Olli Korhonen

SERVICE PATHWAY PERSONALIZATION IN DIGITAL HEALTH SERVICES
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Service Pathway Personalization in Digital Health Services

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University of Oulu, Oulu 2020
Abstract

Information technology (IT) is a primary enabler of personalization. Various personalization approaches are used to design and implement personalization in technologies and to classify personalization through technologies. Still, personalization studies rarely consider personalization and the role of IT more holistically at the level of digital services.

The objective of this thesis is to investigate the role of IT in the personalization of digital health service pathways. The present work applies a service pathway concept as it provides the means by which to consider all the available health services to be included for the individual healthcare user in the context of digital health services.

This thesis is framed in information systems (IS) and specifically IS in healthcare. The present work investigates the role of IT in the personalization of digital health service pathways through a multiple-case study approach. The data collected are thematically analyzed to provide understanding on the role IT can play in the personalization of digital health service pathways.

As a result of the thematic analysis, this thesis proposes personalization filters that represent the role of IT in the personalization of digital health service pathways. The personalization filters are as follows: (1) the contextual filter, where the role of IT is to consider the healthcare-specific parameters for personalization; (2) the data-driven filter, where the role of IT is to consider the aggregated data parameters for personalization; and (3) the user-specific filter, where the role of IT is to consider the characteristics and preferences of the healthcare user as parameters for personalization. In these personalization filters, IT plays a role that varies from fully automated personalization to a more collaborative form of data-driven decision making to make digital health service pathways more personalized for the individual healthcare user.

The work undertaken in this thesis contributes to research and practice by proposing personalization filters that can collectively represent the roles IT can play in the personalization of digital health service pathways.

Keywords: digital health, information systems, personalization, service pathways
Korhonen, Olli, Palvelupolkujen personointi digitaalisissa terveyspalveluissa.
Oulun yliopiston tutkijakoulu; Oulun yliopisto, Tieto- ja sähköteknikan tiedekunta
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Tiivistelmä

Personoinnin suunnittelussa voidaan hyödyntää erilaisia lähestymistapoja ja luokitukseja. Tieto-
järjestelmätieteissä nämä lähestymistavat ja luokitukset keskittyvät personoinnin suunnittelun
pääasiassa teknologisen artefaktin, kuten suosittelujärjestelmän, tasolla. Suunnittelu ei niinkään
tarkastele personointia ja teknologian roolia kokonaisvaltaisemmin digitaalisten palveluiden
tasolla.

Tämä tietojärjestelmätieteiden väitöskirja tarkastelee teknologian roolia digitaalisten terveys-
palvelupolkujen personoinnissa. Väitöskirja hyödyttää palvelulopun käsitettä, sen mahdollista-
essa personoinnin laajemmalla tarkastelulla teknologisen artefaktin sijaan. Väitöskirja tarkastelee
tutkittavaa ilmiötä monitapaustutkimuksen kautta ja hyödyntää laadullisia menetelmiä aineiston
käsittelemässä ja analysoinnissa.

Temaattisen analyysin tuloksena väitöskirja esittää kolme personoinnin filteerintä, jotka kuvaavat
teknologian roolveja digitaalisten terveyspalvelupolkujen personoinnissa. Personoinnin filteerit
ovat: (1) kontekstualinen filteri, missä teknologian rooli on huomioida terveydenhuollon
keskeisiä personoinnin parametreja; (2) datavetoinen filteri, missä teknologian rooli on huomi-
oida kerääntyneestä datasta nousevaa personoinnin parametreja; ja (3) käyttäjäkeskeinen filteri,
missä teknologian rooli on huomioida terveyspalveluiden käyttäjän ominaisuuksia ja mieltymyk-
siä personoinnin parametreina. Personointifiltereissä teknologian rooli vaihtelee täysin automa-
tisoidusti toteutetusta personoinnista yhteistyöperustaisempaan, datavetoinen päätöksenteokoon,
mikä yhdistää muovaa digitaalista terveyspalvelulopusta personoidun yksittäisellessä ter-
evyspalvelun käyttäjälle.

Tämän väitöskirjan tuloksia voidaan hyödyntää personoinnin tutkimuksessa ja suunnittelussa.
Väitöskirjassa esitetty perusmäärä filteerit täydentävät personoinnin tutkimuskentässä esitet-
tyjiä personoinnin lähestymistapoja ja luokitukseja ja niitä voidaan hyödyntää suunniteltessa per-
sontuista palvelupolkujia eri konteksteihin.

Asiasanat: digitaalinen terveys, palvelupolku, personointi, tietojärjestelmät
To my family
Acknowledgements

The journey of writing this thesis started in 2015. Little I knew about writing a doctoral thesis nor the life of a PhD student when I entered the corridor of the information processing science department for the very first time as a PhD student. Now I can say that experiences in this journey have been invaluable to me. The journey has given me a chance to grow as a researcher, but more importantly as a person. I have had the honor to work with a number of inspiring and talented people, who not only contributed to my work, but who also supported and guided me during this PhD journey. Without their support and guidance, it would have been impossible for me to finish this thesis.

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28.09.2020

Olli Korhonen
Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>Computer science</td>
</tr>
<tr>
<td>INR</td>
<td>International normalized ratio</td>
</tr>
<tr>
<td>IS</td>
<td>Information systems</td>
</tr>
<tr>
<td>IT</td>
<td>Information technology</td>
</tr>
<tr>
<td>PCC</td>
<td>Person-centered care</td>
</tr>
<tr>
<td>RA</td>
<td>Rheumatoid arthritis</td>
</tr>
<tr>
<td>RQ</td>
<td>Research question</td>
</tr>
<tr>
<td>SDM</td>
<td>Shared decision making</td>
</tr>
<tr>
<td>TMP</td>
<td>Technology-mediated personalization</td>
</tr>
<tr>
<td>UI</td>
<td>User interface</td>
</tr>
<tr>
<td>WWW</td>
<td>World Wide Web</td>
</tr>
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</table>
Original publications

This dissertation is based on the following five publications, which are cited throughout the text by their Roman numerals, I–V:


The author contributions to each study are listed below:

Study I: I was responsible for designing the study, collecting the data, and analyzing the data. I also led the writing process.

Study II: I was responsible for designing the study and for leading the writing process. I was also involved in the data collection and data analysis.

Study III: I was responsible for designing the study, leading the writing process, and collecting the data. I was also involved in the data analysis.

Study IV: I was responsible for analyzing the data. I also led the writing process.

Study V: I was responsible for designing the study, collecting the data, and analyzing the data. I also led the writing process.
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1 Introduction

“Special price, only for you!” is a slogan many people have heard while wandering around a marketplace. Whether the slogan is intended to be a sales pitch or a promise to offer products and services to an individual customer with a cheaper price, the service provider can use it to try to gain the customer’s attention. The slogan connects to the origins of personalization. Personalization has its roots in antique business, where a service provider, such as a marketer, knew their customers, who they were, and what they needed. This information was then used to provide different products and services to these customers (Tuzhilin, 2009). At that time, the service provider performed personalization for the individual customer in the interaction, keeping the customer’s needs and preferences in mind. This means that if the customer was a peasant, the recommended products and services were likely to be different than the recommendations targeted to the priest of the village.

Personalization has its origins in business and marketing, but advances in information technology (IT) have made personalization a more varied and affordable strategy for service providers to treat their customers individually (Sunikka & Bragge, 2012). The Internet as a single technology has cultivated personalization more than any other technology (Montgomery & Smith, 2009). It changed the game by providing a channel for service providers to offer their products and services globally. As a result, service providers started to integrate technologies as part of their business and use these technologies to personalize their interactions with their customers online (Ho, 2006). These technologies enabled service providers to deliver products and services at the right time for the right customer (Ho, 2006). Meanwhile, personalization technologies, such as recommender systems, started to gain more popularity (Tuzhilin, 2009). Recommender systems are one form of personalization technologies that are capable of learning about the customer, match the aggregated customer data with the available set of products and services, and finally filter and recommend the matching products and services for the individual customer (Churchill, 2013). In this way, the sister of the slogan “Special price for you!” was born—“Recommended for you!”

These slogans illustrate the connection between business and technology that has been at the heart of personalization research (Kwon & Kim, 2012; Salonen & Karjaluoto, 2016). However, the importance of personalization is also addressed in other contexts, such as healthcare (Berry & Bendapudi, 2007; Minvielle, Waelli,
Healthcare is increasingly being transformed by technologies (Carroll, 2016) that have the potential to improve the delivery of health services in different ways (Murray et al., 2016, such as by aggregating different types of data and by providing more opportunities to involve and communicate with the healthcare user (Sacchi, Lanzola, Viani, & Quaglini, 2015). Collectively, the technologies applied in the healthcare context can be referred to as digital health technologies (Lupton, 2014; Fricker, Thümmler, & Gavras, 2015).

Traditional care models in healthcare have focused on disease-centered and healthcare professional-centered approaches (Fricker et al., 2015). Care models, such as national care guidelines (In Finnish Käypä hoito suositukset) (Duodecim, 2019) and different types of organizational care pathways (Schrijvers, van Hoorn, & Huiskes, 2012), can provide different levels of guidelines regarding, for example, the roles and responsibilities of healthcare professionals and the various care options. However, both are used to ensure standardized high-level, evidence-based care for the individual healthcare user. Ensuring the highly standardized quality care is pivotal in healthcare, but at the same time, healthcare users are increasingly expecting to be treated as individuals (Minvielle et al., 2014). Each healthcare user is a unique individual, whose medical conditions, age, sex, personal preferences, and also life situation may vary and need to be considered individually (Berry & Bendapudi, 2007). Standardized evidence-based care that is delivered in a personalized manner continues to be a prominent issue in healthcare.

Current care models, such as care pathways that focus on describing all desired diagnostic and treatment steps for ensuring the coordination and continuity of care, provide a clinical viewpoint from which to treat a healthcare user according to the best care practices (De Bleser et al., 2006; Kinsman, Rotter, James, Snow, & Willis, 2010). However, more participatory forms of healthcare are needed to consider each healthcare user individually (Castro, Van Regenmortel, Vanhaecht, Sermeus, & Van Hecke, 2016). Scholars have suggested that digital health and the aggregation of digital data from different sources can enhance current care models and provide new ways to organize the care around the individual healthcare user (Caulfield & Donnelly, 2013; Chouvarda, Goulis, Lambrinoudaki, & Maglaveras, 2015; Korhonen, Väryynen, & Isomursu, 2018). In this form of care, the role of the healthcare professional is to complement the healthcare user’s own resources in care to treat the healthcare user individually (Lee et al., 2015; von Thiele Schwarz, 2016). This process can also involve other relevant stakeholders, such as the
healthcare user’s family members, who can be connected through the use of digital health technologies (Fricker et al., 2015).

Even though the importance of personalization is recognized in the context of digital health services, prior personalization approaches in IS have mainly focused on the design of technological artifacts, such as personalization systems, as outcomes. These approaches rarely consider the design of personalization more holistically at the level of digital services. To provide understanding on the personalization of digital health services, this thesis applies a service pathway concept that considers an organizational, non-clinical viewpoint for services (Oosterholt & Simonse, 2016). The concept of a service pathway is not exclusive to healthcare as different types of pathways can also take place, for example, in the context of education (Chen et al., 2017). In other words, the service pathway provides the means by which to consider all the available services to be included for the individual user in the context of healthcare or education or something else.

1.1 Research objective

The objective of this thesis is to address the research gap in personalization research and investigate personalization and the role of IT more holistically at the level of digital health services. The present work specifically focuses on the role of IT in the personalization of digital health service pathways. The main research question (RQ) of this thesis is the following:

- **RQ**: What role can IT play in the personalization of digital health service pathways?

1.2 Structure of the thesis

This thesis is structured as follows. The first chapter, *Introduction*, presents the study’s motivation, the research objective, and the RQ. The second chapter provides an *Overview of service personalization* through three personalization viewpoints. The third chapter presents the *Research methods* used, and the fourth chapter presents the *Findings* of this thesis. The fifth chapter presents the *Discussion*, summary of the key findings, theoretical and practical contributions, and limitations of this thesis. *Conclusions and future work* are presented in the Chapter 6.
2 Overview of service personalization

This chapter presents an overview of the relevant literature for this thesis and is divided into three viewpoints for personalization. Section 2.1 presents personalization in the service interaction and addresses personalization in the interaction between stakeholders. Section 2.2 covers personalization technologies and introduces different approaches to the design and implementation of personalization. Section 2.3 introduces personalization in healthcare and addresses the importance of treating each healthcare user as an individual. Finally, section 2.4 summarizes the main points of these viewpoints and addresses the identified research gap.

2.1 Personalization in the service interaction

Personalization in the service interaction originates from the service marketing literature. It follows the idea of one-to-one marketing, where each customer is treated individually (Peppers, Rogers, & Dorf, 1999). One-to-one marketing is an extreme form of segmentation in which the target segment is broken down to the level of the individual (Arora et al., 2008). One-to-one marketing takes place mainly in the interaction between the service provider, such as the marketer or the service personnel, and the customer (Surpranent & Solomon, 1987). One-to-one marketing is highly dependent on the skills and empathy of the service personnel interacting with the customer (Surpranent & Solomon, 1987; Mittal & Lassar, 1996).

At the conceptual level, one-to-one marketing connects to the service personalization with the idea to treat each customer as an individual. This is often done in the interaction, where the service is adjusted to fit with the customer’s needs. This can be seen in the following two service personalization definitions:

- Service personalization refers to “any creation or adjustment of a service to fit the individual requirements of a customer” (Ball, Coelho, & Vilares, 2006).
- Personalized service refers to “any behaviors occurring in the interaction intended to contribute to the individuation of the customer” (Surpranent & Solomon, 1987).

These definitions have similarities as both share the idea of treating the customer individually. The first focuses on adjusting the service offering and outcome of the service, whereas the second also includes the interpersonal behavior in the service
interaction. Service personnel, such as a front-stage clerk (who is responsible for interacting with a customer), can routinely personalize the service interaction for each customer at both these levels (Gwinner, Bitner, Brown, & Kumar, 2005). First, the service offering level refers to the outcome of the service or product that is personalized. Second, the adaptive behavior level refers to the state where the interpersonal behavior is adjusted to fit with the individual customer (Gwinner et al., 2005).

A service offering can be a tangible product (such as custom-made clothes) or an intangible service (such as personalized subscriptions or prices), or it can also be related to communications or information searches (Tuzhilin, 2009). Personalization at this level relates to the service outcome that is being personalized (Surpranent & Solomon, 1987; Churchill, 2013), and still oftentimes the service outcome is personalized in the interaction between the service personnel and the customer (Gwinner et al., 2005). In this form, the service provider can, for example, set the available options for the customer to choose from in order to make the service or product personalized for the customer (De Blok, Meijboom, Luijkx, & Schols, 2013). A practical example could be ordering a pizza, where the customer can choose the pizza ingredients and delivery options from the pre-defined menu the service provider has set.

Personalization at the level of adaptive behavior refers to the personalized interaction between the service personnel and the customer. In this form of personalization, the service personnel adapts the interpersonal behavior to fit with the individual customer (Gwinner et al., 2005). According to Surpranent and Solomon (1987), adaptive behavior can take place in the following two different forms: programmed personalization and customized personalization. Programmed personalization refers to, for example, when the service personnel calls the customer by name in the interaction and uses personalized small talk in the interaction with the customer. Customized personalization refers to when the service provider uses his/her knowledge to assist the customer in choosing the most optimal product or service (Surpranent & Solomon, 1987). Following the pizzeria example, the service personnel may, for example, call the regular customer by name (programmed personalization) and suggest sun-dried tomatoes and other vegetarian ingredients (customized personalization) as the customer has expressed the wish to have less meat on the pizza. Therefore, these two forms of adaptive behavior are performed by the service personnel in the interaction with the customer throughout the service (Gwinner et al., 2005), which emphasizes the role of the service personnel in personalization (Mittal & Lassar, 1996).
Traditionally, service personalization has usually taken place in face-to-face service encounters, but advances in IT have opened new opportunities for personalization (Vesanen, 2007). Personalization in the service interaction and the service delivery using IT is referred to as technology-mediated personalization (TMP) (Shen & Ball, 2009). Personalization through technology can take place in three different ways that have similarities with other types of personalization in the service interaction. Technology-mediated service interaction refers to calling the customer by name. Transaction outcome personalization refers to the personalization of service offerings, such as products and services. Continuity personalization focuses on the use of technology to continuously learn about the customer’s preferences to provide more personalized products and services that are specifically targeted at the individual customer (Shen & Ball, 2009). Personalization through technology can also take place in the form of recommendations, where the technology can display data about the customer’s previous purchases to be used by the service personnel in recommending products and services for the customer (Glushko, 2010). Technology can also mediate personalization in the service interaction by taking place through different channels, such as via the Internet or phone (Sousa & Voss, 2009) or interactive service kiosks (Korhonen, Syrjänen, Kinnula, Isomursu, & Kuutti, 2017). Technologies such as chatbots can also take the lead in handling the whole interaction with the customer (Zumstein & Hundertmark, 2017).

2.2 Designing and implementing personalization in IT

Personalization has its roots in marketing, but in the 21st century, technological advances have made personalization a more varied and affordable strategy for service providers to treat their customers individually (Montgomery & Smith, 2009; Sunikka & Bragge, 2012). These technologies are capable of collecting, storing, and processing the individual user data more efficiently, which helps service providers to offer the right products and services at the right time in the right place to the right customer (Ho, 2006; Sunikka & Bragge, 2012). For the customer, this form of personalization is visible through surfing in the World Wide Web (WWW), which has remained the main platform for personalization (Sunikka & Bragge, 2008; Salonen & Karjaluoto, 2016).

In the IS literature, there is some consensus that personalization is a process in which the service provider tailors services and products to meet the needs of the customer (Tuzhilin, 2009). Often, this is done through IT, which has moved the
focus of personalization research to personalization in IT. Personalization in IS can be defined as a process that changes the user interface (UI), functionality, content, or distinctiveness of IT to increase its personal relevance to the individual user or group of users (Blom, 2000; Fan & Poole, 2006). While the marketing literature often refers to the end-user as the customer, the IS literature also employs the concept of user to represent the end-user.

In IS, the design and implementation of personalization in IT is often considered through different classifications. One of the most well-known and comprehensive classifications through which to design and implement personalization in IT is introduced by Fan and Poole (Fan & Poole, 2006), whose classification has the following three main dimensions: (1) the object of personalization (what is personalized?), (2) the target of personalization (to whom to personalize?), and (3) the subject of personalization (who personalizes?) (Fan & Poole, 2006). The classification and its three dimensions are illustrated in the following sections (2.2.1–2.2.3) and are followed by a section about personalization technologies in practice (2.2.4).

### 2.2.1 Object of personalization—What is personalized?

The first dimension in the classification concerns the object of personalization, which refers to the different aspects of a given technology that can be personalized. Fan and Poole (Fan & Poole, 2006) introduced four different technology aspects of content, UI, channel/information access, and functionality that can be personalized. These aspects and their explanations are summarized in Table 1.

<table>
<thead>
<tr>
<th>What is personalized?</th>
<th>What is means?</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>The information itself</td>
<td>Personalized online recommendation</td>
</tr>
<tr>
<td>UI</td>
<td>The way information is presented</td>
<td>Customization of a webpage layout</td>
</tr>
<tr>
<td>Channel/Information access</td>
<td>The media through which information is delivered</td>
<td>Multichannel services that, for example, comprise physical and digital channels</td>
</tr>
<tr>
<td>Functionality</td>
<td>The function of the IT (what the user can do with the IT)</td>
<td>IT uses context awareness to provide location-based recommendations</td>
</tr>
</tbody>
</table>

Table 1. Object of personalization (based on Fan & Poole, 2006).
The first aspect, content, means that the information itself is personalized. This can mean the manipulation of information to match with the user’s preferences, such as by displaying research articles that match with the user’s personal wishes. The second aspect, UI, refers to the way the information is presented. Personalization in this form can mean different types of personalized layouts or the use of different fonts or colors to represent the information for the individual user. The third aspect, channel/information access, refers to the media through which the information is presented. This can, for example, mean the use of different channels that can comprise digital and physical channels (Sousa & Voss, 2009; Korhonen et al., 2017) for personalized information access through the preferred channel. The fourth aspect, functionality, refers to the particular uses of the technology. For example, the technology can enable a tracking functionality and provide personalized location-based recommendations for the user.

These four aspects that consider the object of personalization have similarities with the findings of other personalization scholars. Wu et al. (Wu et al., 2003) suggest that the object of personalization can be divided into content and UI only (Wu et al., 2003), whereas Sunikka and Bragge (Sunikka & Bragge, 2012) address all these four aspects but suggest that the classification be limited to technology only and certain other aspects, such as also personalizing the communication with the customer (Sunikka & Bragge, 2012).

2.2.2 Target of personalization—To whom to personalize?

The second dimension considers the target of personalization. This dimension can be divided into the individual level and the group level (Fan & Poole, 2006). The difference between these levels is that at the individual level, personalization is targeted at the single individual; at the group level, personalization is targeted at several users who are classified into the same category. For example, consider a group of scholars who are working in the same research unit. For the user, the line between the individual and the group may not always be clear as the individual user may also be part of the group. For example, the author of this thesis is an individual but is part of a research unit and can therefore receive personalization targeted at both levels. These two levels (individual and group) are widely considered by personalization scholars who use both similar and different concepts to represent these levels.

Individual-level personalization is referred to as individuated (Fan & Poole, 2006) and one-to-one personalization (Sunikka & Bragge, 2008, 2012; Kwon &
Kim, 2012). Both concepts focus on targeting personalization at the single individual.

Group-level personalization targeting a group of people is described using concepts such as categorical personalization (Fan & Poole, 2006), micro-personalization (Sunikka & Bragge, 2008), mass-personalization (Sunikka & Bragge, 2012), and one-to-N personalization (Kwon & Kim, 2012). All these concepts emphasize that personalization takes place at the level of the group or a segment of people, which means more than one person.

In other words, these two levels represent the granular level of personalization. Fan and Poole (Fan & Poole, 2006) state that, if desirable, individual-level personalization can be reached by fine-graining the group-level personalization far enough. However, the fine-graining can potentially require the creation of numerous personalization categories, which may not be feasible to consider in all circumstances. For example, in the gaming context, it may not be feasible to create a game narrative for each individual player, but to some extent personalization should be promoted (Göbel, Hardy, Wendel, Mehm, & Steinmetz, 2010; Korhonen, Oduor, & Isomursu, 2017).

### 2.2.3 Subject of personalization—Who personalizes?

The third dimension, the subject of personalization, refers to the actor who performs the personalization. The subject of personalization can be divided into two levels of the system/service provider and the user (Kwon & Kim, 2012; Montgomery & Smith, 2009). In the former, personalization is done automatically for the individual user without actively involving the user (Lee et al., 2015), whereas in the latter, the user is given an option and is actively allowed to choose from pre-defined options (that are pre-set by the service provider) to personalize the service or the product (Churchill, 2013; Lee et al., 2015).

The distinction between the system/service provider performing personalization and the user performing personalization is in the use of different concepts. The system/service provider performing personalization is referred to as implicit personalization (Fan & Poole, 2006), system-driven personalization (Lee et al., 2015), and system-initiated personalization (Kwon, Cho, & Park, 2010; Kwon & Kim, 2012; Sunikka & Bragge, 2008, 2012). Collectively these refer to personalization that is carried out by the service provider or the system on the behalf of the user (Arora et al., 2008; Montgomery & Smith, 2009). For example, technologies can automatically collect information about the user and filter this
information to provide personalized recommendations for the user without actively involving the user in the personalization process.

In the case where the user is actively involved and performs personalization is called explicit personalization (Fan & Poole, 2006), user-driven personalization (Lee et al., 2015), customer-initiated personalization (Sunikka & Bragge, 2008), and user-initiated personalization (Kwon et al., 2010; Kwon & Kim, 2012; Sunikka & Bragge, 2012). More broadly, the user performing personalization is also referred to as customization (Arora et al., 2008; Montgomery & Smith, 2009). In this form of personalization, the user may, for example, customize a webpage, such as MyYahoo, which allows the user to specify and select components to be included on their home page in a personalized manner (Arora et al., 2008). The different concepts used to represent the subject of personalization are summarized in Table 2.

Table 2. Two subjects of personalization.

<table>
<thead>
<tr>
<th>System/Service provider personalizes</th>
<th>User personalizes</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>System-driven</td>
<td>User-driven</td>
<td>Lee et al., 2015</td>
</tr>
<tr>
<td>Personalization</td>
<td>Customization</td>
<td>Arora et al., 2008; Montgomery &amp; Smith, 2009</td>
</tr>
</tbody>
</table>

There is some agreement among scholars regarding the distinction between personalization done by the system/service provider and personalization done by the user. However, scholars have also introduced some minor adjustments to these concepts. For example, Kwon and Kim (Kwon & Kim, 2012) consider implicit and explicit personalization (Fan & Poole, 2006) to be more related to learning and data collection methods than the subject of personalization. This means that system-initiated personalization may not be limited to the use of implicit methods in personalization. Rather, explicit methods, such as directly asking the user, can also provide data for use in feeding the system to provide system-initiated personalization. A similar consideration can be found in the case of personalization and customization, where Sunikka and Bragge (Sunikka & Bragge, 2008) suggest that personalization should be viewed as an umbrella term that is not opposing customization but rather that customization is a sub-concept of personalization (Sunikka & Bragge, 2008).
2.2.4 Personalization technologies in practice

Technological advances made personalization increasingly popular in the context of electronic commerce in the mid-to-late 1990s (Tuzhilin, 2009). Amazon is one of the most well-known enterprises that utilizes personalization techniques and technologies in its core business, and it has been followed by other global enterprises, such as Google, which, for example, announced its personalized search function in 2009. As a result, there are no longer completely similar search results between individual users who are using Google’s search functions (Pariser, 2011), which is a good example of personalization targeted at a single individual (Fan & Poole, 2006). In addition to personalized searches, personalized advertisements, provided by, for example, Facebook and Google, are increasingly designed and implemented to provide personalized user experiences for the individual user (Pariser, 2011). Collectively, these technologies are powerful tools that can be used to learn about the individual user’s needs and to respond to these needs, such as in the form of different recommendations (Tuzhilin, 2009). These technologies have their own characteristics, one being that they still often remain as “black boxes” for the user. This means the user is often not aware of the personalization process nor the data and methods that are used to construct the personalization (Pariser, 2011).

Personalization is a process that typically takes place through different phases (Adomavicius & Tuzhilin, 2005a). The process involves the learning and understanding phase, where different personalization technologies are used to learn about the individual user’s needs, behaviors, and preferences. This phase can take place both implicitly and explicitly (Fan & Poole, 2006). After learning and understanding, the process moves to the matching phase, where personalization technologies are used to match the learnings with the available service offerings (Adomavicius & Tuzhilin, 2005a; Churchill, 2013). At this phase, personalization technologies have data about the individual user, and the data are matched with the available services and products to filter the personalized products and services for the user. Personalization technologies that use different approaches to learn, match, and filter can broadly be categorized into the following three different types of filters (Adomavicius & Tuzhilin, 2005b; Tuzhilin, 2009):

- **Content based filtering**, where the user is given recommendations on products and services based on those the user has preferred in the past.
- **Collaborative filtering**, where the user is given recommendations based on the preferences of others—similar types of users who have been categorized as having similar preferences and likes.

- **Hybrid filtering approaches**, where personalization technologies combine the two approaches of content-based filtering and collaborative filtering technologies.

The matched and filtered information is constantly revised as the personalization process also considers the measurement phase, which refers to the evaluation of the impact of personalization and adjusting the personalization accordingly (Adomavicius & Tuzhilin, 2005a). As the data are continuously generated from different sources, this creates more fuel to provide more accurate and sophisticated forms of personalization (Salonen & Karjaluoto, 2016), for example, in the form of continuity personalization (Shen & Ball, 2009).

### 2.3 Personalization in healthcare

In addition to the combination between business and technology, personalization is an integral part of health services (Lee et al., 2015). Each healthcare user is a unique individual, whose personal characteristics, such as medical condition, age, sex, and personal preferences, may vary drastically (Berry & Bendapudi, 2007) and who also expects to be treated as an individual (Minvielle et al., 2014). This section introduces personalization in the context of healthcare by considering the characteristics of health services (section 2.3.1), standardized evidence-based clinical care (section 2.3.2), and the person-centered approach (section 2.3.3), which considers the idea of involving the healthcare user at the center of the care.

#### 2.3.1 Health service characteristics

The healthcare industry is the largest and fastest-growing industry in the world, and the numbers are expected to grow significantly over the next decades (Fricker et al., 2015). The healthcare industry as a whole can be considered through different health service delivery systems that are responsible for providing different types of health services. These health services include those targeted at the patients but also persons and families and bigger communities and populations (World Health Organization, 2020). Health services in these systems can vary from health prevention, health promotion, and detection to diagnostic, rehabilitation, and finally palliative care, also including the following different levels of care: self-care
home care, community care, primary care, long-term care, and hospital care (World Health Organization, 2020). As there are different types of health services that are designed and delivered for people in different conditions (not all conditions require diagnosis), this thesis will use the concept of a healthcare user, instead of a patient, to represent the person who receives health services.

By their nature, health services have similarities and dissimilarities with other services. Health services are highly knowledge-intensive services (Fichman, Kohli, & Krishnan, 2011) that are often delivered in close interaction between the stakeholders, such as the healthcare professional and the healthcare user (Forlizzi & Zimmermann, 2013). Similar to certain other types of services, such as transportation or renovation services, health services are intangible by nature (Berry & Bendapudi, 2007) but use different technologies, such as different types of medical devices that can support stakeholders in delivering health services (von Thiele Schwarz, 2016).

Health services are also inseparable by nature. This means that the healthcare user often needs to be physically present in the rooms where the health service is delivered (e.g., service delivery takes place at a hospital, at the operating room of the healthcare professional) (Berry & Bendapudi, 2007). This also considers the fact that these services are delivered under the specific circumstances where the healthcare user is at a knowledge disadvantage compared to the healthcare professional (Berry & Bendapudi, 2007). For example, the healthcare user may express the level of pain in a certain body part, but the healthcare professional is needed to evaluate the condition and to make the potential diagnosis for the healthcare user.

Health services are also often delivered under circumstances where the healthcare user is ill and under stress. Healthcare users rarely enjoy spending time at the hospital where health service is delivered, and they may have personal fears and mixed emotions toward these services. For example, in the case of a surgery, the healthcare user may find the operation to be beneficial, but at the same time s/he may be concerned about the risks that are related to the operation (Berry & Bendapudi, 2007).

Health services are also highly personal and sensitive by nature. The healthcare user may need to express his/her personal matters and data to the healthcare professional, but the healthcare user can also be told to undress at the appointment, or s/he can be advised to drink less craft beer, which is unlikely to be required in some other types of services (Berry & Bendapudi, 2007).
2.3.2 Standardized evidence-based health services

One of the central requirements for health services is the high level of standardization. Health services are highly standardized services that need to be delivered with high quality and according to the best care practices. These are often addressed through organizational-level care pathways and national-level care guidelines that are both based on global evidence-based care research.

**Care pathways** (also known as clinical pathways, care maps, or critical pathways) are widely used in healthcare to ensure that health service delivery takes place according to evidence-based care (Kinsman et al., 2010). Care pathways are tools or methods that consider the evidence-based care guidelines and practices but also healthcare user’s expectations of care. This is done by facilitating the communication and coordination of the roles and activities of multidisciplinary healthcare teams, which can include, for example, medical doctors and nurses, but also the healthcare user who receives the care (De Bleser et al, 2006). Care pathways are typically communicated to healthcare professionals through static documentation (Gand & Schlieter, 2016). This means that care pathways display all available health services and treatment steps targeted at a certain disease or condition but also the roles and activities of the healthcare professionals.

For example, Helsinki University Hospital has designed a prostate cancer care pathway that provides a high-level description of the different phases of prostate cancer care (Helsinki University Hospital, 2020). The prostate cancer care pathway starts as the healthcare user gets a “referral to the care center,” which means that there is a reason to suspect prostate cancer. This phase is followed by the “diagnosis and metastasis examination” phase. Once the results of the examinations are available, a “consultation meeting” with a urologist is organized. After consultation, the treatment of the prostate cancer starts. The treatment can have two different phases. If the prostate cancer is local, confined to the prostate, this is referred as “treatment of local prostate cancer.” Alternatively, if the prostate cancer is found to have metastasized outside the prostate, the care pathway leads to the “treatment of metastatic prostate cancer” phase, which is followed by different care options available only to metastatic prostate cancer, such as “hormone therapy” or “chemotherapy.” In the case of local prostate cancer, the options in the following phase include “active surveillance,” “surgery,” or “radiotherapy.” In the case of “surgery” and “radiotherapy,” a monitoring phase called “follow-up” takes place.

**Care guidelines** are independent evidence-based clinical practice guidelines. These guidelines are often set at the national level, such as Finland’s current care
guidelines, which cover essential procedures regarding Finnish health, medical treatment, and the prevention of diseases. These guidelines are designed to act as a basis for treatment decisions and can be used by healthcare professionals, such as physicians or dentists but also citizens. Currently, Finland has 481 different care guidelines covering 45 different care categories in healthcare (Duodecim, 2019). These care guidelines provide concise recommendations that can support healthcare professionals in their practical work with the healthcare user.

As an example, one care guideline considers rheumatoid arthritis (RA) (Duodecim, 2017). In this case, the care guideline provides comprehensive information set on RA and its treatment options. The care guideline is intended to serve healthcare professionals who are working with healthcare users with inflammatory rheumatic diseases with the aim to improve and harmonize the diagnosis and management of RA.

Both care pathways and national care guidelines provide different levels of guidelines for healthcare professionals to treat the healthcare user who has a certain condition. National care guidelines provide national-level guidance about the evidence-based clinical guidelines, whereas care pathways take place at the organizational level, for example, in a university hospital or at a private healthcare service provider. Care pathways and national care guidelines complement each other and support the delivery of high-quality standardized care.

2.3.3 Person-centered care—Time to involve the healthcare user?

Current care models in healthcare are being affected by the changes in our society as it shifts from an industrial- and agricultural-driven society to a service society (Fricker et al., 2015). Traditional care models have focused on hospital-centered and specialist-focused healthcare systems, but these are shifting to a more person-centered approach, where the healthcare user is at the center of the care (Ekman et al., 2011; Chouvarda et al., 2015; Fricker et al, 2015). There is an ongoing trend to move towards proactive care and preventive interventions through the use of technologies (Carroll, 2016). At the same time, having the person at the center of the care may ensure that the care is more aligned with the individual healthcare user’s preferences and values (Oshima-Lee & Emanuel, 2013).

The intention to involve the healthcare user at the center of the care is collectively described through different concepts that share the idea of more participative forms of healthcare. Person-centered care (PCC) (Ekman et al., 2011), co-care (von Thiele Schwarz, 2016), the co-production of healthcare services
(Batalden et al., 2016), and shared decision making (SDM) (Oshima-Lee & Emauel, 2013) all promote the idea of collaborative interaction between the healthcare professional and the healthcare user in health service delivery. Similarly, patient participation, patient centeredness, and patient empowerment are closely related concepts but consider the different aspects of participatory healthcare. Patient participation can be seen as a strategy that can facilitate the patient-centered approach, which can then lead to patient empowerment (Castro et al., 2016). Collectively, all these concepts address this trend of more participatory healthcare and involving the healthcare user.

2.4 Summary and the research gap

Personalization is an interdisciplinary concept and is investigated through different viewpoints. Business and marketing consider personalization mainly through the service interaction, whereas in more technical fields, such as IS, the focus has widely remained in the design and implementation of personalization and in the different approaches to classifying personalization in IT. Classifying personalization into different dimensions—the object of personalization, subject of personalization, and target of personalization—are still valid and provide guidance for the design of technological artifacts. However, as service pathways provide a means by which to consider all the available services to be included for the individual user, these personalization approaches may not be sufficient. Rather, complementary approaches to consider personalization are necessary.

This connects to the idea of a paradigmatic change in design, where the processes, methods, and tools of a certain paradigm may not be sufficient for use in another paradigm (Gardien, Djajadiningrat, Hummels, & Brombacher, 2014). In this thesis, a change paradigm can be seen as a change from the design of technological artifacts into the design of service pathways. This means that the approaches to designing technological artifacts may not be sufficient for considering the personalization and the role of IT more holistically at the level of digital health services. This thesis therefore addresses this gap in the personalization research and focuses on the role IT can play in the personalization of digital health service pathways. It does so by taking a multiple-case study approach, which enables the creation of holistic understanding from different care contexts. The research stance is in the interpretation and creation of understanding through these particular cases in their contexts (Klein & Myers, 1999) without
adopting a more critical stance on the conditions, such as the power structures that lie behind these interpretations (Myers & Klein, 2011).
3 Research methods

This chapter provides information about the research methods and approaches used in this thesis. This chapter consists of four sections. Section 3.1 describes the research domain of this thesis. Section 3.2 introduces the selected research approach—a multiple-case study approach. Section 3.3 presents how the multiple-case study approach was applied in this thesis. The section also introduces the five individual cases (A–E) as well as the data collection and data analysis of each case. Finally, section 3.4 presents the cross-case analysis by summarizing these five cases and comparing the findings across the cases.

3.1 Research domain

This thesis is multidisciplinary, but the main contribution lies in the domain of information systems (IS) and specifically IS in healthcare. IS in healthcare intersects with other fields that are more healthcare-centered, such as health IT and health informatics, which extends the research domain of this thesis also to these fields. As the present work considers personalization in the context of digital health services, the research domain also intersects with the fields that have more traditionally investigated service personalization in the service interaction, such as service marketing.

3.2 Multiple-case study approach

A multiple- or collective-case study is an approach that enables the researcher to collect evidence from individual cases to understand the uniqueness and complexity of each case and the context wherein the case takes place (Stake, 1995). The approach also enables the researcher to compare the similarities and differences across cases (Baxter & Jack, 2008).

The strength of the multiple-case study is that it enables the analysis of each case but also the comparison of similarities and dissimilarities across cases (Yin, 2003). The idea is that individual cases should be broadly comparable even though each case may differ in their nature and depth (Crowe et al., 2011). The multiple-case study approach in this thesis can be also considered instrumental by nature. In an instrumental case study, the researcher’s intention is to use a particular case to gain more understanding on the investigated phenomenon (Stake, 1995). In this
thesis the five cases were carefully selected to provide understanding on personalization at the level of digital health services.

The selected cases investigated the phenomenon—the role of IT in the personalization of digital health service pathways—through different cases that were taking place in different care contexts. The care contexts were occupational care, wellbeing, home care, rehabilitation, and primary care. Collectively, these care contexts broadly represent the spectrum of the health services catalogue introduced by World Health Organization (World Health Organization, 2020).

In each case, qualitative research methods were used to arrive at an understanding of the studied phenomenon. Qualitative research methods were used to collect and analyze the data. Data collection was mainly done through interviews and document analyses. Data analysis was done thematically. Both data collection and data analysis methods were reported in detail in each case, as well as in this thesis, to ensure the transparency of the methods. The transparency of the methods connects to the reliability aspect, which is also essential for multiple-case studies.

3.3 Multiple-case study approach in this thesis

The multiple-case study approach in this thesis consists of five individual cases (cases A–E). These five cases were selected as they enabled me to investigate the role of IT in the personalization of digital health service pathways within several healthcare contexts. The World Health Organization (World Health Organization, 2020) illustrates that health service delivery considers the whole spectrum of care, which can vary from health service promotion and detection to diagnostic, rehabilitation, and palliative care and also to all levels of care, which can include, for example, home care, primary care, and hospital care, to provide integrated health services (World Health Organization, 2020). In this thesis, five of these care contexts—occupational care, wellbeing, home care, rehabilitation, and primary care—were selected to represent the spectrum of health services. The selection process and the rationale for each case is described below.

Case A. I analyzed a depression care pathway that was designed by the Finnish healthcare service provider Terveystalo in the context of occupational care. Terveystalo is one of the largest healthcare service providers in Finland, and the designed care pathway was used to support depression care in occupational care for people who were working in Terveystalo’s client companies. The case enabled me to analyze personalization along the entire service pathway, where several technologies supported the delivery of the service. This was important for me to
start forming an understanding on the personalization of service pathways not only the technologies used in the service.

**Case B.** I analyzed user experiences and expectations for personalization supported by a mobile application in the context of wellbeing. As different mobile technologies and applications are increasingly integrated into people’s lives, this case enabled me to investigate the role of a mobile application as a motivating factor toward healthier lifestyles and to explore the possibilities for the design of personalization. This was done through the analysis of the user- and system-specific characteristics of the selected technology *Zombies, Run!* The application was selected as it utilized the unique feature of narratives to support users’ motivation toward exercising.

**Case C.** I analyzed a telemedicine system designed by the Finnish digital service provider Elisa in the context of home care. Elisa is one of the largest digital service and mobile operators in Finland. Recently they have extended their service catalogue to the realm of healthcare, where Elisa has designed a system that enables home-based self-measurements for various conditions. Through this case, my intention was to investigate and explore the opportunities, potential barriers, value, and trade-offs as well as the technical feasibilities regarding personalization.

**Case D.** I analyzed the role of healthcare technologies in behavior change in the context of Finnish primary healthcare. Primary healthcare is the part of the healthcare system that focuses on preventive healthcare. In this case, I conducted a secondary data analysis to analyze the personalization themes that had emerged from the interviews with the healthcare professionals who were working with behavior change in primary care (Mylonopoulou, 2018). Through this case, my intention was to gain understanding on the care practices and identify and analyze the different personalization themes from the interviews with healthcare professionals.

**Case E.** I analyzed a novel technology called “posture scanning,” which was developed by the Swedish company Qinematic in the context of rehabilitation. The healthcare industry is increasingly using different technologies that can be used to digitalize some parts of the care but also to make the care more personalized for the healthcare user; however, in physiotherapy, the adoption of digital tools has remained low. Here the analyzed posture scanning enabled the objective recording, measuring, and reporting of movement in humans, which can provide different forms of data to enhance traditional physiotherapy. Through this case, I analyzed the viewpoints, expectations, and needs of different stakeholders, healthcare users, healthcare professionals, and IS developers and considered how the designed
technology could enhance physiotherapy and enable a more personalized delivery of physiotherapy.

These five individual cases and their contexts are summarized in Figure 1.

![Figure 1: Five case studies and their contexts.](image)

These five cases enabled me to investigate personalization at the level of digital health services through different care contexts situated along the healthcare spectrum (World Health Organization, 2020). The following sections (3.2.1–3.2.5) describe the case contexts and the data collection and analysis process of each case.

### 3.3.1 Case A: Terveystalo depression care pathway

As I started to investigate personalization in the service pathways, I needed to gain an understanding about the care pathways and the role of IT in care. To approach this, I led a case study (Study I) with Terveystalo. Terveystalo is one of the largest healthcare service providers in Finland. The company provides health services for diverse customer segments, varying from health services targeted at the private sector, insurance companies, and the public sector but that also include occupational care services for organizations. The analyzed depression care pathway was designed in the context of occupational care, and it displayed all available care
options targeted for depression care. Therefore, the analysis enabled me to investigate the role of IT in personalization more holistically, at the level of the entire service pathway.

**Data collection.** The data were collected through interviews and document analysis. Different types of interviews were conducted with key informants, who were occupational physicians working in Terveystalo and who had designed the depression care pathway. The data from the interviews were complemented with the analysis of care pathway and depression care guideline documentation.

The data collection took place in three phases. First, two group interviews with company representatives were conducted to form a comprehensive picture of the case and to determine the key people, requirements, and demands (in our case for personalization). After the first group interview, two forms of documentation—on the depression care pathway and on national guidance for depression care—were delivered for analysis. Second, based on the findings of the group interviews and document analysis, two semi-structured interviews were conducted. In these interviews, physicians were asked to provide more detailed information and to validate our findings that had emerged from the group interviews. Third, one semi-structured interview was conducted with the occupational physician who had designed the care pathway and who had participated in the earlier interview. The intention was to validate our findings and the personalization taxonomy and to provide complementary information to be added to the taxonomy.

**Data analysis.** The data analysis was done iteratively using a thematic data analysis approach (Miles & Huberman, 1994). As the care pathway documentation remained static and did not provide support for personalization, group interviews and semi-structured interviews were the main source through which to understand service personalization in the entire care pathway. As a result of thematic analysis, the findings were categorized under three main categories based on the automation level of personalization. In the most automated type, coercive personalization, certain care options were automatically selected (included or excluded) for the healthcare user. This means that regulations and legislation had pre-defined some care options to be included or excluded for certain healthcare users by default. In the second type, the themes were related to the data that supported the occupational physician in interpreting and making personalization-related decisions in care. Technology, for example, displayed absences from work using the color red as an anomaly to trigger the occupational physician to react accordingly. The themes in the third type were related the data used by the healthcare professional and the healthcare user in collaboration to make personalization-related decisions.
The results of this case study provided me with an understanding on the personalization themes in the entire service pathway. The results revealed that some health services can be pre-set automatically and cannot be adjusted during the care process, whereas other health services are set by the healthcare professional through the digital data. For yet others, the digital data guide collaborative decision making in personalization.

3.3.2 Case B: Zombies, Run! exercise application

Today, people’s lives and leisure activities are increasingly supported by digital technologies (Eklund, 2015), and markets are flourishing with digital tools and applications that can support healthcare users in their health-related activities (Gouveia, Barros, & Karapanos, 2014; Häkkilä, Colley, Inget, Alhonsuo, & Rantakari, 2015). This motivated me to explore the role of technology in personalization in the context of wellbeing, where healthcare users are using these applications as part of their daily lives.

The second study (Study II) analyzed the system-specific and user-specific characteristics of personalization in the context of wellbeing. To approach this, an exercise application called Zombies, Run! was selected as the technology to provide insights for personalization. Zombies, Run! is a unique application in the field of exercise applications as it employs a post-apocalyptic narrative to motivate users to exercise (Helf & Hlavacs, 2016). The application has been available through Google Play and Apple’s App store since 2012 and has gained popularity among users. The apocalyptic narrative was generic and did not provide support for personalization, but through the application I was able to investigate users’ needs and expectations regarding personalization.

Data collection. Data were collected through different qualitative data collection methods, including a group interview, semi-structured interviews, and participant observations. The study participants (6) were female postgraduate students and were recruited for this study using a snowball sampling technique (Patton, 2002). The semi-structured interviews and the group interview focused on exploring participants’ motivation toward exercising and the role of technology in exercising for personalization. In the participant observations, the participants used the application in natural settings. The participants went for a jog with a researcher and were asked to play the narrative and to think aloud during the experience (the run was audio-recorded to obtain an authentic experience).
Data analysis. The data were analyzed thematically, and the emerging themes were analyzed further using a nexus analysis lens. Two main categories that emerged from the thematic analysis were related to users’ motivation toward exercising and the role of the technology in motivating them exercise. Nexus analysis (Scollon, 2004) was applied as an analytical lens to deepen the understanding of the qualitative data collected (Molin-Juustila, Kinnula, Iivari, Kuure, & Halkola, 2015). Two nexus analytic concepts, historical body and interaction order, were applied to consider participants’ backgrounds and previous experiences as they may influence their motivation to exercise and to use technologies in exercising but also their interactions and relationships when they were exercising. For example, did the user prefer to exercise alone or in a group? The findings provided me an understanding on users’ needs and expectations regarding personalization. Personalization in this case was related to users’ goals but also to their wishes for adjustments to the technology (gamification level and genre of narrative).

3.3.3 Case C: Elisa monitoring platform

Telemedicine refers to the use of IT to deliver health services to remote locations (Lupton, 2014). As a technology, telemedicine is not novel, but, along with the increased use of technologies in healthcare, it can enhance current care models by enabling certain parts of the care to take place remotely. This can also provide opportunities for personalization in future care models.

In this study, my intention was to investigate the role of a telemedicine system in health service personalization in the context of home care. I led a case study (Study III) with the Finnish digital service provider Elisa, which is one of the largest digital service providers in Finland. Elisa has provided digital and mobile services but has also recently extended its service catalogue to healthcare. In healthcare, Elisa developed a telemedicine system as a monitoring platform that supported home-based self-measurements of various parameters of diabetes and asthma as well as of hypertension and international normalized ratio (INR). Through this case, I was able to gain understanding on technical feasibilities and values and trade-offs but also on the potential barriers regarding personalization from the perspective of the IS developers who had designed the system.

Data collection. Data were collected from two main sources. First, telemedicine documentation was analyzed (7 documents, total of 218 pages) to form an understanding of the system-specific characteristics and the documented
design decisions that considered personalization-related implementation choices. Second, the documentation analysis was complemented with a group interview with the telemedicine system developers, who were considered to be key informants in this case (Yin, 1994). In the group interview, questions were related to developers’ general knowledge and understanding of personalization, personalization techniques in the telemedicine system, boundaries for personalization, and trade-offs and value provided by personalization. After the group interview, two validating interviews with one of the interviewees were conducted to validate the findings and to provide complementary information for the preliminary findings.

**Data analysis.** The data analysis process was conducted iteratively using a thematic data analysis approach (Patton, 2002). First, the documents were read and analyzed to provide understanding on the telemedicine system. This information was used in planning the focus group interview template. After the focus group, the interview data were categorized thematically into three main categories regarding the different ways in which the telemedicine system supported service personalization. Generating user data refers to the aggregation of datasets that supported personalization in decision making and in progress evaluation in care. Detecting anomalies refers to indicating and visualizing anomalies, such as abnormal measurement results from the data for the healthcare professional to interpret in personalized manner. Enhancing interaction refers to contextual information in the form of written comments that supported the interpretation of measurement results and helped the healthcare professional to provide personalized feedback through the telemedicine system.

### 3.3.4 Case D: Behavior change in Finnish primary healthcare

After exploring the technology opportunities from the IS developers’ side, there was a need to further investigate the healthcare professionals’ viewpoints on personalization. Therefore, a case study (Study IV) investigated personalization themes in behavior change in the context of Finnish primary care. Primary care focuses on that part of the healthcare system that focuses on health prevention and promotion rather than disease management, which in the case of behavior change can mean services that are targeted, for example, at smoking cessation. In behavior change, the combination of the personal life of each healthcare user and their social environment can make behavior change unique for each individual, which provided me an opportunity to explore personalization themes in the context.
**Data collection.** The data were originally collected in 2017 to investigate the role of IT in health behavior change (Mylonopoulou, 2018). Therefore, in this case, I conducted a secondary data analysis for the existing data to come up with the emerging personalization themes. In total, six interviews were conducted with healthcare professionals who were working in Finnish primary healthcare and with behavior change. Three participants were nutritionists, two were medical doctors, and one was a nurse. In the semi-structured interviews, the aim was to understand healthcare professionals’ work practices and the role of technology in the process. In the interview guide, personalization was not specifically asked about; instead, healthcare professionals were asked to rationalize their work practices once they meet with a healthcare user. The unprompted personalization themes emerged from these interviews, and the healthcare professionals initiated them further without being prompted in the discussions.

**Data analysis.** The emerging personalization themes were analyzed using thematic data analysis (Vaismoradi, Turunen, & Bondas, 2013). In the analysis process, two researchers first familiarized themselves with the data independently. Second, the initial themes were formed and discussed among the researchers to come up with the final categories. The themes were finally categorized into three main categories of enablers for personalization, service delivery, and user characteristics.

In enablers, the themes were related to different healthcare systems, standardized healthcare technologies, and care guidelines that had been pre-set for healthcare professionals to enable and support the care delivery. In other words, enablers formed the basis for personalization in the health service delivery. In service delivery, the themes were related to the interaction with the healthcare user and the use of different technologies as part of the service delivery. The themes in healthcare user characteristics were related to healthcare users’ personal values and preferences, which were aggregated mainly verbally in the multi-stakeholder interaction.

In total, the unprompted personalization themes that emerged in the discussions provided me with the understanding that personalization in health services can intertwine pre-defined forms of personalization with more collaborative forms of personalization, where personalization takes place in the multi-stakeholder interaction.
3.3.5 Case E: Qinematic posture scanning

In addition to technologies, such as telemedicine, that have been in use for a while, there is a growing number of novel technologies that can provide various forms of digital data to make the care more person-centered. Although these technologies have been widely adopted in different care contexts, in physiotherapy the adoption of digital tools to support rehabilitation practice remains low even though physiotherapists see potential in digitally supported rehabilitation (Postolache, Oliveira, & Postolache, 2016). Physiotherapy is one form of rehabilitation that aims to improve the function and health of the healthcare user (Areskoug Josefsson & Andersson, 2017). Herein, I led a case study (Study V) with the Swedish company Qinematic, which had designed a posture scanning system that acts as a digital measurement tool to objectively record, measure, and report movement in humans. The novel system was at a prototype stage, which provided me an opportunity to investigate how the designed posture scanning can enhance physiotherapy and enable a more personalized delivery of physiotherapy from the viewpoints of relevant stakeholders (IS developers, healthcare professionals, and healthcare users) co-creating the service.

Data collection. The data were collected primarily using interviews with different stakeholders involved in the case. First, a group interview was conducted with the IS developers to form an understanding of the posture scanning and personalization related decision making in the system. Second, seven semi-structured interviews were conducted with healthcare users to understand their needs and expectations regarding the personalization the posture scanning could enable. Third, two group interviews and nine semi-structured interviews were performed with healthcare professionals to understand their work practices and how they treated the individual healthcare user seeking help and also how technology in general and namely posture scanning could support them in treating a healthcare user.

Data analysis. The data were analyzed using a thematic data analysis approach (Vaismoradi et al., 2013). First, all the data collected were read and analyzed to form a general understanding of the dataset. Then, each stakeholder viewpoint was analyzed separately to understand the common themes from each viewpoint. These themes were discussed extensively among the researchers before forming the final categories, where the themes from different viewpoints were merged to come up with the three main categories. These categories were as follows: modeling the condition, which is about the use of posture scanning data for detecting and
understanding the healthcare user’s condition and the potential root cause of the possible problem; visualization for shared understanding, which is about the use of posture scanning data to inform and involve the healthcare user more in the decisions made in care; and evaluating the impact of the intervention, which is about the use of posture scanning data to evaluate the care progress and impact of the intervention.

### 3.4 Cross-case analysis and synthesis

The five individual case studies that were introduced in the previous section investigated personalization at the level of digital health services through different care contexts. This section first lists and summarizes the findings from these cases as they emerged in the studies (I–V). Second, a cross-case analysis (Crowe et al., 2011) was undertaken to analyze and compare these findings. The aim was to come up with higher-level categories that would consider the personalization aspects across these cases.

**Case A** provided me an understanding on personalization in the entire care pathway in the context of occupational care. The thematic analysis resulted in three categories based on the automation level of IT in service personalization. The categories are the following:

- **Coercive personalization** included themes where certain health services are automatically pre-defined (included or excluded) for the depression care pathway. For example, different types of legislation and contracts can automatically pre-define certain health services to be included in the care pathway for people who were working in a certain industry sector.

- **Data display personalization** included themes where the technologies aggregated data for the healthcare professional to use and interpret and to deliver appropriate health services. For example, different types of values, such as absences from work, were automatically flagged and visualized by technologies. These data displays provided an additional data source for the healthcare professional to use for interpretation and to proceed with health services to be included in the care pathway.

- **Collaborative personalization** included themes where technologies aggregated data to support the collaborative discussion between the healthcare professional and the healthcare user regarding the health services to be included in the care pathway. As an example, certain health services, such as web-based therapies, were considered to be optional services in evidence-based depression care, and once the
technologies indicated such a service to be available (contract allowed such a service to be delivered), the healthcare professional and the healthcare user could discuss and agree in collaboration whether to include the service in the care pathway.

**Case B** provided me with an understanding of role of a mobile application in supporting the healthcare user’s motivation toward physical activity in the context of wellbeing. The study explored both system-specific and user-specific characteristics to explore how digital narratives could motivate users in their physical endeavors. Based on the thematic analysis about users’ needs and expectations regarding personalization, these findings were categorized into three main categories, as follows:

*Personalizing narratives for goal achievement* included themes where users wished the technology to be more aligned with their personal goals. This means that users had varying goals—some desired to run for a certain distance, whereas others desired to lose a few kilos—and the expectations were therefore related to personalization and how the narrative could be aligned with the users’ personal goals.

*Personalizing gamification level of narratives* included themes where users wished the technology features, mainly related to gamification, to be adjustable based on their preferences. When it comes to gamification level, some users preferred gamification elements, whereas others wanted to disable the gamification functionality and just go with the basic narrative.

*Personalizing genre or intensity of narratives* included themes where users desired to adjust the level of the generic narrative. The use of narratives made the mobile application unique compared to other applications in the category of exercise. However, users preferred to have an option to personalize the level of the generic narrative to make the narrative more compelling and better aligned with their own wishes, such as to have a more intensive narrative.

**Case C** provided me an understanding on the role of a telemedicine system in the personalization of a service pathway in the context of home care. As a result of the analysis, the following three different types of personalization categories emerged regarding the support technology can provide for service personalization:

*Generating user data* included themes where the aggregated datasets were used for providing an additional longitudinal data source to evaluate the healthcare user’s condition. As the technology visualized the data automatically, the data aggregation helped the healthcare professional to evaluate the healthcare user’s condition and to consider care in a personalized manner.
Detecting anomalies included themes where the aggregated datasets were used to detect and visualize anomalies in the data. The analyzed technology used different types of visualizations that flagged abnormal values in the data, supporting the healthcare professional in considering the severity level of the abnormality. For example, the technology automatically flagged failed self-measurements and abnormal measurement results using different visualizations for the healthcare professional to consider.

Supporting interaction included themes where the aggregated data were supported by contextual information in the form of written comments to complement the self-measurement result. As an example, in the case of INR, the healthcare user was able to provide additional comments to complement the measurement result, which provided support for the healthcare professional in interpreting the measurement result. This was illustrated through an example of a glass of red wine as it may affect the INR result. Providing written comments about red wine can therefore provide contextual information for the healthcare professional to consider in regard to the potential abnormality in the measurement result.

Case D provided me an understanding on personalization and the role of technology in behavior change in the context of Finnish primary healthcare. Personalization themes emerged from the unprompted discussions with healthcare professionals and were analyzed thematically to come up with the three personalization categories that follow:

Enablers included themes about different types of personalization enablers, such as healthcare IT and the care guidelines set to enable and support the healthcare professional in delivering standardized high-level evidence-based care for the individual healthcare user. These enablers formed the basis for personalization in the health service delivery.

Service delivery included themes related to the interaction and use of different healthcare technologies as part of the service delivery. This means that the healthcare technologies were not only the standardized healthcare technologies (healthcare IT) but also third-party mobile applications that were collaboratively agreed upon and used to evaluate the healthcare user’s condition and the impact of the interventions.

User characteristics included themes related more to the healthcare users’ personal preferences and characteristics. These preferences and characteristics were mainly aggregated verbally in the multi-stakeholder interaction but were supported by various healthcare technologies.
**Case E** provided me an understanding on how a posture scanning system that enabled the objective recording, measuring, and reporting of human movement can enhance physiotherapy and enable a more personalized delivery of physiotherapy. The data were collected through the viewpoints of the different stakeholders who were co-creating the personalized service and were thematically analyzed to come up with the following three main personalization categories that represent the different types of support the posture scanning data can provide to enhance the traditional expert-driven physiotherapy and to help make the delivery of physiotherapy more personalized:

*Modeling the condition* included themes about the use of posture scanning data to support the detection of the healthcare user’s condition and potential root cause of the pain. As an example, the healthcare user may experience pain in the knee, but the potential problem can be a weak hip causing the pain in the knee. As the expression of this dysfunction can be challenging, the additional data source can provide objective measurement data for the healthcare professional to use in evaluating the current condition.

*Visualization for shared understanding* included themes about the use of posture scanning data to visualize the healthcare user’s movement pattern. As an example, the visualization of the movement pattern can be used in the discussion between the stakeholders, and the visualization data can provide a means for the stakeholders to reach a shared understanding on the planned interventions.

*Evaluating the impact of the intervention* included themes about the use of posture scanning data to evaluate and to provide evidence as to whether the prescribed exercises had been effective and the movement potentially improved. The aggregated data were seen as especially helpful for evaluation in cases where the healthcare user’s movement may already have improved even though the pain level had not yet changed.

The comparative analysis (Bradley, Curry, & Devers, 2007) started by extracting the personalization categories from Cases A–E into a compilation of 15 aspects found to be relevant for the design of personalization. These 15 aspects were further labeled as categories. As some of the categories had more abstract labels, such as “Enablers,” and some were more specific, like “Evaluating the impact of the intervention,” the analysis of the main themes within these categories helped to compare these categories and to come up with the higher-level categories. For example, in the category of “Enablers,” the main personalization themes were related to different predetermined healthcare guidelines on how to treat a healthcare user who is seeking help for a certain condition. The established healthcare
guidelines formed the basis for the health service delivery according to best care practices. In “Evaluating the impact of the intervention,” the category included personalization themes related to the aggregation and use of different forms of data to impact the evaluation of the intervention. The aggregated data provided evidence for the healthcare professional to evaluate the care process and use the aggregated data for data-driven decision making.

As a result of the analysis, these 15 categories were re-categorized into three higher-level categories. First, as some of these categories were more healthcare-specific, and pre-defined by nature, they were considered to belong to the “Contextual” category. Second, as some of these categories addressed the different forms of data displays for the healthcare professionals, they were considered to be in the category of “data-driven.” Third, as some of the categories addressed the multi-stakeholder interaction with the healthcare user as well as the preferences and characteristics of the healthcare user, they were considered to be in the category of “user-specific.” The re-categorization to higher-level categories is represented in Figure 2.

Fig. 2. Re-categorization to higher-level categories.
The first higher-level, contextual category included categories of “Coercive personalization” and “Enablers,” which both included themes that were specific to the healthcare context and that were often pre-defined and relatively static by nature. “Coercive personalization” included themes such as “Care pathways” and “Healthcare regulations,” which are pre-defined by nature and may not be adjusted during the care process. As mentioned above, the category “Enablers” included themes such as “Care guidelines,” which enabled the delivery of standardized evidence-based care. Common to the themes in this category was that they were context-specific, and often fixed by nature, setting the frames for service personalization.

The second higher-level, data-driven category included the following categories: “Data display personalization,” “Generating user data,” “Detecting anomalies,” “Supporting interaction,” “Modeling the condition,” “Visualization for shared understanding,” and “Evaluating the impact of the intervention.” These categories included themes that were related to the use of different technologies and data in the care process. This means that the technologies aggregated data and visualized the data through different forms of data displays for personalization. These data displays were then used and interpreted by healthcare professionals in various ways during the care process. Healthcare professionals used the data for “Data-driven screening” when they monitored the aggregated data and screened for potential anomalies in the data. Themes in this category were also related to “Data-driven decision making” and “Data-driven care evaluation,” where healthcare professionals used the different forms of data displays to support the decision-making process and the evaluation of the care process. Common to the themes in this category was that IT aggregated data dynamically and that the data were often interpreted and used by the healthcare professional in terms of service personalization.

The third higher-level, user-specific category included the following categories: “Collaborative personalization,” “Personalizing narratives for goal achievement,” “Personalizing gamification level of narratives,” “Personalizing genre or intensity of narratives,” “Service delivery,” and “User characteristics.” Common to the themes in these categories was that they were specific to “Users’ personal preferences” (such as personal goals or needs) toward care and “Users’ personal characteristics” (such as life situation), which need to be considered in care. Both these user-specific themes were mainly generated verbally, in the interaction, but were supported by various technologies and data. Common to the themes in this category was that they were dynamically aggregated through the multi-stakeholder
interaction and through the use of various technologies to co-create the personalized service.
4 Personalization of digital health service pathways

This section presents the main findings of this thesis. It introduces how the main RQ was answered and presents the synthesis of the findings of the cases (A–E) in the form of personalization filters. It also illustrates how the emerging personalization filters collectively represent the role of IT in the personalization of digital health service pathways. The construct of role was used similarly to that in Sambamurthy, Bharadwaj, & Grover (2003).

4.1 Research question

The main RQ of this thesis, 

- RQ: What role can IT play in the personalization of digital health service pathways?

was answered through a multiple-case study approach, where the role of IT in the personalization of digital health service pathways was explored through different care contexts. As a result of the synthesis of these findings, personalization themes were categorized into three main higher-level categories. These categories—contextual, data-driven, and user-specific—collectively represent the role of IT in the personalization of digital health service pathways.

4.2 Personalization filters in digital health service pathways

The three main categories of personalization themes that represent the role of IT in the personalization of digital health service pathways are henceforth referred to as “personalization filters.” This filter concept was chosen to metaphorically represent the strong role of IT in personalization as content-based filtering, collaborative filtering, and hybrid filtering (Adomavicius & Tuzhilin, 2005b; Tuzhilin, 2009) and the concept of the filter bubble (Pariser, 2011) collectively represent some of the ways IT can be used to estimate the content the user would like to see. As personalization in IT often uses different types of algorithms constructed based on certain personalization parameters, the thesis uses the concept “filter parameter” to illustrate the themes of these personalization filters. This means that each personalization filter includes different personalization parameters.
The three personalization filters are the (1) contextual filter, (2) data-driven filter, and (3) user-specific filter. In these personalization filters, IT can take on the role of a personalization filter in excluding, including, or changing certain health services from generic service pathways to make the service pathways more personalized for the individual healthcare user. Personalization filters, filter parameters, the role of IT, and the specific study (I–V) in which the parameters for the personalization filters appeared are summarized below in Table 3.
<table>
<thead>
<tr>
<th>Personalization filter</th>
<th>Filter parameters</th>
<th>The role of IT</th>
<th>Appeared in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contextual filter</td>
<td>Care pathways</td>
<td>IT automatically provides the best evidence-based care practices and options to treat a healthcare user who has a certain condition, such as to provide guidelines to treat mild depression.</td>
<td>Study I, Study IV</td>
</tr>
<tr>
<td></td>
<td>Care guidelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Healthcare regulations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data-driven filter</td>
<td>Data-driven screening</td>
<td>IT provides data-driven support to understand the healthcare user’s condition and to evaluate the impact of the interventions, such as to provide evidence that the prescribed exercises have been effective.</td>
<td>Study I, Study III, Study V</td>
</tr>
<tr>
<td></td>
<td>Data-driven decision making</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Data-driven care evaluation</td>
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<tr>
<td>User-specific filter</td>
<td>Users’ personal preferences</td>
<td>IT supports the consideration of the healthcare user’s personal characteristics and personal preferences in care, such as to consider that the care options are aligned with the healthcare user’s life situation.</td>
<td>Study II, Study IV</td>
</tr>
<tr>
<td></td>
<td>Users’ personal characteristics</td>
<td></td>
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</tr>
</tbody>
</table>
4.3 Contextual filter

The contextual filter includes personalization parameters that in this context are healthcare-specific. The role of IT is to collectively consider the best care practices and care options for how to treat a healthcare user who has a certain condition but also to consider the legislation and contract regulations that can affect the availability of certain health services. The contextual filter acts as a prerequisite that sets the frames for the personalization of digital health service pathways. It automatically pre-defines certain services to be included in or excluded from generic service pathways to make the pathways more personalized for the individual healthcare user. The contextual filter has three personalization parameters: (1) Care pathways, (2) Care guidelines, and (3) Healthcare regulations.

4.3.1 Care pathways

The first personalization parameter, the care pathway, refers to the different forms of organizational instructions and guidelines on how to treat a healthcare user who has a certain condition with the best care practices available. Care pathways were illustrated in Study I, where the healthcare professionals described the role of the depression care pathway and national-level depression care guidelines in supporting depression care. Both organizational-level care pathways and national-level depression care guidelines acted as supportive artifacts that displayed the best care practices and available health services to treat a healthcare user.

In Study I, the contextual filter was identified through the analysis of a depression care pathway. In the study, we found that the care pathway was a static document used among multidisciplinary healthcare teams to provide support for the delivery of evidence-based depression care. The care pathway guided depression care by displaying all available treatment options at the different phases of the depression care pathway in order to ensure the coordination of depression care in a continuous manner. The different phases of the depression care pathway are depicted in Figure 3.

![Fig. 3. High-level process diagram of care pathway phases.](image)
The “Screening” phase consisted of the screening and recognition of potential risk factors. It is conducted by technologies that aggregated healthcare user data automatically for the healthcare professional. The first arrow after “Screening” indicates different values and also potentially abnormal values that these technologies have flagged for the healthcare professional.

The second phase, “Diagnosis,” consisted of the actual consultation between the healthcare user and the healthcare professional. If depression is diagnosed, the depression care process starts within the frames of the depression care pathway. This is indicated with the second arrow, after “Diagnosis,” which describes a situation where the depression diagnosis is given, and the healthcare user is automatically moved to the “Acute care” phase to receive care.

The third phase, “Acute care,” includes the health services and treatment steps for the first six months following the formed diagnosis. The focus is on evidence-based care and on the use of evidence-based methods that are widely accepted and effective in depression treatments. This phase, after the third arrow (following “Acute care”), is triggered after six months of care have passed, when the healthcare user is automatically moved to the “Maintenance care” phase based on the time that has passed.

The fourth phase, “Maintenance care,” includes the health services that are available after six months from the diagnosis. Maintenance care aims to support the healthcare user’s recuperation but also to prevent the potential recurrence of depression disorders.

4.3.2 Care guidelines

The second personalization parameter in the contextual filter are care guidelines. In addition to care pathways, healthcare uses different types of national-level care guidelines that can support the delivery of health services according to the best evidence-based practices. Care guidelines were established in Study I in the case of national care guidelines displaying the treatment options for depression care, but different forms of care guidelines were also discussed in Study IV, where healthcare professionals described the role of national care guidelines in Finnish primary healthcare.

In Study I, the current care guidelines represented the national guidelines to treat depression. The current care guidelines displayed the evidence-based clinical practice guidelines on how to treat a person who has been diagnosed with depression. Healthcare professionals reported using the current care guidelines as
supportive artifacts along with the care pathways to deliver standardized, evidence-based depression care.

In Study IV, one of the main themes in the discussions with the healthcare professionals was the different types of care guidelines used in health service delivery. Care guidelines included different types of guidelines for health promotion and prevention but also guidelines for disease management. Health promotion and prevention guidelines focused on preventive actions, such as guidelines on how to quit smoking, whereas in disease management the guidelines were targeted at treating a specific disease. Collectively, both types of care guidelines were used to display the evidence-based care practices on how to treat a healthcare user who has a certain condition:

“We have different guidelines for health promotion. For example, how to treat obesity and guidelines to support exercising. Then there are of course guidelines for how to treat different diseases.” (Healthcare professional 4)

As the quote illustrates, there were many different care guidelines used as supportive artifacts to deliver standardized care. Whether the healthcare user needed support to quit smoking or was suffering from obesity, the different forms of care guidelines were used to display the standards for evidence-based care. Therefore, the health services were delivered under the standards of these guidelines.

4.3.3 Healthcare regulations

The third personalization parameter comprises healthcare regulations. In the studies, healthcare regulations included legislation and contracts that had an impact on the availability of health services. Healthcare regulations, both legislation and contracts, were illustrated in Study I, where healthcare professionals stated that healthcare regulations in occupational care can oblige the healthcare service provider (in this case Terveystalo) to deliver certain health services for certain employees working in certain organizations.

In the case of contracts, the client organizations had different types of contracts with the healthcare service provider. These contracts determined the health services to be included for the people who were working in the client organization. Healthcare professionals illustrated that some health services, such data-driven screening and some medical checks, are typically included as a default for every
contract, but the differences between industries and workplaces can mean variety in the catalogue of health services:

“The system displays automatically if a certain healthcare service is not included under contract. It works automatically and well.” (Occupational physician 1)

“The system prevents us from offering a certain healthcare service for the costs of an employer if it is not in the contract.” (Occupational physician 2)

As these examples illustrate, the contracts are one type of regulation that can have an impact on the availability of the health services to be included in the service pathway. This means that if a certain health service was not in a contract, it was automatically excluded from the service pathway.

In addition to contracts, different legislation-based regulations also affected the availability of the health services. Healthcare legislation was, for example, related to the characteristics of different industries. This means that different health services were automatically included for people who were working in certain industries:

“Workplaces have different risks and conditions. For example, people that work with asbestos are required by law to have different tests and follow-ups than people doing office work.” (Occupational physician 1)

“Law regulations demand certain tests to be done in certain industrial sectors.” (Occupational physician 2)

As illustrated in these quotes, certain organizations and industries have different characteristics that are covered by legislation. This, for example, meant that healthcare regulations pre-defined certain types of medical tests to be automatically included for people who were working in organizations operating in certain industry sectors.

4.4 Data-driven filter

The data-driven filter includes personalization parameters derived through technologies and aggregated digital data. This means that the role of IT is to consider the various forms of digital data that are aggregated. The data include the healthcare user’s personal data but also the data surrounding the healthcare user (such as location) to be used and interpreted by the healthcare professional in
service personalization. The data-driven filter has the following three personalization parameters: (1) Data-driven screening, (2) Data-driven decision making, and (3) Data-driven care evaluation. These parameters are described in the following.

4.4.1 Data-driven screening

Data-driven screening refers to the automated screening of data for service personalization. Data-driven screening was highlighted in Study I and Study III, where the different technologies aggregated data automatically and visualized the data for the healthcare professional to be used in personalization.

First, in Study I, data-driven screening emerged in the form of the automated screening of the healthcare users’ data. In that case, technology screened the data and displayed the data for the healthcare professional to interpret. The screening used different forms of automated data visualizations used to highlight anomalies and provide information from the screened data.

Anomalies in the case of occupational care data were related, for example, to absences from work but also other medical information that was highlighted in different data summaries and related periodic reports to indicate the potential abnormality of levels between values. The automated data screening took place in a continuous manner at the two following different levels: screening the individual healthcare user’s data and screening the office or the client company data.

In the case of the individual healthcare user, the data screening employed different data visualizations to illustrate the healthcare user’s status using different colors to indicate different values from the data:

“In basic medical questionnaires, the information system displays answers using green, yellow, and red for classifying the results. If numbers are low, the information system displays those in the color red. For us, it indicates that the situation may need tackling or at least some reaction.” (Occupational physician 2)

In addition to the individual data, screening the office or company data was also discussed as the data summaries and related periodic reports may indicate abnormal values between offices. For example, the screened data may reveal that one office has multiple absences due to back pain, which is an anomaly that may need an intervention:
“Between offices, different values can be compared. For example, here, one office has greatly reduced the number of musculoskeletal disorders, whereas in this other case, we can see that the numbers have increased dramatically.” (Occupational physician 1)

Both these quotes in regard to data screening illustrate the use of digital data in supporting the selection of health services to be included in the service pathway. Therefore, different forms of data visualizations provided support for data-driven decision making regarding care.

Data screening was also illustrated in Study III, where the analyzed telemedicine system aggregated the healthcare user’s measurement data in a continuous manner and visualized that data for the healthcare professional to interpret:

“With the traffic lights, the healthcare professional can easily see the patient’s status. That reduces the workload of the healthcare professional but also enables the rapid reaction for anomalies in measurement results.” (Director of health services)

As the quote illustrates, the screening data were displayed using different forms of data visualization elements, such as “traffic lights.” The screened data were used to give an overview of the healthcare user’s status but also to highlight any potential abnormalities in the values. For example, the different colors may indicate that the values are within normal limits and that there may be no need for additional interventions or to change dosage, but in the case of abnormal values, the healthcare professional can react to these anomalies and discuss on the type of health services that may be needed. Therefore, data screening may reveal the need for certain health services to be included or changed in the service pathway.

4.4.2 Data-driven decision making

Data-driven decision making refers to the use of different forms of digital data in making personalization decisions in care. This means that as digital data were increasingly aggregated, they supported the data-driven decision-making process regarding the health services to be included in the service pathway. Data-driven decision making was illustrated in Study III and Study V, where the different technologies aggregated various types of data. The aggregated digital data from
various sources provided additional information to support the decision-making process.

In Study III, the analyzed telemedicine system aggregated raw data from home-based self-measurements. The raw self-measurement data provided a data source of the healthcare user’s condition, which supported the healthcare professional in evaluating the condition and making decisions in care:

“With this system, we create automatic, real-time user data for healthcare professional to analyze.” (Director of health services)

The aggregation of datasets, such as a set of blood pressure measurement results, provided helpful information to understand the healthcare user’s condition. As this dataset was combined with data from other sensors and devices, the digital data from various sources provided a more holistic picture of the healthcare user’s condition to support decision making. As an example, in INR measurements, the analyzed telemedicine system provided data in the form of digital measurement results but also textual comments that provided contextual information to complement the measurement data:

“In INR, you may provide optional comments to your measurement results, such as that an abnormality in the INR value may be because of the red wine [you drank]. Based on these comments, the healthcare professional may provide comments back [to the healthcare user] to have one glass fewer next time.” (Business manager)

As illustrated in the case of INR, the different forms of datasets can be used in care decision making. This was also illustrated in the case of hypertension, where the optional comments provided contextual information to complement the measurement results.

Data-driven decision making was also illustrated in Study V, where the analyzed posture scanning system enabled the recording, measuring, and reporting of human movement digitally in physiotherapy. The data from the healthcare user’s movement pattern were displayed in digital form, which provided data-driven evidence about the movement levels to complement the healthcare user’s verbal description at the consultancy:

“(If the user has knee pain) the therapist can see that the knee is not the problem. The problem is the weak hip causing pain to the knee.” (IS developer 1)
“If the problem of the user is not clear (e.g., difficulty with getting out of a chair), it can be a trigger to do the scan because that can yield results sometimes. If it is a medical thing you need a physiotherapist, but with vague complaints the scan can give some useful information.” (Healthcare professional 4)

As these quotes illustrate, the data of the healthcare user’s movement levels provided a supportive digital data source for decision making on how to proceed with personalization in physiotherapy. For example, the digital data may indicate that even though the healthcare user has carried out the prescribed exercises, the movement levels have decreased. The digital data complemented with the healthcare user’s verbal description can provide a more holistic understanding for decision making, such as what to change or do differently.

### 4.4.3 Data-driven care evaluation

Data-driven care evaluation refers to the supportive data evidence for evaluating the impact of the intervention. Data-driven care evaluation was highlighted in Study IV, where the different forms of digital data were used to provide supportive information to evaluate the behavior change process, but also in Study V, where the analyzed posture scanning aggregated data about the healthcare user’s movement levels that were used to evaluate the impact of intervention.

In Study IV, the use of data in care evaluation took place through the use of the different forms of digital data the healthcare users were reporting. The reported data, such as different types of nutritional diaries, training diaries, or pictures of food portions, were used to evaluate the progress and to guide the discussion at the consultancy:

“I ask the healthcare user to write a diary for themselves, not me. I ask them to, for example, consider what the healthcare user has been eating, thinking while eating, and their mood and stress level but also notes about how the day has been.” (Healthcare professional 2)

“I would be asking you about what you are eating or, maybe before you came to me, you have filled a diary, food diary that I can see what you eat.” (Healthcare professional 6)

“Taking a picture of the meal helps the healthcare user to estimate the portion size and to see if there are enough vegetables in the portion. This picture can
also be used in the discussions (between the healthcare professional and the healthcare user).” (Healthcare professional 5)

The data in different forms, such as written reports and pictures, helped the healthcare professional to evaluate the healthcare user’s behavior change progress. At the same time, the data also provided means for the healthcare user to reflect upon his/her behavior change process behind the reported numbers. As the reported numbers were complemented with verbal descriptions, this supported the healthcare professional in evaluating the impact of interventions, such as whether the healthcare user was taking small steps toward improvement, but the data could also provide supportive information if there were potential relapses. In the case of relapses, the focus was in rationalizing and discussing the factors and feelings behind relapses in a personalized manner.

In Study V, the data-driven care evaluation was seen through the data about the healthcare user’s movement patterns used to evaluate whether the prescribed exercises were effective (impact of the intervention) and whether the healthcare user’s movement levels had improved. The aggregated movement data were complemented with the healthcare user’s verbal descriptions. This combined information was helpful especially in cases where the healthcare user’s movement may have already improved even though the pain level had not yet changed:

“I would use the scan to show progress. Then I can numerically show people that they are doing better.” (Healthcare professional 10)

“You can compare scans 1 and 2. The healthcare user can say that s/he has done the exercises but has not improved. The exercise may be wrong, or the healthcare user has done the exercise wrongly or has not done the exercises at all.” (IS developer 2)

Both these quotes illustrate the role of data in evaluating the effectiveness of the care interventions. The aggregated data were visualized in various forms, such as comparisons of movement patterns aggregated from posture scanning. These data could illustrate potential improvement in movement levels but also supported the healthcare professional in considering whether the interventions were effective and what types of changes may be needed.
4.5 User-specific filter

The user-specific filter in healthcare includes personalization parameters that are mainly aggregated through communication with the healthcare user. The role of IT is to support the consideration of these parameters, that is, the healthcare user’s personal preferences and personal characteristics in care. Personal preferences were related to the way healthcare users would like to receive care, whereas personal characteristics consider the healthcare user’s current condition while receiving care. The user-specific filter has two personalization parameters: (1) Users’ personal preferences and (2) Users’ personal characteristics.

4.5.1 Users’ personal preferences

Users’ personal preferences refers to personalization in care in regard to the way users’ personal preferences are considered. In the case studies, personal preferences were related to technology and the personalization of care based on users’ goals.

Both types of personal preferences were highlighted in Study II in the context of wellbeing. Healthcare in general is increasingly using technologies that can vary from more standardized technologies to third-party mobile applications. The widespread use of technologies is prevalent especially in the context of wellbeing, where different types of devices and mobile applications have become increasingly popular and where the users may also have opportunities to choose the technology they prefer to be using. In this case, users’ personal preferences toward technology were related to the use of different technologies and how they wished to change some features in the technology to make it more aligned with their preferences and goals. This was related to different features of the technology and a desire for more personalized user experiences when using these technologies:

“You should have different storylines for other people as well; I could never imagine my mom going running with the zombies.” (Abbey)

“There could be some adjusting in the storylines. You could for instance exclude the zombies or choose a different kind of narrative.” (Carla)

As these quotes illustrate, the users preferred to make some adjustments to the technology. This means that the main technological features (such as the apocalyptic narrative) would remain, but some components in the technology would be adjusted to make the technology better aligned with the user’s preferences.
In addition to preferences related to technologies, users had personal preferences related to their goals and adjusting the healthcare technologies and care options to be better align with those goals. Healthcare users expressed having different types of personal goals varying from more concrete goals, such as to lose a few kilos, to goals toward generally healthier lifestyles:

“As for me, I think what I find motivating about running is the improving, getting faster, going further.” (Becky)

“That is one motivation. Losing a little weight.” (Felicia)

As these quotes illustrate, healthcare users can have different types of personal goals that can be best supported by different healthcare technologies. Healthcare technologies have different functionalities, and they may provide different types of data that can better support the individual healthcare user in reaching their aims. This can also influence the care process—as the healthcare users use different types of technologies that can aggregate different forms of data, the healthcare professionals may need to be ready to support them in interpreting those data.

### 4.5.2 Users’ personal characteristics

Healthcare users’ personal characteristics included the behaviors, life situations, and motivation levels of the individual healthcare user. In the case studies, the healthcare users’ personal characteristics were discussed in regard to each healthcare user being a unique individual, who also expected to be treated individually at the consultancy. Healthcare users’ personal characteristics were illustrated in Study IV as the healthcare professionals described the healthcare user’s behaviors, life situations, and motivations to be important elements for consideration in the discussions at the consultancy:

“First, we should discuss your living habits and your situation in life and whether it is the right time for you to take care of your being overweight. If you are, for example, in the middle of graduating and very busy and stressed, it may not be the best time to start losing weight.” (Healthcare professional 2)

“Often patients say that it (smoking) is not the nicotine but the habit. Once I ask when they smoke the first cigarette, and if it is within 30 minutes (after waking up), it is certainly nicotine. If it is at lunchtime, it may not be nicotine but habit.” (Healthcare professional 1)
“Mostly I want to know if there is any motivation for cessation. Sometimes there are men who come here and explain that their wife told them to quit smoking, but actually they may not have any motivation to quit.” (Healthcare professional 1)

All these quotes collectively illustrate that healthcare users may have similar types of goals, such as to lose some weight, but their personal characteristics—their life situation, such as being in the middle of graduation or having small kids combined with habits and motivation levels—can create unique combinations where each healthcare user needs to be considered individually.

4.6 Personalization filters shaping generic service pathways

The proposed personalization filters—(1) the contextual filter, (2) the data-driven filter, and (3) the user-specific filter—collectively represent the role of IT in the personalization of digital health service pathways. These personalization filters illustrate the role of IT in including, excluding, or changing certain health services from generic service pathways to make service pathways more personalized for the individual healthcare user. These personalization filters shaping generic service pathways are illustrated in Figure 4.

![Fig. 4. Personalization filters shaping generic service pathways.](image)

The contextual filter includes the care pathways, care guidelines, and healthcare regulations as personalization parameters. These parameters include both national-level care guidelines and organizational-level care pathways that display the evidence-based care practices and the roles and responsibilities of the healthcare teams in the coordination of care in a continuous manner. The contextual filter also
includes different types of regulations, such as contracts, that can automatically regulate (include/exclude) certain health services for the service pathway.

For personalization, this means that the service pathway is personalized mainly at the granularity level of a group of users. For example, this can mean that the role of IT is to collectively consider the care options that are targeted at all healthcare users who are working in a certain organization that operates in a certain industrial sector.

The data-driven filter includes data-driven screening, data-driven decision making, and data-driven care evaluation as personalization parameters. These personalization parameters consist of various forms of aggregated digital data to be used and interpreted by the healthcare professional. For example, the role of IT is to collectively aggregate, process, and visualize the data to support data-driven decision making regarding the health services to be included in the service pathway.

For personalization, this means that the aggregated data can make service pathways more personalized for the individual healthcare user. Different forms of data that consider both the healthcare user’s personal values (such as measurement results) but also other types of data (such as location-based information) can be considered in order to shape service pathways from the group level to be geared more toward the individual healthcare user.

The user-specific filter includes the user’s personal characteristics and preferences as personalization parameters. This means that each healthcare user is an individual whose personal characteristics, such as life situation, motivation levels, behaviors, and personal preferences, may vary drastically, and the role of the IT is to support the consideration of these in a person-centered manner. Users may, for example, have personal preferences toward technologies that they wish to be using in care (such as a certain type of measurement device), which can also be considered in discussions to make the service pathway more person-centered through personalization.

For personalization, this means that the consideration of healthcare users’ personal characteristics and preferences can make the service pathway more person-centered through personalization. Based on the discussion with the healthcare provider, certain health services can be included in or excluded from the healthcare user’s service pathway. This was, for example, illustrated in the case of occupational depression care, where the healthcare user could choose in the discussions whether to utilize video-based therapy if it was available (potential contract regulation).
5 Discussion

This section summarizes and discusses the key findings of this thesis. It then discusses the theoretical and practical contributions and the limitations of the present work.

5.1 Summary of the key findings

This thesis investigated the role of IT in the personalization of digital health service pathways. It answers the RQ by proposing the following three personalization filters: (1) the contextual filter, (2) the data-driven filter, and (3) the user-specific filter, which represent the role of IT in including, excluding, or changing certain health services from generic service pathways to make the service pathways more personalized for the individual healthcare user. In other words, this thesis proposes that IT plays the role of these three personalization filters in the personalization of digital health service pathways.

The contextual filter, which in the context of healthcare includes different types of care guidelines, care pathways, and healthcare regulations, such as contracts, can automatically be considered by IT in the personalization of service pathways. These personalization parameters are healthcare-specific and are often relatively static and fixed by nature. Care guidelines and care pathways can display all available care options that are targeted at a certain condition, and, in that way, they basically create frames for the personalization of service pathways when it comes to treating a healthcare user who has a certain condition. In addition, regulations, such as contracts, can create frames for the personalization of digital health service pathways at the group level by considering the organizational-level characteristics regarding the health services to be included in or excluded from the service pathways.

The data-driven filter includes data-driven screening, decision making, and care evaluation as personalization parameters. These parameters represent the role of IT in aggregating and processing different forms of data for shaping service pathways to be more personalized for the individual healthcare user. The dynamic aggregation of data enables the automated screening, monitoring, and detection of anomalies, which can support the healthcare professional in data-driven decision making regarding the health services to be included in or excluded from the healthcare user’s service pathway, and the data also support the healthcare
professional in evaluating the impact of the intervention, which may lead to changes in service pathways.

The user-specific filter includes the healthcare user’s personal characteristics and personal preferences as personalization parameters. The role of IT here is to support the consideration of these personalization parameters in a person-centered manner. These personalization parameters were often verbally communicated in the discussions between the healthcare providers and users, and the role of IT was to support the consideration of the health services to be included in, excluded from, or changed within the healthcare user’s service pathway.

Collectively, these personalization filters represent the roles IT can play in the personalization of digital health service pathways. These personalization filters are connected. If the contextual filter were to be discarded, other filters could generate personalization based on the data and the inputs from the individual healthcare user, but the service pathways would not consider the context, which is needed for setting the frames for service pathways.

If the data-driven filter were to be discarded, the other filters could generate personalized service pathways that consider the contextual frames for personalization and the input from the healthcare user. However, as service pathways would not consider the data parameters, personalization would lack the dynamically aggregated data from various sources that are at the essence of data-driven decision making for making generic service pathways more personalized for the individual healthcare user.

In the case of the healthcare user-specific filter, the contextual and data-driven filters could generate personalized service pathways for the individual healthcare user. However, the generated service pathways would not consider the characteristics and preferences of the healthcare user, which may lead into a situation where the generated service pathway may not be aligned to the specific needs of the healthcare user. In other words, personalized service pathways would be generated for the healthcare user, but not for the healthcare user in person-centered manner.

5.2 Theoretical implications

This thesis contributes to the scientific literature on IS in healthcare by providing understanding on the role of IT in the personalization of digital health services. More specifically, this thesis contributes to the body of personalization literature in IS by proposing personalization filters that represent the roles IT can play in the
personalization of digital health service pathways. As this thesis investigated personalization and the role of IT more holistically at the level of digital health services, the proposed personalization filters can inspire the design and consideration of personalization in IT in the future.

In IS, the research around personalization has generally focused on the design and implementation of personalization in IT. Various personalization approaches are created to serve in the design and implementation of personalization in technologies and to classify the different types of personalization through technologies (Blom, 2000; Wu et al., 2003; Fan & Poole, 2006; Sunikka & Bragge, 2008, 2012; Kwon & Kim, 2012). Scholars have introduced different types of classifications that have proven to be useful theoretically, such as to classify personalization in controversial agents in healthcare (Kocaballi et al., 2019), and these classifications have also provided practical contributions as technology developers have often designed and implemented personalization in an ad-hoc manner (Wu et al., 2003) and based on their own knowledge on personalization (Fan & Poole, 2006).

These personalization classifications also promote the idea of the service provider being the one who performs personalization without actively involving the user. The distinction between the service provider and the user can be seen through the opposing concepts of being system-driven and user-driven (Lee et al., 2015), system-initiated and user-initiated/customer-initiated (Sunikka & Bragge, 2008; Kwon et al, 2010; Kwon & Kim, 2012; Sunikka & Bragge, 2012), implicit and explicit (Wu et al., 2003; Fan & Poole, 2006), and finally personalization and customization (Arora et al., 2008; Montgomery & Smith, 2009), which collectively illustrate the distinction as to whether personalization is done either for the user or by the user.

However, the distinction between parties is not in line with the concept of a service where the service process should take a more collaborative form rather than being solely dominated by one party (Forlizzi & Zimmermann, 2013, Lee, 2013; Batalden et al., 2016). Only recently has personalization started to gain more popularity in the context of digital services. Co-created personalized services maintain the idea of performing personalization in collaboration between the service provider and the user (Lee, 2013), and the reflective approach for personalization considers personalization as a form of empowerment, where the healthcare professional can help the healthcare user to realize what matters to them and support them in reaching their goals in a personalized manner (Lee et al., 2015). These studies are representing “the new wave” of personalization research that
considers service personalization in the context of digital services more holistically, not limited to the use of IT solely.

This thesis contributes to this area of personalization research by proposing personalization filters that represent the role of IT in the personalization of digital health service pathways. The thesis proposes that these personalization filters can provide new insights through which scholars can consider personalization more holistically. The proposed personalization filters consider the context in which the personalization of service pathways takes place and the use of data and technologies but also the multi-stakeholder interaction (Korhonen, Mylonopoulou, & Giunti, 2020) between parties. Collectively, this thesis proposes that these personalization filters represent the role of IT in including, excluding, or changing certain health services from generic service pathways to more personalized service pathways for the individual healthcare user.

The findings of this thesis can also broaden the understanding on the personalization of digital services more generally. Healthcare is highly influenced by regulations (Fichman et al., 2011), which may emphasize the role of the contextual filter in setting the frames for personalization. However, as the concept of service pathways is not exclusive to health, the present work suggests that the proposed personalization filters can also be applicable to digital contexts other than health. For example, these personalization filters can provide insights to be considered in the design of personalization in the context of education or social services.

5.3 Practical implications

The practical contribution of this thesis lies in the proposed personalization filters that collectively represent the role of IT in the personalization of digital health service pathways. By investigating personalization more holistically, at the level of digital health services, the findings of the present work can provide inspiration for service designers and healthcare professionals but also people working with service pathways in contexts other than health.

For service designers, the thesis can provide insights to be used in the design of personalized service pathways. Traditional approaches for personalization design in IS have mainly focused on the design of technological artifacts. By exploring personalization more holistically, at the level of digital health services, this thesis provides new insights through which designers can consider personalization in the service pathways. Service design is a human-centered and
participatory approach that considers the needs and expectations of the different stakeholders involved in and impacted by the service (Alhonsuo, 2016), and the three proposed personalization filters can inspire designers to consider and design novel digital service pathways that are more personalized for each user.

For healthcare professionals, the thesis can provide understanding on the personalization of service pathways in the context of digital health services. Healthcare is already shifting from disease-centered and specialist-focused care models toward person-centeredness (Ekman et al., 2011), but there is a continuous need to explore care models that can be better targeted at the individual healthcare user (Chouvarda et al., 2015). The service pathway concept used in this thesis is not a clinical concept, but it can provide a means by which to consider all available health services to be included for the individual healthcare user in a person-centered manner (Korhonen & Isomursu, 2017). This can also inspire the design of future care models that can be more aligned with the individual healthcare user’s needs.

Finally, the findings of this work can also inspire people who are working with different types of service pathways in contexts other than healthcare. Different contexts, such as education or social services, such as employment services, are increasingly promoting the need to design and deliver digital services in such a way that the needs and preferences of the individual person are considered. For example, the personal skills and preferences combined with contextual data that may be applicable to a certain area of the country can provide insights for use in the design and delivery of digital services that are more aligned with the needs of the individual person in the context where the service pathways take place.

5.4 Limitations

The present work also has certain limitations. First, there are limitations related to the multiple-case study approach applied in this thesis. The multiple-case study approach enabled the investigation of the personalization of digital health service pathways in the following five different care contexts: occupational care, wellbeing, home care, primary care, and rehabilitation. The analysis and the comparison of the findings across the cases provided a broad understanding on the personalization of digital health service pathways. However, even though the spectrum can be considered relatively broad, it did not cover all healthcare contexts. Contexts such as hospital care and palliative care, which are included in the spectrum of health services (World Health Organization, 2020), could not be explored within the
frames of this thesis. Therefore, there may be other personalization parameters that did not emerge from the studies included in this thesis.

Second, the results of this thesis should also be considered with caution when it comes to the generalizability of the results. The studies in the thesis were conducted in Northern European countries, mainly Finland, which can be considered to have high-level economic status and a modern healthcare system. Therefore, this thesis does not account for cultural differences across the globe, which can also be considered as a limitation to the generalizability of the results.
6 Conclusions and future work

This thesis investigated the role of IT in the personalization of service pathways in the context of digital health services. It proposed personalization filters that collectively represent the role IT can play in the personalization of digital health service pathways. The proposed personalization filters—(1) the contextual filter, where the role of IT is to consider the healthcare-specific parameters for personalization; (2) the data-driven filter, where the role of IT is to consider the aggregated data parameters for personalization; and (3) the user-specific filter, where the role of IT is to consider the healthcare user’s characteristics and preferences for personalization—collectively represent the role IT can play in the personalization of digital health service pathways. The present work also illustrates how these personalization filters can shape generic service pathways by excluding, including, or changing certain health services to make service pathways more personalized for the individual healthcare user. The findings of this thesis contribute to the body of personalization literature in IS by providing insights through which scholars may consider the role of IT in personalization more holistically, at the level of digital health services and not limited to personalization in IT only.

The findings of the present work provide opportunities for further research. Future research could complement the findings of the present work by investigating personalization in the palliative care context and hospital care context, which were not explored in the frames of this thesis. Future research could also focus on personalization at the level of the service design process and consider how the identified personalization filters might be integrated into the different phases of the service design process.

More broadly, these personalization filters can serve as a starting point for future research to consider personalization. The majority of personalization classifications and approaches in IS emerged approximately a decade ago, and even though they are still valid and provide guidance for the design of technological artifacts, there are needs to complement these classifications. The present work contributes to this area by proposing a complementary approach in the form of personalization filters that can collectively represent the role IT can play in the personalization of digital health service pathways.
List of references


Original publications


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