and the technology acceptance model (204).

The TPB has thus been used to study the adoption of digital health technologies (204, 205). Still, it has been more frequently applied in the design of digital health interventions regarding lifestyle and chronic disease (205). According to a comprehensive review of digital health interventions to prevent and treat CVD, the most used behavioral theories were social cognitive theory, the transtheoretical model, and the TPB (197). However, only half of the included studies reported that they had used a behavior change theory or model. This was suggested as a possible reason for the large variability in intervention effects (197).

Rationale

As described in the preceding Introduction, the last decades have seen a global increase in unhealthy habits and lifestyle-related diseases (30, 106, 108, 166-169, 171). There also appears to be an increased focus on lifestyle recommendations (108, 172, 174, 179). However, there are not enough health care professionals to provide individual advice to all eligible patients (173, 187). Thus, health care in general needs more efficient ways to provide care for a growing patient population. Furthermore, there is a need to prevent disease in the first place through efficient actions directed at unhealthy lifestyle habits (108).

During the same period as the rise in NCDs, there has been a rapid development of new digital tools including digital health technologies. The use of digital health was further sped up by the COVID-19 pandemic, which put a sudden requirement on health care to minimize face-to-face contacts (68). The new digital technologies have also been suggested as one method for more efficiently addressing unhealthy lifestyle habits (30, 113, 125). Thus, a great deal of hope is put into digital technologies and use is rapidly increasing (16, 19, 49, 50). This requires a scientific effort to improve the development and use of digital health and to increase actual health benefits (51).

Digital health technologies are used in many different contexts and need to be studied in these contexts to improve use and development. From a southern Swedish general practice perspective, there were several research gaps with regard to the use of digital health technologies in clinical practice when this thesis was initiated.

Already before the pandemic, from my personal Swedish GP perspective and from professional discussions with colleagues, it seemed as if digital health technologies were not used to their full potential in Swedish health care in general nor in primary care. However, there was little existing scientific literature regarding GPs' overall experience of the use of digital health technologies. A prior study had reported that southern Swedish primary care physicians expressed a high intention to use digital health technologies, but low actual use (74). This could thus be further explored to inform the future use of digital health technologies in primary care from a professional perspective.

An area of professional and some public debate in Sweden (and internationally) has been the use of virtual patient visits, primarily with regard to health equity and resource use (10, 11, 82). Most of these visits had been provided by digital-only, privately owned health care providers who were publicly reimbursed (10). As the public health care provider Region Skåne, where I am situated, was introducing text-based virtual visits (eVisits), and other regions were about to do so, it was a timely area of digital health technologies to evaluate (85, 96). Internationally, some research was available but according to systematic reviews, more research was

needed (17, 55, 56). One suggested research question was to further analyze which conditions are suitable for virtual visits (56).

This still leaves the area of NCDs and digital health technologies out. In contrast to the two research areas just outlined, the prevention and treatment of lifestyle-related disease with digital health technologies has a positive aura and is thus a pertinent contrast for providing a fuller picture of the field of digital health from a southern Swedish general practice perspective.

In the RCT PUSHME, Swedish primary care patients with hypertension received health-promoting text messages with the aim to improve blood pressure and other cardiovascular risk factors (195). Such interventions had been studied with some success in other contexts, but not specifically in Swedish primary care (98, 192-194). In addition, patient experience had been comparably little studied, especially from a behavioral theoretical perspective. Finally, prior studies had requested continued research into mediators and moderators of effect (98).

The overall rationale of this thesis was thus to address some of the identified research gaps and thereby contribute to patient benefit and population health in the context of digital health in southern Swedish general practice.

Aims

Overall aim

To explore and evaluate the use of digital tools in the clinical context of primary care in southern Sweden.

Specific aims

1. To examine southern Swedish primary care physicians' experiences of digitalization in health care as of 2019, with a focus on possible explanations for a previously reported gap between high intention to use digital tools and low reported use.
2. To describe patient characteristics, diagnoses, and subsequent health care contact in a cohort of patients who completed an eVisit to a nurse or a physician in primary care in southern Sweden during 2021, and to analyze whether the need for subsequent health care contacts varied depending on diagnosis for the eVisit.
3. To explore participant experience of a text message lifestyle intervention for patients with hypertension, and implications for future lifestyle interventions.
4. To investigate whether health-promoting text messages sent to patients with hypertension in primary care could affect lifestyle habits, and if the theory of planned behavior could be used to identify moderators of intervention effects.

Summary of thesis

Table 2 Summary of thesis

Paper	Aim	Method	N	Results	Conclusions
1	To examine primary care physicians' experience of digital health.	Qualitative content analysis inspired by Graneheim and Lundman.	100	●Attitudes focused on clinical usefulness. ●Barriers to use were loss of patient contact and deficient technology. ●Concerns focused on risk for patient harm and an increased workload.	●Digital health technologies must be evaluated. ●Increased end user involvement is needed.
2	To analyze patient characteristics, diagnoses, and subsequent health care contacts after eVisits to primary care.	Register-based cohort study.	10 084	●Skin diagnoses were most common (47%). ●Most patients (74%) did not require a subsequent face-to-face visit within 14 days. ●Patients with infections and unspecified diagnoses were more likely to have a subsequent face-to-face visit than a group with varied diagnoses.	●eVisits to primary care may be appropriate for uncomplicated conditions. ●Effects on health care resource use and health equity warrant further study.
3	To explore participant experience of a text-message lifestyle intervention for primary care patients with hypertension.	Systematic text condensation as described by Malterud.	14	●There was a need for more knowledge about lifestyle, hypertension, and cardiovascular disease. ●The text messages were perceived as useful reminders. ●Participants requested increased individualization. ●Some participants reported lifestyle changes while others did not.	●The intervention was well-tolerated. ●Timing, tailoring, and specific suggestions could facilitate lifestyle change from health-promoting text messages.
4	To investigate the behavioral effects of health-promoting text messages to primary care patients with hypertension.	●Randomized controlled trial. ●Questionnaire inspired by the theory of planned behavior.	401	●The text message group reported a statistically significant decrease in the proportion of participants with alcohol use >4 standard drinks/week, and in the proportion that were physically inactive. ●The theory of planned behavior could not be used to explain or predict the effects.	●Health-promoting text messages may be efficient to improve lifestyle habits in patients with hypertension but require further study.

Methods

Overview

Summary of study designs

This thesis uses different study designs to analyze specific aspects of digital health in general practice (Table 2). Paper 1 was a qualitative analysis of questionnaire responses. Paper 2 was a register-based cohort study. Paper 3 was an interview study. Paper 4 analyzed data from an RCT but also included a questionnaire based on behavioral theory.

Setting

All studies were carried out in primary care in southern Sweden, primarily using data from Region Skåne but also from the adjacent Regions Kronoberg and Västra Götaland. Region Skåne is situated in the southernmost part of Sweden, and home to 1.4 million inhabitants distributed between cities and rural areas (206).

Sweden has a tax-funded health care system, where 21 self-governing administrative regions and 290 municipalities are responsible for delivering health care to their inhabitants (207). Swedish health care legislation states that health care should be provided respecting equal rights and dignity, and to all inhabitants according to need. Cost efficiency should also be considered in the organization of publicly financed health care (208). Health care services can be provided directly by the regions and municipalities, and in some cases also carried out via private providers who are then reimbursed (208). This is the case for services provided by primary health care centers, i.e., general practice.

Specific methods

Paper 1: Primary care physicians' experience of digital health

Design, participants, and data collection

This was a qualitative study. In 2019, all primary care physicians in Region Skåne and Region Kronoberg were invited via e-mail to complete a digital questionnaire regarding their experiences and attitudes concerning digital health. The questionnaire contained Likert items, i.e., statements with which the participants rated their agreement or disagreement on a 7-point scale, inspired by the TPB (74). The quantitative part of the questionnaire was analyzed before this thesis project commenced (74). After each section with Likert items there were connected requests for free-text comments, which were analyzed as a part of this thesis. The areas of digital health that were covered in the questionnaire included virtual patient contacts, chronic disease monitoring, and AI.

Approximately 820 primary care physicians at 160 primary health care centers were invited, and 198 questionnaires were returned with 100 containing one or more free-text comments.

Data analysis

The free-text comments were analyzed using qualitative content analysis inspired by Graneheim and Lundman (209). The approach was inductive, labelling meaning units (short free-text comments, or parts of comments) with codes and sorting these into subcategories which were then combined into categories. Through researcher triangulation, we combined the categories into themes. This last step of analysis also involved a deductive approach, where the material was systematized focusing on the discrepancy between high intention to use digital health technologies and low reported use that had been observed in the prior quantitative analysis (74, 76). The manuscript was written following the Standards for Reporting Qualitative Research (SRQR) (210).

Paper 2: eVisits to primary care and subsequent health care contacts

Design and participants

This was a register-based cohort study. We studied demographics, diagnoses, and subsequent health care contacts of patients at Region Skåne's all-virtual primary care unit during 2021. All individuals who had conducted an eVisit (a text-based virtual visit) with Primary Health Care Skåne Online (PHC Online) from February 19 to December 31 were included, except for one individual who declined to participate. Individuals who had conducted a face-to-face or virtual visit with a

physician for the same type of diagnosis within 14 days before the eVisit were excluded. The study was carried out and the manuscript was prepared following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (211).

Primary Health Care Skåne Online

PHC Online was introduced in 2020 as Region Skåne's first service for eVisits to primary care. It was an all-virtual unit staffed by nurses and GPs. The service was primarily directed at patients listed at a primary health care center run by Region Skåne, but it was open to all inhabitants. Presenting complaints were restricted to skin conditions, airways and infections, allergies, common childhood problems, stomach and intestines, urogenital problems, and prescription renewal. The patients first filled out a digital anamnesis. eVisits were usually initiated by a nurse who could ask if the patient would like to continue the visit with a GP if needed. Opening hours were weekdays 8am-5pm and weekends 10am-3pm.

Data sources and variables

We acquired pseudonymized data on eVisits, and health care contacts within two weeks before and after the eVisit, from Region Skåne's Health Care Databases. Only index eVisits, i.e., the first visit to PHC Online during the study period, were analyzed. Variables included sex, age, the patient's primary health care center, and data on each health care contact: type of contact, unit, health care professional, and the International Classification of Diseases 10th Revision (ICD-10) diagnoses. We also acquired the care need index of the patient's primary health care center as a clinic-level measure of socioeconomic index (212).

To answer the research question of whether care-seeking after the eVisit differed between conditions, diagnostic groups were defined according to the presenting complaints for which patients could seek PHC Online. The eVisits and follow-up contacts were then sorted by diagnostic group. For the presentation of descriptive statistics and for statistical analysis, diagnostic groups including <5% of the study population were congregated into one group that was named "all other diagnoses". This resulted in the data being presented and analyzed according to the following diagnostic groups: skin, respiratory tract, urinary tract, unspecified (when the diagnosis did not specify type of condition, e.g., medical advice), and "all other diagnoses".

Outcomes

To describe and analyze health care use after an eVisit, the different types of subsequent health care contacts were grouped into outcome variables. The outcome variables specified type of contact (face-to-face visit, virtual visit, telephone contact, or other remote contact), health care professional (nurse or physician), and health care level (primary care, emergency care, inpatient care, or specialist outpatient

care). Subsequent face-to-face visits to a physician were also grouped regarding if the contact concerned the same diagnostic group as the eVisit. For the other types of subsequent contacts, this was not possible due to missing data on diagnosis. An example of an outcome variable is thus a "face-to-face visit with a physician in primary care for the same diagnostic group as the eVisit". Each outcome variable was coded "yes" if there were one or more contacts of the specified type.

Sample size

The sample size was estimated to find a five percentage point difference in subsequent health care contact rates between major diagnostic groups for the eVisit with an α level of 0.05 and 80% power. Calculations based on preliminary data from PHC Online suggested a study size of 4500 patients who had conducted an eVisit with a GP or a nurse, respectively.

Statistics

Differences in patient characteristics per diagnostic group, and between those who had a subsequent health care contact or not, were analyzed using Pearson's chi-square test for categorical variables and one-way analysis of variance or Kruskal-Wallis test for continuous variables depending on distribution. We used the Bonferroni correction for post-hoc tests regarding which diagnostic groups differed in subsequent health care contact frequency.

To account for differences in age, sex, and care need index between the diagnostic groups, we also analyzed subsequent health care contact frequency (outcome) depending on the diagnostic group for the eVisit (predictor) using multiple logistic regression. We set the diagnostic group "all other diagnoses", which contained a varied spectrum of diagnoses, as the reference group. Analyses were conducted for all eVisits, and for eVisits with a nurse and a GP respectively. As a subsequent analysis, the largest diagnostic groups – skin diagnoses and respiratory tract diagnoses – were divided into subgroups as they contained some different subsets of diagnoses.

The PUSHME trial

Papers 3 and 4 are part of the PUSHME project. Material and methods relevant to both papers are described below, and information pertaining to the separate papers will be detailed subsequently.

Design and participants

PUSHME was a multi-center RCT investigating the effects of health-promoting text messages sent to primary care patients with hypertension (195, 213). Patients aged 40-85 years with a diagnosis of hypertension (ICD-10 code I10.9) were randomly

selected from the patient register at 10 primary health care centers in southern Sweden and invited to participate. Exclusion criteria were blood pressure >180/110 mmHg, systolic blood pressure <120 mmHg, life expectancy <1 year due to serious illness, or expected inability to follow the study protocol (e.g., cognitive impairment or language difficulties). The primary outcome measure of the PUSHME trial was blood pressure change. Secondary outcome measures were changes in other cardiovascular risk factors including lifestyle habits. The trial took place from 2020 to 2023.

Randomization and blinding

After a baseline visit with a study nurse, participants were allocated 1:1 to intervention or control (treatment as usual) by a researcher not connected to the study site, using a computer-generated predefined block sequence for each study site. The patient was informed via postal mail. The patient's GP and the study nurse were blinded to the allocation.

Intervention

The intervention group were sent four health-promoting text messages per week for six months. The messages had been designed by the researchers using national guidelines, regional expert support, and participant input from the pilot trial. Messages belonged to one of four groups: general information on cardiovascular health (including alcohol), diet, physical activity, or smoking. Participants received at least one randomly selected message from each group per week. The text messages began with "Hi [name]…", and only smokers were sent messages regarding smoking, but the intervention was not personalized in any other way.

Paper 3: Patient experience of health-promoting text messages

Design and participants

This was a qualitative interview study. As part of the six-month follow-up visit of the PUSHME trial, participants who had been allocated to the intervention group were asked if they would be willing to participate in a telephone interview regarding their experience of the intervention. Interview study participants were then purposefully selected from those who had provided a positive answer. A total of 14 participants were included before saturation was deemed to have been reached.

Data collection

Interviews were conducted via telephone, using a semi-structured interview guide. The interview guide was evaluated and refined after the first two interviews. Interviews were recorded and transcribed verbatim.

Data analysis

Analysis was performed using the method of systematic text condensation as described by Malterud (214, 215). We used the TPB as further specified in the reasoned action approach as a theoretical framework (76, 77). However, as systematic text condensation is primarily an inductive analysis style that was chosen to allow for the participants' views to be comprehensively explored without initial limitations being put by theory, the theoretical framework was only used in the final stages of analysis.

After finding preliminary themes through repeated reading of the first four interviews, meaning units were extracted from the material and sorted into code groups according to the preliminary themes (214, 215). The code groups were further refined into subgroups. For each subgroup, the meaning units were united into condensates (i.e., constructed quotes). The condensates were then used as the basis for an analytical text. At this stage, the results were reconnected to the research question and the theoretical framework. The same stepwise sequence of analysis was then carried out on three additional interviews, adding new material and reorganizing prior material. This stepwise sequence was then repeated until saturation was deemed to have been reached after a total of four rounds of analysis and 14 interviews. The final analytical text was reconnected to the source material by re-reading the interview transcripts. Researcher triangulation was performed repeatedly (214, 215). The manuscript was prepared according to the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist (216).

Paper 4: Behavioral effects of health-promoting text messages

Design

Paper 4 was part of the RCT PUSHME (195, 213). The paper covered the behavioral effects of health-promoting text messages by analyzing lifestyle outcomes and a questionnaire inspired by the TPB. The manuscript was prepared according to the Consolidated Standard of Reporting Trials (CONSORT) guidelines (217).

Lifestyle outcomes

Data were collected by a study nurse at the baseline visit and the six-month follow-up visit. Lifestyle habits regarding tobacco use, alcohol use, and physical activity were self-reported by the participants using a questionnaire. Alcohol use was reported in the number of standard drinks per week (<1, 1-4, 5-9, 10-14, 15-19, >19). For physical activity, we used two validated questions from the National Board of Health and Welfare which covered moderate-intensity physical activity (such as walking) and vigorous-intensity physical activity (such as running) (218, 219). For analysis, smoking was coded "yes" or "no". Alcohol use was divided into low consumption (≤4 standard units per week) or moderate to high consumption (>4

standard units per week) (142). For physical activity, the formula (moderate-intensity + 2*vigorous-intensity activity) was used to calculate activity minutes per week. Participants were classified as physically inactive (<150 activity minutes per week) or physically active (≥150 activity minutes per week) according to WHO guidelines (167, 218, 219). A lifestyle index was created based on the dichotomized lifestyle habits (smoker or not, alcohol use with cut-off >4 standard units per week, and physical activity with cut-off <150 minutes per week).

The theory of planned behavior

At the baseline visit, participants completed a pragmatic questionnaire inspired by the TPB (Figure 5) (76). The questionnaire was constructed based on a manual, through selection and adaptation of a small number of statements to cover important elements of the theory without making the total number of questions to be answered by the participants unmanageable (220). Participants rated their agreement or disagreement with the statements on a 7-point Likert scale. The primary purpose of the questionnaire was to find predictors to help select patients who would be more likely to have an effect of the intervention. A secondary purpose was to describe and better understand the intervention from a behavioral perspective.

Statistics

Analysis was performed according to the intention-to-treat principle. As a sensitivity analysis, we also performed a complete case analysis. Lifestyle outcome variables were analyzed by comparing the intervention and control groups at follow-up with adjustment for baseline. Dichotomous outcome variables (smoker or not, alcohol use 0-4 or >4 standard units per week, physical activity <150 or ≥150 minutes per week, and lifestyle index of 0 or ≥1 unhealthy habits) were analyzed using binary logistic regression with intervention status and baseline habit as covariates. For analysis of the full range of alcohol use, and for the full lifestyle index, we used ordinal logistic regression. Physical activity minutes per week at follow-up were analyzed using one-way analysis of covariance with baseline physical activity as covariate and intervention status as fixed effect.

Participant baseline ratings on the TPB questionnaire were analyzed using multiple linear regression (221, 222). To analyze the relative weight of the different predictors on behavioral intention for lifestyle change, ratings on the predictors were entered as independent variables, and behavioral intention as the dependent variable. Analyses were adjusted for age and sex.

To analyze whether the TPB could be used to predict lifestyle change in the total cohort, ratings on perceived behavioral control and behavioral intention were entered as covariates in the binary logistic regression analyses of lifestyle habits (76, 77). To analyze whether the TPB could be used to predict the effects of health-promoting text messages, the ratings were also added as interaction terms with intervention status in the regression analyses.

Ethical considerations

General ethical considerations

The studies that are included in this thesis did not pose any obvious risks to the participants. Paper 1 requested the views of health care professionals through a digital questionnaire. Paper 2 analyzed register data with due precautions regarding safe data handling.

For Paper 3, telephone interviews of 30-60 minutes were conducted, which required both time and effort from the participants. Furthermore, interviews can bring up thoughts and ideas that the participants then need support handling. The participants were encouraged to contact the person responsible for the study should needs or questions arise, but as the subject of lifestyle and hypertension was not considered to include emotionally sensitive issues no other follow-up was offered.

For Paper 4, patients with hypertension were randomized to receive health-promoting text messages or treatment as usual. Here, too, time and effort were required from the participants when they underwent a baseline and a follow-up visit. In addition, the text messages could stir emotions and could potentially mean a risk to the participants if suggesting activities or ideas that could be harmful. This was considered in the development of the text messages, and no harm was reported. Finally, if extreme measures were found at the baseline or follow-up visit, the patient's physician was informed.

Thus, a major ethical consideration is to make the time and effort of the study participants – and participating health care professionals and researchers – worthwhile by analyzing, interpreting and using the material and knowledge gained to the best of our ability.

Specific ethical considerations

All studies in this thesis were approved by the Swedish Ethical Review Authority as required (Paper 2: dnr 2019-06388 and dnr 2023-06551-02, Paper 3: dnr 2019-06361 and dnr 2021-02802, Paper 4: dnr 2019-06361).

Paper 1 (questionnaire to primary care physicians) handled only anonymous data, and no sensitive personal data, and thus did not require ethical vetting according to an advisory statement by the Swedish Ethical Review Authority. Research Electronic Data Capture (REDCap) was used for secure data collection (223, 224). Participant information about the study was included in the digital questionnaire. Informed consent to participate, including publication of anonymized comments, was provided by submission of the questionnaire.

For Paper 2 (register-based study of eVisits), patients received information about the study when they logged in at PHC Online, including how to opt out. Written informed consent to participate was waived by the Swedish Ethical Review Authority (dnr 2019-06388). Permission was granted from Region Skåne's Committee for Quality Registers, Health Care Databases, and Drafting (in Swedish: Samrådsgrupp för kvalitetsregister, vårddatabaser och beredning [KVB]) for acquiring pseudonymized data from Region Skåne's Health Care Databases. A data management plan was developed and stored digitally at Lund University's DMP Roadmap (which was then transferred to DMP Online).

For Papers 3 and 4 (PUSHME interview study and RCT), all research subjects were informed orally and in written form regarding the research project that they were approached to participate in, and that participation was voluntary at all stages. The subjects also signed an informed consent form before enrollment. This was done for PUSHME RCT, and separately for the interview study. PUSHME RCT was registered at clinicatrials.gov (NCT03442257). To ensure adherence to the study protocol, all study sites were monitored by an external expert in Good Clinical Practice. REDCap was used for secure data collection (223, 224).

For Papers 2-4, personal and sensitive data were stored and handled in Lund University's high-security database for sensitive research data (LUSEC). Data were pseudonymized before analysis, and the code key was stored safely and separately from the data.

Author contributions

Some author contributions may be evident from the Methods section, but for clarity I will also detail my contributions to the different papers included in the thesis. My contributions were made in collaboration with the other co-authors as appropriate.

For Paper 1, design, data collection, and initial analysis took place before the start of my PhD studies. My contribution was to continue, question, and refine the qualitative content analysis of the material, and to finalize the analysis with one eye on the results of the quantitative analysis of the questionnaire and another on the TPB. I wrote and edited the English draft of the manuscript in collaboration

primarily with co-author MP. I also submitted the manuscript, was the corresponding author, and made the revisions.

For Paper 2, I reviewed the scientific literature, wrote the project plan, acquired data, processed and analyzed the data, wrote the manuscript, was the corresponding author, and revised the manuscript.

For Paper 3, I planned and carried out the study at all stages. I reviewed the literature, suggested theoretical framework and analytical method, constructed the interview guide, wrote the application for additional ethical approval, selected and contacted the participants, conducted the interviews, transcribed the first seven interviews, conducted the analysis with repeated triangulation with the other researchers, prepared the manuscript, was the corresponding author, and revised the manuscript.

For Paper 4, I detailed the project plan for this specific sub-study in the PUSHME project, carried out data analysis and interpretation, wrote the manuscript, was the corresponding author, and revised the manuscript.

Results

Paper 1: Primary care physicians' experience of digital health

A total of 100 primary care physicians from southern Sweden submitted one or more free-text comments regarding their experiences of digital health. The results of the qualitative content analysis are summarized in Figure 6.

Attitudes	**Different opinions among physicians**	Positive physician
		Sceptical physician
	Useful under certain conditions	Suitable for some patients, complaints, and requests
		Need for evaluation
Barriers	**The value of the multifaceted personal meeting**	The value of the multifaceted personal meeting
	Challenges due to a deficient technological infrastructure	Deficiencies in existing technology
		Technology not available
Concerns	**Risks for the patients**	Risk of patient harm
		Increased health care disparities
	Risks for the profession	Stressful time-thief
		Too many patient access routes
		Too high accessibility

Figure 6 Themes, categories, and examples of subcategories
Summary results of qualitative content analysis regarding southern Swedish primary care physicians' experience of digital health.

The physicians expressed attitudes towards digital health that were predominately positive at the general level and regarding future possibilities, as exemplified by the following comment made by one of the participants:

> Stands for development and modernization of primary care.

However, when it came down to specifics the focus was on clinical usefulness, which may be best summarized by the category heading "Useful under certain conditions". It is also illustrated by a remark from one of the physicians:

> It of course depends a lot on how it is used, in which situations, what implementation looks like… Feels like a good alternative in some cases.

Most comments concerned virtual patient contacts, and these were thought to be appropriate primarily for simple complaints or requests from digitally literate patients that the physician preferably had knowledge of. The need for evaluation was raised.

Barriers to the use of digital health technologies were identified in the form of the loss of personal contact with patients when digital filters got in the way and a deficient technological infrastructure. This was well summarized by some of the participants:

> As a general practitioner, I am a specialist in meeting patients, in conversations with the patient, in seeing the whole picture, and I feel that the conversation and personal contact with the patient is being phased out.

> First, we need better digital tools that are better adapted to the needs of patients and health care providers…

The physicians also conveyed several concerns regarding digital health, most notably risks for patient harm, increased health care disparities, and increased stress in the work environment. Major problem areas identified included deficiencies in the quality and usability of digital health technologies, and an increased number of patient access routes.

> We 'drive the car while we build it', and it does not feel good considering that it is patients that we take care of…

> Health care becomes too easily accessible. Only minor ailments can be dealt with. Because health care resources are insufficient, this contact method takes resources from those who need it better.

In summary, the primary care physicians were positive regarding the possibilities of future development but identified several problems and risks with digital health.

Paper 2: eVisits to primary care and subsequent health care contacts

A total of 10 084 index eVisits to PHC Online were analyzed where 5817 were visits with a nurse only and 4267 were visits with a GP. Regarding demographics, women were more frequent visitors than men (6193/10 084, 61.4%), and few patients were older than 60 years of age (Figure 7).

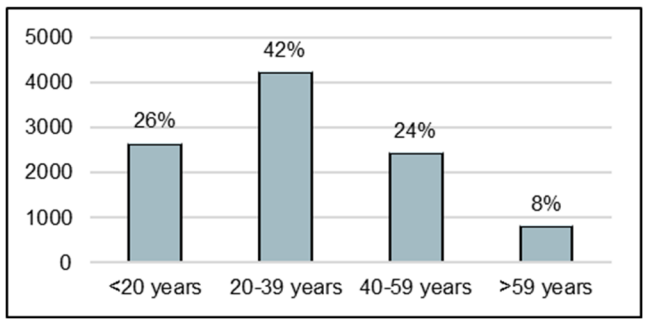

Figure 7 Age distribution for eVisits with PHC Online (*N* = 10 084)
Distribution of age groups for the patients who completed an index eVisit with a nurse or a general practitioner at PHC Online during the study period.

Most patients were diagnosed with skin conditions, followed by respiratory tract conditions and urinary tract conditions (Figure 8).

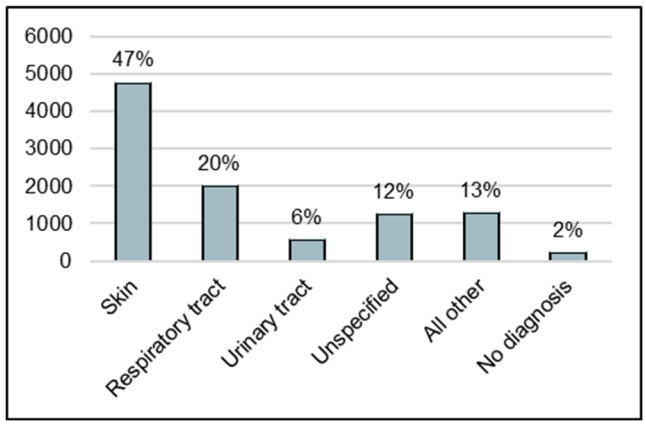

Figure 8 Diagnoses for eVisits with PHC Online (*N* = 10 084)
Visit diagnoses for the patients who completed an index eVisit with a nurse or a general practitioner at PHC Online during the study period. Unspecified = ICD-10 codes that did not indicate symptoms or diagnosis, e.g., medical advice. All other = all diagnoses except skin, respiratory tract, urinary tract, and unspecified diagnoses.

The majority of patients (7478/10 084, 74.2%) did not require a subsequent face-to-face visit with a nurse or a physician within 14 days after the eVisit. Of the patients who did require a face-to-face visit, the majority remained in primary care. The most common face-to-face follow-up was with a primary care physician (1671/10 084, 16.6%). Only 1.6% of the patients visited an emergency unit (160/10 084), and 0.4% (36/10 084) were admitted to hospital.

Subsequent face-to-face visits were more frequent after an eVisit with a nurse than after an eVisit with a GP (P <.001) (Figure 9).

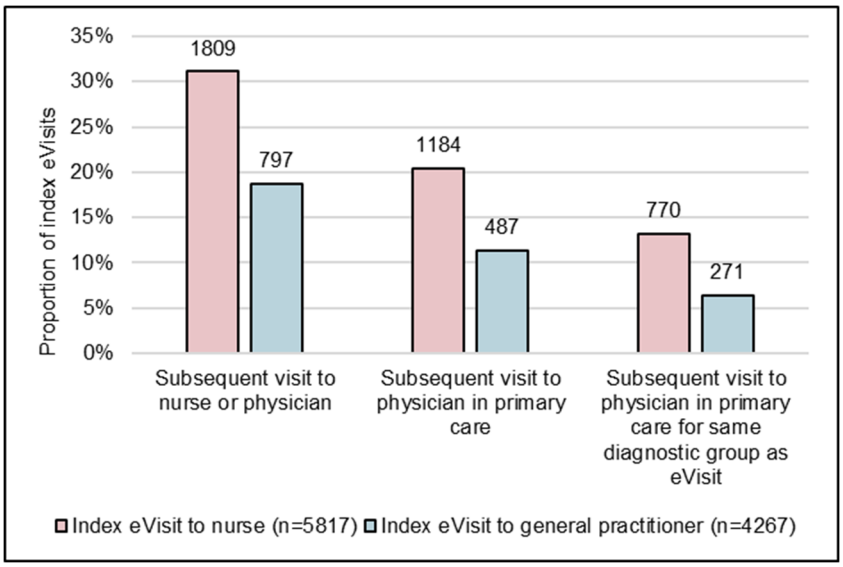

Figure 9 Face-to-face visits after an eVisit with a nurse or a general practitioner (*N* = 10 084)
Subsequent visits within 14 days after an index eVisit with a nurse or a general practitioner at PHC Online during the study period. The types of subsequent visits are presented with increasing precision from a primary care perspective.

There was also a statistically significant difference in subsequent face-to-face visit frequency depending on diagnosis for the eVisit (Table 3). The difference in follow-up depending on diagnostic group was mainly evident after an eVisit to a GP (data published in Paper 2 including supplement).

Table 3 Face-to-face visits after an eVisit depending on diagnosis (*N* = 10 084)
Comparison of subsequent visit frequencies within 14 days after an index eVisit to PHC Online depending on eVisit diagnosis. The types of subsequent visits are presented with increasing precision from a primary care perspective.

Diagnostic group for index eVisit	*n*	Subsequent visit to nurse or physician, n (%)	*P* value	Subsequent visit to physician in primary care, n (%)	*P* value	Subsequent visit to physician in primary care for same diagnostic group as eVisit, n (%)	*P* value
Skin	4769	1172 (24.6)[4]	<.001[8]	676 (14.2)[4]	<.001[8]	537 (11.3)[4]	<.001[8]
Respiratory tract	2009	538 (26.8)[4,5]		405 (20.2)[5]		306 (15.2)[5]	
Urinary tract	568	166 (29.2)[4,5]		115 (20.2)[5]		92 (16.2)[5]	
Unspecified[1]	1241	377 (30.4)[5]		254 (20.5)[5]		5 (0.4)[6]	
All other[2]	1285	302 (23.5)[4]		187 (14.6)[4]		101 (7.9)[7]	
No diagnosis[3]	212	51 (24.1)[3]		34 (16.0)[3]		0 (0.0)[3]	
Total eVisits	10 084	2606 (25.8)		1671 (16.6)		1041 (10.3)	

[1]ICD-10 codes that did not indicate symptoms or diagnosis.
[2]All diagnoses except skin, respiratory tract, urinary tract, and unspecified.
[3]eVisits with no diagnosis were excluded from the analysis of differences between groups.
[4-7]Each number denotes a subset of diagnostic groups whose variable proportions did not differ significantly at the .05 level with Bonferroni correction.
[8]Pearson's chi-square test.

In logistic regression analysis, the adjusted odds ratio for a subsequent face-to-face visit after an eVisit with a GP was raised for respiratory tract diagnoses, urinary tract diagnoses (almost exclusively infections), and unspecified diagnoses, compared to a group with various other diagnoses (Table 4).

Refining the analysis to diagnostic subgroups, the follow-up frequency was most significantly raised for respiratory tract infections and unspecified skin diagnoses. The difference became more pronounced if only follow-up for the same diagnostic group as the eVisit was considered (Table 4).

Table 4 Odds ratio[1] for a face-to-face visit after an eVisit depending on diagnosis (*n* = 4176)
Binary logistic regression[1] with subsequent visit within 14 days after an index eVisit to a general practitioner at PHC Online as the outcome variable, and eVisit diagnosis as the predictor variable.

Diagnostic groups and subgroups for index eVisit to a general practitioner	***n***	**Subsequent face-to-face visit within 14 days, odds ratio[1] (95% CI)**	
		Visit to physician in primary care	Visit to physician in primary care for same diagnostic group as eVisit
Skin[2]	1879	1.29 (0.95-1.76)	2.03 (1.33-3.10)
Skin infection[3]	*516*	*1.31 (0.88-1.94)*	*2.20 (1.33-3.64)*
Skin allergy or eczema[3]	*580*	*0.94 (0.62-1.41)*	*1.36 (0.79-2.33)*
Other skin[3]	*451*	*0.95 (0.61-1.48)*	*1.31 (0.73-2.34)*
Unspecified skin[3]	*332*	*2.51 (1.70-3.71)*	*4.10 (2.49-6.76)*
Respiratory tract[2]	775	1.92 (1.37-2.68)	2.82 (1.80-4.44)
Respiratory tract infection[3]	*514*	*2.55 (1.80-3.61)*	*4.15 (2.62-6.57)*
Other respiratory[3]	*261*	*0.82 (0.47-1.44)*	*0.52 (0.20-1.37)*
Urinary tract[2]	351	1.73 (1.15-2.61)	2.62 (1.54-4.47)
Unspecified[2]	431	2.43 (1.69-3.50)	0.12 (0.03-0.52)
All other[2,3]	740	1.0 (Ref.)	1.0 (Ref.)

[1]Adjusted for age, sex, and care need index of the patient's registered primary health care center.
[2]Model with diagnostic groups.
[3]Model with diagnostic subgroups.

In summary, patients who completed an eVisit with PHC Online were comparably young, and most commonly had skin conditions. A majority of patients did not need to seek further care, and very few patients required emergency care. Subsequent face-to-face visits were more frequent after an eVisit with a nurse than with a GP. Primarily after an eVisit with a GP, follow-up contacts were more common if the patients had been diagnosed with an infection (especially respiratory tract) or received an unspecified diagnosis, than for a group with a varied selection of diagnoses.

Paper 3: Patient experience of health-promoting text messages

From Paper 2 to Paper 3, we change the perspective from numbers describing virtual visits to interviews describing patient experience of a digital lifestyle intervention.

The primary care patients with hypertension who received health-promoting text messages generally expressed their experience of the intervention in positive terms but also provided neutral and some critical viewpoints. The analysis of the telephone interviews, with a total of 14 purposefully selected participants, resulted in three themes composed of two categories and several subcategories each, as shown in Figure 10.

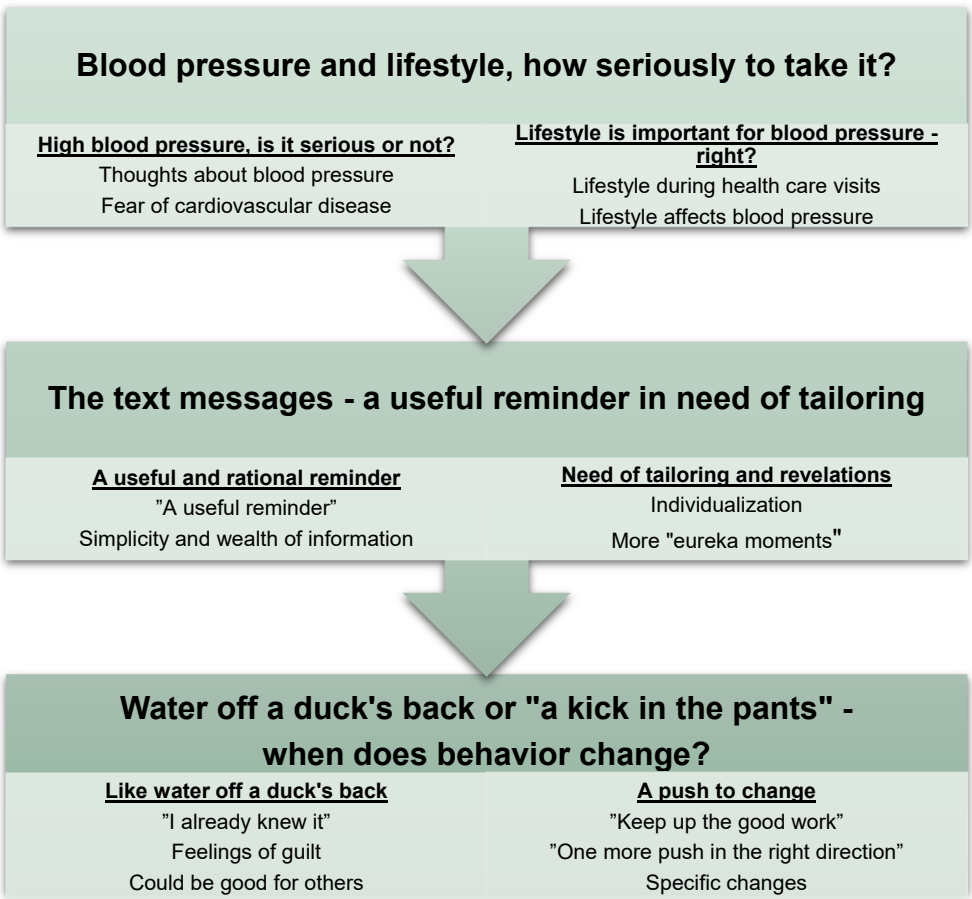

Figure 10 Themes, categories, and examples of subcategories
Results of qualitative analysis of participant interviews regarding the experience of receiving health-promoting text messages as an intervention in the treatment of hypertension in primary care.

Blood pressure and lifestyle, how seriously to take it?

The first theme covered the respondents' knowledge and thoughts regarding hypertension and lifestyle. We identified a need for more detailed knowledge about the relationship between lifestyle, hypertension, and CVD, as illustrated by this interview quote:

> Yes, above all it's the alcohol. Then of course heredity can be of some importance. And maybe also what you eat and what kind of lifestyle you have and such. (…) No, above all it's that. And maybe a little bit the alcohol. (Participant no. 6)

The participants also expressed openness and even a wish for more discussion of lifestyle habits at health care visits for hypertension. Thoughts about the seriousness of the condition and regarding the risk for CVD varied greatly from no expressed worries to a clearly expressed fear:

> Yes, yes, the blood pressure, it… Maybe you don't take it that seriously, when you don't have so to say any pain from it. (Participant no. 14)

> And then she had a stroke. So you think that so that you don't have one yourself. But she had a very high blood pressure. (Participant no. 5)

The text messages – a useful reminder in need of tailoring

The second theme focused on the participants' experience of the specifics of the intervention, i.e., the text messages. In general, the messages were perceived as rational and useful reminders.

> You go and sit down on a couch or whatever, you pick up the phone and then you see that you have gotten a text. That's actually a perfect moment to get the message. (Participant no. 8)

There were also suggestions for improvements, centering on increased individualization of the text messages according to personal habits, knowledge, and circumstances. In addition, some participants articulated a need for advice that would be perceived as new:

> Well, it isn't anything that's given me an eureka moment or any kind of… (Participant no. 9)

Water off a duck's back or a kick in the pants – when does behavior change?

The third theme compiled the participants' descriptions and thoughts regarding lifestyle change. Here, it became evident how some participants responded to the push to change from the text messages, while others did not, resulting in two different categories. However, the respondents could also fit into both categories

with respect to separate responses and behaviors. Two quotes can be used to further illustrate and summarize these two categories:

> Because often you might think 'I already knew it'. It isn't any secrets and news about how you should lead your life and what you should do and so on. Most people already know all of this. (Participant no. 8)

> But it pushed me, because there is always something that you can learn a bit more about. And then you have to decide that you will follow it, that you do it. (Participant no. 4)

Analyzing the material in the framework of the TPB as further specified in the reasoned action approach, we arrived at some factors that appeared to be of importance for participants who described lifestyle change in relation to receiving the text messages:

- Taking note of the fact that the sender was "health care".
- Advice in association with a diagnosis or other motivating factors.
- Advice that the participants could apply in their daily life.
- Advice that was perceived as new.

An illustration of how the results were structured using the theoretical framework is provided in Figure 11.

In summary, the intervention appeared to be well-tolerated and mostly appreciated. However, it was described as effective only in certain circumstances. Tailoring of the intervention was suggested by the participants.

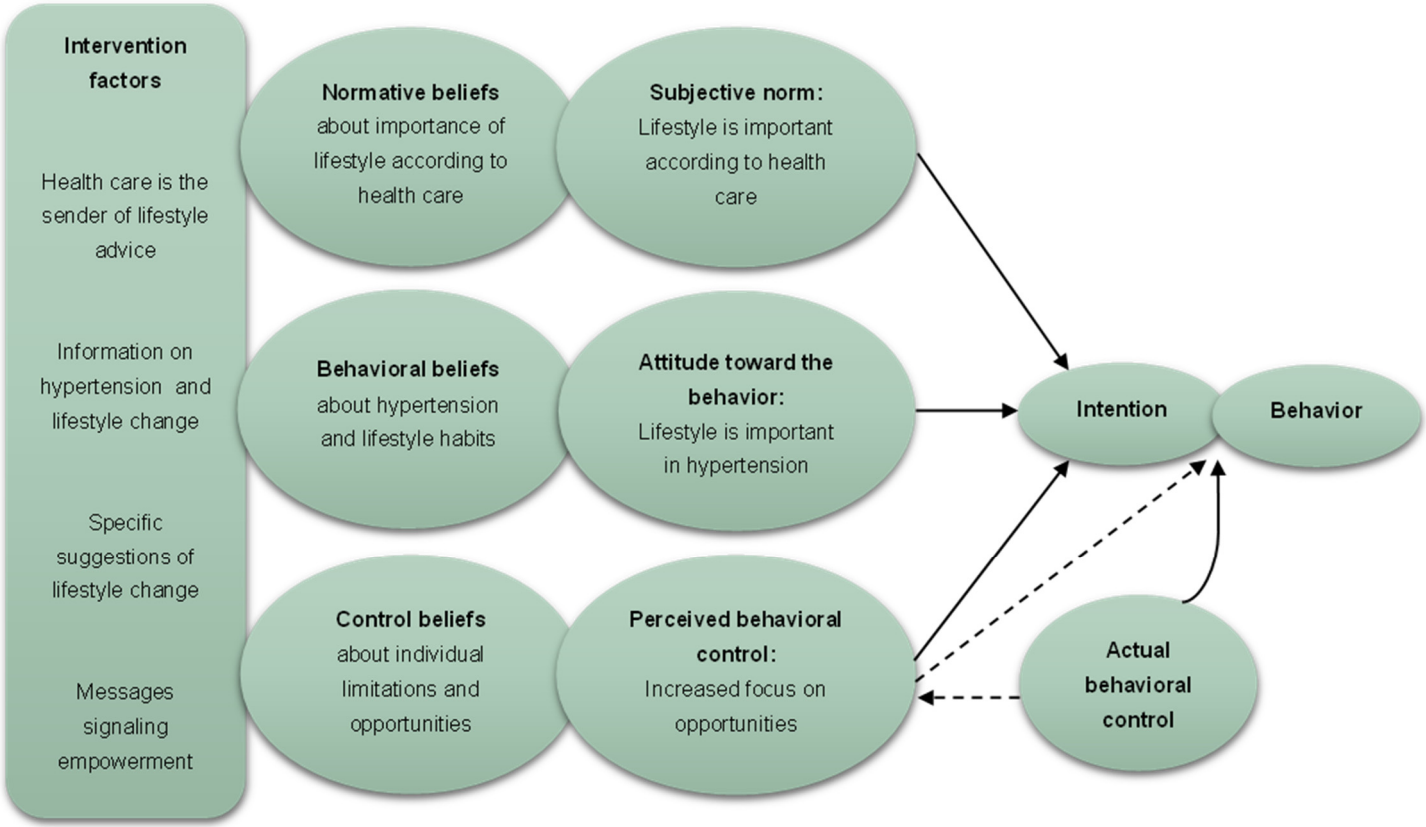

Figure 11 Participant experience of health-promoting text messages in the framework of the theory of planned behavior
Results of systematic text condensation of participant interviews regarding the experience of receiving health-promoting text messages as an intervention in the treatment of hypertension in primary care, in a theoretical framework adapted from Fishbein & Ajzen (76, 77, 203).

Paper 4: Behavioral effects of health-promoting text messages

Paper 4 analyzed the behavioral effects of the text message intervention that was studied qualitatively in Paper 3. From September 2020 to December 2022, a total of 401 participants were included, with 193 allocated to control and 208 to intervention. A total of 29 participants did not attend the follow-up visit after six months, resulting in a dropout rate of 7.2% where most belonged to the control group (24/29). Selected baseline characteristics of the participants are presented in Table 5.

Table 5 Baseline characteristics of trial participants by treatment group and total (*N* = 401)

Variable	Control (*n* = 208)	Text messages (*n* = 193)	Total (*N* = 401)
Women, *n* (%)	103 (49.5)	88 (45.6)	191 (47.6)
Age (years), mean (SD)	69.0 (9.8)	68.2 (8.9)	68.6 (9.4)
Upper secondary or higher education, *n* (%)	153 (73.6)	139 (72.0)	292 (72.8)
>5 years with hypertension diagnosis, *n* (%)	143 (68.8)	129 (66.8)	272 (67.8)
Previous cardiovascular disease, *n* (%)	30 (14.4)	28 (14.5)	58 (14.5)
Body mass index (kg/m^2), mean (SD)	28.7 (5.1)	28.4 (4.8)[1]	28.6 (5.0)[1]
Systolic blood pressure (mmHg), mean (SD)	140.5 (13.1)	140.4 (13.0)	140.5 (13.0)
Diastolic blood pressure (mmHg), mean (SD)	84.6 (10.6)	83.5 (9.4)	84.1 (10.0)
Current smoker, *n* (%)	7 (3.4)	10 (5.2)	17 (4.2)
Current snus[2] user, *n* (%)	16 (7.7)	14 (7.3)	30 (7.5)
Alcohol >4 standard drinks/week, *n* (%)	57 (27.4)	47 (24.4)	104 (25.9)
Physical activity <150 minutes/week[3], *n* (%)	66 (31.7)	62 (32.1)	128 (31.9)
Physical activity minutes/week[3], mean (SD)	237.5 (153.3)	243.7 (151.3)	240.5 (152.2)
Behavioral intention for healthy lifestyle[4], *n* (%)	140 (67.3)	134 (69.4)	274 (68.5)

[1]One patient's data missing.
[2]A Swedish moist tobacco powder that is put under the upper lip.
[3]Calculated as (2*vigorous + moderate activity) from mid-point values of answer options with ranges of minutes of activity/week.
[4]Likert rating of 5-7 on statement "I plan to make a lifestyle change and/or retain a healthy lifestyle onwards" where 1 = "completely disagree" and 7 = "completely agree".

We found that there was no difference in smoking habits between the intervention and control groups at six months follow-up adjusted for baseline (data in Paper 4). However, as shown in Table 6, there was a statistically significant change toward

improved lifestyle habits regarding alcohol use as well as physical activity for the text message group as compared to the control group at follow-up.

Table 6 Lifestyle habits before and after a health-promoting text message intervention (*N* = 401)

Variable	Control (*n* = 208)	Text messages (*n* = 193)	Text messages vs control at follow-up, adjusted for baseline
			Odds ratio (95% CI)
≥1 unhealthy habits at baseline, *n* (%)	114 (54.8)	100 (51.8)	
≥1 unhealthy habits at follow-up, *n* (%)	117 (56.2)	85 (44.0)	0.53 (0.33-0.87)[1]
Alcohol >4 standard drinks per week at baseline, *n* (%)	57 (27.4)	47 (24.4)	
Alcohol >4 standard drinks per week at follow-up, *n* (%)	58 (27.9)	37 (19.2)	0.35 (0.15-0.81)[2]
Physical activity <150 minutes per week[3] at baseline, *n* (%)	66 (31.7)	62 (32.1)	
Physical activity <150 minutes per week[3] at follow-up, *n* (%)	75 (36.1)	54 (28.0)	0.60 (0.37-0.98)[4]
			Mean difference (95% CI)
Physical activity minutes per week[3] at baseline, mean (SD)	237.5 (153.3)	243.7 (151.3)	
Physical activity minutes per week[3] at follow-up, mean (SD)	234.6 (149.2)	264.2 (152.4)	25.8 (2.7-48.9)[5]

[1]Binary logistic regression with baseline unhealthy habits as covariate.
[2]Binary logistic regression with baseline alcohol use as covariate.
[3]Calculated as (2*vigorous + moderate activity) from mid-point values of answer options with ranges of minutes of activity per week.
[4]Binary logistic regression with baseline physical activity level as covariate.
[5]One-way analysis of covariance with baseline physical activity minutes as covariate.

The majority of participants stated a favorable intention regarding lifestyle change at baseline (Table 5). However, analysis according to the TPB could not contribute to explaining or predicting intervention effects. Perceived behavioral control in the form of perceived capacity to make a lifestyle change showed the highest correlation with ratings on behavioral intention to make a lifestyle change, but still only explained 32% of the variance in behavioral intention. The predictive ability of the model was not notably improved when all predictors were added (R^2=36%). There were no significant correlations between baseline ratings on the TPB questionnaire and reported lifestyle changes during the intervention (data published as supplement to Paper 4).

In summary, we saw a statistically significant effect of health-promoting text messages on lifestyle habits in the form of alcohol use and physical activity. The effect could not be explained or predicted by a pragmatic application of the TPB.

Discussion

Main findings

The main specific findings of this thesis are as follows:

1. As of 2019, southern Swedish primary care physicians were positive regarding digital health at the general level. However, the physicians also expressed that the technological infrastructure needed improvement, and that patient safety and workload issues must be considered more in-depth when new digital health technologies were introduced. Virtual patient contact was an important area of concern.
2. Patients who performed a text-based virtual visit (eVisit) to primary care in Region Skåne in 2021 were mostly young to middle-aged, and the most common diagnosis was skin conditions. The majority of patients did not need to seek face-to-face care within 14 days, and there were few emergency visits. Subsequent face-to-face visits were more common after an eVisit to a nurse than to a GP. After an eVisit to a GP, follow-up visits were more frequent for patients with infections (especially respiratory tract) and unspecified diagnoses compared to a group with various other diagnoses.
3. Health-promoting text messages to patients with hypertension in primary care were generally appreciated and well-tolerated. The text messages appeared to have the potential to affect lifestyle habits in some patients, and increased individualization may improve effectiveness.
4. The health-promoting text messages had a statistically and potentially clinically significant effect on lifestyle habits in the form of decreased alcohol use and increased physical activity. A pragmatic application of the theory of planned behavior could not contribute to explaining or predicting the effects.

Discussion of methods

General remarks relating to methods

On the overall and specific aims

The aim of a research project is a pertinent starting point for a discussion of methods, as the methods should correspond to the aim. For this thesis, the overall aim was "to explore and evaluate the use of digital tools in the clinical context of primary care in southern Sweden". Then, there were also aims of the specific research projects that provided a focus on staff and patient experience, eVisits and health care use, and lifestyle change using digital health technologies.

The aim of the full thesis project was thus broad, and the specific papers covered different areas of digital health. This relative broadness can be seen as a strength in that it provides a diverse picture of digital health in primary care in southern Sweden. Such a picture may be useful for distinguishing and beginning to evaluate possible ways forward. However, the broad aim is a weakness in that it is difficult to answer in a simple and clinically applicable way.

An alternative aim would have been to evaluate a specific digital health technology. I could, for example, have chosen to study only eVisits to PHC Online. Separate papers could then have covered nurse and GP experience, patient experience, the register-based study (Paper 2), and maybe an RCT of virtual versus face-to-face visits. That would have allowed for more detailed conclusions on virtual visits. However, it would have decreased the broadness that can be seen as a hallmark and strength of primary care.

A short note on methods

Just as the aim was broad, the methods were too, ranging from qualitative analysis of interviews and questionnaires through a register-based cohort study to an RCT. To some extent, a common thread of the papers was the use of the TPB. The choice of methods as well as theoretical framework was primarily based on the research questions, but also on the experience of the researchers conducting the studies. Below, I will discuss the methods used in the specific studies. Alternative methods will also be discussed. To focus on methods, the order of the papers will be modified. Then a general discussion regarding methods will follow.

Discussion of methods used in the papers

Papers 1 and 3: Qualitative studies

Paper 1 and Paper 3 were both qualitative studies, however quite different in nature. A methodological discussion thus may benefit from covering both papers under the

same heading, allowing for comparisons. Malterud's introduction to qualitative methodology is the primary methodological source used in this discussion (215).

Paper 1 aimed to explore primary care physicians' experiences of digital health, with a focus on why the physicians had reported high intention to use digital tools but low actual use. A qualitative approach thus appears logical. However, our choice to use free-text comments supplied in a digital questionnaire may be further motivated. The simple reason is that the free-text comments were supplied in the same questionnaire where the discrepancy between intention and use had been reported. Also, a strength of using a digital questionnaire is the possibility to reach many respondents and thus get a larger selection than would have been the case with an interview or a focus group study. However, an interview study would likely have supplied more nuanced and elaborate information. A focus group study would have added the value of synergies in discussions but may also have produced more homogenized material.

Regarding Paper 3, in contrast to Paper 1, the potential participants were primary care patients with hypertension who had been allocated to the intervention group in an RCT of health-promoting text messages. Here, the aim was to elicit information about the participants' experience of the RCT to improve future interventions. Consequently, a qualitative approach was again motivated. Furthermore, participants were already asked to fill out a questionnaire regarding their experiences of the study, so the method needed to be complementary. As the intervention was individually oriented in nature, soliciting views through individual interviews was deemed most appropriate. Interviews were conducted with patients in different regions and during the later stages of the COVID-19 pandemic, and therefore telephone interviews were considered most suitable. Compared to face-to-face interviews, body language was lost. However, I was able to elicit both elaborate and emotional responses. So, I consider the information gained to be sufficient in relation to the aim.

For Paper 3 we made a purposeful selection of participants with varied characteristics according to information from the baseline and follow-up visits. Simply put, the quantity in Paper 1 was replaced with quality in Paper 3. For both studies, there was a risk that those who volunteered for participation were more positive toward digital health than those who did not wish to fill in a digital questionnaire or participate in a text message study – i.e., a selection bias that is hard to avoid but important to acknowledge.

Regarding analytical method, for Paper 1 we used qualitative content analysis inspired by Graneheim and Lundman, which is a common type of analysis in the Swedish context (209). For Paper 3, I wanted to explore some more possibilities of qualitative analysis. Systematic text condensation as described by Malterud came up as a suitable method (214, 215). This allowed me to work with the material in detail and depth while including my co-authors along the way. The stepwise

sequence of analysis, analyzing 3-4 interviews at a time, allowed us to reconcile all the material without being overwhelmed and thus missing important common threads and insights. As the method stressed constant reorganization of categories and subcategories, it also allowed for early and late interviews to have an equivalent influence on the results. For both studies, observer triangulation was repeatedly employed during the analytical phase to incorporate perspectives from all researchers and increase credibility.

Regarding the theoretical framework, the TPB was a rational choice as it was already used in the questionnaire and the RCT, respectively. It was also a scientifically motivated choice in a broader sense, as the theory has been much used concerning health behaviors (197, 201). As further detailed in the Introduction, the TPB contains elements of other commonly used theories and has been suggested to be a comprehensive model to understand and affect human behaviors (77). However, an alternative primarily for Paper 1 would have been to use a theory more specifically directed at the acceptance of new technology, such as UTAUT (204).

Regarding reflexivity, all researchers were clinically active GPs or residents in general practice (HG). There was thus a significant preunderstanding of the topics among the co-authors. The inclusion of other professionals in the research process could have increased the ability to make a more encompassing and multifaceted analysis and may be considered for future projects. Furthermore, for Paper 3, a non-physician interviewer could have received different responses, especially regarding subjects such as medication. On the other hand, being a physician, I was able to ask supplementary questions and explore participant views in a way adapted to health care and medicine.

To summarize, Paper 1 and Paper 3 used different types of qualitative methods adapted to the specific research project. However, methodological choices also confer limitations that need to be taken into account when considering the implications and transferability of the results (215).

Paper 4: A randomized controlled trial

The primary aim of Paper 4 was to analyze if health-promoting text messages to primary care patients with hypertension resulted in a change in lifestyle habits. An obvious strength was the use of data from an RCT, which is considered high-level scientific evidence as bias and confounding factors are countered by randomization of the subjects (225). However, a weakness of Paper 4 is that we analyzed secondary outcome measures. Blood pressure change was the primary outcome measure. Lifestyle habits are a preceding step in the chain of events – in other words, an effect mediator. It thus may be argued that it was feasible to analyze the causal pathway of the intervention. However, we still have the problem of multiple comparisons where the risk of a false positive (a type 1 error) increases with the number of

analyses. Results must thus be interpreted with this in mind and are primarily to be seen as an indication of effect.

Another weakness is that data were self-reported. That is common practice for lifestyle habits, but it still makes the results less reliable than if measured objectively by, for example, accelerometer (for physical activity) and phosphatidyl ethanol (a blood test regarding alcohol consumption). Nevertheless, the validated questions on physical activity have been shown to correspond relatively well to accelerometer measures (218).

Analytical choices regarding the lifestyle outcome variables also deserve some more specific discussion. For smokers, the choice was simple as the participants were smokers or not. For alcohol use, a weekly consumption below 100 g of pure alcohol (<2 standard drinks/day) is recommended for persons with hypertension, but recent evidence and guidelines suggest that minimizing alcohol consumption is most beneficial from a general health perspective (111, 125, 142, 155-158). Together with most participants reporting use at <1 or 1-4 standard drinks per week, resulting in a left-skewed distribution, analyzing the data as dichotomous with a cut-off at >4 standard drinks per week was considered the best option regarding a possible clinically significant effect. However, we also analyzed the full range of reported alcohol use for completeness. For physical activity, dichotomous analysis with cut-off <150 activity minutes per week was based on international recommendations (167). Furthermore, there was a sufficient amount of data points and distribution of the data to allow for analysis of the full range of physical activity minutes using parametric methods (221, 226). Unfortunately, data had not been collected on diet as the brevity of the questionnaire was prioritized.

Drop-out was low, but considerably higher in the control group than in the intervention group. We followed the preset analytical plan conducting intention-to-treat analysis. Last observation carried forward was used for imputation as that was considered to be closest to the patients' likely value at follow-up. That could have favored the intervention group if there was a Hawthorne or research participation effect (227, 228). However, we also conducted a complete case analysis which arrived at similar results as the intention-to-treat analysis. Thus, the dropout does not seem to have had any significant effect on the results.

A secondary aim of the PUSHME trial and Paper 4 was to analyze if a pragmatic adaptation of the TPB could be used to predict intervention effects (76). However, we found no clinically significant correlations between ratings on a simplified TPB questionnaire and reported changes in lifestyle habits. Our pragmatic adaptation of the TPB thus may not have measured the theory's components with sufficient precision to predict behavior. Alternative explanations are that the participants did not have enough actual behavioral control for intention to translate into behavior, or that the TPB was not applicable in this context.

In summary, for the analysis of lifestyle change in response to a text message intervention, we could have used more objective measures. We could also have applied the TPB in more detail. Nonetheless, the results of Paper 4 may serve as an indication of intervention effects to be further studied.

Paper 2: A register-based cohort study

In contrast to the other papers included in this thesis, Paper 2 did not use the TPB. This paper aimed to explore health care use related to eVisits in public primary care in Region Skåne. For that aim, analysis of register-based data was deemed most appropriate.

Strengths include a large data set covering almost one year. A limitation of the study was that the patients could only contact PHC Online for specific types of complaints that were thought to be suitable for virtual care. Patients were also comparably young. This limits generalizability to an unselected primary care population. On the other hand, our study population constituted a common representation of patients seeking virtual care.

The reporting and analysis of several types of subsequent health care contacts can be considered a strength and novelty of our study compared to prior studies. This provided a broad picture of health care use related to virtual visits and makes our study comparable to studies with varying types of outcomes in terms of follow-up.

The choice of comparing subsequent health care contacts between different diagnostic groups for the eVisit warrants some discussion. An RCT where patients were randomized to an eVisit or a face-to-face visit after contacting their primary health care center would have had higher evidence value but also required more resources. Another alternative would have been to compare follow-up after eVisits with register-based data on matched face-to-face visits. Such a Swedish register-based study had recently found similar follow-up frequencies between eVisits and face-to-face visits for respiratory tract and urinary tract infections (92). But patients who seek face-to-face and virtual care differ, and it is possible that patients who seek virtual care do so because their condition is milder (10, 17, 82, 83, 86). Thus, comparing subsequent health care use depending on diagnosis could provide additional information regarding the suitability of eVisits for different conditions.

Another point of discussion could be my choice to analyze diagnostic subgroups in addition to the diagnostic groups. The diagnostic groups were predefined and based on the conditions that patients could seek care for. The subgroups were added based on the material, to increase granularity and study if some types of problems within the respiratory or skin area rendered more follow-up than others. However, the findings on subgroups are harder to transfer into presenting complaints and thus to put into clinical use.

General discussion of methods

The discussion of the papers included in this thesis was primarily concerned with specific methods and internal validity, while this general discussion will focus on choice of methods from a wider perspective and on external validity.

Levels of evidence

There is a relative scientific consensus on which methods are appropriate for what question and on how to value evidence depending on method (215, 225, 229). In the practice of evidence-based medicine, study designs are ranked based on the risk of bias. Regarding therapeutical choices, meta-analyses of RCTs have the highest level of evidence while case studies and expert opinion are considered the lowest level of evidence (Figure 12) (225, 229). Observational studies come in between RCTs and case studies. Qualitative studies, on the other hand, are explorative in nature, aiming to describe and understand but not predict, and are thus to be seen as complementary to quantitative research (215). Regardless of method, the quality of the studies must be considered (215, 229). Furthermore, there can and should be value-based judgements involved as we touch on the larger questions of knowledge and purpose when transferring research findings into clinical practice and policy (215, 229).

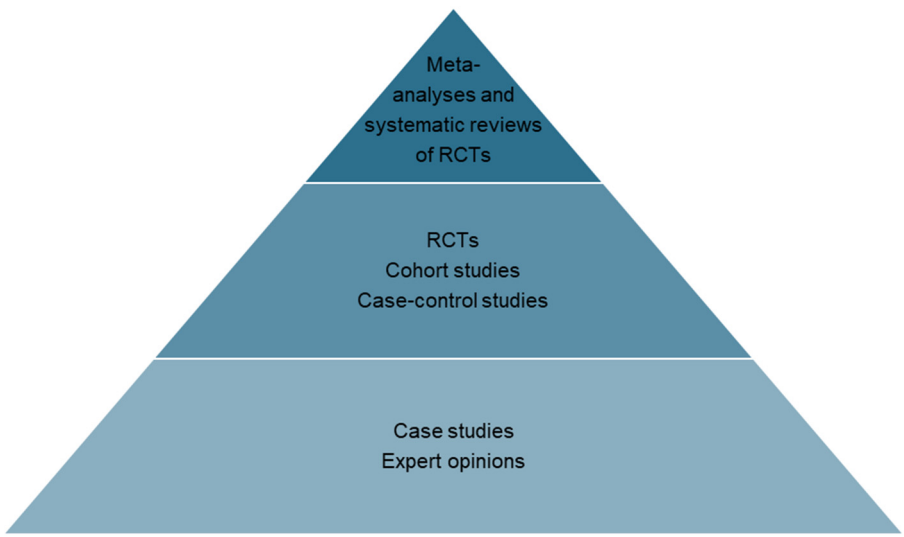

Figure 12 Simplified evidence pyramid
Evidence level for different study designs with regard to therapeutics in medical research, where the highest evidence level is at the top of the pyramid. Inspired by Greenhalgh (229) and Burns (225).

Looking at the evidence level of the papers in this thesis, Paper 4 as part of an RCT aspires at the highest level. As we aimed to evaluate if a text message intervention could be an effective addition for the treatment of hypertension in primary care, an

RCT design was chosen to test this. The results of Paper 4 could thus contribute to motivating application in clinical practice – but with caution, as it is a single study concerning secondary outcome measures. Turning our eyes to Paper 3, patient experience is a vital aspect of any new treatment and especially one that involves changing lifestyle habits. For such an explorative and multidimensional question, a qualitative method is most appropriate and may contribute to the development of future interventions. Paper 3 can also serve as an additional source of information when considering if the text message intervention should be put into clinical practice. Papers 3 and 4 thus illustrate how qualitative and quantitative methodology can be complementary.

Moving down the evidence pyramid we arrive at Paper 2, which was an observational study. A virtual visit could be argued to be a new type of diagnostics or even treatment. Virtual visits may thus optimally be evaluated through an RCT. However, to explore this relatively new field an observational study is also of some value. Paper 2 may primarily be valuable as a descriptive study of care-seeking patterns related to virtual visits. It cannot be used to conclude whether some conditions are more or less suitable for virtual visits, but it could serve as an indication and contribute to generating hypotheses for future research.

Outside of the evidence pyramid, we find Paper 1. There is a need to know more about how health care professionals experience the new digital landscape to generate well-founded hypotheses about how to improve it. Thus, the clinical value of Paper 1 will increase if it is used as a basis for studies that develop and evaluate digital health technologies. The field of medicine builds heavily on natural sciences but also involves social sciences and humanities. This is true for general practice in particular. Consequently, scientific knowledge gained using a combination of methods may create synergies and provide multifaceted information for decision-making.

Generalizability and transferability

Scientific research aims to explain and understand the world, that is, to generate new knowledge through systematic investigation (215, 229). Our results should be externally valid or, in other words, applicable outside of the study setting (215). For quantitative studies, we talk about generalizability (229). We use statistical inference to generalize outcome measures from the study sample to the target population (230). For qualitative research, the corresponding concept is called transferability and describes the extent to which study results could be applied to other contexts than the exact environment where the study was conducted. As for quantitative research, this depends on the selection of research participants but also requires a relevant research question and high internal validity (215).

Internal validity has been discussed with regard to the specific papers included in this thesis and is assumed to be acceptable as a basis for the discussion of external validity. As all sub-studies share the trait of being conducted in primary care in

southern Sweden, generalizability and transferability have some aspects in common. The results could be considered valid for a target population in southern Sweden with some certainty. Results should also, to some extent, be generalizable or transferable to the same target populations in Sweden, as we share major aspects of the health care system but do have different preconditions regarding population density and socioeconomics. Widening the geographical area, the Scandinavian countries have much in common when it comes to population, health care systems, and digital health. So do European countries and high-income countries in general, even if to a lesser extent. Transferability and generalizability to low- and middle-income countries would be lower but not absent.

The PUSHME studies (Papers 3 and 4) can be argued to constitute a more representative sample than the study of primary care physicians' experience of digital health and the study regarding eVisits (Papers 1 and 2). For Papers 1 and 2, participants were more numerous but self-selected. These results may thus primarily be possible to extrapolate to physicians and patients with a greater interest or engagement in digital health than the average person. For Papers 3 and 4, selection was purposeful and randomized, respectively, and results should thus to a greater extent be generalizable to a target population of primary care patients with hypertension. However, there was still a volunteer bias as not all potential participants who were approached wished to participate.

The use of the TPB – a comprehensive theoretical framework concerning human social behavior – may also contribute to internal and external validity (77). Some aspects of the results may be applicable outside of the primary target populations – aiming at health care professionals in general and not only primary care physicians, and patients with chronic conditions other than hypertension.

Discussion of papers in relation to literature

Paper 1: Health care professionals' experience of digital health

Paper 1 explored southern Swedish primary care physicians' experience of digital health. The views expressed by the physicians found several echoes in other studies on health care professionals' experience of digital health technologies. Concerns regarding clinical usefulness, technical issues, and effects on workload were not new (58, 64-67). Looking at the Swedish primary care context, three relatively recent studies also described concerns similar to those voiced in our category "useful under certain conditions" – that digital health technologies and more specifically virtual patient contacts can be suitable for some patients and issues but not for all (71-73).

The loss of personal contact with patients seems not to have been as explicitly mentioned in previous research and thus could be a partially new addition made by

our study. Patient contact and continuity are at the heart of general practice, so it may be considered consequential that it is prominent in the analysis of primary care physicians' views on digital health (33, 231). In more recent reviews of barriers and facilitators to health care professionals' use of digital health technologies, similar areas in the form of psychological issues and technology undermining professional identity were also pointed out as concerns (232, 233).

Being primarily inductive, i.e., based on the views expressed by the participants, even if there was a deductive element from the TPB, our study focused more on barriers and concerns regarding the use of digital health than on facilitators. Two recent reviews have summarized important facilitators to health care professionals' use of digital health technologies – which were largely the opposite of the barriers. Training, and adaptation according to the end users' perceptions and needs, emerged as the most important areas (232, 233).

Our questionnaire included a prompt for the participants' views on the use of AI in health care. As AI was sparsely used in Swedish primary care at the time, responses were not numerous and mainly general in nature. Other and more recent studies have raised some interesting viewpoints regarding AI in health care that may add to the interpretation of our results.

A 2019 investigation of clinician and medical informatics expert views on AI in primary care described opportunities regarding improved management and clinical decision-making and processes. However, the need for careful design and evaluation was also stressed (234). A recent review described that the generally rapid progress of AI has been hard to translate into clinical improvements (235). Evaluation of AI-based clinical decision support systems has tended to focus on technical performance but has taken limited account of implementation into clinical workflow and thus of actual clinical effects (235). These results bear some similarities with overall views expressed by the physicians in our study, which may be summarized by the subcategory headings "need for evaluation", "stressful time-thief", and "the professional perspective is missing".

Consequently, the larger patterns of problems and possibilities regarding health care professionals' experience of digital health seem to be generalizable to some extent. The importance of involving end users is a common thread. In accordance with this, I will use the views expressed by the southern Swedish primary care physicians as a cohesive theme in the discussion of the subsequent three papers of this thesis.

Paper 2: "Too many patient access routes"?

As expressed by the primary care physicians in Paper 1, virtual visits in general, and eVisits in particular, could be argued to be one "patient access route" too many. Patients can already contact their primary health care center via telephone and come for a face-to-face visit. Video visits might be useful when distance is an issue, but

raise questions regarding suitable diagnoses, access, and medical prioritization (71). eVisits are a newer type of visit that come with similar questions. As the mode of contact is clearly different from a face-to-face visit, eVisits may bring matters more to a head.

Considering the results of our register-based study of eVisits to an all-virtual primary care unit in Region Skåne in a wider context, demographics were similar to other studies of virtual visits conducted in Sweden and internationally. Patients tend to be relatively young, and present with simple complaints such as minor infections and skin conditions (10, 17, 56, 82, 83, 86, 93, 236). Concerns regarding health equity in terms of access are thus similar across settings (82). Furthermore, the care-seeking pattern raises concerns regarding the efficient use of health care resources according to medical needs (84).

Health care consumption following virtual visits may be used as an indicator of efficiency (17, 56, 80, 84-86). This can be approximated through follow-up frequencies, or, more precisely, the rates of subsequent health care contact. Face-to-face follow-up frequencies within 14 days in our cohort ranged from 6% to 31% depending on if the eVisit was with a nurse or a GP, and on the type of subsequent visit. The most specific type of follow-up was a visit to a physician in primary care for the same type of diagnosis as the eVisit, following an eVisit with a GP. The most unspecific was any visit to a nurse or a physician after an eVisit with a nurse. This range points to the importance of specifying the type of virtual visit and follow-up studied. Overall, however, the rates of subsequent health care contact in our cohort were within the same range as in other studies of virtual visits (17, 56, 83, 87-95).

For specified skin diagnoses such as eczemas, follow-up rates after an eVisit to PHC Online were similar to those for a group with varied diagnoses. This finding may be considered consistent with recent reviews suggesting the effectiveness of teledermatology in acne vulgaris and atopic dermatitis (237, 238). Our analysis also showed that patients with infections (especially respiratory tract) and unspecified diagnoses had a higher follow-up frequency compared to the group with varied diagnoses. This agrees with a relatively recent review on eVisits suggesting additional research regarding the management of infections (56).

However, the interpretation of what a subsequent health care contact actually indicates can be discussed. Does it indicate that a virtual visit was an inappropriate mode of contact? Or does it indicate a serious condition that would have required further care regardless of where the initial visit was made? And, reversely, could low follow-up frequencies indicate that the patients had a low medical need to begin with? In addition, using register-based comparisons, patients are self-selected for virtual care and thus may have selected the mode of contact depending on the perceived seriousness of the condition – with virtual care being considered more apt for less serious medical problems or concerns (86).

With this in mind, follow-up rates may still, if analyzed and interpreted cautiously, be used to provide additional information regarding virtual visits. In our context, a feasible interpretation would be that the relatively low rates of subsequent health care contacts, together with the comparably young age and uncomplicated diagnoses of the patients, indicate that there is a measure of supply-induced demand involved (84). It may, however, be that the demand is from overstrained primary health care centers for a unit that helps with seeing patients who are mostly not seriously ill but still need contact with a health care professional (239).

A recent review of eVisits in primary care with regard to quality of care concluded that simple conditions could be efficiently resolved (240). However, for complex conditions, evidence indicated that eVisits were inefficient and may result in duplicate contacts. It was further shown that multiple-choice questionnaires (which were used at PHC Online) increased staff and patient workload (240). While our study did not evaluate the digital anamnesis used by PHC Online, it does agree with conclusions regarding suitability for simple rather than complex (unspecified) complaints.

Thus, the increased number of patient access routes may have worked as a way to alleviate pressed primary health care centers that could then provide face-to-face care to older and more complicated patients (239). In the long run, however, it may be preferable to provide virtual visits with relational continuity compared to as a separate service – in terms of efficiency of the specific visit as well as subsequent health care use (11, 241, 242).

As it happens, from 2024 PHC Online is only open outside of office hours, and the same type of service is to be offered to patients by their listed primary health care center during office hours. However, that is yet to be evaluated.

Papers 3 and 4: "Useful under certain conditions"?

"Useful under certain conditions"

From parts of this thesis, other literature, and some media coverage, one may get the impression that digitalization in health care is a problem rather than a possibility – especially when viewed through the eyes of the average health care professional. However, that was not the predominant picture provided in our study of primary care physicians' experience of digital health (Paper 1). Rather, the physicians were generally positive, but more cautious and skeptical when it came to specific tools – at least partially due to the experience that things did not always work out as hoped for (19). This conditionally positive view we termed "useful under certain conditions".

The health-promoting text message intervention for primary care patients with hypertension, from which the material for Papers 3 and 4 was provided, could serve as an example of a potentially clinically useful application of digital health.

Analyzing behavioral changes during the intervention, we found positive effects regarding alcohol use and physical activity in the text message group compared to the control group (Paper 4). There was a statistically significant decrease in the proportion of text message recipients reporting alcohol use >4 standard units per week (odds ratio [OR] 0.35, 95% confidence interval [CI] 0.15-0.81). There was also a significant decrease in the proportion that reported physical activity <150 minutes per week (OR 0.60, 95% CI 0.37-0.98), and a corresponding increase in total weekly moderate-intensity physical activity of 25.8 (95% CI 2.7-48.9) minutes. However, no effect was seen on smoking habits (Paper 4).

Our findings are in line with prior research on text messages with lifestyle advice for cardiovascular prevention, which indicates small but potentially clinically significant effects (57, 98, 101, 193, 243). These results are also in line with existing evidence on digital health interventions for chronic conditions. Such interventions show overall promising effects but with some heterogeneity (98, 244-248). A recent meta-meta-analysis of digital health interventions for lifestyle behaviors found improvements across different behaviors including physical activity, diet, and body weight. The mean difference for moderate-to-vigorous physical activity was 55.1 (95% CI 13.8-96.4) minutes per week. Subgroup analyses did not yield significant results, which was interpreted to signal that digital health interventions can be efficient across modes of delivery and populations (246). Similarly, a meta-analysis of cardiorespiratory fitness effects of digital health interventions reported no difference depending on the mode of intervention (247).

The recently published analysis of the primary outcome measure of the PUSHME trial, blood pressure change, did not show any statistically significant difference between the text message and control groups (213). However, subgroup analyses indicated that the diastolic blood pressure was significantly lowered in the text message group compared to the control group for patients with a sedentary lifestyle and patients with poor self-rated health at baseline (213). The suggested minor effects on blood pressure change are in line with a recent Cochrane review of text messaging interventions in secondary prevention of CVD, even if a meta-analysis of digital health interventions for patients with hypertension has indicated somewhat more promising effects of text messaging on blood pressure (98, 249). Both reviews requested evidence of higher quality (98, 249).

To summarize, there is a potential for clinically significant effects of digital health interventions on lifestyle habits. This potential also encompasses relatively simple interventions such as text messages, including in a Swedish primary care context. Nevertheless, one must also take into consideration how patients experience such an intervention. Such considerations may contribute to increased clinical effects, including blood pressure change.

Regarding overall patient experience, our qualitative interview study of the PUSHME intervention (Paper 3) echoed the reports of participant experience from

similar interventions. As in other studies, we found that the text messages were generally perceived to be useful and positive to receive (97, 99-101, 250, 251). Furthermore, in accordance with prior research, our analysis indicated remaining deficiencies in patient knowledge and health care professionals' communication concerning lifestyle, hypertension, and the risk for disease (252-254). Thus, our results concur with existing evidence in implying a clinical potential and need for digital health interventions with regard to hypertension and lifestyle habits. However, the question of optimizing the effects remains.

Application of behavioral theories

Existing evidence at the initiation of the PUSHME trial suggested that behavioral theories can increase the effectiveness and transferability of lifestyle interventions, including digital health interventions for cardiovascular prevention (196, 197). Consequently, to explore and understand the effects of the PUSHME intervention, we used the TPB for quantitative and qualitative analysis.

The quantitative questionnaire based on the TPB (Paper 4) could not identify any mediators or moderators of intervention effects. However, our interview study regarding participant experience (Paper 3) did provide some insights that can be further explored in relation to the scientific literature.

Behavioral theories used to evaluate lifestyle interventions vary, even if the TPB is among the more frequently applied (197, 255). Regardless of the theoretical framework, behavioral change is often discussed in terms of barriers and facilitators (97, 99, 100, 252, 256). Prior research on similar interventions appears to have focused more on facilitators than barriers (97, 99, 100, 250). Our analysis covered barriers as well as facilitators to change in the third and last theme, "Water off a duck's back or a kick in the pants – when does behavior change?".

Facilitators or enablers of lifestyle change in common with other studies included advice from a credible source (health care), association with motivating factors such as a diagnosis related to CVD, and a feeling of support (99, 100, 250). The seemingly most important factor from our analysis, however, was sufficient individualization or tailoring of the text messages. This need or suggestion recurs in other studies (100, 250, 256). Accordingly, the barriers to change that emerged from our analysis primarily seemed due to a lack of individualization: messages not being sufficiently adapted to prior knowledge, lifestyle, or limitations (perceived or real).

More recent applications of the TPB have focused on the importance of experiential attitude (affective state associated with the behavior) as opposed to instrumental attitude (consequences of the behavior) (75). It has also been suggested to explore a focus on practical skills or demonstration of the desired behavior rather than the outcome (e.g., blood pressure), as the latter shifts focus away from the behavior (247, 257, 258). These findings bear obvious similarities with our proposal of

specific suggestions for lifestyle change as an intervention factor that could contribute to behavioral change.

Consequently, text message advice with specific suggestions for lifestyle change adapted to the individual participant might be an interesting intervention for future exploration (77). To minimize barriers, the advice should be sufficiently adapted to the participants' perceived and real limitations of behavioral change (77).

"Need for evaluation"

Remembering the views of the primary care physicians in Paper 1, we should consider the need for evaluation of new digital health technologies more in-depth. Papers 3 and 4 have not evaluated the health-promoting text message intervention in terms of effects on workflow or opportunity costs. Thus, even for a simple text message intervention, further evaluation is needed before application in clinical practice.

In summary, digital health interventions remain a promising addition in the prevention and treatment of lifestyle-related diseases. Well-implemented, digital health technologies may help with some tasks such as simpler lifestyle advice so that health care professionals can focus on those in need of more intensive interventions and treatment.

General discussion in relation to literature

The importance of evaluation

The results of the papers included in this thesis concur with and underline a recurring recommendation from other studies and reviews: the importance of evaluation in the development and use of digital health technologies. Key areas in this respect include patient safety and the workload of health care professionals (Paper 1), health equity (Paper 2), and health care quality and efficiency (Papers 2-4) (17-20, 52, 53). A repeated request has been to involve end users (19). Implementation science and frameworks have been suggested previously (51). Consequently, the first part of the general discussion will focus on these areas.

End user involvement

A newly published overview of reviews of digital health in primary care found agreement between included studies in that development without the involvement of end users was a major implementation barrier (259). Furthermore, the overview reported mixed results with regard to effects on quality and clinical outcomes – which were proposed to be due to inadequate implementation (259). A systematic review of reviews regarding the implementation of digital health similarly

concluded that fit with organizational workflow was a key facilitator of implementation (62). Reviews of specific digital health technologies such as clinical decision support systems and mHealth also stress the need to include end users in the development process (63, 65). Consequently, the involvement of end users should be an integral part of the development and implementation of digital health technologies to further clinical relevance (260).

To involve end users may appear self-evident. Yet, according to the experiences of the primary care physicians in Paper 1, and recurring recommendations in other studies and viewpoint papers, it is not (19, 232, 233). Furthermore, end user involvement may preferably be structured by an implementation framework to optimize effects (51). Implementation research has also been recommended by the WHO to further the prevention and treatment of NCDs (261).

An implementation framework for digital health technologies

This thesis has not studied implementation frameworks, but the overall results lead to suggesting better use of such frameworks. In 2017, Greenhalgh and colleagues proposed an often-cited new framework focused on challenges related to the implementation of digital health technologies (51). The framework was based on an analysis of existing frameworks, observations, interviews, and organizational data. The idea was to go beyond the question of adoption and address the recurring problems of non-adoption, transferability, and sustained use of new digital health technologies. It was named the Non-adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) framework (51).

In the NASSS framework, seven domains – condition, technology, adopter system, value proposition, organization, wider system, and adaptation over time – are covered through questions (51). In short, supposing the technology is found to be worth developing (value proposition), the less complex the challenges with regard to the seven domains, the greater the chance of success (51). A Complexity Assessment Toolkit (CAT) was subsequently added, and the NASSS-CAT was adapted to further use in real-world projects (262-264). NASSS-CAT tools appear to be under use and further evaluation, including in Sweden (264, 265).

Provisional application of an implementation framework

Application of implementation frameworks such as the NASSS-CAT could contribute to digital tools of greater perceived clinical usefulness (51, 264). In the specific context of this thesis, it could be used to evaluate the health-promoting text message intervention with regard to possible implementation (Papers 3 and 4).

A simple application of the short version of NASSS-CAT to the PUSHME intervention quickly identified a need to take co-existing illnesses or impairments into account (also described by the interview study participants) and for more information on acceptance of health care professionals (51, 264, 266). Perhaps most

importantly, there appeared a need to detail the value proposition regarding value for the health care system and the end users, and also to consider possible negative value. So, even with the technology being simple and the patients finding it useful, there are still areas that need to be addressed (51, 264, 266).

The need for contextual, thorough, and iterative evaluation of digital health technologies could suggest why use is not more widespread despite promise and promotion (51, 57, 111, 113, 267). Considering the overall evidence base for text messaging for cardiovascular prevention, as previously outlined indications are promising (57, 98, 101, 193, 243). Nonetheless, the value proposition still contains uncertainties regarding effects and consequently also cost-effectiveness (98, 249, 264). At the aggregate level, there is evidence that digital health interventions including those distributed via text message are often cost-effective (2, 55, 268). However, results for hypertension are inconclusive compared to those for type 2 diabetes (268, 269). Thus, the components that affect the value proposition – the condition/illness, the technology, and the intended adopters – might need to be reconsidered, with subsequent changes and re-evaluation (264).

Scaling up

As discussed in the preceding subchapter, the digital health technologies studied in this thesis may not primarily be at the scale-up stage but rather at a stage where re-evaluation within a suitable implementation framework could be considered. However, future possibilities for scale-up need to be appraised at all stages of the design process. A prevailing issue in the digital health arena is that tools are often used in limited contexts and never scaled up (51, 270, 271). For example, substantial developmental work has been done separately for different text message interventions for cardiovascular prevention, and transferability remains unclear (271).

There is design knowledge that could be more extensively used in the development of digital health technologies (272). User-friendly design is vital to further digital health equity and spread across settings (273). Behavioral science is another field of research that can contribute to the development of digital health (77, 196, 197, 204). In other words, interdisciplinary research is recommendable in the continued development of digital health (270).

As a final note in this subchapter, it has been put forth that RCTs may not always be the best way to evaluate digital health technologies (60, 270). A common property of digital tools is adaptability and change – which is not compatible with the static intervention assumed by an RCT (270). At any rate, before conducting an RCT, the technology should be stable, the implementation process clear, and a positive outcome expected (60).

Primary health care, cardiovascular prevention, and digital health

Connecting back to the Background section, I described the goal of primary health care as providing good health for all, and general practice as a part of attaining that goal (30, 33). In Sweden, the term general practice tends to be used synonymously with primary health care, but there is value in remembering that general practice is only one part of primary health care. General practice is an important vehicle for the provision of health care through general and specific knowledge of disease and the health care system, and through relational continuity between practitioners and patients (33). However, it should not be the only vehicle for attaining all of the goals of primary health care (30). Primary and some large-scale secondary prevention of steadily rising lifestyle-related diseases should be complemented by work at the public health and community health levels (107, 113).

Community-based CVD prevention programs have been shown to result in multiple risk factor improvements, even if effects vary depending on context (274). The Swedish community-based Västerbotten Intervention Program has been shown to be cost-effective (275). Moving on to the health care professionals' office, nurse-led or multidisciplinary teams have been suggested and successfully tested for the management of hypertension in primary care (276-278). Utilizing these primary and secondary preventive efforts could, firstly, decrease the number of individuals in need of medical treatment, and, secondly, allow for GPs to be involved when needed, thus using health care resources more efficiently. Adding digital health technologies to such projects would appear to be an interesting way to further increase efficiency. mHealth interventions directed at lifestyle habits have been indicated to be more effective for lowering blood pressure in combination with a face-to-face intervention (243).

To conclude, community-based cardiovascular prevention programs, nurse-led management of hypertension, and digital health technologies for cardiovascular prevention have some important aspects in common. As studies are heterogeneous, a need remains to discern which components of the interventions are efficient and to consider transferability between settings (246, 274, 276). Furthermore, possible side effects including psychosocial harms should be explored (172, 174). Consequently, future research could benefit from the use of implementation frameworks, behavioral theory, and mixed methods to cover important aspects of these potentially large-scale health-promoting interventions (51, 77, 196, 215). That may increase the possibility of achieving population health gains from cardiovascular prevention efforts and digital health technologies.

Conclusions

Conclusions in relation to aims

Paper 1 underlined the significance of including health care professionals in the development and implementation of new digital health technology, as tools that end users cannot use as intended will likely be of less clinical benefit. Areas for evaluation of particular importance to general practice were the consequences of digital filters put between patient and health care provider, and an increased number of patient access routes.

Main clinical implications: Clinical usefulness, patient safety, and workload issues should be carefully considered when new digital tools are introduced in primary care.

Paper 2 put forth the importance of considering the effects on health care resource use and health equity when virtual visits are introduced, as the studied eVisits primarily attracted young to middle-aged patient groups with simple conditions such as skin diagnoses. There were no indications of patient safety risks related to eVisits, as most patients did not require face-to-face follow-up and very few patients needed to seek an emergency unit. The frequency of subsequent health care contacts depending on diagnosis indicated a need for further study regarding infections and unspecific complaints, but did not allow for conclusions due to interpretability issues.

Main clinical implications: Older patient groups may need support to access and use eVisits. The effects of eVisits on health care resource use warrants further investigation.

Paper 3 indicated tolerability and potential usefulness of a health-promoting text message intervention to primary care patients with hypertension. Factors of possible importance for effectiveness included health care being the sender, timing in relation to motivational factors, and specific suggestions for making lifestyle changes. Effectiveness might be increased by individualization of the messages according to the recipient's prior knowledge, routines, and constraints.

Paper 4 showed that health-promoting text messages to primary care patients with hypertension in the dose of four messages per week for six months could affect lifestyle habits in the form of decreased alcohol use and increased physical activity. Behavioral theory did not provide additional insights but may be applied in more detail.

Main clinical implications: The health-promoting text message intervention PUSHME could be suggested for use in clinical practice. However, additional investigation regarding individualization, cost-effectiveness, and implementation in workflow is recommended.

The overarching conclusion is that digital health technologies have great potential to further the goals of primary health care. However, to improve clinical usefulness and achieve some of the potential population health benefits, development needs to include end users and employ appropriate implementation frameworks.

As a final reflection, at all stages of evaluation it is vital to remember the human context where digital health is used. Paper 1 may remind us of the importance of personal contact between patient and provider, which cannot always be measured. Paper 2 illustrates the difficulty of evaluating health care use patterns – who is really to say when a health care contact is valuable or not? Paper 3 points to the need for individualization of interventions directed at the divergent group of primary care patients. For Paper 4, the attempt to apply the TPB did elucidate a disagreement between the patients' expressed intention for a healthy lifestyle and their susceptibility to health-promoting advice which illustrates the complexities of predicting human behavior.

Future research suggestions

Paper 1: Health care professionals' experience of digital health

- Increase end user involvement (patients and professionals) through co-design or participatory research projects with regard to digital health technologies.
- Considering primary care physicians' experience, focus on:
    - Technological infrastructure.
    - Workload issues.
    - Risks related to the loss of face-to-face contact between patients and health care providers.

Paper 2: Virtual patients contacts and health care use

- RCTs comparing virtual and face-to-face visits, primarily with regard to follow-up frequencies, quality measures such as antibiotic prescriptions and patient satisfaction, and health care expenditure. Comparisons could also be made depending on presenting complaints.
- Explore the effects of continuity, comparing virtual visits with the patient's own GP, with a professional at the patient's primary health care center, or separate from it. This has been investigated through some register-based studies for example in Canada but could be further studied in a Swedish primary care context (11).

Papers 3 and 4: Health-promoting text messages for patients with hypertension

- Explore health care professionals' views and acceptance towards the intervention through interview, focus group and/or questionnaire studies.
- Evaluate suggested changes to the intervention:
    - Individualization with regard to knowledge, habits, and limitations.
    - More specific suggestions for lifestyle change, also attempting to provide "eureka moments" for patients with new suggestions.
- Include diet in intermediate outcome measures.
- Consider alternative outcome measures such as home blood pressure.
- Compare different intensities and time periods of intervention.
- Repeat intervention with partially new content.
- Long-term follow-up of outcomes.

- Evaluate combination with face-to-face consultations, possibly for groups with different cardiovascular risks.
- Expand the target population by adapting and including a text message lifestyle intervention in community-based cardiovascular prevention.
- More thorough application of the TPB, or another suitable behavioral theory, to understand the mechanisms of the intervention.

Suggestions relating to all papers

- Application of implementation frameworks such as NASSS-CAT to digital health technologies (51).
- Increased use of behavioral theories to explore patient and staff acceptance of digital health more in-depth, and to understand and improve the effects of digital health interventions.
- Scientific discussion and studies are needed regarding how and to what extent research results on digital health technologies can be transferred between settings. This also applies to lifestyle interventions.
- Continued cost-effectiveness studies of digital health technologies.
- Time needed to treat measures for digital health technologies compared to usual care (279).
- Environmental effects of digital health technologies (280, 281).
- Interdisciplinary research may be preferable for several of these suggestions, to gain the level of expertise needed to provide high-quality research and to promote synergistic effects.

Populärvetenskaplig sammanfattning

Kärt barn har många namn. Digitalisering, digitala verktyg, e-hälsa och telemedicin är bara några termer som används för att beskriva den digitala utvecklingen i samhället och i sjukvården. Digitaliseringen har en mängd fördelar – tänk bara på all information som vi nu kan både skicka och få med några knapptryck. Samtidigt är det en genomgripande förändring, där man behöver analysera konsekvenserna. Ett viktigt område för utvärdering är användandet av digitala verktyg i hälso- och sjukvården. Digitalisering i hälso- och sjukvården kan ha såväl positiva som negativa konsekvenser för hur vården fungerar och därmed påverka människors hälsa.

Det finns och genomförs en hel del forskning på olika typer av digitalisering inom hälso- och sjukvården. Men eftersom området är förhållandevis nytt och utvecklingen går fort så finns också mycket kvar att utforska. För att bidra till kunskapsutvecklingen så har jag i det här doktorandprojektet studerat digitala verktyg i primärvården i södra Sverige ur olika aspekter.

Doktorandprojektet består av fyra delstudier. De handlar om allmänläkares erfarenheter av digitalisering, digitala besök i primärvården samt patientupplevelse och effekter av hälsobefrämjande sms vid högt blodtryck.

I den första delstudien fick allmänläkare i södra Sverige svara på olika frågor om sin upplevelse av digitaliseringen i primärvården via ett digitalt formulär. Genom vetenskaplig analys av svaren kom vi fram till några övergripande slutsatser. Allmänläkarna var i grunden positiva till en ökad användning av digitala verktyg, men såg också att befintliga digitala lösningar ofta inte fungerade så bra som man skulle vilja. Den personliga kontakten med patienterna minskade, och antalet ingångar för vårdkontakt ökade. Det gav en större arbetsbelastning, och man såg en ökad risk för missförstånd och för att patienter inte skulle få rätt vård i rätt tid. Den huvudsakliga slutsatsen av studien är att utvärderingen av digitala verktyg behöver stärkas, och att vårdpersonalen bör involveras mer och tidigare i processen.

I den andra delstudien undersökte vi en av de nya ingångarna för vårdkontakt: digitala besök i primärvården, i det här fallet chatbesök i Region Skånes regi (Primärvården Skåne Online, PVonline). Vi använde information från vårdregister för att beskriva vilka patienter som sökte PVonline under 2021, vad de fick för diagnos och om de hade ytterligare vårdkontakter efter det digitala besöket. Vi såg att patienterna var relativt unga; få var över 60 år gamla. Nära hälften

diagnosticerades med olika typer av hudbesvär. De flesta (tre fjärdedelar) sökte inte fysisk vård inom två veckor efter det digitala besöket. Det var vanligare med ett uppföljande fysiskt besök för patienter som sökt för infektioner eller för ospecifika besvär jämfört med andra diagnoser.

Den huvudsakliga slutsatsen av studien är att digitala besök i skånsk primärvård i stor utsträckning rörde enklare besvär hos unga till medelålders, och att patienterna hade ett relativt litet uppföljande vårdbehov. När digitala besök införs bör man följaktligen utvärdera hur det påverkar olika gruppers tillgång till vård, utifrån principen att vård ska ges efter behov.

I den tredje och fjärde delstudien undersökte vi hälsobefrämjande sms till patienter med högt blodtryck i primärvård. Cirka 400 deltagare slumpades till att få sms eller inte. Vi intervjuade ett riktat urval av dem som fick sms kring deras upplevelser. Det framkom ett behov av mer kunskap om kopplingarna mellan levnadsvanor, högt blodtryck och risken för hjärtkärlsjukdom. Deltagarna uppskattade överlag att få sms:en. De upplevdes som en nyttig påminnelse, och en rationell användning av vårdresurser. Samtidigt efterfrågade man större anpassning av innehållet till tidigare kunskap och erfarenheter.

För vissa deltagare verkade sms:en fungera som ”en spark i baken”, medan de för andra rann av ”som vatten på en gås”. Vi analyserade resultaten i ett beteendeteoretiskt ramverk, och kom då fram till att större fokus på specifika förslag som kan tillämpas i vardagen skulle kunna ge ökad effekt av interventionen. Slutsatsen blir att det finns ett behov av information och att sms:en upplevdes som en nyttig påminnelse, men skulle kunna individanpassas för att göra större nytta.

I den fjärde delstudien analyserade vi om levnadsvanorna (rökning, alkoholkonsumtion och fysisk aktivitet) förändrades i gruppen som fick hälsobefrämjande sms jämfört med kontrollgruppen som inte fick sms. Vi såg att de som fick sms totalt sett minskade sin alkoholkonsumtion och ökade sin fysiska aktivitet. Vi använde även en beteendeteori för att se om vi kunde hitta frågor att ställa för att förutsäga om en patient skulle förändra sina vanor till följd av sms:en. Vi fann inte något sådant samband. Sammanfattningsvis talar vår analys för att patienter med högt blodtryck i primärvård kan ha nytta av hälsobefrämjande sms i syfte att förbättra sina levnadsvanor.

För att sammanfatta hela doktorandprojektet, och återknyta till syftet, så kan digitala verktyg vara till nytta för patienter i primvården exempelvis genom sms-interventioner som enkelt når många med riktad hälsobefrämjande information. Man kan öka användbarheten genom att inkludera personal och patienter i utformning, införande och utvärdering. Man behöver ta specifik hänsyn till hur digitaliseringen, särskilt digitala besök, påverkar jämlik tillgång till vård. Fokus måste med andra ord var på hur de digitala verktygen kan bidra till att förbättra vården – inte på om digitalisering i sig är bra eller dåligt.

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References

1. World Health Organization. Global strategy on digital health 2020-2025 [Internet]. Geneva: World Health Organization; 2021 [cited 2024 Nov 12]. Available from: https://www.who.int/publications/i/item/9789240020924.
2. Eze ND, Mateus C, Cravo Oliveira Hashiguchi T. Telemedicine in the OECD: An umbrella review of clinical and cost-effectiveness, patient experience and implementation. PLoS One. 2020;15(8):e0237585. doi:10.1371/journal.pone.0237585.
3. World Health Organization. Disability-adjusted life years (DALYs) [Internet]. Geneva: World Health Organization; 2024 [cited 2024 Nov 24]. Available from: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/158.
4. World Health Organization. WHO guideline recommendations on digital interventions for health system strengthening [Internet]. Geneva: World Health Organization; 2019 [cited 2024 Nov 12]. Available from: https://www.who.int/publications/i/item/9789241550505.
5. Borges do Nascimento IJ, Abdulazeem HM, Vasanthan LT, Martinez EZ, Zucoloto ML, Ostengaard L, et al. The global effect of digital health technologies on health workers' competencies and health workplace: an umbrella review of systematic reviews and lexical-based and sentence-based meta-analysis. Lancet Digit Health. 2023;5(8):e534-e44. doi:10.1016/S2589-7500(23)00092-4.
6. World Health Organization. Digital tools positively impact health workers' performance, new WHO study shows [Internet]. Geneva: World Health Organization; 2023 [updated 2023 Jul 27; cited 2024 Nov 12]. Available from: https://www.who.int/europe/news/item/27-07-2023-digital-tools-positively-impact-health-workers--performance--new-who-study-shows.
7. European Foundation for the Improvement of Living and Working Conditions. Digitalisation [Internet]. Dublin: European Foundation for the Improvement of Living and Working Conditions; 2024 [cited 2024 Nov 12]. Available from: https://www.eurofound.europa.eu/en/topic/digitalisation.
8. Glock H, Jakobsson U, Borgstrom Bolmsjo B, Milos Nymberg V, Wolff M, Calling S. eVisits to primary care and subsequent health care contacts: a register-based study. BMC Prim Care. 2024;25(1):297. doi:10.1186/s12875-024-02541-y.

9. World Health Organization Regional Office for Europe. The ongoing journey to commitment and transformation: digital health in the WHO European Region, 2023 [Internet]. Copenhagen: World Health Organization Regional Office for Europe; 2023 [cited 2024 Nov 12]. Available from: https://www.who.int/europe/publications/digital-health-in-the-who-european-region-the-ongoing-journey-to-commitment-and-transformation.
10. Ekman B, Thulesius H, Wilkens J, Lindgren A, Cronberg O, Arvidsson E. Utilization of digital primary care in Sweden: Descriptive analysis of claims data on demographics, socioeconomics, and diagnoses. Int J Med Inform. 2019;127:134-40. doi:10.1016/j.ijmedinf.2019.04.016.
11. Lapointe-Shaw L, Salahub C, Austin PC, Bai L, Bhatia RS, Bird C, et al. Virtual Visits With Own Family Physician vs Outside Family Physician and Emergency Department Use. JAMA Netw Open. 2023;6(12):e2349452. doi:10.1001/jamanetworkopen.2023.49452.
12. Mold F, Cooke D, Ip A, Roy P, Denton S, Armes J. COVID-19 and beyond: virtual consultations in primary care-reflecting on the evidence base for implementation and ensuring reach: commentary article. BMJ Health Care Inform. 2021;28(1). doi:10.1136/bmjhci-2020-100256.
13. Nergårdh A, Andersson L, Brage A-K, Eklöf N, Elgán C-O, Printz M. God och nära vård: en reform för ett hållbart hälso- och sjukvårdssystem [Good and close care: a reform for a sustainable health care system] [Internet]. Stockholm: Swedish Ministry of Health and Social Affairs; 2020 [cited 2023 May 25]. Available from: https://www.regeringen.se/rattsliga-dokument/statens-offentliga-utredningar/2020/04/sou-202019/.
14. GBD 2021 Diseases and Injuries Collaborators. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2024;403(10440):2133-61. doi:10.1016/S0140-6736(24)00757-8.
15. GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1204-22. doi:10.1016/S0140-6736(20)30925-9.
16. Swedish Ministry of Health and Social Affairs. Vision for eHealth 2025 - common starting points for digitalisation of social services and health care [Internet]. Stockholm: Swedish Ministry of Health and Social Affairs; 2016 [cited 2023 May 28]. Available from: https://ehalsa2025.se/wp-content/uploads/2021/02/vision-for-ehealth-2025.pdf.
17. Mold F, Hendy J, Lai YL, de Lusignan S. Electronic Consultation in Primary Care Between Providers and Patients: Systematic Review. JMIR Med Inform. 2019;7(4):e13042. doi:10.2196/13042.
18. Hickson R, Talbert J, Thornbury WC, Perin NR, Goodin AJ. Online medical care: the current state of "eVisits" in acute primary care delivery. Telemed J E Health. 2015;21(2):90-6. doi:10.1089/tmj.2014.0022.

19. Abernethy A, Adams L, Barrett M, Bechtel C, Brennan P, Butte A, et al. The Promise of Digital Health: Then, Now, and the Future. NAM Perspect. 2022;2022. doi:10.31478/202206e.
20. Pagliari C. Digital health and primary care: Past, pandemic and prospects. J Glob Health. 2021;11:01005. doi:10.7189/jogh.11.01005.
21. Ledley RS, Lusted LB. Reasoning foundations of medical diagnosis; symbolic logic, probability, and value theory aid our understanding of how physicians reason. Science. 1959;130(3366):9-21. doi:10.1126/science.130.3366.9.
22. Atherton J. Development of the electronic health record. Virtual Mentor. 2011;13(3):186-9. doi:10.1001/virtualmentor.2011.13.3.mhst1-1103.
23. Andersson G. Using the Internet to provide cognitive behaviour therapy. Behav Res Ther. 2009;47(3):175-80. doi:10.1016/j.brat.2009.01.010.
24. Holmstrom I. Decision aid software programs in telenursing: not used as intended? Experiences of Swedish telenurses. Nurs Health Sci. 2007;9(1):23-8. doi:10.1111/j.1442-2018.2007.00299.x.
25. Johansson AM, Lindberg I, Soderberg S. Healthcare personnel's experiences using video consultation in primary healthcare in rural areas. Prim Health Care Res Dev. 2017;18(1):73-83. doi:10.1017/S1463423616000347.
26. Eldh AC, Sverker A, Bendtsen P, Nilsson E. Health Care Professionals' Experience of a Digital Tool for Patient Exchange, Anamnesis, and Triage in Primary Care: Qualitative Study. JMIR Hum Factors. 2020;7(4):e21698. doi:10.2196/21698.
27. Svenberg J. Länge leve faxen - över 4000 maskiner kvar i regionerna [Long live the fax - more than 4000 machines left in the regions]. Dagens medicin [Today's medicine] [Internet]. 2023 Sep 23 [cited 2024 Nov 13]. Available from: https://www.dagensmedicin.se/vardens-styrning/digitalisering/lange-leve-faxen-over-4-000-maskiner-kvar-i-regionerna/.
28. Mathews SC, McShea MJ, Hanley CL, Ravitz A, Labrique AB, Cohen AB. Digital health: a path to validation. NPJ Digit Med. 2019;2:38. doi:10.1038/s41746-019-0111-3.
29. International Conference on Primary Health Care. Declaration of Alma-Ata. WHO Chron. 1978;32(11):428-30. Available from: https://www.who.int/publications/i/item/declaration-of-alma-ata.
30. World Health Organization and the United Nations Children's Fund (UNICEF). A vision for primary health care in the 21st century: towards universal health coverage and the Sustainable Development Goals [Internet]. Geneva: World Health Organization and the United Nations Children's Fund (UNICEF); 2018 [cited 2024 Nov 17]. Available from: https://iris.who.int/handle/10665/328065.
31. World Health Organization. Primary care [Internet]. Geneva: World Health Organization; 2024 [cited 2024 Nov 16]. Available from: https://www.who.int/teams/integrated-health-services/clinical-services-and-systems/primary-care.

32. World Health Organization and the United Nations Children's Fund (UNICEF). Operational framework for primary health care: transforming vision into action [Internet]. Geneva: World Health Organization and the United Nations Children's Fund (UNICEF); 2020 [cited 2024 Nov 16]. Available from: https://www.who.int/publications/i/item/9789240017832.
33. World Organization of National Colleges Academies and Academic Associations of General Practitioners/Family Physicians Europe. The European definition of general practice/family medicine [Internet]. Ljubljana: WONCA Europe; 2023 [cited 2024 Nov 16]. Available from: https://www.woncaeurope.org/kb/european-definition-gp-fm-2023.
34. Jamoulle M, Resnick M, Vander Stichele R, Ittoo A, Cardillo E, Vanmeerbeek M. Analysis of definitions of general practice, family medicine, and primary health care: a terminological analysis. BJGP Open. 2017;1(3):bjgpopen17X101049. doi:10.3399/bjgpopen17X101049.
35. Royal College of General Practitioners. Becoming a GP [Internet]. London: Royal College of General Practitioners; 2024 [cited 2024 Nov 16]. Available from: https://www.rcgp.org.uk/your-career/becoming-a-gp.
36. American Academy of Family Physicians. The specialty of family medicine [Internet]. Leawood (KS): American Academy of Family Physicians; 2024 [cited 2024 Nov 16]. Available from: https://www.aafp.org/about/dive-into-family-medicine/family-medicine-speciality.html.
37. Swedish Medical Association. Description of the objectives for doctors' specialty training [Internet]. Stockholm: Swedish Medical Association; 2018 [cited 2024 Nov 16]. Available from: https://slf.se/app/uploads/2019/01/description-of-the-objectives-for-doctors-specialty-training.pdf.
38. Grueninger U. European definition of family medicine: core competencies and characteristics (WONCA 2002/2011) [Figure]. Swiss College of Primary Care Medicine; 2004/2011.
39. Swedish National Board of Health and Welfare. About the Swedish healthcare system [Internet]. Stockholm: Swedish National Board of Health and Welfare; 2024 [cited 2024 Nov17]. Available from: https://www.socialstyrelsen.se/en/about-us/healthcare-for-visitors-to-sweden/about-the-swedish-healthcare-system/.
40. Swedish National Board of Health and Welfare. Om primärvård [Regarding primary care] [Internet]. Stockholm: Swedish National Board of Health and Welfare; 2024 [cited 2024 Nov 17]. Available from: https://kunskapsguiden.se/omraden-och-teman/god-och-nara-vard/fast-lakarkontakt-och-vardkontakt/om-primarvard/.
41. Black RE, Taylor CE, Arole S, Bang A, Bhutta ZA, Chowdhury AMR, et al. Comprehensive review of the evidence regarding the effectiveness of community-based primary health care in improving maternal, neonatal and child health: 8. summary and recommendations of the Expert Panel. J Glob Health. 2017;7(1):010908. doi:10.7189/jogh.07.010908.
42. Kruk ME, Porignon D, Rockers PC, Van Lerberghe W. The contribution of primary care to health and health systems in low- and middle-income countries: a critical review of major primary care initiatives. Soc Sci Med. 2010;70(6):904-11. doi:10.1016/j.socscimed.2009.11.025.

43. Starfield B. Primary care: an increasingly important contributor to effectiveness, equity, and efficiency of health services. SESPAS report 2012. Gac Sanit. 2012;26 Suppl 1:20-6. doi:10.1016/j.gaceta.2011.10.009.
44. World Health Organization. Non-communicable diseases [Internet]. Geneva: World Health Organization; 2023 [cited 2024 Nov 17]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
45. GBD Causes of Death Collaborators. Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2024;403(10440):2100-32. doi:10.1016/S0140-6736(24)00367-2.
46. The Lancet Global Health. Getting to the heart of non-communicable diseases. Lancet Glob Health. 2018;6(9):e933. doi:10.1016/S2214-109X(18)30362-0.
47. Piovani D, Nikolopoulos GK, Bonovas S. Non-Communicable Diseases: The Invisible Epidemic. J Clin Med. 2022;11(19). doi:10.3390/jcm11195939.
48. GBD Forecasting Collaborators. Burden of disease scenarios for 204 countries and territories, 2022-2050: a forecasting analysis for the Global Burden of Disease Study 2021. Lancet. 2024;403(10440):2204-56. doi:10.1016/S0140-6736(24)00685-8.
49. United Nations. Transforming our world: the 2030 agenda for sustainable development [Internet]. New York (NY): United Nations; 2015 [cited 2024 Nov 18]. Available from: https://sdgs.un.org/2030agenda.
50. European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Commitee of the Regions on enabling the digital transformation of health and care in the Digital Single Market; empowering citizens and building a healthier society [Internet]. Brussels: European Commission; 2018 [cited 2024 Nov 18]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:233:FIN.
51. Greenhalgh T, Wherton J, Papoutsi C, Lynch J, Hughes G, A'Court C, et al. Beyond Adoption: A New Framework for Theorizing and Evaluating Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies. J Med Internet Res. 2017;19(11):e367. doi:10.2196/jmir.8775.
52. Cummins N, Schuller BW. Five Crucial Challenges in Digital Health. Front Digit Health. 2020;2:536203. doi:10.3389/fdgth.2020.536203.
53. Alami H, Lehoux P, Shaw SE, Papoutsi C, Rybczynska-Bunt S, Fortin JP. Virtual Care and the Inverse Care Law: Implications for Policy, Practice, Research, Public and Patients. Int J Environ Res Public Health. 2022;19(17). doi:10.3390/ijerph191710591.
54. Litchfield I, Shukla D, Greenfield S. Impact of COVID-19 on the digital divide: a rapid review. BMJ Open. 2021;11(10):e053440. doi:10.1136/bmjopen-2021-053440.
55. Bashshur RL, Howell JD, Krupinski EA, Harms KM, Bashshur N, Doarn CR. The Empirical Foundations of Telemedicine Interventions in Primary Care. Telemed J E Health. 2016;22(5):342-75. doi:10.1089/tmj.2016.0045.

56. Nguyen OT, Alishahi Tabriz A, Huo J, Hanna K, Shea CM, Turner K. Impact of Asynchronous Electronic Communication-Based Visits on Clinical Outcomes and Health Care Delivery: Systematic Review. J Med Internet Res. 2021;23(5):e27531. doi:10.2196/27531.
57. Klimis H, Thakkar J, Chow CK. Breaking Barriers: Mobile Health Interventions for Cardiovascular Disease. Can J Cardiol. 2018;34(7):905-13. doi:10.1016/j.cjca.2018.02.012.
58. Kruse CS, Ehrbar N. Effects of Computerized Decision Support Systems on Practitioner Performance and Patient Outcomes: Systematic Review. JMIR Med Inform. 2020;8(8):e17283. doi:10.2196/17283.
59. Zakim D. Development and significance of automated history-taking software for clinical medicine, clinical research and basic medical science. J Intern Med. 2016;280(3):287-99. doi:10.1111/joim.12509.
60. Murray E, Hekler EB, Andersson G, Collins LM, Doherty A, Hollis C, et al. Evaluating Digital Health Interventions: Key Questions and Approaches. Am J Prev Med. 2016;51(5):843-51. doi:10.1016/j.amepre.2016.06.008.
61. Tossaint-Schoenmakers R, Versluis A, Chavannes N, Talboom-Kamp E, Kasteleyn M. The Challenge of Integrating eHealth Into Health Care: Systematic Literature Review of the Donabedian Model of Structure, Process, and Outcome. J Med Internet Res. 2021;23(5):e27180. doi:10.2196/27180.
62. Ross J, Stevenson F, Lau R, Murray E. Factors that influence the implementation of e-health: a systematic review of systematic reviews (an update). Implement Sci. 2016;11(1):146. doi:10.1186/s13012-016-0510-7.
63. Jacob C, Sanchez-Vazquez A, Ivory C. Social, Organizational, and Technological Factors Impacting Clinicians' Adoption of Mobile Health Tools: Systematic Literature Review. JMIR Mhealth Uhealth. 2020;8(2):e15935. doi:10.2196/15935.
64. Gagnon MP, Desmartis M, Labrecque M, Car J, Pagliari C, Pluye P, et al. Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. J Med Syst. 2012;36(1):241-77. doi:10.1007/s10916-010-9473-4.
65. Khairat S, Marc D, Crosby W, Al Sanousi A. Reasons For Physicians Not Adopting Clinical Decision Support Systems: Critical Analysis. JMIR Med Inform. 2018;6(2):e24. doi:10.2196/medinform.8912.
66. Davis MM, Freeman M, Kaye J, Vuckovic N, Buckley DI. A systematic review of clinician and staff views on the acceptability of incorporating remote monitoring technology into primary care. Telemed J E Health. 2014;20(5):428-38. doi:10.1089/tmj.2013.0166.
67. Salisbury C, Murphy M, Duncan P. The Impact of Digital-First Consultations on Workload in General Practice: Modeling Study. J Med Internet Res. 2020;22(6):e18203. doi:10.2196/18203.
68. Murphy M, Scott LJ, Salisbury C, Turner A, Scott A, Denholm R, et al. Implementation of remote consulting in UK primary care following the COVID-19 pandemic: a mixed-methods longitudinal study. Br J Gen Pract. 2021;71(704):e166-e77. doi:10.3399/BJGP.2020.0948.

69. Fagerlund AJ, Holm IM, Zanaboni P. General practitioners' perceptions towards the use of digital health services for citizens in primary care: a qualitative interview study. BMJ Open. 2019;9(5):e028251. doi:10.1136/bmjopen-2018-028251.
70. Gronning A, Assing Hvidt E, Nisbeth Brogger M, Fage-Butler A. How do patients and general practitioners in Denmark perceive the communicative advantages and disadvantages of access via email consultations? A media-theoretical qualitative study. BMJ Open. 2020;10(10):e039442. doi:10.1136/bmjopen-2020-039442.
71. Bjorndell C, Premberg A. Physicians' experiences of video consultation with patients at a public virtual primary care clinic: a qualitative interview study. Scand J Prim Health Care. 2021;39(1):67-76. doi:10.1080/02813432.2021.1882082.
72. Johansson A, Larsson M, Ivarsson B. General Practitioners' Experiences of Digital Written Patient Dialogues: A Pilot Study Using a Mixed Method. J Prim Care Community Health. 2020;11:2150132720909656. doi:10.1177/2150132720909656.
73. Entezarjou A, Bolmsjo BB, Calling S, Midlov P, Milos Nymberg V. Experiences of digital communication with automated patient interviews and asynchronous chat in Swedish primary care: a qualitative study. BMJ Open. 2020;10(7):e036585. doi:10.1136/bmjopen-2019-036585.
74. Pikkemaat M, Thulesius H, Milos Nymberg V. Swedish Primary Care Physicians' Intentions to Use Telemedicine: A Survey Using a New Questionnaire - Physician Attitudes and Intentions to Use Telemedicine (PAIT). Int J Gen Med. 2021;14:3445-55. doi:10.2147/IJGM.S319497.
75. La Barbera F, Ajzen I. Instrumental vs. experiential attitudes in the theory of planned behaviour: two studies on intention to perform a recommended amount of physical activity. International Journal of Sport and Exercise Psychology. 2022:1-13. doi:10.1080/1612197X.2022.2161107.
76. Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes. 1991;50(2):179-211. doi:10.1016/0749-5978(91)90020-T.
77. Fishbein M, Ajzen I. Predicting and changing behavior: the reasoned action approach. 1st ed. New York (NY): Psychology Press; 2010.
78. Larsen JH, Neighbour R. Five cards: a simple guide to beginning the consultation. Br J Gen Pract. 2014;64(620):150-1. doi:10.3399/bjgp14X677662.
79. Ward K, Vagholkar S, Sakur F, Khatri NN, Lau AYS. Visit Types in Primary Care With Telehealth Use During the COVID-19 Pandemic: Systematic Review. JMIR Med Inform. 2022;10(11):e40469. doi:10.2196/40469.
80. Campbell K, Greenfield G, Li E, O'Brien N, Hayhoe B, Beaney T, et al. The Impact of Virtual Consultations on the Quality of Primary Care: Systematic Review. J Med Internet Res. 2023;25:e48920. doi:10.2196/48920.
81. North F, Crane SJ, Chaudhry R, Ebbert JO, Ytterberg K, Tulledge-Scheitel SM, et al. Impact of patient portal secure messages and electronic visits on adult primary care office visits. Telemed J E Health. 2014;20(3):192-8. doi:10.1089/tmj.2013.0097.
82. Parker RF, Figures EL, Paddison CA, Matheson JI, Blane DN, Ford JA. Inequalities in general practice remote consultations: a systematic review. BJGP Open. 2021;5(3). doi:10.3399/BJGPO.2021.0040.

83. Dahlgren C, Dackehag M, Wandell P, Rehnberg C. Determinants for use of direct-to-consumer telemedicine consultations in primary healthcare-a registry based total population study from Stockholm, Sweden. BMC Fam Pract. 2021;22(1):133. doi:10.1186/s12875-021-01481-1.

84. Rosen R. Meeting need or fuelling demand? Improved access to primary care and supply-induced demand [Internet]. London: Nuffield Trust and NHS England; 2014 [cited 2024 Jan 11]. Available from: https://www.nuffieldtrust.org.uk/sites/default/files/2017-01/meeting-need-or-fuelling-demand-web-final.pdf.

85. Swedish Agency for Health and Care Services Analysis. Besök via nätet: resursutnyttjande och jämlikhet kopplat till digitala vårdbesök [Online visits: resource use and equity linked to digital health care visits] [Internet]. Stockholm: Swedish Agency for Health and Care Services Analysis; 2022 [cited 2024 Jan 11]. Available from: https://www.vardanalys.se/rapporter/besok-via-natet/.

86. Gabrielsson-Jarhult F, Kjellstrom S, Josefsson KA. Telemedicine consultations with physicians in Swedish primary care: a mixed methods study of users' experiences and care patterns. Scand J Prim Health Care. 2021:1-10. doi:10.1080/02813432.2021.1913904.

87. Penza KS, Murray MA, Pecina JL, Myers JF, Furst JW. Electronic Visits for Minor Acute Illnesses: Analysis of Patient Demographics, Prescription Rates, and Follow-Up Care Within an Asynchronous Text-Based Online Visit. Telemed J E Health. 2018;24(3):210-5. doi:10.1089/tmj.2017.0091.

88. Murray MA, Penza KS, Myers JF, Furst JW, Pecina JL. Comparison of eVisit Management of Urinary Symptoms and Urinary Tract Infections with Standard Care. Telemed J E Health. 2020;26(5):639-44. doi:10.1089/tmj.2019.0044.

89. Penza KS, Murray MA, Myers JF, Furst JW, Pecina JL. Management of Acute Sinusitis via e-Visit. Telemed J E Health. 2021;27(5):532-6. doi:10.1089/tmj.2020.0047.

90. Johnson KM, Dumkow LE, Burns KW, Yee MA, Egwuatu NE. Comparison of Diagnosis and Prescribing Practices Between Virtual Visits and Office Visits for Adults Diagnosed With Sinusitis Within a Primary Care Network. Open Forum Infect Dis. 2019;6(9):ofz393. doi:10.1093/ofid/ofz393.

91. Johnson KL, Dumkow LE, Salvati LA, Johnson KM, Yee MA, Egwuatu NE. Comparison of diagnosis and prescribing practices between virtual visits and office visits for adults diagnosed with uncomplicated urinary tract infections within a primary care network. Infect Control Hosp Epidemiol. 2021;42(5):586-91. doi:10.1017/ice.2020.1255.

92. Entezarjou A, Sjobeck M, Midlov P, Nymberg VM, Vigren L, Labaf A, et al. Health care utilization following "digi-physical" assessment compared to physical assessment for infectious symptoms in primary care. BMC Prim Care. 2022;23:4. doi:10.1186/s12875-021-01618-2.

93. Albert SM, Shevchik GJ, Paone S, Martich GD. Internet-based medical visit and diagnosis for common medical problems: experience of first user cohort. Telemed J E Health. 2011;17(4):304-8. doi:10.1089/tmj.2010.0156.

94. Mehrotra A, Paone S, Martich GD, Albert SM, Shevchik GJ. Characteristics of patients who seek care via eVisits instead of office visits. Telemed J E Health. 2013;19(7):515-9. doi:10.1089/tmj.2012.0221.
95. Courneya PT, Palattao KJ, Gallagher JM. HealthPartners' online clinic for simple conditions delivers savings of $88 per episode and high patient approval. Health Aff (Millwood). 2013;32(2):385-92. doi:10.1377/hlthaff.2012.1157.
96. Network for IT Directors in the Swedish Regions. IT och digitalisering i hälso- och sjukvården 2023 [IT and digitalization in health care 2023]. [Internet]. Stockholm: Network for IT Directors in the Swedish Regions; 2023 [cited 2024 Jan 11]. Available from: https://www.inera.se/globalassets/inera/media/dokument/projekt/it-och-digitalisering-i-halso-och-sjukvarden_2023.pdf.
97. Saleh S, Farah A, El Arnaout N, Dimassi H, El Morr C, Muntaner C, et al. mHealth use for non-communicable diseases care in primary health: patients' perspective from rural settings and refugee camps. J Public Health (Oxf). 2018;40(suppl_2):ii52-ii63. doi:10.1093/pubmed/fdy172.
98. Siopis G, Moschonis G, Eweka E, Jung J, Kwasnicka D, Asare BY, et al. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with hypertension: a systematic review and meta-analysis of randomised controlled trials. Lancet Digit Health. 2023;5(3):e144-e59. doi:10.1016/S2589-7500(23)00002-X.
99. Leon N, Surender R, Bobrow K, Muller J, Farmer A. Improving treatment adherence for blood pressure lowering via mobile phone SMS-messages in South Africa: a qualitative evaluation of the SMS-text Adherence SuppoRt (StAR) trial. BMC Fam Pract. 2015;16:80. doi:10.1186/s12875-015-0289-7.
100. Redfern J, Santo K, Coorey G, Thakkar J, Hackett M, Thiagalingam A, et al. Factors Influencing Engagement, Perceived Usefulness and Behavioral Mechanisms Associated with a Text Message Support Program. PLoS One. 2016;11(10):e0163929. doi:10.1371/journal.pone.0163929.
101. Klimis H, Thiagalingam A, McIntyre D, Marschner S, Von Huben A, Chow CK. Text messages for primary prevention of cardiovascular disease: The TextMe2 randomized clinical trial. Am Heart J. 2021;242:33-44. doi:10.1016/j.ahj.2021.08.009.
102. Kerr D, Ahn D, Waki K, Wang J, Breznen B, Klonoff DC. Digital Interventions for Self-Management of Type 2 Diabetes Mellitus: Systematic Literature Review and Meta-Analysis. J Med Internet Res. 2024;26:e55757. doi:10.2196/55757.
103. van Olmen J. The Promise of Digital Self-Management: A Reflection about the Effects of Patient-Targeted e-Health Tools on Self-Management and Wellbeing. Int J Environ Res Public Health. 2022;19(3). doi:10.3390/ijerph19031360.
104. Nymberg VM, Bolmsjo BB, Wolff M, Calling S, Gerward S, Sandberg M. 'Having to learn this so late in our lives...' Swedish elderly patients' beliefs, experiences, attitudes and expectations of e-health in primary health care. Scand J Prim Health Care. 2019;37(1):41-52. doi:10.1080/02813432.2019.1570612.
105. Madanian S, Nakarada-Kordic I, Reay S, Chetty T. Patients' perspectives on digital health tools. PEC Innov. 2023;2:100171. doi:10.1016/j.pecinn.2023.100171.

106. Vaduganathan M, Mensah GA, Turco JV, Fuster V, Roth GA. The Global Burden of Cardiovascular Diseases and Risk: A Compass for Future Health. J Am Coll Cardiol. 2022;80(25):2361-71. doi:10.1016/j.jacc.2022.11.005.

107. Zhou B, Perel P, Mensah GA, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. Nat Rev Cardiol. 2021;18(11):785-802. doi:10.1038/s41569-021-00559-8.

108. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020 [Internet]. Geneva: World Health Organization; 2013 [cited 2024 Nov 23]. Available from: https://www.who.int/publications/i/item/9789241506236.

109. Institute for Health Metrics and Evaluation (IHME). GBD 2021 cause and risk summary: cardiovascular diseases - level 2 cause [Internet]. Seattle (WA): IHME, University of Washington; 2024 [cited 2024 Nov 24]. Available from: https://www.healthdata.org/research-analysis/diseases-injuries-risks/factsheets/2021-cardiovascular-diseases-level-2-disease.

110. Nationellt programområde hjärt- och kärlsjukdomar [National program area cardiovascular diseases]. Kliniskt kunskapsstöd: hypertoni [Clinical knowledge support: hypertension] [Internet]. Stockholm: Swedish Regions in cooperation; 2021 [cited 2024 Nov 24]. Available from: https://vardpersonal.1177.se/kunskapsstod/kliniska-kunskapsstod/hypertoni/?selectionCode=profession_primarvard.

111. McEvoy JW, McCarthy CP, Bruno RM, Brouwers S, Canavan MD, Ceconi C, et al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension. Eur Heart J. 2024;45(38):3912-4018. doi:10.1093/eurheartj/ehae178.

112. World Health Organization. Global report on hypertension: the race against a silent killer [Internet]. Geneva: World Health Organization; 2023 [cited 2025 Jan 25]. Available from: https://www.who.int/publications/i/item/9789240081062.

113. Olsen MH, Angell SY, Asma S, Boutouyrie P, Burger D, Chirinos JA, et al. A call to action and a lifecourse strategy to address the global burden of raised blood pressure on current and future generations: the Lancet Commission on hypertension. Lancet. 2016;388(10060):2665-712. doi:10.1016/S0140-6736(16)31134-5.

114. Razo C, Welgan CA, Johnson CO, McLaughlin SA, Iannucci V, Rodgers A, et al. Effects of elevated systolic blood pressure on ischemic heart disease: a Burden of Proof study. Nat Med. 2022;28(10):2056-65. doi:10.1038/s41591-022-01974-1.

115. Blood Pressure Lowering Treatment Trialists Collaboration. Pharmacological blood pressure lowering for primary and secondary prevention of cardiovascular disease across different levels of blood pressure: an individual participant-level data meta-analysis. Lancet. 2021;397(10285):1625-36. doi:10.1016/S0140-6736(21)00590-0.

116. The Lancet. Is the concept of hypertension as a disease unhelpful? Lancet. 2019;394(10199):611. doi:10.1016/S0140-6736(19)31964-6.

117. GBD Risk Factors Collaborators. Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2024;403(10440):2162-203. doi:10.1016/S0140-6736(24)00933-4.

118. Institute for Health Metrics and Evaluation (IHME). GBD 2021 cause and tisk summary: non-communicable diseases - level 1 cause [Internet]. Seattle (WA): IHME, University of Washington; 2024 [cited 2024 Nov 24]. Available from: https://www.healthdata.org/research-analysis/diseases-injuries-risks/factsheets/2021-non-communicable-diseases-level-1-disease.
119. Institute for Health Metrics and Evaluation (IHME). GBD 2021 cause and irsk summary: high systolic blood pressure - Level 2 risk Seattle (WA): IHME, University of Washington; 2024 [cited 2024 Nov 24]. Available from: https://www.healthdata.org/research-analysis/diseases-injuries-risks/factsheets/2021-high-systolic-blood-pressure-level-2-risk.
120. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. Lancet. 2020;395(10226):795-808. doi:10.1016/S0140-6736(19)32008-2.
121. Murray CJL. The Global Burden of Disease Study at 30 years. Nat Med. 2022;28(10):2019-26. doi:10.1038/s41591-022-01990-1.
122. NCD Risk Factor Collaboration. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet. 2021;398(10304):957-80. doi:10.1016/S0140-6736(21)01330-1.
123. Law MR, Wald NJ, Morris JK, Jordan RE. Value of low dose combination treatment with blood pressure lowering drugs: analysis of 354 randomised trials. BMJ. 2003;326(7404):1427. doi:10.1136/bmj.326.7404.1427.
124. Thomopoulos C, Parati G, Zanchetti A. Effects of blood pressure lowering on outcome incidence in hypertension. 1. Overview, meta-analyses, and meta-regression analyses of randomized trials. J Hypertens. 2014;32(12):2285-95. doi:10.1097/HJH.0000000000000378.
125. Whelton PK, Carey RM, Aronow WS, Casey DE, Jr., Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol. 2018;71(19):e127-e248. doi:10.1016/j.jacc.2017.11.006.
126. Maniero C, Lopuszko A, Papalois KB, Gupta A, Kapil V, Khanji MY. Non-pharmacological factors for hypertension management: a systematic review of international guidelines. Eur J Prev Cardiol. 2023;30(1):17-33. doi:10.1093/eurjpc/zwac163.
127. Fu J, Liu Y, Zhang L, Zhou L, Li D, Quan H, et al. Nonpharmacologic Interventions for Reducing Blood Pressure in Adults With Prehypertension to Established Hypertension. J Am Heart Assoc. 2020;9(19):e016804. doi:10.1161/JAHA.120.016804.

128. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, et al. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. N Engl J Med. 1997;336(16):1117-24. doi:10.1056/NEJM199704173361601.
129. Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E, Elmer PJ, et al. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA. 2003;289(16):2083-93. doi:10.1001/jama.289.16.2083.
130. Gay HC, Rao SG, Vaccarino V, Ali MK. Effects of Different Dietary Interventions on Blood Pressure: Systematic Review and Meta-Analysis of Randomized Controlled Trials. Hypertension. 2016;67(4):733-9. doi:10.1161/HYPERTENSIONAHA.115.06853.
131. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ. Effect of lower sodium intake on health: systematic review and meta-analyses. BMJ. 2013;346:f1326. doi:10.1136/bmj.f1326.
132. He FJ, Li J, Macgregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. BMJ. 2013;346:f1325. doi:10.1136/bmj.f1325.
133. Huang L, Trieu K, Yoshimura S, Neal B, Woodward M, Campbell NRC, et al. Effect of dose and duration of reduction in dietary sodium on blood pressure levels: systematic review and meta-analysis of randomised trials. BMJ. 2020;368:m315. doi:10.1136/bmj.m315.
134. Cornelissen VA, Smart NA. Exercise training for blood pressure: a systematic review and meta-analysis. J Am Heart Assoc. 2013;2(1):e004473. doi:10.1161/JAHA.112.004473.
135. Hanssen H, Boardman H, Deiseroth A, Moholdt T, Simonenko M, Krankel N, et al. Personalized exercise prescription in the prevention and treatment of arterial hypertension: a Consensus Document from the European Association of Preventive Cardiology (EAPC) and the ESC Council on Hypertension. Eur J Prev Cardiol. 2022;29(1):205-15. doi:10.1093/eurjpc/zwaa141.
136. Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. Ann Intern Med. 2002;136(7):493-503. doi:10.7326/0003-4819-136-7-200204020-00006.
137. Inder JD, Carlson DJ, Dieberg G, McFarlane JR, Hess NC, Smart NA. Isometric exercise training for blood pressure management: a systematic review and meta-analysis to optimize benefit. Hypertens Res. 2016;39(2):88-94. doi:10.1038/hr.2015.111.
138. Carlson DJ, Dieberg G, Hess NC, Millar PJ, Smart NA. Isometric exercise training for blood pressure management: a systematic review and meta-analysis. Mayo Clin Proc. 2014;89(3):327-34. doi:10.1016/j.mayocp.2013.10.030.
139. Xin X, He J, Frontini MG, Ogden LG, Motsamai OI, Whelton PK. Effects of alcohol reduction on blood pressure: a meta-analysis of randomized controlled trials. Hypertension. 2001;38(5):1112-7. doi:10.1161/hy1101.093424.

140. Roerecke M, Kaczorowski J, Tobe SW, Gmel G, Hasan OSM, Rehm J. The effect of a reduction in alcohol consumption on blood pressure: a systematic review and meta-analysis. Lancet Public Health. 2017;2(2):e108-e20. doi:10.1016/S2468-2667(17)30003-8.
141. Liu F, Liu Y, Sun X, Yin Z, Li H, Deng K, et al. Race- and sex-specific association between alcohol consumption and hypertension in 22 cohort studies: A systematic review and meta-analysis. Nutr Metab Cardiovasc Dis. 2020;30(8):1249-59. doi:10.1016/j.numecd.2020.03.018.
142. Cecchini M, Filippini T, Whelton PK, Iamandii I, Di Federico S, Boriani G, et al. Alcohol Intake and Risk of Hypertension: A Systematic Review and Dose-Response Meta-Analysis of Nonexperimental Cohort Studies. Hypertension. 2024;81(8):1701-15. doi:10.1161/HYPERTENSIONAHA.124.22703.
143. Neter JE, Stam BE, Kok FJ, Grobbee DE, Geleijnse JM. Influence of weight reduction on blood pressure: a meta-analysis of randomized controlled trials. Hypertension. 2003;42(5):878-84. doi:10.1161/01.HYP.0000094221.86888.AE.
144. Blumenthal JA, Babyak MA, Hinderliter A, Watkins LL, Craighead L, Lin PH, et al. Effects of the DASH diet alone and in combination with exercise and weight loss on blood pressure and cardiovascular biomarkers in men and women with high blood pressure: the ENCORE study. Arch Intern Med. 2010;170(2):126-35. doi:10.1001/archinternmed.2009.470.
145. Juraschek SP, Miller ER, 3rd, Weaver CM, Appel LJ. Effects of Sodium Reduction and the DASH Diet in Relation to Baseline Blood Pressure. J Am Coll Cardiol. 2017;70(23):2841-8. doi:10.1016/j.jacc.2017.10.011.
146. Krishnamoorthy Y, Nagarajan R, Murali S. Effectiveness of multiple combined lifestyle interventions in reducing blood pressure among patients with prehypertension and hypertension: a network meta-analysis. J Public Health (Oxf). 2023;45(2):e319-e31. doi:10.1093/pubmed/fdac027.
147. Silva CC, Presseau J, van Allen Z, Schenk PM, Moreto M, Dinsmore J, et al. Effectiveness of Interventions for Changing More Than One Behavior at a Time to Manage Chronic Conditions: A Systematic Review and Meta-analysis. Ann Behav Med. 2024;58(6):432-44. doi:10.1093/abm/kaae021.
148. Estruch R, Ros E, Salas-Salvado J, Covas MI, Corella D, Aros F, et al. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet Supplemented with Extra-Virgin Olive Oil or Nuts. N Engl J Med. 2018;378(25):e34. doi:10.1056/NEJMoa1800389.
149. Delgado-Lista J, Alcala-Diaz JF, Torres-Pena JD, Quintana-Navarro GM, Fuentes F, Garcia-Rios A, et al. Long-term secondary prevention of cardiovascular disease with a Mediterranean diet and a low-fat diet (CORDIOPREV): a randomised controlled trial. Lancet. 2022;399(10338):1876-85. doi:10.1016/S0140-6736(22)00122-2.
150. Neal B, Wu Y, Feng X, Zhang R, Zhang Y, Shi J, et al. Effect of Salt Substitution on Cardiovascular Events and Death. N Engl J Med. 2021;385(12):1067-77. doi:10.1056/NEJMoa2105675.

151. He FJ, Tan M, Ma Y, MacGregor GA. Salt Reduction to Prevent Hypertension and Cardiovascular Disease: JACC State-of-the-Art Review. J Am Coll Cardiol. 2020;75(6):632-47. doi:10.1016/j.jacc.2019.11.055.
152. Rossi A, Dikareva A, Bacon SL, Daskalopoulou SS. The impact of physical activity on mortality in patients with high blood pressure: a systematic review. J Hypertens. 2012;30(7):1277-88. doi:10.1097/HJH.0b013e3283544669.
153. Tasnim S, Tang C, Musini VM, Wright JM. Effect of alcohol on blood pressure. Cochrane Database Syst Rev. 2020;7(7):CD012787. doi:10.1002/14651858.CD012787.pub2.
154. Klatsky AL. Alcohol and cardiovascular mortality: common sense and scientific truth. J Am Coll Cardiol. 2010;55(13):1336-8. doi:10.1016/j.jacc.2009.10.057.
155. Mukamal KJ, Chen CM, Rao SR, Breslow RA. Alcohol consumption and cardiovascular mortality among U.S. adults, 1987 to 2002. J Am Coll Cardiol. 2010;55(13):1328-35. doi:10.1016/j.jacc.2009.10.056.
156. Ding C, O'Neill D, Bell S, Stamatakis E, Britton A. Association of alcohol consumption with morbidity and mortality in patients with cardiovascular disease: original data and meta-analysis of 48,423 men and women. BMC Med. 2021;19(1):167. doi:10.1186/s12916-021-02040-2.
157. Zhao J, Stockwell T, Naimi T, Churchill S, Clay J, Sherk A. Association Between Daily Alcohol Intake and Risk of All-Cause Mortality: A Systematic Review and Meta-analyses. JAMA Netw Open. 2023;6(3):e236185. doi:10.1001/jamanetworkopen.2023.6185.
158. GBD Alcohol Collaborators. Alcohol use and burden for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2018;392(10152):1015-35. doi:10.1016/S0140-6736(18)31310-2.
159. Semlitsch T, Krenn C, Jeitler K, Berghold A, Horvath K, Siebenhofer A. Long-term effects of weight-reducing diets in people with hypertension. Cochrane Database Syst Rev. 2021;2(2):CD008274. doi:10.1002/14651858.CD008274.pub4.
160. Ma C, Avenell A, Bolland M, Hudson J, Stewart F, Robertson C, et al. Effects of weight loss interventions for adults who are obese on mortality, cardiovascular disease, and cancer: systematic review and meta-analysis. BMJ. 2017;359:j4849. doi:10.1136/bmj.j4849.
161. Zomer E, Gurusamy K, Leach R, Trimmer C, Lobstein T, Morris S, et al. Interventions that cause weight loss and the impact on cardiovascular risk factors: a systematic review and meta-analysis. Obes Rev. 2016;17(10):1001-11. doi:10.1111/obr.12433.
162. Groppelli A, Giorgi DM, Omboni S, Parati G, Mancia G. Persistent blood pressure increase induced by heavy smoking. J Hypertens. 1992;10(5):495-9. doi:10.1097/00004872-199205000-00014.
163. Primatesta P, Falaschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure: evidence from the health survey for England. Hypertension. 2001;37(2):187-93. doi:10.1161/01.hyp.37.2.187.

164. Anthonisen NR, Skeans MA, Wise RA, Manfreda J, Kanner RE, Connett JE, et al. The effects of a smoking cessation intervention on 14.5-year mortality: a randomized clinical trial. Ann Intern Med. 2005;142(4):233-9. doi:10.7326/0003-4819-142-4-200502150-00005.
165. Thomson B, Emberson J, Lacey B, Lewington S, Peto R, Jemal A, et al. Association Between Smoking, Smoking Cessation, and Mortality by Race, Ethnicity, and Sex Among US Adults. JAMA Netw Open. 2022;5(10):e2231480. doi:10.1001/jamanetworkopen.2022.31480.
166. World Health Organization. Global health risks: mortality and budren of disease attributable to selected major risks [Internet]. Geneva: World Health Organization; 2009 [cited 2024 Dec 2]. Available from: https://www.who.int/publications/i/item/9789241563871.
167. Strain T, Flaxman S, Guthold R, Semenova E, Cowan M, Riley LM, et al. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5.7 million participants. Lancet Glob Health. 2024;12(8):e1232-e43. doi:10.1016/S2214-109X(24)00150-5.
168. Kotseva K, De Bacquer D, Jennings C, Gyberg V, De Backer G, Ryden L, et al. Adverse Lifestyle Trends Counter Improvements in Cardiovascular Risk Factor Management in Coronary Patients. J Am Coll Cardiol. 2015;66(14):1634-6. doi:10.1016/j.jacc.2015.07.061.
169. Kotseva K, De Backer G, De Bacquer D, Ryden L, Hoes A, Grobbee D, et al. Primary prevention efforts are poorly developed in people at high cardiovascular risk: A report from the European Society of Cardiology EURObservational Research Programme EUROASPIRE V survey in 16 European countries. Eur J Prev Cardiol. 2021;28(4):370-9. doi:10.1177/2047487320908698.
170. Kotseva K, Jennings C, Bassett P, Adamska A, Hobbs R, Wood D, et al. Challenge of cardiovascular prevention in primary care: achievement of lifestyle, blood pressure, lipids and diabetes targets for primary prevention in England - results from ASPIRE-3-PREVENT cross-sectional survey. Open Heart. 2024;11(2). doi:10.1136/openhrt-2024-002704.
171. Larsson SC, Akesson A, Wolk A. Healthy diet and lifestyle and risk of stroke in a prospective cohort of women. Neurology. 2014;83(19):1699-704. doi:10.1212/WNL.0000000000000954.
172. Albarqouni L, Ringsten M, Montori V, Jorgensen KJ, Bulbeck H, Johansson M. Evaluation of evidence supporting NICE recommendations to change people's lifestyle in clinical practice: cross sectional survey. BMJ Med. 2022;1(1):e000130. doi:10.1136/bmjmed-2022-000130.
173. Albarqouni L, Montori V, Jorgensen KJ, Ringsten M, Bulbeck H, Johansson M. Applying the time needed to treat to NICE guidelines on lifestyle interventions. BMJ Evid Based Med. 2023;28(5):354-5. doi:10.1136/bmjebm-2022-112225.
174. Johansson M, Niklasson A, Albarqouni L, Jorgensen KJ, Guyatt G, Montori VM. Guidelines Recommending That Clinicians Advise Patients on Lifestyle Changes: A Popular but Questionable Approach to Improve Public Health. Ann Intern Med. 2024;177(10):1425-7. doi:10.7326/ANNALS-24-00283.

175. Gillman MW. Primordial prevention of cardiovascular disease. Circulation. 2015;131(7):599-601. doi:10.1161/CIRCULATIONAHA.115.014849.
176. Zulman DM, Vijan S, Omenn GS, Hayward RA. The relative merits of population-based and targeted prevention strategies. Milbank Q. 2008;86(4):557-80. doi:10.1111/j.1468-0009.2008.00534.x.
177. Qin X, Jackson R, Marshall R, Lee L, Cao W, Zhan S, et al. Modelling the potential impact of population-wide and targeted high-risk blood pressure-lowering strategies on cardiovascular disease in China. Eur J Cardiovasc Prev Rehabil. 2009;16(1):96-101. doi:10.1097/HJR.0b013e32831fd6de.
178. Masters R, Anwar E, Collins B, Cookson R, Capewell S. Return on investment of public health interventions: a systematic review. J Epidemiol Community Health. 2017;71(8):827-34. doi:10.1136/jech-2016-208141.
179. Rozanski A, Blumenthal JA, Hinderliter AL, Cole S, Lavie CJ. Cardiology and lifestyle medicine. Prog Cardiovasc Dis. 2023;77:4-13. doi:10.1016/j.pcad.2023.04.004.
180. Li WHC, Ho KY, Wang MP, Cheung DYT, Lam KKW, Xia W, et al. Effectiveness of a Brief Self-determination Theory-Based Smoking Cessation Intervention for Smokers at Emergency Departments in Hong Kong: A Randomized Clinical Trial. JAMA Intern Med. 2020;180(2):206-14. doi:10.1001/jamainternmed.2019.5176.
181. Kaner EF, Beyer FR, Muirhead C, Campbell F, Pienaar ED, Bertholet N, et al. Effectiveness of brief alcohol interventions in primary care populations. Cochrane Database Syst Rev. 2018;2(2):CD004148. doi:10.1002/14651858.CD004148.pub4.
182. Lamming L, Pears S, Mason D, Morton K, Bijker M, Sutton S, et al. What do we know about brief interventions for physical activity that could be delivered in primary care consultations? A systematic review of reviews. Prev Med. 2017;99:152-63. doi:10.1016/j.ypmed.2017.02.017.
183. Green ET, Cox NS, Arden CM, Warren CJ, Holland AE. What is the effect of a brief intervention to promote physical activity when delivered in a health care setting? A systematic review. Health Promot J Austr. 2023;34(4):809-24. doi:10.1002/hpja.697.
184. Unwin D, Delon C, Unwin J, Tobin S, Taylor R. What predicts drug-free type 2 diabetes remission? Insights from an 8-year general practice service evaluation of a lower carbohydrate diet with weight loss. BMJ Nutr Prev Health. 2023;6(1):46-55. doi:10.1136/bmjnph-2022-000544.
185. Treciokiene I, Postma M, Nguyen T, Fens T, Petkevicius J, Kubilius R, et al. Healthcare professional-led interventions on lifestyle modifications for hypertensive patients - a systematic review and meta-analysis. BMC Fam Pract. 2021;22(1):63. doi:10.1186/s12875-021-01421-z.
186. Bulto LN, Roseleur J, Noonan S, Pinero de Plaza MA, Champion S, Dafny HA, et al. Effectiveness of nurse-led interventions versus usual care to manage hypertension and lifestyle behaviour: a systematic review and meta-analysis. Eur J Cardiovasc Nurs. 2024;23(1):21-32. doi:10.1093/eurjcn/zvad040.
187. Johansson M, Guyatt G, Montori V. Guidelines should consider clinicians' time needed to treat. BMJ. 2023;380:e072953. doi:10.1136/bmj-2022-072953.

188. Katz DL, Karlsen MC, Chung M, Shams-White MM, Green LW, Fielding J, et al. Hierarchies of evidence applied to lifestyle Medicine (HEALM): introduction of a strength-of-evidence approach based on a methodological systematic review. BMC Med Res Methodol. 2019;19(1):178. doi:10.1186/s12874-019-0811-z.
189. Omboni S, Gazzola T, Carabelli G, Parati G. Clinical usefulness and cost effectiveness of home blood pressure telemonitoring: meta-analysis of randomized controlled studies. J Hypertens. 2013;31(3):455-67; discussion 67-8. doi:10.1097/HJH.0b013e32835ca8dd.
190. Thakkar J, Kurup R, Laba TL, Santo K, Thiagalingam A, Rodgers A, et al. Mobile Telephone Text Messaging for Medication Adherence in Chronic Disease: A Meta-analysis. JAMA Intern Med. 2016;176(3):340-9. doi:10.1001/jamainternmed.2015.7667.
191. Liu S, Dunford SD, Leung YW, Brooks D, Thomas SG, Eysenbach G, et al. Reducing blood pressure with Internet-based interventions: a meta-analysis. Can J Cardiol. 2013;29(5):613-21. doi:10.1016/j.cjca.2013.02.007.
192. Shariful Islam SM, Farmer AJ, Bobrow K, Maddison R, Whittaker R, Pfaeffli Dale LA, et al. Mobile phone text-messaging interventions aimed to prevent cardiovascular diseases (Text2PreventCVD): systematic review and individual patient data meta-analysis. Open Heart. 2019;6(2):e001017. doi:10.1136/openhrt-2019-001017.
193. Tam HL, Wong EML, Cheung K, Chung SF. Effectiveness of Text Messaging Interventions on Blood Pressure Control Among Patients With Hypertension: Systematic Review of Randomized Controlled Trials. JMIR Mhealth Uhealth. 2021;9(9):e24527. doi:10.2196/24527.
194. Chow CK, Redfern J, Hillis GS, Thakkar J, Santo K, Hackett ML, et al. Effect of Lifestyle-Focused Text Messaging on Risk Factor Modification in Patients With Coronary Heart Disease: A Randomized Clinical Trial. JAMA. 2015;314(12):1255-63. doi:10.1001/jama.2015.10945.
195. Bolmsjo BB, Wolff M, Nymberg VM, Sandberg M, Midlov P, Calling S. Text message-based lifestyle intervention in primary care patients with hypertension: a randomized controlled pilot trial. Scand J Prim Health Care. 2020;38(3):300-7. doi:10.1080/02813432.2020.1794392.
196. Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. Annu Rev Public Health. 2010;31:399-418. doi:10.1146/annurev.publhealth.012809.103604.
197. Winter SJ, Sheats JL, King AC. The Use of Behavior Change Techniques and Theory in Technologies for Cardiovascular Disease Prevention and Treatment in Adults: A Comprehensive Review. Prog Cardiovasc Dis. 2016;58(6):605-12. doi:10.1016/j.pcad.2016.02.005.
198. Cummins KM. Explanations for the Cloudy Evidence That Theory Benefits Health Promotion. Front Psychol. 2022;13:910041. doi:10.3389/fpsyg.2022.910041.
199. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the Health Belief Model. Health Educ Q. 1988;15(2):175-83. doi:10.1177/109019818801500203.

200. Bandura A. Health promotion by social cognitive means. Health Educ Behav. 2004;31(2):143-64. doi:10.1177/1090198104263660.
201. McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-Analysis of the Reasoned Action Approach (RAA) to Understanding Health Behaviors. Ann Behav Med. 2016;50(4):592-612. doi:10.1007/s12160-016-9798-4.
202. Bosnjak M, Ajzen I, Schmidt P. The Theory of Planned Behavior: Selected Recent Advances and Applications. Eur J Psychol. 2020;16(3):352-6. doi:10.5964/ejop.v16i3.3107.
203. Ajzen I. Theory of planned behavior with background factors [Figure]. 2019 [cited 2024 Dec 8]. Available from: https://people.umass.edu/aizen/tpb.background.html.
204. Venkatesh V, Morris M, Davis G, Davis F. User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly. 2003;27(3):425-78. doi:10.2307/30036540.
205. Wade V, Gray L, Carati C. Theoretical frameworks in telemedicine research. J Telemed Telecare. 2017;23(1):181-7. doi:10.1177/1357633X15626650.
206. Region Skåne's Unit for Social Analysis. Hur har det gått i Skåne? [How has Skåne done?] [Internet]. Kristianstad: Region Skåne; 2023 [cited 2024 Jan 15]. Available from: https://utveckling.skane.se/digitala-rapporter/huga/.
207. Swedish Institute. Healthcare in Sweden [Internet]. Stockholm: Swedish Institute; 2024 [updated 2024 Dec 11; cited 2025 Feb 22]. Available from: https://sweden.se/life/society/healthcare-in-sweden.
208. Hälso- och sjukvårdslag [Health and Medical Services Act] (SFS 2017:30) [Internet]. Stockholm: Swedish Ministry of Health and Social Affairs [cited 2021 June 22]. Available from: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/halso--och-sjukvardslag_sfs-2017-30.
209. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurse Educ Today. 2004;24(2):105-12. doi:10.1016/j.nedt.2003.10.001.
210. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. Acad Med. 2014;89(9):1245-51. doi:10.1097/ACM.0000000000000388.
211. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. PLoS Med. 2007;4(10):e296. doi:10.1371/journal.pmed.0040296.
212. Sundquist K, Malmstrom M, Johansson SE, Sundquist J. Care Need Index, a useful tool for the distribution of primary health care resources. J Epidemiol Community Health. 2003;57(5):347-52. doi:10.1136/jech.57.5.347.
213. Borgstrom Bolmsjo B, Bredfelt J, Calling S, Glock H, Nymberg VM, Bengtsson Bostrom K, et al. Health-promoting text messages to patients with hypertension-A randomized controlled trial in Swedish primary healthcare. PLoS One. 2025;20(2):e0314868. doi:10.1371/journal.pone.0314868.
214. Malterud K. Systematic text condensation: a strategy for qualitative analysis. Scand J Public Health. 2012;40(8):795-805. doi:10.1177/1403494812465030.

215. Malterud K. Kvalitativa metoder i medicinsk forskning: en introduktion [Qualitative methods in medical research: an introduction]. 3rd ed. Lund: Studentlitteratur AB; 2014.
216. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-57. doi:10.1093/intqhc/mzm042.
217. Schulz KF, Altman DG, Moher D, Group C. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMJ. 2010;340:c332. doi:10.1136/bmj.c332.
218. Olsson SJ, Ekblom O, Andersson E, Borjesson M, Kallings LV. Categorical answer modes provide superior validity to open answers when asking for level of physical activity: A cross-sectional study. Scand J Public Health. 2016;44(1):70-6. doi:10.1177/1403494815602830.
219. Kallings L. Validering av Socialstyrelsens screeningfrågor om fysisk aktivitet [Validation of the National Board of Health and Welfare's screening questions on physical activity] [Internet]. Stockholm: Swedish National Board of Health and Welfare; 2014 [cited 2024 Sep 17]. Available from: https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/dokument-webb/nationella-riktlinjer/levnadsvanor-validering-av-indikatorfragor-till-patienter-om-fysisk-aktivitet.pdf.
220. Francis J, Johnston M, Eccles M, Walker A, Grimshaw JM, Foy R, et al. Constructing questionnaires based on the theory of planned behaviour: a manual for health services researchers [Internet]. Newcastle upon Tyne: Centre for Health Services Research, University of Newcastle upon Tyne; 2004 [cited 2024 Oct 13]. Available from: http://openaccess.city.ac.uk/id/eprint/1735.
221. Norman G. Likert scales, levels of measurement and the "laws" of statistics. Adv Health Sci Educ Theory Pract. 2010;15(5):625-32. doi:10.1007/s10459-010-9222-y.
222. Sullivan GM, Artino AR, Jr. Analyzing and interpreting data from likert-type scales. J Grad Med Educ. 2013;5(4):541-2. doi:10.4300/JGME-5-4-18.
223. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. doi:10.1016/j.jbi.2008.08.010.
224. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform. 2019;95:103208. doi:10.1016/j.jbi.2019.103208.
225. Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. Plast Reconstr Surg. 2011;128(1):305-10. doi:10.1097/PRS.0b013e318219c171.
226. Rosenblum M, van der Laan MJ. Using regression models to analyze randomized trials: asymptotically valid hypothesis tests despite incorrectly specified models. Biometrics. 2009;65(3):937-45. doi:10.1111/j.1541-0420.2008.01177.x.

227. McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J Clin Epidemiol. 2014;67(3):267-77. doi:10.1016/j.jclinepi.2013.08.015.

228. McCambridge J, Kypri K, Elbourne D. Research participation effects: a skeleton in the methodological cupboard. J Clin Epidemiol. 2014;67(8):845-9. doi:10.1016/j.jclinepi.2014.03.002.

229. Greenhalgh T. How to read a paper: the basics of evidence-based medicine and healthcare. 6th ed. Hoboken (NJ): John Wiley & Sons Ltd; 2019.

230. Kirkwood BR, Sterne JAC. Essential medical statistics. 2nd ed. Malden (MA): Blackwell Science Ltd; 2003.

231. Sandvik H, Hetlevik O, Blinkenberg J, Hunskaar S. Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: a registry-based observational study in Norway. Br J Gen Pract. 2022;72(715):e84-e90. doi:10.3399/BJGP.2021.0340.

232. Borges do Nascimento IJ, Abdulazeem H, Vasanthan LT, Martinez EZ, Zucoloto ML, Ostengaard L, et al. Barriers and facilitators to utilizing digital health technologies by healthcare professionals. NPJ Digit Med. 2023;6(1):161. doi:10.1038/s41746-023-00899-4.

233. Oudbier SJ, Souget-Ruff SP, Chen BSJ, Ziesemer KA, Meij HJ, Smets EMA. Implementation barriers and facilitators of remote monitoring, remote consultation and digital care platforms through the eyes of healthcare professionals: a review of reviews. BMJ Open. 2024;14(6):e075833. doi:10.1136/bmjopen-2023-075833.

234. Liyanage H, Liaw ST, Jonnagaddala J, Schreiber R, Kuziemsky C, Terry AL, et al. Artificial Intelligence in Primary Health Care: Perceptions, Issues, and Challenges. Yearb Med Inform. 2019;28(1):41-6. doi:10.1055/s-0039-1677901.

235. van de Sande D, Chung EFF, Oosterhoff J, van Bommel J, Gommers D, van Genderen ME. To warrant clinical adoption AI models require a multi-faceted implementation evaluation. NPJ Digit Med. 2024;7(1):58. doi:10.1038/s41746-024-01064-1.

236. Nijhof D, Ingram A, Ochieng R, Roberts EJ, Poulton B, Ochieng B. Examining GP online consultation in a primary care setting in east midlands, UK. BMC Health Serv Res. 2021;21(1):1030. doi:10.1186/s12913-021-07039-2.

237. Mehta S, Metko D, Maazi M, Wang OJE, Li MK. Teledermatology and Virtual Visits for Acne Management: A Review. J Cutan Med Surg. 2024:12034754241291028. doi:10.1177/12034754241291028.

238. Verma L, Turk T, Dennett L, Dytoc M. Teledermatology in Atopic Dermatitis: A Systematic Review. J Cutan Med Surg. 2024;28(2):153-7. doi:10.1177/12034754231223694.

239. Hagglund M, Ekwall AK, Davoody N, Farrokhnia N. Escape to the future - a qualitative study of physicians' views on the work environment, education, and support in a digital context. BMC Med Inform Decis Mak. 2023;23(1):231. doi:10.1186/s12911-023-02337-7.

240. Darley S, Coulson T, Peek N, Moschogianis S, van der Veer SN, Wong DC, et al. Understanding How the Design and Implementation of Online Consultations Affect Primary Care Quality: Systematic Review of Evidence With Recommendations for Designers, Providers, and Researchers. J Med Internet Res. 2022;24(10):e37436. doi:10.2196/37436.
241. Johnsen TM, Norberg BL, Kristiansen E, Zanaboni P, Austad B, Krogh FH, et al. Suitability of Video Consultations During the COVID-19 Pandemic Lockdown: Cross-sectional Survey Among Norwegian General Practitioners. J Med Internet Res. 2021;23(2):e26433. doi:10.2196/26433.
242. Lapointe-Shaw L, Salahub C, Bird C, Bhatia RS, Desveaux L, Glazier RH, et al. Characteristics and Health Care Use of Patients Attending Virtual Walk-in Clinics in Ontario, Canada: Cross-sectional Analysis. J Med Internet Res. 2023;25:e40267. doi:10.2196/40267.
243. David CN, Ziegelmann PK, Goveia P, Silvani J, Silveira L, Fuchs SC. The effect of mobile health focused on diet and lifestyle on blood pressure: a systematic review and meta-analysis. Eur J Prev Cardiol. 2022;29(7):1142-55. doi:10.1093/eurjpc/zwac017.
244. Moschonis G, Siopis G, Jung J, Eweka E, Willems R, Kwasnicka D, et al. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. Lancet Digit Health. 2023;5(3):e125-e43. doi:10.1016/S2589-7500(22)00233-3.
245. Sun S, Simonsson O, McGarvey S, Torous J, Goldberg SB. Mobile phone interventions to improve health outcomes among patients with chronic diseases: an umbrella review and evidence synthesis from 34 meta-analyses. Lancet Digit Health. 2024;6(11):e857-e70. doi:10.1016/S2589-7500(24)00119-5.
246. Singh B, Ahmed M, Staiano AE, Gough C, Petersen J, Vandelanotte C, et al. A systematic umbrella review and meta-meta-analysis of eHealth and mHealth interventions for improving lifestyle behaviours. NPJ Digit Med. 2024;7(1):179. doi:10.1038/s41746-024-01172-y.
247. Rowland S, Bach C, Simon K, Westmark DM, Sperling E. Effectiveness of digital health interventions to increase cardiorespiratory fitness: A systematic review and meta-analysis. Digit Health. 2024;10:20552076241282381. doi:10.1177/20552076241282381.
248. Zangger G, Bricca A, Liaghat B, Juhl CB, Mortensen SR, Andersen RM, et al. Benefits and Harms of Digital Health Interventions Promoting Physical Activity in People With Chronic Conditions: Systematic Review and Meta-Analysis. J Med Internet Res. 2023;25:e46439. doi:10.2196/46439.
249. Redfern J, Tu Q, Hyun K, Hollings MA, Hafiz N, Zwack C, et al. Mobile phone text messaging for medication adherence in secondary prevention of cardiovascular disease. Cochrane Database Syst Rev. 2024;3(3):CD011851. doi:10.1002/14651858.CD011851.pub3.

250. Bhandari B, Narasimhan P, Jayasuriya R, Vaidya A, Schutte AE. Effectiveness and Acceptability of a Mobile Phone Text Messaging Intervention to Improve Blood Pressure Control (TEXT4BP) among Patients with Hypertension in Nepal: A Feasibility Randomised Controlled Trial. Glob Heart. 2022;17(1):13. doi:10.5334/gh.1103.
251. Tahkola A, Korhonen P, Kautiainen H, Niiranen T, Mantyselka P. Personalized text message and checklist support for initiation of antihypertensive medication: the cluster randomized, controlled check and support trial. Scand J Prim Health Care. 2020;38(2):201-9. doi:10.1080/02813432.2020.1753380.
252. Khatib R, Schwalm JD, Yusuf S, Haynes RB, McKee M, Khan M, et al. Patient and healthcare provider barriers to hypertension awareness, treatment and follow up: a systematic review and meta-analysis of qualitative and quantitative studies. PLoS One. 2014;9(1):e84238. doi:10.1371/journal.pone.0084238.
253. Noordman J, Verhaak P, van Dulmen S. Discussing patient's lifestyle choices in the consulting room: analysis of GP-patient consultations between 1975 and 2008. BMC Fam Pract. 2010;11:87. doi:10.1186/1471-2296-11-87.
254. Hamilton K, Henderson J, Burton E, Hagger MS. Discussing lifestyle behaviors: perspectives and experiences of general practitioners. Health Psychol Behav Med. 2019;7(1):290-307. doi:10.1080/21642850.2019.1648216.
255. Zhou Y, Li SJ, Huang RQ, Ma HM, Wang AQ, Tang XY, et al. Behavior Change Techniques Used in Self-Management Interventions Based on mHealth Apps for Adults With Hypertension: Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Med Internet Res. 2024;26:e54978. doi:10.2196/54978.
256. Bhandari B, Narasimhan P, Vaidya A, Subedi M, Jayasuriya R. Barriers and facilitators for treatment and control of high blood pressure among hypertensive patients in Kathmandu, Nepal: a qualitative study informed by COM-B model of behavior change. BMC Public Health. 2021;21(1):1524. doi:10.1186/s12889-021-11548-4.
257. Patterson K, Davey R, Keegan R, Kunstler B, Woodward A, Freene N. Behaviour change techniques in cardiovascular disease smartphone apps to improve physical activity and sedentary behaviour: Systematic review and meta-regression. Int J Behav Nutr Phys Act. 2022;19(1):81. doi:10.1186/s12966-022-01319-8.
258. Yan YY, Chan LML, Wang MP, Kwok JYY, Anderson CS, Lee JJ. Technology-supported behavior change interventions for reducing sodium intake in adults: a systematic review and meta-analysis. NPJ Digit Med. 2024;7(1):72. doi:10.1038/s41746-024-01067-y.
259. Fava VMD, Lapao LV. Provision of Digital Primary Health Care Services: Overview of Reviews. J Med Internet Res. 2024;26:e53594. doi:10.2196/53594.
260. Nickel GC, Wang S, Kwong JCC, Kvedar JC. The case for inclusive co-creation in digital health innovation. NPJ Digit Med. 2024;7(1):251. doi:10.1038/s41746-024-01256-9.

261. Hyder AA, Rylance S, Al Saegh A, Feigin VL, Kataria I, Laatikainen T, et al. Strengthening evidence to inform health systems: opportunities for the WHO and partners to accelerate progress on non-communicable diseases. BMJ Glob Health. 2023;8(11). doi:10.1136/bmjgh-2023-013994.
262. Maylor H, Turner N. Understand, reduce, respond: project complexity management theory and practice. International Journal of Operations & Production Management. 2017;37(8):1076-93. doi:10.1108/IJOPM-05-2016-0263.
263. Gremyr A, Andersson Gare B, Greenhalgh T, Malm U, Thor J, Andersson AC. Using Complexity Assessment to Inform the Development and Deployment of a Digital Dashboard for Schizophrenia Care: Case Study. J Med Internet Res. 2020;22(4):e15521. doi:10.2196/15521.
264. Greenhalgh T, Maylor H, Shaw S, Wherton J, Papoutsi C, Betton V, et al. The NASSS-CAT Tools for Understanding, Guiding, Monitoring, and Researching Technology Implementation Projects in Health and Social Care: Protocol for an Evaluation Study in Real-World Settings. JMIR Res Protoc. 2020;9(5):e16861. doi:10.2196/16861.
265. Hellstrand Tang U, Smith F, Karilampi UL, Gremyr A. Exploring the Role of Complexity in Health Care Technology Bottom-Up Innovations: Multiple-Case Study Using the Nonadoption, Abandonment, Scale-Up, Spread, and Sustainability Complexity Assessment Tool. JMIR Hum Factors. 2024;11:e50889. doi:10.2196/50889.
266. Nuffield Department of Primary Care Health Sciences - Medical Sciences Division. NASSS-CAT tools [Internet]. Oxford: University of Oxford; 2024 [cited 2024 Dec 27]. Available from: https://www.phc.ox.ac.uk/research/resources/copy_of_nasss-cat-tools.
267. Erku D, Khatri R, Endalamaw A, Wolka E, Nigatu F, Zewdie A, et al. Digital Health Interventions to Improve Access to and Quality of Primary Health Care Services: A Scoping Review. Int J Environ Res Public Health. 2023;20(19). doi:10.3390/ijerph20196854.
268. Gentili A, Failla G, Melnyk A, Puleo V, Tanna GLD, Ricciardi W, et al. The cost-effectiveness of digital health interventions: A systematic review of the literature. Front Public Health. 2022;10:787135. doi:10.3389/fpubh.2022.787135.
269. Willems R, Annemans L, Siopis G, Moschonis G, Vedanthan R, Jung J, et al. Cost effectiveness review of text messaging, smartphone application, and website interventions targeting T2DM or hypertension. NPJ Digit Med. 2023;6(1):150. doi:10.1038/s41746-023-00876-x.
270. Kwasnicka D, Keller J, Perski O, Potthoff S, Ten Hoor GA, Ainsworth B, et al. White Paper: Open Digital Health - accelerating transparent and scalable health promotion and treatment. Health Psychol Rev. 2022;16(4):475-91. doi:10.1080/17437199.2022.2046482.
271. Ricci-Cabello I, Bobrow K, Islam SMS, Chow CK, Maddison R, Whittaker R, et al. Examining Development Processes for Text Messaging Interventions to Prevent Cardiovascular Disease: Systematic Literature Review. JMIR Mhealth Uhealth. 2019;7(3):e12191. doi:10.2196/12191.

272. Persson J, Rydenfalt C. Why Are Digital Health Care Systems Still Poorly Designed, and Why Is Health Care Practice Not Asking for More? Three Paths Toward a Sustainable Digital Work Environment. J Med Internet Res. 2021;23(6):e26694. doi:10.2196/26694.
273. Wilson S, Tolley C, Mc Ardle R, Lawson L, Beswick E, Hassan N, et al. Recommendations to advance digital health equity: a systematic review of qualitative studies. NPJ Digit Med. 2024;7(1):173. doi:10.1038/s41746-024-01177-7.
274. Soltani S, Saraf-Bank S, Basirat R, Salehi-Abargouei A, Mohammadifard N, Sadeghi M, et al. Community-based cardiovascular disease prevention programmes and cardiovascular risk factors: a systematic review and meta-analysis. Public Health. 2021;200:59-70. doi:10.1016/j.puhe.2021.09.006.
275. Lindholm L, Stenling A, Norberg M, Stenlund H, Weinehall L. A cost-effectiveness analysis of a community based CVD program in Sweden based on a retrospective register cohort. BMC Public Health. 2018;18(1):452. doi:10.1186/s12889-018-5339-3.
276. Stephen C, Halcomb E, Fernandez R, McInnes S, Batterham M, Zwar N. Nurse-led interventions to manage hypertension in general practice: A systematic review and meta-analysis. J Adv Nurs. 2022;78(5):1281-93. doi:10.1111/jan.15159.
277. Ito M, Tajika A, Toyomoto R, Imai H, Sakata M, Honda Y, et al. The short and long-term efficacy of nurse-led interventions for improving blood pressure control in people with hypertension in primary care settings: a systematic review and meta-analysis. BMC Prim Care. 2024;25(1):143. doi:10.1186/s12875-024-02380-x.
278. Creegan D, McEvoy JW. Selected highlights in the updated treatment of hypertension. Trends Cardiovasc Med. 2024;34(6):416-20. doi:10.1016/j.tcm.2023.11.001.
279. Kidholm K, Jensen LK, Johansson M, Montori VM. Telemedicine and the assessment of clinician time: a scoping review. Int J Technol Assess Health Care. 2023;40(1):e3. doi:10.1017/S0266462323002830.
280. Powell D, Burrows F, Lewis G, Gilbert S. How might Hospital at Home enable a greener and healthier future? NPJ Digit Med. 2024;7(1):252. doi:10.1038/s41746-024-01249-8.
281. Dullet NW, Geraghty EM, Kaufman T, Kissee JL, King J, Dharmar M, et al. Impact of a University-Based Outpatient Telemedicine Program on Time Savings, Travel Costs, and Environmental Pollutants. Value Health. 2017;20(4):542-6. doi:10.1016/j.jval.2017.01.014.

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Digital Health in General Practice

This thesis investigates digital health technologies and cardiovascular prevention from a general practice perspective. The four papers that serve as the backbone of the thesis all use material from primary care in southern Sweden. The author, Hanna Glock, works clinically as a general practitioner at Delfinen Primary Health Care Center in Höganäs, Sweden.

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