From Prototype to Proposition: a Design Perspective on Scaling The Box

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From Prototype to Proposition: a Design Perspective on Scaling The Box

*Framing Design Opportunities for Scaling while Supporting
an Efficient Workflow that Reduces the Burden on Healthcare Professionals*

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EXECUTIVE SUMMARY

With the increasing digitalization of healthcare, eHealth is on the rise to be of great influence in the care pathway of patients. As LUMC saw the importance of eHealth, and with that patient home monitoring, they started implementing The Box six years ago at the department of Cardiology. "The Box" is literally a box, filled with monitoring devices that patients can use to perform monitoring activities in the comfort of their own home. Measurements are taken at home, in order to discuss the results, if necessary, later on with their treating physician or nursing specialist over phone or video consult. The success of the service relies on active patient participation. With The Box, the treating medical team now has insights in the patient's health condition from a distance. Not only does it not require the patient to be physically present in the hospital, but there's now even more reliable data available to adjust the treatment to. It makes the care path insightful and approachable by both parties, resulting in accessible digital consultations.

Since The Box has proven to be a success in patient care, several departments started adopting this service as well. However not much attention has been given to how the healthcare staff at LUMC is experiencing the implementation of The Box. As the idea of patient home monitoring looks very promising, the reality however is quite discrepant. Not having the physical presence of patients in the hospital, would appear to reduce the burden on healthcare staff, as instead these "empty" hospital bed will simply be taken up by other, even more severe cases, causing a larger amount of patients to both monitor digitally and take care for physically. It leaves us with the question of "Who will do it?". Who will take on the so to speak additional workload?

Due to the aging population, their chronic diseases and even comorbidities, the amount patients that requires frequent care increases every day. This concludes in a shortage of doctors and nurses, leaving them with more work than they can to take on, resulting in a high workload and regular burn-outs which doesn't really contributes to the care-team well-being. The healthcare staff at LUMC is experiencing more workload with the implementation of The Box as its intended use is mostly focussed on

remote and safe patient monitoring, while missing out on an opportunity for assisting the care-team. It occasionally happens that additional staff is hired to cope with the excessive workload, or that LUMC is also investing in an intelligent system that prioritizes patient data. But momentarily, healthcare staff's solution is simply to not check up on every patient that sends in data.

The reason why staff reacts the way they do when being asked about workload, is because for them The Box appears as an implemented innovation in their care practice, when in reality it is still a prototype; a research experiment. Therefore The Box requires scaling from a prototype stage towards a mature proposition for an improved standard healthcare practice. The combination of opportunities that came out of the research resulted in the creation of a future vision which is that The Box becomes more than a tool for patient remote monitoring, as it reduces the workload and burden on healthcare staff by increasing patient independence and strengthens hospital resources. The goal is to turn The Box into a mature proposition that can be implemented hospital-wide, but also has the ability to change the current healthcare system. The burden on the care-team must be suppressed or else the future will include an immense scarcity of healthcare professionals of which the majority will be burnt out.

A roadmap is created to show both opportunities for continuous prototyping and what value they bring, scaling strategies, patient monitoring and what level of staff involvement it demands, required developments and finally stakeholder collaboration. What it actually proposes are the changes that need to be made to create an integrated healthcare solution that is focussed on "unburdening" the staff. However, LUMC is not capable of bringing this change along solo: they are specialized in research, education and healthcare, yet they lack expertise on data management, financial resources, digital developments, etc. It therefore needs the support of multiple organisations. The aim of this deliverable is to show a designer's perspective on scaling The Box from a prototype level towards a mature healthcare proposition

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0. BEFORE WE GET STARTED

This chapter provides information that is relevant for the reader to know and understand before starting to explore the following graduation project. In here a brief overview will be given on the project context regarding the partners. It also provides the reader with a project guide that provides information on how to read this paper in addition to the three most relevant definitions to the project, which are workload, efficiency and scaling. Finally, a project structure is given to understand the approach of the graduation project.

PROJECT CONTEXT

PARTNERS

This project was established between Leiden University Medical Centre (LUMC) and CardioLab, which is a Delft Design Lab. It is in collaboration with Philips and the faculty of Industrial Design Engineering at the Delft University of Technology. This sums up the most important and direct partners of the project –TUDelft, LUMC and Philips– however, there are other parties involved, who offered their support at times, but served a rather indirect contributing role in the project –HLC and NeLL–.

Delft University of Technology (TUDelft)

The project is carried out for the Delft University of Technology; a university where education and research lay at the heart of the organization. At this technical institute, the master of Strategic Product Design is provided at the faculty of Industrial Design Engineering (IDE) to students who wish to pursue a future in strategy, design and technology. In order to obtain a TUDelft Master of Science degree, the university is providing both mentor and chair to supervise the project, which are in this case respectively Dirk Snelders and Maaike Kleinsmann. Valeria Pannunzio will serve as the CardioLab company mentor, and was be the primary mentor and contact person for the graduation.

CardioLab

Together with the faculty of Industrial Design Engineering at the TUDelft, Philips Design decided to join forces to create this design lab, where they explore how smart technologies can help improving the life of cardiac patients and detect or even prevent cardiovascular diseases. The lab aims to and supports its students to design data generating product service systems, mainly for cardiac diseases, but also for other medical conditions (CardioLab, n.d.). Both Maaike Kleinsmann, lab director, and Valeria Pannunzio, project company supervisor, are affiliated with CardioLab.

Philips

Over the last few decades, Philips has become more healthcare oriented and this is noticeable in all their latest innovations, focussing on human-centredness. They provide products, services, technologies, and solutions in general to improve and promote healthy living. At the heart of innovation is research and

with that in mind, Philips reaches out more often to universities for student projects (Philips Healthcare, n.d.). Design Innovation Manager Jeroen Raijmakers assisted in the project when necessary as a Philips company mentor, however he is not listed officially in the project brief.

Leiden University Medical Center (LUMC)

Medical innovation is what the LUMC stands for. They are constantly looking for improvement in patient care by doing scientific research. That's why it's not just a hospital, but also a research centre performing many activities in order to provide better care for patient and family. Leiden University Medical Centre is a joint collaboration and partnership between the Academic Hospital Leiden and the Faculty of Medicine of the Dutch University of Leiden (Leids Universitair Medisch Centrum, n.d.). The Box was co-initiated by Douwe Atsma, a Cardiology professor at Leiden University, who will also be supporting this project.

Hart Long Centrum Leiden (HLC)

The Hart Long Centrum Leiden covers three hospital departments; Cardiology, Thorax surgery and Long diseases, and was one of the driving forces behind the very first box project for the department of cardiology. It's an organization within the Leiden University Medical Centre, that provides patients of those departments with the most innovative care (Hart Long Centrum, 2015). As they are not involved in the department of Gastrointestinal surgery, they will not be an official partner this specific box project, however they are still supporting all other outcomes and extensions of the box projects.

National eHealth Living Lab (NeLL)

The right care can be expensive and is not always available for everyone. To assure ourselves of a prosperous future in healthcare, the National eHealth Living Lab was founded by LUMC to develop new implementations of digital transformations to promote smarter care. The lead role in this story is for eHealth. Nowadays the understanding of eHealth regards Artificial Intelligence, such as Machine Learning, but also the incorporation of apps, sensors, wearables, video communication, and even robots. But in general, it just includes digital information and communication to improve and support health and healthcare (National eHealth Living Lab, n.d.).

PROJECT GUIDE

As the majority of this graduation project exist out of elaborative research and its extensive analysis, it evolved into a comprehensive report. Simply said: there is a lot of text. To provide the reader with a good hold on the research and its structure, there is a short introduction written at the beginning and end of each chapter. The introduction highlights what will be discussed in that portion of the paper. If there is only a limited amount of time to go through the report, it is advised to read those sections first and dig deeper into the preferred chapters.

List of Abbreviations

AI	Artificial Intelligence
ECG	Electrocardiograms
EHR	Electronic Health Records
EPD	Elektronisch Patienten Dossier *(Electronic Patient Files)*
FAIR	Findable, Accessible, Interoperable and Reusable
FCM	Frame Creation Method
HIT	Health Informatioxn Technology
HiX	Healthcare Information X-change
HLC	Hart Long Centrum
ICT	Information Communication Technology
IT	Information Technology
LUMC	Leiden University Medical Centre
NeLL	National eHealth Living Lab
Poli	Outpatient Clinic
QA	Quadruple Aim
SEH	Spoedeisende Hulp *= ER = Emergency Room*
TA	Thematic Analysis
WHO	World Health Organisation

Important Definitions
On the right.

WORKLOAD

Workload is defined as the variety of tasks healthcare professionals have to perform during working hours, both on The Box and on all patient-care related activities. It is a subjective interpretation as it relies on one's perception of workload and not the actual amount of work.

EFFICIENCY

Efficiency is defined as the way time and resources are spend on tasks by health professionals during working hours, both on The Box and on all patient-care related activities. It is an objective interpretation as it relies on measuring the use of time and resources that is spend on doing the activities.

SCALING

Scaling is defined as the development of The Box from the prototype stage towards a mature proposition for an implementation in LUMC as a general way of doing practices. The Box is seen as a solution that is used in an experiment but has an intended use to become a mass product on a national —or even international— level.

PROJECT STRUCTURE

In addition to finding out 'how' and 'why' healthcare professionals at LUMC experience more workload coming from The Box, this project aims to identify what the challenges and potential barriers are for scaling this service. The goal is to identify opportunities for both TUDelft, Philips, and LUMC in assisting scaling up The Box from a prototype level towards a mature proposition. A brief overview is given on how this is addressed in the graduation project, and is visualised in **Figure 1: Project Approach**

The main structure of the thesis consists of the Double Diamond approach by the Design Council (2005). It is a regularly used technique because on its iterative structure in converging and diverging. There are four phases in total: '*Discover*', '*Define*', '*Develop*' and '*Deliver*'. These will also be used as a format for separating the report into meaningful sections. The first diamond is represented by '*Discover*' and '*Define*' *which* assist in answering the question of "Am I designing the right thing?", as with 'Develop' and 'Deliver', it's more about "Designing things right".

The Double Diamond is not the only approach that is providing structure to the report. With acknowledging the complex context of The Box, and uncovering a paradox in the research, the decision was made to incorporate the Frame Creation Method of Kees Dorst as well (2015). The majority of the structure of this graduation project's research will be based on the Frame Creation Method as it provides a structed outcome to multiple-stakeholder complex problems. "Problem framing emerges as a key design practice that can be adopted and adapted to other fields, and one which provides a valuable alternative to conventional types of problem solving" (Dorst, 2015).

The Frame Creation Method consists of nine steps, of which the first three, 'Archaeology', 'Paradox' and 'Context' is covered by desk research and the literature study. However the next three, 'Field', 'Themes' and 'Frames' needed more in-depth information on the healthcare staff's experiences, which was retrieved from in-depth qualitative interviews with them, and the processing of it through thematic analysis (Braun & Clarke, 2006). To add more context to the results, an observational study was performed as well, and was connected to the outcomes of the thematic analysis through an improvised method, called "service mapping".

Finally all insights of the previous methods are combined into a future vision, which is mainly about scaling The Box from a prototype level towards a mature proposition to cope with the workload healthcare staff is experiencing. As a recommendation to fulfil that future goal, a roadmap was created based on the acquired insights, their assessment, and possible opportunities to overcome the determined challenges and barriers. This roadmap is visualised in the 'Deliver' section of the report as it represents the "Final Deliverable" of this graduation project.

DOUBLE DIAMOND

FRAME CREATION METHOD

COMBINATION OF RESEARCH AND DESIGN METHODS

DISCOVER

DEFINE

DEVELOP

DELIVER

ARCHEOLOGY → literature study and desk research

▽

PARADOX → outcome paradox

▽

CONTEXT → interviews + observations

▽

FIELDS

▽

THEMES

experts   users

thematic analysis + service mapping

▽

FRAMES

scaling opportunities and limitations

efficiency and workload barriers and enablers

▽

FUTURES → future vision

▽

TRANSFORMATIONS → roadmap

- - - research
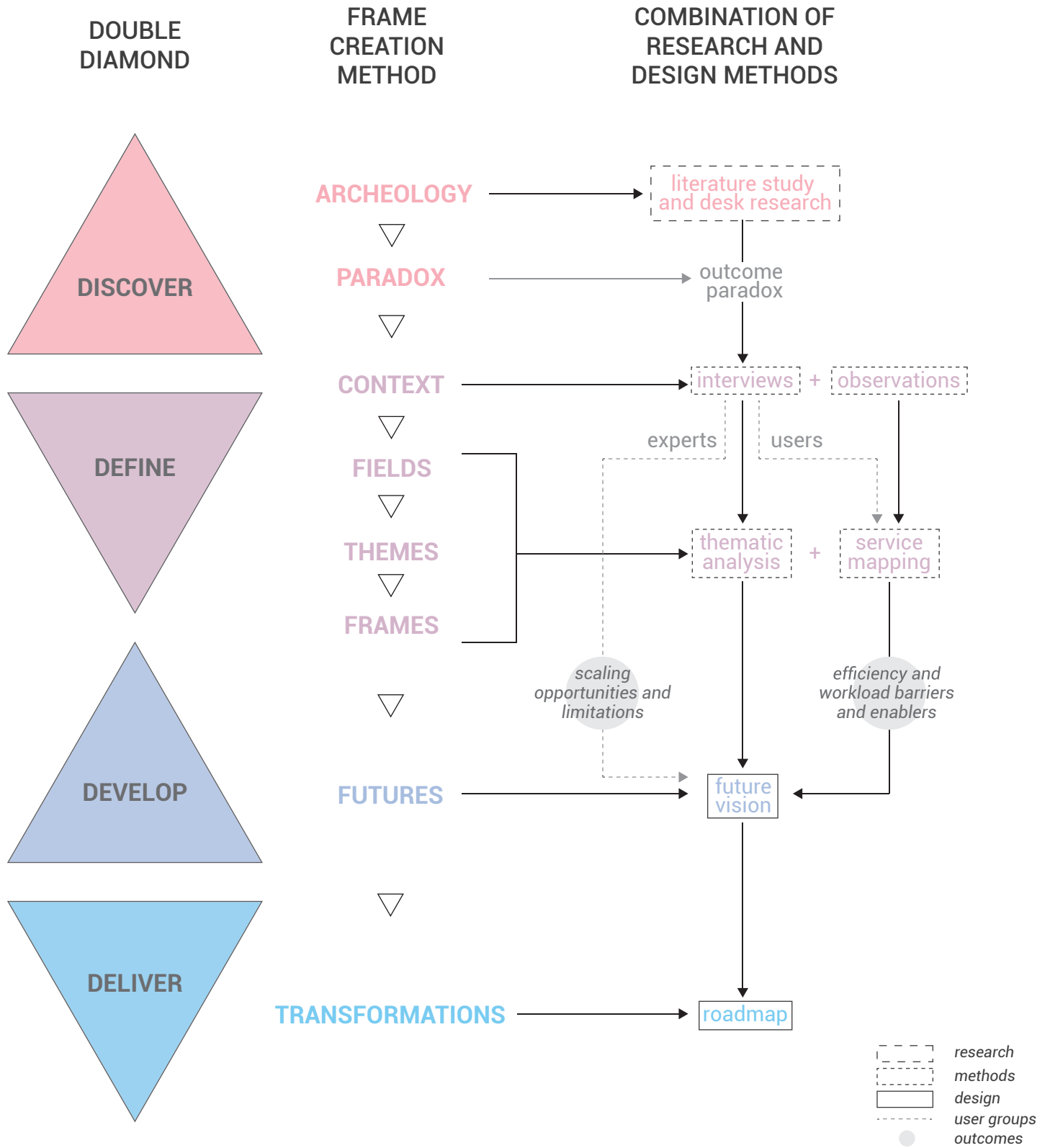······ methods
─── design
- - - user groups
⬤ outcomes

Figure 1: Project Approach

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DISCOVER

INTRODUCTION

With the increasing digitalization of healthcare, eHealth –*the use of information and communication technologies in healthcare*– is on the rise to be of great influence in the care pathway of patients (Blaauwboer, 2020; Sanchini & Marelli, 2020; Wernhart et al., 2019). With the current COVID-19 developments, the use of eHealth services such as mHealth –*health practice supported by mobile devices*– and telemonitoring –t*he use of information technologies to monitor patients at a distance*– accelerated and many hospitals and general practices were encouraged to start using these tools (Rompelber et al., 2020). LUMC saw the importance of eHealth earlier on and started implementing "The Box" as of 2015, not knowing it would be of great use in the pandemic 5 years later by allowing safe patient home monitoring. With "The Box", patients receive a package filled with different devices, suitable for performing monitoring activities in the comfort of their own house. Measurements such as blood pressure, temperature, etc, are taken at home, in order to discuss the results later on with their treating physician or nursing specialist over phone or video consult (The Box, 2015).

The success of the service relies on active patient participation at the cost of staying safely at home. With "The Box" the treating medical team now has insights in the patient's health condition from a distance. Not only does it not require the patient to be physically present in the hospital, but there's now even more reliable data available to adjust the treatment to. It makes the care path insightful and approachable by both parties, resulting in accessible digital consultations. Some benefits according to the National eHealth Living Lab are improved disease management, earlier and more accurate diagnosis, higher quality of live and a lower number of adverse events (The Box, n.d.). Because the first box has proven to be a success, over the years it has expanded from solely anticipating on myocardial infarction to the regulation of many other illnesses in and outside the department: it varies from monitoring kidney-transplant-patients to overseeing pregnant women with high blood pressure (The Box in COVID-tijd, 2021).

This progression shows that LUMC has focused strongly on service differentiation, rather than lifting the project to the next level and expand to a larger scale of digital care. Their vision has been to broaden the horizons of "The Box" over the different departments, which implies a horizontal direction of scaling –*also known as spreading*–. But in order to grow and increase the impact of "The Box" on the Dutch healthcare system, vertical scaling should be addressed as well. Vertical growth, in this case, meaning "health systems changes needed to institutionalize the innovation at the national or sub-national level" (Simmons et al., 2010). Currently "The Box" is being referred to as each individual physical box using similar monitoring devices for each specific disease and its connected services as instead it should be introduced as a united and seamless integrated networked service of boxes.

The idea of patient home monitoring looks very promising, yet the reality is discrepant. Not having the physical presence of patients in the hospital, would appear to reduce the burden on healthcare staff, as instead these "empty" hospital bed will simply be taken up by other, even more severe cases, causing a larger amount of patients to both monitor digitally and take care for physically. Each patient at home also includes a large set of data and information that needs to be overseen. The notion of reality is what causes healthcare staff to believe eHealth will increase the workload (Treskes et al., 2019). The literature review on eHealth by Granja et al. (2018) addresses a similar issue in which several studies (12) revealed that eHealth was indeed more time- and resource intensive. They also uncovered a disparity between "the foreseen benefits of research and clinical reality" (Granja et al., 2018).

It leaves us with the question of "Who will do it?". Who will take on the so to speak additional workload? The same review (Granja et al., 2018) collected multiple studies (7) addressing the changing, yet undefined role of the healthcare professionals working with eHealth tools, uncovering the need for new capabilities and responsibilities. Many experts acknowledge the changing role of nurses and physicians caused by the increasing use of electronic health technologies and the accompanying patient monitoring and data analysing role (Granja et al., 2018; Kouri & Ahonen, 2018; Morse et al., 2019; Sølling et al., 2014). Nevertheless, none of the articles have tried to predict how these professions could transform, leaving an open space to identify possible opportunities and construct various recommendations.

> **"** **89.4% of the respondents indicated that they considered eHealth to be clinically beneficial, improving patient satisfaction (90.2%), but also that it will increase the workload (83.9%)** **"**
>
> *–Treskes et al., 2019*

It is important to unfold the nuance of this increasing workload. Starting with the distinction between the types of healthcare: within the Dutch Healthcare System there are different "lines" of care. The first one being "the generalists", referring to general practitioners and other non-referral caregivers; the second line introduces "the specialists", including all healthcare professionals with a specific expertise in a certain domain; and for the third line, "the academics" are brought up, which mentions the academical medical centra who offer leading-edge and highly specialised clinical care (Van der Burgt et al., 2002). At the moment eHealth innovations are weighing on the shoulders of the third-line health workers, as instead it should offer a pathway transverse to all lines of care, which is referred to as chain-care (Ketenzorg). "Chain-care is described as multidisciplinary care, in which care providers deliver integrated care to patients with a specific condition in an organized and coordinated manner" between all lines of care (translated from Holtrop, 2015).

Due to the aging population, the amount patients treated increases everyday (United Nations, 2016). This results in a shortage of doctors and nurses, especially in third line, which also happens to be the more expensive workforces. Alternatively this scarcity could be shifted, resulting in replacing the high-priced personnel costs by cheaper ways of healthcare provision. Currently, "nurses represent the largest group of healthcare providers who have direct interaction with eHealth technologies" (Morse et al., 2019). It's the third-line (specialized) nurse in particular that is taking on the additional workload, as instead a new kind of personnel should be thought of to provide this additional digital care. "There is a need to create new and innovative models of care to meet the growing demands of patients and nurses" (Cloyd & Thompson, 2020). It's because these "new and innovative models" haven't been translated yet to a well thought out caregiving system, that this is strengthening the concern of increased workload.

WHAT IS NEXT?

There are two main elements to further investigate. On one hand there is the perceived workload that comes with The Box and how staff is experiencing this. Are the current healthcare professionals still up for this task? A closer look will be given to roles and professions, and how they might have to change towards the future. On the other hand, there is the scaling-part that requires more attention as well. How can such a healthcare innovation, like The Box, be scaled? And what does scaling mean in this context? This will also have an effect on the roles and professions. Thus, the general focus for the next steps is the scalability of The Box, and how this affects the roles and professions in healthcare.

1. WHAT IS GOING ON

This chapter provides the reader with an understanding on what is happening in the world of healthcare, meaning trend research, that is relevant for this graduation project. Next to that a literature study is provided on themes like the healthcare landscape, the wellbeing of healthcare professionals and previously scaled healthcare solutions. This chapter is more generally oriented as it doesn't provide direct information on The Box yet (that will come in chapter 2)

WHAT IS HAPPENING IN HEALTHCARE?

People tend to live longer! Nowadays, that is one of the most well-known trends (United Nations, 2016). This isn't without consequences; people live longer at the cost of the occasional chronical illness, resulting in an increased number of diagnosed chronic diseases each year (Bardhan et al., 2020). A wave of aging population, chronic illnesses, more severe cases, and the rising complexity of all this, is coming towards the already burnt-out healthcare workers. Luckily information communication technology tools are simultaneously progressing, allowing more patients to be treated, in exchange for active participation, which would result in a more autonomous care model (Gandarillas & Goswami, 2018).

In a European study on improving integrated Care for Older People Living at home, De Bruin et al. (2018) identified the need for a well-established collaboration between different health services in order to sustain the complexity that comes with chronic diseases. Besides the upcoming chronic disease management, other large scale trends are revealing the need for significant shifts in healthcare. Healthcare is going through transition, as with demographic changes, it is only becoming more costly. For example, in Italy, it's not just the soaring elderly community that is causing the demographic process, but it is followed by a declining young population (Lopreite & Mauro, 2017). This is confirmed and identified as a European problem by the European Journal of Public Health (England & Azzopardi-Muscat, 2017). This issue is gaining more weight as it is this last group, the young adults, that are in the most ideal age range to provide care.

As with a growing number of old people, more care is needed, which marks this complex context as one of the most prominent problems of the present, and the future. Healthcare workers are scarce and the shortage will continue to grow further, whereby nurses count for almost half of the need (Oliver & Care, 2019). Ageing and workforce shortage leads to stressful environments: these are just a few of many different factors causing turnover and personnel leaving according to Sasso (2019). The quest for labour forces is becoming more diverse, and with the rise of AI, it is not limiting itself anymore to human workers. In addition, new tools among eHealth, such as telemedicine, telemonitoring, mHealth, patient home monitoring, etc., are being investigated to make health care workload less intensive.

> " The National Syndicate of Nursing Professionals (SNPI) has predicted a shortage of 18 million healthcare professionals by the year 2030 "
>
> *– Oliver & Care, 2019*

THE ROLE OF DESIGN
by Tseklevesa and Cooper

In The Design Journal, an International Journal for All Aspects of Design, Emmanuel Tsekleves and Rachel Cooper wrote a piece on Emerging Trends and the Way Forward in Design in Healthcare: An Expert's Perspective (2017). Through the research of multiple chapters (20) and case studies (26), they have identified 5 emerging trends in how design can contribute to the future of healthcare, with a key interest in preventative care. Besides investigating future trends, Tsekleves and Cooper have listed and visualised some of the current challenges influencing personal health.
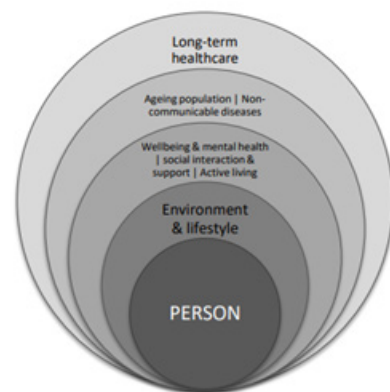
Figure 2: Casual relationships between the challenges in design in healthcare (Tseklevesa & Cooper, 2017).

"Starting from the inner circle of the nested circle diagram below, we can see that the environment and lifestyle affect our personal health at a holistic level, influencing our wellbeing and mental health, our opportunities for social interaction and the extent of how active our lives are. These in turn have an impact on our ageing process and the prevalence of non-communicable diseases. The rise of those along with an ageing population pose a massive challenge and strain to long-term healthcare access, provision and management affecting each individual. It is the first three in Figure 3 that we present and discuss below as they relate the most to the emerging trends".

As identified in the previous section, the Design for Health book confirms long-term healthcare as an important challenge in the current healthcare model. "As the number of people with long-term (or chronic) health conditions increases through living longer and with changing lifestyles a massive challenge in maintaining present levels of high quality patient care at an affordable cost emerges" (Tseklevesa & Cooper, 2017). The greying of our population demands a new approach: preventative care. It's not about focussing on extending life expectancy, it' about quality of life and reducing the risk or severity of illnesses. Supporting patients to become more pro-active is one way, but Tseklevesa and Cooper identified five trends to address the previously discussed challenges.

Figure 3: Circle of emerging trends in design in healthcare: hierarchical depiction of emerging trends revealed by the thematic analysis with a focus places on the individual person (Tseklevesa & Cooper, 2017).

"Person-centric healthcare
The focus here is designing for a person rather than for a patient aiming at improving a person's quality of life along with health.

Self-management healthcare
In light of the increase and penetration of digital technologies across both the home and the healthcare setting, there is the expectation that patients with the support of technology and in particular personal medical devices, may be motivated and empowered to monitor and manage their own health status.

Community healthcare
These services are expected to increase on one hand placing personal health within a social context and on the other hand shifting more services into the community and patients' homes.

Holistic healthcare
Refers to every aspect of a person's life including physical functioning, mental wellbeing, social and professional aspects of their lives

Preventative and health promoting care
The environment and lifestyle are catalyst for the increase of ill-health promoting risk factors, such physical inactivity, unhealthy diet, anxiety and stress". present and discuss below as they relate the most to the emerging trends".

Healthcare workers are critical when it comes to design. They are intrigued by the creativity, but highly aware of the limitations of all these new innovations and suggestions. Highlighting the added value and benefits of a designer is a complicated task, it is therefore important to truly show what design is capable of. In healthcare we, strategic designers, should use our "power" to bring complex subjects to understandable perspectives that make it discussable for stakeholders in all different areas.

WHAT DOES LITERATURE SAY ABOUT IT?

CHANGING THE LANDSCAPE OF HEALTHCARE

Healthcare 'as we know it' is being transformed by eHealth developments, changing the current model of health provision worldwide (Ball & Lillis, 2001; van Lettow et al., 2019; Wouters et al., 2019). eHealth has been making an impact on the modern healthcare system in the Netherlands since 2013, creating digital transformations where care-pathways and technological possibilities are coming together (Wouters et al., 2019). According to Wouters' eHealth-monitor 2019 Rapport, it requires proper working technologies to join in on the current health institutions' structure, where "Health processes need to be redesigned and/or tasks needs to be redivided to optimize the use of eHealth" (Wouters et al., 2019).

Where eHealth has always been steadily paving a way in the health industry (Sanchini & Marelli, 2020; Tossaint-Schoenmakers et al., 2021), it is mHealth that had the most significant boost with the turnout of mobile devices (Dinya & Tóth, 2013). Because of these technologies and wearables, remote patient monitoring suddenly became possible on a large scale. mHealth is defined as the use of mobile devices to collect data of the patient's health, providing valuable information to both patients and monitoring caregiver, and when necessary, it allows for direct virtual communication (Dinya & Tóth, 2013). The way healthcare is delivered, has changed significantly because of accessible mobile devices and applications. Think of all the smartphones, smartwatches, activity trackers, pulse-oximeters, and other smart wearables that are being used to track valuable data.

All eHealth related services, such as mHealth and remote monitoring −often in combination− are making, and will keep on making, a significant impact on healthcare, but more importantly, on staff and patients as well. With "revolutionizing healthcare", the promise was to improve its efficiency, to energize its practitioners and to engage their patients (Meier et al., 2013), yet what it is actually doing, is changing the roles and professions. The implementation of eHealth "requires organizations to change the way they work and their structure, and care processes to be adapted", increasing the burden on health staff (Tossaint-Schoenmakers et al., 2021). Healthcare professionals aren't strangers to novel technologies and are familiar with adapting to innovations and learning how to incorporate them into their care practices. However, none of the past technological implementations ever implied a radical transformation, whereas eHealth is trying to provoke compelling changes. Tossaint-Schoenmakers confirms eHealth is making a compelling impact on the workflow for healthcare professionals (2021).

> **eHealth is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.**
>
> *– Eysenbach, 2001*

As patient home monitoring is reshaping the way continuous care is being delivered, some of healthcare's main values and intentions are changing. Current workflows are disrupted as routinely seeing patients who don't require immediate attention becomes outdated. Leonhardt, MD at HIZ Berlin, says "The solution to this dilemma is continuous remote monitoring, which enables physicians and clinics to direct their attention to the right patient at the right time" (2016). Patient home monitoring improves efficiency, allows for better treatment through personalized care, and patients are at ease in the comfort of their own home, yet patient safety is still the number one priority for remote monitoring. It is important for patients to experience this feeling of 'being safe at home', which could be perceived by regular feedback through the monitoring system (Andersen et al., 2017). At the moment, this feedback, among many other different tasks, is provided by healthcare workers, as instead artificial intelligence should be considered for this job in the future.

The healthcare industry is continuously striving to make everything patient-centred, even with keeping in

mind the 'technicalization' of the future of healthcare, yet the question arises of how something as digital and technical as this, can become patient-centred. Fortunately, recent literature remains a positive attitude towards increasing patient-centredness in a digital future (World Health Organization, 2016; Morse et al., 2019; Tossaint-Schoenmakers et al., 2021). According to WHO, transitioning towards a care-model that revolves around the patient, is often substantiated by eHealth solutions, since the use of these technologies allow for the patient to manage their own health nowadays (2016). Morse suggests the ideal care-model is that where patients are encouraged to participate in their own disease management (2019), making them "partners in their own health" (Ball & Lillis, 2001). While it is causing "a shift in the relationship between patient and caregiver" (Ball & Lillis, 2001), the patient's health is simultaneously improved and even more, the workload per patient can be reduced due to their independence (Leonhardt, 2016).

As the patient-caregiver-relationship is shifting, the professional workload is facing new challenges. How does healthcare staff adapt to this? Many research has been done on what patients think and patient satisfaction, yet rarely the care-team experiences have been investigated (Golay, 2019; Lapão & Dussault, 2017; Treskens et al., 2019). According to Treskes et al., "The attitudes of physicians towards e-Health have been less well evaluated. Literature describing the attitude of doctors towards e-Health is scarcely available" (2019). Remote monitoring, among many other health information technologies has been recognized as "introducing more cumbersome workflows for nurses and other end users" (Golay, 2019). An exploration must be done on how the integration of these technologic advancements is affecting the workflow of healthcare professionals - especially nurses -, their role within the organisation and what their expectations are towards these implementations (Golay, 2019), resulting in a possible addition of new roles and professions (Lapão & Dussault, 2017).

As the implementation of remote monitoring in regular care-models is causing a second shift in the completion of healthcare professions, a critical reflection must be done in what the future role will be for those professionals working with eHealth. Are roles and professions changing, or will additional people be hired to take over a portion of the workload?

> " **The opinion and expectations of citizens, patients, healthcare insurers and especially administrators about e-Health have been documented in the popular literature, the attitudes of physicians towards e-Health have been less well evaluated. Literature describing the attitude of doctors towards e-Health is scarcely available.** "
> *— Treskes et al., 2019*

There is a concern if this implementation is a threat for the current healthcare system or not, as a big part about caregiving is to "care" for the patient. The way health professionals care for patients is changing. Yet this transformation can support a third possible shift: Not many doctors truly understand what impact certain illnesses have on patients' life and mental well-being (Corin, 2019). As a future possibility, a distinction can be made between caregivers "seeing" the patients for treatment related purposes, and others for supporting the patient in various way, with new roles taking over a part of these responsibilities.

FUTURE WELLBEING AT WORK

As mentioned earlier, eHealth is changing current healthcare, but it brings along many benefits as well. Patients' experience and satisfaction; clinical outcomes and improved quality of care; and reducing costs and increase of efficiency are some of the most important proven beneficial outcomes (Ossebaard & Van Gemert-Pijnen, 2016). When bringing in the Quadruple Aim (Bodenheimer & Sinsky, 2014) to the evaluation of eHealth and as such, patient home monitoring, it is remarkable that the latest parameter, Care-Team Well-Being – distinguishing the Quadruple from the Triple aim – is lagging in the investigated literature and is almost nowhere to be found. Besides examining the quantitative opinion of selected caregivers on a possible use of eHealth, current research is not familiar with how healthcare staff is experiencing the implementation of these technologies (Treskes et al., 2019). Therefore, an in-depth qualitative analysis is highly suggested when moving forward into this topic.

What is known so far is that eHealth increases the workload (Granja et al., 2018; Treskes et al., 2019).

Ganja's review identifies 7 papers mentioning workload as one of the key failures for implementing eHealth (2018), but the true limitation is the lack of depth in the perception of health professionals' experiences and how this relates to their well-being. Several questions rise to the surface, where current literature fails to provide thorough answers to: What should be included when it comes to care-team well-being?, Which stakeholders understand what it is and what the importance is of it?, What compromises the well-being, is it just workload, or are there other factors involved?, etc. Within the Quadruple Aim model, 'Care-team Well-being' is ought to be equally important to 'Patient Experience', 'Population Health', and 'Reducing Costs' (Bodenheimer & Sinsky, 2014), but in reality, it is often the least evaluated parameter. Further investigation is necessary to identify how the well-being of healthcare professionals can be improved in order to achieve a higher level of fulfilment in their work.

Nowadays a good work-life balance has become an unrealistic ideal for most physicians, it results in a majority of health practitioners susceptible to burnouts. As the aging population is creating a larger set of patients, the amount of caregivers decreases (Gandarillas & Goswami, 2018), causing an increase in workload, which contributes to the risk of burnout. "Doctors are working in a system which is under pressure due to chronic underfunding, workforce shortages, and rising patient demand, which is affecting their mental and physical wellbeing. Intense workloads, understaffed rotas, and long hours are leaving doctors at risk of illness and burn-out" (British Medical Association, 2018). Care-team well-being should be a priority in healthcare organisational structures, as it indirectly improves patient outcomes. This could benefit the majority of the stakeholders involved.

> " **Increasingly, physician burnout has been recognised as a public health crisis in many high-income countries because it not only affects physicians' personal lives and work satisfaction but also creates severe pressure on the whole health-care system—particularly threatening patients' care and safety.** "
>
> *— The Lancet, 2019*

There are several elements, such as administrative tasks, order entries, billing documentation and cetera, that contribute to the experienced workload and possible burnouts. Besides that, workload is not the only factor responsible for lowering the care-team well-being (Lianov et al., 2020). Policy, regulation, and information technology all share the best intentions for healthcare, yet unintentionally, it adds up a decreased well-being (Sinsky, 2017). It is a well-known fact that the lack of user-friendly, fully operational and integrated, seamless technology is the biggest frustration of every health professional, making it their main professional desire for future healthcare. However, according to the Philips Future Health Index 2020 Report, "Smart hospitals, make happier professionals", which on one hand is somewhat contradictory to caregiver's aversion to technology, but on the other hand, an expected outcome as "technology has an important role to play in keeping a younger generation [of physicians] motivated" (Philips, 2020).

> " **Many health professionals are acutely aware that we have been down this path before with technology—for example, integrating electronic health records that are clunky to use and costly to improve. Thus, for us to realize the potential of AI we must not make the mistakes of the past and must ensure that any time efficiencies gained are poured back into care, not into generating more income** "
>
> *— Indra, 2019*

As the role of technology is increasingly becoming more important, health provision shouldn't be looked at in a solely human form. The majority of the workload lands on the shoulders of the healthcare professionals (Granja et al., 2018), whereas in the future, this might be supported by technologic advancements such as deep medicine. "How Artificial Intelligence can make healthcare human again" is the target question for this relatively new and somewhat curious concept of Deep Medicine (Topol, 2019). It imagines a technology lifting a certain workload off from the caregiver, so they

can focus on their patients again. This is especially useful, because with eHealth, there is an increasing amount of patient-data that can be explored, which doesn't necessarily represent more knowledge on the patient's clinical image. Artificial Intelligence is there to help. However, this is still a future desire rather than a present implementation, which causes an intermediate increase in workload until technology is ready to bridge the gap.

SCALING IN THE HEALTHCARE CONTEXT

Implementing new healthcare technologies is a challenging task, however being able to go beyond a small-scale demonstrative project and move on to a larger setting is one of the most difficult things to do as it brings many complexities with that (Greenhalgh et al., 2017). There aren't many examples in the healthcare context that have successfully scaled. According to Dr. Jennifer Dixon −*Chief Executive at the Health Foundation*− the reason for this, is that it often involves complex, multifaceted things. "The more complex the innovation, the more context is more likely to be prevalent and acting" − *Dixon for the Nesta Health Lab*− (Nesta - The UK's Innovation Agency, 2016). She explains that is not always possible to "cut and paste" the innovation in a different context, then it is not "spreadable", as some are too dependent on the interplay of factors. Spreading however is something different from scaling. Making something that works "bigger" is what is intended with scaling, yet spreading implies taking something that works and diffusing it out to different, yet often similar, organisations (Dixon for Nesta - The UK's Innovation Agency, 2016).

The reason why promising new healthcare practices fail to be implemented on a broader scale is because they rarely go beyond the pilot project test phase. Additional human, financial and organizational resources are exceptionally included in the early stages, however these will not be available when the innovation scales, and as a consequence managers are faced with an enormous challenge: "they have to implement the innovation on a large scale with few resources and in health systems that may be characterized by weak capacities and multiple, pressing priorities" (World Health Organisation, 2010). Dr. Helen Bevan −*Chief transformation officer at NHS horizon group*− agrees that there is a big knowledge gap there. "Very often we evaluate what happens on a local level and whether the pilot

or the pioneer works. But what we don't evaluate and we don't build knowledge on, is around actually spreading and scaling that", on the topic of scaling complex innovations at the previously mentioned health conference (Nesta - The UK's Innovation Agency, 2016)

In response to that, and as a means to overcome the knowledge gap, WHO has created a nine-step approach to scaling novel healthcare technologies from a test-phase to an integrated practice as scaling-up requires a systematic plan on the implementation of an innovation prototype in order to make sure it can achieve a broad impact on a larger scale: 'Planning actions to increase the scalability of the innovation', 'Increasing the capacity of the user organization to implement scaling up', 'Assessing the environment and planning actions to increase the potential for scaling-up success' , 'Increasing the capacity of the resource team to support scaling up', 'Making strategic choices to support vertical scaling up (institutionalization)', 'Making strategic choices to support horizontal scaling up (expansion/ replication)', 'Determining the role of diversification', 'Planning actions to address spontaneous scaling up', and 'Finalizing the scaling-up strategy and identifying next steps' (World Health Organization, 2010).

VERTICAL SCALING

"Vertical scaling up refers to the policy, political, legal, regulatory, budgetary or other health systems changes needed to institutionalize the innovation at the national or sub-national level" (WHO, 2010).

HORIZONTAL SCALING

"Expansion or replication is also referred to as horizontal scaling up. Innovations may be replicated in different geographic sites or can be extended to serve larger or different population groups" (WHO, 2010).

2. ABOUT A BOX

To explain the relevance of this graduation project, the first part of this chapter will introduce The Box as a project LUMC has been working on for a few years now, and what the motives were to investigate it further for this thesis. This chapter highlights the changes LUMC is experiencing with The Box. Furthermore, a paradox is uncovered in this part of the report, which will be of further relevance. Then The Box is positioned on the three pillars of design, which substantiates the focus and scope of the project, which is about roles, professions, and the scaling of The Box.. The chapter ends with suggesting the next steps for the research and delivers an initial research question for the following phase.

EMPIRICAL CASE: THE BOX

So far, it has been made very clear that eHealth is transforming healthcare, and that hospitals are compelled to adjust their care-structure accordingly. So when it comes to adopting new innovations, there will always be a range from innovators to laggards (Rogers, 2010), but being an academic and research based hospital, LUMC decided to put themselves on the Dutch map as an early adopter of eHealth technologies with implementing The Box. As Roderick Treskes (then promovendus, now AIOS Cardiology) was looking for an orientation topic, he landed on eHealth and its opportunities for the Department of Cardiology. He initiated his research in 2015 and could count on the support of Dr. Prof. Douwe Atsma (Cardiologist) and other specialists, together testing the capabilities of eHealth in practice, and creating The Box as a result to their research (source: Roderick Treskes).

The Box is as the name suggest: a box. It includes different devices to support patient home monitoring. The patient is empowered to self-monitor several vital signs, such as blood pressure, temperature, oxygen saturation, and to generate Electrocardiograms (ECG). If required, a digital appointment can be arranged between clinician and patient (The Box, 2015). Because there is more data available, doctors now have more valuable information on the patients' health. So far there is no significant notice of increasing the clinical effectiveness and patient satisfaction (Treskes et al., 2017). However, the right treatment can be provided more easily and as an intended outcome, patient care will become more efficient gradually.

An intended outcome however, and rarely discussed topic in literature is the workload on the current professions and the wellbeing of healthcare-workers. The Box allows for safe patient home monitoring, generating an additional care-model next to traditional in-hospital care. This extension of healthcare corresponds with the increasing number of patients, simply resulting in more work. It's an issue of which 75% of the Dutch Cardiology Practice respondents identifies with (Treskes et al., 2019). By now, the majority of health professionals is informed on remote monitoring, but only for some, time has been made available in their work schedules to check-in on their patients at home (Silven et al., 2020). Silven and his colleges describe how "the extra workload associated with the development

and implementation of a telemonitoring care pathway should be minimized, for example, through dedicated support teams and a helpdesk for technical problems".

Currently, this issue is "solved" in two ways: on one hand, by adding professions, such as eHealth consultants, and support services, of which The Box Office and The Box Support are some examples; and on the other hand, by changing existing roles and disrupting their workflow with 'e-tasks'. An example of this, is the transition of nurse practitioners [verpleegkundig specialisten] in Cardiology, towards a medical eHealth consultant for a specific patient group regarding heart diseases. The first scenario sketches a clear distinction between physical and digital caregiving, whereas in the second case, the employee experiences a blended version of care, hinting at a new model of healthcare hybridization. There is no conclusion on which method is the most optimal, but both role-division scenarios are equally interesting to further investigate for future scaling.

There are multiple ways to possibly reduce the burden on healthcare staff, by redirecting, dividing or even ease the additional workload. The question "Who will do it?" arises: Who will take on the additional workload?, To whom can the workload be redirected?, How can it be divided, and between who? Or maybe there's someone who knows how to ease the additional work? Unfortunately caregivers and employees' opinion on this matter is often neglected, leaving their experiences often undefined. Are they satisfied with the work they deliver now, considering The Box implementation circumstances? Besides 'Patient Experience', 'Population Health' and 'Reducing Costs', 'Care Team Well-Being' is the latest addition to the optimizing health system performance approach, making it a Quadruple Aim (Bodenheimer & Sinsky, 2014). It stresses the importance of investigating the experiences and well-being of the healthcare staff.

Within the research theme of Scaling up eHealth: framing new roles and professions to support home monitoring, a temporary research question for future purposes can be proposed: How can additional workload generated by "The Box" be redirected to novel roles and professions?, which will be further investigated through the lens of healthcare employees. After doing desk research

Figure 4: Quadruple Aim by Bodenheimer & Sinsky (2014), image source: Microsoft

and having studied the literature, a part was missing on contextual knowledge on The Box. In the following sections, a more thorough analysis is being made on what is known of The Box in literature and trustworthy websites. Afterwards, in the next chapter a methodologic approach will be discussed an how all information is processed and developed into actionable results. The focus of the following parts will be on acquiring good understanding of the positioning of The Box related to the intermediary research question.

INTERMEDIARY RESEARCH QUESTION

How can additional workload generated by "The Box" be redirected to novel roles and professions to support scaling?

through the perspective of Healthcare professionals

IMPLEMENTING THE BOX in the LUMC

Since The Box has become a part of the care-model, health professionals are now able to extend the treatment pathway for patients over a longer period of time. At the same time, it allows for more intersections between patient, patient data and caregiver. It doesn't only affect the treatment, but The Box is changing the way care is provided to the patient: it is slowly shifting towards a remote form of healthcare. This digitization allows for patients to be treated at home, simultaneously causing a more extended set of patients to care for, and depending on the clinical picture, more frequent (Sanchini & Marelli, 2020; Wernhart et al., 2019). As stated in a previous part, there are now patients to take care for remotely, and within the hospital, resulting in a larger number of patients to take care for. Is it a justified assumption to say that more patients equals more work? According to Granja (2018) this is the case, stating eHealth innovations lead to an increasing amount of workload.

Despite the negative connotation that comes with additional workload, it can be an opportunity to rethink the current workflow processes. "The need to reengineer the workflow to integrate eHealth can be a trigger to improve efficiency, distribution of tasks, patient safety, and the quality of the data collected from the patient", (Granja et al., 2018 on Bowens et al., 2010). Instead of looking at the issue as an increment of workload, another perspective can be the change in workflow, presenting a different approach to healthcare work. This frame of reference might even be the rationale behind the assignment of looking at scaling The Box and how this affects the current roles and professions. Provoking such a distinctive change is never without consequences, yet the increased turnover justifies the decision to implement The Box in several departments.

The cost reduction depends on the severity of the patients' illness: Is it a healthy patient with risk factors?, Is the patient in a pre-disease phase? or Does the patient have a severe disease? In the final case, such a patient has a higher percentage of experiencing a sudden hospitalization procedure (acute care), leading up to highly expensive immediate (emergency or ambulant) care in possibly an unfamiliar hospital. Whereas now with the implementation of The Box, such an event can be anticipated on. The staff could request for a patient

31

to come in for an appointment, and if necessary, a hospital bed can be freed up, knowing in advance this patient will be hospitalized in the attending medical center (elective care). This makes The Box a justifiable investment.

> 66 **Acute care is 4 times as expensive as elective care** 99
>
> *– Frouzan Soltani,*
> *LUMC 2.0 Senior Business Controller*
> *& Manager Implementation*

PREPARING THE BOX – as a service – FOR SCALE-UP

In 2015, The Box started as an 'eHealth at Cardiology' research project, when a few years later, it resulted in a study with a controlled trial group to investigate the impact of these new technologic implementations on monitoring patients who've experienced Myocardial Infarction (Treskes et al., 2017; 2020a), leading up to a semi-integrated service that is now used in several departments at the LUMC (The Box in COVID-tijd, 2021). Besides expansion throughout the hospital, the quest remains active for elements that can support a further scaling for The Box. Currently the project is in a "start-up" phase, where the groundwork is being done for building up this venture, while simultaneously adapting the care path for patients and changing the workflow for the professionals under the assumption all will become more efficient and effective.

> 66 **Clinicians may find it necessary to redesign their internal clinical workflow processes to ensure productivity is optimized and seamless integration of EHR technology with clinical workflow is achieved** 99
>
> *– Bowen et al., 2010*

As mentioned earlier, The Box changes the way care is being provided, which is why the healthcare model is starting to look differently at LUMC: it has become more technology and data driven. Not only is it changing the model, the implemented eHealth technologies are affecting a change in the existing roles and professions (Morse et al., 2019; World Health Organization, 2016). As professions remain care-oriented, caring for people has become more versatile, leading to jobs developing into all-around and resourceful activities where caregiving can be either, or both, physical or digital. It can even go as far as rethinking training and education of health professionals, preparing them for the 'technicalization' of healthcare roles. It provokes the question if the practice of medicine and nursing should be diversified?

In order for an innovation to grow and expand, it should first be successfully integrated in its own current environment. Bowens et al. have written a review on several essential elements for successful integration of Electronic Health Records (EHR) technologies, clinical workflow and meaningful use (2010). Keeping in mind that the working principle of The Box is built upon gathering and storing patient data frequently within LUMC's versions of EHR, the critical elements of Bowen's framework might be applicable on this matter as well, being 'Workflow assessment and evaluation', 'Workflow redesign', 'EHR champions', 'Leadership and change management', 'Training', and 'Integration of other technologies: personal digital assistants (PDAs), voice recognition software, data upload software'.

Besides a seamless implementation of EHR, where the ICT department is working on intensly, several experts at LUMC are actively trying to find additional ways guarantee a successful practice for The Box. Yet no significant steps have been undertaken in order to grow, expand vertically or even scale up: Multiple healthcare professionals are changing their job, new employees are being hired to fill in additional functions, systems and software are being created, but none of these measures are actually taking it to the next level. The reason for that is that each department is performing the monitoring activities in their own way, resulting in many different 'islands'. Since each box has its own team with on top, a specialist who is the owner of one specific box, they are trying to figure it all out individually.

The box has become scattered. At the moment there are over 30 different boxes with each one of them, having their own organised care-pathway and connected software, making it hard to scale-up. In order to make scaling possible again, certain

things need to be standardized in order for The Box to grow. It is desired to go from a variety of thirty different boxes to one holistic concept overviewing all different boxes. It is important to first create cohesion within LUMC before scaling to a regional level prior to thinking about going national. As The Box project manager Kim Brons states: "If you want to give this technology to the whole LUMC, you need to standardize certain things as centralized". The figure below visualises this research project's intentions.
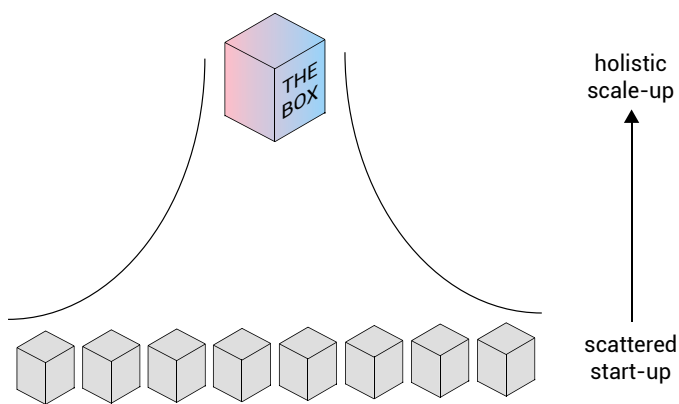
Figure 5: From Scattered Start-up (Prototype) to Holistic Scale-up (Proposition)

THE BOX CARE-CENTRED APPROACH

One of the aims of The Box is to make patient care more efficient and to accommodate them with a more personalized treatment. To make sure the provided service is successful, it demands from its patients to monitor themselves frequently in order to gather more data on their health (Treskes et al., 2017). Because there's more data now, there is more knowledge. This allows for a better understanding of the patient's clinical picture for both provider and the patient itself to which care and disease management can be improved (LUMC, 2015; Treskes et al., 2020b). After learning about their own health and treatment pathway, patients are capable of requesting consultations as well. When patients start to understand their data, they are in a more comfortable position to undertake the right action. Next to that, they are taught when to reach out to The Box Support, when to refer to a general practitioner and when to call the emergency or ambulatory services (The Box - Mission Infarct Box LUMC Care app, n.d.).

On the other side of the digital wall, 'patient follow-ups' – looking at data and important values – becomes more frequent in most use-cases, whereas the number 'patient check-ups' – digital and physical consultations – remains quite the same, unless an additional appointment is necessary, perhaps because of unusual values that are observed in the data (Treskes et al., 2017). Extra sessions can thus be arranged from both sides, giving the patient a more active role in the subject of remote monitoring. It results in an improvement of connection in patient care, which aligns with the progress of treatment personalization (Morse et al., 2019; Seljelid et al., 2021). For this connection to be effective, it requires both patient and provider to actively participate in the care pathway, leading up to a dual involvement in patient treatment. And so, a new relationship emerges: patient engagement versus supervising health provider.

As The Box maintains its care-centred approach, health professional well-being is often overlooked. And as mentioned previously, additional patient data results in more personalized care, but it also leads to extra work, which again can be very different from what such a professional is used to. Currently the most common workflow variant is blended care, in which physical and digital supervision is intertwined, creating a demanding and complicated workload that falls onto the shoulders of the care-team (Granja et al., 2018). The origin of this problem surpasses the issue of additional workload, and lands onto a deeper concern: organizational design. Changes need to be made on a deeper level, while keeping in mind the care-team well-being. What do they want?, Which type of caregiving do they prefer?, Maybe there are certain caregivers who prefer tech-infused health professions over standard care? Treskes and his co-workers concluded their research with a great remark: "The question is not if the way we provide healthcare will change, but to what extent healthcare professionals together with patients will be able to fundamentally redesign healthcare in a structured manner" (2016).

PARADOX

Continuing with the upbuilt knowledge, The Box should make patient care more efficient, and it does, but the implementation of The Box is also currently creating additional work. Which then again requires for more efficient processes, and thus the workload conflict continues. And so, the paradox of remote patient monitoring arises. An intervention should be made to break this 'efficiency search – increased workload' continuum. Instead, the workload should be redirected, divided or eased (Meier et al., 2013). 'How to do this?' is an important question to find an answer to in the next few chapters.

"The Box" should make patient care more **efficient**

as a result

the implementation of "The Box" would increase **workload**

there is a need for

as a result

"The Box" should make patient care more **efficient**

the implementation of "The Box" would
| REDIRECT **workload**
| DIVIDE
| EASE
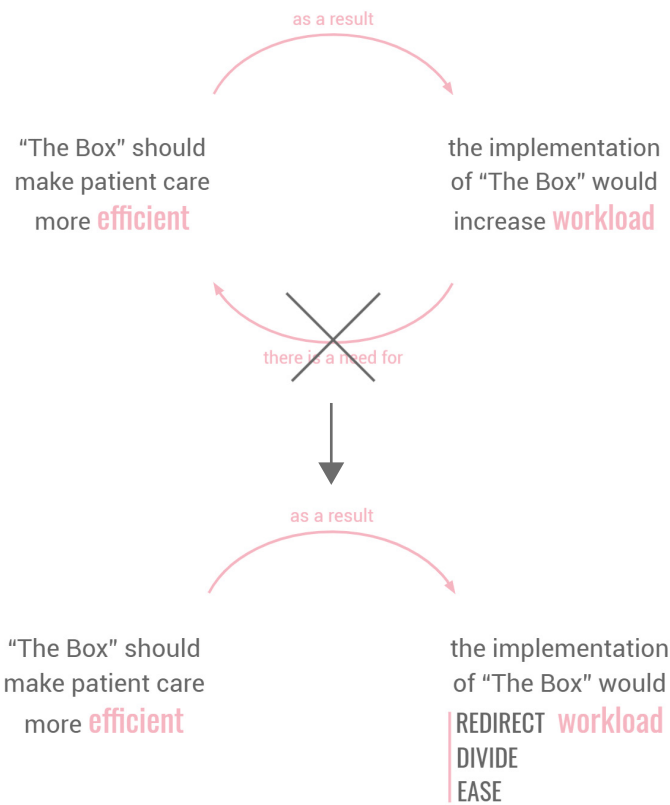
MAPPING OUT THE PROBLEM

To sum up, patient home monitoring provides the caregiver with more relevant data about the patient's clinical image, but in addition, it is also known that this eHealth intervention increases the workload and pressure on healthcare professionals. All these additional datapoints are great for personalized treatment and with that improving care. But some questions arise, such as 'who monitors the patients?', 'who checks up on the patient's data?', and 'who adapts the treatment for the patients considering all extra data?'. This all leads to the main question of 'who is taking on the additional workload?'.
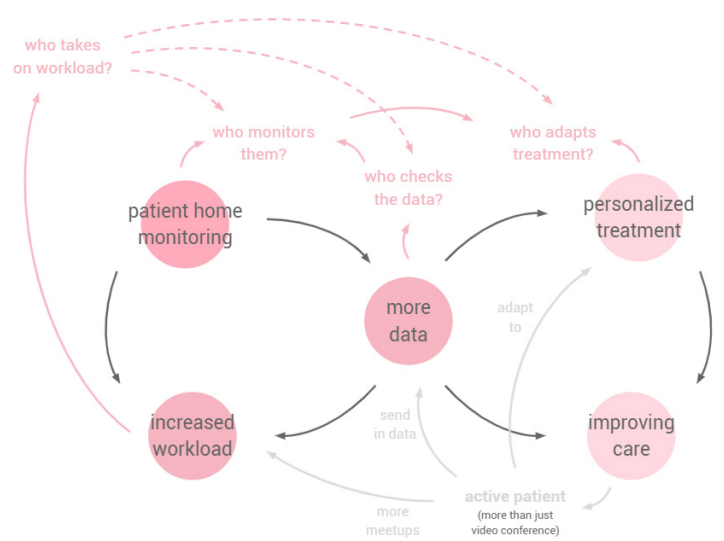
Considering an active patient is involved, even more data is being send in. It can be assumed that such patients are more involved in their health journey and will demand more attention, which can be done by requesting more meetups. Even though such a patient might require more work at first, they do adapt to the personalized treatment, making the care pathway more successful for them. When a patient becomes more independent, they take over the managing position of their own illness, and that is when the workload for the health professionals starts to decline. Patient home monitoring should be the responsibility of the patient and not that of the care-team.

NEW FRAMEWORK

Due to the scarcity of healthcare workers, and the continuously rising number of patients, caregivers felt the burden increase over the years (Oliver & Care, 2019; Sasso, 2019). One-on-one physical appointments aren't the way to go for future healthcare, they aren't even appropriate anymore for present care-models. With The Box, LUMC is trying to prepare for these inevitable and approaching changes. The role of AI pops up regularly as a solution to this problem, yet technologic advancements such as this are important ambitions for the future, but there is still a gap to bridge until then. And The Box might be able to do that: A proactive patient that is actively involved in their care, can take away a part of the work, and the burden, of the care-team, making them invigorated and fresh again, which is why caregivers will be requesting patients' participation more often.
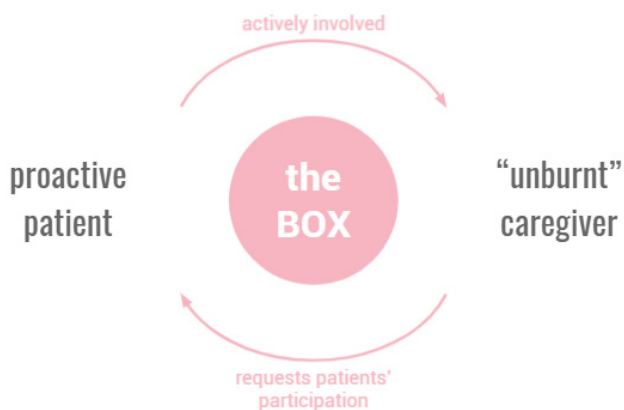
This framework however doesn't support a future vision comprehensively. There will always be a role for an engaged patient, but this "solution" is not futureproof, it serves more as a means to bridge the gap until the required technologic advancements are implemented. In the future there will be a role for Artificial Intelligence: where some aspects will be automized, other require more intelligent developments. In this framework The Box allows for frequent and convenient patient-caregiver communication, whereas towards the future, some elements might be replaced with the involvement of AI and there will be a triangular form of communication. The image below is solely based on experience and understanding of context.
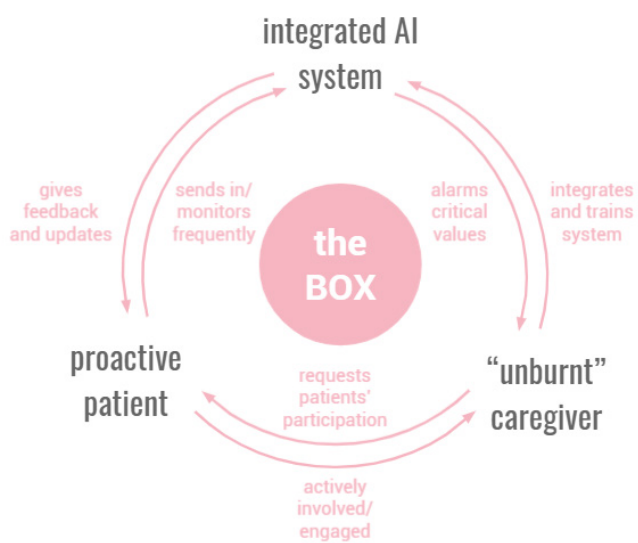
POSITIONING OF THE BOX

ORIENTATION

The Delft method of design relies on three perspectives that need to be analysed in order to create valuable product-services: those three pillars are people, technology and organization (TUDelft, n.d.). The Box considers all three perspectives, making it a great innovation to study and investigate within a graduation assignment. It is a realistic problem definition coming from an academic medical centre, making it the perfect project to investigate through the design lens. Keeping in mind the three pillars, The Box's main goal is to deliver better treatment, making care more efficient. This reflects on the aspect of 'People'. What makes The Box such a great case, is the accessibility of technology. Here the 'Technology' side really shows the feasibility of the project. Finally, the biggest complexity of The Box might lay in the 'Organisation' section of product-services, where it aspires cost-effectiveness and work-efficiency.
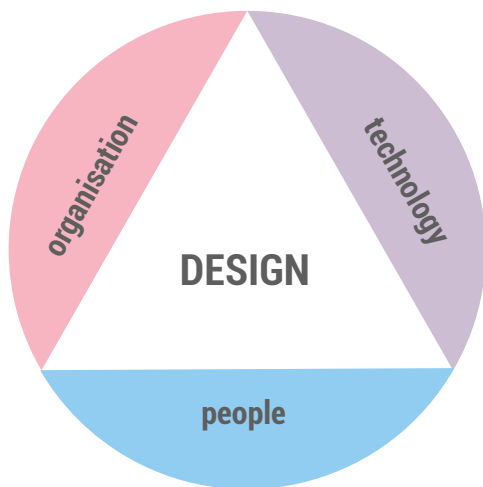
Figure 6: TUDelft design method for creating valuable product-services, relies on 3 pillars: People, Technology and Organisation (TUDelft, n.d.)

Better Treatment (people)

This section discusses the people-incentive for The Box and why it provides better treatment. First of all, and most obvious one, (1) more measurements are available now for both patient and physician, educating them about the clinical picture (The Box, 2015). But this has also been mentioned a few times before in the report. The additional information makes sure that (2) clinical decision making can be improved (Ball & Lillis, 2001). And even though this paper goes back to 2001, the writers have done a thorough analysis in "eHealth: transforming the physician/patient relationship", which according to current literature, is still relevant (cited 268 times, of which 25 since 2020). This improved clinical decision making then again also (3) increases the efficiency of treatment and follow-up according to Ball and Lillis, (4) strengthening the communication between patient and physician (2001).

Accessible Technology (technology)

In this technology-segment, several reasons for the success of adopting The Box are discussed, but all of them are connected to accessible technology. (1) The Box makes use of everyday technology, such as smartphones, the internet, Wi-Fi and wearable devices (Treskes et al., 2017), so there is nothing that is unfamiliar to the broad public. Furthermore according to Treskes* et al., (2) the devices are easy-to-use and do not require the assistance of trained staff (2017). He also mentions (3) the data integration in electronic medical records. Later on more research is done and Treskes and his team identified that The Box is also (4) the first systematic integration of eHealth in cardiovascular disease management (2019).

Roderick Treskes is the initiator of The Box and was the main researcher during his medical specialisation.

Cost Effecitve and Work Efficiency (organisation)

The cost effectiveness and work efficiency of The Box relates to the organisation-theme of the triangular design approach. For LUMC, it is a matter of using the resources they already have, but in a smart way. At the moment, nurses are the most critical resources, which makes it highly interesting to look at, and how organisational changes might affect this. The first one that influences the cost effectiveness and work efficiency of nurses, but also for many other health professionals, is (1) the discharge of the patient at an earlier stage by sending them home safely with The Box. Therefore (2) the bed-patient ratio becomes more efficient, because they only need to take physical care of the severe cases. Furthermore (3) the physical presence isn't required anymore in some cases, which then saves on outpatient clinic visits (Treskes et al., 2020), increasing the convenience for both patients and caregiver, resulting in (4) 'market-driven healthcare' where there is no loss of time and money (Ball & Lillis, 2001).

FOCUS

Within the same three pillars in mind, the focus of the project is being determined. Within the section about people, the focus will be on the staff rather than the patients. It will try to frame the experiences of the team working on and developing The Box, but also for the professionals who use it with their patients. It shows their experienced workload and well-being during the use of The Box. Furthermore the capabilities of the staff is also very important. Think of a medical trained nurse who suddenly needs to change her profession that require technical abilities. Technology-wise, eHealth will be the most discussed topic, but since it's so broad and comprehensive, patient home monitoring will be the focus of choice for The Box. It also contains monitoring devices which will be looked at. Lastly there is a future role for AI, which is now still underdeveloped and underexplored. LUMC represents the organisation of this project. Even though The Box as a concept will be investigated generally, the scope will be narrowed down to two departments, Cardiology and Covid, since they represent very different use-cases. Finally scaling-up the project is a more specific scope within organisation, in order to figure out the next moves for The Box.

reduced. Healthcare professionals are not meant to be sitting behind their computer, as instead, they should be taking care of patients. It will be scrutinized how The Box is affecting these roles and professions.

The service has expanded hospital-wide, yet the scope will be limited to the boxes at Cardiology −11 different boxes− and the Covidbox. Ideally all boxes would have been incorporated in the research, but in order to have good, clear, and understandable outcomes, it has been decided to solely focus on Cardio and Covid. The reason for these two is because those are the two most opposite use-cases. Where the Cardioboxes treat mostly chronic and long-term diseases, the Covidbox serves more acute and short-term cases. Furthermore the Cardiology department is more experienced, whereas the Covidbox is relatively new and didn't have room nor time for trial and error. In this comparison will be looked at the similarities and the difference in order to find out if and how The Box is scalable. And if so, what can be scaled, and what not?

organisation
1. lumc
2. cardiology
3. "the box"
4. scale up

people
1. nurses
2. experiences
3. workload
4. capabilities

technology
1. e-health
2. smart tech
3. wearables
4. ai

SCOPE

Within The Box project, the spotlight has mostly been on patients and technology, yet it rarely focused on the staff. In combination with the urging scarcity of healthcare professionals and the increased burden on them −as research showed−, the decision has been made to narrow down the scope of the project to the care-team. This will be the starting point for the next phases. As research uncovered that workload is perceived as the largest barrier in the adoption of new healthcare implementations, such as The Box − and its patient home monitoring service−, the focus will be on WHY and HOW the staff is experiencing this workload, and it will be analyzed how it can be

WHAT NEEDS TO BE DONE?

It has become clear that how staff experiences workload and what their opinion is on roles, professions, and scaling, form the centre of attention in this project. Therefor the next phase of the project is to find out more on that. What needs to be done, is gathering more information from the perspective, this time, from the healthcare professionals. This will be done through interviewing participants and doing observations to position the insights and findings from the interview and provide them with rich context. Those results need to be analysed in order to bring structure and understanding to the research project. This step should clarify why and how the workload is perceived, and more importantly, what can be done about it? As there are now new eHealth functions, it highlights the possibility for workload redirection to these new professions. Furthermore, by analysing the processes, the opportunity for scaling can be identified and visualised as a future vision, in which also the solution to the workload problem can be visualized. All this comes together in a roadmap, showing the path that needs further exploration in the future. But this all starts by asking the right question.

INTERMEDIATE RESEARCH QUESTION

In the theme of the research 'Scaling up eHealth: framing new roles and professions to support home monitoring', previous sections identified workload being the biggest scare of healthcare professionals. So in order approach this issue, while keeping the scalability of The Box in mind, the main research question became "How can additional workload provided by The Box, be redirected to novel roles and professions to support scaling?". The reason for this focus is the lack of interest in literature on care-team well-being, definitely when it comes to implementation new technologies. Answering this question will lead to a more fulfilling response to the complex issue of scaling The Box. Current research is very elaborative on patient satisfaction with eHealth implementations, technologic requirements for remote monitoring and improvement of care-pathways due to larger patient data-sets, but it fails to communicate the demands and desires of healthcare professionals. With this research question, the aim is to dig deeper into staff experiences, how their roles have changed with the implementation of The Box, and what they envision for the future.

How can additional workload provided by "The Box" be redirected to novel roles and professions to support scaling?

Intermediate Research Question

38

DEFINE

3. GUIDED BY DESIGN

It is not only advised to have a good design method for structuring data and research, but also the report in general. As for this, the Frame Creation Method is introduced in this chapter as it provides structure and guidance to both the report and the research. This section will also show how this design method is connected to other methodologies used in the qualitative approach of the next chapter, which is thematic analysis, and how it is combined in the final result with creating a future vision, and design road mapping.

METHODOLOGY

In order to give a deliberate answer to the current research question, a clear perspective on the matter, guided by informative insights is required. And so an appropriate method needs to be selected to provide this research with the right guidance, so that a coherent answer to the question can be constructed. There are several elements within the intermediate research question which literature fails to cover. A methodologic approach is necessary to fill in the gap of staffs' experiences and thoughts on The Box case. The structure of this graduation project's research will be based on the Frame Creation Method of Kees Dorst (2015) as it provides a structed outcome to multiple-stakeholder complex problems. "Problem framing emerges as a key design practice that can be adopted and adapted to other fields, and one which provides a valuable alternative to conventional types of problem solving" (Dorst, 2015).

As mentioned earlier, there is the paradoxical issue of aiming for efficiency and effectiveness in patient care, whereas it is more likely to lead to an increased workload. Fortunately, the Frame Creation Method is also known for its approach to the complexity of a paradox. As patient home monitoring provides the caregiver with more relevant data about the patient's clinical image, in addition, this eHealth intervention increases the workload and pressure on healthcare professionals. All these additional datapoints are great for personalized treatment and with that improving care, but simultaneously it significantly digitizes the profession of caregiving. This is controversial to many health professionals motives to step into the field of healthcare, which is primarily to care for patients, physically. Approaching the paradox to reshape and reframe the profession of doctors, nurses and all related health professions is substantiated by the guidance provided by Dorst's method.

For this method to work, in-depth insights into the work of professionals, associated with The Box, are necessary in order to construct an understanding of their experiences and future goals. The aim is to combine a multi-perspective approach to acquire deep understanding on the variety of experiencing the impact of The Box. Several in-depth interviews with different professionals need to be performed. Relevant respondents need to be selected so that every individual contributes to a holistic vision in creating a new approach in redirecting the workload

to novel roles and professions. Investigating what is meaningful to the participant and what they genuinely think requires a qualitative and in-depth interviewing method. That way a decent attempt can be made in proposing novel roles and professions to support The Box in future scaling, while simultaneously involving the interviewee's considerations (Patton, 2002).

FRAME CREATION METHOD
by Kees Dorst

Due to its differentiation, the multiple stakeholders and the presence of the paradox, The Box finds itself in a complex context. Luckily, The Frame Creation Method **(Figure 7)** is no stranger to such complicated systems (Dorst, 2015). To approach the complexity, and the paradox, it is recommended to find the underlying aspirations, opinions and experiences in the variety of key actors. The aim is to keep the stakeholders at the centre of the process. As Dorst says "central to the Frame Creation model is the fifth step (referring to 'themes'), where a phenomenological analysis of the values held by stakeholders in the broader societal field leads to the identification of common themes that underlie the problem situation" (2015). The intermediate research question reflects on possible novel roles and professions, and such common themes can help in identifying a frame for redirecting the workload to this revised line of work.

Archeology, Paradox and Context

'Archeology' is about "analysing the history of the problem", which has been covered broadly in Chapter 1: What is going on and Chapter 2: About a Box. This research study analysed the existing literature and other relevant information to uncover the history of the problem, which briefly comes down to the additional workload that is generated by The Box. In the first few chapters it was possible to define the level of archaeology: The impact of The Box on the current healthcare system, the effect on the existing roles and professions and how this relates to care-team well-being.

Not only was there a gap in the literature about staff's wellbeing, but a paradox was uncovered on how the desire to increase efficiency, is causing the workload to increase. As Kees Dorst identifies "design contains a process of thinking around the paradox rather than confronting it head-on. The

solution is not within the core paradox itself (which is stuck in closed definitions), but in the broad area of contextual values and themes surrounding the paradox" (2015). The 'Paradox' is what makes this problem situation hard.

As to 'Archeology' and 'Paradox', 'Context' is about analysing. "Analyzing the inner circle of stakeholders" however, requires more than just desk research and literature studies. A preliminary understanding can be acquired this way, but an in-depth knowhow on the reciprocal relationships between stakeholders and the level of importance of each individual and group can only be achieved through inside knowledge and comprehensive insights. It requires thorough analysis to find out the point of view of the most relevant stakeholders, but this will be further investigated in the next few phases.

Field, Themes and Frames

The 'Field'-phase is about "exploring the broader field", going in-depth by doing qualitative interviews with several respondents who represent the broad range of stakeholders. "The problem solver is invited to embrace the complexity of the situation by expanding the problem-solving arena to understand the needs and values located in the broader field" (Dorst, 2015). This stage of the method goes deeper than the stakeholders' surroundings; it defines their needs, values and aspirations and will be taken into account in the following steps.

Continuing with the 'Theme'-section, it is a way of "investigating the themes that emerge in the broader field". The understanding of needs and values allows for common themes to appear, resulting in stimulation and inspiration for further development of opportunities. "New approaches to the problem situation can then be created through a subtle process of inference: once commonalities in themes have been identified" (Dorst, 2015). The themes are based on a structurization of the above mentioned needs and aspirations that underlie the complexity of the paradox.

After going through the previous phases, the findings of 'Archeology', 'Paradox', 'Context', 'Field' and 'Themes' are combined in the most significant step of the process: 'Frames'. The section is about "identifying patterns between themes to create frames". By organizing the emerging themes in such a way, a structure through the qualitative data may finally become clear. When creating the frame, it exposes the patterns and relationships between the most important themes, supporting a clarifying and summarizing set-up of the complex context. The intention of the Frame Creation Method in this research is to entangle the complexity of the project in order to resolve the paradox, so that the workload can be eased, redirected or divided towards new roles and professions, as a means to prepare a scalable context for The Box.

Futures, Transformations and Integration

The Frame Creation Method is used as a means, not only to bring clarity throughout the themes, but to allow for a future perspective on the complex situation to emerge, as it provides the researchers with "techniques that designers use to look ahead" (Dorst, 2015). When it comes to 'Futures', the emerging frames are used for "exploring the possible outcomes and value propositions for the various stakeholders", challenging the designer or researcher to figure out "what" to create. A glance into the future will be created.

Yet "how" something is, or can be, created is another challenging dispute. "How" is what provides guidance in leading the insights to a desired outcome. Dorst strengths the importance of creating or choosing both a "what" and a "how", since there is a strong dependence between both questions, they should be simultaneously investigated (2015). And so with 'Transformation', the "how" is investigated by looking into "the changes in stakeholders' strategies and practices required for implementation" so that ideas for implementation can be developed and refined.

Due to scope definition of the project, the part about 'Integration' will be left out, as "drawing lessons from the new approach and identify new opportunities within the network" requires for the transformation to be actually implemented and reflected on. As a substitute, a validation will be done on the proposed "changes in stakeholders' strategies and practices", serving as a replacement for the concluding step in the Frame Creation Method.

Frame creation

1. Archaeology
analyzing the history of the problem owner & of the initial problem formulation

2. Paradox
analyzing the problem situation: what makes this hard?

3. Context
analyzing the inner circle of stakeholders

4. Field
exploring the broader societal filed

5. Themes
investigating the themes that emerge in the broader filed

6. Frames
create frames by identifying how these themes can be acted upon

7. Futures
exploring the possible outcomes and value propositions for the various stakeholders

8. Transformation
investigate the change in stakeholder's strategies and practices required for implementation

9. Integration
draw lessons from the new approach & identify new opportunities within the network

Figure 7: Frame Creation Method
by Kees Dorst (2015)

QUALITATIVE APPROACH

As mentioned in the preceding section, the phase of 'Archeology' and 'Paradox' has been covered previously by doing desk research and performing a literature study. Even though the Frame Creation Method of Kees Dorst provides clear guidance, the information for each phase needs to be acquired somehow. 'Archeology' and 'Paradox' can be retrieved from Chapter 1: What's going on, and Chapter 2: About a Box. To gain the necessary insights to fulfil the 'Context'-phase, a qualitative study will be performed. In order to bring 'Field', 'Themes' and 'Frames' to completion, an analysis of the qualitative data is required. Thematic analysis will be the method of choice. All this can be found in the next chapter. But for now the qualitative approach of the research involves a combined method of the above mentioned research and analysis techniques **(Figure 8)**.

These results need to be reported and transformed into actions or a visual of the complex context, or both. Since the outcomes of the qualitative approach aren't defined at this point of the research, what will be done in the section about 'Futures' and 'Transformation' remains unclear. However, as a design student, visualising the future might be an appropriate outcome for delivering value to the various stakeholders. As a means for implementation, a roadmap approach might be in place, but this will be re-evaluated further along the report.

ARCHEOLOGY
literature study

▼

PARADOX
outcome of the literature study

desktop research

▼

CONTEXT
sample strategy - key stakeholder
qualitative research - semi-structured interviews

qualitative study

▼

FIELDS
1. familiarizing yourself with the data
2. generating initial codes

▼

THEMES
3. searching for themes
4. reviewing themes
5. defining and naming themes

thematic analysis

▼

FRAMES
6. producing the results

▼

FUTURES
visualisation of recommendations

future vision

▼

TRANSFORMATION
road to implementation

roadmap

Figure 8: Thematic Analysis is integrated within the Frame Creation Method. The Thematic Analysis is used to process 'raw' data into interpretative results. Which will eventually be the foundation of answering the research question

4. DEEP-DIVE

It is important to understand the complexity and perspectives on a deeper level in order to gather valuable and understandable insights. Therefore this chapter will continue with the intermediate research question for investigating how The Box is experienced by the staff, and if there are new roles and professions, what their tasks are and what they would like to see The Box becoming in the future and what their ideal future vision is. To have the answers to these questions an in-depth qualitative analysis is done through interviewing employees at LUMC. As each respondent is different, they are individually positioned as stakeholders in this chapter. The results are analysed based on a thematic analysis of which the process will be visualized and the results are processed in frames.

QUALITATIVE RESEARCH

Gathering in-depth information through interviewing is a convenient method for retrieving qualitative data based on user insights and experiences. This is highly valuable since the focus is on the workload perception of the care-team, their experiences with The Box, and how they envision this service in the future. The qualitative interviews are necessary to overcome the research gap on how health professionals experience the workload and what their underlying needs and aspirations are. To deep-dive into their opinions on the matter, an inductive qualitative research method will be performed (Patton, 2002).

By conducting semi-structured interviews, the interviewer is provided with the opportunity to explore what topics, such as workload, professions and role composition, and future steps for The Box, mean to the respondents. As mentioned previously, one of the contributors to the complexity of the project, is the variety of stakeholders, therefore it is important to discover the various point of views of the respondents and use them as insights to combine them into actionable outcomes. Those different perspectives are fundamental in order to answer the research question in a complete and through manner.

Within the context of The Box, there is an indescribably large amount of stakeholders. Every contributing individual has a different workflow, perspective, and opinion of this service. Which is why it was necessary to create a certain scope. After doing some literature study and desk research on The Box, it became clear that there are many different departments within the hospital that are making use of The Box. The decision was made to only look at the Covidbox and the boxes being used at the Department of Cardiology (HartLongCentrum). Besides the insights from those two departments, it is also valuable to interview some of the "decision-makers", who are either on the managerial level or have performed a consulting or assistance role for the managing team. This has led to the following sampling strategy.

SAMPLING

For the purpose of the 'Context' phase of the Frame Creation Method, a key informant strategy will be carried out. Participants will be selected based on their "great knowledge or influence that can shed light" (Patton, 2015) on the matter. As mentioned earlier, the interviewees either need to be employed on the Covidbox, working with one of the boxes at HartLongCentrum, or need be part of or have a link to the managerial team. Which means the participant can be of either profession. The goal is to have a diverse group of key informants and gather different perspectives on The Box, through conducting semi-structured interviews so that more depth, richness and detail on the data can be gathered (Braun & Clarke, 2013).

Due to a rather inconvenient situation (read: Covid-pandemic), getting in touch with participants wasn't always going to be easy, therefore a preference is also given to a snowball strategy, allowing for "one or few respondents to identify additional relevant contacts" (Patton, 2015). The sampling procedure will be flexible, so that there is room for expanding or reducing the pool of participants depending on the results throughout the interviewing process. Since the partial focus is on the roles and professions, their needs, values and aspirations; diversity among the respondents' roles is desired. That way a range of perspectives can be acquired through the selection of various professions. Combining those different point of views can assist in achieving a comprehensive understanding of the complex context and how the interviewed stakeholders experience this.

Criteria

In order to have a bit of diversity among the participants, a few categories were established to find key informants in. It started with wanting to have "experts" and "users" on the participant-list. Experts are defined as people with inside information on the development of The Box; they are aware of the decisions being made – or are even a part of making them –, and in addition, they are the experts in implementation and understand who needs to be involved. Users on the contrary, are much more aware of what happens in the front end. They are the ones who experience the implementations being made and they are the ones who communicate with the patients. Whereas "experts" create The Box and investigate possible implementations, "users" make use of The Box and incorporate it into the care path of their patients.

Role/function	Inclusion	Exclusion
Expert	Having behind-the-scene information on The Box	Not aware of what happens behind the scenes
	Working ON The Box: Developing or researching The Box implementations	Being a "front-end user" of The Box
User	Having "front-end experience" with The Box	Not communicating with or supervising the patients
	Working WITH The Box: Making use of The Box and dealing with patients	They CAN partially be a "back-end expert" of The Box, making them a user/expert

Table 1: Inclusion and exclusion criteria
per role of expert or user

Since The Box is already quite spread out over the hospital, it's important to narrow down the fishing pool of possible participants. As the previous research is solely focused on Covid and Cardiology, this selection overarches the methodologic section as well. As a result there are three groups of key informants: experts and/or users who are employed within the Covid "department", experts and/or users from Cardiology (representing HartLongCentrum), and experts in general of the managerial team, who are not specifically bound to either Covid or Cardio. The aim is to have around 10 participants in general, with an equal distribution of experts and users. Furthermore each category –Covid, Cardio and Managerial– must be represented by at least three participants. All respondents were approached via email or through LinkedIn

This has led to the following participant selection. Three people within the Covid "department" agreed

on doing an interview. They were selected, based on their years of experience and high involvement with the Covidbox. Four people in fact agreed on participating in an interview regarding the existing boxes within the Cardiology department, yet only three gave permission for recording. These participants were approached partially for their experience, but they also showed a significant distinction in roles. Selections for the managerial pool were quite broad and solely based on key intel the participants could give on "back-end" of The Box. Two managers agreed on doing an interview and one intern assistant was chosen for a different and fresh perspective. Lastly, there was a minimum of three months of experience. The reason for this is that there are also students working on it, and they never work on it for a long time. In addition covid has only been here for a year so they had to learn/work fast. Within this timeframe, somebody is fully up to date and properly trained.

Department	Inclusion	Exclusion
Covid "department"	Experience with The Box (+ 3 months)	No experience with The Box (- 3 months)
	Actively using The Box, OR having used The Box recently	Not using The Box, OR too long ago (+ 3 months ago)
	The Box is a part of the workflow	The Box is not integrated in the workflow
Department of Cardiology = HartLong Centrum	Experience with The Box (+ 3 months)	No experience with The Box (- 3 months)
	Actively using The Box, OR having used The Box recently	Not using The Box, OR too long ago (+ 3 months ago)
	The Box is a part of the workflow	The Box is not integrated in the workflow
Managerial team, and including assistants/ interns	Experience with The Box (+ 3 months)	No experience with The Box (- 3 months)
	Developing or working on The Box, OR having worked on The Box recently	Not developing or working on The Box, OR too long ago (+ 3 months ago)
	The Box is one of the Use Cases	The Box isn't one of Use Cases

Table 2: Inclusion and exclusion criteria
per department of Covid, Cardiology or Managerial

INTERVIEW GUIDES

After doing some desk research on The Box and finding out the first bits and pieces on the working principles, it became clear that there are two large groups of people: the ones who develop The Box, make executive decisions, perform research, implement changes et cetera, and then there are employees who use The Box as a means to provide care to their patients. This resulted in two flexible interview guides: one for users and one for experts. The majority of the questions remains quite similar, so that the results can easily be compared, however when necessary, questions were altered or replaced when more specific knowledge from the respondent was desired. The informal conversations with the participants were accompanied by a flexible interview guide. Even though questions might be slightly different, the focus is always the same, being: how they experience working on or with The Box – reflecting on roles, professions and even workload–, how they see The Box growing, what needs to be improved and their ideal vision of The Box –reflecting on scaling, improvements, pitfalls and their future vision–, and then a part of the interview is devoted on understanding their position, context, and how The Box is influencing that –reflecting on workflow, patient communication and supervision– but also if they agree The Box is making patient care more efficient.

The semi-structured interview guides were established, accordingly to the guidelines for a qualitative interview (Patton, 2002). As mentioned previously, it is the "how" and the "what" questions that provide the researcher with deep understanding of the complexity (Dorst, 2015). After providing the participant with a short introduction on the research topic –without giving away future research ambitions–, questions about their demographics, their opinions, what they value, their knowledge, and how they feel, were asked (Patton, 2002). Such a flexible interview guide grants the researcher the opportunity to ask other questions or explore different topics that may appear relevant during the conversation. Furthermore, if permission is granted –in writing or verbally– the interview will be recorded and transcribed afterwards. However, only one participant didn't authorize audio recording, and is not included in the table below. Yet fieldnotes were made of that interview and will serve as a support in further research. Lastly, all interviews were carried out online. Due to the current Covid-situation, digital interaction was strongly advised over physical contact. Tools such as Zoom, Microsoft Teams and a basic phone call were used.

Department	Particip. Group	Contact	Gender	Context	Context
Managerial	Expert	Zoom	Female	Freelance Project Manager for The Box	2y as The Box Project Manager, studied Industrial Engineering and Management, specialized in Healthcare and its ICT and in eHealth
Covid	User/ Expert *received interview for USERS*	Zoom	Female	Former non-medical eHealth consultant, supervisor of Covidbox studentteam	Since April 1st, Quality Officer for Internal Medicine, combining it with supervising Covidbox student-team. Before that, she was assisting in setting up the Covidbox (and Transplantbox)
Managerial	Expert	Microsoft Teams	Male	Assistant intern to and supervised by Project Manager and Douwe Atsma	Intern assistant for 5 months, focused on making PRI's for the monitoring devices (Prospective Risk Inventory). Giving advice in how workload is experienced and how it can be made feasible
Cardio	User	Zoom	Female	HeartRhythm Disorder Specialized Nurse, "like an eHealth nurse"	Specialised Nurse at Cardiology department/HartLongCenturm, initiated eHealth protocol (The Box) with her patientgroup. Provides blended care to her patients, mostly digital.

Cardio	User	Zoom	Female	Box Support eHealth assistant in Cardiology	eHealth Assistant within the Box Support at Cardiology department/ HartLongCentrum since two years, providing monitoring support
Managerial	Expert	Phone call	Female	Manager of operations LUMC2.0, use cases The Box and THiNK	(Recently) Former LUMC 2.0 The Box Case Senior Business Controller & Manager Implementation, studied Technical Medicine and Business administration: knows all about the financial aspect of The Box
Covid	User/ Expert *received interview for USERS*	Zoom	Female	Student assistant to Onno Teng, Nefrologist and Specialist on the Covidbox	MSc Technical Medicine Student, assists LUMC, and Onno Teng in Implementing the Covidbox. She was there from the beginning of Covid. Now, she's still involved in making the schedules for the Covidbox team
Covid	User/ Expert *received interview for USERS*	Zoom, no video	Female	Medical eHealth Consultant for LUMC2.0: The Box and THiNK	Job description was to create functions specifically for integrating Covidbox into LUMC, including how to go from analogue to digital box. Developing workflow for Covidbox. Background in medicine.
Cardio	User	Zoom	Female	Cardiologist, specialised in Heart Failure	Until 2019, assistant Cardiologist, and since then Cardiologist for Heart Failure patient group. P rovides blended care to her patients, mostly physical. Started new research group for additional new monitoring device for apnoea.

Table 3: List of participants' context

ETHICS

The Delft University of Technology has a strong concern towards the ethical protections of participants who are willing to participate in scientific research. Therefore the TUDelft Human Research Ethics Committee (HREC) is precautious when it comes to involving human subjects (Human Research Ethics, 2019). Therefore this graduation project takes into account the ethics code of the HREC. The mandatory checklist can be examined in Appendix [FIXME]. Everything has been anonymised in the research and the interview transcriptions, in order to guarantee the privacy and safety of the respondents.

DATA ANALYSIS

First, the interviews will be transcribed. The reason for this, is the amount of quality and depth that is acquired while transcribing. It allows the researcher to "access the thoughts and feelings of research participants, which can enable development of an understanding of the meaning that people ascribe to their experiences" (Sutton & Austin, 2015). Then a data processing method is applied in order to create structure in the excessive amount of information. The method of choice is Thematic Analysis. Initially the

Grounded Theory Method (GTM) was the preferred tool for dealing with the data as "GTM allows for the systematic collection and analysis of qualitative data to inductively develop middle-range theories to make sense of people's actions and experiences in the social world" (Belgrave & Seide, 2019). Yet there was the issue of losing the context of the interviews. Several methods were explored and even created to allow for qualitative analysis. Eventually the decision was made to pin it down to Thematic Analysis as this combines the most useful aspects of the GTM, together with visual processing, while maintaining the context of the interviews. The method will be further explored and applied in the next section.

THEMATIC ANALYSIS

In order to analyse the qualitative data from the interview transcripts, Thematic Analysis is an appropriate method. Even though this processing tool was originally established for research in the field of Psychology, it doesn't mean that it can't be adopted by other research domains, such as design (Braun & Clarke, 2006). There are many resemblances as this design research is just as well trying to identify people's views and values, knowledge and opinions, and especially their experiences. This information is then processed by the researcher into common themes. The official method consists of six steps: 'Familiarization', 'Coding',' Searching for Themes', 'Reviewing Themes', 'Defining and Naming Themes', and lastly, 'Producing the Results'. The first step of familiarizing yourself with the data is almost automatically achieved when transcribing the interviews. The next few steps are about structuring all the information coming from the in-depth interviews, and lastly, everything needs to be written down and presented as results of the research. Then finally this approach is integrated into the Frame Creation Method.

Clarke mention in their research: "the time spent in transcription is not wasted" (2006). The starting phase of the analysis is always the most thorough, yet demanding phase to get through, since a deep understanding is necessary to acquire, in this case through transcribing the data.

> " The process of transcription, while it may seem time-consuming, frustrating, and at times boring, can be an excellent way to start familiarizing yourself with the data. Further, some researchers even argue it should be seen as 'a key phase of data analysis within interpretative qualitative methodology', and recognized as an interpretative act, where meanings are created, rather than simply a mechanical act of putting spoken sounds on paper. "
>
> – *Braun and Clarke, 2006*

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Table 3: Braun & Clarke's Phases of Thematic Analysis (2006)

INTERVIEW GUIDES

In this approach, 'Familiarizing yourself with the data' is accomplished through transcribing the audio recordings of the interviews yourself. Because transcribing is such a time-consuming task, the question arises if it is worth putting in the time and work within a relative short-time-framed research. The decision was made to put in the effort since this is the most crucial step and will always come in handy for reflecting critically, for substantiating results, for drawing conclusions, for quoting important sayings, or just simply to remember how it was framed by the participant. It can be really easy to quickly look back on certain things, instead of listening again to the audio-recording multiple times. As Braun and

This first step of the Thematic Analysis corresponds with the 'Field'-phase of Kees Dorst's Frame Creation Method as it is about going in-depth to the needs, values and aspirations of the selected stakeholders, serving as interview participants to the research (2015). Since attention to detail is key when it comes to transcribing, it can assist in analysing and interpreting the data. First, the analysis will provoke a complicated perception of the context, since so much information is processed, yet afterwards, the researcher should be able to embrace the complexity of the situation. Slowly it will start making more sense as the process continues. As a means of marking what is important or interesting, relevant parts of the transcript were highlighted and cut out afterwards. But to make things more clear, everything will be visualised at the end of this chapter.

GENERATING INITIAL CODES

After reading the interview transcripts, the researcher is familiarized with the data. Then a list can be created of 'bits and pieces' that seem relevant to the research. Ideas start to arise at this point: what is most important is identified based on what the researcher finds interesting (Braun & Clarke, 2006). Then the labelling starts. The coding is done through assigning descriptive words to those 'bits and pieces' of the transcripts that seem relevant and interesting. Braun and Clarke say that "codes identify a feature of the data that appears interesting to the analyst, and refer to 'the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenom" (2006). To bring more structure to the method, the temporary research question is taken alongside the process, so it provides a little bit of support in deciding how to code and what labels to use.

> ❝ In qualitative research, codes are tags or labels that researchers use to organize data into manageable units or chunks so that you can find, group, and thematically cluster various pieces of data as they relate to your research questions, findings, constructs, and/or themes across the data set. All data can be coded, including transcripts, […] Once a researcher develops codes through specific processes of reading and organizing the data, codes are then defined succinctly ❞
>
> *– Ravitch & Mittenfeller, 2015*

To create some boundaries on the excessiveness of the data, 5 to 10 highlighted parts per interview were set aside as most important or most interesting. The remainder of the cut-outs were grouped together per interview as a "back-up". They will not be used in first instance, but will be revised when themes are created. If they support or possess useful information on that theme, they will be added. To continue with the 'Generating Codes'-phase, five categories that seemed most relevant in supporting the temporary research question were pre-established before starting to create the actual themes. These categories were 'Care-team', 'Patient', 'Data (monitoring)', 'Technology' and 'Organisation'. Five

different colours in post-it's were assigned to each category. Now when looking at the cut-outs, not only was it given a descriptive label, but it was written down on a coloured post-it that corresponded with that category. For example:

> *[MAN1-KB]: So I think what's crucial in it is that we need to inform the patients really well about what the box is, what they can expect, and also what their own responsibility is, because the box isn't for emergency care. So if the patient doesn't trust his feeling or his situation is getting worse, it's their responsibility to call their specialized, or their specialists or the ambulance. But I think the better we are capable of explaining what we're doing, why we're doing it and how we want to organize it, the bigger the chances they will have a good experience with the box.*

This would be given the code 'Patient Responsibility', and since it mainly concerns the patient, it was written on a pink post-it. Pink represents the category 'Patient'. Then 'Care-team' was linked to blue post-it's, 'Organisation' with orange, the yellow notes where assigned to 'Data (monitoring)', and finally green represented 'Technology'. Descriptive words that were written down on the same coloured post-it notes, weren't necessarily going to be grouped in the same theme. But this will be discussed in the next part. As instead, the colour coding of the post-its served as a tool to quickly scan and identify the relevancy of the code and with what part of the research question it mostly corresponded with.

SEARCHING FOR THEMES

In order create themes, the descriptive labels need to be compared in a critical and analytical manner so they can be assigned to the most appropriate group. This is based on similarities and congruencies of the transcribed content that belongs to the code. As Saldaña says, the researcher needs to "group similarly coded data into categories because they share some characteristics" (2013). This process of grouping codes is an iterative task that requires a lot of time, attention, reviewing, and even taking breaks in order to not be overwhelmed by the data and being able to see the wood for the trees. Slowly a compelling network will emerge through the extensive amount of information. Structuring the interviews into themes will help in creating an overview of all the data.

As mentioned before, there were five different colours of post-it's to write the descriptive word – also known as the code or the label– on. Doing this, is already a preliminary way of thematizing: the code

and its corresponding quote is immediately assigned to either 'Care-team', 'Patient', 'Data', 'Technology' or 'Organisation'. This doesn't define the themes yet, but it narrows down the context of the transcribed part to the most important field. When debating later on in which theme this code and matching quote belong, the colour of the post-it can assist in "cutting the knot". As mentioned in the above section, the codes are grouped together based on the descriptive word and its corresponding content in the transcript. The aim is to create themes that are more or less of equal size. The goal is to try to stay within five to ten labels per theme.

REVIEWING THEMES

This phase resembles the previous step. In the literature of Brauw and Clarke, the 'Reviewing Themes'-phase was explained a bit more different than how it is approached here, yet the baseline remains the same. This phase is all about the refinement of the themes from the previous section. "During this phase, it will become evident that some candidate themes are not really themes (e.g., if there are not enough data to support them, or the data are too diverse), while others might collapse into each other (e.g., two apparently separate themes might form one theme). Other themes might need to be broken down into separate themes" (Braun & Clarke, 2006). It should be obvious at the end which codes belong in which themes, what makes them coherent within that theme, and what distinct the themes from each other. At the end of this part of the Thematic Analysis it should be clear what the different themes are and how they tell the story, and even more: how they answer the research question.

Not only were the themes reviewed and changes were made for this step, but another look was taken at the "back-up"-quotes. Remember the "back-up"-quotes? That were the highlighted parts from the interviews that didn't make the first selection of relevant parts from each interview. Now that the themes have been established, the additional quotes are reviewed to see if they fit any of the existing themes and support them or even give extra value or relevancy to them. To sum up, 139 codes and their corresponding quotes were grouped into 11 themes. Afterwards 26 "back-up"-quotes were added to 9 out of the 11 themes: 'System collaboration (6+0)', 'Standardization and generalization (7+1)', 'Starting out and building up (8+3)', 'Workload and

its feasibility (6+2)', 'Patient at home vs. hospitalized (6+3)', 'Efficiency and error sensitivity (10+5)', 'Patient education, awareness and responsibilities (5+7)', 'Growing - demands and expectations (9+0)', 'Selective monitoring (trough prioritization) (7+1)', 'Different roles and responsibilities (10+3)' and 'AI system support (5+1)'. The first number between brackets represents the initial codes, whereas the second number represents the "back-up's".

DEFINING AND NAMING THEMES

As a final step to the actual analysis, the themes are defined and refined. With that, Braun and Clark meant to capture "the essence" of what each theme is about, in addition to determining what part of the data those themes correspond to. Yet the researcher must be aware that within this phase of the analysis, "it is important not to try and get a theme to do too much, or to be too diverse and complex" (Braun & Clarke, 2006). In order to make a coherent story around the data and the structure, each theme must be clearly defined in what it is about and what it represents. And of course, each theme must be named.

After ending up with 11 themes from the previous phase, another look was given to the structure, and it was decided to combine several themes into larger main themes, making the original 11 now sub-themes. This would make it more clear to create a storyline around the results. For further reference and convenience, the initial 11 themes, then sub-themes, will be referred to as 'categories' from now on, whereas the new main-themes will be baptised as themes. Meaning 11 categories were grouped into 3 themes: 'Things we know: workload vs efficiency', 'Looking for the independent patient' and 'Preparing for scaling towards the future'. Which categories belong in which theme and what the description is of each theme, will be discussed in the next section 'Producing the report', also familiar as 'Writing up the results'.

PRODUCING THE REPORT

The last phase starts right after a complete set of themes has been collected. It entails the report's final analysis and writing. The objective of the Thematic Analysis is to write-up the results in such a coherent way, that it is suitable for further use in this research assignment. Braun and Clarke explain that the goal

is "to tell the complicated story of your data in a way which convinces the reader of the merit and validity of your analysis" (2006). Furthermore, the reporting must include enough extractions from the data in order to illustrate the theme's prevalence, as well as adequate proof. This can be done by selecting examples that are especially vivid and convey the core of the argument that is being made, without making it overly complicated. Writing-up the report must do more than merely give statistics: Examples of the data must be included in an analytic narrative way that vividly depicts the story being told through the data. It must go beyond a description of the facts to build a case to answer the research question (Braun & Clarke, 2006).

Three themes emerged from the data analysis: [1] Things we know: Workload vs. Efficiency, [2] Looking for the Independent Patient, and [3] Preparing for Scaling towards the Future. It can be shortly summarized that Theme 1 stands for "what we know" and "what we've learnt" from the existing box projects. Theme 2 is about how the staff is coping with the situation at the moment, so "what we do now", and Theme 3 is more about "what we want" in the future and how to grow. Respectively, the themes roughly refer to the past, the present and the future. In addition, even though all theme are supported by the information given by all stakeholders involved, each theme relies significantly more on one group of stakeholders. Theme 1 is mostly underbuilt by the respondents from the Covid "department". Theme 2 is essentially substantiated by the people at Cardiology (HartLongCentrum). And the content for Theme 3 was mainly provided by the interviewees from the managerial side. In the next section, all themes are discussed, and substantiated by quotes (translated from Dutch) that serve as examples.

It might have been noticed that 'Different roles and responsibilities' was not grouped in any of the themes. In theory, the content behind the codes is mostly coherent with Theme 2: Looking for the independent patient, yet this category is way more important than a sub-level of just one theme. As a matter in fact, Category 11: Different roles and responsibilities runs like a thread through all themes. The way the Care-team performs their roles and responsibilities is affected by all categories from 'Things we know: Workload vs. Efficiency': it describes several issues. Then again, the roles and responsibilities are adapted to accommodate the categories from 'Looking for the independent patient': when aiming for the pro-active participation of the patient, the functionalities and responsibilities of the Care-team change. And finally the different roles and responsibilities are also affected by 'Preparing for scaling towards the future': it shows how there is room for their roles to change with the implementations being made for scaling.
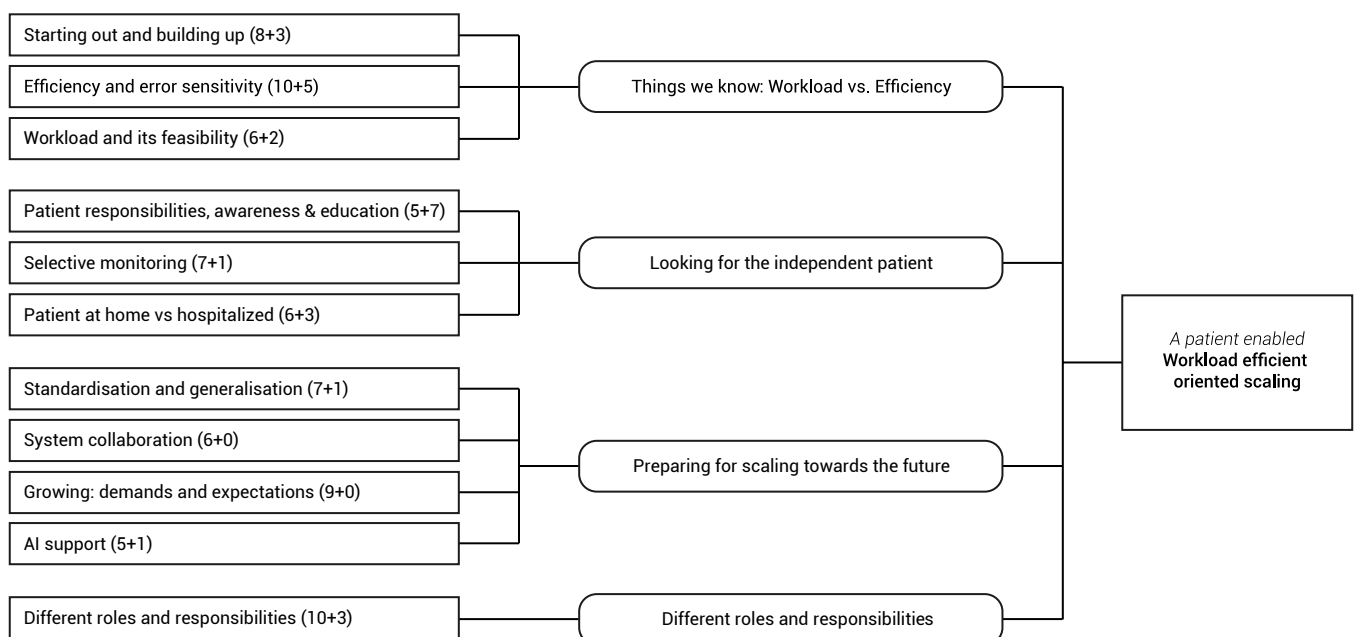

Figure 9: The Coding Tree of the Thematic Analysis visualizes all 11 categories and their amount of codes (incl "back-up"), which are then combined into 3 themes. These will later on be used to create a frame.

Theme 1:
Things we know: Workload vs. Efficiency

In 'Starting out and building up', the interviewed staff talks about the decisions that needed to be made when a box was created for their department, but also how they perceived the implementation of the box in the beginning and how it changed their tasks or created additional ones, and how they have experienced working with it so far. This category is supported by codes such as: Learn from each other, Shaping work environment, Workflow Covid patient, Internal collaboration, Investing in what you already have, Short vs. long term care, Involved care-team, and Creating collaboration.

[COV2-SM]: How can we integrate this (refers to the service around The Box) on the workplace, and how can we shape this? So I mean, I have been hired especially for this. At least, that's how you could call it, because this function didn't exist at the time. A complete team has been established to do this of course, and to support you in this. So that is something you, as additional staff, can scale.

(represents 'Shaping work environment')

'Efficiency and error sensitivity' is a rather broad category, including, pitfalls, workflow troubles, permission request to access data and other inconveniences. This group is mainly about certain aspects of The Box that need improvement. The codes that underlie this category are: Application automatization, Time schedule, Measurements acute vs. chronic care, Technological difficulties, Daily patient calls, All access to patient data, Errors in responsibility, User friendly devices, Pitfalls and child diseases, and Data sharing permission. The codes might not always trigger the right perception and understanding of the describing word, but this category was mainly constructed on the content of the quotes rather than the codes itself.

[COV3-CO]: The bigger the team, the less responsible people feel, the faster errors occur. I think it should be possible, but then you need a better system, that is less sensitive to errors, and also that you have more people who do this as a full-time job, or part-time. But not, let's say, that it's solely build on students. Students can do many tasks, but in administration, you want it to be super secure. I also think it should become a part of the real job of a clinician. So, that the doctor checks more frequently, like, what are the values of the patient, and not just when he thinks of it […] This way, you have more people who are sitting on this very closely. So something large scale, but less errors. Imagine overlooking someone.

(represents 'Errors in responsibility')

Sometimes the interviewees complained about their workload, the tasks they must do, or simply just explain relevant aspects of their work and how it connects to the feasibility of the task and the work they must deliver in their role. This is all combined in the category of 'Workload and its feasibility'. In here they talk about new workflows, and additional workload, in general, but also specific to certain professions. This will become more clear in some of the codes: Workload specialised nurse, New work division, Lowering patient occupation, System workload, Data overload, and High workload (SEH and Poli).

[CAR3-MdH]: I understand that for the, yeah, the nurses at Heart Failure, that they think, yes, well, it's nice that you come up with this, but somebody has to look at it. That is why I think it is so important that the system helps them in that. Because else it is not going to be workable for them.

(represents 'System workload')

What is remarkable is that this theme aligns with the paradox of workload vs. efficiency. It was mentioned previously that literature fails to deliver good-quality insights into the matter, and prevented this graduation project to really built upon this and further research was necessary. The results of the Thematic Analysis provide the researcher with a clear understanding of the care-team's experiences within this paradox and if they perceive this paradigm too in their everyday workflow.
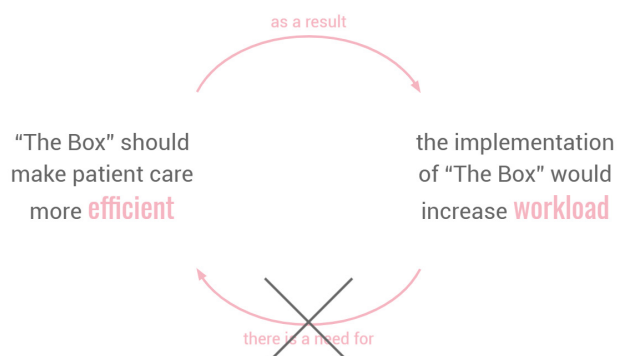
Theme 2:
Looking for the Independent Patient

'Patient responsibilities, awareness & education' is probably the most self-explanatory category. It can also be connected to the categories from theme 1. The codes that represent the transparency of this category are: Patient responsibilities and safety feeling, Patient responsibility and expectations,

Support healthcare through patient education, Data responsibilities, and Patient awareness. As the patient is taking on more responsibilities, the workload on the care-team is reduced. Essentially, all categories are related somehow, but there is a strong coherence between this category and the 'Workload and its feasibility' from the previous theme.

[CAR1-RvdP]: It's just, we also think that the patient should be responsible. It is not that he must do it for me, sending in his blood pressure. Like I should do something about it the whole time, to say something like that. I believe that the patient can have responsibility on his own. Ans if we see that the measurements aren't good or right, that they are aware of that themselves. Like they would do it usually, even if eHealth wasn't there, then they would also say like, oh doctor, I'm not feeling well, can we talk about it? So you keep the responsibility with the patient, so that we don't have to take over. Because then, you also create a feeling of fake safety. Like, oh but the doctor will look at it. But yeah, what if you miss one then.

(represents 'Patient responsibility – and safety feeling')

As a result to the large amount of patients and the overload of information that comes along with it, it is not possible to monitor every bit of data that comes in from every patient. Therefore there is a whole category dedicated to 'Selective monitoring'. As the previous quote explained so well, it is required from the patient to take their own responsibility, because a large part of data will not be looked at on a daily base. Codes that define this category are: Monitoring frequency, Limited monitoring, Looking at data, Prioritization, Patient information, Timing monitoring checks, and Monitoring safety net.

[CAR3-MdH]: With us, it is in fact the Heart Failure nurse who looks at it. I will only look when my patients visit the outpatient clinic and I just want to have a look back at their blood pressure, and how their weight is. But, myself, I am not actively checking the data. Only the Heart Failure nurses will do that, I think about two times a week, more or less.

(represents 'Patient information')

In the last category of this theme, a comparison is made between a patient who is at home and a patient who is in the hospital and how this affects the workflow, but also the collaboration with and the education of the patient. It is noticeable that again this category shares many links with other themes. In 'Patient at home vs hospitalized' it is discussed how The Box is an intervention for keeping the patients out of the hospital and giving them the right tools to stay at home safe. Codes that provide more explanation

of this category are: Supervising patients, Digital follow-up, Positive outcomes Covidbox, Acute vs. elective care, Patient personalisation, and Selective hospitalization.

[COV1-MH]: With the Covidbox, you can see some great results, that there are fewer days patients spent in the hospital. Due to the Covidbox, somebody is able to go home sooner, and is less likely to be readmitted. So definitely for the Covidbox, you just really see the great results.

(represents 'Positive outcomes Covidbox')

Now looking back at what this graduation research has previously described: "A proactive patient that is actively involved in their care, can take away a part of the work, and the burden, of the care-team, making them invigorated and fresh again, which is why caregivers will be requesting patients' participation more often". This is what was written alongside a preliminary framework that was created after digging into the existing literature The outcomes of the of the Thematic Analysis within this theme confirm that this framework is a step in the right direction in overcoming the additional workload The Box brings along. The answer might not be future-proof, but for now: giving the patient more responsibility is a possible intermediate solution in reducing the burden on healthcare professionals.
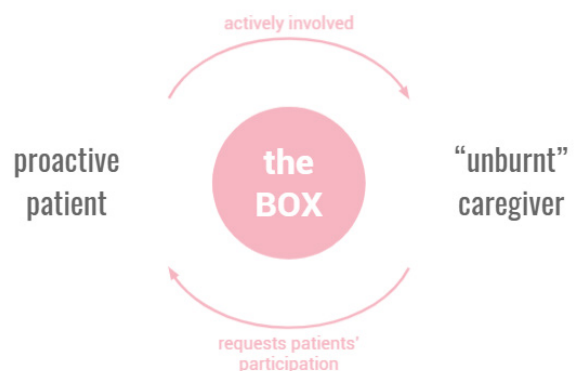
Theme 3:
Preparing for Scaling towards the Future

'Within this category, the participants talk about how certain systems, and software, are different from each other and how that is sometimes inconvenient to work with. But also the way they work with The Box in the departments is distinctive. This lead to the staff saying they want more generalization, or how things should be or could be combined or brought together. This was grouped in 'Standardisation and

generalisation' which includes the following codes: Generic service and ICT, Outsourcing the combined box, Standardization care path, Overarching system, Standardization, Knowledge unity, and Holistic approach.

[CAR2-TI]: We are actually a bit of the frontrunner of how it actually, of how you would like it to be in the end. To have it working, so to speak, for the patient and for the specialists. And then I think, here you have the knowledge, here you have, let's say, just sort of, the origin of The Box so to speak. And then I think, well, how nice would it be if you could share that knowledge with the other departments and such. And then I think yeah, you know like you just have to reinvent the wheel every time, or something. And then you think yes, that is not necessary, is it? A lot of time can simply be saved in this, if you could get that information from each other, so to speak. And there are also sometimes things that we run into and maybe there are other departments that are like, oh well, we are much further along on that. And then I think yes, how cool would that be that you can support each other in this. I mean, you're one hospital after all.

(represents 'Knowledge Unity')

In 'System collaboration (EPD vs. HiX)', the participants talk about certain functionalities that are either different or similar for the department's systems. For example how HiX and EPD often fail to collaborate, and that they find it odd since both systems work so similar. Others even address the issue that it is hard to work together with other hospitals since the system only allows for registering LUMC-patient numbers. Additionally, many respondents mentioned in their interviews that they always have to log in onto different accounts and systems in order to properly process all patient information. The category is represented by the codes: Aligning ICT with care, Department differentiation, LUMC as data warehouse, Seamless integrated technologic system, Medical dashboard, and System collaboration failure

[MAN1-KB]: What you see is that the ICT is now very much focused on the LUMC. So the app is directly connected to the data platform at the LUMC. It's kind of like a data warehouse, and we are in the transition of disconnecting it and maybe to another kind of server outside of the hospital. And that makes it more easy for other hospitals to connect to that, because now it's if you want to use the LUMC care app, if you need an LUMC patient number. And that's if you want to grow and you want to give the possibility to other hospitals, that's not the best option. That's not the best way of working.

(represents 'LUMC as data warehouse')

The 'Growing: demands and expectations' category involves future visions, goals and must-have's for

the interviewees when thinking about expanding the service. They talk about how they think The Box must grow and what things need to be accomplished. These often were interesting tips or take-aways for a possible scaling strategy. Yet they also talk about the things to overcome if LUMC wants to grow with The Box. The codes were: Expanding to periphery, Educate other hospitals, Growing professions, Continuous innovation of general box, One central point, Holistic approach to care, Role and involvement of LUMC, Technologic development, and Expanding the service

[MAN3-FS]: But what is happening now at the LUMC, is that we want to do everything ourselves. And we are not. Medical content? Absolutely. We can. But logistics? We are not good at that. Maintenance? We are not specialists in. All that equipment out there: that's not us. So I think we have very clear choices there, at least, that's my view: we have to make very clear choices about , don't we have to do this together with someone? [...] And I think if you want to start scaling now. That you have to do it with partners that you can work with.

(represents 'Role and involvement of LUMC')

Finally, the category 'AI support' is as transparent as the name suggests. And with descriptive words such: AI support integration, Critical attitude, Technological assistance LUMC 2.0 outcomes, and Technological care path, the category is substantiated by clear codes. They discusses a possible role for AI in the future of The Box. It is impossible to manage all patients and their data at the moment. This leads to the majority of the participants saying that they see technological advancements, such as AI, become a part of the solution. If it's not now, it will be integrated later on, but it will be implemented eventually. Let AI take on the majority of the data, and let the care-team take care of the most severe cases, without having to worry about the others.

[MAN2-MD]: I think it will be nice, so to speak, that AI can deliver a large functionality on level 1 of The Box. So that actually, the human aspect will depend more on it. So that the time that remains can be used for the necessary. And then we want, let's say, AI to take over a large part of the responsibility of humans, whereby the system can become better than that humans could ever do [...] It will not be there in the short term. But eventually, you have to strive towards that to keep healthcare affordable and feasible.

(represents 'Critical attitude')

Most importantly, theme 3 serves as a great source of inspiration for scaling needs and requirements. Having a multi-stakeholder perspective on this topic

is a desirable and productive outcome of the Thematic Analysis. Multiple point-of-views combined can substantiate a vision for the future that is thorough and coherent. Besides that, this theme corresponds with what was mentioned earlier when reviewing the research: "There will always be a role for an engaged patient, but this "solution" is not futureproof, it serves more as a means to bridge the gap until the required technologic advancements are implemented. In the future there will be a role for Artificial Intelligence". The theme 'Preparing for scaling towards the future' supports the pre-established opinion on this matter.

DIFFERENT ROLES AND RESPONSIBILITIES

'In the previous ten categories, "roles" and "responsibilities" has been mentioned several times. This proves how related everything all is, and especially to this category. 'Different roles and responsibilities' describes how professions are perceived, how tasks are divided, how roles are changing and how the responsibility is so dependent on many different aspects. It compares the roles and responsibilities with how it used to be, but also where it's heading towards. Codes like Customer support service, Role development, Think tank LUMC, Remote monitoring care-team, Attachment to physical care, Technological improvement, Close patient monitoring, No acute care, Expanding collaboration, and Task division, sketch quite the picture of that.

[MAN1-KB]: These were nurse practitioners who were already working at the department, so they have patient contacts as part of their job, and some of the patient contact is replaced with looking at the eHealth data. But on the other

hand, it also created a new function: like an eHealth consultant for helping the patient using the technology, but also to answer some more functional or technical questions. So the things were not medical, just for judging the medical data, those were nurse practitioners who were already part of the department before the implementation of The Box.

(represents 'Role development')

The category-theme 'Different roles and responsibilities' provides the most overarching information when it comes to answering the research question. "How can additional workload provided by The Box be redirected to novel roles and professions to support scaling?", and then the scope was to investigate this through the lens of healthcare professionals. What stood out from the Thematic Analysis results on this final category, is that roles and professions are already changing because of The Box. eHealth assistants and consultants are being hired in addition to the existing roles, and current healthcare professionals such as nurse practitioners, are transforming their role towards eHealth nurses and consultants. The interesting thing is that each department does it differently. Another question arises: what resources and activities contribute to the decision on how the department copes with the implementation of The Box? What separates the departments from each other that it causes the workflow for each to be so divergent?

VISUALIZING THE PROCESS

The above step-by-step explanation of the Thematic Analysis may sound a little bit abstract. Therefore this section aims to provide more clarity to the process. The old-school 'cutting-and-pasting' approach is visualised in the table below:

Familiarization
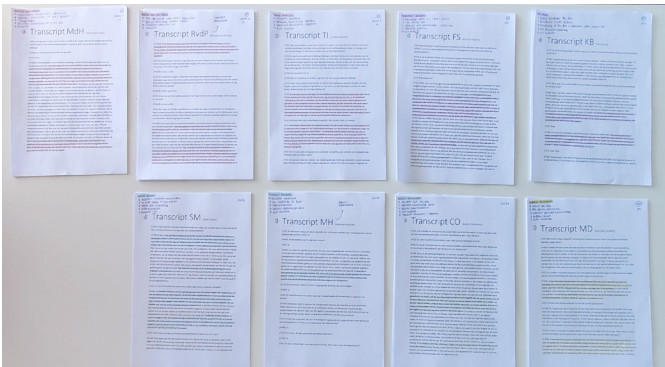
Highlight the most important parts of the interviews. No limit on the amount of marked parts.

Coding
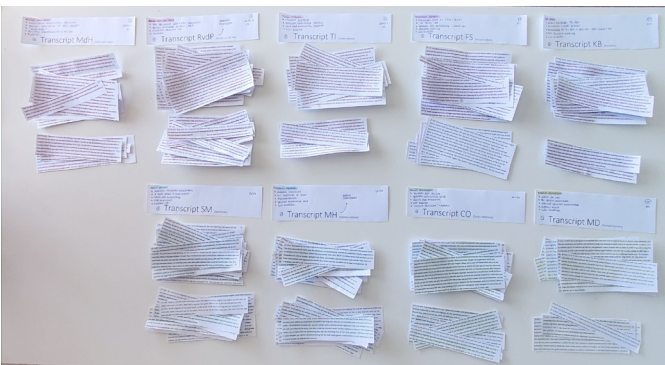
Re-read the highlights and decides which ones to cut out. Decide on 5 to 10 parts per transcripts that are most relevant to that interview and in answering the research question. The left-over quotes are places in a different pile.
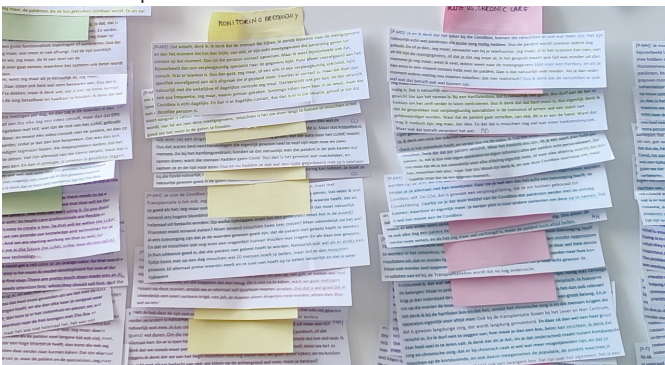
Write down a descriptive word for the relevant quotes on post-its. These will serve as codes.

Searching for Themes

Combine all labelled post-it's and their corresponding quote together in groups.

Reviewing Themes

Restructure the themes based on the codes.

Add the left-over (also known as back-up) quotes to existing groups. Only include them when they substantiate the theme.

Defining Themes
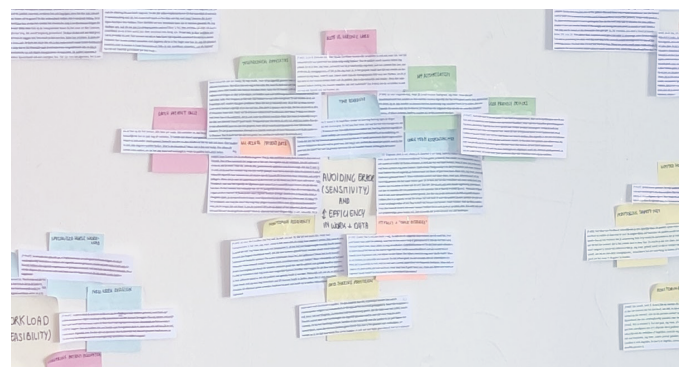
Define and name the established themes.
 later on referred to as categories that will be sorted into the actual bigger themes.

IMPORTANT INDIVIDUAL STAKEHOLDERS

Each participant has a specific role in their department and therefore carry out a certain function with its corresponding tasks and responsibilities. This background has a tremendous impact on what their opinion is, how they experience The Box and its surroundings and in what way they respond to the questions. By interviewing all these different stakeholders, a combined perspective can be created. However, as mentioned, each respondent is different, so two people might have different opinions on the same topic, it is then important to understand why. In the next section –positioning the participants– all respondents are located on a radar plat to provide some context and weight to their responses. In addition, a stakeholder map is created to visually show how they are related to The Box, each other, and to the patient.

POSITIONING THE PARTICIPANTS

As every participant is different, they all carry distinctive opinions. Each one of them had something to say about the research itself and direct it towards their experiences. As mentioned earlier there were 5 categories that were pre-determined

for structuring the codes into 'Care-team', 'Patient', 'Data (monitoring)', 'Technology' and 'Organisation'. Besides a few exceptions, almost every respondent mentioned something on each aspect. How many times exactly a participant said anything about any of these topics, says a lot about them. In short, it is possible to create a positioning system for the respondents so that contextual information can be captured. Each time a quote of a participant is used to underbuilt one of the themes, makes them more relevant to the research. An interviewee who has 5 used care-team quotes, is more decisive than someone with only one used quote. Therefore all participants are laid-out on a radar plot:

This visualisation shows on which topic the participants had something to say on. It also structures how often a category is mentioned by a respondent. The combination of categoric responses and the background of the interviewee says a lot about how they reflect on The Box, and thus how they experience it, and in what way. What can be concluded from the visual, is that organisational related perspectives has the upper hand when it comes to the content of their responses to the interview questions. Patient

Radar Plot based on Respondents Interview Positioning
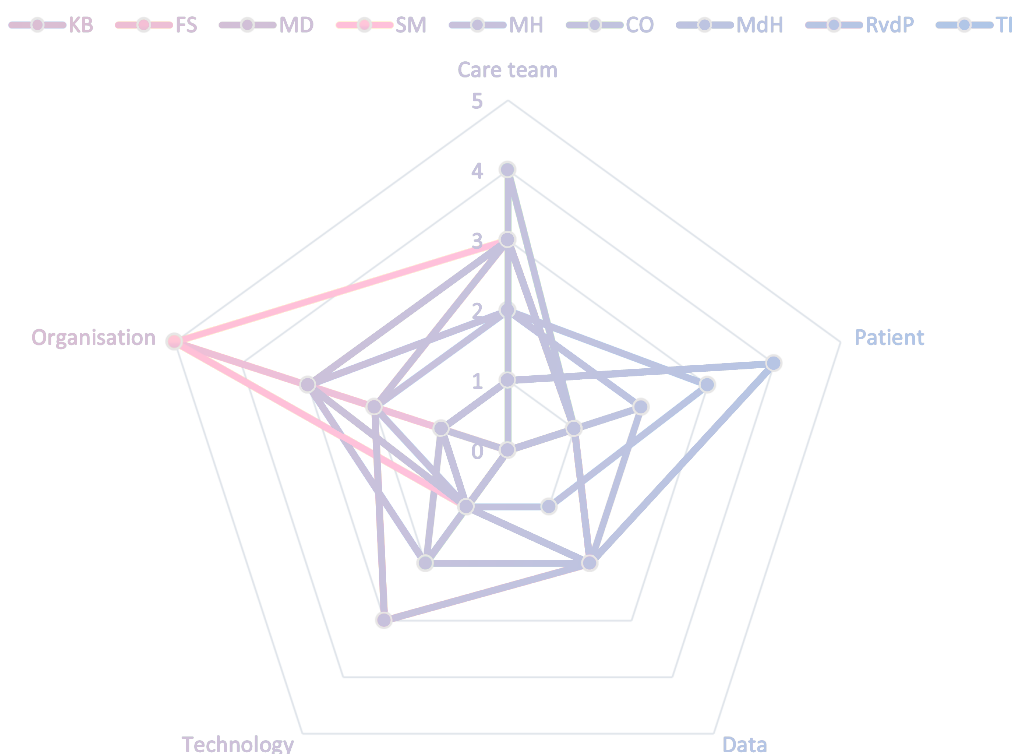
Figure 10: Radar Plot based on Respondents Interview Response Frequency Positioning

and care-team show great relations too. However it is technology, and especially data, that doesn't comply in most participants' their answers. As most questions regarded workload, roles and professions, and scaling, it is no surprise organisation, care-team and patient scored highest.

Furthermore, no other actions will be taken with these positionings, yet they do give weight to the quotes, the codes, the categories, and eventually the themes. It made it easier for interpreting the results and deciding what was important, so the most relevant things could be addressed. In addition, it makes it visually easy to understand how each participant reflects towards the results and with each other. As each respondent positions themselves differently on the radar plot, there background and connection to The Box is also very distinctive. In the next section, this will be further discussed and it will be shown how each participant is located in the stakeholder map.

STAKEHOLDER MAP

Of the interviewed participants, there were six respondents who had a significant role within The Box service of their department. The other three are positioned within the managerial team and had no direct link to the use of The Box. They are still a relevant stakeholder, but play a more important role on the back-end. The interviews of the initial six respondents —three covid, three cardio— are accommodated with rich context on their positioning within their departments. A stakeholder map was created to give an idea of who is working more closely with The Box, or their position towards it. This solely involves the people working with The Box. There may be other relevant actors within the department, but who have no contact with The Box, and are therefore not positioned on the stakeholder map.

Covid Department

For Covid, participants [COV1-MH], [COV2-SM] and [COV3-CO] were interviewed in order to find out more on who is all occupied with The Box service, and how closely everybody is involved. It came to the understanding that the student teams —both medical and non-medical— are the ones who initially use and take care of The Box the most. They are also the ones who come in contact with the patients
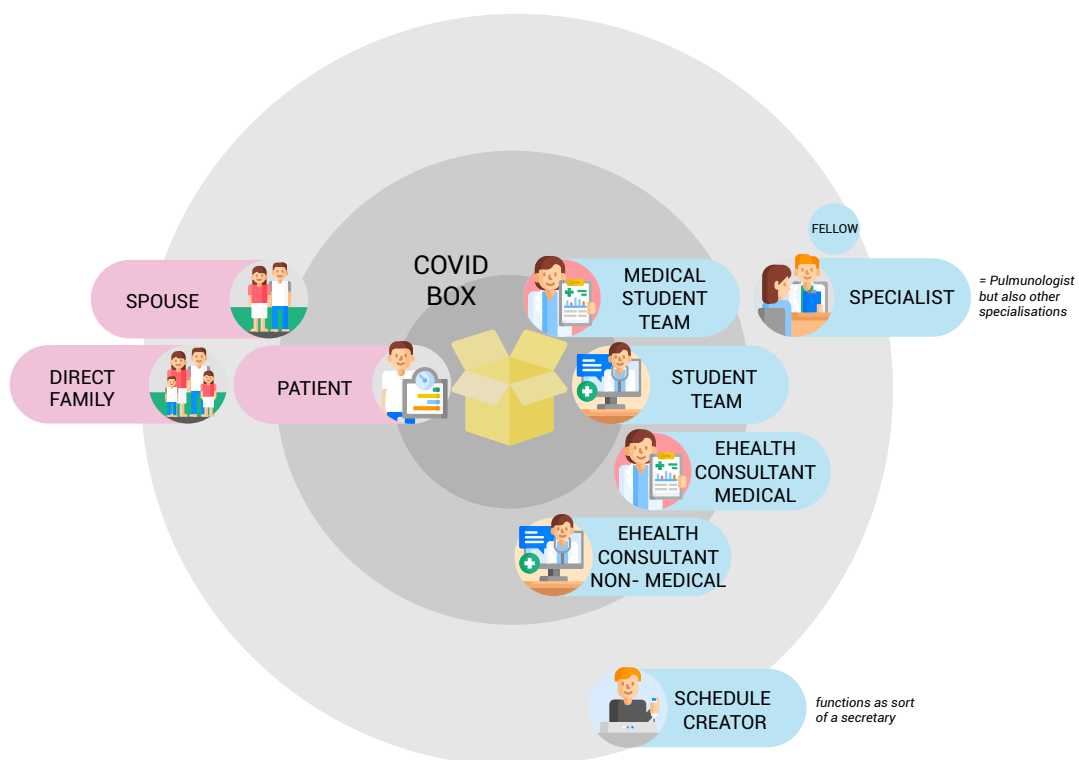
Figure 11: Stakeholder Map of Covid Department

more frequently. The specialist for example, has in fact no contact with the 'The Box'-patients. It also became clear that since Covid patients are mostly in isolation, their spouse and close family usually are more distant and have only little involvement with The Box.

Participant [COV1-MH] was a non-medical eHealth consultant, and is located in the stakeholder map with a similar distance to The Box itself, compared to the medical eHealth consultant. This one is represented by [COV2-SM]. Respondent [COV3-CO] played a very active role in the early stages of the Covidbox and took most tasks and functionalities on her part, now that more people are involved, she has a more distant position as a schedule creator and serves a rather secretarial role as a part-time occupation. Later in the project, there will be contact with the student teams in the observational research.

Department of Cardiology

Within the department of Cardiology there is an incredibly large amount of important actors, yet only relevant stakeholders in the use of The Box are positioned on the map. This stakeholder map was established, based on the insights of participants [CAR1-RvdP], [CAR2-TI] and [CAR3-MdH]. Within this department, it's the eHealth assistant that has the most frequent contact with the patient as they identify themselves as The Box Support: a customer support service of The Box within the department of Cardiology. Furthermore the nurse practitioners have relatively close contact with their patients, definitely if it regards an illness that requires close supervision on the monitoring activities. The specialist is a bit more distant and usually just checks up on the patient, or The Box data, right before an appointment.

Furthermore they have their own ICT'ers taking care of EPD Vision where they can see the patient data. Whenever there is a meeting regarding The Box, the ICT service will always sit around the table to brainstorm about next In this case. The spouse and direct family are in much closer contact with The Box than with covid. Participant [CAR1-RvdP] is a nurse practitioner for a certain condition. In addition [CAR2-TI] works as an eHealth assistant for The Box Support and [CAR3-MdH], and is a specialist for a specific patient group.
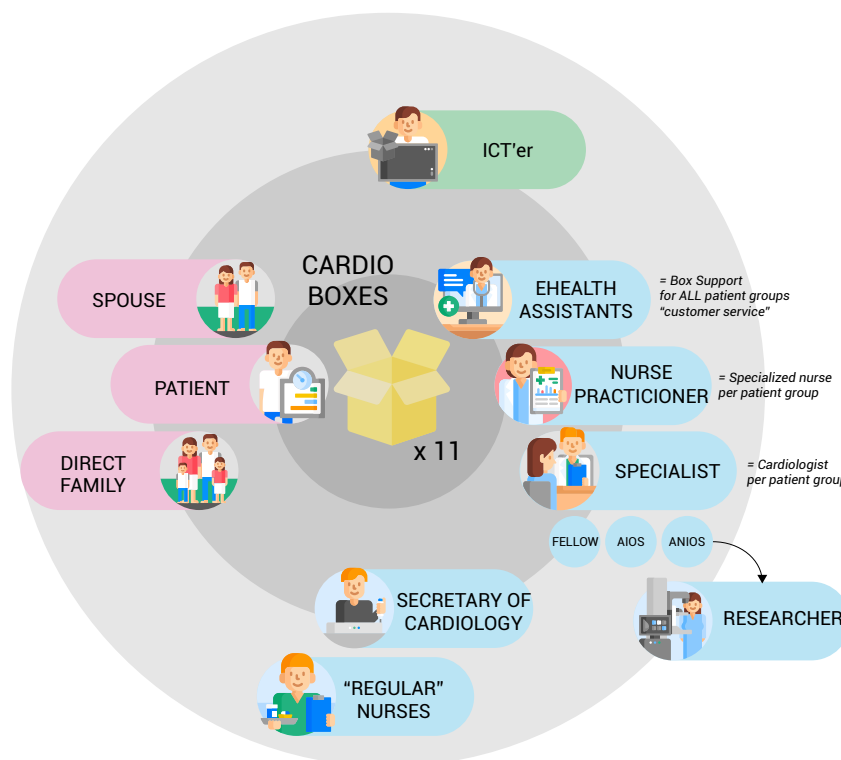
Figure 12: Stakeholder Map of Department of Cardiology

FRAMES

The framework is the last iteration of the analysis that will assist in answering the research question. When an issue occurs in a complicated context, the Frame Creation Method is typically used (Dorst, 2015). The most significant stakeholders, as well as their mutual relations, are included in the framework so that it can provide the researcher with important insights on the research question, in the assumption it can assist in "solving the problem". The outcomes of the qualitative interviews are processed through the Thematic Analysis. This method allows for structuring the pile of information that came out of the research. The established structure will eventually help in creating a framework from the analysis.

When it comes down to the results that supported the researcher in answering the research question, many "in-mind" insights were processed. Therefore, it remains a difficult task to take along the reader in the train of thought. To create a better understanding, the most prominent insights were combined in a visualisation, which is a rather extensive elaboration on the framework. In first instance, there is an introductory frame to the problem: it introduces the patient-dependant monitoring diversity, and simply how there are now more patients to supervise. Secondly, the frame tries to sum up some of the key characteristics that arose from the analysis that co-defined the complex context. This is the first time several opportunities emerged on paper.

DEVELOPMENT OF UNDERSTANDING: FRAMING THE PROBLEM CONTEXT
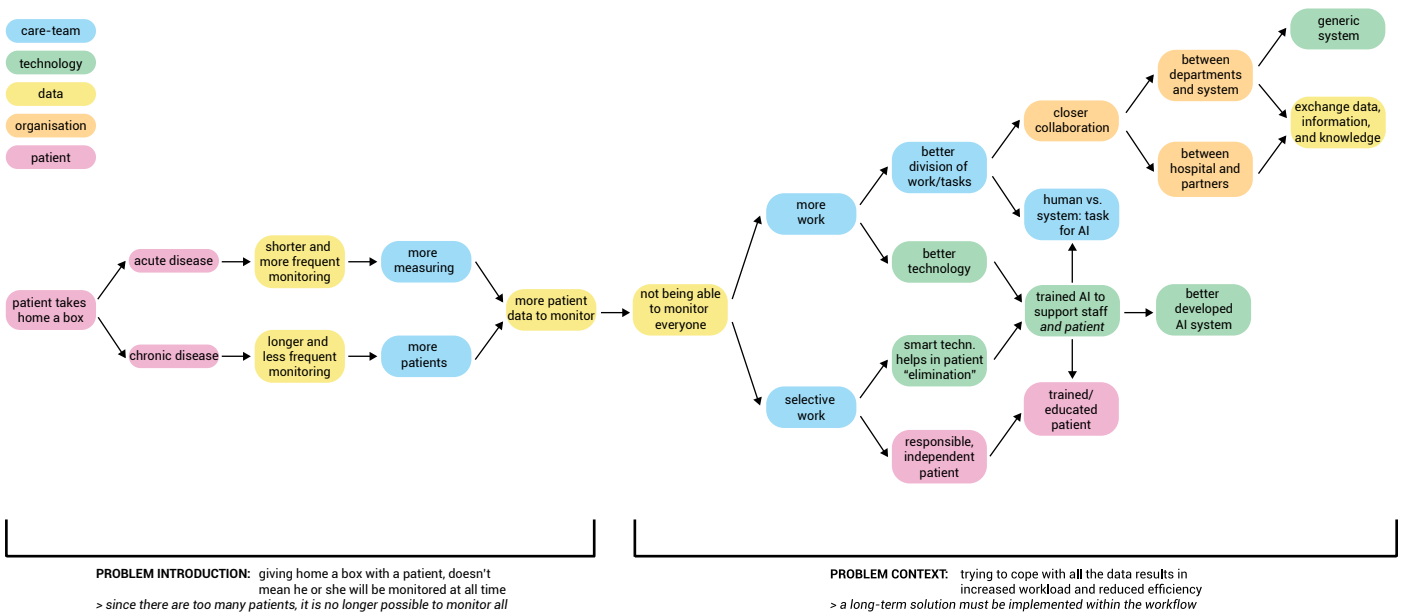
Figure 13: Framing the Problem Context

This framework serves as a structure to develop an understanding of the most prominent aspects of the acquired knowledge from the qualitative research. All of these elements surfaced during the thematic analysis. It simply represents a visualizing summary of the most important insights and how each one leads to the another one. Every labelled insight is colour-coded similarly to the descriptive words from the Thematic Analysis. It shows which insight came from where. These understandings contributed to the development of the themes, as represented in the visual below **(Figure 14)**. As a final iteration, several insights from the themes resulted in certain propositions for possible opportunities. A first stage of imagination is triggered.

DEVELOPMENT OF UNDERSTANDING: FRAMING THE PROBLEM CONTEXT
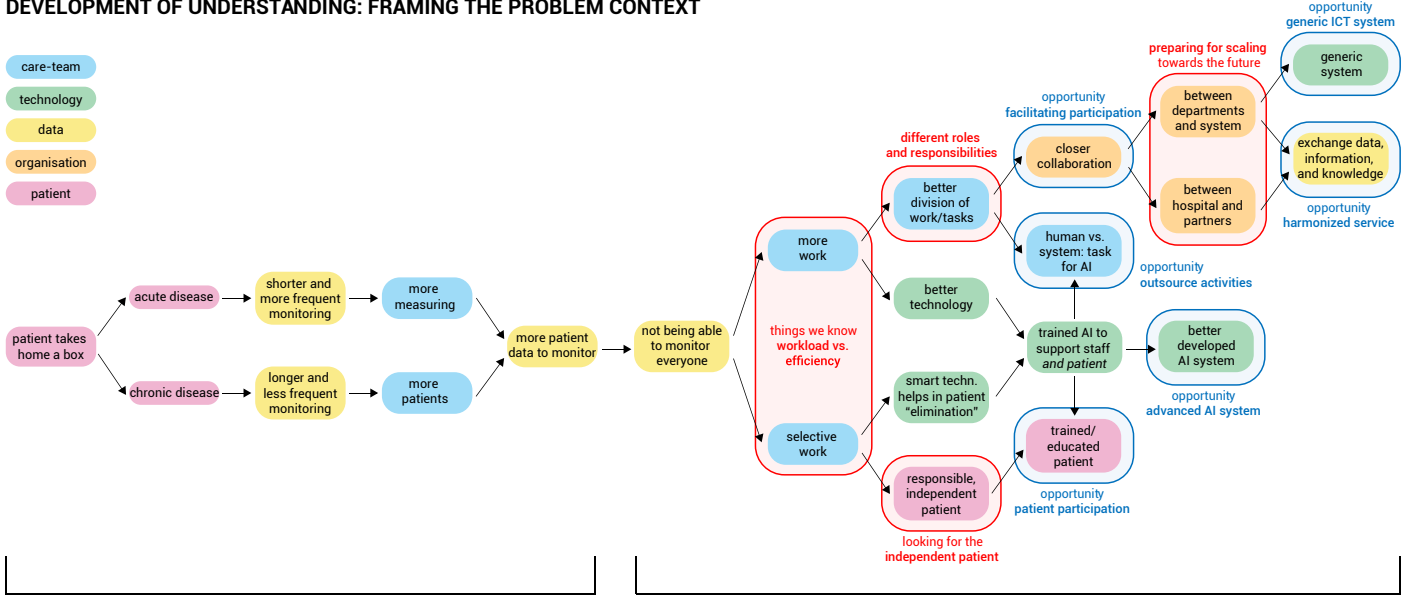
Figure 14: Connecting to Thematic Analysis and Identifying Opportunities

Based on the emerging themes, the above framework can be reduced to a thematic frame **(Figure 15)**. This simplified frame doesn't not only assist in answering the research question, yet in addition, it reflects critically on it as well. The framework below covers each section of the intermediate research question of how additional workload provided by "The Box" can be redirected to novel roles and professions to support scaling? The first theme maps out the paradoxical issue of the workload. The theme of 'Different roles and responsibilities' reflects on the redirection to novel professions. And the final one identifies important aspects for supporting a scaled service. The knowledge behind these themes are combined into an understanding and elaboration on the research question.
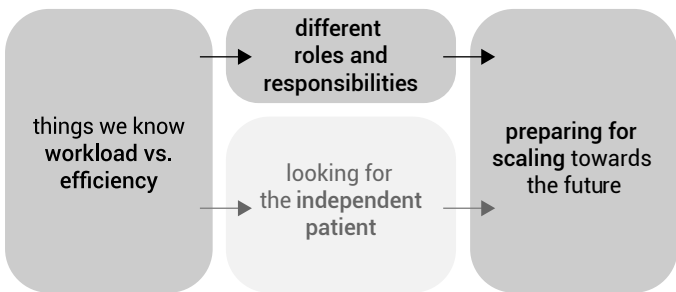
Figure 15: Thematic Frame

ANSWERING THE RESEARCH QUESTION

The question arises of how this now all relates to each other. How did the research's interpretation go from workload, to roles, to scaling? There are three elements to the research question: the additional workload provided by The Box, the redirection to novel roles and professions, and the support for

scaling. As previously discussed, these elements correspond with the themes, visualized in the above image. In conclusion, each theme supports a part of the research question. Additionally, the content from each theme not only tries to identify the problem context and the solution space of each research element, but also how everything is related. It all comes down to the workflow, which will be the red thread throughout this section.

Theme 1   How can additional workload provided by "The Box"
Theme 2   be redirected to novel roles and professions
Theme 3   to support scaling?

Intermediate Research Question

This means that with 'additional workload provided by The Box', the insights originate from Theme 1 – Things we know: workload vs. efficiency. The key element to remember here is workflow as the staff already has their regular workload and now, with The Box, a new element is added. Extra tasks surfaced in the current workflow, yet no other tasks disappeared. Within the interviews a perception of high workload was discussed multiple times. The main reason for this increased workload, is that there is no standard protocol for dealing with The Box. Which is why it is highly relevant to integrate the additional work, provided by The Box, into the workflow and to determine which tasks will be, or can be, replaced in the future workflow.

When it comes to the redirection of workload to 'novel roles and professions', it speaks for itself Theme 2 – Different roles and responsibilities is the category to address for further information. The main insight that emerged is that a generalization in novel professions is rather impossible since every department, and even health image, requires a different division of roles and responsibilities. It is important to identify when a professional function needs to be adapted, or when additional roles are required. In addition, this responsibility plays a large role in the execution of tasks, and with that, in patient care. Which profession carries which responsibility is an important question to ask in future workflow developments.

The insights of Theme 3 – Future opportunities for scaling help in clarifying the research part regarding 'support scaling'. What resulted from this category is that The Box is not ready for scaling. Instead, it can be seen as a successful experiment that has been widely adopted. But now LUMC has "this experiment" that works with a thousand patients, but what they really want, is to use The Box for many more patients. The hospital has both the service and the product, and it has been applied in this experiment already. But with 'future opportunities for scaling', a "mass product-service" is desired so that more patients can be treated with The Box. In conclusion, the aim is to go from an experiment with thousands to a solution for millions.

REFRAMING THE PROBLEM

With the acquired insights in this stage of the project, it's not about simply answering the research question. It is about critically reflecting and wondering if it's the right question to ask. The limitation to the intermediate one, was the lack of strategic understanding on the current state of The Box: it was interpreted as a vital product, yet the reality is discrepant. The Box is actually still an experimental research project, trying to become a standard healthcare implementation, However, it was interpretated as a final product. Now that the context and positioning of The Box has been revised, the question needs to be asked of how The Box can be scaled from an experimental to a solution phase. Technologically wise, a lot must be done, developed and improved, and an immense task lies ahead for ICT, but the real challenge for LUMC, in order to scale The Box, is to define the workflow for its employees.

UPDATED RESEARCH QUESTION

How can The Box scale from an experimental phase to a solution stage through redefining the workflow?

In order to move from the prototype stage towards a real healthcare implementations, it is necessary to take a look at workflow efficiency for the perspective of scaling. Workload and efficiency are very important elements in a workflow, which is why these two aspects required this much attention in the analysis phase and will stay the focus within the next few stages of the project as well. It is relevant to identify what in the concept or in the organisational design needs to change to be able to create a healthcare production that is applicable workload wise, and has good efficiency. Before workload can be redefined, it must be defined in the first place. For this the next part will revolve around observations, focused on workload and efficiency.

5. LET'S HAVE A LOOK

After the interviews and its thematic analysis, it felt necessary to perform observations as well, which will be documented in this chapter. The observational study provided the research with a deeper level of knowledge. The results are processed into a service map which shows a general pattern of tasks within a department using The Box, which in this research are the departments of Cardiology and of Covid. These maps are complemented with quotes from the interviews on efficiency and workload. Afterwards, a comparative study between the two departments was elaborated on. The project finishes with personal findings before continuing with the Develop-phase of the thesis.

OBSERVATIONS

The interviews contained great depth in qualitative information. Even though the answers were often extensive, sometimes it was hard to place their responses in the right context. As thematic analysis is all about "discovering, interpreting and reporting patterns and clusters of data", it excels at providing structure, yet it underdelivers in mapping out the context (Spencer et al., 2014). For that it is desired to compensate with an additional technique that provides more depth on a contextual method: observations. The goal is to go beyond what people say and think, but to experience what they actually do. This observable step goes one level deeper underneath the surface (Visser et al., 2005).
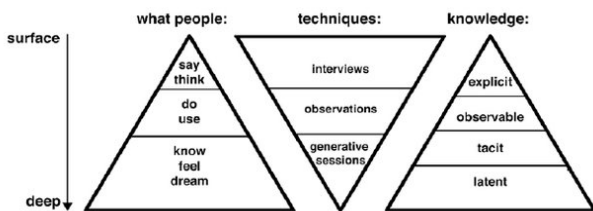
Figure 16: Different levels of knowledge about experience are accessed by different techniques.

Multiple times the interviewee said "if you can, you must come and have a look here". Few participants explained that it was hard to paint a picture in words and advised the researcher to pass by someday to observe the day-to-day tasks and routines. Since the Covid-pandemic was still very much present, certain things needed to be arranged and requested. Luckily many of the interviewed participants were just the right person to reach out to. One of the managers gave the permission, an eHealth consultant from the Covid department and an eHealth assistant from the Cardiology department agreed on having the researcher over for observations. Next to taking notes during the observations, sometimes pictures were taken when permission was granted. One additional interview was performed at the end of each observation day. This moment was used to reflect on the gained insights throughout the shift.

The aim of this observational research is to acquire a deeper level of understanding in several elements of workflow: the experienced workload, the barriers and enablers in efficiency, task and role divisions, but also to identify possible opportunities for collaboration, generalisation or standardisation within or between departments, and where AI can have a role. The findings were structured in service maps. A service map here is seen as an intermediary concept between a journey map and a service blueprint. It doesn't go as deep into showing the experiences, and neither does it describe the service in all its aspects. It rather focusses on sketching a clear storyline of what happens from the minute a patient arrives at the hospital and receives a box, until the moment The Box is returned or the service has ended. The service maps are based on primarily observations, and complemented with substantial information from the interviews. For both Covid, and Cardiology, such a map was established.

Two days for observations were arranged at the "Covid department". They welcomed me at The Box Office, which kind of resembles a customer support service for all patients who have been diagnosed with Covid, and have been send home with a box. The other day, they expected me at The Box Support. Which is the other customer support service variant, but this time of the Cardiology Department (HartLongCentrum). Based on my observational experiences, several conversations with the employees that day, and a follow-up interview to answer the final questions, a service "map" was created. During the day notes were taken, and additional questions were asked to get a complete understanding. These insights were combined with the already acquired knowledge from the antecedent interviews to aim for a comprehensive perspective.

The term "service blueprint" is intentionally avoided, as the visual simply does not fulfil the criteria for being labelled as a blueprint. Instead it is a map: A map showing what happens in the life of a box, from A till Z. It starts with a requiring the assistance of The Box as a service for a patient, and it ends the moment The Box is being safely returned at the office and is being prepared for reuse. Every step is reflected in the service map, varying from highly important, to less relevant. To create the service map, only the perspectives of staff, and personal observations were used, yet patient experiences were left out. Simply because this is out of scope, and to remain the focus on the care-team. The patient-side however is still included in the map, but is only represented by a reflection of the participants and insignificant encounters with few patients during the days of observation.

OBSERVATION-BASED SERVICE MAP

The service map is built upon a chronologic summation of tasks performed by the staff, or also known as their regular workflow, which were either observed or interrogated. Both small and large tasks were documented in the map. To make more sense of the activities that were happening, a patient-side was added to the linear visualisation to represent significant events influencing the activities of the care-team. However, these were not objectively obtained as the brief "patient-journey" was only perceived through information received from the staff. The utility of this was merely to provide a complete overview, and understanding, of the perceived and observed workflow.

Primarily, the service maps are based on the observations. Yet sometimes the acquired knowledge from the interviews and its thematic analysis were often involved in adding onto the comprehensiveness of the map. In many cases, these steps were strongly represented by quotes from the interviews, and other times the interview references served more as a clarifying example to specific steps. For this reason, significant quotes from the interview transcripts were added alongside the service map, next to its corresponding step. On the other hand there are also steps which don't include substantiation from the interviews, and are merely based on observed actions and the closing interviews –not transcribed– to each day of observation. However this doesn't make them less important.

Lastly there were some specific quotes from several interviews that discussed workload- and efficiency-related situations, which could also be reflected to a combination of steps from the service map. Such a quote about these topics could explain something positive about the workload or efficiency, and is then represented in green writing. It is also possible that what the interviewees said, had quite a negative association with these subject matters, and was then coloured in red. Sometimes it was also just a fair-minded reflection or evaluation on workload or efficiency and was then marked as orange text. This addition to this processing method of the observations and interviews presents relevant "hooks" for further investigation or development, or can even be seen as future guidelines.

Several things that are necessary to mention for further clarification of the following visuals: On the left, the patient side is represent. The main actions are marked in yellow, and if any technological involvement is mixed into the action, it is represented on a green post-it. This could vary from using the device to filling in the data in an app. Sometimes a blue post it is presented on the left, this means, there is a direct link to a technologic aspect within back-end on the side of the care-team. Which is showed on the right side of the journey-line. Pink represents a main action, performed by a staff member. And again here the blue post-it's still have the same interpretation as mentioned earlier. If certain actions need to repeated, a loop is created and reflected on by a purple-coloured label. Finally the orange circles represent which staff member's responsibility this task is.

SERVICE MAP COVID BOX
based on observations and interview quotes covid box

START OF JOURNEY

Patient arrives at hospital with Covid symptoms

Patient has to register at SEH — Register patient by arrival at SEH — *Secretary of registering desk SEH*

Patient is being examined in SEH — Check on patient's symptoms and severity of Covid — *Nurse, med student, AIOS or clinician*

Decide on what to do — *Nurse, med student, AIOS or clinician*

Treat patient traditonally until further notice

Send patient home with box — Send patient home without box — Hospitalize patient at IC or nursing ward

END OF JOURNEY

Assign box to patient: create LUMC patient number — Patient is registered in EPD (HiX) — *Nurse, med student, AIOS or clinician*

Patient receives the box, including all necessary information — Give patient the box and explain how everything works — *Nurse, med student, AIOS or clinician*

Patient goes home with the box

Communicate to Covidbox-team: patient number + boxnumber — Box is added to OneNote and manually "linked" to EPD (HiX) — *Box office employee (student/ flex)*

Patient performs monitoring activities — Use of bloodpressure-, saturation-device and measure temperature — Repeat every day — Keep on supervising patient through monitoring activities

Patient fills in values on paper form — Patient fills in data in LUMC Care app — Data shows in medical dashboard

Data is being uploaded to medical dashboard — Use of LUMC Care app on smartphone

Patient explains how it went and moment to ask questions — Only the first day — Call patient the NEXT day to see if monitoring went successful — *Box office employee (student/ flex)*

Plan for consultation hour — Schedule consultation hour and register in OneNote — *Box office employee (student/ flex)*

Patient explains how it went and moment to ask questions — Call patient to run through their measurements and ask how their doing — *Medical student*

Patient tells what they have written down — Ask what their values were when they used the form — See the LUMC Care app data in EPD medical dashboard — Copy paste data from dashboard to EPD (HiX) — *Medical student*

Fill it in for them in EPD (HiX) — *Medical student*

Call supervisor shortly after all patients have been called to discuss cases — *Medical student* — *Supervisor (+specialist)*

Decide on continuation or discontinuation of monitoring patient — *Medical student* — *Supervisor (+specialist)*

Terminate monitoring protocol — Continue with patient monitoring — *Medical student* — *Supervisor (+specialist)*

Patient agrees on planning final appointment and termination of monitoring activities — Plan final appointment for evaluation with doctor or medical student — *Box office employee (student/ flex)*

Patient has final appointment with doctor — Doctor or medical student has final appointment for evaluation — *Medical student* — *Supervisor (+specialist)*

Inform Box Office that pick-up appointment can be made — *Medical student* — *Box office employee (student/ flex)*

Patient agrees with pick-up appointment — Plan appointment for picking up The Box: ask for address — Colourcode patient in OneNote that box can be picked-up — Schedule appointment for patient in OneNote + include address — *Box office employee (student/ flex)*

Drive to patient's house for picking up The Box — *Box office employee (student/ flex)*

Patient gives box back at his/her door — Retrieve box at patient's home — *Box office employee (student/ flex)*

Return box to Box Office at LUMC — Colourcode patient in OneNote that this patient's case is closed — *Box office employee (student/ flex)*

Clean used devices — *Box office employee (student/ flex)*

Check used devices and their batteries or if they are charged — *Box office employee (student/ flex)*

Order new devices at manufacturer if necessary — Re-use all devices — *Box office employee (student/ flex)*

Create new boxes for new patients coming in so they are ready to be distributed — *Box office employee (student/ flex)*

Patients fills in the questionnaire and shares opinion and experiences with The Box — Send patient a questionnaire about their experiences with The Box — *Box office employee (student/ flex)*

At the end of the shift, "hand over" all information for the next shift — Fill in a "hand over" sheet in OneNote with all important information — *Box office employee (student/ flex)*

END OF JOURNEY

[COV1-MH]: Especially for the Covid Box, the great thing about that is that actually the patients who have been seen first in the ER: if The Box weren't there, the majority would be hospitalized, simply because you just can't monitor them all.

[COV3-CO]: And then, for example, we also had boxes in the emergency room. And of course, they weren't going to do all those actions, so calling the patient: they don't do that sort of things. Or register for a consultation hour. But they did: hand out the box, and then they actually had to write down which patient it was given to and what number of the box it was, so that we could, for example, report it to the box office the next day, you know. But then you did indeed sometimes have that someone forgets to write that number down. You have often had those kinds of things and that you are then trying to find out which patient has that Box. So that's just what you get when a lot of people are dealing with something like that.

[COV3-CO]: So the ER can now also issue the box themselves and such.

[COV1-MH]: But for the Covidbox itself: we always bring The Box to the secretary. She keeps it there and she gives it to the patient when they are discharged. But otherwise no adjustments have been made.

[COV2-SM]: The moment the patient went at home, and everything had gone well from the first measurement, and from that point on, the department where the patient was then was also contacted.

[COV2-SM]: We kept the analogue box, but also the digital box. Because you also have patients who, for example, do not have a Wi-Fi connection at home, or who are not familiar with the use of smartphones, because we also worked with an application, so an app on the phone. That's all kind of reasoning that you have to really think about and offer both of these things, because uh, and getting that right, that takes, that takes a lot of time and energy and that's my, very challenging and very fun. But you have to be very conscious of that, you know what people have, and what can people handle? For example, we had the very first patient who got a digital box, he was really sick, he said yes if I have to do this all by myself now, or whatever, then I really don't know at all what I'm doing, so you just learn, during the process, you learn a lot from it.

[COV1-MH]: Not all devices are directly linked to the app yet, so that it is forwarded to the hospital. For some, this is still an intermediate step that the patient has to fill in himself.

[COV2-SM]: Then it was actually anyway, then we went from the analog box to a digital box, so that was really the starting point of integrating that.

[COV3-CO]: Where we also gave digital and analog for a long time, just in case that digital stopped, like it really a bit to try it next to it. Because you also had that, for example, the thermometer was linked to the app, but the saturation meter could not be linked, because that was again from Massimo, and again not from Withings. And of course you had a lot of things. So, now that is done, yes that took a very long time.

[COV2-SM]: Yes, of course, as, I just said that then the first patients who came home, that we had thought out very well, then you call that patient, and then we make sure that he is "on board", like we call that. And then such a patient, if you can't get a hold of him at first, because he says yes, I'm just so sick, I'm going to bed now. Yes, we were initially expecting, our idea of course, that someone will be monitored. But if someone is not "on board" yet and is therefore not actually monitored at the moment. Then it's possible that it is a risk?

[COV1-MH]: Giving explanation, is also a little bit more tricky for the patient because they are isolated or are in isolation. So you can't just go and see the patient.

[COV1-MH]: Patients must be registered at a consultation hour and in the hospital they do not actually fall into one outpatient clinic or one clinical department.

[COV1-MH]: In other words, the students always call the patient when we ask whether everything is clear or the equipment they receive, if they are scheduled for the consultation hour. To be called back when they have received the box home and the box is collected later. There is always a doctor, who actually calls the patients for fourteen days. In some cases, these are medical students and they are always under the supervision of a pulmonologist, for example.

[COV1-MH]: Yes, that is, so basically they send the measurements. And a list of questions is actually always asked to them every day and that is with the Lung-pol. Yes most patients who are not under treatment in the hospital, are Lung-pol placed, on the agenda. And then for 14 days at home monitoring and they are called by the pulmonologist and he actually calls, so he actually goes because that triage from asks questions about whether someone is short of breath. What is saturation? How's the muscle soreness. That questionnaire is taken there, it is administered and on the basis of the outcome, it is decided whether home monitoring will continue or whether it can be discontinued because, for example, the patient is doing much better.

[COV2-SM]: And from there, contact was made for fourteen consecutive days, at least, so daily contact was made by means of a video consultation or a TCD, a telephone consultation. And the patient was contacted to continue monitoring.

[COV3-CO]: We received an email that said, the box has to be picked up and you even had patients who still want to keep the box. But in principle, we were allowed to pick it up from then on.

[COV1-MH]: And the equipment also has to be returned. So, let's say, a whole schedule has to be made for the boxes to be picked up again.

[COV3-CO]: So then we really shared the setup and coordination, and so we actually also shared the same pager. And so we had two or three students who had their own car and could drive, so pick up the boxes from people who were ready. We usually didn't have to do it ourselves every now and then. And the rest is really simple.

[COV3-CO]: And you also have to contact people from the, what do you call that, if you want to clean that device, for example, also, for example, in between. So that everything goes well, after all, so that we have contact with everyone. And so set up that project a bit.

[COV3-CO]: If you are called for the pager, prepare that Box yourself and then run to the emergency room or something and deliver it there as quickly as possible. We then also called the patient to see if they already had one of those three meters, so that you then, yes, because of course we had a little shortage. So if they already had the saturation meter at home, for example, we didn't add it for a while.

[COV2-SM]: But what you do see change is a kind of, the trust for patients has remained very bad, precisely because you coordinate from home. And so we always called after that, so that people felt very heard. And also because of course we all had to distance ourselves from each other, and that it was of course very difficult, but the fact that we remain very actively involved with the patient, creates a lot of confidence in healthcare. Yes, we've had quite a few patients that we've talked to afterwards, who said, I loved it so much, you know, that feeling that someone said to you, you know, despite the distance we had. What I really want to describe it as, is actually that we have been close from a distance.

SERVICE MAP CARDIO BOX

based on observations and interview quotes covid box

START OF JOURNEY

Or through SEH, but this is less likely
Or post- or pre-surgery

Patient arrives at Cardiology department for his/her appointment

Patient has his/her appointment with the specialised nurse

Specialised nurse sees the patient — *Specialised nurse*

Patient provides personal/identifying information

Specialised nurse asks for identifying patient information — *Specialised nurse*

Patient provides requested information

Register new patient | Open existing patient

Create profile in EPD Vision for new patient

[CAR1-RvdP]: You can say hospital-wide, on ICT, they do the general system. Only the Cardiology in Leiden has always been stubborn. We have actually always had our own patient file, from day one, and we are always developing it.

Patient explains and tells about their symptoms, complains, etc.

Possible diagnose + Specialised nurse decides if patient is suitable for receiving a box — *Specialised nurse*

Treat patient tradionally until further notice

Send patient home with box | Send patient home without box | Hospitalises patient at IC or nursing ward

END OF JOURNEY

Not likely to happen, unless they are already hospitalized

[CAR3-McH]: With my immediate colleagues who supervise the clinic. Who decide okay, this is someone who is or is not a good fit for Box, in the clinic. And with the outpatient clinic, we also decide that for our own patients. And in addition, we have care specialists, in addition to the heart failure nurses, and those nurse specialists, we can also decide for their own outpatients: OK, I think this is a good candidate for a box. And sometimes they discuss it with one of us, but they can also do that themselves. Then we have the agreement, that is also stated in the information for those patients that they have certain alarm values, hey, this is normal for them. Outside of that you have to contact us. And it also states that we check on average about twice a week, but that is not emergency care. In short, the responsibility lies with the patient for contacting outside those alarm values.

Send request to Box Support for creating a box for the patient — *Specialised nurse*

Patient receives information and directions on how often to use The Box

Explaining to patient how often and for how long they have to monitor — *Specialised nurse*

Processing request for providing box — *Box Support*

Registering box in EPD Vision, connected to Patient + create account in Whitings

[CAR1-RvdP]: I also custom make each box. My colleagues, they always give everyone the same content. And I also look, if someone has high blood pressure, they get a blood pressure monitor. Is someone overweight? Then mine gets a scale. I don't do everything by default. I think that's nonsense. You should also not want people to measure and do too much. But because you give them a scale, yes you are too heavy, so we give you a scale, but that is also comforting. But I do see that people really lose weight because of that because they know that I can watch.

Creating a personalized box for the patient (or using a standard one) — *Box Support*

Scanning all devices that go into the box, create a barcode for the box, link it to the patient and to Whitings

[CAR2-TI]: We actually only visit the patients if the patient has just undergone surgery. And so actually the moment before a patient goes home, then we try, say, to have everything explained. That is actually the only moment that we really see the patient physically, (inaudible) or if they really can't figure it out, have an appointment in the hospital, or we have that email or telephone contact. But then actually the only time that we are really, say, physically present with the patient, it is at the bedside.

Making an appointment to bring a (personalized) box to the patient — *Box Support*

Deliver box to the patient — *Box Support*

[CAR2-TI]: As an eHealth assistant, we make contact with patients. So that's both at bedside, so installing the equipment, explaining it, kind of on the precaution of it, so yeah you know, also just making sure your stock is up to par, say, orders... Yes in the end does a patient also go home, they occasionally get, do they sometimes have problems with the equipment, or if the measurements are successful, we have a support line. So when we go home, we also try to help people on their way, so to speak, by e-mail or by telephone. If they really can't figure it out, they can always come to the hospital and we'll schedule an appointment. So actually a bit of everything around The Box, that's what we actually do.

Give patient the box and explain how everything works — *Box Support*

Patient receives the box, including all necessary information

[CAR2-TI]: One patient has to measure daily, the other once a week. So that depends a bit on patient group

Explain all devices, what they are for and how to use them | Connect to patient's smartphone and install them — *Box Support*

[CAR2-TI]: And you're also talking about the apps, about installing equipment, and doing a bit of puzzling yourself.

Patient is being guided through the set-up of all devices and app

Plan both physical and digital appointments with the patient | Schedule them in the calendar of secretary and specialist/sp. nurse) — *Secretary*

Patient agrees on physical (Poll) and digital consults

[CAR2-TI]: And that resulted in the four check-ups after an infarction, in the year after the infarction, because after that people are discharged again, in general. That two of the four are digital checks: so people no longer have to come to the hospital. And so we have just adjusted that after admission, we normally had, yes, then they call the heart failure nurse once after two weeks, and then again after six weeks with the cardiologist. We now have very strict after 1 and after 3 weeks, and really that box

Send patient home — *Specialist or specialised nurse*

Patient goes home with The Box

Data is automatically uploaded to Whitings | Use of selected (personal selection) devices | Patient performs monitoring activities

Mostly Whitings, but also CardioSecure

Keep on supervising patient through monitoring activities | Repeat every day, for the same patient

Data is automatically transferred from Whitings to EPD Vision

[CAR1-RvdP]: But they now use the Withings app, in which they can now see all measurements. And yes, those Withings are linked to our system.

Checking general data on a daily basis | Checking data in EPD Vision and sometimes in Whitings — *Box Support* *Specialised nurse* *Specialist*

[CAR1-RvdP]: I have chosen, with my patient groups, that I see them 3 or 4 times a year and right before that moment I will check all their data. That is what I have agreed with my patients. So I'm not going to look at that every day.

[CAR1-Rvd]: What is the case now look, now we have also made clear agreements in the department about not promising patients that all measurements will be checked 24 hours a day. There has been a turnaround in that, including explanation in information

Call patient after 2 WEEKS to see how the monitoring is going | After two weeks — *Box Support*

[CAR2-TI]: And if you now open EPD, for example, you would take a patient. Then you could, for example, enter the patient's data, so you could immediately follow all measurements of blood pressure, heart film, steps and things like that. So you can actually see the patient right away, well I measured him yesterday and you can watch.

Patient explains how it went and moment to ask questions

Noticing a patient doesn't monitor enough or device don't work properly | EPD Vision gives colourcode to patients who don't monitor well — *Box Support*

Devices might not work appropriately (connection etc.)

Patient doesn't monitor appropriately

[CAR2-TI]: How we work is, the patient is given equipment and then we always say to the patient, well, you will be contacted within one or two weeks, by e-mail or by telephone, to let you know that the measurements are transmitted. That they at least know of, I do the measurements at home, neh well, if I, as soon as I do the home measurements, it enters the system. Also just a little reassurance and also to check if everything is going well

Patient explains why they aren't monitoring (well) | Call patient to find out why they aren't monitoring (well) — *Box Support*

[CAR2-TI]: Or is there something wrong with the coupling of the equipment? And we didn't have that before. Then we really had to manually look like, okay when was the last time this patient measured? Okay, well not for a month, so after that we have to call or email, like ah, sir, madam, do you want to pick it up again? So now, we actually have a much more refined, yes, structure also, say, in there. That we can also call earlier. So if the patient does not measure for a longer period of time, or if someone in front of us has high blood pressure several times in a row, then that will also be higher in the priority list.

Patient continues monitoring after problem is "fixed"

[CAR2-TI]: Our job is actually really more support for the equipment and if there are questions in that, really support it

Patient has divergent or more extreme values | Deciding if it is severe or not | List of prioritization in EPD Vision — *Specialised nurse*

[CAR2-TI]: Uhm, yes, describe as, real support, both in the technical field and yes, guiding the patient, say, also a bit through the process, in terms of the steps they have to take, so the questions they are dealing with. In that respect, they can always come to us in some kind of first aid, always on a first-line basis, with us. And yes, if we can't figure it out, we will pass it on to the cardiologist or to nursing specialists. So yes, actually a piece of logistics that we all see, you have to see it this way: the equipment, the boxes, the leaflets. Actually everything is all around that, we actually do that from A to Z.

Deciding to have patient check in | Deciding to act patient on monitoring | Decide to continue monitoring patient

[CAR2-TI]: And we also have a whole algorithm in it, so if someone doesn't measure for an extended period of time, for example. It goes into a sort of, in a priority list, of well, well, like a pop-up of, well look at it, Is there something wrong with the patient?

Patient agrees on appointment | Call patient for making a digital or physical appointment — *Secretary*

[CAR1-RvdP]: I used to see everyone physically in between office hours: so a lot of patient contact. And that is actually less now, because we have also decided on this, even if we keep an eye on people via eHealth, we also link a digital consultation to this. Because yes, the patient does not have to come, because yes, I already have a blood pressure, I already have a heart film. I actually have everything I want. You don't have that physical exam. And I think that is something you should keep thinking about as a nurse specialist. OK, everything is digital now, but who do I have to see? That you keep thinking that sick people should be able to keep coming. It shouldn't be that everything just happens digitally.

Check on patient's data over the past few weeks/months before appointment | Open personal data of patient in EPD Vision — *Specialised nurse OR specialist*

[CAR3-McH]: So I'm involved in supervising the heart failure nurse on certain patients of my own or their patients, and nurse specialists. So I don't look at the data every day. I do look at the data, the moment I get a question about a patient that they email me, or when I call a patient who has a box.

Patient has physical or digital appointment | Discuss results with patient — *Specialised nurse OR specialist*

[CAR1-RvdP]: I have chosen, with my patient groups, that I see them 3 or 4 times a year and right before that moment I will check all their data. That is what I have agreed with my patients. So I'm not going to look at that every day.

Patient finishes his period of monitoring or decides to quit

[CAR1-RvdP]: My patients are usually also working people, yes they just sit at work. Thoy walk to a separate room and take their laptop with them. And let's chat with me for fifteen minutes. Then they go back to work. They think this is ideal.

Decide to terminate monitoring activities — *Specialised nurse OR specialist*

Patient agrees on keeping the box (or sending it back) | Call patient for closing their case and say they can keep their box — *Box Support*

Patient sends box back through post office | Decides to return box | Decides to keep box

Clean used devices — *Box Support*

Check used devices and their batteries or if they are charged / return to factory settings — *Box Support*

Order new devices at manufacturer if necessary | Re-use all devices — *Box Support*

[CAR2-TI]: In principle yes, because that is what we actually do, we have contact with the patients, with the cardiologists, with nursing specialists, with those who say, supply the products. So yes, we know a little bit about everything, so to speak. In general, we're kind of, sort of, the waste pit

Create new boxes for new patients coming in so they are ready to be distributed — *Box Support*

Patients fills in the questionnaire and shares opinion and experiences with The Box | Send patient a questionnaire about their experiences with The Box — *Box Support*

At the end of the shift, "hand over" all information for the next shift | Fill in a "hand-over" sheet in OneNote with all important information — *Box Support*

END OF JOURNEY

WORKLOAD

[CAR1-RvdP]: We actually have a support desk here as well. That's actually four girls we hired, who answer all the questions. I now understand how their phone works, I now understand how the app works, but well, you can't leave that to the healthcare provider, because I don't have the time for that. This wasn't there in the beginning either, but you'll find out if you do this a lot. Yes, there should also be a support system if it doesn't work. So that's ideal too. I think you really need that, that support system

EFFICIENCY

[CAR1-RvdP]: I think what you should take with you, I think a take-away for others, if they also want to start, I think that the ICT behind it is the most important thing. If not, just what you want to do in your daily work, and it takes too much time to look up things, to measure, to see, then... That's also now, after this is the result of the arrhythmia, okay and we continue. And now I have to scroll through that myself and look there myself and find that. You will also become more adept at this, but we have implemented those things. But in the beginning it cost me a lot of extra time.

EFFICIENCY

[CAR1-RvdP]: So what do I do? If I now go to the website, I will log in there one by one. That takes time, plus what you also see is that a lot of notifications are given with such a product. So it is very carefully adjusted. Well, beware, this looks a little different. Contact your doctor. Or beware, you have no blood flow: you see your doctor now. And those are quite pronounced reports, which made patients call me in a panic, and then I think yes, that heart film looks really good, what is going on now? In the end, we chose to put that product aside, because of those reports. We can't turn them off, like, I think, please turn them off. Or you are creating unrest now.

EFFICIENCY

[CAR1-RvdP]: What we now have is that you integrate all measurements into the health system in which you work. That you don't have to work with separate systems or login things. We had that very bad in the beginning. Then I had three different products from different manufacturers. Then I had to log in to the system where I could prescribe my medicines, register in the patient file, log in, log in to my email. I had to log into four of those systems to see all the data: yes, that doesn't work.

EFFICIENCY

[CAR2-TI]: So now we have, say, a nice watch. They can also make the heart film with it. And those heart films automatically enter our system right away and they can be assessed. And we also have a whole algorithm in it, so if someone doesn't measure for a long time, for example, it comes in some kind of, in a priority list, of well, well, like a pop-up of, well look at it, Is there something wrong with the patient? Or is there something wrong with the coupling of the equipment? And we didn't have that before. Then we really had to manually look like, okay when was the last time this patient measured? Okay, well not for a month, so after that we have to call or email, like ah, sir, madam, do you want to pick it up again? So now, we actually have a much more refined, yes, structure also, say, in there. That we can also call earlier. So if the patient does not measure for a longer period of time, or if someone in front of us has high blood pressure several times in a row, then that will also be higher in the priority list, so that patient can. These have all been quite big steps lately, which will help you, yes, let's say, a lot for the patient and the specialists.

WORKLOAD

[CAR1-RvdP]: I just work 36 hours a week. That sounds very silly, but it is true. I can't do this 7 days a week

WORKLOAD

[CAR1-RvdP]: Yes, and checking those measurements takes a lot more time for me. I now have to do that myself, whereas before, when I make such an appointment for such a 24 hour cabinet, we now call it the Holter. And then someone else checked that for me. And you just got that back, I could look up in the system, after this is the result of the arrhythmia, okay and we continue. And now I have to scroll through that myself and look there myself and find that. You will also become more adept at this, but we have implemented those things. But in the beginning it cost me a lot of extra time.

WORKLOAD

[CAR3-McH]: And there was a lot of talk about it then and it was all decided then that it was okay. I think we're giving more and more patients more new responsibility for themselves, let's put it this way. I think at the beginning we might have been very like, we're going to actively watch, and now we've really thought of okay we'll watch in the background, but you are responsible for contacting us if it's not good. And for that you get these handles like those alarm values. So I think that's changed, and it's also easier to check. If you used to have to click on everyone and now I think you can leave all those green people for what it is.

WORKLOAD

[CAR3-McH]: Because with the previous telemonitoring system, you had to consciously click on each patient to see the value, but there were fewer patients and now it is of course already a large group. And if we do this in the study association, even more people will join. So I understand that it's far, hey it for the heart failure nurses, but they really think, yes it's nice that you think of this, but someone has to look at it too. So that's why I think it's very important that the system helps them from there. Because otherwise it just doesn't work very well. Because if you are only checking this one day a week, so to speak, and therefore you do not get to other tasks, then the question is of course whether it is profitable enough, so to speak.

As mentioned before, the Service Map on the left is strengthened by the interview quotes in the middle and oriented within the workflow as an enabler or barrier, opportunity or limitation for workload and efficiency on the right. It is this right section –of workload and efficiency– that refers to the first theme again of 'Things we know: workload vs. efficiency'. Not only does it provide rich insights into the barriers and enablers, the failures and the successes of these workflow related elements, but it defines the things that can be changed or created in the service. In order to have an idea of what works, and what doesn't, what both maps have in common, and what is completely different, a brief comparative study is performed between the Service Map of Covid and of Cardiology in the next chapter.

Before continuing with the comparative study, a structure will be created in all workload- and efficiency- related quotes to represent the main takeaways. In the following paragraphs, the insights of the quotes were summarised and sorted in an endorse-enhance-eliminate categorization system. The 'Endorse' category reflects on the green quotes: useful things that should be considered to include. 'Enhance' aligns with the orange quotes and stands for things that require improvement before they can be included in the service. And 'Eliminate' is a combination of all the red quotes, that simply should just be avoided in or excluded from The Box related workflows.

COVIDBOX TAKEAWAYS

Endorse

Efficiency: Keep on doing research into identifying the added value The Box really has for patients. In addition to the investigation if patients in fact don't need to be hospitalized as much or can go home earlier, resulting in less lying days.

Takeaway: Always reflect on changes in the service by The Box.

Workload: Additional jobs were added to prevent an increased pressure on doctors. These extra professions made sure, the burden was not on the doctors. Furthermore, the department reflected on the current working conditions and the workplace in order to identify how the service can be shaped.

Takeaway: Adding jobs to support The Box prevents increasing the pressure and burden on doctors. In addition to that, always reflect on what the current conditions are of the department before implementing The Box.

Enhance

Efficiency: Time-wise, a lot was lost on installing The Box, starting with a Covid-positive patient, until the actual monitoring. The time-span was to large. A timetable was created to figure out how long it actually took and where there were learning opportunities. It always takes some to time getting used to and to experience the efficiency-losses and the pitfalls.

Takeaway: It's okay that (time-)efficiency wise, it doesn't go smooth at first. It is important to learn from it, and improve by critically reflecting on the processes of The Box.

Workload: The workload and pressure has changed because of The Box as the department is now much more busy to also call patients, pick-up boxes, hand-out boxes, checking schedules, etc. It would be better if other departments could do these tasks for themselves, and The Box Office shouldn't be responsible for all.

Takeaway: Be very careful that with trying to eliminate workload, it doesn't result in a different kind of workload somewhere else.

Eliminate

Efficiency: Patients struggle with downloading and registering the app, things often go wrong with the devices and their Bluetooth connection, etc. and they require help with that. Offering this help doesn't always go as smooth since they are often very tired and sick. Additionally, it's hard to have a consultation with a patient as it requires multiple systems to utilize simultaneously. In combination with the fact that there are two different EPD systems within one hospital, things often don't run smooth. When this happens, it's important that the right people take the right responsibility, but with large teams, relying on mostly students, this often goes wrong. A system is required that is less prone to errors, and more full- or part- time workers instead of flexi- are desired.

Takeaway: Avoid unnecessary tasks for patients which they often struggle with and exclude devices that are difficult to operate or provide a better trouble-shooting system. Try to prevent to much system differentiation as it is hard to work with and reduces the efficiency. Don't hire too many flexi-workers as it will often result in more errors an inefficiencies that rely on fixed-staff to be solved.

Workload: At the emergency room, they suddenly had to issue The Box themselves without proper training or protocol, which resulted in a higher pressure for them. What also added up to that pressure was that at the Lung-Poli (outpatient clinic), the pulmonologists suddenly were responsible for their patients inside the Poli, and the ones at home with The Box. The Covid-crisis became a sudden reality which resulted in extra work for almost everyone as they had to take on more hours to continue to function properly in this crisis.

Takeaway: Don't just "drop" a service like The Box on a department and expect it to run smoothly. Implementing The Box requires proper training, and even more important: protocols. In addition to that, it's impossible to expect doctors to be able to work full shifts at the Poli, while simultaneously provide care for the ones at home.

CARDIOBOX TAKEAWAYS

Endorse

Efficiency: A decision was made to go for a specific brand (Withings) for the devices as they automatically upload the patient data to the system, EPDVision, at Cardiology/HartLongCentrum. Even though for certain devices there are other alternatives that work better or are more accurate, it was decided to go for a set of appliances that could be integrated into their own system. Next to that, there is a more intelligent system that assists the monitoring tasks by creating a list of prioritization, and even separated urgencies based on lack of monitoring or exceeding the predetermined boundary values.

Takeaway: Invest more in system intelligence and in the integration of the devices into the (EPD) system that are being used in the department.

Workload: Having a support desk works really well, since they are hired to answer questions of patients

regarding their phone, app, and devices so that the healthcare providers don't have to. Having this is ideal for supporting the system. Simultaneously giving the patients more responsibility adds up to the reduction in workload. Instead of actively watching everyone "in the background", they now just leave al those "green people" for what it is and focus on the ones exceeding their values.

Takeaway: Having a support service to take over the logistic and technical tasks works really well. They check up on the patient for non-medical purposes. Patients are now expected to take responsibility for their own disease, this makes it possible for selective monitoring. This is achievable in a department such as Cardiology as the majority of the patients is chronically ill, whereas the question still remains if this will also work with acute diseases.

Enhance

Efficiency: It is always hard to get the ICT behind it work accordingly, yet it is one of the most important elements. If it isn't sufficient it takes too much time to look things up, to measure, to see, etc. With a phone and its apps for example, everything is within reach, this should also apply to the ICT, otherwise it won't work. Having one database instead of multiple ones, also adds up to a good working system. No more logging into separate EPD's, medicine registers, email, etc.

Takeaway: Approach system architecture in a holistic way. It might not always be possible to use one system for all, but everything should at least be seamlessly integrated into one another, or an overarching system might be in place. Make sure it doesn't take up too much time to locate something in a different system.

Workload: It's not possible to supervise every patient each day as checking those measurements takes too much time. The NP has to scroll through all patient measurements herself, which in the beginning took way more time, but as they are implemented, the experience and know-how grows. It is nice that somebody thinks of this, but somebody has to look at it too. That is why it is important that a system helps in that. Otherwise it doesn't work very well. Checking it more than once a week is not possible as there would be no time for other tasks elsewise.

Takeaway: It is normal for a new implementation to take up more time in the beginning of the process, but it should be a learning process towards an improved workflow instead of providing more and more tasks. It takes some time to find a balance and adjust to a new process.

Eliminate

Efficiency: Certain devices are connected to their own app which are not connected to any LUMC systems. They were pre-set to give notifications that weren't personalized to a patient's needs. This resulted in unnecessary panic from the patient. For this the department had to stop using these devices.

Takeaway: Each and every product should be thoroughly assessed. Not every device can be a part of The Box, just because it's a good monitoring device. There should be more requirements and stronger policies.

Workload: It is not possible to perform all monitoring activities in a 36h week. Therefore some tasks will be put aside.

Takeaway: Don't give more tasks to a staff-member than can be processed within working hours. A clear protocol should be established on this to avoid a high workload or burden on healthcare professionals.

COVID VS. CARDIOLOGY - a comprative study

First of all, it is important to understand that there is a nuance between some of the differences. Both departments simply have a different workflow, because their patients require different care. On one hand there is the Covid department which has to take care of their patients only for a short period of time, but require constant supervision. On the other hand, there is the Cardiology department who has in fact many different cases, but most commonly their patients are monitored over a larger timeframe and don't require the same close supervision as with Covid patients. Another nuance is that not every disease is equally complex or urgent, which has a noticeable influence on certain monitoring decisions. This is visualized in the image below **(Figure 17)**.

could not be more different than these two. Second of all, the aim is to figure out what parameters and characteristics both boxes have in common, and where they differ: with more boxes in the mix, this would have become a complicated task. Therefore the strategic decision within the project was made to solely investigate the boxes within the Covid- and the Cardio-department. The ultimate test will be to see if the outcomes of this investigation, match with the set-up of the other boxes.

Finally, another big difference in the maturity of the workflow is the difference in years of existence of The Box and the time that was spend on the development of the service within the department.
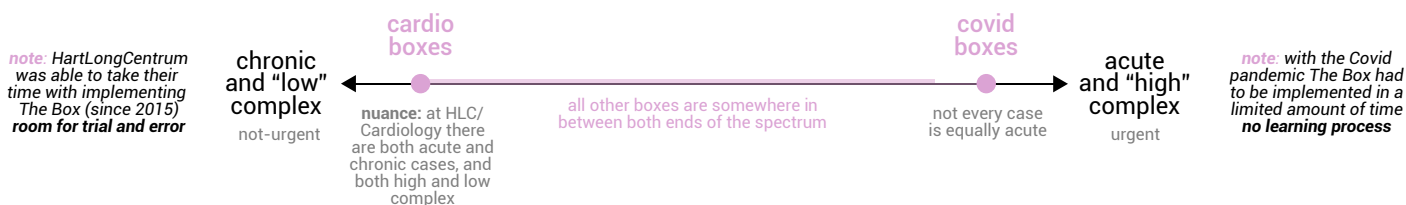
Figure 17: Spectrum of Different Boxes
based on Covid vs. Cardio Analogy
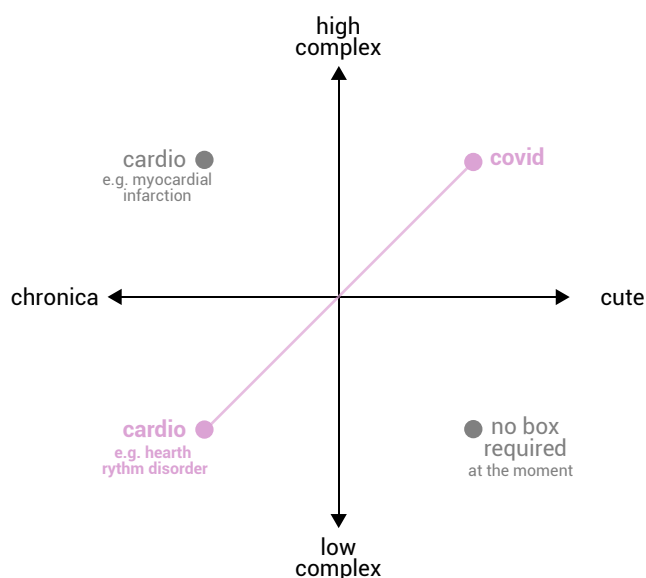
Figure 18: Spectrum Axis

There are many other departments and several other boxes that would be relevant to the research, and highly interesting to investigate, such as the Diabetesbox, The Box for kidney-transplantation, The Box for pregnant women with high blood pressures, and so on. But yet, it makes sense to stick to the Covid vs. Cardio comparison. First of all, two boxes

Within Cardiology, or in this case also often interchanged with HartLongCentrum, they started with implementing The Box piece by piece since 2015. It was a long learning process in which there was room to make mistakes, learn from them and grow. This makes them the most experienced department in the use of The Box. Opposite to that is the Covidbox, which had to be established under immense time-pressure, meaning there was no room for trial and error. This resulted in a decision making process, focussed on a quick service set-up.

In the next part, a comparative summary is made between certain elements that co-define the workflow from the Covid Box-Office, and that of the Cardiology Box Support. Among them are 'Monitoring team', 'Health image', 'Monitoring frequency', 'Duration', 'Range of boxes', 'Devices', 'System', 'Intelligence', 'ICT', and 'Box exchange'. This is already a summarized overview of key-elements defining the way the departments operate with The Box. Based on the observations, and the perceived knowledge from previous sections of this research, a decision was made to reduce it to these ten workflow-elements. The overview is given in the following table (FIXME: table x):

Workflow	Covid	Cardiology (HartLongCentrum)
Team: who is monitoring?	Student team + flexi-workers = **The Box Office**	eHealth assistants = **The Box Support**
	Medical student team Under supervision of specialist	eHealth nurses = Specialised nurse/nurse practitioner *NP*
	eHealth consultants	Specialist
Health image	Acute	Mostly chronic, sometimes acute
Monitoring frequency	Every day all patients (by Student team)	Every day in general (by The Box Support)
	Every day all patients (by Medical team)F	ew times a week the priority list (by NP)
	Every day all patients (by eHealth consultant)	Before each patient's appointment (by NP and/or specialist)
Duration	Weeks or months	Months or years
Range of boxes	1 general box: Usually isn't personalized	11 different boxes: Can be personalized
Devices	Usually a fixed box, containing: - Blood pressure monitor - Saturation meter - Thermometer	Depends on patient, but varies from: - MOVE (Activity tracker) - MOVE ECG (Activity tracker including ECG)or CardioSecur or Kardia - Blood pressure monitor - Scale - Saturation meter - Thermometer
System	HiX (incl. Medical Dashboard)	EPD Vision
	OneNote + LUMC Care App	Withings (+ LUMC Care App)
Intelligence	Hand-made List of all patients	List of prioritization with patients "at risk"
	Manual colour coding	Automatic colour coding
ICT	General hospital ICT (with PeopleSoft: creators of HiX)	Personal ICT service (own ICT sets up desired EPD Vision ICT)
Box exchange	Explained by "outsider"	Explained by someone from Box Support
	Retrieving The Box at patient's home	Patient gets to keep The Box

Table 4: Observed Differences and Similarities
between Covidbox and Cardioboxes

Besides showing the most essential elements in the above table, there is more that can be said on comparing the two. Understanding how different the workflows truly are, and if an efficiency or inefficiency appears, or a workload is higher or lower, leads to new valuable insights. It needs to be questioned if this is the case in both departments. Finding out the differences and similarities within the workflows is highly relevant to see when it leads to efficiency and workload, barriers and enablers. The essence of The Box service can be evaluated, whereas the differences can possibly be learning opportunities or lessons for other departments. What emerges from this chapter is the viability of a modular concept for The Box, which will be further discussed in Chapter 6: The Future of The Box.

PERSONAL FINDINGS

Throughout the days of observation certain things appeared to be different from what was understood in the interviews. Several examples of this are the additional student teams in the Box Office to support the service of the Covidbox, the patient contact the eHealth assistants and consultants have, the different interpretation of similarly named professions between both departments, and so on. Certain things were very surprising in a less positive way as they were performed in a very inefficient way, an example of this is the patient-discharge from the Covidbox, and the collection of that box.

The research started with the intermediate research question of "How can the additional workload provided by The Box be redirected to novel roles and professions to support scaling". The initial thought was that the results would suggest new type of professions or alternate role divisions, which could then be used to create a set-up for a standard 'The Box'- team. Yet in reality, both departments had such different workflows that it became clear this was not the best question to ask. As instead it became "How can The Box scale from an experimental phase to a solution stage through redefining the workflow?" The reason for this is that it's more about the workflow than the actual roles and professions.

When asking the care-team –in both interviews and observations– about how they experience the box regarding workload and efficiency, they had very strong opinions on this matter. But there is a reason why the respondents reacted the way they did. Certain healthcare professionals showed a sings of frustration towards the workflow related elements regarding The Box. The reasoning behind it is because they interpret The Box as a solution; an implemented product. Yet The Box is still in an experimental phase: it is just a prototype. The "real thing" will work differently on some levels. There are elements the staff has to cope with, they shouldn't actually be dealing with if this was an integrated service.

There are many things of The Box, as a prototype, that are generally agreed upon because it is still in a research phase, but these cannot be accepted in a real product. In the next chapter certain propositions will be discussed to support the scaling from this observed experimental research phase towards a viable product that can be widely implemented. The propositions will be portrayed as "opportunity cards" since they represent possible solutions for levelling up The Box. These opportunities emanate from the results from both the observational research and the thematic analysis of the interviews.

> " You accept a lot of things in a prototype because you are still researching that you cannot accept in a real product "
>
> — *Jeroen Raijmakers,*
> *Design Innovation Manager*
> *at Philips Design*

DEVELOP

6. THE FUTURE OF THE BOX

The chapter starts with explaining what a future vision will contribute to the project and how it is constructed based on opportunity cards, which will also be elaborated on in this part of the research. The opportunity cards are based on the results of the thematic analysis from the interviews and on the findings from the observations and the service mapping. They are divided into service and system propositions. Afterwards they are validated in different sessions with participants to assess their importance, feasibility and efficiency gain in order to identify their contribution to scaling The Box towards that proposition level. Finally a design vision is discussed.

CONSTRUCTING A FUTURE VISION

Because of its wide adoption of in many departments, and its differentiation, The Box is often mistaken for a mature and integrated solution, yet in reality it is actually still in a prototyping phase. What LUMC experiences right now is that it has become hard to take further steps that bring The Box to the next level. Therefore it is desirable to create a future vision of which the goal is to scale The Box from a prototype level to a proposition or standardized care model. At the moment The Box serves as a solution that is used as an experiment on thousand patients, but its intended use is to benefit a million patients. The Box possess a tremendous amount of potential to become a mass service, but therefore it needs to grow: it needs to scale. A future vision is constructed as a guideline for possible opportunities and it serves as an interpretation for a desired future (Simonse, 2017).

In the past chapters many difficulties, bottlenecks, and pain points surfaced, but it simultaneously presented multiple possibilities for improvement and development towards the future. Through the research many "hooks" for design were laid out that triggered certain conceptual ideas. All of them were gathered to reflect upon. After analysing them, some concepts turned into independent proposition, whereas others were combined into one, and some were just thrown out the window if they didn't possess enough potential. A total of twelve opportunity cards were created, of which six suggested system developments and the other six identified service changes. The final future vision will be based on the evaluation of them through individual and combined critical reflection, matrix positioning and generative validation.

OBSERVATION-BASED SERVICE MAP

An opportunity card represents a future idea that has the possibility to guide the box from a prototype phase to a solution stage. One card contains one very specific idea if it has enough "weight" on its own, else it addresses a combination of propositions that together form a bigger concept. Other terms can be given to them, such as concept cards or ideation cards. A card-based ideation method provides the perfect opportunity for designing a validation session with participants (Avouris et al., 2018), but more on that later. The next sections provide more depth into the suggested opportunities before being evaluated.

SYSTEM PROPOSITIONS

These conceptual ideas are merely an outcome of the framework, serving as a result from the thematic analysis. The concerned categories are encircled in blue and marked as an opportunity and resulted in the creation of four opportunity cards. It regards facilitating participation through closer collaboration; a generic system; a harmonized service through data-, information- and knowledge- exchange; outsourcing activities based on the task, an advanced AI system; and more patient participation by investing more in patient training and education. The last one however is considered to be out of scope, but therefore not less relevant. Besides that, two ideas emerged from the observational data and the corresponding comparative study of both departments, which is on one hand a modular concept of The Box, and on the other hand a two-way communicational approach. Each concept will be briefly discussed.

Turning The Box into a Modular Concept

1 TURNING THE BOX INTO A MODULAR CONCEPT

Based on the differences and similarities between the existing boxes

Boxes are analysed to find out **what they have in common**, and **where they are different**. Based on that, a modules can be defined, and the modular concept of The Box can be designed, with in the centre, **the essence** of The Box. This reflects on what they all have in common. Around that, there are the modules,: they represent what is different. Based on these modules, each existing box should be able to be **recomposed**.

👍 *Allows for better interoperability, learning processes, and make it easer to create new boxes (stop reinventing the wheel)*

👎 *Certain things will be generalized, standardized, or merged, and those aren't preferable things for healthcare professionals*

This concept is based on the differences and similarities between the existing boxes. The boxes were analysed to find out what they have in common, and where they are different. Based on

that, a modules can be defined, and the modular concept of The Box can be designed, with in the centre, the essence of The Box. This reflects on what they all have in common. Around that, there are the modules: they represent what is different. Based on these modules, each existing box should be able to be recomposed. It is a great opportunity for creating better interoperability, learning processes, and make it easier to create new boxes, and to stop "reinventing the wheel" with each new box. However, certain things will be generalized, standardized, or merged, and those aren't preferable things to hear for healthcare professionals.

The comparative study from the previous chapter contained rich information that can be used for guiding The Box towards this modular concept. By comparing them and trying to find out what they have in common and what they share in values, the "essence" of The Box can be captured: what all boxes share. What The Box is really about will become more clear. After a wide service differentiation, it now is time to create a unity again, while simultaneously allowing for variations. These are the modules. But even where The Box differs, it can still be sorted in a module. Such a module represents the interchangeabilities that are different for each box, or each department. For example, the care-path of a certain illness requires close supervision daily, whereas another patient is requested to only monitor once a week. They both fit under the same module of 'monitoring frequency' yet the chosen objective is very different.

This opportunity's proof of concept lies in the utilization of the modular concept onto the already existing boxes. If every existing box can be entirely "re-created" with this system, the idea of modularity works. This can become an iterative process of adding and eliminating modules along the way until there is one concrete concept that applies to all. When a new box needs to be created, the initiator or the organisation just has to run through all the modules and select the preferred content for each of them. This will lead to a composition of The Box that is based on a standardized concept, but still allowed for personalising a new box set-up that satisfies all required elements for a certain disease or department.

The image below portrays such an example of modules as it is based on the results of the

comparative study. Ten modules surfaced from the analysis, of which each time two modules formed a pair as they are very interrelated. They could be combined, but for this particular visualisation the choice was made to keep them separated. The reason for this is the next visual where some of the modules −within such a pair− are marked as grey now. This means that this module is so generic, it could be seen as a part of the essence. For example, the available devices for each department and the way they are being put to use is highly concurrent. The selected devices for a particular box are then based on the patient's needs and the clinician's preferences.
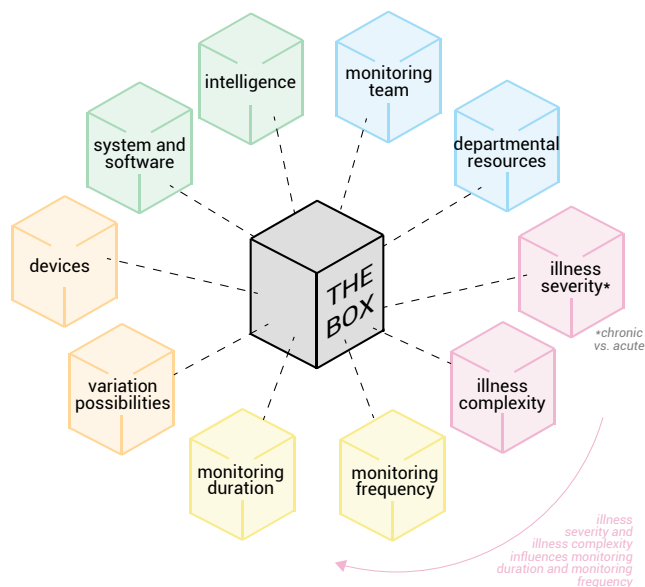
Figure 19: An Initial Representation of The Box as a Modular Concept
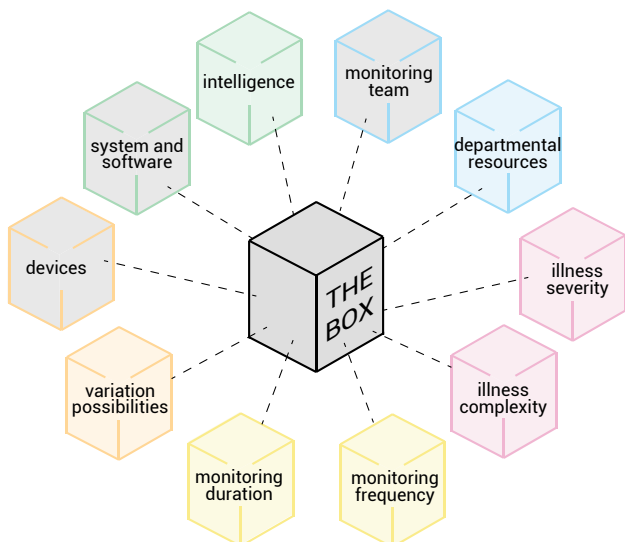
Figure 20: Identification of the Modules which are Part of the Essence of The Box

The Box is a Two-Way Street

Based on the observed data and the additional follow-up interviews at the end of the day, a missed opportunity was identified as all the data came in via The Box devices and corresponding app, but the interaction with the patient went via mail or phone. There lies an opportunity in The Box for communication in both ways. Patients send in data through the LUMC Care app, or via Withings after their devices are connected. It is transferred to EPD Vision or HiX medical dashboard. Yet the patient doesn't know that, neither does he get reassured when it's going well. Only when the measurements aren't good, he gets a call or mail. As instead the app/box should be used to notify the patient if and when it's checked. It doesn't replace the necessary interaction, but adds on to the service. With this, the patient is more involved in their own care and gain more confidence in their monitoring understanding and abilities. Another benefit is that less time and work is consumed by calling or mailing patients. Yet false notifications might appear and give the patient a feeling that everything is okay, when instead the patient should get checked.
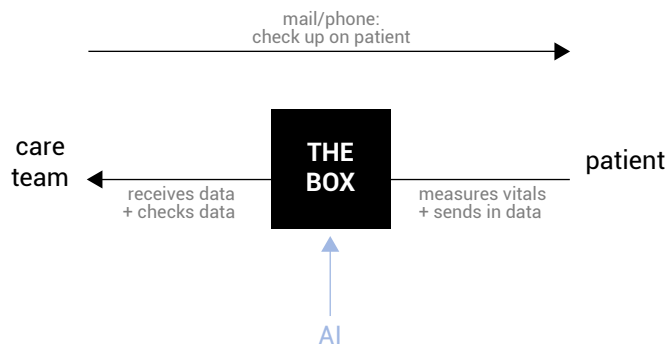
Figure 21: One-Way Communication Via The Box
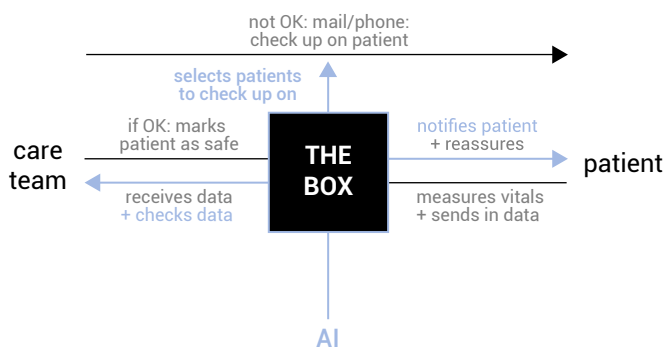
Figure 22: Two-way Communication Via The Box

Creating a Generic System with FAIR

It was mentioned several times in the interviews, and it was also noticed during the observations, that it remains difficult to exchange data between both systems for storing Electronic Health Records (EHR, in Dutch: Elektronisch Patienten Dossier, EPD) because of the absence of interoperability. At the Cardiology department they use EPD Vision, whereas at Covid −and the rest of the hospital for that matter− they use HiX. This is also a reflection of a common problem that is both national and international acknowledged: the failure to operate between Health Record systems. The opportunity presents itself for creating a generic system that allows for interoperability between different EHR's. This would allow for sharing relevant patient data between systems and for patient information to be adopted by another system. But it requires a change of 'habits', and that is not desirable by healthcare professionals

This was later discussed with Prof. Dr. Douwe Atsma −Professor of Cardiology at Leiden University Medical Center, Board Member at National eHealth Living, and strong believer and endorser of The Box− who highlighted the use of the FAIR principles in data management during the conversation. The first step to create interoperability between systems is to exchange information. If this is possible, it

can be customized into a generic system, and can even conform the system according to the FAIR principles of data, which stands for making the data findable, accessible, interoperable, and reusable. When including a "FAIRification" of electronic health records (meta-) data, a harmonized and interoperable health service can become part of the future vision. These principles also "recognize the importance of an automated process for computational support to deal with intensive data processes" minimizing the involvement of healthcare professionals in future for these type of labour-intensive tasks (Sinaci et al., 2020).

Platform for Facilitating Participation and Collaboration

Sometimes it was mentioned in the interviews that everything would be so much better if departments could just mutually enrich each other when it comes to The Box, as it is learning process everyone, and struggles with at some point. Sharing knowledge and experiences will benefit everyone. This concept opportunity is based on a platform that connects the whole network of health services, the patient, and data from The Box. It is a platform which allows for sharing information and important know-how, but also provides the opportunity for helping or assisting each other. Both organisations and individuals can participate, but also public and private sectors, research-based and social organisations, and so on. Participation of all relevant stakeholder parties is requested to facilitate this platform. Such a platform can almost be seen as a database of valuable knowledge. Individuals, groups, departments, hospitals, etc. can learn from each other and can communicate about certain issues. However they should be cautious with information overload and have to make sure relevant data is prioritized and that it is trustworthy.

Technologically Advanced System Supported by AI

This continues on the opportunity given by a 'The Box as a two-way street' where a visualisation was presented of how The Box is being used now and what could still be done with it. To support this process, the input of AI could result in great technological advances in the system. Based on the learnings from patient cases, the current level of intelligence restricts itself to a list of prioritization, yet there are so many other possibilities for further developing the AI. The system needs an AI supported technologically advanced system, that is able to: support staff in monitoring tasks and activities −AI system monitors data and "spits out" abnormalities and inconsistencies for either eHealth assistants to look at, or a specialist/nurse practitioner− ; assist patients in disease management, and prevent diseases in general, or prevent them from getting worse. The system should also be smart enough to know when it's a "false negative". It is capable of taking over a huge part of the workload. Yet such a system needs extensive training, which requires an incredible amount of work in the early stages.
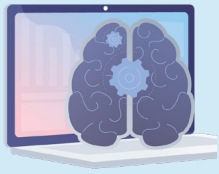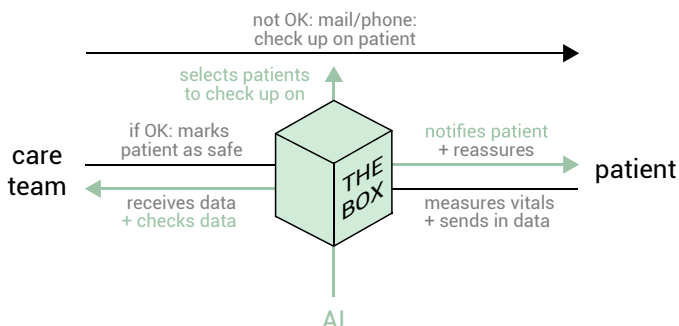
Figure 23: AI Supporting the Use of The Box by Technologically Advancing the System

Harmonized *inter*National (e)Health Service
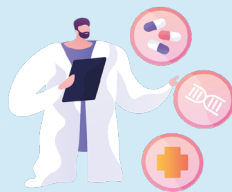
In the opportunity card 'Creating a generic system with fair' it was discussed how the system can be transformed into an interoperable dataset. This proposition serves as an initial phase to a harmonized health service. This is based on the interoperability and collaboration between (e)Health services such as hospitals, general practitioners, physiotherapists, healthcare insurers and so on. As patient data is transferred through system when a patient arrives at the GP, he or she receives clearance to see the information on the hospitalization of the patient etc. All required and relevant patient information is shared. This results in a seamless, harmonized, and interoperable system on a national level, but could even serve on a European level. Permission for sharing should be in control of the patient, who has to allow for their data to be shared. In the future all systems collaborate on a higher level which results in less time- and efficiency losses over patient data acquisition. Such a system however is privacy sensitive and allowing for shared patient data requires many new regulations in the field.

The first intention of this opportunity is to create a harmonized health service on a national level, yet the European Union (EU) is working on a proposal for international interoperability between EHR's which goes by the name EU4Digital. It is an initiative in which the EU supports "the development of a harmonized national framework for eHealth, both among EaP partner countries and with the EU" (EU4Digital, 2021). The task for the EU is to establish guidelines and standards for this initiative, and to present them with informative recommendations. On the other hand the goal is to develop an international eHealth platform for the exchange of know-how and valuable information on eHealth. Their aim is to involve relevant project from within the European

region. The Box could play a significant role in this as they are looking for international pilot projects. The future vision of the initiative is that "ultimately, improvements in eHealth will result in healthier citizens, greater efficiency in the provision of care, more responsive insurers, and better regulation" (EU4Digital, 2021).

SERVICE PROPOSITIONS

The following opportunity cards are mostly based on the outcomes of the service map, especially what came out of the two right columns – which was a result of the efficiency- and workload- related quotes – combined with the endorse – enhance – eliminate analysis. The next concepts are more service than system related as they are merely associated with the workflow of The Box. Furthermore a second look was taken on the research regarding scaling healthcare innovations and what the requirements were for a successful implementation in practice. This last analysis resulted in the final idea on this list, making it a total of six opportunity cards.
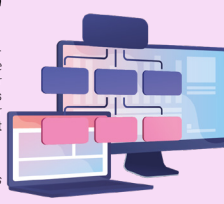
Connecting the "Islands" to the Mainland

The first concept card is based on the separate monitoring services for each individual department. This leads to the suggestion of connecting all separate entities. Instead of having different monitoring "islands", efficiency-wise, it makes more sense to just have one monitoring unit, that is a combination of both medical and non-medical professions. This could result in also having just one Box Office for the whole LUMC and inviting patients here: to this physical and "eye-catching" service point. It could be transformed into a hospital wide customer service. There could also be a steady contact person or other reference from the Box Office that goes to provide explanation to patients at different departments and performs initial tasks

such as: delivering The Box, connecting it to the EPD, and setting up the devices and applications. This is a good example of a service that can be inhouse at first, but after a while, could be outsourced to an external organisation, specialised in healthcare-related customer service. This would redirect the workload from the "expensive" medical healthcare staff to "affordable" non-medical workforces. However, the efficiency gain here is questioned since one part of the monitoring activities has to stay in-house, and the other is united or outsourced to a different organisation, which could result in more inefficient communication.
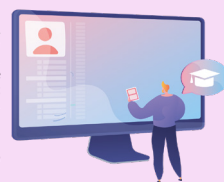
Include eHealth Courses in Modern Education and Training

This concept is based on the opportunity that is based on educating and training medical staff to cope with, and understand how healthcare is changing. By including relevant technological healthcare implementations, such as eHealth, mHealth, remote patient monitoring, et cetera in education, future caregivers will start their career more prepared. For the existing staff, trainings and additional education will be added to their routines. Another step is to create a new profession: that of an eHealth nurse, eHealth assistant, eHealth consultant, and so on. For these new professions, separate educations might be required. The true gain in workflow lies at the beginning with bringing education and trainings up to date to the current healthcare model, including eHealth and prepare them even for a future one. In addition to that, it will improve the division of roles and professions in the workplace. However, changing one the oldest educations (medicine, nursing, …) doesn't happen overnight and is a delicate process. Creating a new education however is less complex and more promising.

Using "Traditional" Health Professionals Wisely

3 USE "TRADITIONAL" HEALTH PROFESSIONALS WISELY

Based on the scarcity of nurses and clinicians now and in the future and them being expensive workforces

Use scarce professionals such as nurses, clinicians and other important caregiving roles to take care of the most severe cases, and use designated medically trained staff in health technology for monitoring patients remotely and a non-medical team for providing customer support. Incorporate more people in this system who are not necessarily medically trained but know how to develop and/or work with ICT.

👍 *Save cost on expensive medical workforces*
Save on scarce healthcare professionals

👎 *Leads to inefficiencies when patient needs medical attention but lands on the non-medical customer support service*

A worldwide known problem is the scarcity of nurses and clinicians, and this issue will only become bigger towards the future. In addition to that, not only are those professions immensely scarce, they're also one of the most expensive workforces, so they should be used "wisely". Use those professionals such as nurses, clinicians and other important caregiving roles to take care of the most severe cases, and use designated medically trained staff in health technology for monitoring patients remotely and a non-medical team for providing customer support. Incorporate more people in this system who are not necessarily medically trained but know how to develop or work with health information and communication technologies. That way, cost is saved on expensive medical workforces and the scarcity will slowly start to decrease. However, it could lead to inefficiencies when a patient needs medical attention but lands on the non-medical customer support service.

Who has the Ownership of The Box and who is Responsible for it?

4 OWNERSHIP OF THE BOX

Based on the comfort of owning personal box and not having to return or retrieve it

When patients have their own box, it doesn't have to be returned by them, retrieved by staff or replaced by another box with additional or new illnesses. Patient's own box is addressed for monitoring. First box is acquired via hospital, but replacement of devices is done through manufacturer or online store. Patients are also able of loaning a box. The acquisition model depends on the frequency and lenght of the use of The Box for that patient.

👍 *Save cost and workforce on transportation of retreiving boxes*
Patient is used to its own box, also before surgery for example

👎 *Patient can be neglectant of box and not have all necessary devices ready or in use*

This opportunity is based on the comfort of owning personal box and not having to return or retrieve it. When patients have their own box, it doesn't have to be returned by them, retrieved by staff or replaced by another box when a patient is diagnosed with an additional or new illnesses. Patient's own box is addressed for monitoring. The first box is acquired via hospital, but replacement of devices is done through manufacturer or through an online store. Patients are also able of loaning a box. The acquisition model depends on the frequency and length of the use of The Box for that patient. In the future, the healthcare insurers are the ones responsible for owning The Box, maintaining its resources and for looking after the devices. This way, cost is saved on workforces for these tasks and on transportation of retrieving the boxes. By having patients owning their own box, they can get used to it completely. It is theirs. Just like a mobile phone. This tremendously benefits the care-path before and after surgery for example, as they are adjusted to it already. However, a patient can be negligent of box and not have all the necessary devices ready or in use.

A Fixed Team who Assists The Box Service

5 FIXED TEAM ASSISTING THE BOX SERVICE

Based on a fixed number of tasks every department is required to do: combine this into a "taskforce"

When there is a clear division between tasks and responsibilities, it becomes clear which tasks should be perfmormed within the department, and what not. Those tasks can be outsourced to an overarching, yet external fixed team. This team will support The Box Office and patient monitoring. Therefore the studentteam will no longer be required and can be eliminated. Useful since students don't cary the same feeling for responsibility.

👍 *Clear division of tasks*
Clear division of responsibilities

👎 *Unclear of who should be in fixed team as many departments have different needs*

There are certain tasks that revolve around The Box that each department –that has implemented this product– has to do. These tasks can be passed on to a fixed team that assist The Box as a service. A "taskforce" can be created. When there is a distinctive division between tasks and responsibilities, it becomes clear which tasks should be performed within the department, and what not. Those tasks can be outsourced or passed on to an overarching, yet department-external fixed team. This taskforce will support The Box Office and patient monitoring. Therefore the student team will no longer be required and can be eliminated. This is especially useful since students or flexi-workers don't carry the same feeling for responsibility. The efficiency gain lies in the clear division of tasks and responsibilities. Yet it remains unclear of who should be in fixed team as many departments have different needs.

Create a Nudge for the Departments to Grow towards the Desired Practice

6 | **NUDGE DEPARTMENTS INTO DESIRED PRACTICE**

Based on desired outcomes for the box service in all departments: let bottom- and top-level meet

Start by creating a "nudge" for departments who aren't monitoring yet in order to get them involved. Departments who are already monitoring are too different from each other, so the "nudge" can help them to create more standardization and generalization. Give nudge from top-level, but let department figure it out from bottom-level: don't force it onto them. For example, persue a collaboration between Withings and LUMC Care app, or eliminate One Note.
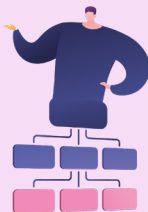
👍 *Let change up to departments*
Best examples of scaling started with a nudge

👎 *Department might not be persuaded by nudge and neglect it*
Thin line between nudge, advice and imposement

It Is always hard to bridge the gap between top-level decisions and bottom-level resources. This opportunity is based on the desired outcomes for The Box service in all departments and the aim to let bottom- and top-level meet. It starts with creating a "nudge" for departments who aren't monitoring yet in order to get them involve, and for departments who are already monitoring but who are too different from each other. In the last case the "nudge" can help them to create more standardization and generalization. By giving a nudge from top-level, the department is given the opportunity to figure out from bottom-level how they can achieve the top-level goal, but based on what they have on resources. Forcing a solution hardly works, so a department needs to get the opportunity to figure it out themselves with the right nudges. Let change up to departments. This conceptual idea is based on some of the best examples of healthcare implementations that scaled to a national level, where it all started with a nudge. However, a department might not be persuaded by the nudge or neglect it as there is a thin line between a nudge, advice and an imposition.

VALIDATION

A total of twelve opportunity cards were created, however not each concept is equally valuable. Even though all of them were based on the results from the research −interview insights, thematic analysis and its framework, observational findings, service map or comparative study−, that doesn't necessarily mean it is a viable, feasible or desirable opportunity. All the system propositions will be evaluated according to a relative difficulty vs. relative importance and impact matrix, whereas the service propositions will be assessed based on a relative difficulty of feasibility and relative efficiency gain matrix. Afterwards both system- and service- opportunities will be organised into an empty roadmap.

This will not be assessed individually. The idea of positioning and evaluating the opportunity cards was turned into a generative session with two participants. A separate session was organised for the project manager of The Box and all cards were evaluated, but the opinion on the system propositions was most significant. Another session was arranged with a medical eHealth consultant where the viewpoint on the service proposition was decisive. Besides evaluating the cards and organising them in both the matrices and the roadmap, their opinion was requested on each conceptual idea. The insights from these sessions will be used to create a future vision and where the opportunity cards can be positioned in the final roadmap.

POSITIONING THE CARDS

The image below **(Figure 24)** shows the initial canvas that was presented to the participants in the beginning of the session. First all, the opportunity cards were discussed so that everything was clear for them. This was also a moment for a critical reflection on the concepts. If something was quite unclear, notes were taken in a separate document to alter the propositions later on. Next, the participants were asked to first sort al the blue cards −representing system propositions− on the first axes, and then critically reflect on it. Afterwards they were asked to do the same for the pink cards −representing service propositions− on the second axes, and also here another analytical look was given to the positioning of the cards. Finally the concepts were structured in an empty roadmap as presented below in order to find out what they gave preference to, to develop first, and also give the participants the opportunity to explain why. This is shown more detailed in the Appendix.

Figure 24: Brainstorm and Prioritize as a Team

Kim Brons
The Box Project Manager

Kim only had a limited amount of time available, so when it came to the division of time, certain tasks had a higher priority than others. Therefore more attention was paid to the system propositions than on the service ones. This is way the roadmap remained incomplete without the positioning of the pink service propositions. For her, it came quite naturally to position and evaluate the blue cards in the left matrix, whereas she had more difficulties with organising the pink opportunity cards in the right matrix. The reason for this is that she never experienced the workflow of The Box directly, yet her opinions on the blue card propositions were highly valuable.

> ## " I really like the way you think about The Box, you gave me some new inspiration "
>
> — *Kim Brons,*
> *The Box Project Manager*
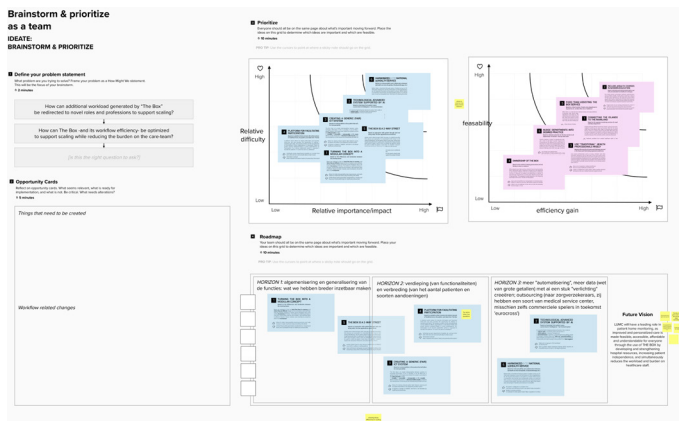
Sofie Muller
Medical eHealth Consultant

Sofie on the other hand, had an unlimited amount of time available for the session. Which was quite convenient to really push through with some questions and reflect even more on the card positionings. She was quite impressed with the system propositions on the blue cards, yet she could be a lot more critical on the service propositions, represented on the pink cards. The reason for this is that besides being partly responsible for the implementation of the Covidbox, she is mostly experienced with the actual use of The Box as a service. A last remark is that with positioning the opportunity cards in the roadmap, she highlighted the early start of certain propositions multiple times. For example, she acknowledged the importance of a 'Technologically advanced system, supported by AI', but she emphasized how they have to start with it now already to have it implemented in the future.

> ## " This is such a fun thing to do, I like how I can drag everything around and talk about it like this with you "
>
> — *Sofie Muller,*
> *Medical eHealth Consultant,*
> *Covidbox*
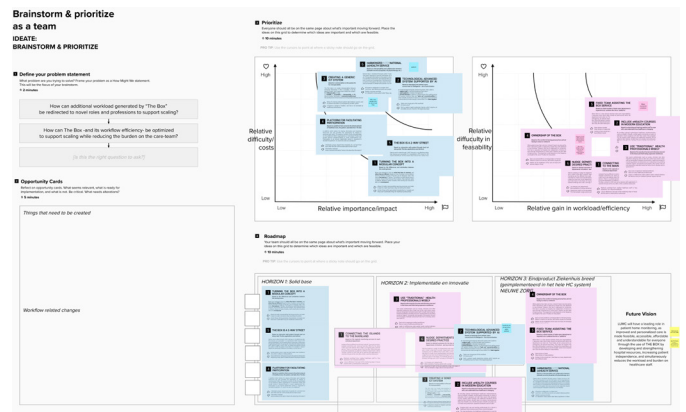
DESIGN VISION

At the end of both generative sessions, the participants were guided through a preliminary, yet general future vision and were asked for their opinion. Together with their input, the following general future vision was established: LUMC will have a leading role in developing feasible and affordable healthcare, as improved and personalized care is made accessible and understandable for everyone through the use of "The Box" by promoting and strengthening hospital resources, increasing patient independence, and simultaneously reducing the workload and burden on healthcare staff. This inspired a revised constraint for The Box:

The Box is more than a tool for patient remote monitoring, as it reduces the workload and burden on healthcare staff by increasing patient independence and strengthens hospital resources

and should be further evaluated based on the quadruple aim

Currently The Box is mainly used as a medium to supervise both more patients and in a remote manner, as instead, The Box also possesses the tools to relieve the healthcare staff of a large portion of their workload and simultaneously improve the workflow efficiency. LUMC uses the quadruple aim model to assess new healthcare implementations, yet the majority of the focus with The Box has been on cost-effectiveness, population health outcomes and patient experiences. However, the most pressing problem is that of staff burnout, which makes it is so urging to evaluate the care-team well-being. The Box should not give staff more work, it should be used as a means to support them in their workflow. In the future, medical healthcare professionals should be able to get back to what they are supposed to do: taking care of their patients and having the time to do so.

The aim is to take this prototype –The Box and its service– and turn it into a mature proposition that can be implemented hospital-wide, but also has the ability to change the current healthcare system. The burden on the care-team must be suppressed or else the future will include an immense scarcity of healthcare professionals of which the majority will be burnt out. The Box must be elevated to a standard

healthcare implementation which increases the workflow efficiency and supports the staff in their tasks and care-delivery. However, LUMC is not capable of bringing this change along solo: they are specialized in research, education and healthcare, yet they lack expertise on data management, financial resources, digital developments, etc. It therefore needs the support of multiple organisations. This all lead to constructing the following holistic design vision for The Box:

Creating a mature proposition for standardized care with an integrated low-burden, efficient workflow, through urging the collaboration between significant parties

to fulfil the need for scaling The Box

The Box needs to be scaled from a prototyping solution towards a mature proposition for standardized care. This development is substantiated by a combination of a user-centred service, a value base care model, and a data enabled design approach, while focussing on increasing the intelligence. The Box is familiar with data enabled design in a single small experiment, yet there is no experience on a continuous broader scale. Furthermore, the best way to speed up the implementation of the scaled solution is were different stakeholders collaborate as a team, while keeping in mind the systems and workflows in the future. This leads to the question of which parties or stakeholders can be involved to make this work.

DELIVER

7. THE ROAD TO SCALING

The chapter is introduced with more information on how the roadmap is created and why that became the deliverable of the graduation project. Every horizon and the section of the future vision within the roadmap is also individually discussed. Then the final roadmap will be presented. Afterward this deliverable is evaluated based on what could be identified as a "validation session" with a key person of interest for each involved party (LUMC, TUDelft and Philips) and recommendations are made based on the outcomes of the roadmap. The result of the future vision within the roadmap considers the quadruple aim and are discussed as the final part within this chapter.

CREATING A ROADMAP

As mentioned before, the current state of The Box can be positioned on a prototyping level, yet what it should become is a mature proposition for standardized care. Getting to this stage requires planning and close collaboration. The solution to this is to create a line of continuous prototyping and framing a path of bringing that prototype to a proposition level. A transparent order is desired, therefore a process is visually proposed in which the prototypes of the elements in the horizons get to a mature level. This way, a perspective on a scaling strategy from a prototyping solution towards a mature proposition should become clear. Therefore a roadmap is the ideal deliverable as it is "a visual portray of design innovation elements plotted on a timeline" (Simonse, 2017).

It is important to understand that the opportunity cards form the building blocks that support the horizons. To determine what needs to be achieved and what could be done, should be evaluated on the desirability, viability and feasibility of the presented opportunities, this is approximated through the matrix assessment of their feasibility versus importance, or on their difficulty versus gain in efficiency. Only the title of each card is included in the roadmap. It is therefore advised to have a look at the content of them in the previous chapter if they were skipped or only scanned quickly before. They represent the insights and outcomes of both thematic analysis, and observation maps, and they form the bridge from the research and methodology towards the result phase of the project, which is the roadmap.

This creation of the roadmap is based on several elements from a care-team perspective. First of all it has been described in previous chapters what the current state is of The Box and what it should become in the future. Each horizon represents a scaling step in the roadmap towards that vision. In addition to that, the opportunity cards formed the essential elements for building the horizons. They were evaluated on several characteristics which resulted in an assessment of how important they were within the healthcare landscape. Each horizon is sustained with four of those opportunity cards – two system, and two service propositions–, giving shape to the environment of The Box. Both medical and development goals are described, and finally the organisations –LUMC, TUDelft: CardioLab and Philips– are placed on the roadmap with their roles

or capabilities. More detail will be presented in the separate sections of the horizons.

* A side not that will help in the interpretation of the visuals is that the people in pink shirts represent patients, purple tops are eHealth professionals, white coats or shirts visualize medical healthcare staff, and a blue top means it's a decision maker.

HORIZON 1:
STANDARDIZE AND MODULARIZE

The first horizon regards the standardization of certain capabilities and functionalities the departments have in common. Besides identifying what the shared essence is of The Box, it also creates the required generalization in order to simplify the integration of this product-service. This is ideally achieved by modularizing the system, which is one of the most important opportunities that corresponds to this horizon. When all functionalities, and even requirements, can be grouped in different modules, it allows for an increased service efficiency. In addition to the modularization, creating an agreed differentiation in the use of traditional healthcare professionals also adds up to workflow improvement. It should be clearly defined which professionals perform which tasks, so that the ones with a medical degree can focus on the patients. The others will have a more digital tasks, yet it is important to train those people and to create eHealth related professions and educations. These roles support the digital interaction with the patient. This is substantiated by a dual involvement of both patient and eHealth consultant through the use of The Box

In this horizon the intended use of The Box remains to be the supervision of the care-path of the patient. This requires active contribution of the healthcare staff, but relies on a level of responsibility from the patient. As this horizon appears quite early, no major changes are suggested. The Box is merely being prepared for spreading out and for the following stages in the scaling process, yet the first steps from a prototype to a proposition level are taken through simplifying the integration. Additionally the groundwork is being laid out for advancements on artificial intelligence. LUMC's role in this, − besides the research on patientcare and health outcomes−, is the provision of The Box data. Through the connection with the devices, Philips is able to collect the data. TUDelft supports this horizon by providing their experience they have on research in design − Faculty of Industrial Design Engineering−, and in AI −Faculty of Electrical Engineering, Mathematics and Computer Science−. Although it is not shown in the roadmap, an important party is the health insurer as the finances for delivering a proposition for The Box must be coming from somewhere.

HORIZON 2:
DEEPEN AND BROADEN

Horizon two focusses on deepening and broadening The Box as a user centred service that considers value based care through data enabled design of which the data gathering started in horizon one already. Several opportunities are featured in this phase of the roadmap as The Box needs some "rethinking" in order to take a leap in the process towards a mature proposition. It becomes a design process that is based on the gathered data. It has the goal to deliver more value for not only the patients, but also for the healthcare staff. As a result, many changes must be implemented to create a better workflow. First of all the efficiency is increased through service interaction which is achieved by a platform for facilitating participation and by connecting "the islands" to the "mainland". The islands are referred to as the separate monitoring units per department. In order to allow for this collaboration on a system level, a more generic ICT must be created, preferably including the FAIR principles on data. Finally both spreading and scaling become more feasible when all departments use The Box in a certain way to achieve a desired standard practice.

At this stage of the development towards a healthcare proposition, the main use of The Box is dedicated to a preventative care model, which is partially focussed on coping with the issue of comorbidities. In this horizon the attention is on a balanced participation of the care-team and can rely on the participation of patients as they are now actively involved in their own health. AI developments will be at a stage capable of supporting both staff and patient by helping the care-team in monitoring the patients and selecting which patients to look at and it assists the patients in their disease management and follow-up. Furthermore, LUMC will be the party delivering and evaluating solutions for patient remote monitoring. TUDelft will be substantiating this phase of the horizon with their research in data enabled design. And Philips will be working on a smart system that is integrated in the service.

HORIZON 3:
RELIEVE AND OUTSOURCE

In relieve and outsource, the pressure is released from the healthcare staff. This is mainly done by reducing their workload through distributing it to designated professions, by letting AI take over the majority of the tasks and through outsourcing certain activities to organisations, whether or not medical, and possibly commercial. This horizon prepares The Box − both on system, and on service level− for scaling. One of the opportunities that make this happen is the fixed team assistance for helping and taking over a large portion of the activities that still require human intervention. Then another one is the advanced system, supported by AI, that takes

on the automized tasks, which causes the workload to redirect itself to this technological intervention. For this service to be truly efficient and effective, it is advised to combine existing health and eHealth service into a harmonized healthcare system. A final opportunity that needs to be given thought to is the ownership of The Box. It will become impossible on this future scale for LUMC to still manage and control all boxes. This horizon is mainly about how to prepare The Box for the actual scaling to a mature healthcare proposition.

The Box has now become a tool for a full life course treatment of the patient, yet with minimal involvement of the staff, as it is now the patients responsibility that not only strengthens their participation, but empowers them in this lifelong care-path. When the patient is able to take on this role, this too unburdens the healthcare professionals. The patient is supported by AI in their disease management, and the staff is exempted from unnecessary activities. However, such AI must be trained, and before it is possible for the care-team to enjoy this technology, first the effort must be put in to create the required knowledge and intelligence for the system so it can become operative on this complicated level. This will also require the assistance of a specialised company, not represented in the roadmap. However, a data platform for the health system is a necessity, which Philips will deliver and LUMC will validate the implementation of. Furthermore TUDelft can assist in the strategy and design for the platform.

FUTURE VISION

As mentioned before, The Box is more than a tool for patient remote monitoring as it reduces the workload and burden on healthcare staff by increasing patient independence and strengthens hospital resources. Furthermore, LUMC will have a leading role in the development of feasible and affordable healthcare as improved and personalized care is made accessible and understandable for everyone through the use of The Box, and when all four objectives of the quadruple aim are met. As the research is done mostly on the role and involvement of the LUMC, the future vision is mainly based on their perspective, and that of their staff. The upper part of the roadmap, and thus of this future vision is dedicated to future intentions for LUMC, as it is their main goal to make healthcare affordable and feasible. It is the bottom part that is more general and regards the other parties in this collaboration as well.

The focus of the research and the future vision was on staff, however the perspective on the other elements of the quadruple aim —patient experience, population health and reducing costs—, never went out of sight as they all contribute to both the burning problem, and the solution. The focus has just been on care-team well-being as it was often overlooked and their burden urgently needs to be eliminated. It is further elaborated that if time is spend more wisely, and tasks are better divided between both different professions and technology, then the caregivers have more time to invest in patients who really need care, whereas the others are thus supported by AI or

an eHealth professional. Furthermore, the ambition of this proposition is to create a harmonized care support, in which the healthcare industry can become a seamless system. LUMC becomes the front runner when it comes to new digital care delivered by both staff and technologic innovations. In this vision, the TUDelft becomes a pioneer in both design- and AI-related solutions, and Philips will be the provider of a collaborative digital ecosystem that will facilitate this all.

The main takeaway that should be picked up from this part is that The Box is more than a tool for patient remote monitoring. It does support staff in caring for more patients, but only when a large portion of the workload is eliminated, the care-team can get back to their main activity, which is take care of the patients who actually require treatment –as instead to using the staff's time on delivering good news for example–, and find meaning in that again. This corresponds with one of the most promising outcomes of AI in medicine, which according to Topol's book on Deep Medicine is the gift of time (2019). Time is essential to the quality patients receive and their health outcomes. It is about staff, but also about the results that come from investing more quality time in patient-staff interaction.

ROADMAP

The roadmap is a result of the extensive research, both literature study and desk research, observational studies, the outcomes from the thematic analysis and that of the service maps, and based on the insights from the generative sessions. The goal of this deliverable is to show a designer's perspective on scaling The Box from a prototype level towards a mature healthcare proposition. The roadmap shows both opportunities for continuous prototyping and what value they bring, scaling strategies, patient monitoring and what level of staff involvement it demands, required developments and finally stakeholder collaboration. What it actually proposes are the changes that need to be made to create an integrated healthcare solution that is focussed on "unburdening" the staff.

THE ROADMAP: A FINAL DELIVERABLE

from prototype to proposition for standardized care

ROADMAP

- HORIZON STRATEGY
- CONTINUOUS PROTOTYPING
  - **service** propositions
  - **system** propositions
- HEALTHCARE LANDSCAPE
  - Value based healthcare
  - Data driven care
  - AI in healthcare
  - Workflow in healthcare
- SCALING CYCLE
- THE BOX ENVIRONMENT
- MEDICAL GOALS
- DEVELOPMENT GOALS
- PARTIES COLLABORATION

HORIZON 1 *2022*

STANDARDIZE AND MODULARIZE

Standardize common capabilities and functionalities and modularize different system and service components

- wisely use traditional health professionals
- The Box is a two-way street
- turning The Box into a modular concept
- include eHealth courses in modern education

PREPARING FOR SPREADING

CARE-PATH SUPERVISION
+ active contribution of staff

Simplify integration of The Box into **departments** through *system modularity* while improving *service efficiency*

- *health research & data povision* (LUMC)
- *research in design & AI* (TU)
- *data collection via connected devices* (PHILIPS)

HORIZON 2 *20...*

DEEPEN AND BROADEN

Deepen and broaden the user centered serv... and value based care through data enabled d...

- platform for facilitating participation
- creating a generic ICT system with FAIR
- nudge departments into desired practice
- conne... island... ma...

SPREADING

PREVENTATIVE CARE MODEL
+ balanced participation of staff

Spread out The Box over the whole **hospital** and... for *system collaboration* and *service interac...*

- *deliver solutions remote monitoring* (LUMC)
- *data enabled design research* (TU)
- *servi... smar...* (PHILIPS)

MATURE PROPOSITION FOR STANDARDIZED CARE
with an integrated low-burden, efficient workflow,
through urging collaboration between significant parties

2024

HORIZON 3 *2027*

FUTURE VISION

RELIEVE AND OUTSOURCE
Relieve healthcare staff from pressure and workload
and outsource to (commercial) (medical) organisations

*The Box is **more than a tool** for patient remote monitoring, as it **reduces the workload and burden** on healthcare staff by increasing patient independence and strengthens hospital resources.*

*Furthermore, LUMC will have a leading role in the development of feasible and affordable healthcare, as improved and **personalized care** is made **accessible and understandable for everyone** through the use of The Box, and when all four objectives of the **quadruple aim** are met*

ce
design

cting the
ds to the
inland

ownership of
The Box

technologically
advanced system
supported by AI

harmonized
(inter)national
ehealth services

fixed team
assistance for Box
service

PREPARING FOR
SCALING

SCALING

LIFECOURSE TREATMENT
+ minimal involvement of staff

HARMONIZED CARE SUPPORT
makes sure staff becomes unburdened

d allow
ion

Support adoption of The Box in external **health services**
through *system advancement* and *service exchange*

Scale The Box within the healthcare system through
seamless system integration and *service authority*

ce integrated
t system

validate platform
implementation

startegy & design
for platform

health system
data platform

new digital care
front runner

design and AI
solutions pioneer

collaborative digital
ecosystem provider

ROADMAP EVALUATION

Based on a validation session with Chair, Maaike Kleinsmann −representing TUDelft, especially CardioLab and also associated with NeLL (not mentioned in the roadmap)−, and another session with company mentor, Jeroen Raijmakers − representing Philips Design− , the horizons of the roadmap were evaluated. The involvement of the three parties in the collaboration was checked with Maaike, for TUDelft, Jeroen, for Philips, and with Frouzan Soltani, the manager of operations of The Box, for LUMC to make sure this section of the roadmap resonates with their company goals. As with that, both desirability, feasibility and viability was evaluated of the steps undertaken in the roadmap.

VALIDATION BASED RECOMMENDATIONS

It is preferable to transform the role of LUMC from being the owner of The Box to becoming the "testing ground" for further exploration. They will become the frontrunner of their own concept, in which they are still capable of optimalization, displaying and having control over the situation, but it is important to place it in a broader perspective and imagine The Box being implemented in different locations. It is a desire for Philips as well to develop and define a platform together with LUMC that can be expanded on a worldwide level. It is the scaling that is highly relevant for Philips, and not just having an implementation in the LUMC. The data that comes out of this can be used for adding intelligence to the platform. The goal is to have a concept of continuous innovation with AI solutions, in addition to the algorithms of Philips −but that of others organisations too− so that it can become an "open ecosystem".

At Philips, it isn't about delivering devices anymore and are now focussing more on delivering patient management solutions. "Let external parties provide the devices, that's fine". It is not Philips' business model anymore, as they want to base their profit model on a platform level that provides LUMC, but also other organisations, with data management and add-on intelligence to the system. "The possibilities for devices is very limited to what a business can do with it". Eventually it always is more about the system itself, and that is why insurance companies are so relevant to the story. Their role can't be neglected as such a system needs to be reimbursed, because else there won't be any incomes for anyone. In addition, it is important to think of the rules and regulations for this product-service system, which is not something

Philips, nor LUMC, nor TUDelft highly identifies themselves with. For this, the National eHealth Living Lab (NeLL) must be thrown into the mix as well.

The purpose of The Box and its technology is to have a better interaction with patients and have a more efficient process, however in reality The Box has become more of an obstruction than a solution, and that needs to change. Time is the most desired element in this whole story. Every minute that can be saved on "not having to check on measurements that are good", is a minute more that can be spend on delivering value and quality to the interaction with the patient. In addition to that, a huge amount of costs can be saved by preventing readmissions. With this system all "good news conversations" are eliminated, resulting in a time-span for things that really require attention. This is what makes it so desirable for staff as well, as they don't have to spend their time on useless follow-ups, but they get their fulfilment from getting the severe cases back on track.

The roadmap suggest a feasible system change in workload and reduced burden on staff. Yet this change is made without doing harm on the other three elements of the quadruple aim. Each quadrant will be briefly discussed in the next section, however the main interest remains the care-team well-being. Health outcomes, reducing costs and patient eventually all play a role in solving the "workload-problem" of staff. This is a burning issue that continues to pop up in multiple medical fields. When things are being standardized, there will be broader scale in which people can be separately educated to become eHealth consultants as it is desired to have more of those people on the right spot. In the future vision the care-team gets the centre stage, yet their environment is framed by on one hand the hospital −economic and workflow related focus−, and on the other hand the patient −health framework− that is now capable of taking over certain tasks of the staff, which leads to improved care-team well-being. This shows the relation to the quadruple aim.

In conclusion, the elements of the work environment of the staff have an impact on the decrease in workload and the rise in workflow efficiency, according to the validations with the representatives from the three collaborative parties. The outcomes are desirable as it is focused on what the user −the care-team− needs, and it has been the main result

from the research that workload was the main pain-point. The "solution" is built on the strengths of each stakeholder's capabilities which implies proper feasibility. Finally, the roadmap contributes to a sustainable and long-term scaling strategy. It can be concluded that the final result, visualised in a roadmap, is based on valuable insights.

DISCUSSION BASED ON QUADRUPLE AIM

The focus of the research and the future vision has been mostly on staff so far, however the perspective on the other elements of the quadruple aim –patient experience, population health and reducing costs–, never went out of sight. Eventually, the goal is to try to create a more efficient system in which more patients can be treated. But this is exactly it: More efficiency and effectiveness is always the goal, but while implementing these changes, it is often at the cost of the care-team well-being to cope with these changes and assist in its implementation. The right intentions are right when it comes to creating more efficiency, yet in reality this often adds up to the healthcare burden. Therefore the ideal solution considers all quadrants of the quadruple aim.


Figure 25: A Future Vision Proposition on the Quadruple Aim by Bodenheimer & Sinsky (2014)

Patient Experience

A The outcomes of this research support the idea of involving the patient more in their own health by educating them more on their disease or other health issues. Patients will feel empowered and will be capable of taking decisions themselves, for example whether they feel like it is necessary to reach out to hospital staff. Readmissions can either be prevented or anticipated on. For instance, diabetes is a chronic disease, and patients carries this for the rest of their lives. However these are not the patients who require most attention as they are very aware of their symptoms. They understand what affects their body or severity of the illness. With the proper devices, they know what to do when. This kind of independence is desires for all types of patients. This is the goal to reduce the workload, when it comes to patient experience. Give patients the right tools, and they feel motivated, empowered and independent.
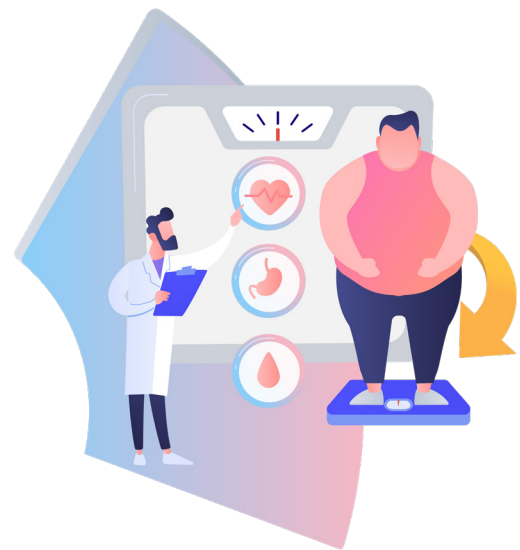
Population Health

An urging problem in today's healthcare, but also that of the future, is patient comorbidity. When a patient lives unhealthy are already has a primary condition, it tends to happen that they end up with multiple disorders or diseases all together. The ultimate goal is to deliver a box to each patient who might need it. "Who The Box is given to?", is not the right thing to ask, however "Why doesn't that patient have a box yet?", becomes the future question. "Why not" instead of "why". Having a system to monitor and manage all those patients supports the evolution towards a healthy population as symptoms are earlier detected and comorbidities are earlier diagnosed. Many opportunities find themselves in the follow-up of large patient populations and lifestyle changes.

Reducing Costs

Many departments in the hospital have a "Poli", which is an outpatient clinic, and according to the manager of operations, what they all have in common is the immense amount of visiting patients. Together they account for over one million patients a year. By sending people home with The Box, who don't require immediate physical care, it reduces the costs of admissions. It also saves on the cost of patients arriving at the hospital unplanned via the Emergency Room. Furthermore, a patient with excellent values, measured with the devices from The Box, might not require a digital of physical follow-up after all, resulting in a cost reduction on the number of appointments. In addition, even these digital check-ups need reimbursements, which is why health insurers need to be involved.

Care-Team Well-Being

There are many patients who sit at home with The Box, and if they are actively using the devices to monitor themselves, a large amount of data exists on that patient. AI supports the care-team in supervising all of those patients, and only "spits out" the ones who require attention and the staff must take a closer look at. Allowing AI to assist, reduces a tremendous amount of workload on the care-team. Not only does this "unburdens" the healthcare professionals, but this results in a larger portion of their valuable time to be spend on the things that matter the most. For example, the interaction with the patient who really need it. Time is essential to the quality the care-team delivers to the patient, and to their health outcomes. This contributes to the well-being, as the staff mainly gets their satisfaction from bringing those severe patients back on track.

X. BEFORE WE END

As the research has come to an end, it is time to have a final discussion before terminating this graduation project. Within this discussion part, the principal results of the research are highlighted and the research questions are answered for the last time. The limitations of the project will be considered as well. Afterwards the contribution that this thesis made to the field of healthcare, and that of strategic design, is presented. A final conclusion is written as the last part of this chapter, and with that, brings an end to this elaborative graduation project. A final reflection on the project is made, but doesn't contain new substantial information to any of the results.

DISCUSSION

To answer the research question 'How can The Box scale from an experimental phase to a solution stage through redefining the workflow?' the roadmap is created. I can be used as a starting point or foundation for creating a more advanced strategy on scaling The Box and on improving the workflow of healthcare professionals, both traditional and eHealth. The roadmap reflects on the collaboration of three different stakeholders within this multi-faceted environment. The added value to the current research is the prioritization of the experiences of staff, and therefore highlighting the care-team well-being within the quadruple aim. Basing the research on their experiences strengthens the desirability, feasibility and viability of The Box within LUMC.

PRINCIPAL RESULTS

The aim of this study was to develop a proposition that contributed to the workload reduction and an increase in efficiency in the workflow of the healthcare staff. Even though the focus was merely on the workload experience of the staff, the research eventually led towards a roadmap that showed how The Box can be scaled from an experimental prototyping stage towards a mature proposition for a healthcare practice that contributes to the improvement of workflow efficiency and therefore unburdens the care-team. It might be confusing that as the emphasis of the research lies on staff, it is hardly shown in the roadmap itself. This is because the healthcare team doesn't have much control over taking The Box from a prototype stage to a proposition level. Yet they are the ones dealing with the workload and other workflow issues, and therefore form the structure of the research on which the results are based upon.

So, what is now the answer to the research question? To go back to the intermediate research question: 'How can addition workload provided by The Box be redirected to novel roles and professions to support scaling?', at that time, the word "scaling" didn't have a clear definition yet. After determining what scaling really meant for the scope of the project, the research question was reframed to 'How can The Box scale from an experimental phase to a solution stage through redefining the workflow?'. With the eventual outcomes of the research it is now possible to answer to both research questions.

How can addition workload provided by The Box be redirected to novel roles and professions to support scaling?

First of all, the additional workload that is provided by The Box should reduce over time by improving to a higher level that is closer to a mature proposition. When it reaches that level of standard healthcare practice, The Box will be taken into any protocol, defining a new workflow and improved practice for healthcare, and healthcare professionals. Furthermore, with each stage in the roadmap, the level of intelligence of The Box is improved, the amount of patient participation and responsibility rises, and therefore the number of tasks and responsibilities for the care-team decreases. In addition to that, more and more new professions on eHealth surface and allows for them to take on the digital workload The Box brings along so that the care-team can get back to their intended and preferred task, which is to care for patients.

How can The Box scale from an experimental phase to a solution stage through redefining the workflow?

Now that it is known what is meant with "scaling", setting up this research question made much more sense. The main problem that was causing the workload and burden on the healthcare staff was the underdevelopment of The Box and the failure in bringing this product-service further along than its current prototype stage. It resulted in the healthcare staff needing to cope with it and make up for several inefficiencies by simply doing more tasks in this experimental phase. As the workflow is redefined with an input of the patient, a rise in the technological developments of AI resulting in a significant contribution and an addition of new eHealth professions, The Box can progress from being an experiment towards a new and improved healthcare practice. This is done by first standardizing and modularizing The Box, then by deepening and broadening the user centred service and value based care through data enabled design, and finally by relieving the staff from their workload and burden through outsourcing several tasks and responsibilities to other organisations.

Furthermore, it was it was determined at an earlier stage that The Box, its roles and professions, and its scalability would be investigated from a point of view of the healthcare staff that are working with or on this innovative project. That didn't mean that the other elements, besides care-team well-being, from the quadruple aim would be neglected. They were always taken in consideration, but simply did not have the focus. A complete subchapter has been dedicated on this in the last part of the Roadmap-chapter. The Box has the possibility to deliver great outcomes in all quadrants of the quadruple aim, both for patient experience, population health, reducing cost, and care-team well-being. They are also a part of the discussion, but were already elaborately explained in the previous chapter. In addition, even though the research started with a scope on the care-team at LUMC, the roadmap still showed an involvement of other stakeholders as well in the outcomes for creating the solution.

LIMITATIONS

Even though the research always considered all elements of the quadruple aim, the focus merely has been on the care-team well-being. The participation of the patient often popped up during the project research as an important key factor for solving the problem. The amount of opportunities is endless on the patient side, but since it was not included in the scope of the project, it was never further investigated. The same counts for AI and other technological developments. Ideally this would have been researched more thoroughly as well, but again, since it was not part of the scope, it was not incorporated in further research. However, the outcome of the thesis is based on what the involvement could be of both patient and AI, according to staff experiences and perspectives.

Lastly, the majority of this research project is based on the qualitative insights from the interviews, observations, and the methods that were used for analysing and processing them. As it was a qualitative study, the data is quite rich, yet hardly quantifiable. For this type of data, a quantitative study would be more in place, and then triangulation would be reached. What was not earlier mentioned in the project is that LUMC itself is focussing more on a large-scale inquiry with their healthcare employees by sending out questionnaires to multiple departments. So what is a limitation to this project is

already captured by the "client", LUMC, itself. LUMC shared those results, but are for confidentiality reasons, not included in this graduation project. However they did substantiate the results from the qualitative research.

THESIS CONTRIBUTION

The results of this thesis aim on making a contribution towards the three main stakeholders, which are LUMC, TUDelft and Philips. In the developments of scaling The Box, it isn't clear for them what their contribution could or should be, and this graduation projects commends a suggestion that can be appraised towards the future by every involved partner. The project tried to come up with a solution to the problem in an environment that doesn't know many successful scaled healthcare solutions. For that reason it does not only make a contribution in the field of healthcare innovation —more specifically on eHealth— but also on a level of strategic design and planning in the medical field.

The contribution goes beyond solely the results as it highlighted the importance of the perspective of the healthcare staff. It stresses why care-team well-being should never be overlooked in evaluating new healthcare implementations. Their experiences contribute to the failure or success of novel innovations. The thesis brought awareness to the rising workload on these professionals and how this affects the workflow and efficiency of both the system and the service of The Box. Hopefully, the results of this thesis will be taken into consideration by LUMC, TUDelft and Philips when planning the next steps for The Box. Ideally, this will also be picked up by other organisations, partnering in similar healthcare innovations such as patient remote monitoring.

FINAL CONCLUSION

The transition from a prototype to a proposition for standardized care is shown in the roadmap. It proposes a mature proposition for standardized care with an integrated low-burden, efficient workflow, through urging the collaboration between significant parties. Through this process, the intended outcome of the roadmap is to reduce the workload in this improved healthcare practice and with that, it strengthens the solution towards an unburdened healthcare staff. The majority of the research contributes relevant insights and findings on the care-team well-being and their experiences with The Box, but simultaneously involved the role of the patient as their participation can make the difference in workload, next to the performance of technologic advancements in AI for improving the workflow. Finally, the roadmap resulted in suggesting a collaboration with relevant parties to deliver value in the scaling of The Box and turning it into a desired low-burden healthcare practice.

PERSONAL REFLECTION

I made it! Not that I thought that I wasn't going to make it, but when you actually get there, it is hard to believe. A week from now, I will be graduating, and that is literally the most bizarre feeling. The end of an unbelievable study career. Looking back, I wish I would have enjoyed my masters a little bit more as my focus really has been on having good grades in order to look attractive to future employees. I can definitely say that I am proud of myself, and I did everything I had in my power to get the desired results. But was it worth giving up most of my free time to stay ahead of the rat-race? Well, yes and no. Yes, I am very proud of myself for giving it my all and trying to go for the extra mile. No, since I often gave priority to my graduation over hanging with friends and enjoying my time here in Delft. So as advice to myself, and as a recommendation to future graduating students: try to find a good balance.

I wasn't always this stressed about my graduation project. It turned out to be a rough beginning as there were some complications and uncertainties on the project that just weren't in my control. In week six these were still not resolved and together with my mentor, I decided it was a good idea to switch to a different project. Yes there were times of frustration and disbelieve, but I used the momentum to really go for it. So I started working on the weekends to catch up on lost time. In week 10, I felt so confident and encouraged as I managed to approach the predetermined timing of the project again. I had acquired so much valuable insights, and I could simply not make a decision in how to go about it. I got so lost in all my information, and I felt like time stood still for 4 weeks. However it didn't. Suddenly The greenlight got really close, and I was losing valuable time. So much even, it started to worry my supervisory team. Was I going to make it in time?

I can tell you, that I did. Even with the project switch in week 6 and the –I guess almost mandatory to every student– phase of feeling utterly lost that lasted for 4 weeks, I graduated in week 22. Luckily I had great friends that reminded me that feeling this was so normal and that I was doing an amazing job with trying to catch up in order to make the determined deadlines. I guess every student has good and bad experiences when it comes to their graduation project, but when you look at other people's report, you think "wow this is so good". And you only see the perfect results, and not the struggles they probably also went through. Until there was a moment I read the most honest personal reflection ever, and I was so encouraged by her words, and it made me see that I am really not alone in this. So to whom it might regard, if you read this, please know that a graduation is not going to be the most wonderful time of your life as you are going to experience many ups and downs, but the moment you hand in that report, it is going to feel like one of the most satisfying moments ever.

But now back to some more positive thoughts, as I can say that what I learned in this project, went beyond my personal learning goals. I wanted to learn how to design more independently, and I absolutely did. The majority of the master in Strategic Product Design consists of groupwork, so it was quite a change when I suddenly had to make decisions on my own. I found this especially difficult in the beginning, but successfully managed to do it after all. I wanted to learn more about health-tech, which I did, but on a different level of what I had in mind. I thought I would go more in depth, but eventually I learned how it reflects on actual healthcare implementations, which is actually even more relevant in strategic design. One of my ambitions was to work with Philips, and to my luck, my supervisory team made that happen. They brought in a company mentor for the remaining part of the project, and that really helped me in taking this project to a level that wend beyond my expectations.

What I am most happy about, is the types of collaborations I experienced in my graduation project. I enjoyed such an exquisite supervision of my mentoring team, who's input made the most valuable contribution to my thesis. The staff at LUMC, almost literally welcomed me with open arms, and all of the people I interviewed, or observed, or even just had brainstorm sessions with, provided me with such pleasant conversations. The social interactions I experienced during my graduation were the most enjoyable moments, and I was very happy not all of them were digital, as the Covid pandemic is still very much present in the Netherlands. In the end I hope that I pleased both LUMC, TUDelft and Philips with my results and that it inspires them in future practices.

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