Care plan making

Design a hybrid patient journey in supportive care

Strategic Product Design
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Preface

Welcome to my graduation report. This project is the final one of my two years of studying at the faculty of Industrial Design Engineering at TU-Delft. It has been the most challenging yet most inspiring project I have done throughout my education. I would like to take the chance to thank everybody who has supported me during this project.

Richard, thank you for all your support throughout the project. At every meeting with you, I got more clarity about where I was going. You have enriched me with new knowledge and new perspectives.

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To my classmates in Delft, I always felt relaxed at every gathering. It has been a way for me to relax under a tight schedule. Also, thank you for your valuable comments on my graduation project.

I would also like to thank all participants who received the interview and attended my evaluation process.

Thanks to my family, friends, and others who have helped me throughout this journey.

Thank you for reading the report. Enjoy!

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Executive summary

Supportive care, regardless of its diversity or who provides it, aims to enhance and preserve the quality of life and independence and to empower and optimize well-being (Fitch, 2008). We can see that digital health can benefit supportive care by empowering users, providing more accessible support, and encouraging self-management. However, the impact of digital health interventions on existing organizations and systems is not always positive and effective.

We could conclude that even with the rapid development of DHIs, physical or traditional interventions cannot be replaced entirely. That is to say, digital health intervention remains a viable option rather than a necessity, its purpose being to be a supplement and complement to the current medical system. (Yildiz & Oksuzoglu, 2020)

This project explores how to connect digital and traditional care to create a seamless experience that fully embraces patients in cancer care when and where they need it. However, it is unclear how this hybrid model fits in the context of the supportive care plan.

To understand how to build such a hybrid patient journey, we decided to research the types of problems in SCP and think about what role the DHIs could play.

To gain a more systematic understanding, we researched three groups of people: patients, health professionals, and medical experts. The result of the research led to a picture of the current patient journey, which helped us identify opportunities for intervention. We believe the DHIs can help alleviate the current pressure on the system and provide patients with timely, adequate and effective supportive care. However, it must be based on providing patients with digital care that fits their situation. Based on this, we designed the future patient journey. It shows how digital care can be combined with traditional care. Also, it includes 1) the opportunities to involve more DHIs in SCP; 2) the concept of the AI support system to help the HCPs decide the care plan.

In addition to this, an extensive validation study has proven that the new patient journey has the potential to help the patients access care and increase their well-being. Also, the AI support system could help HCPs make decisions and reduce their workload.

The whole project started with women with breast cancer. However, in the interviews, we found that this could apply to other cancer care where the patient can use the digital tool.

Glossary

These are a list of words abbreviations used in this report:
SCP: Supportive care plan
DHIs: Digital health interventions:
MDT: Multidisciplinary team
HCPs: Healthcare providers
AI: Artificial intelligence

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Introduction

This chapter contains all the essential information to contextualise this thesis project. It presents an introduction to the project, the project context and the project approach. This section is where the project begins.

1.1 Background of project

The use of digital health interventions has accelerated dramatically due to concerns about patient and healthcare provider safety during the coronavirus pandemic. Online consulting and self-management tools enable people to appreciate the convenience of technology. It is worth noting that digital health interventions have shown the potential to improve cancer care by involving more people in care, effectively managing cancer-related fatigue, and meeting the needs of a diversified population. Many cancer patients have a positive attitude toward digital health interventions. In conclusion, there is a tendency to integrate these new technologies into cancer care (Marthick et al., 2021). Currently, the burden of cancer incidence and death is increasing rapidly globally (Sung et al., 2021). In 2020, an estimated 19.3 million new cancer cases and almost 10.0 million cancer deaths occurred globally. It also means that cancer care should be delivered to an increasing cancer patients. Therefore, there is a need to research the application of digital care to cancer care for later implementation.

However, the impact of DHIs on existing organizations and systems is not always positive and effective. For example, some users with low digital literacy cannot accept digital care procedures; physicians may not be able to diagnose and treat many medical conditions virtually correctly. Even with the rapid development of DHIs, physical or traditional interventions cannot be replaced entirely. That is to say, and digital health intervention remains a viable option rather than a necessity, its purpose being to be a supplement and complement to the current medical system. (Yildiz & Oksuzoglu, 2020) The hybrid model was proposed, which might balance digital intervention and physical intervention that combines their benefits (Figure 1). (Chan et al., 2021).

	Physical intervention	Digital intervention
Benefits	• Low capability barrier for patients • Patients feel more security and more convincing • The way the organization more familiar with	• Improved access to information; • Provision of care not previously deliverable; • Improved access to services and increasing caredelivery; • Improved professional education; • Quality control of screening programmes;(Hjelm, 2005) •
Drawback	• Time and money consuming • Health providers have huge workload • Corona-risk	• Distrust-hurt relationship between health professional and patientt; • Issues concerning the quality of health information; • The digital divide-affect low-income, rural, disabled, racial/ethnic-minority, and elderly populations.(Gray et al., 2020) • Bad influence on decision making without physical contacts(Oudshoorn, 2009)

Figure 1 The benefits and drawbacks of digital and physical health interventions

1.2 Project assignment

This project explores how to connect digital and traditional care to create a seamless experience that fully embraces patients in cancer care when and where they need it. However, it is unclear how this kind of hybrid model fits in the context of the supportive care plan. For example, there are fuzzy definitions of the roles of physical and digital health interventions at different stages and a few descriptions of the interaction among stakeholders. These are not conducive to implementing hybrid models in real-world health contexts.

This project would specify how to include a hybrid model in a patient-based supportive care plan and the opportunities to involve more digital care. From a system perspective, the interaction of the various actors would be described. These findings could serve as a basis for implementing and developing the hybrid model in supportive care.

1.2.1 Research questions

-What type of role does digital care play in the support care plan? when and how?
-What other opportunities to improve the digital health experience in supportive care?
-What factors drive patients to choose different care models?
-What does an organization need to offer ,and how do they adapt to change?

We will introduce the context of this project in detail here to further explain the content of this project.

1.2.2 Supportive care

Multinational Association of Supportive Care in Cancer defines *Supportive care* as "the prevention and management of the adverse effects of cancer and its treatment. It includes managing physical and psychological symptoms and side effects across the continuum of the cancer experience from diagnosis through treatment to post-treatment care. Enhancing rehabilitation, secondary cancer prevention, survivorship, and end-of-life care are integral to supportive care" (Olver et al., 2020). Supportive care interventions, regardless of their diversity or who provides them, seek to improve and preserve the quality of life and autonomy and are aimed toward empowerment and optimizing wellness. To be worked effectively, supportive care must be aligned with an individual's needs in the patient's unique situation (Fitch, 2008). Thus, the different patients would choose the support care for which the actors involved are different.

Quality cancer care must provide cancer therapy in patient-centred cancer care, and cancer service providers must respond to patients' supportive care needs. Previous research has shown that cancer patients have unmet supportive care needs in the psychological and informational areas that influence cancer treatment outcomes and quality of life (Harrison et al., 2009). Inequitable access for patients to health services, not enough information to know supportive care plans, and other factors are barriers to patient access to the service. Digital care has great potential to help improve these issues, but it can replace physical care as a supplement. Thus, this project will explore how hybrid models build and the opportunities in which DHIs could intervene to optimizing th e whole patiens experience.

1.2.3 Hybrid model

How the hybrid model is implemented in supportive care is the focus of this project. Hybrid healthcare brings together the best of digital health and traditional health(physical care). For example, replacing a portion of the face-to-face sessions with more efficient online sessions reduces costs and improves treatment access for those suffering from diseases. Healthcare providers can interact with patients in a physical setting to establish relationships. Recent research in India has shown that the hybrid model has the potential to provide accessible and affordable healthcare to a broader part of its population. However, the challenges remain in creating this seamless system. Moreover, we should consider their impact on the current model and its stakeholder for using them wisely and appropriately. (Raj Westwood, 2021) This project would provide insight into how to implement this hybrid model.

1.2.4 Digital health intervention

The eHealth experience must evolve if a hybrid care model is established.Various terms are used to describe a particular form of applied technology in health care settings, such as e-health, telehealth, or digital health intervention. In order to avoid misunderstanding, the term Digital Health Interventions (DHIs) is used in this report. DHIs can be defined as "health services delivered electronically through formal or informal care. DHIs can range from electronic medical records used by providers to mobile health (mHealth) apps used by consumers" (Soobiah et al., 2020). The World Health Organization has recently produced a classification of DHIs, identifying four main types: clients, health care providers, health systems, and data services(World Health Organization, 2018).

In our practice during the COVID-19 pandemic, we have experienced the benefits of digital health interventions, which delivered patient care while reducing the sharing of virus transmission. Aapro clarified the benefits and drawbacks of digital healthcare solutions under the context of SCP for different stakeholders by reviewing the 66 full-text articles and associated clinical trials in Medline, Cochrane, and Clinicaltrials.gov(Aapro et al., 2020) (Figure 3). We can see that digital health can bring many benefits to SCP by empowering users, providing more accessible support, and encouraging self-management. At the same time, DHIs can optimize processes and improve the quality of services with less use of health resources. For the system, DHIs will bring cost-effectiveness benefits in the long run. These benefits lead 92% of physicians to expect to continue to use telehealth even post-pandemic to a recent Amwell survey.

However, many recent studies have indicated that although overall satisfaction with DHIs is high in patients, a significant minority still prefer face-to-face consultations(Gilbert et al., 2020). They indicated the transition of interaction would hurt the relationship between healthcare providers and patients. Additionally, patients with low digital capacity would be further alienated from the digital divide. It will take a great deal of time and money for the system to develop rules and train staff in the early stages of development DHIs

These problems have affected the popularity of DHIs. In order to apply the hybrid model to the supportive care system, how to improve the user's digital health experience and encourage them to use it is also a focus of this project.

Figure 3 Benefits and drawbacks of DHIs
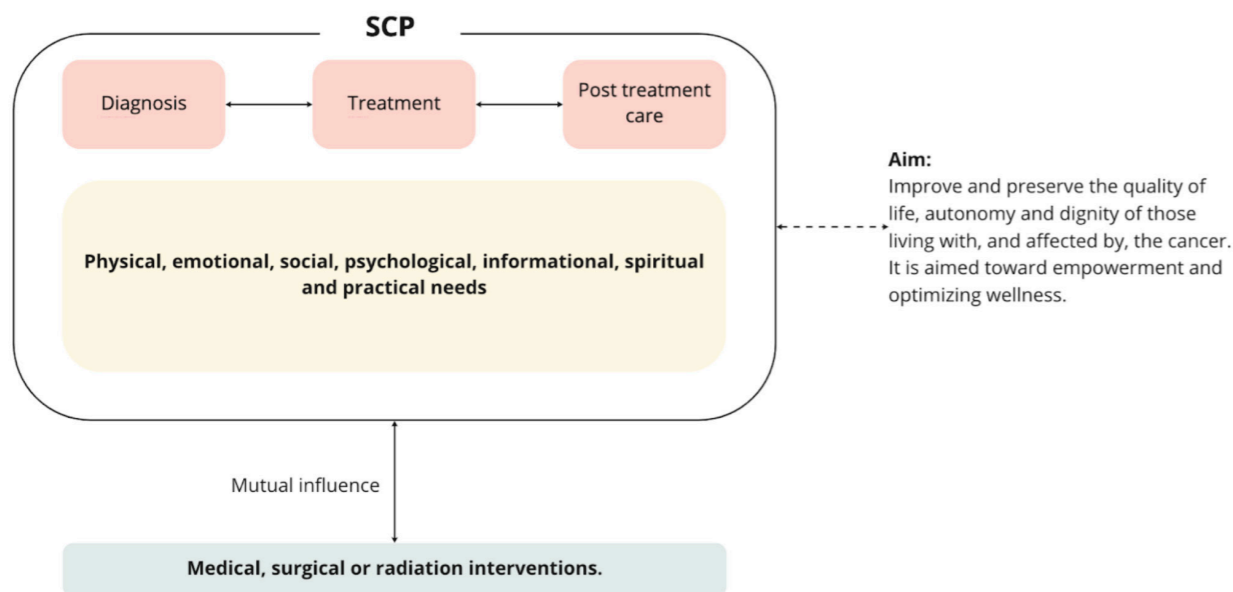
Figure 2 The scope of Supportive care

1.3 Approach

This thesis project was divided into four general phases and followed the method known as the Double Design Diamond. Through these four phases, different tools were used to perform the main objective of the phase and are described below(Figure 4). We will introduce two main design methods in detail.

1.3.1 Patient journey map

The patient journey map methodology we would like to use could visualize this dynamic and complex process. It could demonstrate the physical, rational, and functional aspects of the patient experience and the emotional, interactive and emotional aspects of the patient's experiences (Simonse et al., 2019). Furthermore, it is also helpful to show how stakeholders interact with one another in different phases.

We expect to deliver two journey maps. The first one is the current patient's journey which we can use to identify opportunities for intervention. After that, we will process future patient's journey to convey our concept.

1.3.2 Roadmap

A *roadmap* is the visualization tool that frames the time pacing and maps the pathways towards the desired future vision. (Simonse, 2018) In this project, a roadmap could help healthcare providers understand the gap between the current system and future vision and guide them in implementing the future hybrid journey.

Based on these methods, this project would have two main kinds of deliverables. The first is to map the current future patient journey for understanding the current system and the future hybrid patient journey of the supportive-care plan accompanied by a future vision. The second one is the roadmap which leads to the future supportive care plan.
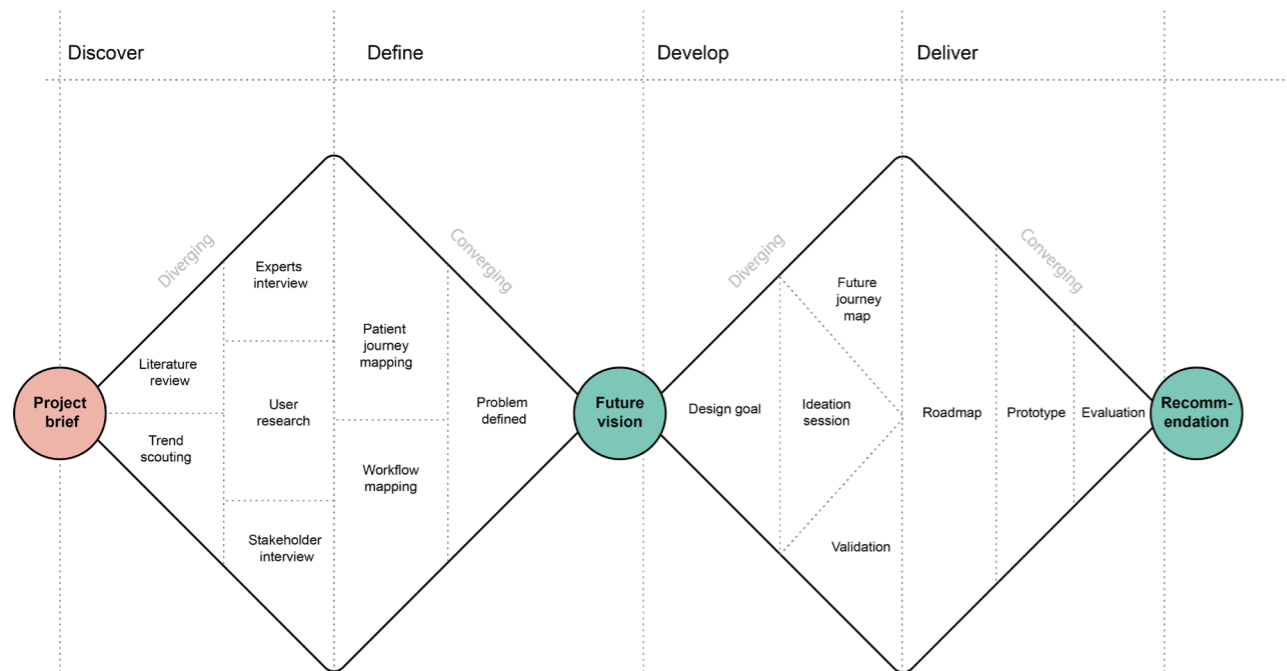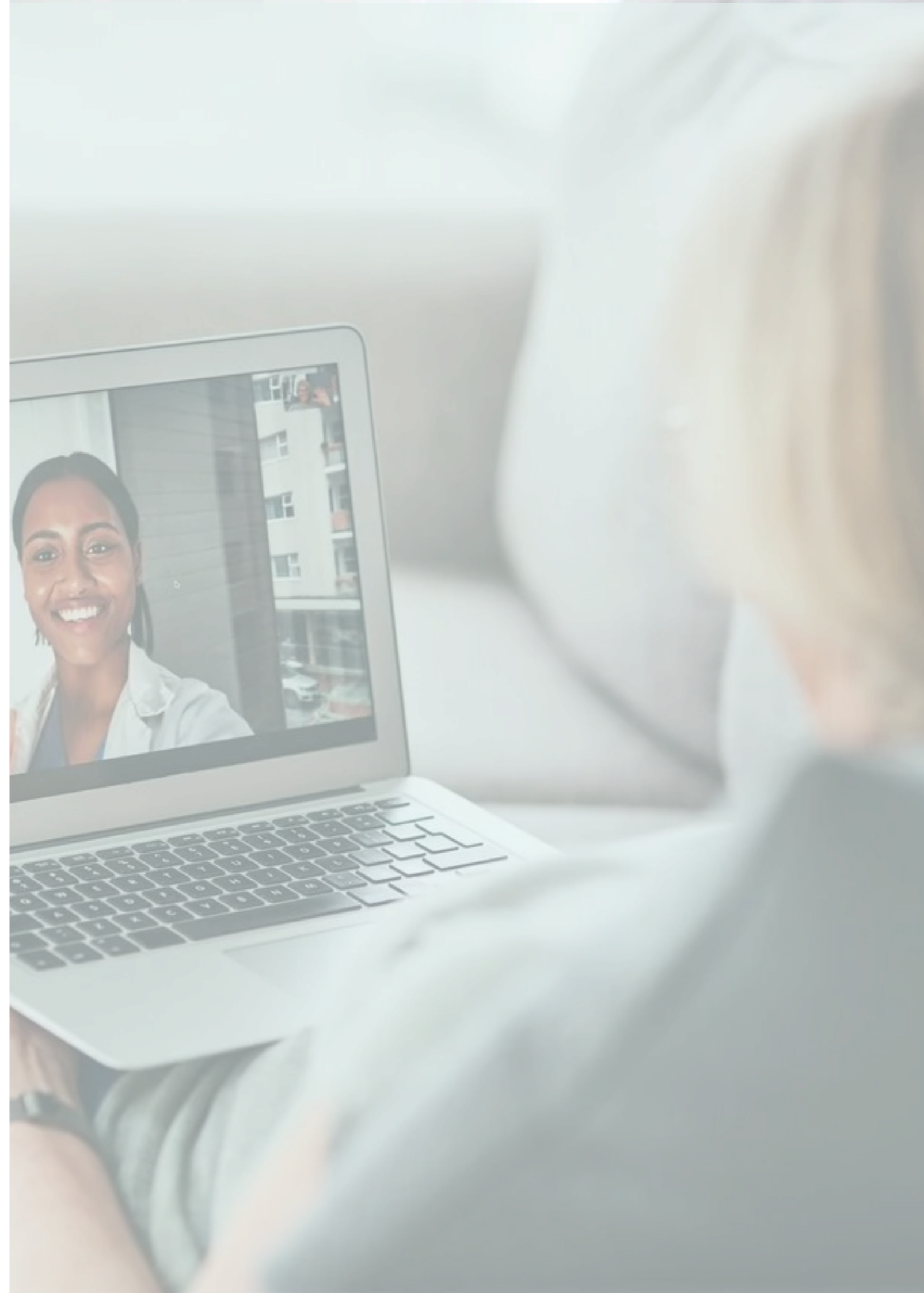
Figure 4 Visualized design process

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Discover I:
Preliminary Study

This chapter reviews recent literature on related research contexts as a basis for the following in-depth research.

We narrowed the focused patient group during the literature study and summarized existing issues from the literature on supportive care. After this, we collected the strengths and weaknesses of DHIs in SCP context. In addition, SCP and technology trends are gathered to set the stage for future strategies.

2.1 Patient groups

2.1.1 Definition of patient groups

We select breast cancer patients as a case study to narrow the scope of the research. In the Netherlands, about one in eight women will have breast cancer at some point in their lives. It makes breast cancer the most prevalent type of cancer in the Netherlands, with a ten-year prevalence of 128,000(RIVM, n.d., 2014). This group also has some unmet supportive care needs that have reduced their quality of life. The most serious two are informational and emotional support(Hodgkinson et al., 2007). Previous research has established that breast cancer patients benefit most from DHIs(Yildiz & Oksuzoglu, 2020). Therefore, it is reasonable to choose breast cancer as a case study of how the supportive care plan integrates with the hybrid model.

The treatment for breast cancer lasts for a long time and is very complex. To make the study concrete, We clarified user characteristics through a literature search - women aged 30 to 60 years during breast cancer treatment. We took that decision for the following reasons:

1)Age
Based on the target group and the scope of the design (digital health), the age distribution of breast cancer patients and the age distribution of eHealth acceptance among patients were considered. Moreover, we chose the segment with more overlap between the two as the study target - patients aged 30 to 60 (Figure 3).

2)Treatment period
Patients in treatment have higher support needs and a poor quality of life than after treatment (Faller et al., 2019). The integration of early supportive care among advanced cancer patients is a growing trend (Moffat et al., 2019). Although there are many studies for supportive care, the research on supportive care during treatment remains limited.
To conclude, we believe that selecting patients in treatment as the target group rather than survivors can make the project more consistent and meaningful.

2.1.2 The unmet supportive care needs of the patients group

Patients' perceived supportive care needs have been categorized into five core domains: psychological needs, health system and information needs; physical and daily living needs; patient care and support needs and sexuality needs(Okediji et al., 2017). Several studies suggest that breast cancer patients require the most assistance in the first three areas during cancer treatment. The need for sexuality and care and support were less critical than the first three. Meanwhile, due to factors such as region and age, the demand for supportive care will vary. For example, Rural patients who lived far away from health centres had less access to resources and appeared to have higher needs than urban patients in the areas of daily physical living (Schmid-Büchi et al., 2013).

1) Psychological
The majority of unmet needs come from the psychological domain, usually as a result of fear that cancer will spread, uncertainties about the future, sadness, thoughts of death and dying, feelings of depression, and worry about the immediate family (Schmid-Büchi et al., 2013), Okediji et al., 2017). It is the most common need of breast cancer patients (Lam et al., 2011).

2) Health system and information
Breast cancer patients reported showing a high need for information. They need to obtain information about the disease, diagnosis, treatment, and follow-up (Schmid-Büchi et al., 2013). For example, patients always want to be informed about things to help themselves and get the test results as soon as possible.

3) Physical daily living
Patients also need help coping with the physical symptoms and side effects of treatment, such as breast-conserving surgery and chemotherapy. Professional advice was needed to perform routine tasks and physical

activities (Fontes et al., 2019). For instance, they need guidance from physical therapists and nutritionists to return to their daily routine.
4) Care and support
This domain addresses the needs of healthcare providers who demonstrate sensitivity to physical and emotional needs, privacy, and choice. For example, they want more choices about which cancer specialists and more choices about the available best treatment (Schmid-Büchi et al., 2013).

5)Sexuality
Sexual needs are associated with sexual relations. Younger patients have reported a greater need for this, but as they age, the need starts to decrease (Fiszer et al., 2014). Meanwhile, needs with 'sexual issues' seemed to be more likely for married or partnered patients than patients who did not live in an intimate relationship (Schmid-Büchi et al., 2013).

Overall, these studies thus far provide evidence that breast cancer patients still have many unmet supportive care needs. In addition, this project will be focused on the three most essential needs: psychological needs, health system and information needs, and physical and daily living needs.

Focus on

30-60year-old women during breast cancer treatment

The age of Breast cancer patients
(KNOW YOUR LEMONS, 2021)

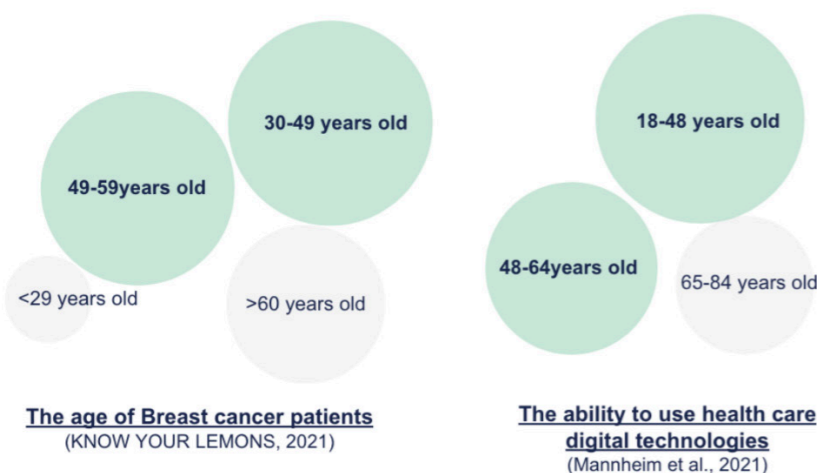The ability to use health care digital technologies
(Mannheim et al., 2021)

Figure 5 The distribution of target group

2.2 Problem of supportive care

A series of recent studies have indicated many problems with supportive care. Three categories from the stakeholder perspective were divided during the analysis——patients, healthcare providers, and the health system (Figure 4). Lastly, the four main problems were concluded as the main takeaway for this part.

1) Communication and cooperation
Due to the busy schedule of HCPs, it is difficult for patients to communicate with HCPs immediately, which impedes their needs from being fully met. On the other hand, the lack of communication and clear division of work between HCPs and HCPs results in a very inefficient collaborative process and an inability to deliver a high-quality SCP.

2) Make an SCP
Each patient varies by medical condition and life context, while supportive care needs change throughout treatment. HCPs lack the tools and information about the patient to access the needs of patients and lack

sufficient knowledge to make a reasonable and flexible SCP.

3) Information and education
Patients lack sufficient information about SCP and cancer treatment, which prevents them from seeking professional help. For HCPs, the lack of experience and knowledge can affect their ability to develop and implement SCP.

4) Medical resources
Lack of financial support, inequitable medical resources across regions, and tight HCPs schedules have prevented many users from accessing HCPs or obtaining good SCP services.

We learned more about SCPs from different perspectives during the collection of these problems. Moreover, we will use these as a foundation, combined with insights from in-depth interviews, to map the current patient's journey

Patients	Insufficient monetary support for supportive care	(Wait et al., 2017)
	Lack communication with HCPs	(Wait et al., 2017) (Ha & Longnecker, 2010)
	Hard to know the supportive care plan clearly	(Morken et al., 2022) (Herrmann et al., 2020)
	Hcps hard to assess needs and condition of patients	(Regnier Denois et al., 2017)
	Have less access and awareness of supportive care	(Morken et al., 2022) (Regnier Denois et al., 2017)
Healthcare providers	Less communication among the HCPs	(IJsbrandy et al., 2020)
	Lack of time to discuss issues or response quickly	(Nadler et al., 2017)
	My responsibility and role are not clear	(Morken et al., 2022) (Baravelli et al., 2009)
	Hard to make a suitable and changeable supportive care plan	(Regnier Denois et al., 2017) (IJsbrandy et al., 2020)
	Hard to understand the conditions of patients	(Morken et al., 2022)
	Lack of knowledge, safety issues and lack of training	(Nadler et al., 2017)
Health system	Scarce resource of HCPs ,the gap between supply and demand	(Walsh et al., 2010)
	Inequitable access to health services	(Wait et al., 2017) (Walsh et al., 2010)
	Not enough cooperation between healthcare institutes	(Baravelli et al., 2009)
	Insufficient quality insurance and unclear insurance	(IJsbrandy et al., 2020)
	Not enough information for patients to know SCP	(Morken et al., 2022) (Regnier Denois et al., 2017)

Figure 6 The problem of supportive care

2.3 Digital health intervention in SCP

2.3.1 The role of DHIs in SCP

A recent study found that DHIs are helpful and practical for supportive cancer care by systematically researching the literature published between 2000 and 2020. Meantime, the author summarized the five types of digital tools, which they could make the interventions in six aspects, such as psychotherapy, and nursing support. As a result, they could have six positive effects, from reducing the side effects to improving health-related quality of life.DHIs, and

the positive effect on cancer care(Marthick et al., 2021)(Figure 5).

Furthermore, another research indicates that virtual reality and video games could be platforms for intervention with young patients (McCann et al., 2019). Through such exploration, the role of DHIs in SCP will become more apparent, which is conducive to depicting future digital opportunities in hybrid patients' journey.

Type of digital tools	Type of intervention	Positive affect
web-based portal or web-based experience	Digital health education	reduce pain
telephone or smartphone	psychotherapy	reduce fatigue
combination of web-based and telephone interactions	nursing support	improve health-related quality of life
social media networks	remote exercise	improve cancer-related symptoms
wearable activity trackers	rehabilitation program delivery	improve functional capacity
	digital mindfulness interventions	reduce depression

Figure 7 Digital health intervention

2.3.2 Facilitators to adopt DHIs

To know how to implement digital innovation in SCP, we collect adoption facilitators from literature. Aapro has collected a list of factors that drive implementing a digital solution. From patients' perspective, ease of use, assurance, ease of use and usefulness are the main factors. From the perspective of HCPs, the most important reasons for adoption reported were the usability and usefulness of the tool. Other research has stated implementation of digital systems needs to be simple and uncomplicated and improve clinical workflows for staff (Bucci

et al., 2019). Besides, for HCPs, keeping professional autonomy also plays an important role and the IT, legal and organizational support (Li et al., 2013). These factors will serve as an important support for the design of DHIs and roadmapp.

Patients

-Ease of use
-Reassurance
-High usability and usefulness
-Improved communication with HCPs
-Correct generation of system alerts and fast
response to alerts
-Patient empowerment and
-The convenience of real-time reporting of
symptoms;

HCPs

- Usability and usefulness of the tool
- Improve the efficient of workflow
- Professional autonomy
- IT, legal and organization
- Interference with health care provider-patient
relationship

Figure 8 Facilitators to adopt DHIs

Figure 9 Model to illustrate interactions between mechanisms that influence preference for virtual consultations

2.4 Factors for choosing care model

The hybrid model, a mix of physical and digital health care, provides an approach to combining the benefits of both care models. When applying hybrid care, it is first necessary to determine when to provide digital care to patients and when to provide physical care.

As mentioned before, each patient varies by medical condition and life context. Dekkers suggests that cancer care should be tailored to the patient. More emphasis on self-management could be established for patients with a low-risk profile(Dekkers & Hertroijs, 2018). The virtual follow-up would be an efficient and reasonable option for this low-risk profile(Kwan et al., 2019). Vice versa, patients with a high-risk profile, could receive more intensive disease management in a physical setting, to address their care needs and preferences.

In addition, DHIs have great advantages in transportation costs and waiting time-saving. Prior research suggested the hospital should implement digital care when the transportation cost is high, or patients have a large gap between online and offline waiting sensitivity.

Hybrid care is dynamic and needs to be organized according to different patient conditions. Several authors have assessed different factors related to patient preference for digital health care. Recently, Anthony designed the model to illustrate interactions between mechanisms that influence preference for virtual consultations by conducting 44 qualitative interviews with patients and healthcare professionals (Figure 7).

There are four main factors:
1) Situation of care:
It represents how patients understand and explain their clinical status, treatment requirements and care pathway.
The treatment needs and the impact of the clinical status of their body and daily life, for example, may cause them to be immobile and challenging to carry out offline care. The type of care, including the length of time and the number of appointments, can also affect their preferences. For example, when the appointed time is short, the patient may not be inclined to go to the hospital.
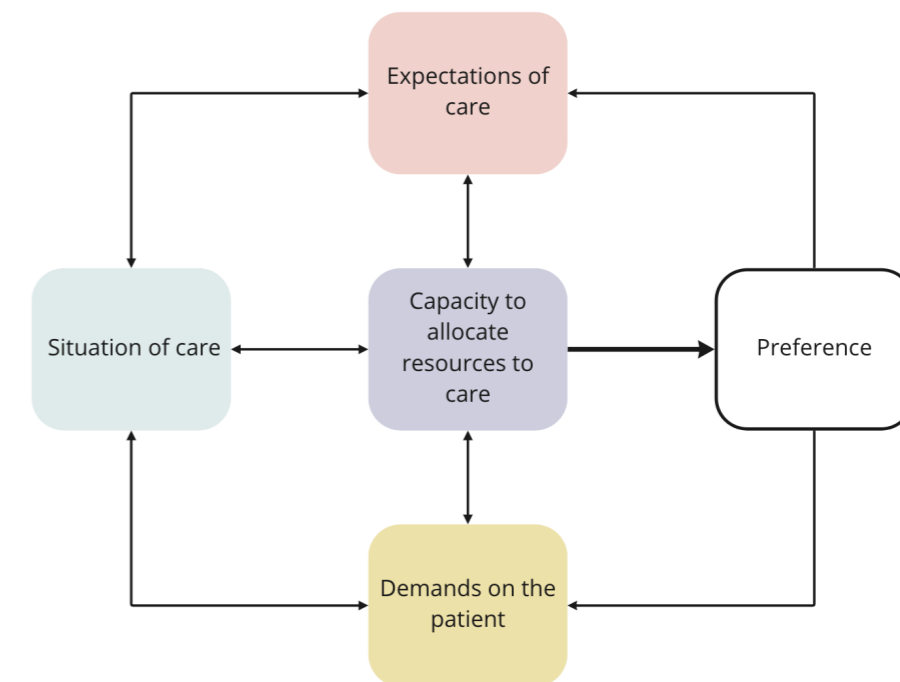
2) Expectations of care:
Patients' desires for contact and perceived requirements of care influence their preferences. For example, when they think the care plan could be more effective in physical, they want to have physical care. In addition, psychological states such as motivation and self-efficacy can influence their choice; for example, they also choose physical care when they feel they can interact better offline. Finally, patients' previous experiences, digital and physical, can also influence their preferences.

3) Demands on the patient:
After selecting a digital or physical care plan, patients can face multiple and different demands, including the requirement from care activity, social needs about competing life demands that may interfere with health care, and the impact of choosing digital or physical.

4) Capacity to allocate resources to care: It is about whether a patient can get enough financial, material, and informational resources which need for a care plan and whether the health system and social networks could help them go through the care plan.

This model told us what factors should be considered when providing DHIs, and helped us understand the essential preferences to support hybrid patient journey design(Gilbert etal., 2021).

2.5 Trends scouting

Simonse emphasized the importance of research on trends in road mapping (Simonse, 2017). Conducting trend analysis can ensure the service roadmap does not miss out on change signals in the changed context. In this part, a series of trends has been collected and

analyzed. The first section will dive into trends in supportive care and the second section is about technology trends. In the last part, the analysis has been performed to help the future roadmapping process.

2.5.1 Trends of Technology

IoT and Wearables
Wearables can track real-time biometric signals across a large segment of the population without the constant monitoring of a healthcare professional. The IoT provides faster connectivity that allows a range of medical devices to be connected to a server. As a result, telemedicine technology can function efficiently using real-time data from these devices, allowing high-quality virtual care.(GlobalData Thematic Research, 2022)

Privacy & Data
Organizations with a stake in the movement toward a more digitally enabled health delivery system might commit themselves to addressing these privacy issues. Consumers may expect more control over their data, and they likely will demand more security, transparency, and granular privacy preferences with personalized experiences. (Gisby, 2020)

VR and AR
VR and AR train doctors and surgeons, enabling both surgeons and patients to get more comfortable with procedures. In terms of treatment, they can help medical staff make accurate diagnoses to release their physical pain and mental problems. Also, they could reduce the risks and costs of the health system. (Johansen, 2019)

Big data
When big data is synthesized and analyzed, healthcare providers and other stakeholders in the healthcare delivery system can develop more thorough and insightful diagnoses and treatments, resulting in higher quality care at lower costs and better outcomes overall. (Sally-Anne Jones, 2017)

Telemedicine and the Evolution of Remote Care
Telemedicine can come in live video calls, mobile health apps, remote patient monitoring, store-and-forward imaging, or other solutions that allow long-distance communication between a doctor and patient. They could improve patient engagement and control the medical cost. (Dolbey, n.d.)

AI and machine learning
AI tools and machine learning are required to organize, screen, and analyze personal health data. It will help extract insights about healthcare trends and forecast the likelihood of developing a disease(GlobalData Thematic Research, 2022).
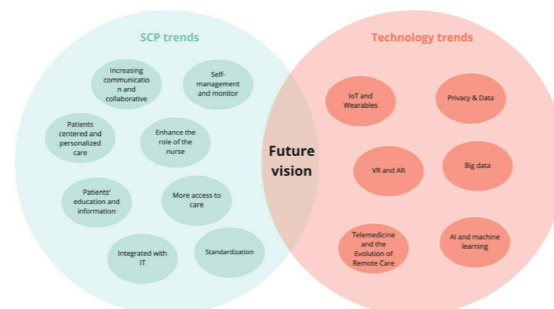
Figure 9 Trending scouting

2.5.2 Trends of SCP

Increase communication and collaboration
SCP is an interdisciplinary task that requires greater collaboration between different medical departments such as Multidisciplinary team meetings (Walsh et al., 2010) and coordination of care between speciality and primary care settings(Baravelli et al., 2009). Besides, clearly defined roles and optimized workflow are required for high efficiency (Morken, 2021).

Patients centered and personalized care
Supportive care should be based on and tailored to a person's unique circumstances. Care needs to be tailored to each patient's type of cancer and treatment status (Kim et al., 2021).

At the same time, quality of life is subjective, so only the patients can assess the impact of SCP (Olver et al., 2020). A good SCP is patients as a source of control. HCPs should fully listen to their opinions and communicate politely with them during the decision-making process (McMaster Health Forum, 2021).

Patients' education and information
Patients need to get enough information to understand their condition and information about SCP to better accept SCP and work with HCPs (McMaster Health Forum, 2021). Also, clear information should be provided to navigate them through the healthcare system and follow the plan (Malmström et al., 2013).

Self-management and monitor
Previous qualitative studies on self-management reported that cancer patients are interested in managing their care(Jansen et al., 2015). Self-management would alleviate the burden on the medical system and personal medical costs. Meanwhile, careful monitoring during self-administration of home treatments becomes essential to facilitate early intervention to reduce patient severity and to help patients improve their quality of life(Aapro et al., 2020).

Enhance the role of the nurse
Nurses could have greater flexibility and capacity to integrate more resources and information to provide personalized supportive care to patients than specialists. They should design patient-oriented interventions using their peers as direct support to promote effective coping strategies (Mollica & Nemeth, 2015).

More access to care
Interventions improving a patient's health and fitness before initiation of antineoplastic treatment proved to improve the tolerance of the treatment. Integrating early supportive care in patients with advanced cancer is an increasing trend that can improve mood and quality of life (Moffat et al., 2019).

In addition, multidimensional support can help patients better survive treatment and reduce recurrence rates(Olver et al., 2020). With early, multidisciplinary intervention and considering ways to provide additional support, access to care could be improved.

Standardization
Standardization across the entire process can help collaboration, increase efficiency, help save costs, and facilitate SCP education). It includes many aspects, such as communication approaches with others, evaluation criteria, and the development of supportive care programs for medical students.

Integrated with IT
Electronic patient-reported outcomes (ePROs), videoconferencing, and virtual reality have been shown to improve patient quality of life and reduce hospitalizations and healthcare costs. Using more digital care can help reduce patient and hospital care costs and allow more users to access HCPs while optimizing care delivery (Moffat et al., 2019).

2.5.3 Trends analysis

After collecting trends, we conduct an analysis process to classify trends. The trends for SCP and workflow were identified in this section as essential elements of innovation (Figure 9). The link between the main SCP trends and technology trends was analyzed by referring to several reports (Dickson, 2019), (Six, 2020), (AMD, 2018),(Hannans, 2019), (TEKTELIC Communications Inc., 2022), (Fiebig, 2016) (Tulane University, 2021), (Abouelmehdi et al., 2018) and (Malek et al., 2022). Technology development has brought many benefits to SCP, making SCP move in a more intelligent and efficient direction. In addition, this could reduce medical costs and optimize the SCP by increasing patient engagement and reducing the time required to obtain support. The greatest threat to all the technology developments found is the issue of privacy. Technological progress must be made with respect for and protection of patient privacy. We must care about the safety for technological innovations to thrive, such as using data through de-identification, enhanced compliance monitoring, and access controls. These connections support subsequent future vision building.

Main SCP Trends	Telemedicine and the Evolution of Remote Care	AI and machine learning	IoT and Wearables	VR and AR	Big data	Privacy & Data
Increasing communication and collaborative	Remote care can reduce communication costs, promote real-time communication, and improve communication efficiency.	By providing patients and HCPs with tailored communication, AI can help them reach better decisions.	These wearables provide doctors with real-time access to the health status of their patients	VR and AR improve the experience of remote communication and improve the way of communication through the sense of presence	Through big data, doctors can better understand the situation of patients, promote the cooperation between HCPs and patients, and optimize the decision-making process.	The privacy and security issues that should be considered in health care delivery: -Data use through de-identification -Vendor due diligence — data access, data storage, and ransomware -Enhanced compliance monitoring -Access controls -Training the staffs
Self-management and monitor	HCPs can intervene remotely to provide advice and reduce the seriousness of the issue.	AI provides feedback to users through data analytics, to guide their self-help.	IoT helps patients monitor their own body data and better understand their own situation		Empowering patients to engage with their own health histories with easy-to-access medical records, while reducing patient risk through real-time alerting	
Patients centered and personalized care	It could improve routes to communication and help patients more control over their care	AI can respect patients preferences and customize services for them.	It lets patients take control of their healthcare. The feedback of their data support patients in proactively managing their illnesses.	VR and AR can enhance empathy by assisting HCPs self-training to provide patient-centred care.	The analysis of new and varied sources of data currently available to researchers in health have the potential to better measure, monitor and describe health outcomes of patients	
Patients' education and information	This improves education and reduces costs by providing medical information remotely	AI could generate additional information for patients that will help them to understand their situation		Through visualization, they reduce the learning cost for patients and help them to better understand the therapeutic process.	Customize information and educational content for users by conducting data analysis	
More access to care	Telemedicine is reducing medical costs and making it easier for patients to access care.	AI can deliver is the acceleration of current healthcare processes, resulting in times for accessing healthcare.	Patients can understand their own physical conditions, get health care faster, and lower the threshold for obtaining health care	HCPs run simulation experiments using digital twins, etc., which reduces errors and medical costs.	It could save on health care spending by reducing decision errors and optimizing workflow. Providing users with virtual services through big data also could lower the threshold for obtaining medical support	

Trends for policy or workflow

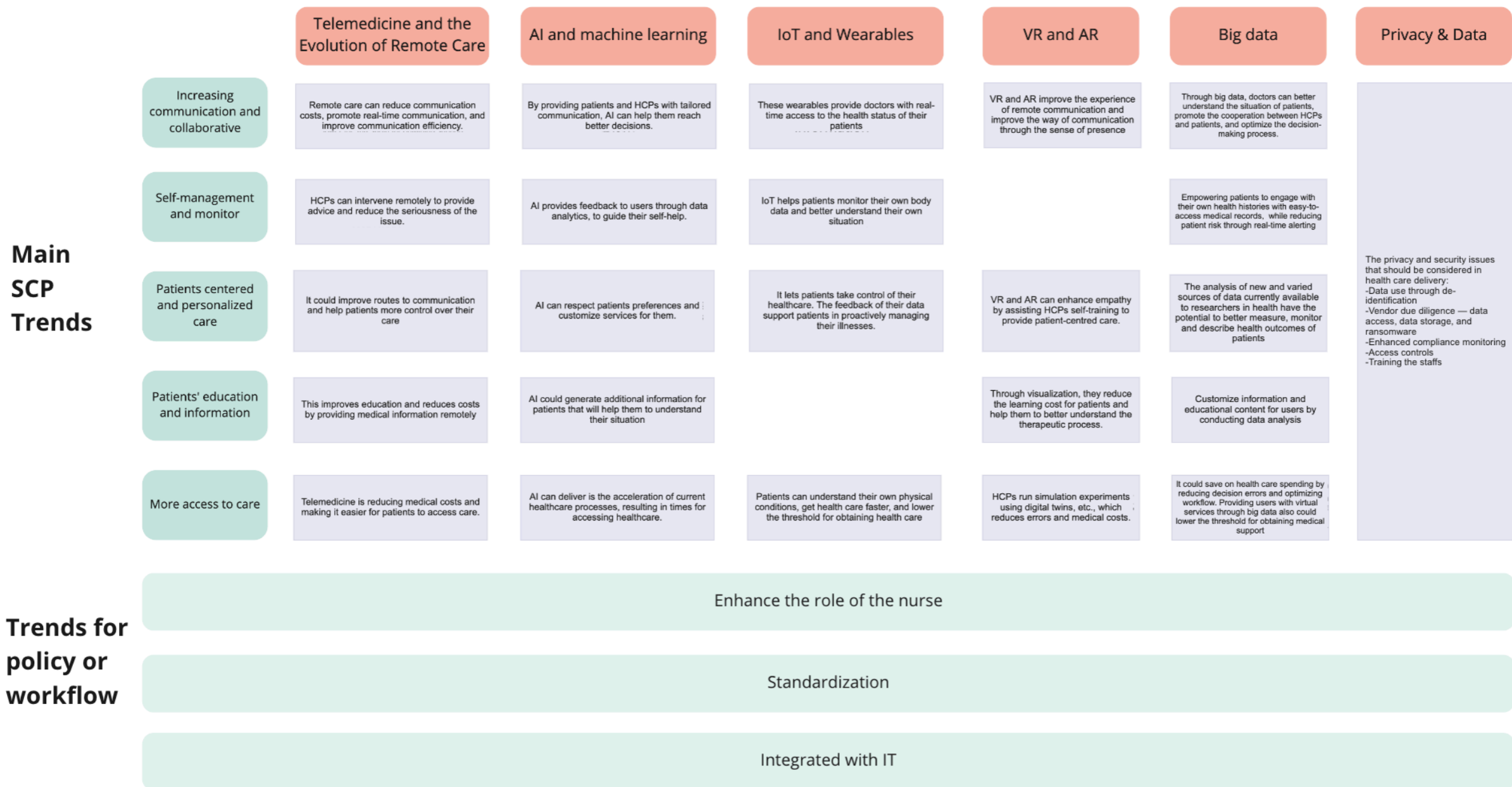| |
|---|
| Enhance the role of the nurse |
| Standardization |
| Integrated with IT |

Figure 10 Trend analysis

Chapter conclusion

The following subject was discussed in this section:

-The general problems of the SCP and the role of the DHIs have been summarised in the analysis process above. They could solve some of the existing problems of SCP, but some risks cannot be ignored.

-Trends have been collected, while the analysis process was conducted to find the connection between technology trends and SCP trends;

-The founded model allowed us to determine the factors to be considered when providing DHIs.

Main take away

• **Focus on main supportive care needs**
The primary supportive care needs of breast cancer are psychological, health system and information, and Physical daily living. To narrow the scope of the study, we make the project focus on these supports to implement the hybrid model and find more opportunities for DHIs.

• **Care model cannot be decided by a single factor**
Gilbert's preference model (Figure 9) told us that patients' preference for digital tools is affected by several factors. The choice of model of care to be provided is challenging to envisage or divide by one factor. The decision-making process is complicated.

• **Need the opinions from medical staffs**
It is essential to consider the views of medical staff on digital innovation in order for these systems to be successfully adopted and implemented. In the following research process, we should collect the opinions of medical staff.

3

Discover II:
In-depth research

In this chapter, more profound research has been conducted for figured out the unaddressed problem listed in the last part. After this research, the current patient journey was mapped and the current workflow of the current medical staff. Besides, the current digital intervention touchpoints and pain points were concluded for future design.

After the literature review, we still need to solve a series of remaining questions:

-The context of the target group is unclear, and the specific needs of the SCP for them have not been identified.
-The workflow of SCP and the interaction process of stakeholders should be understood.
-Existing digital touchpoints on the current journey should be mapped and stakeholder attitudes collected.

As a result, more research is required to obtain this information to map the patient's future path. Thus, we conducted three main types of research to obtain different points of view. Figure 11 presents the process of research. This research process enables a multifaceted understanding of the problems of the existing system and the attitudes to incorporate DHIs which support us to identify the design opportunity points.

We will present the objective and approach of three research firstly. After that, the main findings will be described in the following three parts: Patients' experience in supportive care plans, Digital health intervention experience, and Stakeholder interaction.

3.1 Researches set-up

Research aim
The user interview aims to dive into the patient group's context and know their attitude and experience about "current supportive care" and "digital care". The main result questions were as follows:
   -**What is their experience and attitude toward supportive care?**
   -**what is their experience and attitude toward DHIs?**
   -**what are their unmet needs in SCP?**

Research resource
Data on cancer patients'expereince were collected from the online cancer community: kanker.nl. Kanker. nl is the central online platform in the Netherlands that provides cancer-related information. Kanker.nl now has more than 550,000 unique visitors, 30,000 participants, and about 1,250 bloggers every month (Figure 12). As more and more cancer patients start using online platforms to share resources, patient-reported health care experiences in a narrative format on the internet are a valuable data source for implementing patient-centred care (Zolnoori et al., 2019). More online platforms, like youtube, presented an ideal venue because it proliferated cancer cases generated by users. In this project, kanker.nl was chosen for the richness of its content and the integrity of the patient story, which could enable more detailed data collection about an entire journey experience.

Data collection strategy
There are two types of patient stories in kanker.nl: Blog and talk group (Gerprekken). In blogs where we could read personal stories of certain types of patients. We could find the patients' opinions on different topics in the talked group. In conclusion, two parts of the stories were collected in our project. We will introduce the data collection process here. (Figure 14).

1) The main part: breast cancer patients' story
Firstly, we searched for 30 breast cancer patients who recently posted more than 40 blogs. Also, all of them are 30-60 years old and under cancer treatment, the scope of the chosen patient group.

Secondly, we excluded some stories unrelated to supportive care/ digital care from browsing their stories. Finally, the stories of 9 breast cancer patients were collected.

2) Supplement: short story
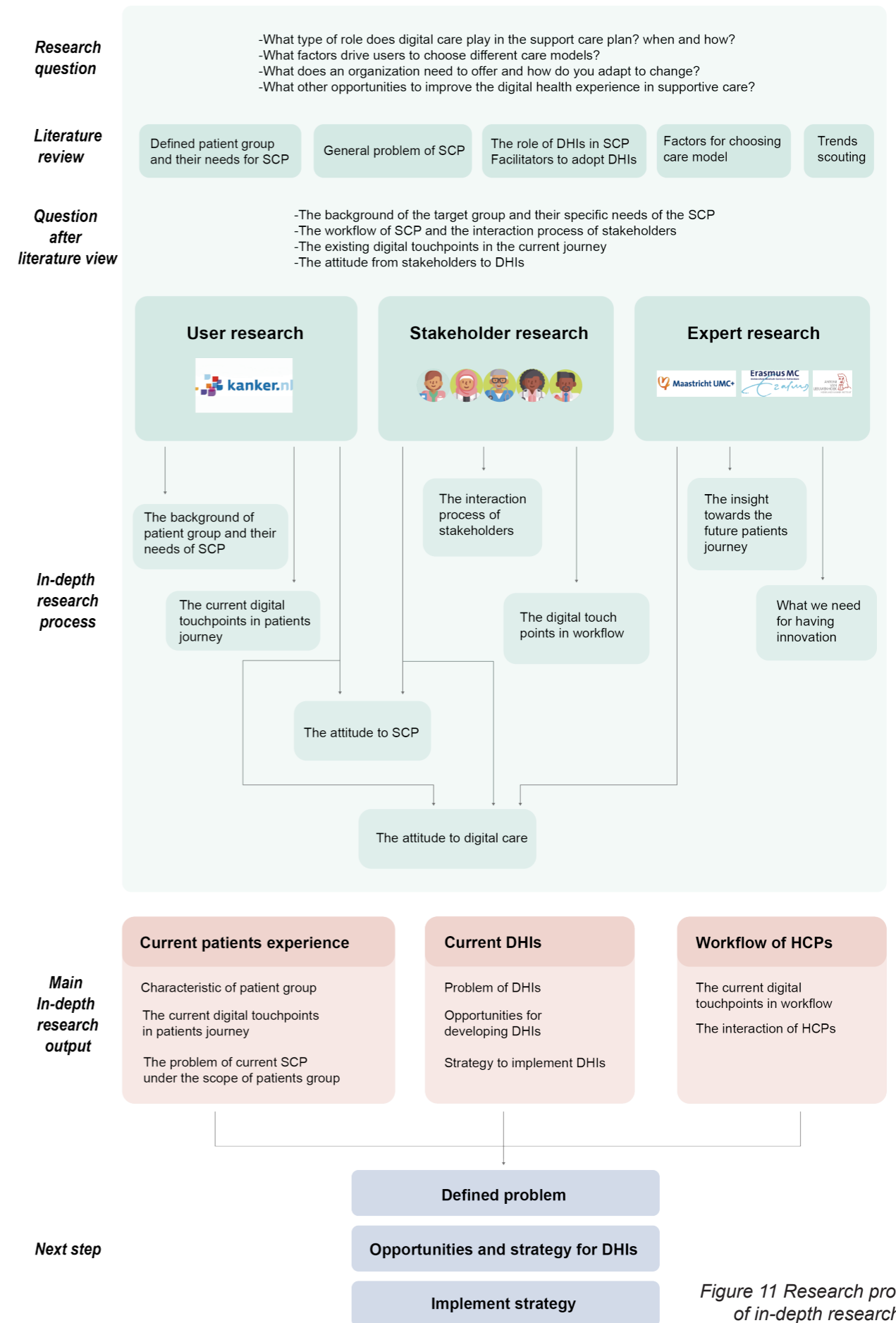First, We found some patients blogging about

Figure 11 Research process of in-depth research

supportive care/digital care sporadically while browsing. These stories contain patient attitudes and emotions that are invaluable to this study to enhance the validity. Thus, the stories were decided for collection after using the search terms "Supportive care", "Digital", "Consultation", "App", and "Meeting".

Secondly, in the talk group, the groups around supportive care and digital care were screened: "Breast cancer", "Exercise, sports and physical recovery in cancer", "Communication between patient/relative and care provider", "Corona and cancer", "Physical recovery from cancer", "Fatigue" "Requests, announcements and calls" and "Nutrition".

We checked topics created within the last year

in each talked group. Moreover, the comments from patients who were not "30-60 years old under treatment" were excluded.

In the end, 167 stories were gathered in both ways. Figure 14 shows the selection process clearly.

Data analysis process

The qualitative content analysis was chosen to analyze the collected story(Zolnoori et al., 2019). Thematic analysis to identify critical themes recurring in the patient's story that could answer the questions listed above. The analysis was run on Nvivo software. We mapped the patient journey map as a main finding on the theme and problems found, which will be presented later.
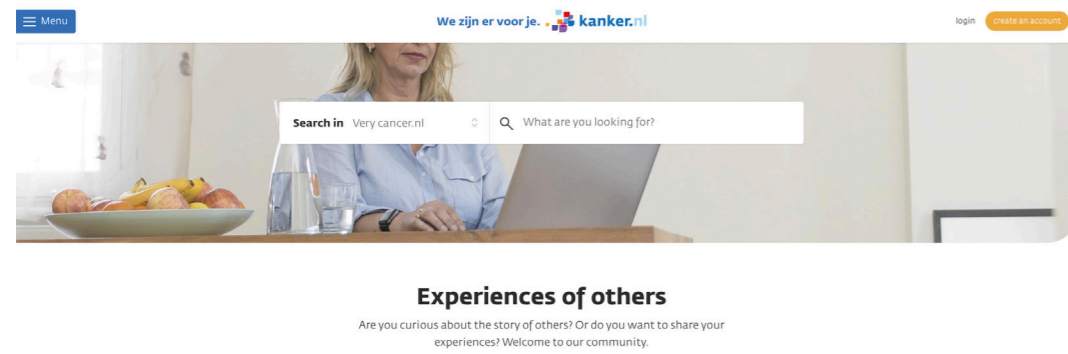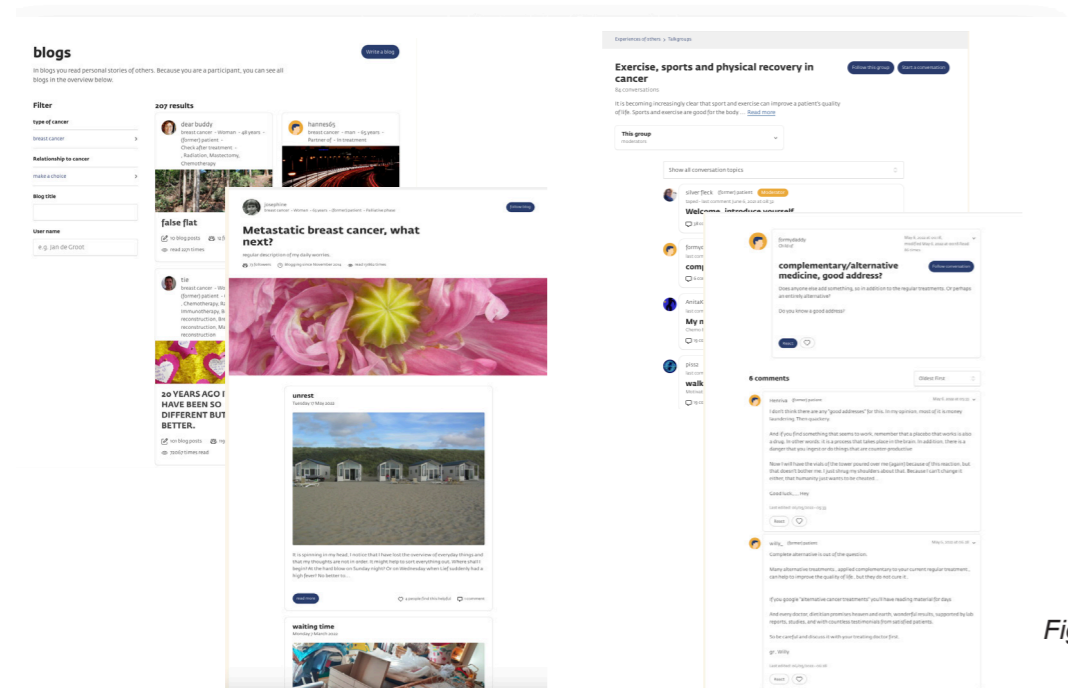
Short description of theme
Ultimately, 347 codes were defined, split into nine themes in total. Appendix F has more clearly coding tree which has quotes from online stories. We will briefly explain every theme below (Figure 15). Three themes, "Problem of SCP", "Digital health intervention", and "Condition of patients", will be explained further in the next section. These themes are the basis for building the patient journey.

• *Problem of SCP(94)*
The problems of the existing support system had been summarized from the patient's point of view. Current supportive care is always delayed, inadequate, and sometimes ineffective. On the one hand, patients are easily tired and find it hard to communicate with them. On the other hand, doctors are always busy, and patients cannot book an appointment with them, so patients are difficult to access help. At the same time, doctors cannot fully understand the patient and make the proper intervention for them.

• *Digital health intervention(189)*
This theme is mainly divided into three parts 1) categories of DHIs used for supportive care, 2)advantages of DHIs from the patients perspective;
3) and disadvantages of DHIs.

• *Condition of patients(42)*
This theme mainly introduces the condition of patients: they are easy to feel tired and find it hard to manage their schedule. Also, they feel worried about their body conditions.

• *Need support(246)*
During cancer treatment, patients demonstrated the importance of obtaining the support of their medical staff. The needs reported here are also familiar with those from the literature review, primarily information needs, dietary and physical interventions in daily activities, and psychological interventions. Apart from that, the remarkable thing is that they need someone to help organize the busy schedule or manage energy. We would also take those requirements as our starting point in the following research.
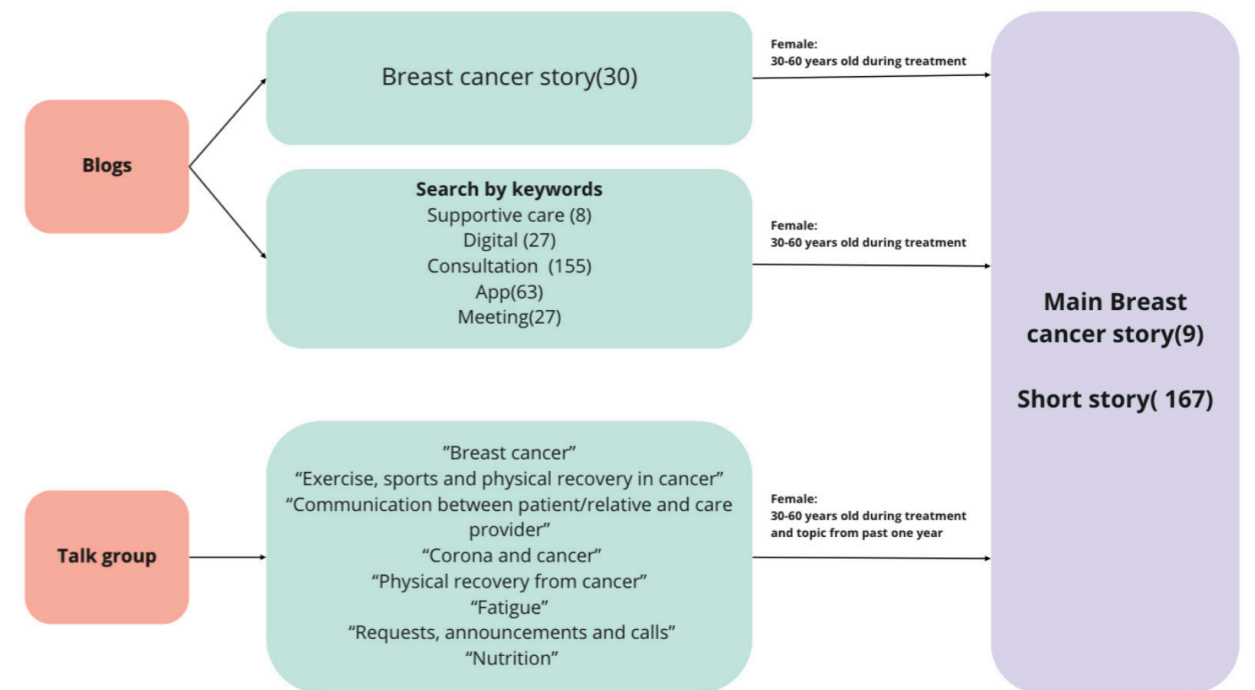

Figure 12 Kanker.nl

Figure 13 Blogs and Talk group(Gerprekken)

Figure 14 Data collection process

- ***Requirement of SCP(35)***

It mainly describes the patient's requirements for SCP. They hope to communicate more with HCPs, such as frequent communication to confirm body condition and discuss the care plan. Secondly, they hope that different HCPs could make a collaboration to formulate a more reliable and convenient care plan. Apart from that, they also would like to have a good connection with HCPs, personalized care, and need the companionship of others. These will serve as a reference for the design of future patients' journeys in SCP.

- ***Physical visiting(82)***

This theme contains the advantages and disadvantages of physical visiting from patients' perspectives. They could receive a more detailed examination during the physical visit, direct guidance and build more social connections with others. Contrastly, they feel tired of transportation, nervous during the long waiting time and find it hard to book appointments with doctors immediately. Moreover, they feel guilty when they waste time accompanying their parents. Physical experience is a significant part of the hybrid journey. In the design section, we also think about how to improve the physical experience.

- ***Consultation process(25)***

A consultation is an important form of providing supportive care. But for the patient, the information received through the process is complex, and they would like to record the entire process. In addition, the schedule is tight. They have to prepare the plan in advance in order to ask all the questions they want. These insights will be involved in the patient journey (Figure 21).

- ***Friends and relatives(18)***

Friends and relatives play an important role during supportive care. They could help to accompany patients to the consultation and overcome the negative emotion. As well, it is important that patients share related information with them.

- ***Peer group(19)***

Peer group also is a good way for patients to release the pressure. They could find their peers through workshops, consultation rooms, or search online communities. However, peer groups also put pressure when they always share too many negative emotions. Peer groups can also be an important part of supportive care.

3.1.2 Stakeholder interview

Research aim

All research activities among medical stakeholders aimed to identify the overall current workflow of the SCP and get their views on the current system and DHIs. There is an investigation of what the interaction between stakeholders looks like and an exploration of what medical staff thinks about the digital health intervention touchpoints and pain points.

Participants

As you can see from the previous article, the main needs of breast cancer patients during treatment were psychological, health system and information, and daily physical living. According to this, we invited these participants to attend the interview (Figure 16). The navigator nurse knows the supportive care system best and provides all kinds of information to patients. The physiotherapist and dietitian mainly support the physical daily living and information. The last two are the social worker and psychologist, who provide the information and psychological support.
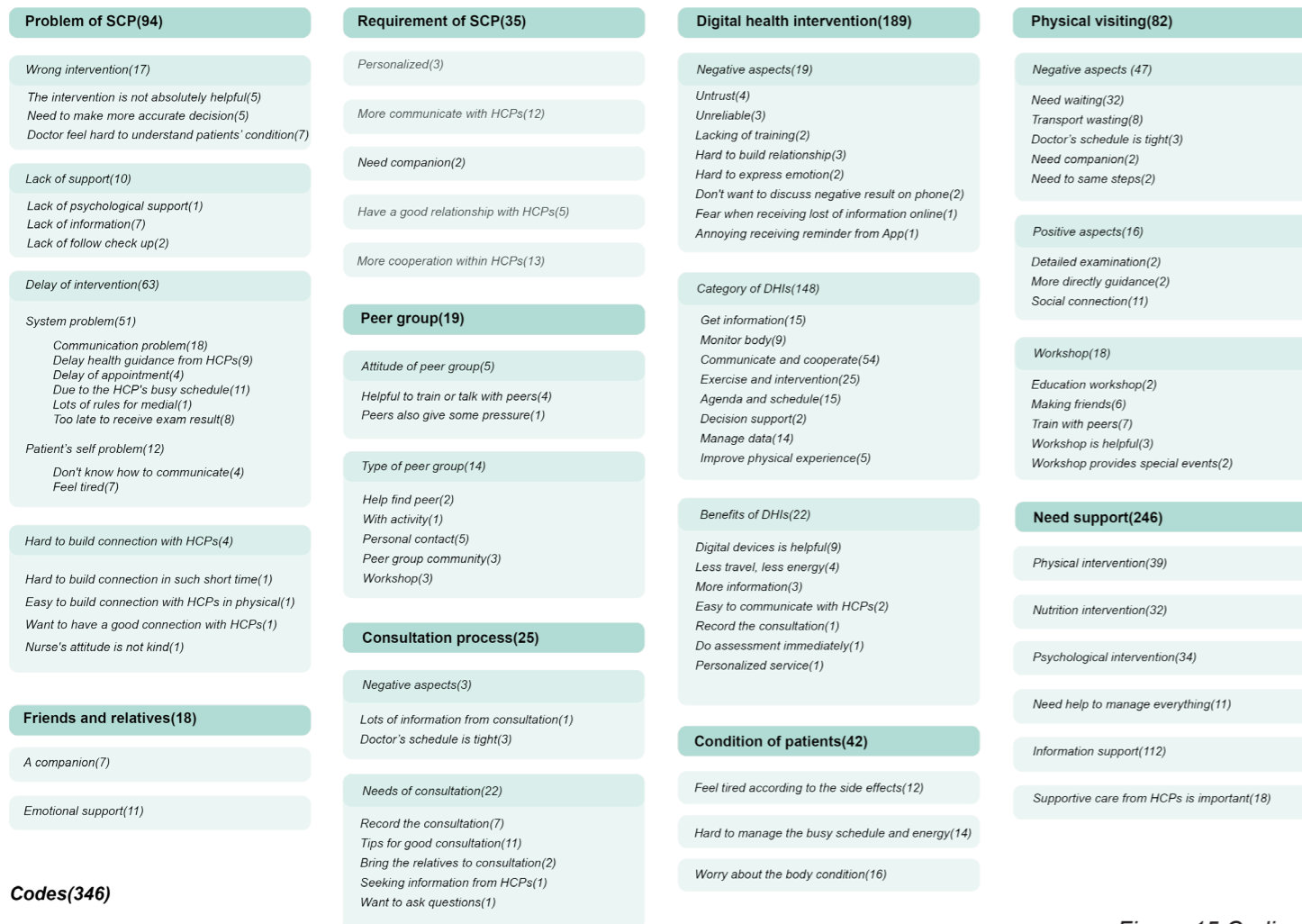
Problem of SCP(94)

Wrong intervention(17)

The intervention is not absolutely helpful(5)
Need to make more accurate decision(5)
Doctor feel hard to understand patients' condition(7)

Lack of support(10)

Lack of psychological support(1)
Lack of information(7)
Lack of follow check up(2)

Delay of intervention(63)

System problem(51)

Communication problem(18)
Delay health guidance from HCPs(9)
Delay of appointment(4)
Due to the HCP's busy schedule(11)
Lots of rules for medial(1)
Too late to receive exam result(8)

Patient's self problem(12)

Don't know how to communicate(4)
Feel tired(7)

Hard to build connection with HCPs(4)

Hard to build connection in such short time(1)
Easy to build connection with HCPs in physical(1)
Want to have a good connection with HCPs(1)
Nurse's attitude is not kind(1)

Friends and relatives(18)

A companion(7)

Emotional support(11)

Codes(346)

Requirement of SCP(35)

Personalized(3)

More communicate with HCPs(12)

Need companion(2)

Have a good relationship with HCPs(5)

More cooperation within HCPs(13)

Peer group(19)

Attitude of peer group(5)

Helpful to train or talk with peers(4)
Peers also give some pressure(1)

Type of peer group(14)

Help find peer(2)
With activity(1)
Personal contact(5)
Peer group community(3)
Workshop(3)

Consultation process(25)

Negative aspects(3)

Lots of information from consultation(1)
Doctor's schedule is tight(3)

Needs of consultation(22)

Record the consultation(7)
Tips for good consultation(11)
Bring the relatives to consultation(2)
Seeking information from HCPs(1)
Want to ask questions(1)

Digital health intervention(189)

Negative aspects(19)

Untrust(4)
Unreliable(3)
Lacking of training(2)
Hard to build relationship(3)
Hard to express emotion(2)
Don't want to discuss negative result on phone(2)
Fear when receiving lost of information online(1)
Annoying receiving reminder from App(1)

Category of DHIs(148)

Get information(15)
Monitor body(9)
Communicate and cooperate(54)
Exercise and intervention(25)
Agenda and schedule(15)
Decision support(2)
Manage data(14)
Improve physical experience(5)

Benefits of DHIs(22)

Digital devices is helpful(9)
Less travel, less energy(4)
More information(3)
Easy to communicate with HCPs(2)
Record the consultation(1)
Do assessment immediately(1)
Personalized service(1)

Condition of patients(42)

Feel tired according to the side effects(12)

Hard to manage the busy schedule and energy(14)

Worry about the body condition(16)

Physical visiting(82)

Negative aspects (47)

Need waiting(32)
Transport wasting(8)
Doctor's schedule is tight(3)
Need companion(2)
Need to same steps(2)

Positive aspects(16)

Detailed examination(2)
More directly guidance(2)
Social connection(11)

Workshop(18)

Education workshop(2)
Making friends(6)
Train with peers(7)
Workshop is helpful(3)
Workshop provides special events(2)

Need support(246)

Physical intervention(39)

Nutrition intervention(32)

Psychological intervention(34)

Need help to manage everything(11)

Information support(112)

Supportive care from HCPs is important(18)

Figure 15 Coding

Hospital	Amsterdam UMC	ANTONI VAN LEEUWENHOEK	ANTONI VAN LEEUWENHOEK	ANTONI VAN LEEUWENHOEK	ANTONI VAN LEEUWENHOEK	ANTONI VAN LEEUWENHOEK
Role	Nurse practitioner	Navigator nurse	Physiotherapist	Dietitian	Social worker	Psychologist
Department	Supportive care team	Centre of quality of life	Centre of quality of life	Centre of quality of life	Centre of quality of life	Centre of quality of life
With toolkit or not	With toolkit	With toolkit	With toolkit	With toolkit	No toolkit	No toolkit
Location	Offline	Online	Offline	Offline	Online	Online

Figure 16 Overview of participants

Figure 17 Meeting with head of the department in AVL)

After three weeks of invitations with different medical staff, the following relevant medical staff were invited successfully to conduct Interviews.

Methods
Interviews were conducted using a semi-structured approach using an interview guide consisting of a set of identified questions (Appendix xx). Some interviews were supported by toolkits to uncover additional and more concealed information. There are three parts of toolkits(Figure 18):
  -A workflow map was designed to help interviews go through the workflow.
  -A communication map helps them rethink whom they are working with within the whole process.
  - The last part is the digital tools map, where they could point out the current and wanted digital tools.

Also, besides the map, patients could use stickers with different colours to describe their feeling. To accommodate the medical staff's schedule, We interviewed using a combination of online and offline methods. In the end, the content was analyzed by transcribing the interviews.

Output
The main outputs of this section are:
1) stakeholder opinions on existing digital touchpoints;
2) more opportunities for DHIs; and
3) interaction process between stakeholders and the digital touchpoints during workflow.

3.1.3 Experts interview

Research aim
The purpose of the interviews with experts is to understand further the application of digital tools in the medical field and understand their views on digital tools and the role of digital tools in future healthcare to support the subsequent future vision design. Besides, we would like to get insight into how to implement innovation in the medical setting.

Participants
The experts from the different fields related to healthcare were invited. They have used digital tools in their work or are conducting related research(Figure 19).

Methods
We set up new interviews with a semi-structured approach to gain insight from experts. Questions were adjusted based on the background and job content of the expert (Appendix X). Expert interviews have no design-related toolkits and are all conducted online. In the end, the transcript of the interviews was analyzed to gather insight.

Output
The main outputs of this section are:
1) the potential to apply some technologies in the health system;
2) some tips for implementing innovation in the health system;
3) the tools used in the current system to help decide care model; and
4) more opportunities for DHIs

Figure 18 Toolkits of interview

Hospital	Maastricht UMC+ Beter door meer kennis	Maastricht UMC+ Beter door meer kennis	Erasmus MC	ANTONI VAN LEEUWENHOEK NEDERLANDS KANKER INSTITUUT
Expert	Expert in innovation process in healthcare	Expert in IT department of Healthcare	Medical student who had experience in consultation	E-health advisor
Interview location	Online	Online	Online	Online
Work experience	>10 years	2-5 years	2-5years	2-5years

Figure 19 Overview of participants

3.2 Patients' experience in SCP

3.2.1 The condition of the patients group

Three main characteristics of the patient groupare defined by coding the online patient's story. The interview's words are in quotation marks.

• **Feel tired according to the side effects**
"I am still very tired after 2 operations and because of the side effects of my medication. But for the time being, I have postponed this (physiotherapy)due to severe fatigue. "

• **Hard to manage the busy schedule and energy**
"I want to enjoy my life as much as possible. It feels nice not to be busy with your illness every moment of the day."
"But the result is that there is hardly any energy left for other things, so I live to work instead of work to live. 1 day less will certainly give me peace. Furthermore, it remains important to guard my boundaries."

• **Worry about the body condition**
"The physical discomfort, the lump I still felt in my right breast, the pain that I had from time to time, the recurring doubts and worries about my recovery chances."

In conclusion, we can see that breast cancer needs supportive care during treatment, and they are concerned about changes in their body and fear about overwhelmed by medical information. However, because of side effects from chemotherapy and surgery, their physical condition is too weak to go through the supportive care process, which affects their access to medical resources. Last but not least, they need people to help them maintain a balance between life, work, and medical schedule. They have limited energy and time since many young breast cancer patients still work to make a living. They needed guidance and help to manage their energy and schedule.

3.2.2 The problems of SCP from research

We got plenty of themes from the process of coding patient history online. This section is from the theme "Problem of SCP". Figure 20 presents the sub-codes in greater detail. These overviews and the previous literature review constitute the patient journey, which becomes the basis for defining the problem.

👤 **Patient's perspective**

• **Wrong intervention(19)**
Patients report that some supportive interventions are ineffective. Health professionals cannot fully understand patients' issues according to insufficient data and lack of communication time. In addition, not all support care is effective for every patient. Sometimes, due to the limitation of knowledge, the patient and the HCPs are unsure how to decide the plan, and they need help making decisions. Lastly, after failing many times, the HCPs-patient relationship and the patient's belief in SCP would be affected.

• **Delay of intervention(65)**
It is the most frequently reported issue. There are two main kinds of reasons. The first relates to the problem of the patient's condition. Their side effects of medical treatments are too onerous to help them go through offline supportive care. Moreover, the patient does not know how to actively express their feelings with HCPs or ask for help. However, more problems are with the medical system. For example, the busy schedule of doctors leads patients to wait for a long time to get an appointment; they do not have enough time during consultations; patients need to do many things to get medical support, like filling out too many questionnaires. All of these issues will result in the delay of interventions.

• **Lack of support(10)**
Patients also reported problems with lack of support: lack of psychological support, lack of information, and lack of follow check-ups. Based on the previous literature review, the first two were in line with patients' most essential needs, and the latter reflected users' needs for communication with HCPs.

• **Hard to build connection with HCPs(4)**
Patients need to maintain a good relationship with HCPs. At the same time, the attitude of health professionals is critical; patients need to be treated as persons, not as sick persons. They also believe it is challenging to build good relationships with physicians during short consultations.
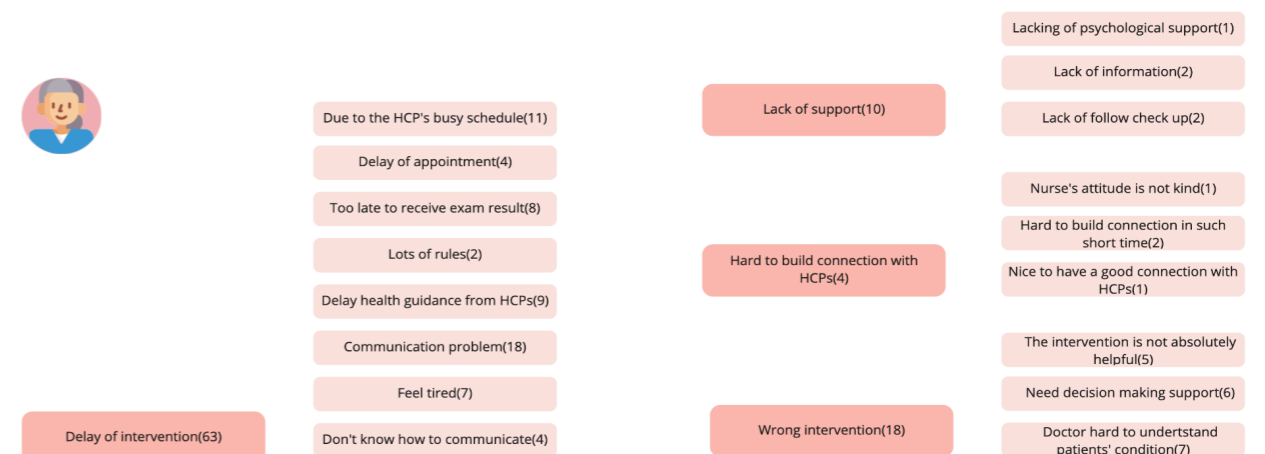

		Lacking of psychological support(1)
		Lack of information(2)
	Lack of support(10)	Lack of follow check up(2)
Due to the HCP's busy schedule(11)		
Delay of appointment(4)		Nurse's attitude is not kind(1)
Too late to receive exam result(8)		Hard to build connection in such short time(2)
Lots of rules(2)	Hard to build connection with HCPs(4)	Nice to have a good connection with HCPs(1)
Delay health guidance from HCPs(9)		
Communication problem(18)		The intervention is not absolutely helpful(5)
Feel tired(7)	Wrong intervention(18)	Need decision making support(6)
Delay of intervention(63)	Don't know how to communicate(4)	Doctor hard to undertstand patients' condition(7)

Figure 20 More details codes from patients

3.2.3 Patients journey map

We developed a patient journey map for combining all the information from the user research process. This map aims to identify how patients' emotions changed during the whole journey and where are the opportunities for intervening.

The timeline is divided into three parts: before the first consultation, during the consultation and follows up care. We mainly selected 5 elements for building the journey and will introduce them here:

Location: The main scenes are divided into hospital and home. Because the main scenario of digital care is at home, We think it is marked in the user journey to know which interventions are digital quickly.

Patient action: the most critical activities are performed by the patient at this point.

Patient emotion: The most crucial part of this patient's journey is that green means the patient's mood is positive, and red means that the patient's emotion is negative. We used different emojis to express moods and explained them with text next to them.

Patients quote or literature review: Here is the most representative quote related to emotional changes in online stories or the critical insight from the literature review. We hope that readers can quickly understand the emotions of users in this way.

Opportunities: Based on changes in patients' emotions, we summarized the opportunity points to support subsequent design interventions.
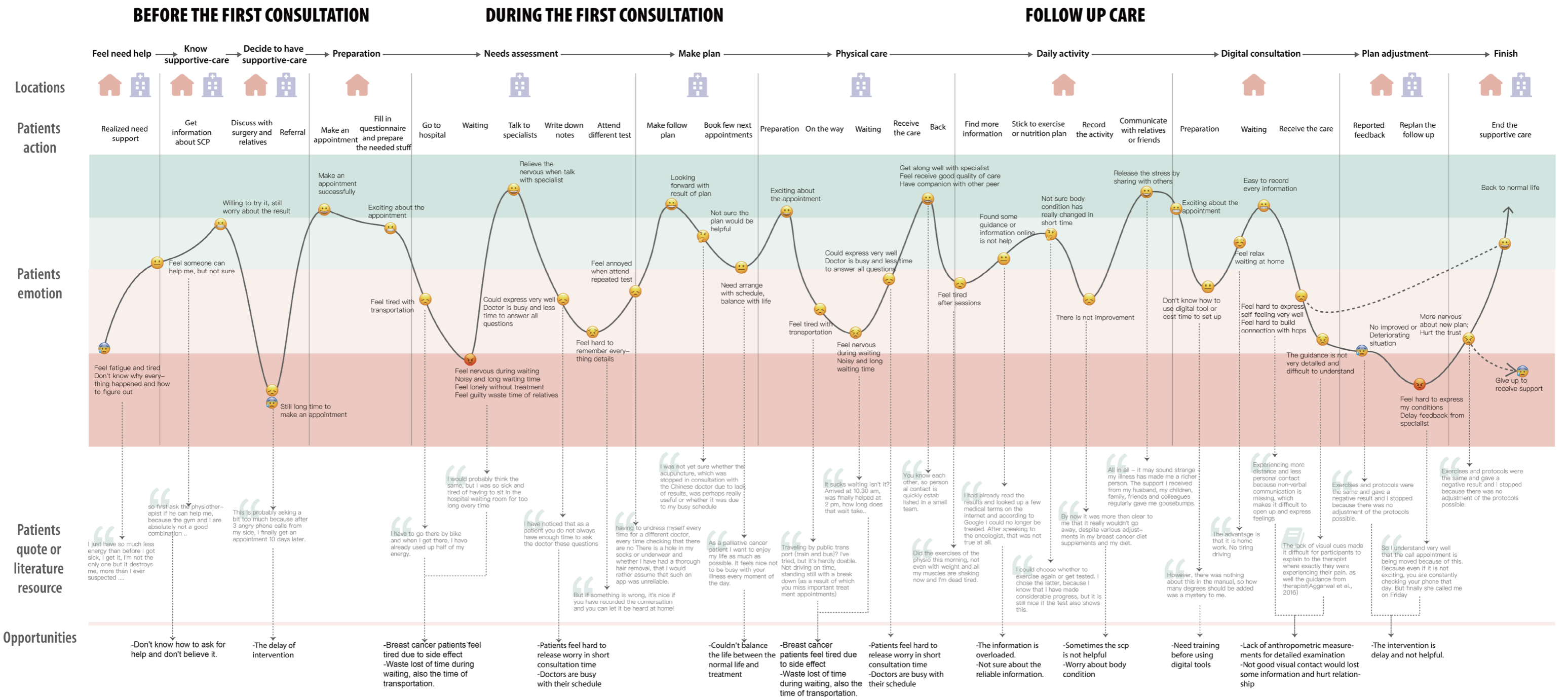
Figure 21 Patient journey

3.2.4 Take away from patients journey map

It can be seen from the patient journey that the emotional changes of patients during the whole process are very complex. Moreover, there are plenty of factors that can affect emotional changes. The most significant factor which may be perceived as positively affecting mood is a rapid and effective intervention. For negative mood-affecting factors, we divided them into four categories according to the type of cause. We also distinguish the opportunities on the map by colour, which will be explained separately below..

● Here is mainly the problem of the SCP system. Due to the delay and ineffectiveness of the intervention, the patient's problem becomes more serious, which affects their own experience. Alternatively, in consultation, they cannot get enough support due to tight time. These are also the factors that have the most significant impact on the patients' mood.

● These are related to the problem of the patients themselves. They tend to become tired after long hours of traffic or long time offline treatment due to the side effects of the treatment. Moreover, they feel nervous due to the inability to balance treatment with personal life. The use of more DHIs in a system can ameliorate these problems.

● It is a problem in offline medical treatment. Much time is wasted on traffic and waiting. It is easy for patients to become more tired or restless while waiting. On the one hand, we could involve more DHIs. On the other hand, we could improve the physical experience to solve this problem.

● Moreover, the unperfect digital experience also negatively affects their emotions, including not knowing how to use it, being unable to perform a specific intervention, and distrusting online information. In the next part, we will look at how to improve the DHIs' experience
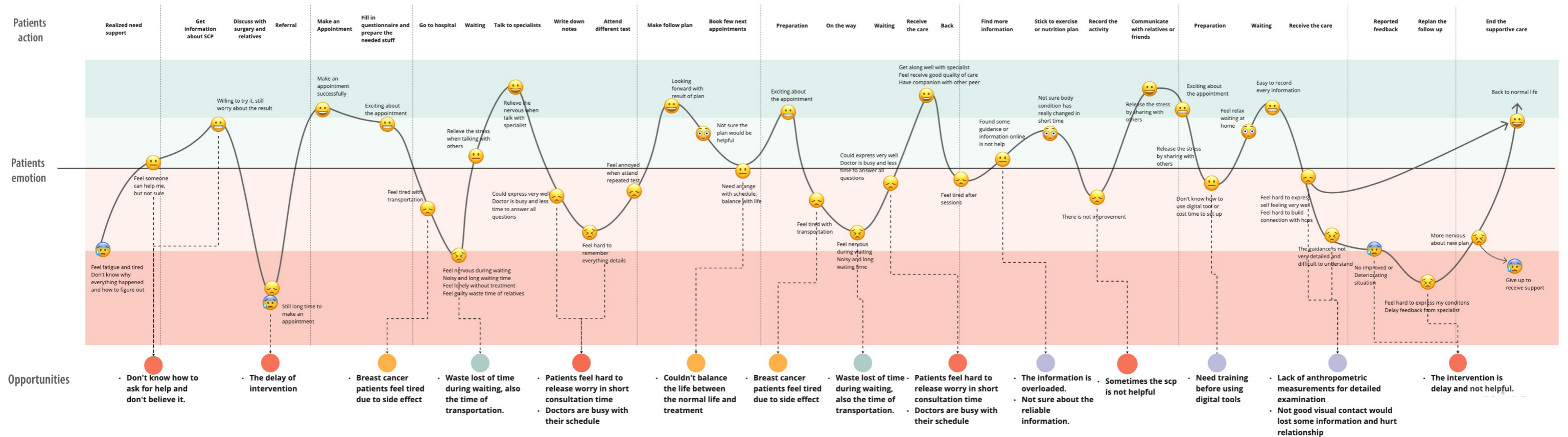
3.3 Digital health intervention experience

3.3.1 Current digital touchpoints in SCP

According to user research, eight categories of DHIs that patients current used were divided.
-Get information(15)
-Monitor body(9)
-Communicate and cooperate(54)
-Exercise and intervention(25)
-Agenda and schedule(15)
-Decision support(2)
-Manage data(14)
-Improve physical experience(5)

Not every patient will use all DHIs, and this map only depicts the existing touchpoints during the patient journey(Figure 23). Green is for digital care, and purple is for physical care. The longer the line, the more it works during the whole journey. The current digital touchpoints map would be the basis for finding more opportunities for DHIs.

3.3.2 The attitudes of DHIs

In chapter one, we have generally introduced the benefits and drawbacks of DHIs. In this part, we still discuss the problem of DHIs, but for more specific DHIs. During the in-depth research, we have gathered the insights from the perspectives of literature, patients, experts, and medical staff, hoping to gain a more systematic understanding.

Literature review
We analyzed the drawbacks of DHIs (Figure 22) from three types of interventions, in line with the context of supportive care. For example, non-verbal communication is missing for online physiotherapy, which makes it challenging to open up and express feelings; for information support online information sites vary in terms of their quality and wrong information would increase patients' fear (Sillence et al., 2007). These more specific drawbacks would guide improving the patients experience under different supports.

Physical daily living	Nutrition	1. Lack of anthropometric measurements 2. Interpersonal or communication difficulties 3. Difficulties stemming from conducting the session in the home environment(Kaufman-Shriqui et al., 2021)
	Physiotherpy	1. Experiencing more distance and less personal contact because non-verbal communication is missing, which makes it difficult to open up and express feelings 2. No travel time means less time to reflect, prepare and let go before and after a session 3. Missing support from colleagues to reflect and let go and being more exhausted at the end of the day(Lee & Schellekens, 2020)
	Psychology	1. The lack of visual cues made it difficult for participants to explain to the therapist where exactly they were experiencing their pain. as well the guidance from therapist(Aggarwal et al., 2016)
	Health system and information	1. Information online sites vary in terms of their quality 2. health professional feels threatened by the information the patient brings and responds defensively by asserting their 'expert opinion' (health professional-centred relationship) 3. Patients feel fear about the overload information or wrong information(Sillence et al., 2007)

Figure 22 More specific drawback of current DHI(literature review)

Figure 23 The current digital touchpoints map

🧑 Patient's perspective

Figure 24 shows the patients' perspectives on DHIs. For breast cancer patients, the benefits of DHIs to patients are less travel and fewer energy costs. They can provide more information in response to patient information needs. The digital system can help them communicate with doctors and report their physical conditions on time. These are the same as finding from the literature review. Luckily, we got some new findings. Some digital tools could help them record the consultation process for later reviewing or sharing the information with relatives. And some applications may save the review for a future exam and make a quick evaluation through the AI system. In addition, DHIs could help with a personalised support service.

On the other hand, with DHIs, patients also expressed their distrust. Some patients cannot use the DHIs due to a lack of training. In terms of new findings, they think it is difficult to express their emotions in online communication. They don't like talking about negative results on the phone, where they need more emotional support. In addition, they will feel fear when receiving loss of information online and annoyed by receiving a reminder from APP. We'll focus on the negative aspects, which will become our design opportunities.

🧑 HCP's perspective

The attitude of HCPs is generally positive. They believe that offline will become dominant, and online is just a form of support. Different people have slightly different attitudes toward them. Dietitians thought their current workflow could have more online consultations, while physiotherapists felt that online video consultation was more challenging for physiotherapy due to a lack of non-verbal information.

Also, HCPs defined new digital opportunities. This insight is based on practical experience and should be taken into consideration.

Patients file
-Different programs for different specialists
-More data should be involved in the patient's file
-Let HCPs know what has been discussed before in patients' file

Online information
-Provide more digital sheet
-Provide digital video about the treatment

Online session
-Patients need to review the session
-Training apps for personalized service

Connect with other hospitals
-Better to contact other medical institutions

Diary record
-Patient could write an online diary, and HCPs could check it

E-learning
-Patients could learn the course by themselves online and specialist only give the feedback

🧑 Experts's perspective

Compared with HCPs, experts' insights will be more forward-looking, no longer limited to existing workflows. For example, IT experts talked a lot about AI systems, medical students who focused on VR, and more about visualizing the information during the consultation. These talks provide much inspiration to define a future vision. In the next section, we will describe the new insight from experts.

Advantages of DHIs

-Easy changed in different consultation

There is no need to clean the room for future patients during the online consultation for physicians. They need to hold the consultation line and go straight to the following line once it is done and closed. Physicians can quickly switch between different consultations and save lots of time for HCPs.

-Easy to record the consultation for patients get all information

Patients always forget Half of the information from consultation because it is too new and overwhelming to remember. That could be a huge benefit of digital consultations. Because if patients can record a lot of the information, they can watch it again when they calm down or want to understand things better.

Disadvantages of DHIs

-Easy to talk about emotional problems physically

It is easier for patients to talk about emotions, problems or fears when they are in the presence of someone.

-Hard to explain online

It can be harder to explain things online when losing non-verbal information. It is easier for people to talk face to face and are together in the same room.

-Not physical examination

Patients have to come to the hospital because they need physical examinations, which cannot be held at home.

-The current DHIs are not integrated well

Many DHIs have been implemented, like information files, collaboration platforms, and decision support. However, it is not integrated well, which affects the experience negatively.

-Difficult to learn and training

Physicians are more comfortable sitting behind their desks when the patient arrives. They only need to talk, which is much easier than learning how to use a digital system and set up a video consultation.

Opportunities

-AI can support doctors in making a decision

IT experts believe AI will play a massive role in supporting doctors and patients in their decisions. Now there is too much to know as a doctor who could not also make the right decision. Thus, AI would help them and give them the advice to decide on the future.

-Patients ask their questions

Patients can only ask questions by phone call or in the personal portal in the existing system. The former will decrease the doctor's work efficiency, and the latter may not get a quick response. So there needs to be a new tool where patients ask questions online and get an answer immediately

-Patients could make the appointment by self

Patients can now only make appointments with physicians by telephone, led by medical staff. If patients could schedule their appointments, they would better manage their schedules.

Same as literature review	😊 Positive aspects	😣 Negative aspects
	Digital devices is helpful	Untrust
	Less travel, less energy	Unreliable
	More information	Lacking of training
	Easy to communicate with HCPs	
New finding	Record the consultation	Hard to build relationship
	Do assessment immediately	Hard to express emotion
	Personalized service	Don't want to discuss negative result on phone
		Fear when receiving lost of information online
		Annoying receiving reminder from App

Figure 24
The drawback of current touch points(User sides)

-Visualization in the consultation room

During the consultation, there are lots of medical information, which is hard for patients to understand. So visual tools are needed to help doctors educate patients and improve consultation efficiency.

3.3.3 Strategy for developing DHIs

The drawbacks of DHIs from different perspectives are on the left side of Figure 25. We will focus on the red one. Based on the interview and literature review, the right sides are the strategies we proposed for developing DHIs in the SCP. These would provide design direction for the brainstorming in DEVELOP phrase. The detailed explanation for strategy is as follows:

• **Give more information to the doctor besides a single view of the patient's space or virtual.**
To allow HCPs to obtain more clues to decide to do, we can provide physicians with more visualized patient information through screen interaction. It could be reached by the data from patients' files or wearable technology. As these technologies provide information in the form of abstract visualization, the patient's privacy can also be safeguarded.

• **Design according to the specific needs of specialists and patient**
For each specialist, each patient, their information needs during the consultation and the healthcare services are different. So we need to personalize different services for different care services. We need to tailor different interfaces to different sides, even for online consultation.

• **Ensure it simulates a face-to-face consultation, such as expanding time sequence, to keep a good connection**
A good relationship between the HCPs and the user is conducive to the progress of the treatment. In order to help them build a good relationship online, digital therapy should simulate traditional treatment as much as possible and increase the way of interacting with HCPs.

• **Guide patients to reliable and accurate health resources, such as information resource**
Patients feel unreliable as a result of the unreliable DHI resource. HCPs can guide patients to understand and find reliable resources to enhance the sense of trust. At the same time, the hospital system can also start to build such resources on its own.

• **The DHIs should be integrated into the health system**
Developing a DHI should integrate with the current system and other DHIs well. It allows HCPs to use and familiarize innovations within a short period and create a seamless experience for HCPs and patients.

• **The support for HCPs is as essential as developing DHIs**
In addition to developing this, it is also essential to support HCPs and patients during adaptation. Not just a training course but also timely support, which is conducive to improving HCPs and patient acceptance of new DHIs.
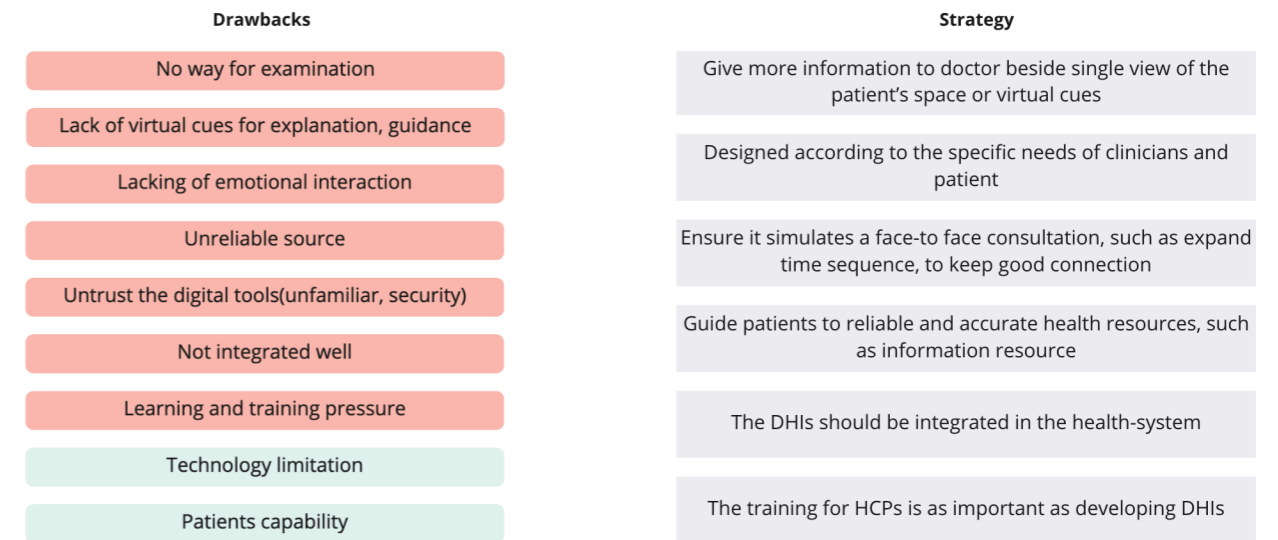

Figure 25 Drawbacks and developing strategy for DHIs

3.3.4 Current tools for deciding care model

These tools have been used in Mumc. We Maastricht UMC+ have used the tools to help decide whether to provide digital care or not. We got the picture and content from the interview with the experts who worked there. In practice, only the Dutch version is used(Figure 26). We translated the English version on the right.

Toolkits are made up of two parts. Firstly, the questionnaire helps medical staff estimate patients' digital capacity (Figure 27). After that, three types of patients would be divided: beginner, reasonably proficient, and advanced users (Figure 28). Based on this, the medical staff could use the second tool, which references how to choose the digital tools.
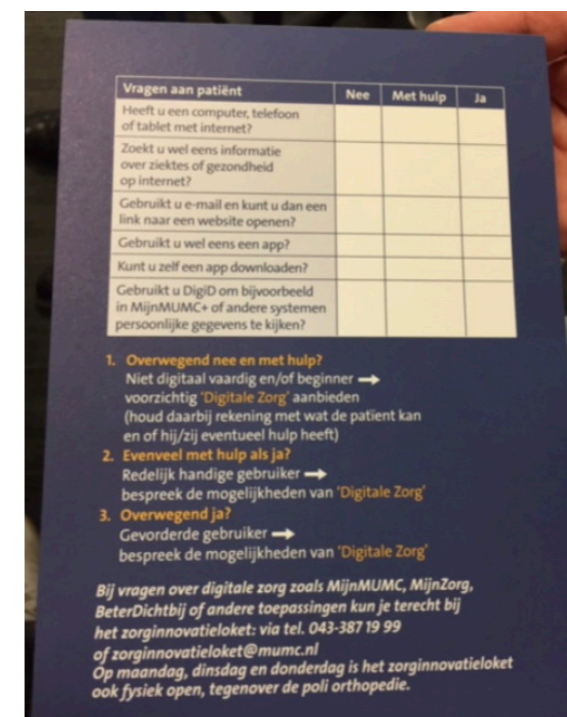

Figure 26 The tooklits used in hospital(Dutch)

There are some obvious disadvantages of toolkits. Firstly, these toolkits only divide patients according to their digital capacity and resources. Gilbert has developed the model which told us the preferred to choose the digital tools have affected by multi-factors: 1) Situation of care; 2) Expectations of care; 3) Demands on the patient: care requirements, social demands, and consequence of choice; 4) Capacity to allocate resources to care (Gilbert etal., 2021). As for this, the first shortage of these toolkits is that the factors considered are too singular to support the physician in making an accurate decision.

Secondly, the card for helping medical staff make decisions is too complex. It has the

risk of making the consultation process less efficient. At the same time, there are more opportunities of DHIs in supportive care, not just informational support, online intervention, and schedule.

This toolkit tells us that medical staff have realized that it is necessary to provide the proper care model for the right patient. However, their current toolkits are not helpful enough, and there is much room for improvement, which can be our design opportunity.

	No	With help	Yes
1. Do you own a computer, telephone or tablet with internet?			
2. Do you ever search for information about diseases or health on the internet?			
3. Do you use email and can you then open a link to a website?			
4. Do you ever use an app?			
5. Are you able to download an app by yourself?			
6. Do you ever use Digital to view personal information in MijnMUMC+ or other systems?			

The answers lead to three possible advices to the medical professional:
1. Predominantly "No" or "With help" -> Not digitally proficient and/or beginner -> Carefully offer digital care (consider what the patient is capable of and possibly needs help with)
2. Equal number of "With help" as "Yes" -> Fairly proficient user -> Discuss the possibilities of digital care
3. Predominantly "Yes" -> Advanced user -> Discuss the possibilities of digital care

Figure 27 Toolkits: questionnaire for assess patients digital capability

	Not digitally proficient and/or beginner	Fairly proficient user	Advanced user
The patient can read information and educational materials through the internet	View information on the internet or You Tube with others	After advice, can find information independently. Provide direct links to trustworthy websites.	Can find information indpendently, including more complex information.
The patient can use and apply apps and online interventions	Only with intensive help and guidance.	After advice, can use apps and interventions independently. Provide direct links to the intended app or online intervention.	Can use apps and interventions independently. Possibly provide general advice about available apps or interventions.
The patient can make or request appointments digitally	Probably not or only with intensive help.	Can do this independently after explanation.	Can make digital care appointments independently or work with a personal online file, such as MijnMUMC+.

Figure 28 Toolkits: card for HCPs make the decision

3.4 Stakeholder interaction

3.4.1 Introduction of stakeholders

Based on the information from the previous report and AVL's "supportive care team" information, a stakeholder map could be formulated for the supportive care process in Figure 29. Lines indicate contact between one stakeholder and another. Only essential connections are specified in the case of a stakeholder with many employees, such as the hospitalfied. First and foremost, this stakeholder map illustrates the number of different peoplem the patients would meet during the supportive care process. Second, we wanted to focus on the stakeholders in the supportive care centre, the red line on the map, since the project aims to figure out the workflow in the supportive care system. The other stakeholder, such as the general practitioner, and caregiver at home, would be not focused. The following section will briefly describe the current roles of the stakeholders with the red line.

3.4.2 Stakeholders role

Patient

Patients are the centre of this healthcare system. The patient receives care from all the healthcare providers. They can reach the health providers by themselves or referrals to visit other healthcare providers. HCPs only give suggestions, but patients make their own decisions in the end. In addition, they are expected to take on some responsibilities themselves in the care process, such as preparing consultations. Finally, every effort aims to improve the life of the patient.

Nurse navigator

Generally, a Navigator nurse is the beginning of SCP. They give the support by consultation. A Navigator nurse can provide information and advice applicable to patients' situations during a consultation. Also, the navigator nurse can

refer patients to a paramedical or psychosocial care provider at the Supportive care Center or a local care provider.

Dietetics

The dietetics department aims to prevent and treat nutrition and food issues caused by patients' illness or treatment. They automatically get into the care plan when patients are in a worse situation. Also, patients could reach them by referral from a physician or nurse.

Physiotherapy

During patients' stay at the hospital, the physical therapist will regularly discuss their progress with the specialists. If not admitted to the hospital, patients still can request treatment from a physical therapist.

The therapist will assess patients' problems or the risk of developing problems before, during and after treatment. The treatment may consist of education and information, advice, oedema physical therapy, or referral to a specialized physical therapist in the local area.

Psychology

Suppose patients are experiencing psychological problems that are related to their illness, such as depression, anxiety, panic, trauma, or problems in the relationship or with the sexuality. The psychologist can help them find a way to alleviate the symptoms and learn to manage their emotions. Also, the sexologist can map out complex sexual problems and can offer brief treatment. Patients could reach a psychologist by the physician, hospital psychiatrist, or medical social worker.

Medical social work

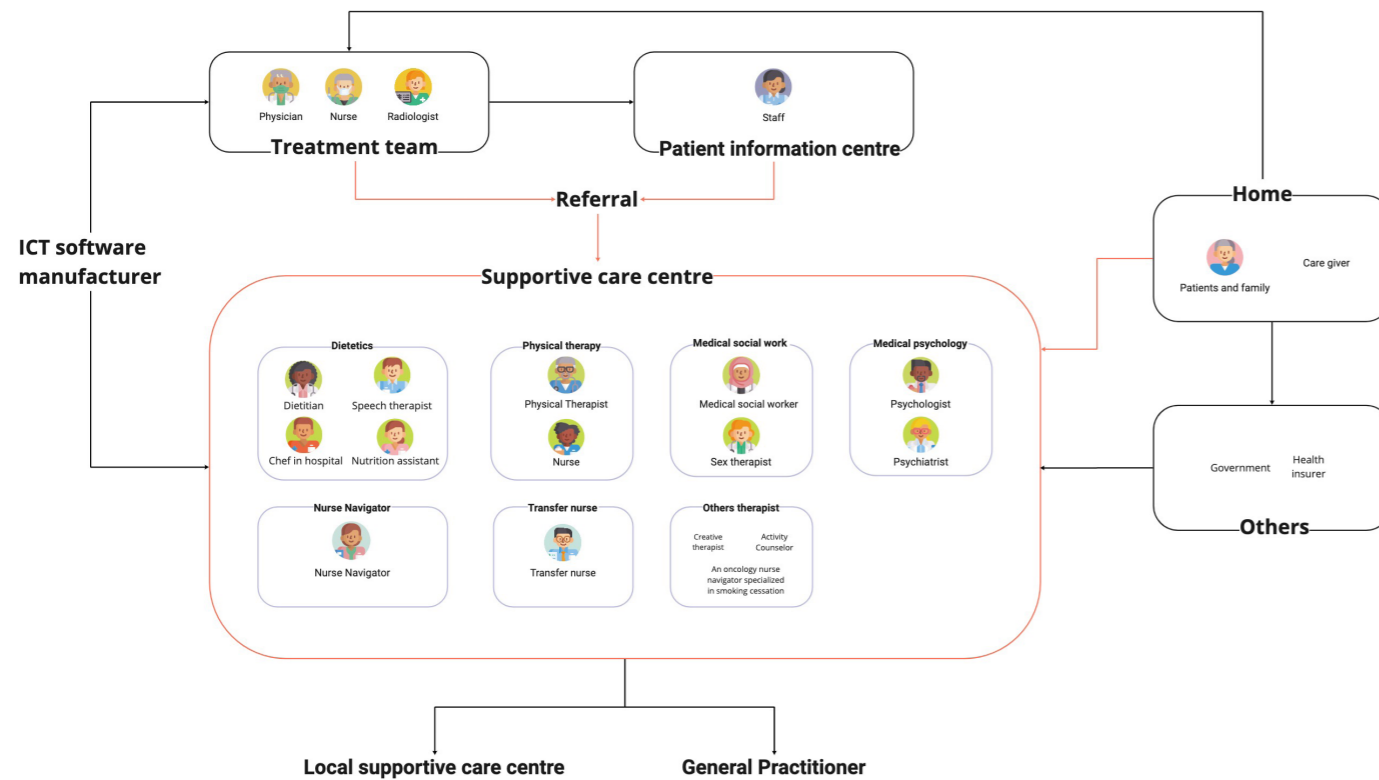Our medical social worker will help patients search for something that can best help

Figure 29 Stakeholder map

them restore balance in the life, such as the consequences of the illness and treatment and how to fit them into life, going back to work and all related concerns, rehabilitation. Also, the medical social worker can refer patients to a rehabilitation physician or program if they believe patients need it.

Treatment team

When physicians find that a patient needs supportive care, they can refer the patient to the appropriate department. At the same time, it provides information about patients for medical staff in the support care centre.

Transfer nurse

Transfer nurses help patients or their families arrange the care after discharge.

Patients information centre

The Patient Information Center is often the primary information point for patients. They can provide reliable information about the condition, the support available to patients, and other practical information. Besides, they assist patients with questions about the personal patient portal or other digital problems.

Other therapist

In addition to the above therapies, art therapy, smoking cessation clinic, and others also help patients go through cancer treatment.

3.4.3 Workflow map

The workflow has been mapped(Figure 30). As well, the DHIs used in the workflow have been pointed out. Different colours represent different stakeholders: green represents medical staff from SCP, while yellow represents staff in cancer treatment. Colored solid lines represent their work throughout the supportive care process, and the dashed lines represent the interactions between different stakeholders. This workflow is just a general one, aims to help us better understand the current SCP, to ensure that the innovation is in line with the existing workflow as much as possible, which helps for implementation. We will give the suggestion to current workflow after the future patient journey is proposed.

3.4.4 Problem of workflow

In previous research, we have collected patients with problems with existing SCP. It can be seen that patients' views are more focused on their own experiences. Here, we presented the workflow problem in SCP from the stakeholder's opinion. These different perspectives contribute to our systematic understanding of SCP and future design. Also, the details codes and quotas could check in Appendix X.

Most frequented used DHIs in workflow

Electronic patient file (EPD)
This patient file is not only the record of patient data but more about an integrated platform whereby all processes seamlessly unite in a single workflow, such as file management, workflow management, care logistics, E-health, and financial administration that always stands at the start of the life cycle. Each medical institution chooses a different system, which creates data barriers.
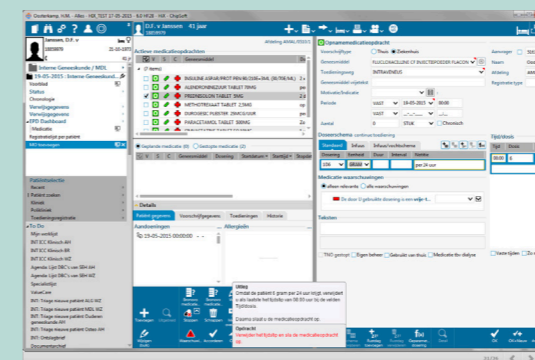

Online consultation tools
Some hospitals have established a special video consultation, and patients can open the link through the web page without installing software. However, the user experience of this software is not as good as the popular online consultation software, such as teams zoom. Some physicians are more likely to have an online meeting by teams.

Online therapy
Hospital has invested in some online therapies for giving support to patients. Also, the 'EVA– Online program in AVL provides valuable tips and information for young women with menopausal symptoms. Patients can ask their attending HCPs for a referral to this.
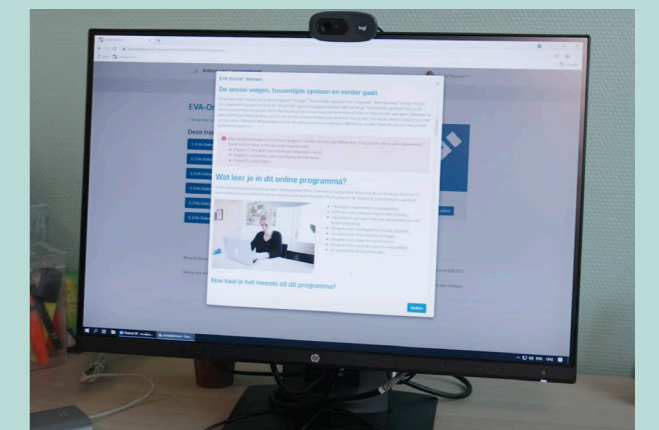
Other digital tools
Besides these commonly used tools, the various specialists also have their websites and information. For example, include pharmacological queries cal calculation program. Meanwhile, they will also upload some videos on their youtube channel for patients to learn the medical information.

Workflow

- **Better when HCPs/patients could prepare**

Before starting a consultation, healthcare professionals will learn about the user's condition and the overall problem by examining the patient files. Before parting of the treatment, they will send the patient questionnaire in advance to further evaluate the patient's condition. However, some HCPs reported that some patients would not fill out the questionnaires, which led them to use the consultation time to fill them out. Some patients did not understand why they were doing consultations, and they did not prepare for the consultations. These all affect the effectiveness and efficiency of the consultation.

- **Couldn't make sure patients followed the advice**

The purpose of the current SCP is to provide advice to patients or their physicians rather than asking them to do something that has to be done before. So there is no way to monitor whether the patient sticks to the advice or not.

- **Low-efficient collobration between stakeholders**

Stakeholder cooperation methods mainly communicate through patients' files, phones, and email. These are feasible for HCPs in the same institutions. However, due to the patient's preference, HCPs need to cooperate with external HCPs, and these exchanges and cooperation require much energy. In different medical systems, the collaboration between stakeholders varies: some have regular meetings between the all involved stakeholders, while others only have one or two stakeholders in the meeting. To formulate better care plans, HCPs report that more specialists need to cooperate, and more stakeholders should attend the MDO(Multidisciplinary overleg).

Too busy to manage everything

HCPs have too many patients everything. Besides having a consultation with patients, they must make notes in the EHR system or write an email. There are many patients every day; it is difficult for them to make their administration and deal with this clutter.

Figure 30 Workflow
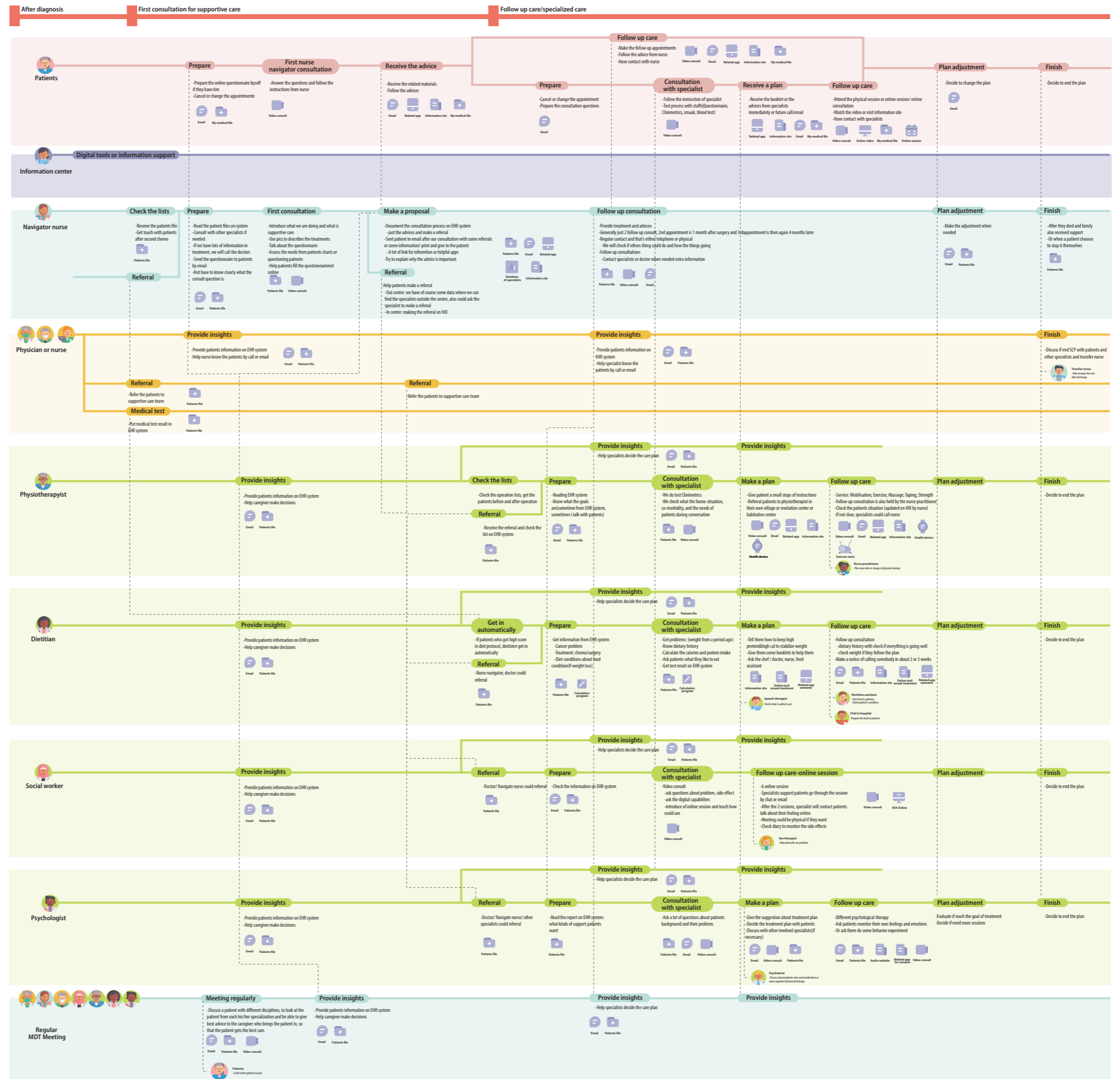
Chapter conclusion

Take away:

•   **Delay of intervention is the biggest problem from the patient's side.**
From the interviews with patients, we know that delay of intervention is the biggest problem that patients think of SCP, which may be caused by the characteristics of the patients themselves, but more of a problem with the medical system.

•   **There are lots of DHIs opportunities in the supportive care process.**
From the perspectives of users, experts, and doctors, we have known a lot of room for improvement and design opportunities for existing DHIs. At the same time, we may need to refer to their opposing views on existing SCPs to discover more possibilities.

•   **The toolkits to help decide to choose a care model need to be improved.**
Medical staff have realized that it is necessary to provide the proper care model for the right patient. But the current toolkits have a lot of room for improvement. We can considerably improve it by referring to the preference model from Gilbert.

•   **Large varieties in stakeholder relations and roles make the stakeholder complex.**
The relationship between stakeholders is particularly complex. When necessary, they can refer to each other and communicate with each other. Besides, HCPs believe that more stakeholders are required to participate, making the whole system more complicated.

4

Define

In this chapter, the main insights were clustered as a conclusion from previous research. After that, the problem and future vision were defined. Based on these, the design goals and requirements were stated as the starting points of the following design part.

4.1 Main insights

Main challenges

Combing with all studies above, we could frame these main challenges:

•   Breast cancer patients may not be able to follow the current support plan because their body condition was negatively affected by treatment side effects. And the existing supportive care is offline, which takes time and energy for the patient. As a result, it becomes more challenging to balance work and medical treatment for patients and access care quickly.

•   Patients have varying preferences in physical and digital care. Digital care is not suitable for all patients or all phases of treatment, as is physical care.

•   Offline care prevents HCPs from providing high-quality services to their patients and resolving issues within tight timelines. Too many patients are waiting to be supported, but medical resources are insufficient. It also leads to their inability to make a quick and effective response, making the patient's symptoms worse.

•   Current digital care tools do not fully meet the needs of patients, such as online consultations that lack anthropometric measurements and non-verbal contact, which can lose information and harm relationships between patients and HCPs.

•   Some digital tools have been implemented, like patient files, consultation tools, and information sites. But it is not integrated well, which affects the experience negatively.

Delay intervention

Physical care is not always good

Various preference for care model

Busy schedule of doctors

Digital tools needed to be improved

Help HCPs provide right care at the right time

Main opportunities

•   AI can analyze big data sets – pulling together patient insights and leading to predictive analysis. AI innovations in healthcare do not substitute doctors but support doctors and patients in their decisions.

•   Even though the current healthcare system already has some DHIs, we have identified many opportunities to improve the user experience. It is not just a matter of improving the existing experience but also introducing more DHIs and even using digital tools to improve the physical experience.

•   There is a toolkit for assessing patients' digital capability and helping medical staff decide. We could know that the healthcare system has realized that it is necessary to provide the right care model for the right patient. However, the current toolkits have much room for improvement.

AI could support HCPs

More opportunities for involve DHIs

Improve the current decision making tools

Involve more DHIs to release the pressure of the current system

4.2 Problem framing

Offline-oriented supportive care does not always helpful to every patient, and it has increased pressure on health systems, leading to delays and insufficient supportive care。

4.3 Future vision

Only by providing patients with digital care that is in line with their situation can the current pressure of the system be relieved, and timely, adequate and effective supportive care be provided to patients.

Since not everyone needs to receive physical care, we can provide more digital care with high quality for them. More digital health interventions would involve reducing the offline part of supportive care and releasing the pressure on the current medical system. Moreover, the patients who need physical care could get access quickly.

Also, since the medical condition of each patient and their personal preferences for physical or digital care differ, a support system would be provided for HCPs. It allows them to make the right decisions: when to provide patients with the type of care they want. Besides, this system could help integrate all digital care. In this way, doctors can know which kinds of DHIs could be used and obtain more information from patients using history to help make better decisions.

"
The more we could do digitally the more advantages. It has generally so for us patients who we can have digital consultations with.
Means fewer patients who have to come to the hospital, which is nice. And they use up fewer consultation rooms and you know anything like that, so that's an advantage.
"

------The IT expert in healthcare

4.3 Design goals and design requirements

Under such a future vision, two problems need to be solved, the first is how to provide the correct care for patients, and the second is what kind of digital care would be involved in the supportive care context. These two issues have also become the two design goals of our project.

First design goal:
I want to develop a supporting system that helps HCPs assess the patients' situation, provide them with appropriate digital care at the right time, and reduce the pressure on the health system to optimize the delivery of supportive care.

Design requirements:
Aim
- It could increase the patient's well-being
- It could decrease the pressure on the current supportive care system
- It could help HCPs to choose the care model for patients

Feasibility
- It could be integrated with workflows well
- It could be in line with the trend in technology

Design deliverables requirements:
- It describes the future vision clearly
- It describes the way in which AI support systems integrate into a future vision
- It describes the road to reach the future vision

Second design goal:
I want to enhance digital health interventions to reduce the pressure of physical care in hospitals and optimize their experience.

Design requirements:
Aim
- It could fit the requirement of different supportive care
- It could support patients for self-management
- It could improve the quality of life of the patient
- It could help patients get access to care quickly
- It could allow the more stakeholder to communicate with each other

Feasibility
- It could be integrated with workflows well
- It could be in line with the trend in technology

Design deliverables requirements
- It describes the strategy to improve the DHIs
- It points out the opportunities to involve more DHIs

5

Develop

This chapter talks about the design process, and the first concept from brainstorming was presented here. After that, an iteration process with input from stakeholders and experts was followed. We will introduce the final concept in the next chapter.

5.1 Ideation

Based on the design requirements, we design a future patient journey to reflect the future vision and the kinds of DHIs opportunities there (the two design goals). We conducted multiple iterations to optimize the concept for achieving both design goals. Figure 31 shows the overview of the ideation process. The concept was explained in meetings with various stakeholders with a corresponding visual document. Feedback is received and used to improve the concept. In the end, all the different iterative steps lead to the final concept. We would describe the process step by step.
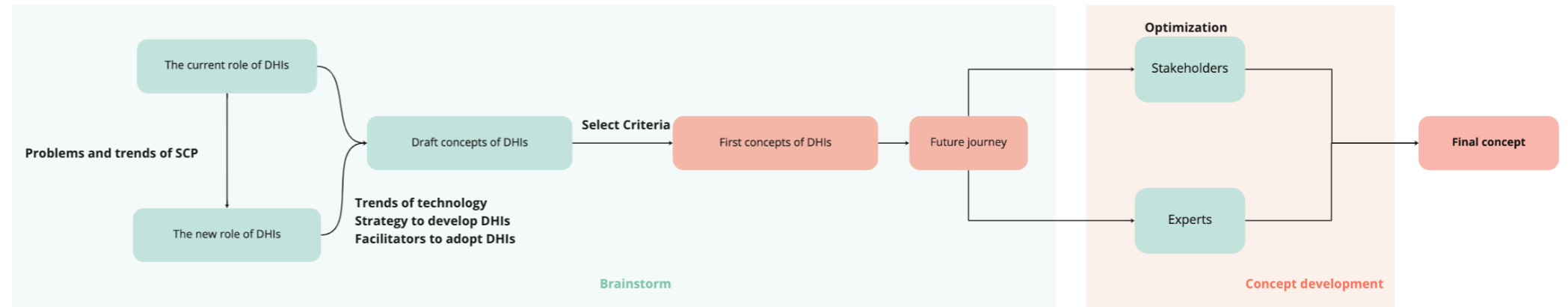
Figure 31 Ideation approach

5.1.1 Brainstorm

Based on the design goals and the findings of problems and trends, a brainstorming section was conducted to explore ideas for two kinds of design goal (Figure 32). After that, we selected the ideas to combine the future patient journey by following the below criteria.

Criteria developed from previous design requirements were set to select ideas:
• The ideas could reach the design requirements and design deliverables requirements.

5.1.2 Design ideas

Finally, the concepts was chosen. Figure 33 shows a drawing of all selected ideas. These design ideas are intergated with AI system.
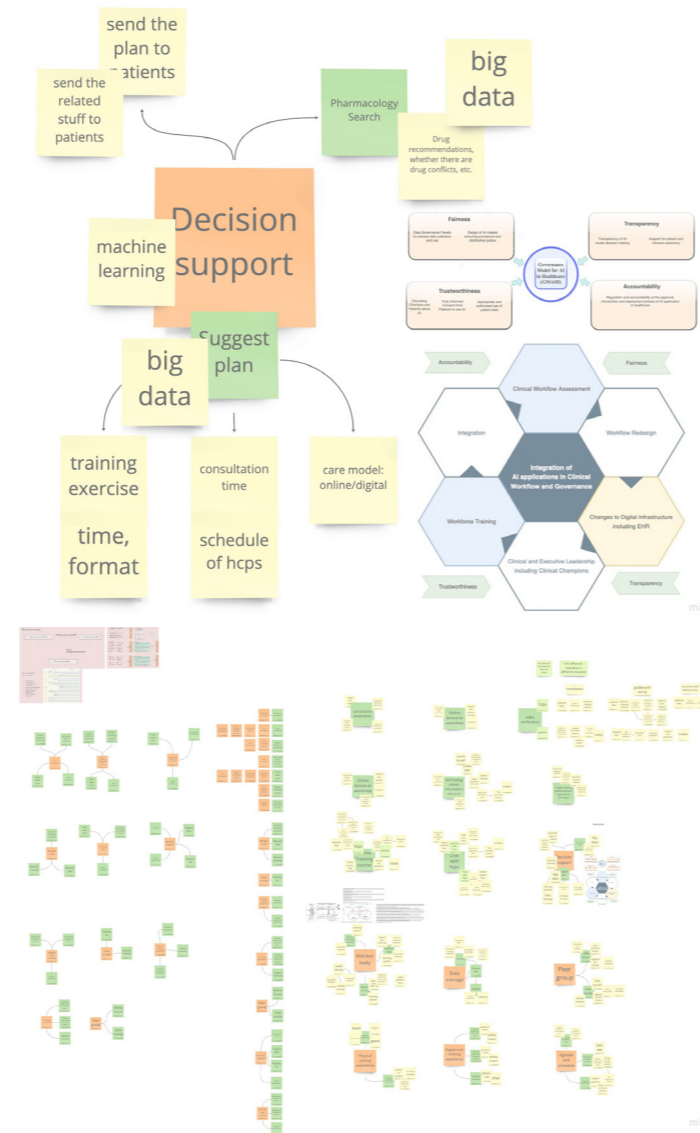
5.1.3 First future patients journey

The future journey map in Figure 34 was defined as an overview to show how these DHIs could be engaged in the future.
The pink represent digital interventions in the physical environment, the green one is for digital care, and the purple represents digital tools in backstage.
Also, we put the evaluation result here to show how we going to develop it.

Brain storm process

Future journey mapping process

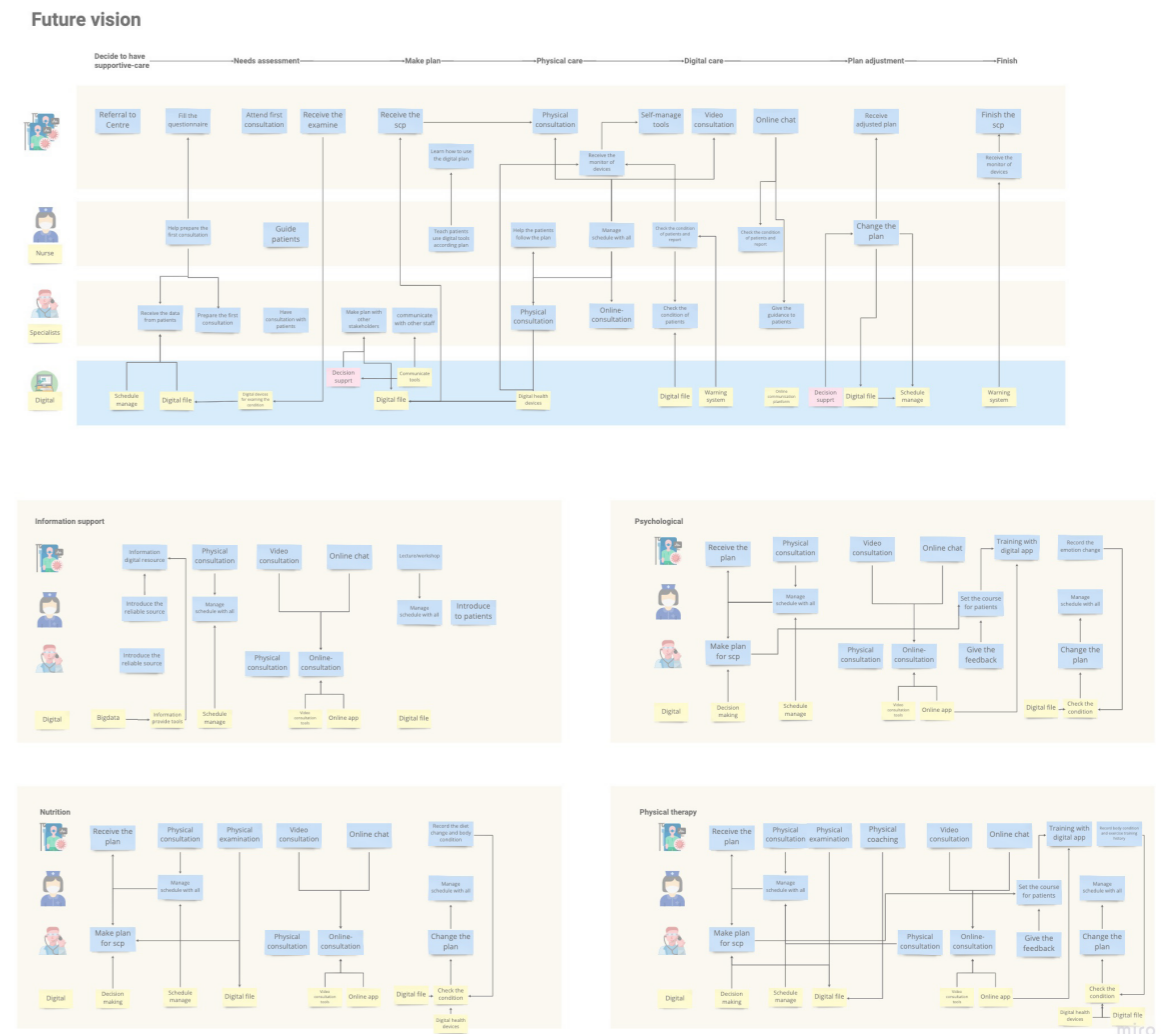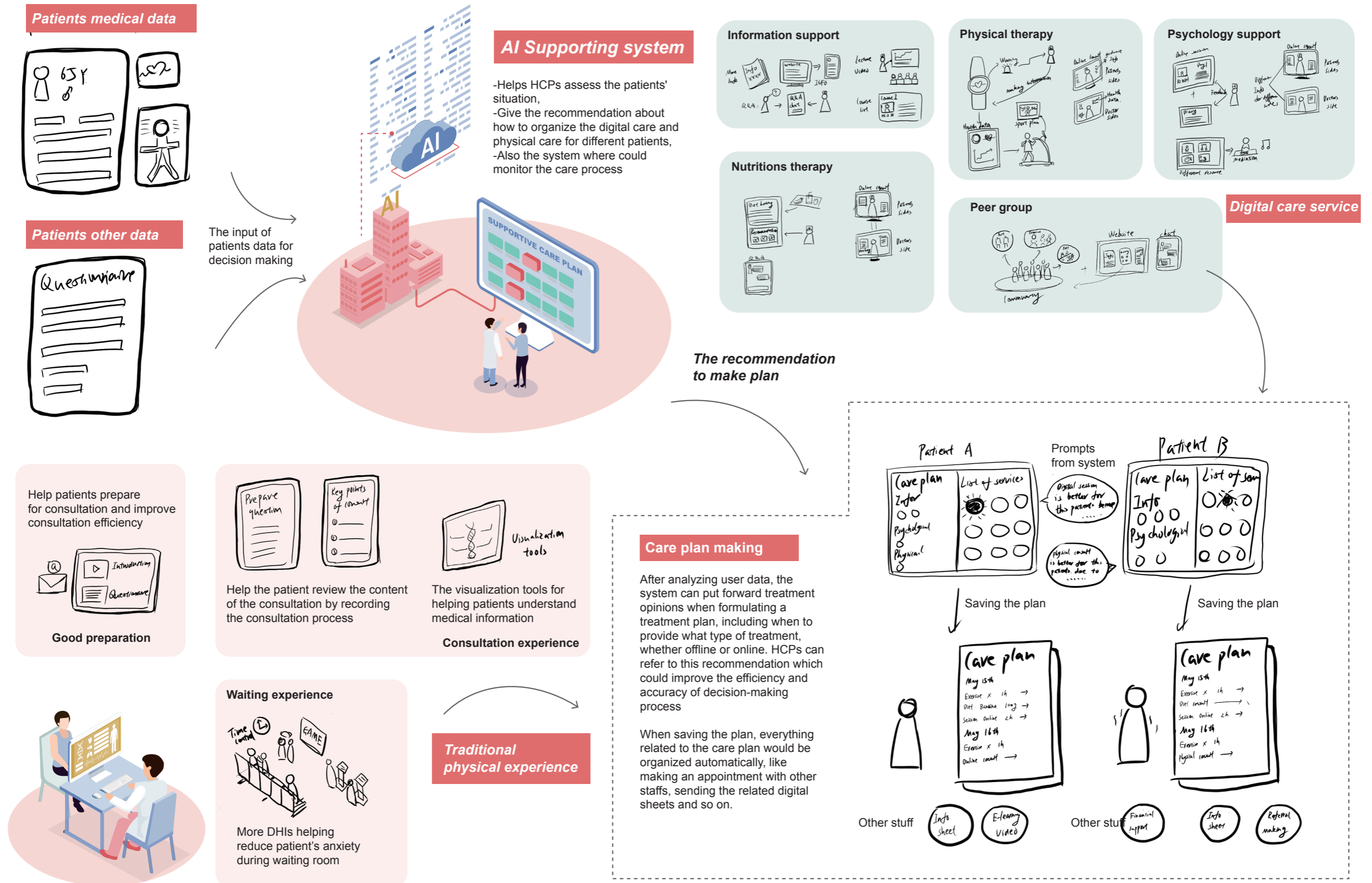*Figure 32 Ideation process*

Patients medical data

Patients other data

The input of patients data for decision making

AI Supporting system

-Helps HCPs assess the patients' situation,
-Give the recommendation about how to organize the digital care and physical care for different patients,
-Also the system where could monitor the care process

The recommendation to make plan

Information support

Physical therapy

Psychology support

Nutritions therapy

Peer group

Digital care service

Help patients prepare for consultation and improve consultation efficiency

Good preparation

Help the patient review the content of the consultation by recording the consultation process

The visualization tools for helping patients understand medical information

Consultation experience

Care plan making

After analyzing user data, the system can put forward treatment opinions when formulating a treatment plan, including when to provide what type of treatment, whether offline or online. HCPs can refer to this recommendation which could improve the efficiency and accuracy of decision-making process

When saving the plan, everything related to the care plan would be organized automatically, like making an appointment with other staffs, sending the related digital sheets and so on.

Saving the plan   Saving the plan

Other stuff   Other stuff

Waiting experience

Traditional physical experience

More DHIs helping reduce patient's anxiety during waiting room

Figure 33 Final chosen design ideas

The digital preparation could be done physically
"Physical support as an alternative, every service should be in the hospital, and staff could help orderly people finish everything."

Make clear who make decision
"Using ai as basis for plan seems good, but important that everyone understand who is actually make the plan"
Know how it works
"I would like to know how to predict, according to which factors; what exactly they want from a tool like this? and how can we present the advice in the best way?"

Good but need to train the HCPs
"It would require you are also going to have to train the health care professional to think digitally, to recognize the benefits."
"Recommending steer patients in the right direction; So that they don't Google themselves, silly in the right direction instead of Google."

Self-management empower patients
"Self management could support patients and make the patient be responsibility for their own health."

Good (legend)
Need to be improved (legend)
Not interest (legend)

Before first consultation   **During first consultation**   **Follow up care**

Decide to have supportive-care → Preparation → Needs assessment → Make plan → Receive plan → Plan adjustment → Finish

Use digital tools to prepare the consultation

Make supportive care plan by AI-support
-when and how make intervention

Referral

Good to increase waiting experience
"Because the only thing we do now shows how long you have to wait; it would still be fun to let people move around more freely and do what they want instead of sitting anxiously in the waiting room."

Increase physical experience
-Waiting experience
-Examine experience
-Consultation experience

Information support
Physical experience
Digital online source
Digital lecture or course

Physical therapy
Physical experience
Digital self management
Online guidance or consultation

Psychology support
Physical experience
Digital self management
Online guidance or consultation

Nutritions therapy
Physical experience
Digital self management
Online consultation

Peer group
Physical peer group
Online peer group

Other tools
Digital tools training
Health device: monitor body

Good to help patients find peers
"I think there's right now there's not one platform for it and it's help patients to have some contact with other patients. And also they can communicate online to find more information or to have some questions."

Better way for asking questions
"now is just call the general phone call, and sometimes the caregiver doesn't have time to answer or call back."

Health device has risk for information overload.
"It can be useful. But there is also a large group overwhelm of information"

Backstage
Patient file   Schedule manage   Insight sharing   Financial and insurance

New tool:
"The patients file with other hospitals: Hospitals information about a patient and it would be very easier. If you click and you can send it instead of you have to make a new story about patients. That would be fine."

Show the discussed topic
"if everyone who has access to the patient dossier can see what has already been discussed,caregivers could expand on conversations already had with the patient.

Patients can plan their appointments
"the patient could plan their appointments myself which could help them manage the schedule. it's more about being able to plan your own appointments"

Not a needed tools:
HCPs lose the interest in this DHI during the evaluation.

Not a needed tools:
During the evaluation, we got less insight in this digital tool. Thus, in this project, we won't focus on it.

Figure 34 Future patient journey and evaluation outcome

5.2 Evaluation

Figure 35 shows the toolkits to elaborate the concept better. In the evaluation session, we printed these ideas cards which showed a detailed description and an illustration of the scenario for each DHI. Also, patients journey with the defined problem and future visions was printed to ask the opinions of experts and different stakeholders. Within this section, only the conclusions of the evaluation are shared. The detailed insights could be found in Appendix K. We will present the final concept developed from insights after evaluation in the next chapter. The figure 34 shows how the evaluation result connected to patient journey.

5.2.1 Evaluation with stakeholders

Particpants

Nurse practitioner working for supportive care team

Navigating nurse working as a support consultant in supportive care for about 6 and half years

Dietitian working in supportive care for one and half year

Physiotherapist working in supportive care for 23 years

Social worker working in supportive care for 2years

General feedback:
They like the concept of this hybrid model. Some people think that it would be helpful for patients and doctors to categorize patients and give them different things. Some see digital tools as a complement to, not a replacement for, traditional care.The main force is face-to-face.

"It will be very helpful and also maybe for the doctor. The patient we don't have to see which I see them (the reminders) from the prompts(on the screen). After that, we could think more for people needing help."

For AI system:
Regarding the AI support system, HCPs also raised concerns. They believed that the AI system could only be used as support or to make decisions based on the opinions of patients and doctors:

"Using AI as basis for plan seems good, but important that everyone understand who is actually making the plan"

"Maybe also (give chance to)the patient say if they want or they could have choice in it."

For digital health interventions:
• Patients file: if everyone who has access to the patient dossier can see what has already been discussed, the patient wouldn't have to repeat information, and caregivers could expand on conversations already had with the patient.

• Patient files: It would be ideal but difficult to share the patient's file with other hospitals. If you click and you can send it instead of making a new story about patients.

• Online information site: It would require to have to train the health care professional to think digitally, to recognize the benefits

• Health devices: Health devices can be useful for monitoring the body condition and making a good decision. But there is also a large risk point: patients would feel nervous about overwhelming information. Especially they found the data showing they have a bad body condition
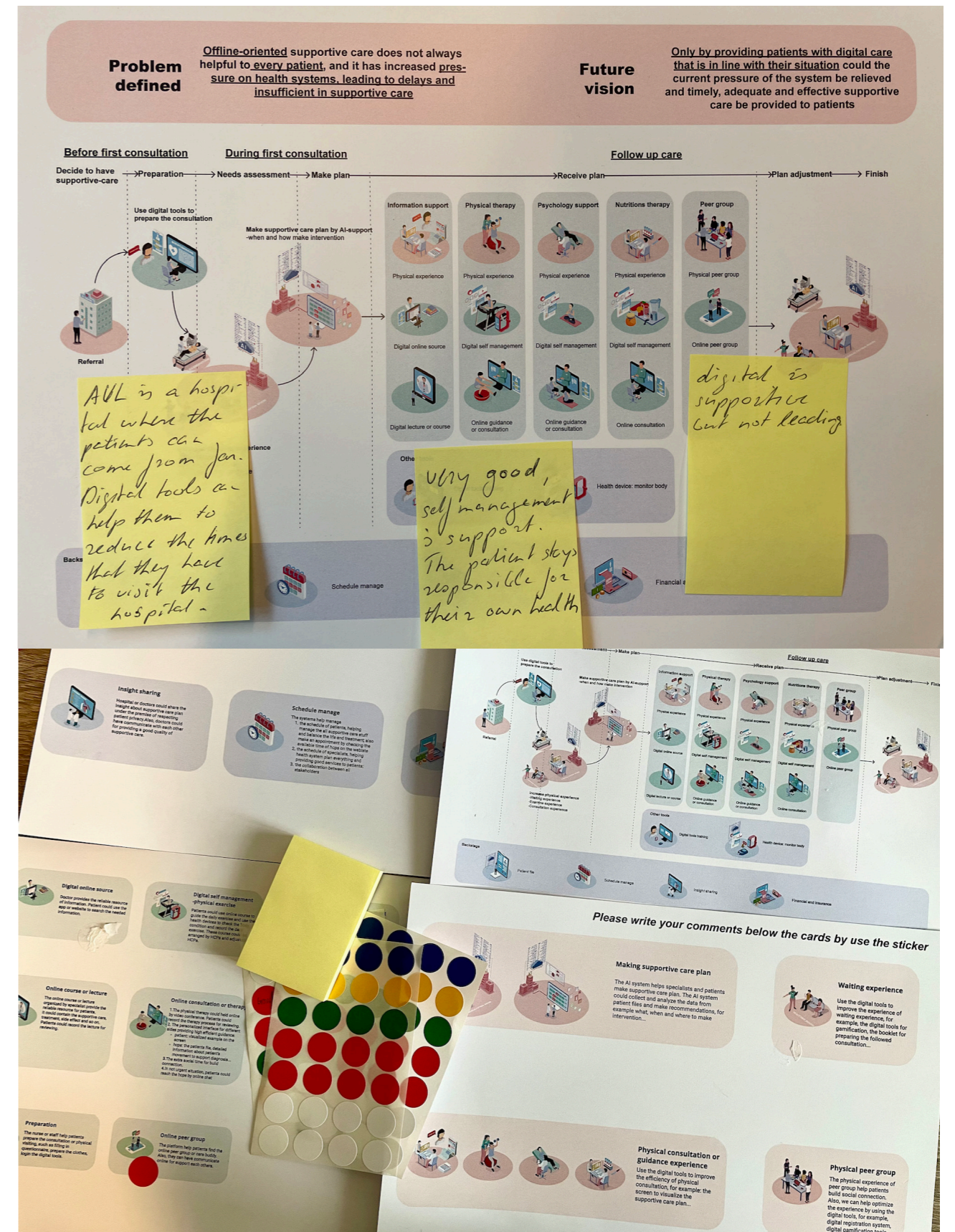
Figure 35 Toolkits for evaluation

5.2.2 Evaluation with experts

Particpants
• One Medical PhD working in IT department of Healthcare

• One E-health advisor working for digital strategy for 7 years

General feedback:
Experts are also positive about this new service system; they think there is room for improvement and it is worth paying attention to development.

> *"Offered it as a proper package or what you say assess the patient beforehand and offer like a selection of these tools you know what with the patient prefer to use. That I think is where there's a lot of room for improvement. Yeah, good point."*

For AI system:
They would like to know how to predict, according to which factors; what exactly they want from a tool like this; and how can we present the advice in the best way.
Also, privacy and security should be considered.

For digital health interventions:
• Questionnaire design: If asking patients to fill in a questionnaire, it should let patients understand the questionnaire's aim. Also, only put the most important one in the questionnaire for reducing the workload of patients.

• Physical support as an alternative: Even giving online support for patients, every service should be in the hospital, and staff could help orderly people finish everything.

• For waiting experience, the only thing hospital do now shows how long patients have to wait; it would still be fun to let people move around more freely and do what they want instead of sitting anxiously in the waiting room.

• Other DHIs: help patients ask their questions like they could ask questions online and get an answer immediately; use digital tools to help patients better prepare to make the right decision; the patient could plan their appointments myself which could help them manage the schedule.

5.2.3 Conclusion
The evaluation results show that the stakeholders and experts agreed that the hybrid patient journey are future-oriented. In the design of the AI system, they believe that the system is only an auxiliary function, and the primary decision-making authority is always the doctor and the patient. Besides, they need more detailed information, including how to build such a system and the data required to make the decision. In terms of digital health interventions, they also give some opinions for improvement, as shown in figure 34.

Therefore, we have concluded that such a design direction is worth it in-depth. In the next chapter, we present our optimized final deliverable design output according to the evaluation result.
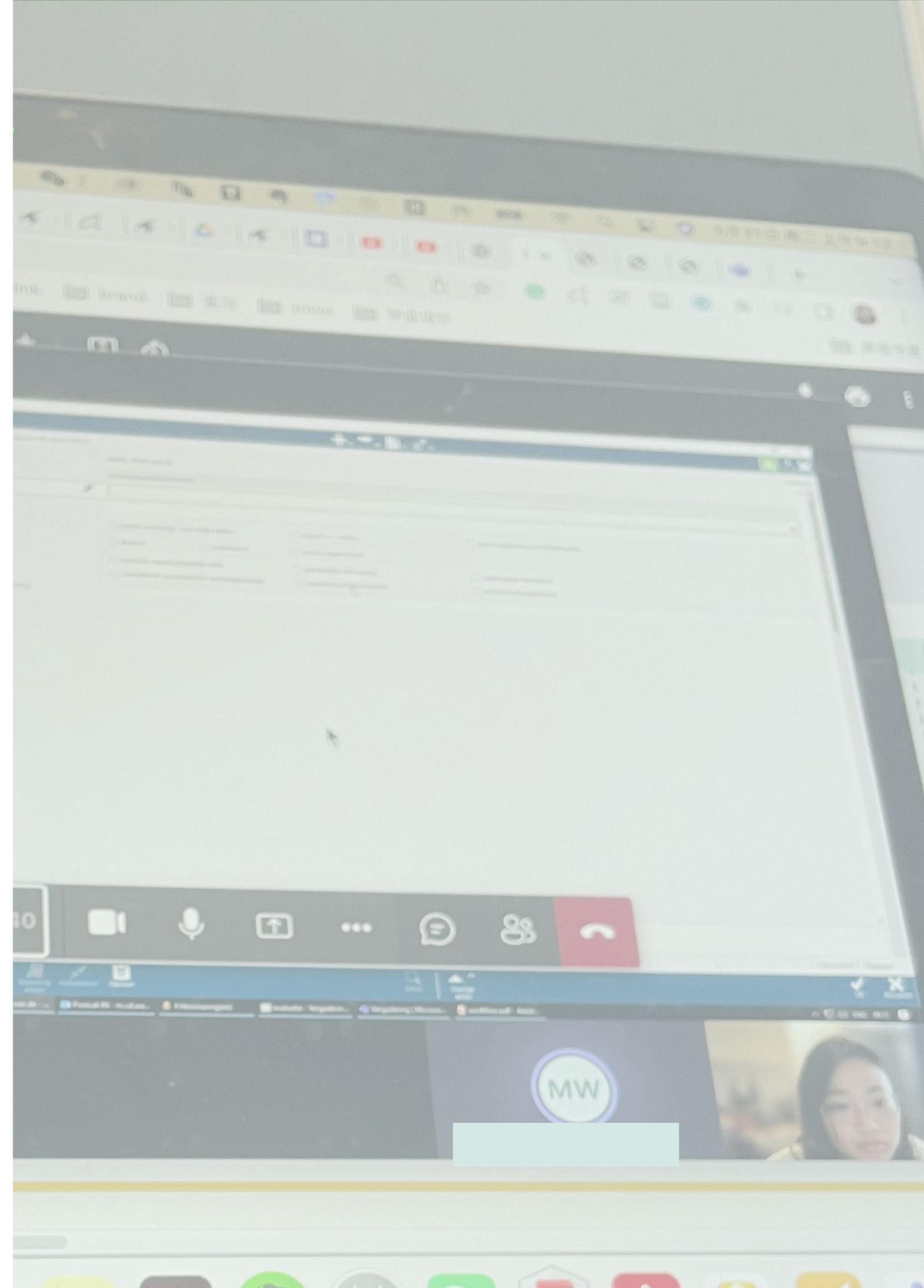
6

Deliverable

This one is mainly about the patient's journey under the future vision after evaluation. At the same time, other deliveries, including prototype and checklist, help us understand the concept better. In addition, we also provide roadmapping for guiding to implementation. After that, we set up the validation process to validate the output for collection the opinions from different stakeholders.

There will be several deliverables here for the final concept.
-Future patient journey
-Opportunities cards for DHIs
-Checklist
-Prototype of supporting system
-Feasibility analysis
-New workflow

The primary delivery is a hybrid patient journey under future vision. It illustrates supportive care in the future and underscores

the opportunities for DHIs. Afterwards, in order to explain the future vision clearly, the prototype has been designed to show how the AI support system help healthcare providers make decision for care plan, and the checklist could be used before implementing the AI support system were designed. In addition, as part of the feasibility analysis, the roadmap would be discussed where each horizon would be presented. Further, other technology and workflow considerations will be explained for further implementation.

6.1 Final concept

6.1.1 Hybrid patient journey

The future patients journey in figure 36 for supportive care plan would be introduced after the evaluation process. The AI system would be developed as a key role in serving this care system. It can help HCPs decide whether to provide online or offline services to patients. Besides that, the digital touchpoint would be integrated more into this system

This hybrid care model incorporates the rapidly developing digital health into the supportive care system. We will describe this hybrid journey clearly here.

• **Before the first consultation**
-Preparation
Digital health interventions begin when the user is referred to the SCP department. Before the first consultation, we help them prepare for their first visit with an online guide, including:
1) an introduction to existing SCP to help patients prepare for treatment;
2) an introduction about different services to prepare for later decisions
3) the questionnaire about gaining more patients' information besides medical data, such as digital capability, digital experience

It is not something the patients have to do at home, as can be done during the wait time. We provide it as an option to ease their emotions and gather the information for helping healthcare providers prepare for consultations.

• **At the first consultation**
Need assessment
At the first consultation, we could control the waiting time and optimize the waiting experience through digital health interventions.

For example, we could reduce patient anxiety during waiting times by estimating the waiting time and adding activities to the waiting time (entertainment, preparation for consultation). Also, in the consultation room, on the one hand, we provide more digital sheets and visual tools to help patients understand the content of supportive care. On the other hand, DHIs such as patient files help HCPs assess the patient's condition and preference for the care model.

-Making care plan
After the first contact with the patients, the healthcare providers, with the help of the AI support system, will design a hybrid care pathway for the patient. The AI system is only an auxiliary tool for HCPs, the real decision-makers are still HCPs and patients. When HCPs encounter difficulties, they also can cooperate with other specailists (MDT meetings) to discuss the patient's situation in order to make the right decision.
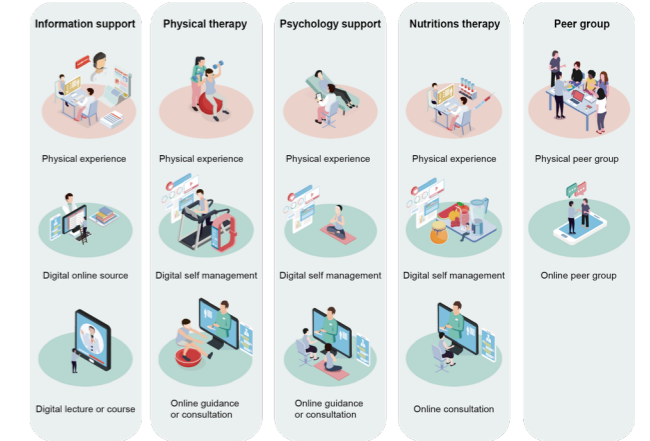
• **Follow up care**
There are five types of care services in follow-up care: the first four care corresponds to cancer's supportive care needs (Information support, Physical therapy, Psychological support and Nutritions therapy) and Peer group. A peer group is a good way for emotional and information support from user research. Thus we think it should be involved in future journeys.

Under each support, there are different digital experiences (Green card) and physical experiences (Pink card). For instance, online consultation, offline consultation, online therapy sessions, information search material, online peer groups, etc. In addition to these, there are other digital tools for backstages (Purple card) for laying the foundation of the hybrid patient's journey. For example, a health device would help monitor the patient's body condition and collect more data for diagnosis.

Depending on the condition, patients would be offered a seamless, personalized experience by combining the different kinds of care services at different periods.

With such a hybrid model, medical resources could be allocated. It would transfer patients who do not have or do not need physical care to online care, reducing the waste of physical medical resources. Because of this, the physical health care system would be less busy, and patients could access care faster and improve their quality of life.
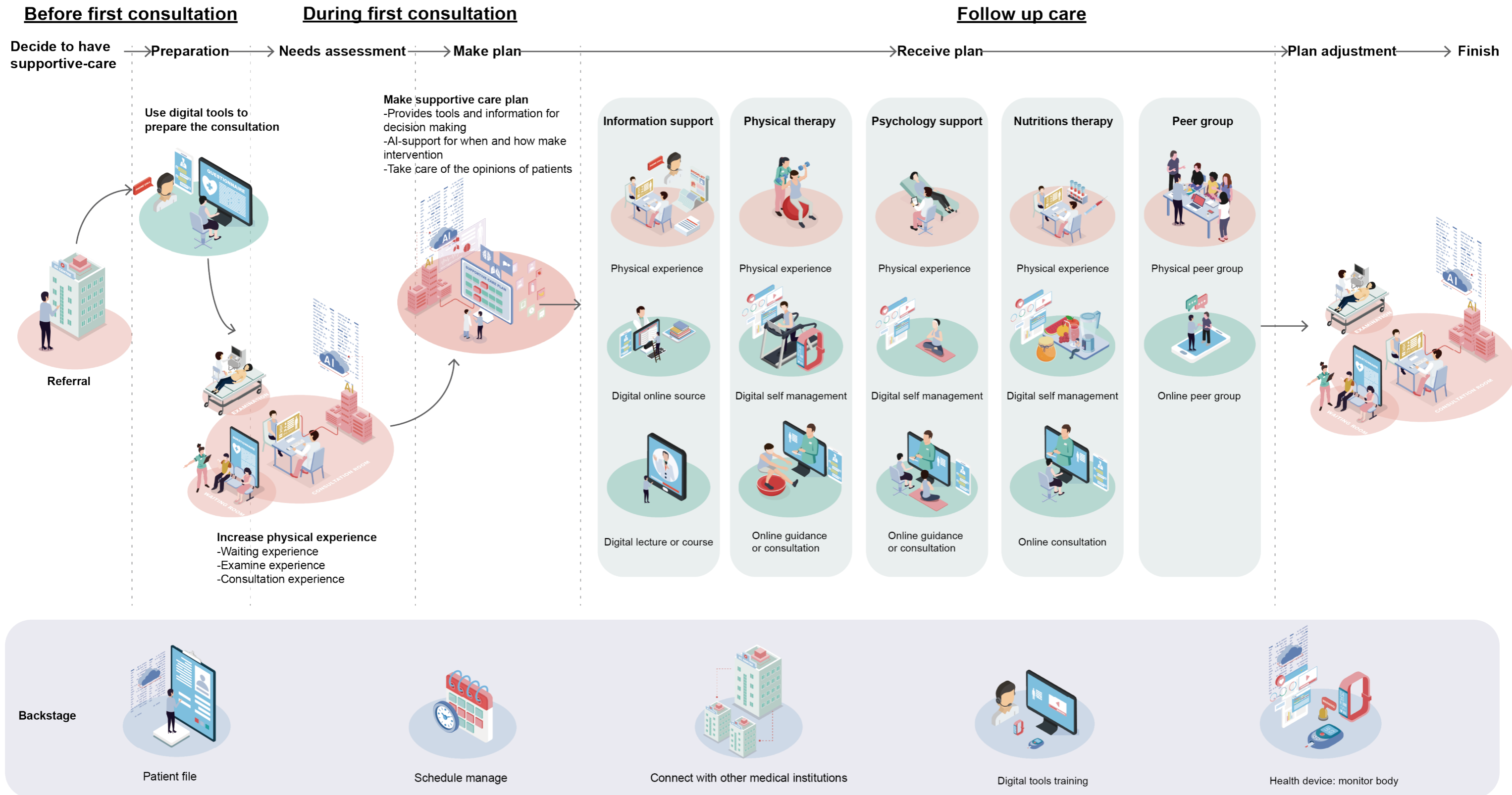
Before first consultation

During first consultation

Follow up care

Decide to have supportive-care → Preparation → Needs assessment → Make plan → Receive plan → Plan adjustment → Finish

Use digital tools to prepare the consultation

Make supportive care plan
-Provides tools and information for decision making
-AI-support for when and how make intervention
-Take care of the opinions of patients

Referral

Increase physical experience
-Waiting experience
-Examine experience
-Consultation experience

Information support	Physical therapy	Psychology support	Nutritions therapy	Peer group
Physical experience	Physical experience	Physical experience	Physical experience	Physical peer group
Digital online source	Digital self management	Digital self management	Digital self management	Online peer group
Digital lecture or course	Online guidance or consultation	Online guidance or consultation	Online consultation	

Backstage

Patient file

Schedule manage

Connect with other medical institutions

Digital tools training

Health device: monitor body

Figure 36 Final future patient journey

Video 2: https://youtu.be/5WAW-a--noA

6.1.2 Opportunities of future DHIs

These cards in figure 37 and 38 mainly show the opportunities for DHIs under the future vision. These cards can be viewed along with the future patient's journey for a better understanding. Pink card is about DHIs in physical experiences (Pink card), green card is the digital experiences (Green card) and purple card is for the DHI in backstage.

Each card describes the develop direction of each digital health intervention and even the risk point of DHI in the future patient's journey. Also, the quotes from stakeholders, patients, and experts is presented on the right side. We believe these quotes would help the reader to understand the opportunity of each DHI. For example, there are four design points for online consultation or therapy:

1. Therapy could be done via online video conferencing. Patients could record the therapy process for review.
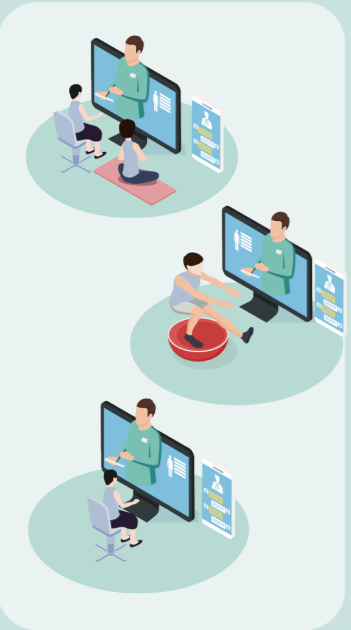
2. Personalized interface for different sides offering practical guidance:
   • Patient: example displayed on the screen.
   • HCPs: patient file, detailed information on the patient movement to support the diagnosis.
3. Extra social time to establish a relationship.
4. In non-emergency situations, patients could contact HCPs by online chat.

These opportunities come from insights from different stakeholders in supportive care and have been iterated after the evaluation process. Some DHIs have been already built-in some hospitals, but the description on the card provides the orientation in which they could develop. For those who want to develop more digital tools in the medical system, these tools can give them inspiration and research direction.

Online consultation or therapy

DEVELOP DIRECTION:

Record for reviewing: Therapy could be held via online video conferencing. Patients could record the therapy process for reviewing.

Design different interface for different sides: Personalized interface for different sides offering practical guidance:
  Patient: example displayed on the screen;
  HCPs: patient file, information on the patient movement to support diagnosis...

Extend timeline: Extra social time to establish a relationship.

Online chat: In non-emergency situations, patients could contact HCPs by online chat.

"During the physical therapy treatment, it is very difficult to know what's wrong. I can't do it with a camera; if you have shoulder pain, I have to take tests, but I can't (do it by camera)."

---Health providers

"We(dietitian) can do more digital(video consultation). We talk a lot, so it's more possibly online I think"

---Health providers

"When patients want to ask questions, now is call the general phone number, but sometimes the caregiver doesn't have time to answer or call back."

---E-health advisors

The description of DHIs opportunities

The quotes from patients, expert and healthcare providers.

Online information source

DEVELOP DIRECTION:
Build more resource: HCPs provide a reliable source of information or digital files. The patient could use the digital file, app, or website to search for the needed information.

RISK POINT:
The information should be easily understandable for patients.

"It could steer patients in the right direction; So that they don't Google themselves, silly in the right direction instead of Google."
—Health providers

"It would require you to train the health care professional to think digitally; to recognize the benefits"
—Health providers

"I think when we are going to more digital health, then we also need good online sheets to give people."
—Health providers

Online course or lecture(e-learning)

DEVELOP DIRECTION:
Build more resource: The online course or specialist-led conference is a reliable resource for patients to get more information.
It may include supportive care, treatment, side effects, etc. HCPs could recommend some courses for patients; patients could record the lecture for reviewing.

"They(patients) can read a lot of information and about some problems. For example, the program about anxiety or depression or tiredness. They can read it at home and also do some exercises at home. They can also be more independent from the psychologist and do it more on their own."
—Health providers

"I thought it might be helpful to see some digital videos about breast cancer operations or all the things they need to know when getting treatment."
—Health providers

"Not only do you get no information about this, but you don't get accurate information about anything. And that doesn't just apply to cancer patients."
—Patient

Online peer group

DEVELOP DIRECTION:
Build an online community: The platform could be build to help patients find an online peer group or care buddy. In platform, they could share the story for finding a help, find the care buddy who could accompany them through their care plan and so on.

RISK POINT:
Peers with more negative emotions can cause stress to patients.

"I think there's not one platform for it, and it helps patients to have some contact with other patients. And also, they can communicate online to find more information or to have some questions."
—Health providers

"I felt very much at home here on the forum. I feel so much warmth and connection for each other when I am active on cancer.nl. Depending on what I read, this can touch me. But I also often feel very happy. It is so special to support each other."
—Patient

Digital self management

DEVELOP DIRECTION:
Online session: Patients could use the online course to guide daily exercise, daily diet and emotion change. These session could be reviewed by HCPs

Self-monitoring: The healthcare devices to check body status and record daily exercise. Thus, patients and HCPs could understand the result of care plan and make a adjustment.

Diary record: Patients could write a diary for reflection about current care plan. HCPs could check it for understanding the condition of patients.

RISK POINT:
Treatment effectiveness highly depends on patients' motivation.

"Self-management supports the care plan; the patient should be responsible for their health."
—Health providers

"I mean, it's just getting bigger and bigger and the number of people, so we're forced to go to digital self-management"
—Health providers

"To develop some programs, a patient can have a diary from what they take for food and send it to us in the patient file. This would also be helpful. "
—Health providers

Online consultation or therapy

DEVELOP DIRECTION:
Record for reviewing: Therapy could be held via online video conferencing. Patients could record the therapy process for reviewing.

Design different interface for different sides: Personalized interface for different sides offering practical guidance:
  Patient: example displayed on the screen;
  HCPs: patient file, information on the patient movement to support diagnosis...

Extend timeline: Extra social time to establish a relationship.

Online chat: In non-emergency situations, patients could contact HCPs by online chat.

"During the physical therapy treatment, it is very difficult to know what's wrong. I can't do it with a camera; if you have shoulder pain, I have to take tests, but I can't (do it by camera)."
—Health providers

"We(dietitian) can do more digital(video consultation). We talk a lot, so it's more possibly online I think"
—Health providers

"When patients want to ask questions, now is call the general phone number, but sometimes the caregiver doesn't have time to answer or call back."
—E-health advisors

Preparation

DEVELOP DIRECTION:
Help patients make preparation at home: The nurse or staff help patients prepare for the consultation or physical visit in advance. For example: filling out the questionnaire, preparing the questions, watching the video about supportive care and trying some digital services in advance.

RISK POINT:
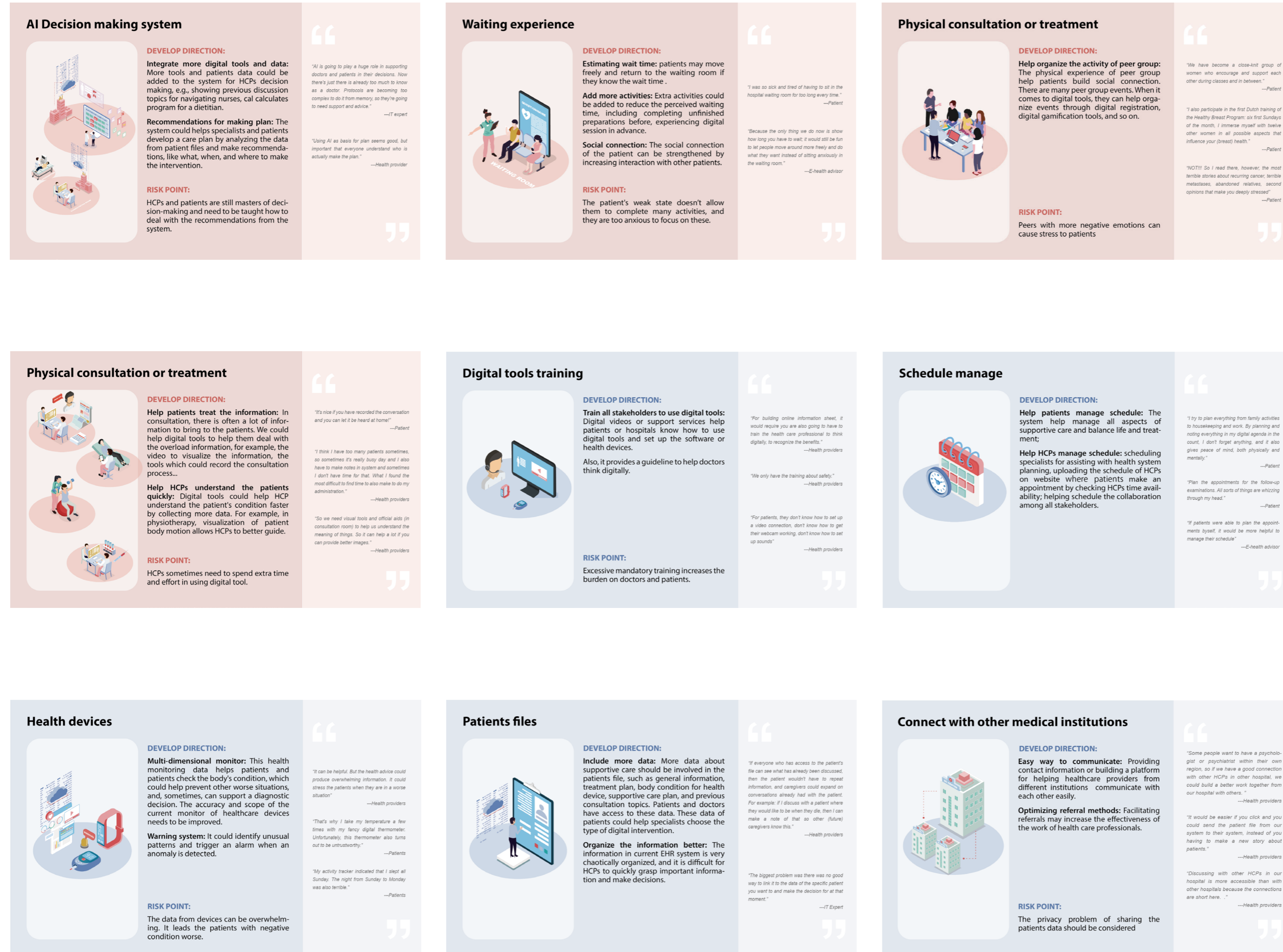Too much preparation can be intimidating for patients.

"Most of the time we came in patients don't even know that we came to him. It would be better if they are preparing."
—Health providers

"Patients not fill the form because they feel too much workload, too busy to do. Preparation is huge workload."
—Health providers

*"Increase the questionnaire experience:
-Let patients understand the aim of questionnaire
-Only put the most important one in questionnaire
-The questionnaire also could be finished before the hospital visiting or during hospital waiting
-Staff could help orderly people to finish the questionnaire."*
—IT expert

Figure 37 Cards for opportunities of DHIs

Figure 38 Cards for opportunities of DHIs

AI Decision making system

DEVELOP DIRECTION:

Integrate more digital tools and data: More tools and patients data could be added to the system for HCPs decision making, e.g., showing previous discussion topics for navigating nurses, cal calculates program for a dietitian.

Recommendations for making plan: The system could helps specialists and patients develop a care plan by analyzing the data from patient files and make recommendations, like what, when, and where to make the intervention.

RISK POINT:

HCPs and patients are still masters of decision-making and need to be taught how to deal with the recommendations from the system.

"AI is going to play a huge role in supporting doctors and patients in their decisions. Now there's just there is already too much to know as a doctor. Protocols are becoming too complex to do it from memory, so they're going to need support and advice."

—IT expert

"Using AI as basis for plan seems good, but important that everyone understand who is actually make the plan."

—Health provider

Waiting experience

DEVELOP DIRECTION:

Estimating wait time: patients may move freely and return to the waiting room if they know the wait time .

Add more activities: Extra activities could be added to reduce the perceived waiting time, including completing unfinished preparations before, experiencing digital session in advance.

Social connection: The social connection of the patient can be strengthened by increasing interaction with other patients.

RISK POINT:

The patient's weak state doesn't allow them to complete many activities, and they are too anxious to focus on these.

"I was so sick and tired of having to sit in the hospital waiting room for too long every time."

—Patient

"Because the only thing we do now is show how long you have to wait; it would still be fun to let people move around more freely and do what they want instead of sitting anxiously in the waiting room."

—E-health advisor

Physical consultation or treatment

DEVELOP DIRECTION:

Help organize the activity of peer group: The physical experience of peer group help patients build social connection. There are many peer group events. When it comes to digital tools, they can help organize events through digital registration, digital gamification tools, and so on.

RISK POINT:

Peers with more negative emotions can cause stress to patients.

"We have become a close-knit group of women who encourage and support each other during classes and in between."

—Patient

"I also participate in the first Dutch training of the Healthy Breast Program: six first Sundays of the month, I immerse myself with twelve other women in all possible aspects that influence your (breast) health."

—Patient

"NOT!!! So I read there, however, the most terrible stories about recurring cancer, terrible metastases, abandoned relatives, second opinions that make you deeply stressed"

—Patient

Physical consultation or treatment

DEVELOP DIRECTION:

Help patients treat the information: In consultation, there is often a lot of information to bring to the patients. We could help digital tools to help them deal with the overload information, for example, the video to visualize the information, the tools which could record the consultation process...

Help HCPs understand the patients quickly: Digital tools could help HCP understand the patient's condition faster by collecting more data. For example, in physiotherapy, visualization of patient body motion allows HCPs to better guide.

RISK POINT:

HCPs sometimes need to spend extra time and effort in using digital tool.

"It's nice if you have recorded the conversation and you can let it be heard at home!"

—Patient

"I think I have too many patients sometimes, so sometimes it's really busy day and I also have to make notes in system and sometimes I don't have time for that. What I found the most difficult to find time to also make to do my administration."

—Health providers

"So we need visual tools and official aids (in consultation room) to help us understand the meaning of things. So it can help a lot if you can provide better images."

—Health providers

Digital tools training

DEVELOP DIRECTION:

Train all stakeholders to use digital tools: Digital videos or support services help patients or hospitals know how to use digital tools and set up the software or health devices.

Also, it provides a guideline to help doctors think digitally.

RISK POINT:

Excessive mandatory training increases the burden on doctors and patients.

"For building online information sheet, it would require you are also going to have to train the health care professional to think digitally, to recognize the benefits."

—Health providers

"We only have the training about safety."

—Health providers

"For patients, they don't know how to set up a video connection, don't know how to get their webcam working, don't know how to set up sounds"

—Health providers

Schedule manage

DEVELOP DIRECTION:

Help patients manage schedule: The system help manage all aspects of supportive care and balance life and treatment;

Help HCPs manage schedule: scheduling specialists for assisting with health system planning, uploading the schedule of HCPs on website where patients make an appointment by checking HCPs time availability; helping schedule the collaboration among all stakeholders.

"I try to plan everything from family activities to housekeeping and work. By planning and noting everything in my digital agenda in the court, I don't forget anything, and it also gives peace of mind, both physically and mentally."

—Patient

"Plan the appointments for the follow-up examinations. All sorts of things are whizzing through my head."

—Patient

"If patients were able to plan the appointments byself, it would be more helpful to manage their schedule"

—E-health advisor

Health devices

DEVELOP DIRECTION:

Multi-dimensional monitor: This health monitoring data helps patients and patients check the body's condition, which could help prevent other worse situations, and, sometimes, can support a diagnostic decision. The accuracy and scope of the current monitor of healthcare devices needs to be improved.

Warning system: It could identify unusual patterns and trigger an alarm when an anomaly is detected.

RISK POINT:

The data from devices can be overwhelming. It leads the patients with negative condition worse.

"It can be helpful. But the health advice could produce overwhelming information. It could stress the patients when they are in a worse situation"

—Health providers

"That's why I take my temperature a few times with my fancy digital thermometer. Unfortunately, this thermometer also turns out to be untrustworthy."

—Patients

"My activity tracker indicated that I slept all Sunday. The night from Sunday to Monday was also terrible."

—Patients

Patients files

DEVELOP DIRECTION:

Include more data: More data about supportive care should be involved in the patients file, such as general information, treatment plan, body condition for health device, supportive care plan, and previous consultation topics. Patients and doctors have access to these data. These data of patients could help specialists choose the type of digital intervention.

Organize the information better: The information in current EHR system is very chaotically organized, and it is difficult for HCPs to quickly grasp important information and make decisions.

"If everyone who has access to the patient's file can see what has already been discussed, then the patient wouldn't have to repeat information, and caregivers could expand on conversations already had with the patient. For example: if I discuss with a patient where they would like to be when they die, then I can make a note of that so other (future) caregivers know this."

—Health providers

"The biggest problem was there was no good way to link it to the data of the specific patient you want to and make the decision for at that moment."

—IT Expert

Connect with other medical institutions

DEVELOP DIRECTION:

Easy way to communicate: Providing contact information or building a platform for helping healthcare providers from different institutions communicate with each other easily.

Optimizing referral methods: Facilitating referrals may increase the effectiveness of the work of health care professionals.

RISK POINT:

The privacy problem of sharing the patients data should be considered

"Some people want to have a psychologist or psychiatrist within their own region, so if we have a good connection with other HCPs in other hospital, we could build a better work together from our hospital with others."

—Health providers

"It would be easier if you click and you could send the patient file from our system to their system, instead of you having to make a new story about patients."

—Health providers

"Discussing with other HCPs in our hospital is more accessible than with other hospitals because the connections are short here. ."

—Health providers

6.1.3 Checklist for HCPs

We also improved the existing tools and designed a new checklist to help HCPs make care plans. The example case show how it used. This checklist is designed according to the proposed model from Gilbert, and HCPs can use this checklist to evaluate whether the user is suitable for digital care from four aspects: Situation of care, Expectations of care, Demands of the patient and Capacity to allocate resources to care. If there are predominate "no" or "neutral" after checking the questions, HCPs could discuss digital care with patients more when making the care plan. Besides, HCPs are not required to answer all of these questions but use as a reference when making decisions. The example case on the right was presented to show how the checklist used.

Prior to applying the AI system, such a checklist can be provided to HCPs, so that they have the belief of providing the proper medical care for the appropriate patient. It is conducive to progressively helping HCPs adapt to the new workflow and lays a foundation for applying the AI system in the future.

This section is to understand the clinical status and needs of the treatment for the patient and consider whether digital care is in line with these situations.

This section aim to determine patient preferences and whether they accept digital care.

This section mainly considers the different demands on patients, including the need from care plans or the social relationship.

This section mainly considers whether the user has the ability or resource to digital care or physical care

These questions could be answer by HCPs

These questions should be answered with patients

Figure 39 Design of checklist

Example case

35 years, women, Dutch

Situation of care	Breast cancer patients, 3 weeks after mastectomy; **Symptoms**: uneasy about side effect of mastectomy, very stressed; Feeling guilty about the family; Others: High level of mobility;

Demands on the patient	**Supportive care:** Already have 1 hour consultation with psychologist; Need: Attend 30mins psychologist therapy session everyweek, 30mins follow-up consultation every month(3 times); **Personal life required:** Live with children(3 years), need to take care of children every day;

Expectations and preference of care	Fine with digital or physical, but don't want to cause much burden on the family; Want to get support in current hospital; Haven't used online therapy before;

Capacity to allocate resources to care	Lives 1 hour from the hospital by train; High digital capability; Good at computer and digital stuff;

Checklists for deciding the care model

Theme	Questions	Yes	Neutral	Not
Situation of care	- Do patients' problems require them to be seen face to face?		✓	
	- Would digital care not make things easier for patients?			✓
	- Does the care content require for patients in face to face?			✓
Demands on the patient	- Is the period long per appointment?		✓	
	- Is it infrequent to have an appointment?		✓	
	- Is it convenient for patients to go to the hospital??			✓
	- Do patients not have social or family work that keep them from face to face?			✓
Expectations and preference of care	- Do patients feel bad about digital care?		✓	
	- Would patients not like to see themselves on a computer screen?		✓	
	- Would F2F care affect patients more positively?			✓
	- Do patients feel F2F care is required?		✓	
Capacity to allocate resources to care	- Is there not financial problem if choosing F2F care?	✓		
	- Do patients have no access to what they need for digital care?			✓
	- Do patients not know how to use the things they need for digital care?			✓
	- Do patients have anyone who could support them with a F2F care?	✓		
	- Do we have any policy to help address F2F problem?	✓		

Conclusion

We can see that in the "situation of care", "expectations of care" and "demands on patients", most of the answers are "netural" and "not". And some of the "yes" in "capability to allocate resource". In general, HCPs can discuss with the patients to arrange more online consultations in care plans.

6.1.4 Prototype of supporting system

The prototype is designed to show what the support system will be like in the future. We visualize the interaction method of the AI support system and share it with medical workers to obtain design suggestions through the evaluation process to guide future design. The expert said, "what makes a success in the hospital is that it is integrated with Hixs (the decision-making software)". Considering this insight, we developed this prototype from the current decision-making software(Figure 40), which means healthcare professionals can adapt more quickly to new workflows in this way.

The "plan" model would be added to the current decision-making interface to help staff organize the care plan (Figure 41). After analyzing patient data, the system would recommend what services-based care is best for patients, digitally or physically. For example, the consultation would be booked

if we recommend the information resource and online consultation for a patient. The information would be sent automatically after the plan is saved.

This recommendation based on patient data could be a reference for the staff. Staff could follow the recommendations and create a new one after considering the patient's opinion in an actual situation. Also, staff could monitor the process of each care service: "in process", "in referral", or "scheduled", and even can contact the related staff directly to enhance the collaboration among different specialists. Different support content has different tabs, which makes the medical staff easy to manage everything.

This support system could help medical staff assess patient needs and provide patients with the proper digital care at the right time.

Figure 41 Main interface

Figure 40 Current decision making system

Patients data: treatment plan, test report...

Writing report: where they could making report for further tretatment

The description of main interface

1 The structure of interface
Following the structure of the current system, the patient's data is still on the left, and the area for planning and writing reports is on the right. It could reduce the sense of unfamiliar and increases the speed of adaptation by medical staff.

2 The tab for report and plan
Based on the current interface, the plan tab has been added, and medical staff can switch back and forth between the two tasks of writing reports and making plans.

3 The tab for different support content
For ease of management, we have added different sub-tabs under the plan module, and these tabs represent different care content. Medical staff can find services related to them more quickly, and can better monitor the condition of patients.

4 In plan and recommendation
After analyzing the patient's data, the system will suggest what care service is suitable for this patient according to the data, and the HCPs can choose to involve the care plan. "In plan" shows all the service items that have been included in the care plan

5 "Create new" or "Save" button
After the medical staff clicks create new, the interface for creating a new care service will appear. After clicking save, it will automatically start to organize everthing about care service, such as book an appointment with related staff.

The description of key flow

• Making the care plan

The medical staff clicks the "Plan" tab to enter the plan making panel. The right side is the recommendation card from system. It is translucent and visually distinguishes from the selected service card. After clicking these service cards, the card moves to the "In plan" on the left, which has normal display, rather than translucent, indicating that the service has been included in the plan.

When clicking the save button, the related task will be organized, such as an appointment with the physiotherapist. When the HCPs needs to modify it again, they can click "edit" button in the lower right corner to return to the editing interface.

Report interface

Plan interface

After choosing the care service

After saving the plan

Prototype video: https://youtu.be/AJBsaFQPVzM
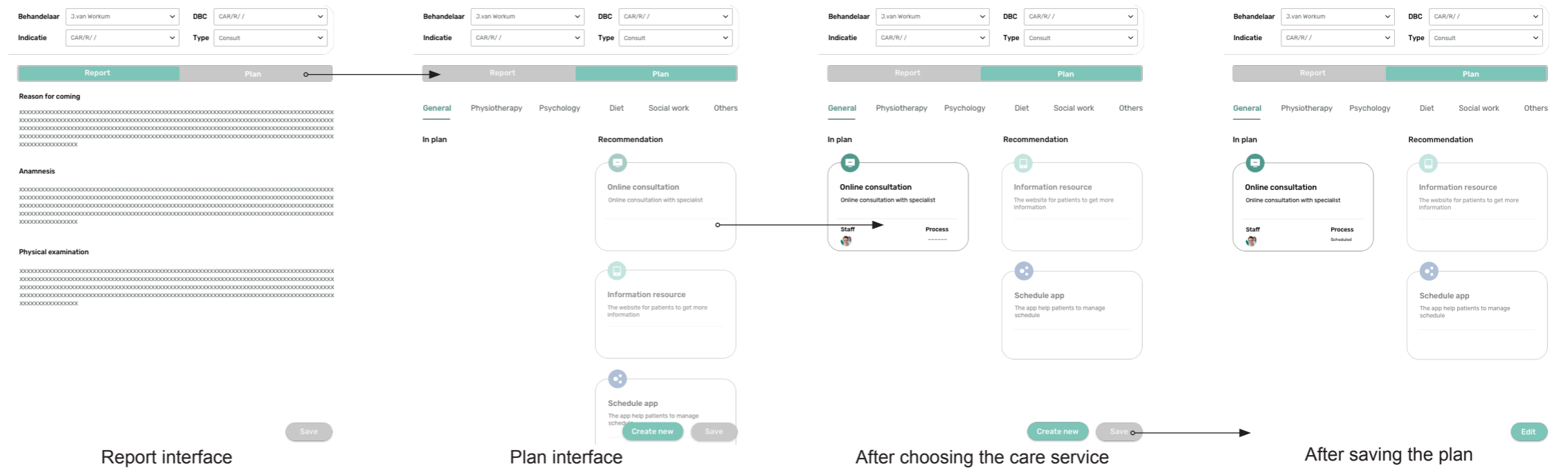
• Create a new care service

When HCPs and patients think that the service recommended by the system does not meet their needs according to the actual situation, HCPs can enter the create panel by clicking the "create new" button. In the create panel, HCPs could find all related care services. The drop-down menu still shows the recommended care services prioritized. Different colors represent different service types, red for physical care, green for digital care, and purple for others. After selecting the care service, the relevant staff will be automatically generated. For example, the system will choose the available physiotherapist for the physiotherapy consult. HCPs can make modifications for the medical staff.

At this moment, the create button is activated and can be clicked.

• Monitoring the process

In addition to creating a care plan, such an integrated platform can facilitate the HCPs to manage the patient's care process. For example, there are generally 6 courses for an online session, and the HCPs can view the patient's progress and click to view the result of each course. Referrals and appointments can be started automatically for services that need to be booked with

other HCPs. The HCP who initiates the referral, such as the navigator nurse, can view the process to better work as a coordinator.

Creating a new service

Choosing a new category

Select a staff

Process: service in process

Process: service in referral
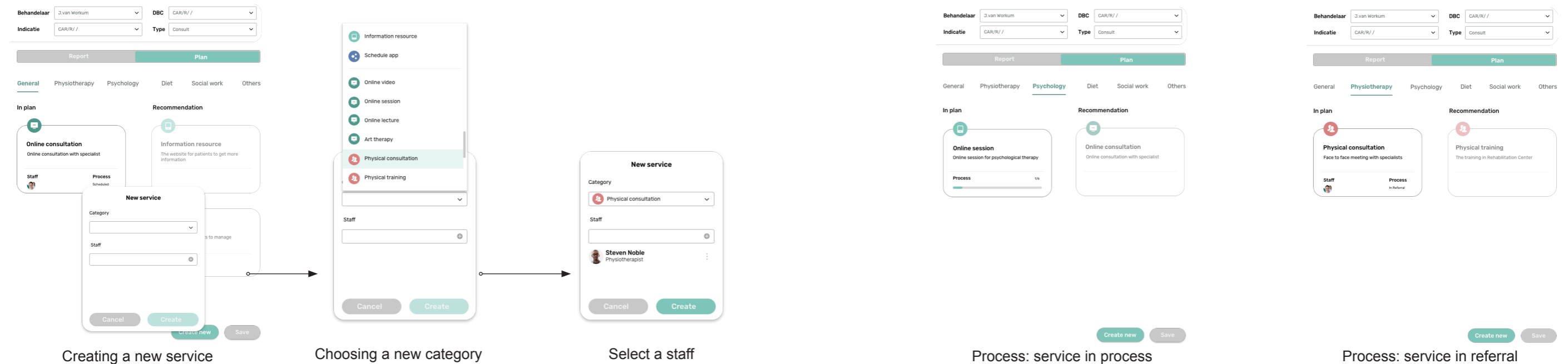
Scenario

Two kinds of patient story was shown here to communicate the aimed effect of AI support system.

Analyze the the factors that affect the patient's preference for care plan

Provide suggestions in the interface when the doctor makes the plan

Automatically arrange related stuff according to the plan

The patient follows the care plan

1-1 Anne, a breast cancer patient who had just completed her first chemotherapy, had become very mentally ill. Her digital literacy is average, and her home is far from the hospital. She also needs more time to take care of her children.

1-2 According to her situation, the system suggested providing online consultation and sessions for the patient. In the conversation, Anne agreed to such a plan, but she also wanted offline consultation in the last consultation.

1-3 After the care plan is completed, the system will automatically schedule appointments with related HCPs. HCPs can also check the progress and give feedback for the online session. At the same time, some information sheet was sent to Anne without requiring the HCPs to spend extra time writing emails.

1-4 Through this plan, Anne received care from HCPs step by step, which improved her psychological condition in such a mixed hybrid model and made her chemotherapy successfully.
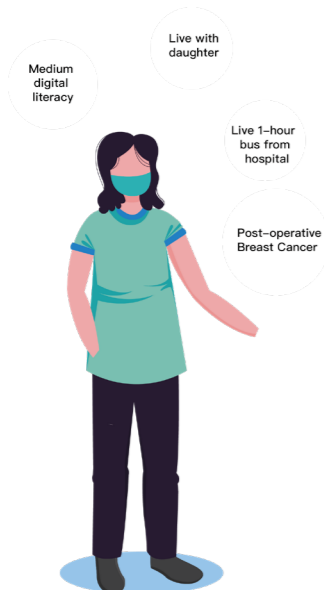
2-1 Marie felt some swelling in her arm after the breast-conserving surgery. Her digital literacy is average, but her daughter can support her. Also, she lives far from the hospital.
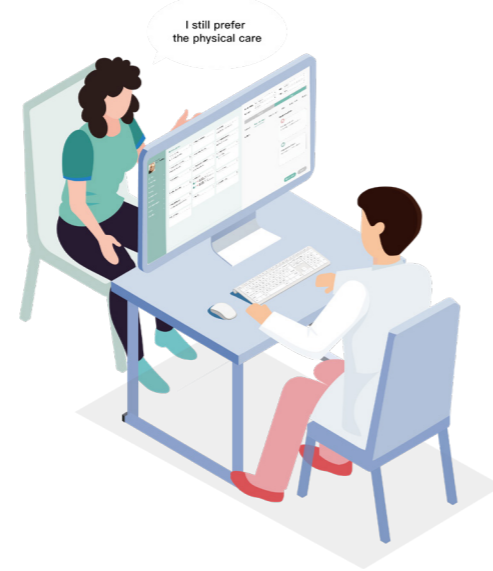
2-2 According to her situation, the system recommends online consultation and training for Marie. But Marie insist on physical treatment.
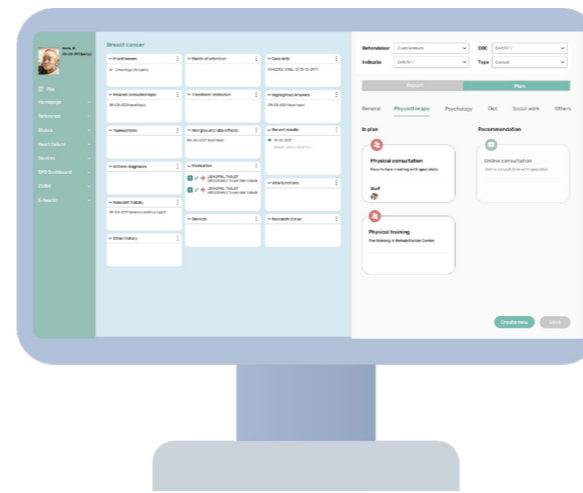
2-3 Therefore, HCPs redesigned the plan according to Marie's wishes. Physical consultation and training have been added, but online learning resources have also been added for Marie to facilitate review at home.

2-4 Marie received care offline on time and occasionally watched videos online for review. In such a hybrid care model, she have improved the physical condition and reduced the side effects of surgery.

6.2 Implement strategy

6.2.1 Roadmapping

This roadmap aims to show what needs to develop in three horizons to reach the future vision. The roadmap created within this project is meant for a large target audience; every stakeholder in support care. It should be a discussion starter between the different parties who want to develop the digital care in the current system.

Explaining the different elements

It only consists of a selection of elements communicating the project's central message. The starting point of the coloured dotted line indicates the beginning of development, while coloured circles indicate the degree of development. The roadmap consists of the following parts besides the timeline:

- **The three horizons:**
They display the three visions in different periods, and also the visualization helps understand the horizon quickly.

- **Time pacing:**
We refer to the development time of the AI healthy product for pacing the time. Also, we verified it in the expert interview.

- **Education with HCPs:**
Training the medical staff is also essential for the HCPs to quickly adapt to the new workflow from our previous research.

- **The AI system implementation and building:**
The most important part is showing how to build this AI system from data collection and training and introducing innovation to the current system.

- **Physical experience:**
It is also an essential part of the hybrid care model. However, we will not focus on it but briefly describe it here.

- **Digital experience:**
This part shows how to develop and optimize DHIs, the essential part of the hybrid model. Developing the digital experience would impact the construction of the artificial intelligence system. Moreover, the black vertical line shows how digital tools connect to the AI system.

- **Backstage:**
It shows how to develop the digital tools in backstages to support the hybrid system.

Figure 42 Roadmap
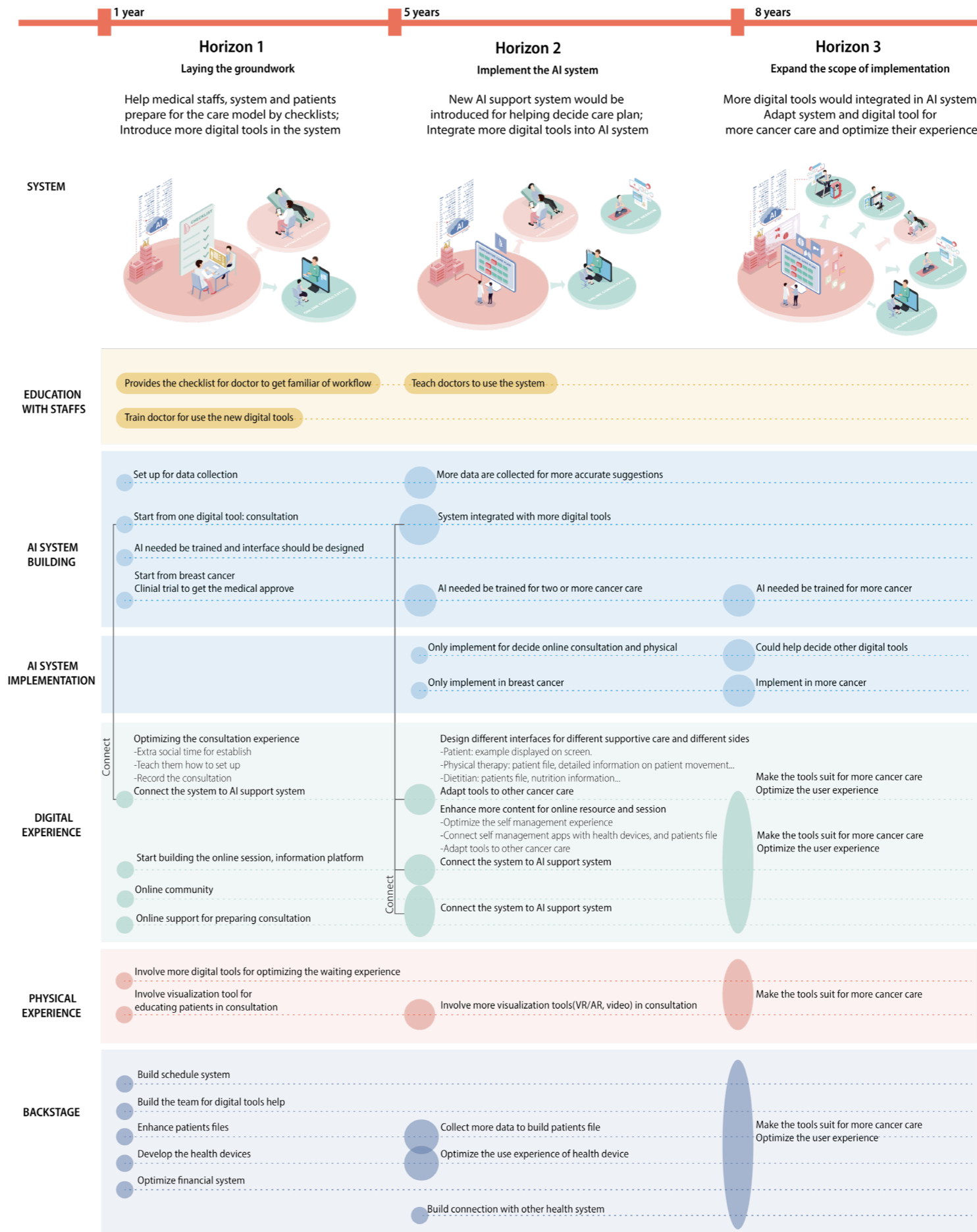
Future vision for 2032
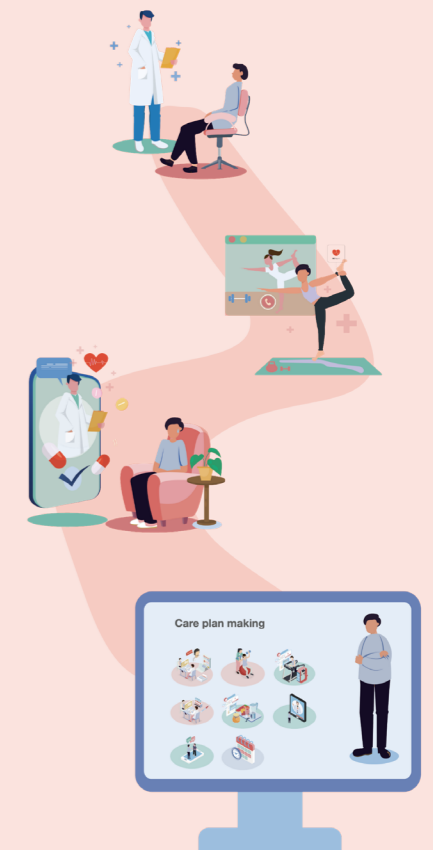
Only by providing patients with digital care that is in line with their situation could the current pressure of the system be relieved and timely, adequate and effective support-ive care be provided to patients

Explaining the three horizons

Horizon 1

Horizon 2

Horizon 3

Laying the groundwork

On this horizon, we expect the health care system to establish the framework to prepare for the future gradually.

At this backstage, the AI system would be developed. We need to collect data to lay the foundation for AI training and conduct clinical trials to obtain qualifications. Also, the system only focuses on deciding on physical or digital consultation to reduce the risk of development in the beginning.

Second, the consultation experience will be optimized, and more digital tools will be introduced in the care plan.

Besides, before implementing the AI system, we help medical staff, system, and patients decide on the care model by providing checklists.

These projects will start with breast cancer patients and expand to other fields step by step in the future.

Implement the AI system

Horizon 2 is a transitional phase when a new AI support system will be introduced to help decide care plan. However, the AI system only helps determine for the implementation of online or physical consultation. It is the result from development in horizon 2.

In terms of digital experience, we keep optimizing the experience of DHIs and adapt these tools into other cancer.

In backstage, we need to continuously optimize the AI system and expand its application of the AI system. On the one hand, we try to implement this system for other cancers, on the other hand, we try to combine more digital tools with the system.

In addition to these, we will also provide courses to help HCPs adapt to digital health interventions.

Expand the scope of implementation

On this horizon, the developed result from horizon 2 would be implemented: integrated with more digital tools and implemented for multi types of cancer.

With the development of digital care, more tools will be used in cancer treatment. This AI system would serve as the platform for integrating all digital tools. In this way, workflow efficiency will be improved, and AI decision-making will be more accurate as more data is collected.

6.2.2 Data collection

For the training of AI to make accurate predictions, the quality of data is the most important. Figure 43 shows what kind of data predicts what care service the patients prefer. This guideline is supplemented and improved by adding the findings from Rosalie and Renn's research on the Gilbert model.

There are six types of data. Firstly, the demographic factors and medical data are available in the existing patient's file. The requirement of supportive care could be input from the HCPs. And patients' perception and capability to care are required for extra patient input, like questionnaires. Others are about the policy implications of the hospitals.

6.2.3 AI training

Before applying this system, we need to spend a lot of time training the artificial intelligence model. Firstly, it needs to be clearly stated that a third-party company develops this AI system. Ideally, it is used in conjunction with the EHR currently used by the hospital, which can be integrated with doctors' workflow and reduce the difficulty of adaptation. In Roadmapping, we can see that the entire system initially only focuses on online consultation and gradually integrates with more digital tools. Starting small is conducive to success. From interviews with IT experts, we know that the requirement to choosing the cancer is that digital can make a difference in this kind of disease. We will initially focus on breast cancer, which is benefited from the application of digital tools from previous research. And then, after passing the clinical test, we continue to expand the scope of application to other cancer.

The lower part of figure 43 shows how these data will affect the patient's preference. For example, patients have other things in their daily life that get in the way of face-to-face care; they may be inclined to choose digital or physical care. These can be the basis for the training AI model.

Figure 43 Data collection guide

As can be seen from Figure 44, training AI is a long process; we need to collect data, train, validate and optimize the model(Sande, 2022). In addition, legal issues (e.g., what happens when the decision is wrong is that the system or HCP is to blame) will take 8 to 10 months to set up. We also need to prepare a clinical study. The medical ethical committee has to approve the clinical trial, which will take 3 months. And get legal approval to go into the market (might cost 8 months).

6.2.4 Privacy consideration
Privacy concerns need to be taken into account when we process data. There are a few tips for addressing the problem.

- Data collection:
Patient consent should be obtained, and we should clearly explain the risks and benefits of participation in research.

- During the training process:
The used data should be anonymized and encrypted. In addition, we introduce a new kind of Swarm learning (Warnat-Herresthal et al., 2021), a decentralized machine-learning approach: SL enables multiple partners to jointly train models without sharing data, potentially facilitating the collection of such large training cohorts. This new approach and principles can ensure data security.

6.2.5 HCPs education
For HCPs, how integrating new digital tools with their work is very important. It is a point repeatedly raised in previous interviews. So in horizon 1, before the AI system is applied, we need to introduce the checklist to prepare the HCPs for the follow-up innovation. We will also provide relevant courses for HCPs to inform them about digital tools, which will be integrated into the system.

In addition, health professionals should be trained to properly use the technological capabilities of AI and digital tools and the limitations of using them as safe tools in practice. HCPs must be able to interpret the results from the system and share a recommendation with patients. HCPs should also be exposed to the new ethical challenges that artificial intelligence will bring to the workplace. (Grunhut, 2021)
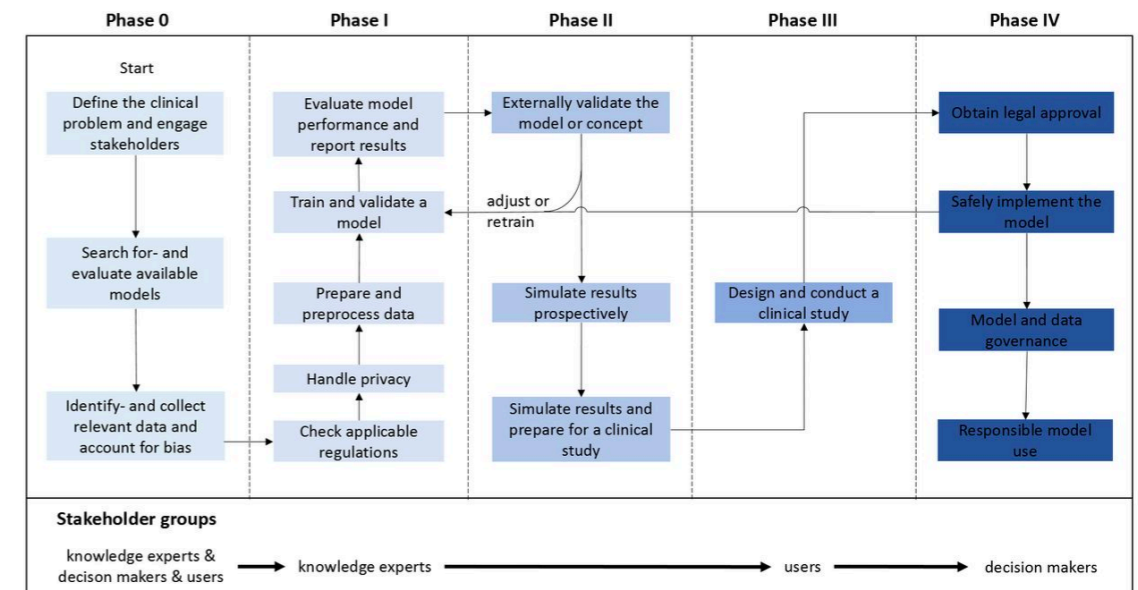

Figure 44 Steps for AI training

6.3 New workflow consideration

We put forward some suggestions for the existing workflow based on the future journey. Figure 45 shows what kind of modification we made in the current workflow. Figure 46 is a "future flow" representation of the following suggestions. Coloured solid lines represent their critical work throughout the supportive care process, and the dashed lines represent the interactions between different stakeholders.

• **Categorize the role of HCPs**
We can see that supportive care will be composed of different forms in the future, like online consultation, offline consultation, and online sessions. A health professional cannot be proficient in all forms of care support, so the division and assignment of roles of health professionals are considered very important. We propose some future parts of health professionals here:
 -who major in physical experience and online-video consultation
 -who major in other digital experiences: like answering the question in chatbot, managing the online session
 -who builds/develops the digital source: writing the medical information or uploading online video
Risk point: In this setting, the patient needs to deal with more medical staff, which will increase his/her social pressure. At the same time, the more people involved in caring for one patient, the more difficult it is to communicate and assign responsibilities.
.
• **Enhance the role of the nurse**
According to the trends, the role of nurses should be enhanced in the future: they could be the coordinator of care services (Carter et al., 2011). They would address patients' information needs and provide emotional support. In a workflow, they make the primary care plan for patients and make a referral when patients need other help. Besides, they could monitor each care service. If there is any reported problem for stakeholders or system, they could be the leader in addressing it.

Risk point: It may confuse the responsibilities of nurses and doctors, so the division of labour between doctors and nurses needs to be precise. In the meantime, the pressure on nurses will increase with increased responsibilities. So there has to be more policy support.

• **Team of digital support**
As more and more DHIs are added to supportive care, we recommend designing a team to provide patients and HCPs with support for digital care. On the one hand, it can help them solve technical problems promptly and optimize the user experience. On the other hand, courses or teaching resources can be created to help them adapt to the new service experience as soon as possible.

Risk point: Providing educational sessions for HCPs or patients will add to their daily stress as they are already busy with their original treatment plans. We must therefore consider increasing their motivation, for example, letting them know that receiving this kind of digital tool can help them in the long term or supporting them with organizational policies.

More stakeholders involved
Supportive care in the future will be more comprehensive, and the scenarios will be more diverse. To provide better service, we should involve more stakeholders in the care system: general practitioners, caregivers, and family members. We could bring them into the MDO meeting to discuss the care plan and consider their opinions when making the care plan.

Risk point: The coordination work between stakeholders becomes essential, including coordinating different people's itineraries and collecting feedback. At the same time, considering patients' privacy, it also needs to be considered whether all stakeholders have the same authority to access patients' data or not.
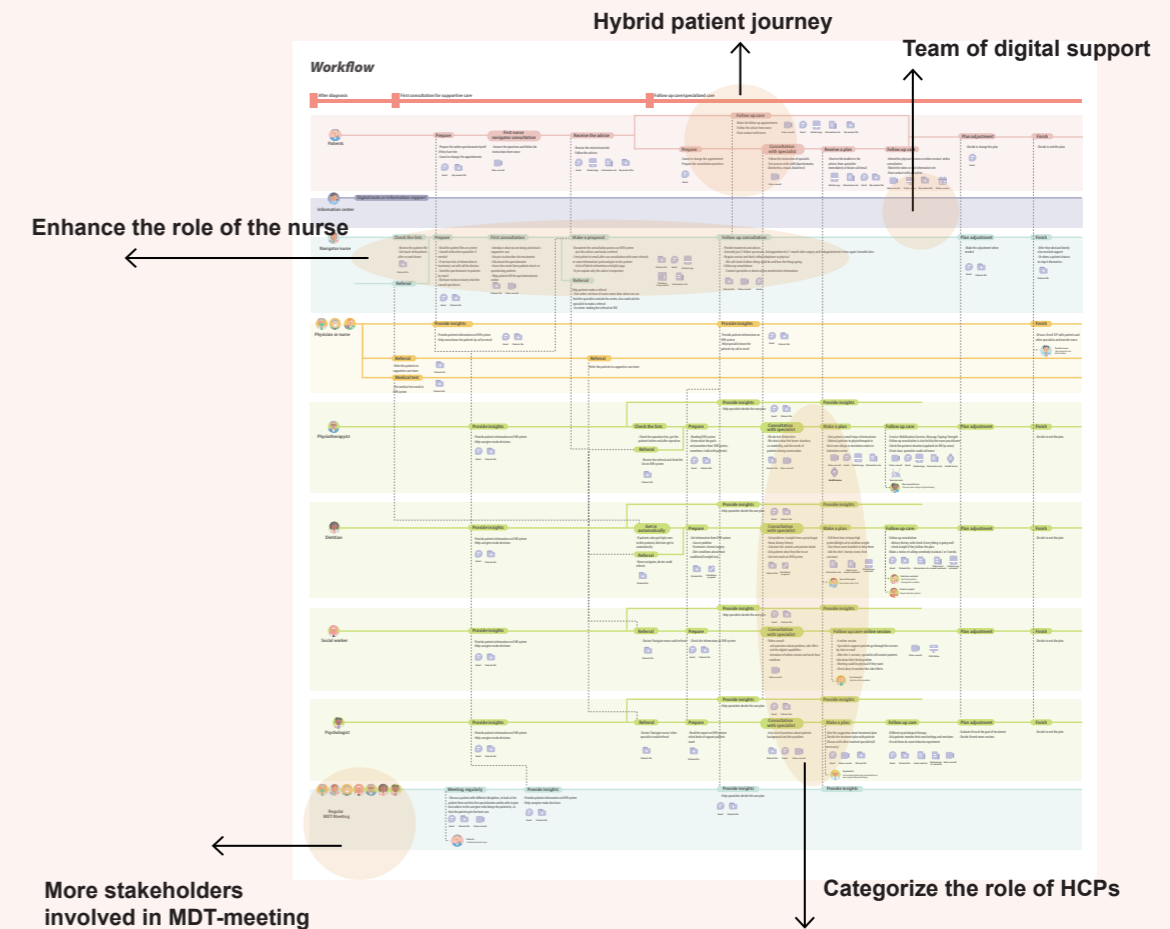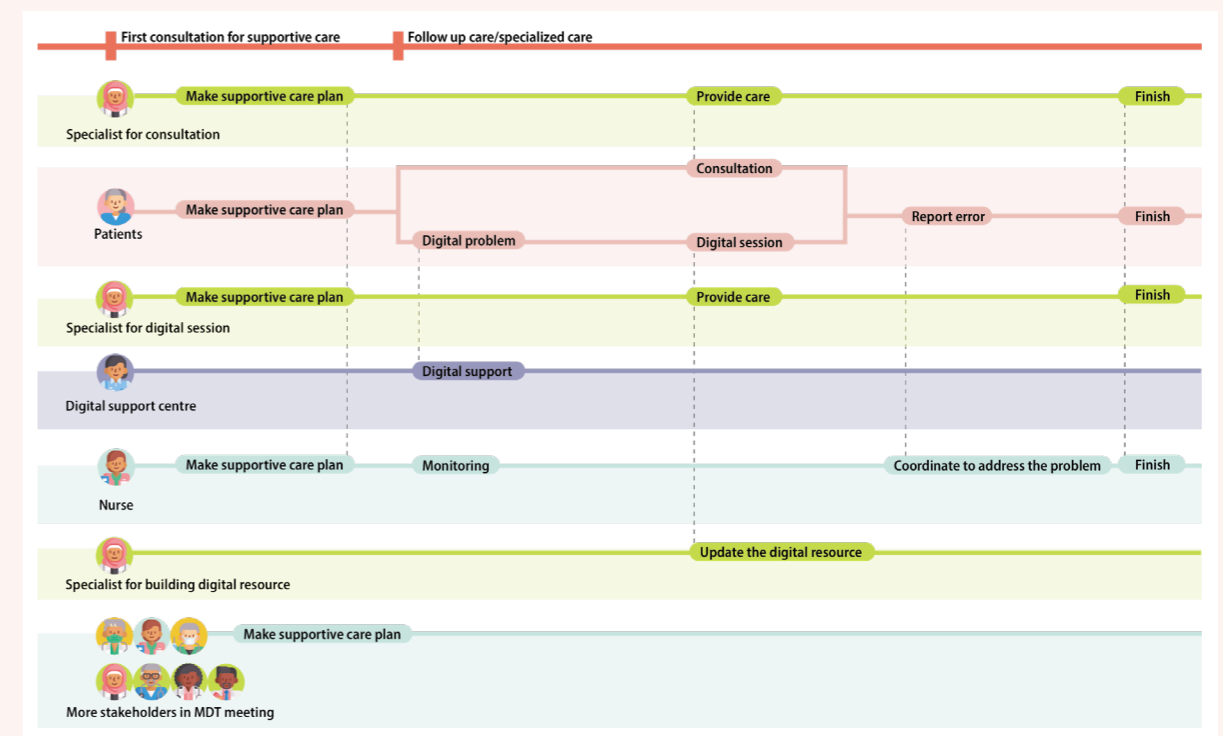

Figure 45 The modification on workflow

Figure 46 Future workflow

6.4 Validation

6.4.1 Validation process

Goal of validation
With the concept developed, we conducted a round of validation with stakeholders and experts. The objective of the validation was to assess if the concept fits with the design requirements set at the design goals and find the strengths and weaknesses for implementation.

Set up validation
The best way to validate is to have a semi-structural interview with the stakeholders. But considering the busy schedule of HCPs, we provide a questionnaire for collecting more feedback as an alternative approach. Thus, there are two ways for validation.
-Fill out the questionnaire
-Have a semi-structure

Questionnaire design
The participants have been required to rated the different interventions accordind to followed questions. The detailed of questionnaire could be found in Appendix L.

Part 1: Future patient journey

• To what extent would this system help patients have more access to care?-Not at all or great (score 1-7)

• To what extent would this system help meet patients supportive care needs?-Not at all or great (score 1-7)

• In this future scenario, to what extent, the workload for doctor would be released than current?-Not at all or great (score 1-7)

• How do you feel this future scenario? why?

Part 2: AI support system

• For the AI system, to what extent, would it be integrated well with the current workflow?-Not at all or very well (score 1-7)

• To what extent would this system help HCPs know how to provide care in digital or physically?-Not at all or great (score 1-7)

• If this system applied in supportive care centre, how do you feel? and why?

• How would you improve this system?

Part 3 Checklist

• Two exercise for helping HCPs go through the checklist and know how to use the checklist.

• To what extent would this checklist help HCPs know how to provide care in digital or physically?-Not at all or great (score 1-7)

• How would you improve this checklist?

Hypothesis

For the future scenario, it could increase the patients well-being

For the future scenario, it could decrease the pressure in current supportive care system

For the AI system, stakeholders think its integrated well with the current workflow

For the AI system, it could help stakeholder to choose the care model for patients

For this checklist, it could help stakeholder to choose the care model for patients

Participants
We have invited four medical workers to attend this validation. They are from different fields of healthcare. Also, as a design project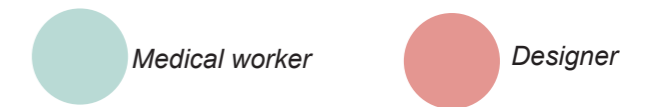, we asked three designers to give their opinion from design perspectives. Their background and the type of validation they received have been presented in figure 47.

Particpant	Expert in IT department of Healthcare	Navigating nurse	Nurse practitioner	Healthcare designer	Healthcare designer	User experience designer	Psychologist
Background	The Medical PhD working in IT department of Healthcare	Working as a support consultant in supportive care for about 6 and half years	Working for supportive care team for over 10 years	Master student	Master student	Master student	Working experience around 5 years
Type of validation	Interview with questionnaire	Interview with questionnaire	Questionnaire	Questionnaire	Questionnaire	Questionnaire	Only with interview

Figure 47 Overview of participants

6.4.2 Result
We have calculated the average score of medical workers and designers. Also, their opinions from open questions and interviews are concluded for further development.

Medical worker   *Designer*

Future patient journey

Not help patient access to care — Helpful
4.67
6.00

Not help meet patients supportive care needs — Helpful
5.33
6.00

Not help release workload — Helpful
4.00
5.00
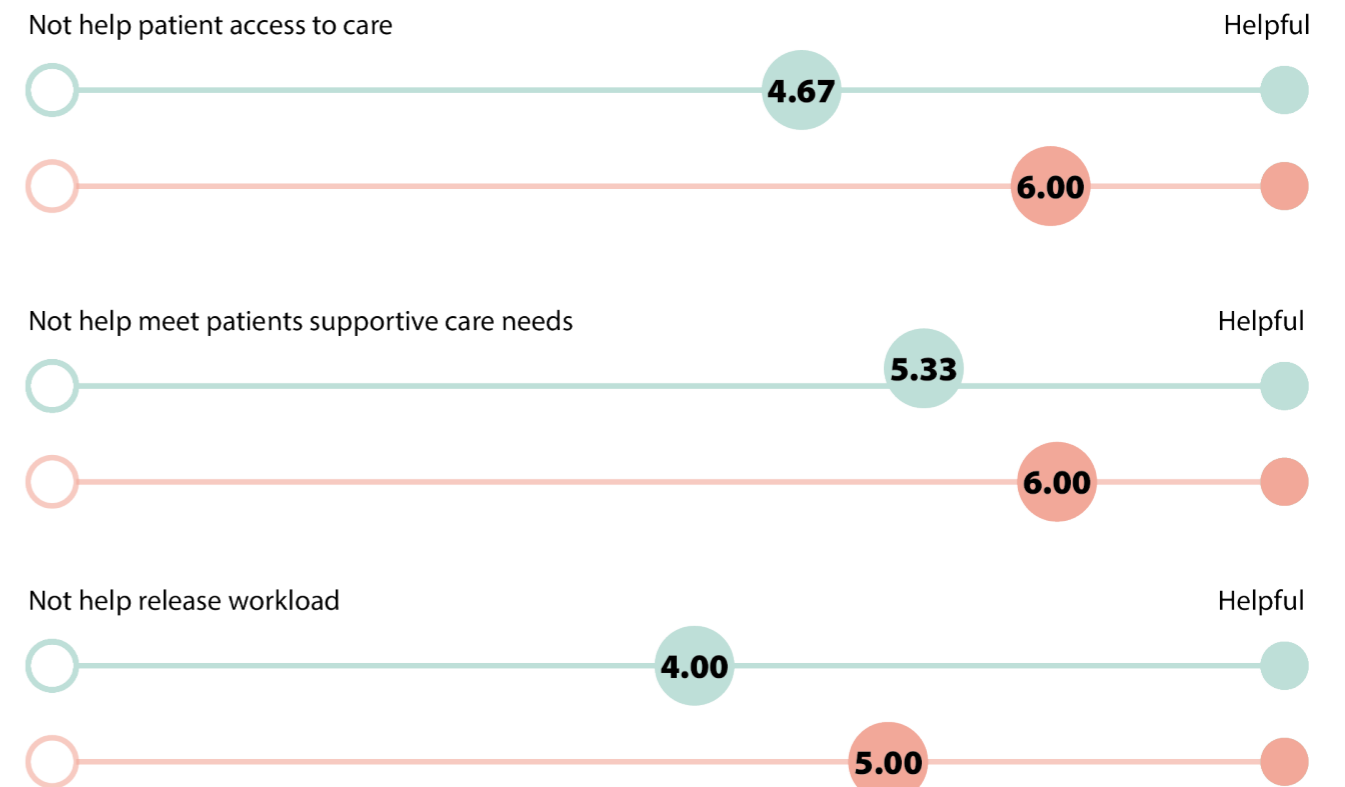
Medical worker

Medical workers like personalized care pathways, believing the patients would have more control over their treatment. Also, it could help patients with digital skills access care and release the burden on the long waiting list. Besides, they consider it essential to clearly show the benefits of digital care, which would help HCPs and patients adapt to digital care.

> "For patients with digital skills, it would give them more control and personalization options for their diagnosis and treatment. Digital tools might be more available to them than scarce healthcare resources. "

> "I like the idea of personalized care pathways. We would need a more robust digital foundation to enable it. "

> "It's very dependent on how you present that option to the patient, and they could decide whether they would use it or not. The way you present it could lead patients to use it more."

Designer

Designers also believe the patients would be more in control and get help effectively. But they are still concerned that even with AI, it may take time for doctors to personalize the patient journey and feel curious about the role of other stakeholders, like family support.

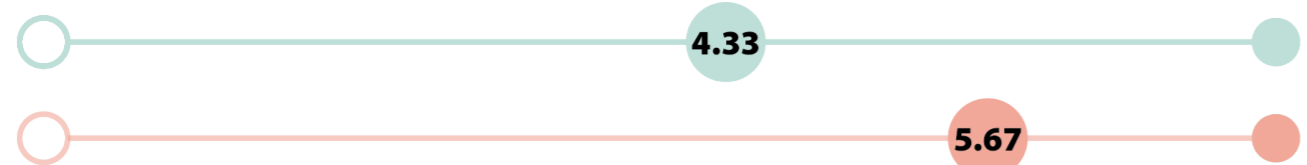> "I could feel it is an ideal scenario of supportive care for a cancer patient."

> "AI could predict and set the personal paths for the patient that is quite nice. So the patients will feel more control of their conditions."

> "Their relatives could also be the people who contact the hospital directly on behalf of the patient. Then you could also consider these stakeholders."

AI support system

Not integrated well with the current workflow ⎯⎯⎯⎯⎯⎯ Integrated well

○ ⎯⎯⎯⎯ **4.33** ⎯⎯⎯⎯ ●

○ ⎯⎯⎯⎯⎯⎯⎯ **5.67** ⎯⎯ ●

Not help HCPs make decision ⎯⎯⎯⎯⎯⎯ Helpful

○ ⎯⎯⎯⎯⎯⎯⎯ **5.67** ⎯⎯ ●

○ ⎯⎯⎯⎯⎯⎯ **5.33** ⎯⎯⎯ ●

Medical worker

They think such a system can benefit and help integrate physical and digital care. But there are still a lot of workloads to achieve. At the same time, they think it is essential to incorporate patients' opinions when making care plans.

> "This would be amazing to have working. It could really integrate digital care with more traditional physical care. a major hurdle for now would be the *digital infrastructure required to*

enable it. But this could all be solved technically, if we would really work at it."

> "I think it will be the future:) The digital way makes it easier and gives the patient his information and mayby it gives the patient more control."

> "Maybe some patients would also like to pick it up themselves by going to this online environment, and they could browse you know what's available and see what fits them or not"

Designer

The designers all think that the design of the system is clear, and it could give freedom to HCPs to make a new plan. And they also provide suggestions for optimizing the interface design. For example, maybe it could add the communication part where the staff

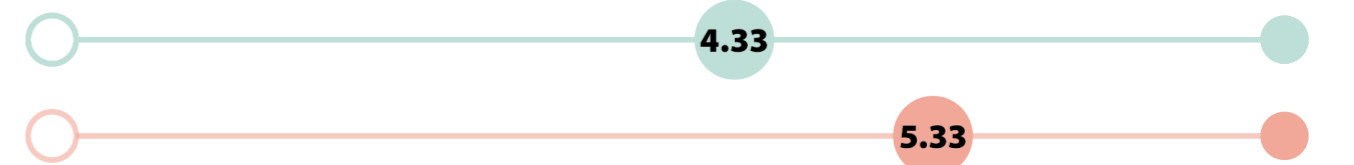could leave a message for the patients.

> "I think it's quite flexible to use for the staff. The staffs are free to follow the recommendations or their own opinion."

> "The system is quite easy for HCP to provide hybrid consultation. The UI design is clear. And it's smart to show the process of each consultation service."

Checklist

Not help HCPs make decision ⎯⎯⎯⎯⎯⎯ Helpful

○ ⎯⎯⎯⎯ **4.33** ⎯⎯⎯⎯ ●

○ ⎯⎯⎯⎯⎯⎯ **5.33** ⎯⎯⎯ ●

Medical worker

They think this checklist helps clarify their thinking, but the sentences used should be more concise to be easier to understand. Also, one nurse reported that she did not know when to use it, which was caused by the unclear description in the questionnaire design.

> "Questions/prompts by the checklist are a bit unclear for me."

> "I think the checklist build the questions are OK, it's understandable."

> "It's unclear when to use the checklist for me."

Designer

The designer thinks it can be helpful but proposes some revisions, such as emphasizing the important word like "not" in the question.

> "As a novice for supportive care, it could help me make the decision easier."

> "Maybe different categories could have the priority which depends on the patients' preference. Then staff could make the decision easier."

> "Emphasize the important word like "not" in the question."

6.4.3 Conclusion

Overall, healthcare workers and designers rated the design output highly. First, for the future journey, such a personalized approach can help meet the needs of more patients for supportive care. By involving more e-health, users can get treatment faster and have more control over the treatment plan. In addition, the AI system prototype and checklist exhibited can help doctors make decisions, but the AI system is in more positive feedback. The validation result shows the potential for implementing such hybrid patients journeys in the supportive care context.

Medical worker

We can see that the scores from healthcare workers are generally lower than that of

designers, especially for workload-related questions(4.00). From the interview outside the questionnaire, we found they think it's pretty nice that the system is related to the current decision-making system. Still, they feel it would have a considerable workload to develop it and know how to use it.

Designer

The designers gave a high score but also gave a lot of improvement ideas from the design point of view, which we summarized in the recommendation in the next chapter.

Conclusion and recommendation

This chapter is the closure of the project. We presents a reflection on the design concept and a conclusion of the project, including recommendations for the future development.

7.1 Recommendation

Design of AI system
We hope to strengthen the interaction design of the AI support system. Here are two recommendations for future innovation:
1. It's important to consider integrating this system with the existing workflow. Besides, the way of interaction cannot be complicated, and it should adhere to the principle of high efficiency
2. For the recommendation from the AI system, it is necessary to explain the reason behind it, like why this patient is suitable for digital care. We believe it can help HCPs better understand the system's suggestions.

Personal patient portal
We also recommend optimizing the personal patient portal. Some hospitals now have their patient portal to keep the patients up to date on their health status, like MijnAVL. However, from our research, it has shortcomings such as untimely updates of data and lack of functions. We suggest in the future, it could have more modules, like providing a preview of future care content, or the patient could add care context myself. It is also a place for patients to manage their care plan progress and communicate with medical staff.

The experiments of Checklist
Additional experiments are needed to test the Checklist's usability. We recommend asking the medical staff to use this Checklist to formulate a care plan in the actual consultation. Thus, practical feedback could be collected for further research.

Validation with patients
This project's evaluation and validation processes are only conducted with medical workers. The input from patients with cancer is only in the research part. Therefore, we suggest that in future research, it is necessary to have more feedback from patients, which is conducive to ensuring that innovation is user-centred.

Co-creation on workflow
In the previous article, we mentioned suggestions for future workflows. These suggestions provide a possible direction. In our opinion, workflow innovation requires perspectives from different related interests. Therefore, we think it is necessary to carry out a co-creation workshop. The division of responsibilities can be agreed upon in the workshop. And they could discuss the problem of who becomes the coordinator and how to incorporate more stakeholders into the care plan in the workshop.

Consider involving family member
Family support is an important part of supportive care. Not too much consideration was given to this project. We suggest increasing the responsibility of family members in the care plan. For example, they can support patients with digital care. Also, we can add the tasks which should be finished with the family in therapy and invite them to join the MDT meeting.

Increasing physical experience
This project has focused on digital experience. However, to build a good patient experience in the hybrid model, it is also essential to have an excellent physical visiting experience. It is, therefore, also necessary to strengthen this part in future research and examine if any problem influences the smooth transition between digital and physical.

Data visualization
The patient information from the current EHR system(Hix) is clear and well organized, but it has too much text to understand immediately. I think visual symbols such as icons could be used more widely. Meanwhile, the level of information needs to be designed more. For example, information could be displayed differently for different specialists as each requires different information. It facilitates the reading of all the patient data.

Data management
Data privacy has always been an issue in the development of digital tools. In particular, we need to develop the AI system and need more data to train the system. As a result, we must inform patients of the intention to use their data and obtain their consent before adopting them.

Furthermore, as more stakeholders are added to the care plan, there is a need to manage individual stakeholder access to patient data. Data management needs strict regulation.
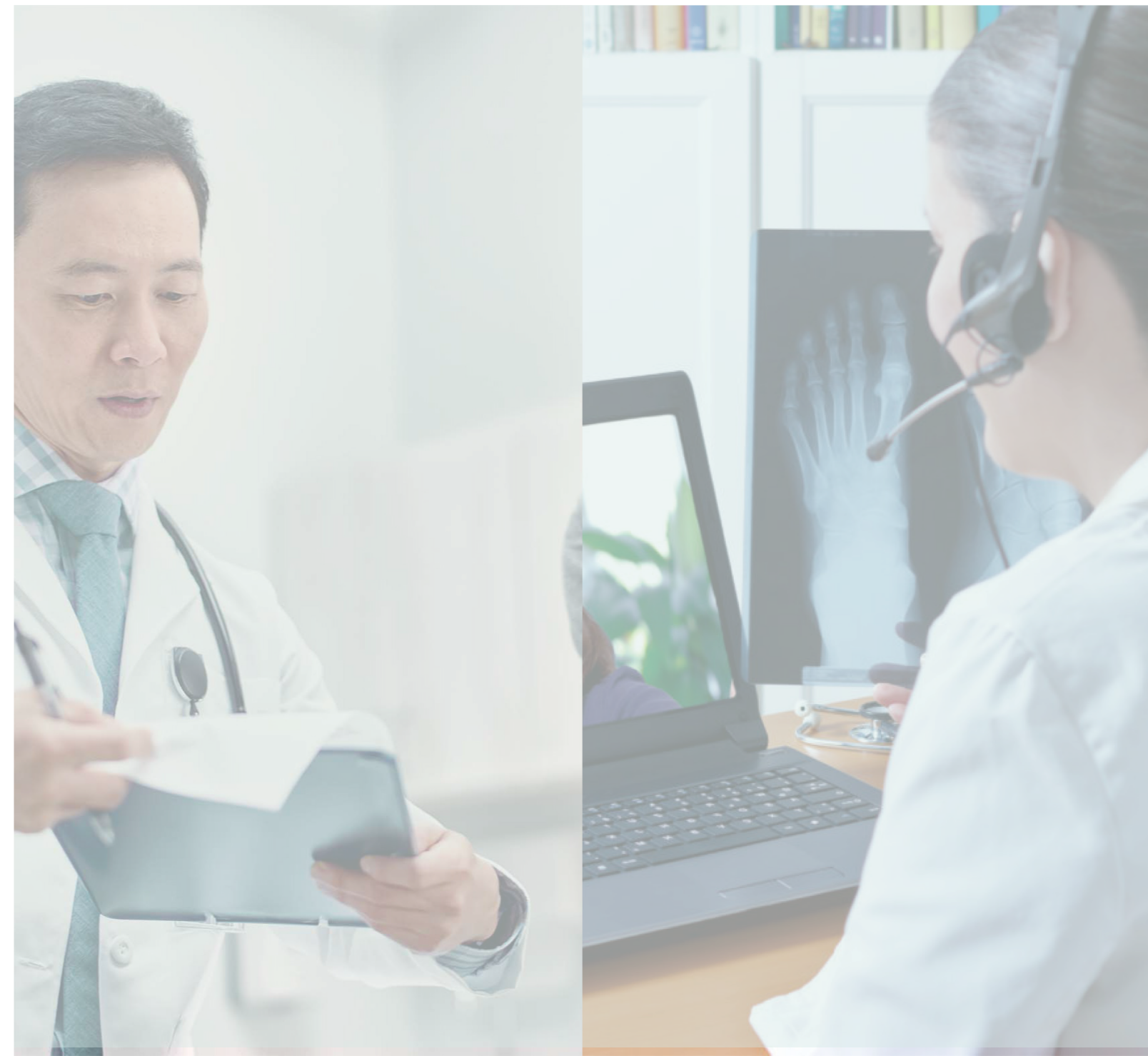
7.2 Conclusion

Throughout this project, the initial research aim was to design: **Design a hybrid patient journey in supportive care**. Also, the following sub-questions have been answered:

-What role does digital care play in the support care plan? when and how?

-What other opportunities to improve the digital health experience in supportive care?

-What factors drive patients to choose different care models?

-What does an organization need to offer, and how do they adapt to change?

In literature research, we narrowed the focus group to 30-60-year-old breast cancer patients under treatment. We also got a preliminary understanding of the problem in SCP and the role of this in SCP. These became the basis for later research investigations. And most importantly, we found the model to illustrate interactions between mechanisms that influence preference for digital care. This model became the design of the checklist and data collection guidelines.

Supportive care is a complex issue, and understanding the attitudes of different stakeholders can help us understand the problem systematically. Thus, we conducted different researches on patients, HCPs and experts in healthcare. These insights have told us about the issues in SCP and e more possibility of more DHIs. The main outputs of the in-depth research are the current patient journey and workflow. The former is helpful for us to find design opportunities, and the latter is useful for implementing innovation within the organization.

We found that delay intervention is the biggest problem of SCP, which has prevented patients from accessing care quickly. It is mainly because most care plans are offline, and the limited medical resources could not handle so many patients. Many patients can improve their quality of life through self-management or online therapy, while HCPs can pay attention to those patients who need a face-to-face consultation. It is also the most crucial advantage of DHIs.

But we can't blindly transfer all patients to digital care; it's essential to provide the proper care to the suitable patients. Therefore, we build the future vision:

Only by providing patients with digital care that is in line with their situation can the current pressure of the system be relieved, and timely, adequate and effective supportive care be provided to patients.

Under such a future vision, we have two design missions. The first is how to provide the correct patient care, and the second is what kind of digital care would be selected in the supportive care context.

We finally mapped the future patient journey through continuous design and iterative testing with stakeholders. It shows how two design missions make up the hybrid patient journey. Besides, for the first mission, we designed the prototype to visualize how the AI support system will help patients in the future. Meanwhile, to help better application innovation, we also designed the roadmap and other implementation strategies. We found that for implementing innovation successfully, it is essential for HCPs to adapt it quickly and smoothly, so we took the following measures:

1. We design a checklist to help HCPs have a mindset of the hybrid journey before the AI system is fully applied.

2. The prototype is also recommended to develop on the existing EHR system rather than design a new product.

3. In roadmap, we recommend providing training courses for HCPs about AI supporting systems and new digital tools.

For the second design mission, we proposed the digital touchpoint in the future patient journey and designed the opportunity card to give a more detailed description. It would provide a lot of inspiration to those who want to conduct digital innovation in the medical field.

After completing the design, we also conducted verification. From the results, the future patient journey, including prototype and checklist, can help patients get intervention faster and help HCPs focus on patients who need more care, which met the design goals.

7.3 Relevance of project

This project gives the overlooking of the hybrid model. This sub-chapter describes the project's relevance by reflecting on the desirability, feasibility, and viability from the point of view of the patient and HCPs.

From the point of view of the patient

Desirability: Does it address the user's needs?
The concept was developed through two insightful research phases that led to conclusions that contributed to creating a justified and desired design. First, we thoroughly read the literature in the preliminary study, which was built upon reliable user research.

Secondly, in in-depth research, we coded the online patient story to conclude the main problem in SCP. Patient-reported health care experiences in a narrative format on the internet are a valuable data source for implementing patient-centred care (Zolnoori et al., 2019). These stories are data uploaded by patients, reflecting their needs and thoughts. We also reviewed the data to ensure compliance and validity.

Third, we also received a great deal of information from health professionals. They are often connected to patients and can understand their needs. In the later validation process, the design results also obtained positive feedback. They believed this could help patients have reasonable control over their care plan and access to care.

However, there is still a long way to go. For example, we do not have an evaluation with patients to obtain more direct advice. We recommend testing ideas with patients in further research.

Feasibility: Can it be done?
The concept proposal uses technology developments that are already there. Indeed, to complete such innovation does require a lot of work, including data collection, institutional innovation, etc. Still, as long as the investment is started, we will solve these problems.

> *"A major hurdle for now would be the digital infrastructure required to enable it. But this could all be solved technically, if we would really work at it."*

Viability: Will it survive in the long term?
Digital has become a trend to be involved in the health system. In the future, the technology will be more developed to support more digital medical services.

Meanwhile, more and more cancer patients require more care from professional doctors. Therefore, the demand for this service will gradually increase, resulting in a shortage of medical resources. By introducing digital health, the pressure on the medical system can be relieved.

Furthermore, with the popularization of intelligent products, elderly patients will also have higher digital literacy in the future. The patients are also getting used to the technology developments and advantages.

From the point of view of the HCPs
Desirability:
Our proposed hybrid patient journey, AI support system and opportunity points of DHIs in the future user journey. The concepts were developed and finally validated with HCPs. They thought these concepts could help them categorize patients, focusing more on patients who need more help and relieving the patients on waiting lists.

The hybrid model proposal will not replace traditional treatment but will combine the advantages of traditional and digital care. Meanwhile, the design of the AI system will not replace the doctor's dominant position in decision-making and care plans but will assist in decision-making. Furthermore, the digital tools could also reduce the HCP's workload, giving them enough time to discuss with the patient. These benefits would lead to creating patient-centred care.

> *"I think it suits our future vision as well. I believe these plans are in my colleagues or me's minds."*

Feasibility:
To truly realize such a vision requires innovative development from technology and organization. Technology development is feasible, as we have analyzed in the previous article, as the roadmap toward the future vision we have given before.

Regarding the organizational innovation, we proposed a new workflow, including refining the refined classification of HCPs and adding more stakeholders to the MDT meeting. These developments would take time, but they are also achievable. Meanwhile, before applying the AI system, we also provide a series of measures, like the checklist, to help HCPs adapt to the new workflow.

The design is financially feasible. Early investment takes a lot of money. However, after practical implementation, the hospital can take care of more patients, and it will be able to optimize its types of service and hours, thus increasing revenues.

Viability:
The new patient journey combines artificial intelligence support systems with various digital possibilities. Patient data will become increasingly complex, making it challenging for health professionals to process such complex data. AI support systems will help them process complex data and increase decision-making effectiveness. At the same time, according to the patient's condition, the system formulates different care plans for the patients so that medical resources can be allocated more reasonably and give doctors more capacity to handle more patients.

In addition to introducing more digital tools for optimizing the patient's service experience, the digital tools backstage will also help physicians improve the efficiency of working. Such new hybrid care models would be the future of supportive care.

> *"Now, there's already too much to know as a doctor. You can't know all; you can't always do the right thing. Protocols are becoming too complex to do from memory, so they will need support and advice and want to do when."*

7.4 Reflection

Thinking after a project is always a good thing. In this chapter, I will reflect on the past twenty weeks of my journey and summarize what I have learned and developed in my graduation project.

As I deepened the design issues, the personal learning goals I listed in my project presentation were achieved. In addition, I have also discovered that I have reached the additional learning objectives that have not been listed in the project brief. I will elaborate on these various learning objectives later.

7.4.1 Personal learning objectives

• **Developing the ability to deal with complex problems**

This learning objective has been achieved. In preliminary research before the kick-off meeting, I found the exciting topic "hybrid model". This topic is also about medical design, which I believe could increase the ability to deal with complex problems. It is the case. As digging deeper, I discovered that the subject was more difficult than I thought. There is not much literature on the hybrid model. I always had a lot of doubts at different stages. Luckily, with my mentors' help, I could always find a design approach to solve it.

At the same time, I got a lot of data during the research process, and I tried many ways that I could present such complex data. I believe the ability to deal with complex data could help treat complex problem. Throughout the project, I learned how to simplify complex problems, solve different issues in different ways, and deal with complex information.

• **Developing the ability to optimize the patients' digital experience.**

The learning objective means I want to get more insights into how to develop the patient's digital experience.

First, the insights I gained during my research can be translated into ways to deliver a digital experience. So I think I have reached my goal.

Second, in addition to knowing a lot of insights, I learned a lot of methods to gain the insight. For example, how to utilize online patient stories to conduct user research, design toolkits to help interviewers express themselves during interviews, etc.

Finally, I also learned that in addition to improving the experience of patients, for innovation to be applied in the medical field, it must be accepted by medical workers. So I collected voices from different stakeholders. It was an interesting experience to learn the point of view of non-designers, who also know the medical industry best.

• **Digging deeper into the fields of health context**

The purpose of this goal is to hope that I can learn more about the medical field. I think I've made progress towards this goal.

First, I visited different hospitals in the Netherlands and learned more about the organization of care centre, which Chinese hospital doesn't have.

Second, in addition to the patient experience, I mapped staff workflow, including the digital tools they use at work. Before the project, I had only been to visit General practitioners and pharmacies. During projects, I gradually learned about the Dutch healthcare system.

7.4.2 Additional learning objectives

• **Make good use of resources**

During the research process, I interviewed many staff and experts in the medical field. Thanks to my mentor for introducing their resource of HCPs to me. Also, I feel pround that most of them were contacted by myself. I found their email address online and sent multi emails proposing an interview. Especially the interview with the caregivers in AVL, I sent different files and even gave a presentation before the department leader to get this chance.

• **Communicating my project**
I introduced my research to various people throughout the project, including IT specialists, medical students and design students. Sometimes I prepared slides; sometimes, I used video. By speaking with many stakeholders and asking for their comments, I developed my project and gained a lot of confidence. I am also better at communicating my designs through this experience.

• **Have more empathy for patients with cancer**
I am thankful that I chose supportive care as my research topic. Arthur Kleinman has proposed four medical paradoxes, one of which is that traditional medicine places care at the heart of clinical practice. However, it is increasingly marginalised in practice, and the medical system lacks humane patient care (Kleinman, 2019). Throughout my research, I have deeply felt the need for patients for supportive care and how important it is for patients. I am happy that much medical staff are working to resolve this issue.

7.4.3 Conclusion

This graduation project was also a process of self-discovery for me. It lets me know what I like, my strengths and weaknesses, and where I want to go. I felt grateful I was dominant throughout the project, which means I could do what I wanted. Thanks for the inspiration and encouragement from my mentor. I hope my graduation project has added value for both the patient and the health care sector by giving these insights to develop a hybrid model. I felt proud of my dedication and results.
Thank you.

Best regards,
Tingwei Long