A visualization guided co-design technique for the implementation of health monitoring of newborn infants.

Master Thesis by Julia Broos
Strategic Product Design
TU Delft, July 2024

Chair: Dr. ir. Lianne W.L. Simonse
Mentor: MSc. Fredrik K. Karlsson
Company Mentor: MD. Josephine H.L. Wagenaar

Erasmus MC University Medical Center Rotterdam

TU Delft

Acknowledgments

With the completion of this thesis, my journey at the Delft University of Technology draws to an end. Three years ago, I enrolled the master's degree in Strategic Product Design after completing my bachelor's here in Delft and some travelling in between. Entering this direction of design, I have been consitently challenged to strive for excellence from day one. Through this journey, I have become the most hardworking version of myself. This graduation project for Erasmus MC serves as a fitting peak of my efforts. Despite the challenges, I am very grateful for this experience and proud of my achievements.

However, reaching this point would not have been possible without my supervisory team. First of all my mentor Fredrik, I can't thank you enough for your involvement and guidance throughout the project. You supported me on professional and educational level, for which I am truly grateful. I hope I can make you proud with my deliverable to this project and contribution to your own research. I wish you all the best with the remainder of your PhD.

Next, I want to thank my other mentor Josephine. Your guidance played a crucial role in helping me navigate through challenges. Whenever I found myself lost in a maze of thoughts, you provided the listening ear and clearity I needed to move forward. Your passionate attitude has been an inspiration to me and without your drive and contacts, it would not have been possible to achieve this result. I also want to thank my chair Lianne who supported me in taking the project to a higher level. Your knowledge and experience in strategic design and healthcare made me keep looking critically and able to translate knowledge to practice. I appreciate your dedicated time to brainstorm with me and listen to my ideas.

Furthermore, I want to express my gratitude to all the dedicated individuals at EMC, Amphia, and beyond for their invaluable contributions. Their insightful interviews, feedback during meetings, co-creation efforts, and proactive assistance in connecting me with the right people were essential to this project's success.

Finally, I want to express my gratitude to my family and friends for their constant support, encouragement, and belief in me, not only during this graduation project but in everything I undertake.

Thank you all for your incredible help and support. To the readers, I hope you enjoy reading my thesis!

Julia Broos
Delft, July 2024

Executive Summary

Neonatology, the medical subspecialty dedicated to newborn infant care, faces capacity issues in Rotterdam. In response, a research team from Erasmus Medical Center (EMC) in Rotterdam, in collaboration with the Amphia Hospital in Breda, launched the TeleNeo pilot project in January 2024. TeleNeo is a digital health service that establishes audio-visual communication between healthcare professionals at EMC and Amphia, providing remote medical advice to prevent unnecessary patient transfers. The pilot project represents the first use case of TeleNeonatology in the Netherlands. This study involves a collaboration between the TU Delft and EMC, serving as a qualitative analysis to prepare for TeleNeo implementation. The literature underscores common challenges that digital health solutions like TeleNeo encounter during implementation, such as conflicting stakeholder values and the necessity for alignment with both the users and broader healthcare system. Successful TeleNeo implementation in other countries depended on several factors: service design, characteristics of healthcare professionals, the implementation process, contextual factors, and inner-hospital dynamics. A critical issue identified in implementing such solutions is the lack of adaptability and insufficient proof of concept often stemming from inadequate prototyping. This can hinder their usability and effectiveness in real-world settings. Findings from stakeholder interviews revealed situation-specific barriers to the pilot's success, including difficulties in scheduling consultations, followed by unclarity in roles and responsibilities of healthcare professionals involved in the different phases of planned TeleNeo consultations. Besides, the TeleNeo pilot project is unique in its integration of diverse outcome measures, aimed at improving care experiences for individual patients, their parents, and healthcare providers. This distinctive setting calls for innovative approaches distinct from other Dutch healthcare innovations. Design practices play a pivotal role here, particularly through the use of visualizations as service prototypes by envisioning how solutions should ideally function and integrating them into existing healthcare systems.

Additionally, expert interviews and literature on co-design and visualization highlighted the benefits of involving healthcare professionals in the design process. Therefore, the proposed solution is a visualization guided co-design technique designed to address the situation-specific barriers to successful implementation. This approach involved healthcare professionals in a collaborative session centered on visualization guided activities. The goal was to facilitate meaningful discussions about TeleNeo's potential impact on the current system, specifically enhancing consultation scheduling and clarifying roles and responsibilities within planned TeleNeo consultations. Future work could involve repeating the session for scaling to a multi-center setting after the pilot and the expansion of visualization guided co-design techniques to other contexts. Overall, this study established a foundation for integrating visualization guided co-design techniques into digital health implementation, aiming to support healthcare by addressing barriers through interactive design practices.

Table of Contents

Chapter 1: Introducing the Project

This chapter serves as an introduction to the project, explaining its background, objectives and expected outcomes. It details why the project was initiated and outlines the approach using the Double Diamond Design Model.

1.1 Background

Neonatology is a medical subspecialty that focuses on the care of newborn infants, particularly those who are ill or born prematurely (Lissauer et al., 2016). In the region of Rotterdam in the Netherlands, Neonatology is facing the following challenges due to capacity issues (Erasmus MC, 2023):

- 600 NICU (Neonatal Intensive Care Unit) admissions per year
- 7100 Neonatal admissions per year
- More than 100 pregnant women denied admission to Sophia annually (Erasmus Medical Center children's hospital), due to lack of space in the NICU
- More than 1200 instances did not have a Neonatal bed available in a hospital annually

Therefore, the challenge for Neonatology in Rotterdam is about how the capacity can be managed more efficiently.

Healthcare providers are responding to this capacity issue by offering a digital health solution that is already used in other countries. Within this context, a research team from Erasmus Medical Center (EMC) in Rotterdam has been setting up a pilot in January 2024 together with the Amphia Hospital in Breda called 'TeleNeo' (Erasmus MC, 2023).

TeleNeo is a telemonitoring service in which healthcare professionals apply their expertise remotely to make better estimations of the most appropriate care location for newborn infants (Fang & Chuo, 2021). It consists of a Teladoc Health Lite 4 device, which includes a camera and video screen to make a live connection with remote healthcare professionals at other hospitals (*Figure 1*). This is the first use case in the Netherlands in which healthcare professionals utilize TeleNeonatology.

Figure 1: Device TeleNeo service (Teladoc Health, 2024)

1.2 Project Brief

Assignment

This project is a collaboration between the TU Delft and Erasmus MC, with a project setting up audio-visual communication for newborn infants at a teaching hospital in the region. When implementing digital health solutions, such as TeleNeo, challenges often arise at implementation when values clash because the digital health solution must fit with both the users of the technology and the system as a whole (Ross, 2016). What designers can do here is improving methods for moving from problem to solution in current implementation practice and create a common language among the many stakeholders. Therefore, the assignment of this project can be formulated as: *"To design and evaluate a visualization guided co-design technique to support the transition from pilot to the implementation of TeleNeonatology"*

The related research questions are:

- What are the main determinants for a successful implementation of TeleNeo in the pilot project setting?
- How can visualization support the transition from pilot to full implementation of TeleNeo?

Goal

This project aims to develop and evaluate a visualization guided co-design technique designed to provide healthcare professionals with a new perspective on the current system they are working with. The technique intends to enhance understanding and facilitate discussions about potential adjustments. Additionally, it strives to empower healthcare professionals in proactively addressing risks and engaging in problem-solving discussions, thereby mitigating potential implementation issues at an early stage. The added value of my graduation project lies in the development of this visualization guided co-design technique for the research team at Erasmus MC, serving as an additional qualitative analysis for implementation preparation, with potential integration into a scientific article for future use. The visualization guided co-design technique will be created based on insights from literature and desk research, followed by in-depth interviews with involved stakeholders. Ultimately, the co-design session for utlizing the technique will be organized in collaboration with healthcare professionals from both hospitals.

Approach

The design challenge of this project will be approached using the Double Diamond Design Model for its iterative focus (Kochanowska et al., 2021). In this model, moving from problem to solution involves undertaking diverging and converging steps (*Figure 2*). The approved project brief detailing this approach is presented in ***Appendix A***.

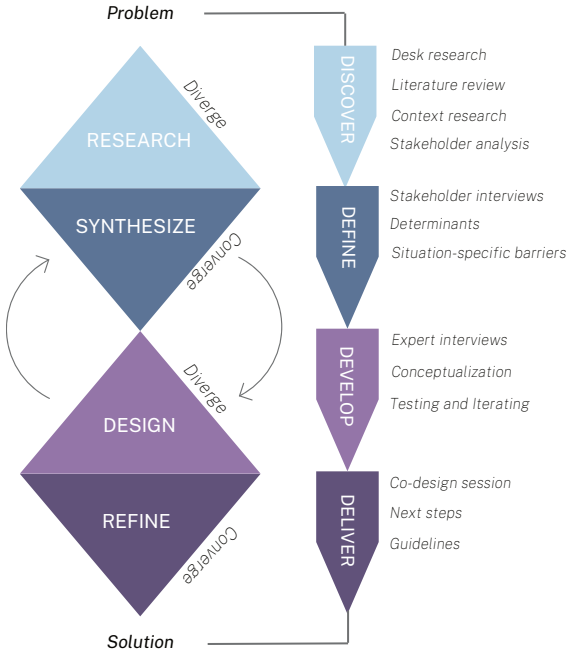


Figure 2: Project approach
Made by Julia Broos

Chapter 2: Desk Research & Literature Review

To have a complete understanding of the context of the project, desk research was conducted on the TeleNeo pilot setting. This was followed by a literature review on the relevant fields of digital health solutions, implementation and service experience to reveal challenges and possibilities. Next, prototyping as a part of the design practice was explored for its potential to address implementation issues. Based on these insights, the chapter ends with a clear direction for the project.

2.1 The TeleNeo Pilot

In the pilot project setting, the TeleNeo service is deployed between EMC and Amphia. The Teladoc Health Lite 4 Boom device is stationed at the HC (High-Care) department at Amphia, facilitating audio-visual consultations with the NICU (Neonatal Intensive Care Unit) department at EMC (Erasmus MC, 2023). This digital health service is depicted in *Figure 3*, showing a TeleNeo consultation conducted between nurses at Amphia and a Neonatologist at EMC. For this specific use-case, it's important to distinguish between the types of hospitals involved. On the one hand, Amphia can be categorized as a peripheral hospital, which serves rural or suburban areas and tends to offer a broad spectrum of healthcare services but may have fewer specialized departments and resources compared to academic hospitals (Vegting et al., 2015). Conversely, EMC can be classified as an academic hospital, affiliated with Erasmus University, and is actively engaged in medical research, education, and the training of healthcare professionals.

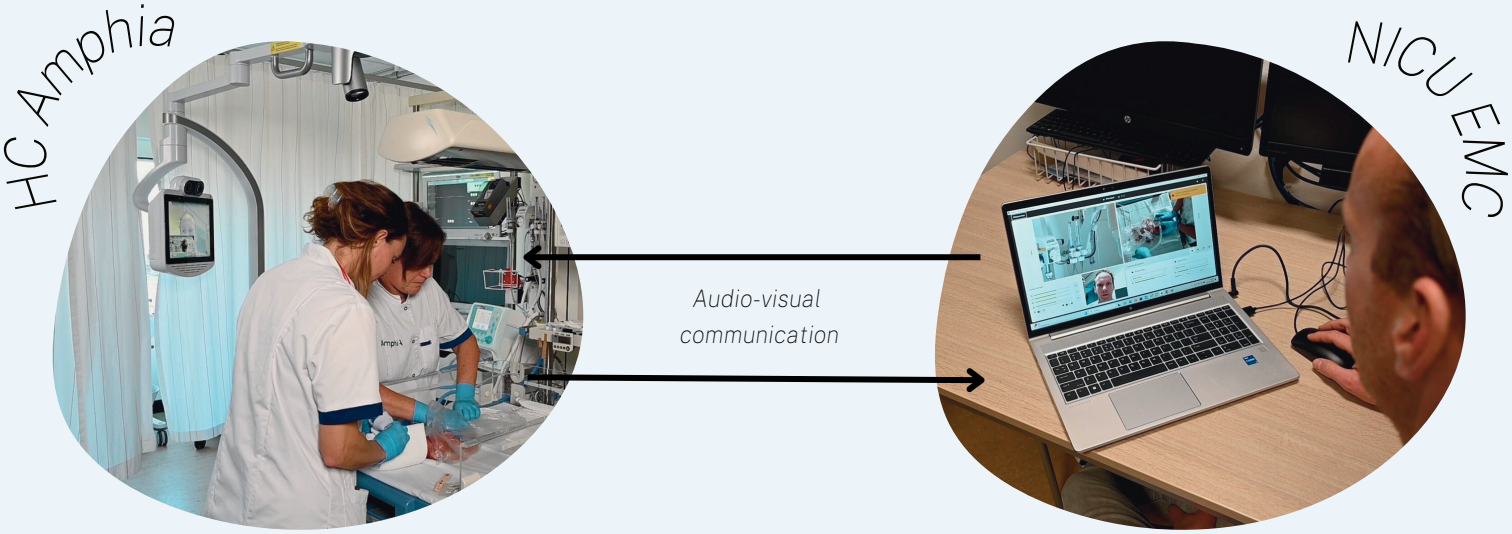


Figure 3: Service overview TeleNeo pilot
Made by Julia Broos

As a result from the pilot, the research team is striving for:

- Improvement of the quality of care for newborns (additional support in care, prevention of unnecessary transfers and care closer to home when possible)
- Positive impact on capacity (reduction in the number of NICU admissions)
- Shortened length of stay for both NICU and HC (High-Care)
- Reduced transports and cost reduction
- Enhancement of the deliverd care experience for the infant, parent(s), and healthcare professionals

The research team is already facing resistance by healthcare professionals that come with the introduction of TeleNeo. It leaves them with questions like *''What does it add?''*, *"Is it truly necessary?"*, and *"We've always done it this way"*.

Many health solutions are implemented only after proven effective enhancing patient care (survival rates, reduced diseases) in a specific context. The validity of the effectiveness of TeleNeo to the specific Dutch setting is not yet evident.

Therefore, the research team is conducting a type 3 hybrid pilot, combining implementation, service and client outcome measures; a relatively new study design in the medical field (Wagenaar et al., 2024). An overview of all types of these outcome measures is presented in *Figure 4*, based on the categorization from Proctor et al. (2010).

After completing the pilot, the research team will decide if the TeleNeo service will be first implemented in EMC and Amphia, followed by Albert Schweitzer Hospital, Maasstad Hospital, and Franciscus Gasthuis & Vlietland, using the following outcome measures (highlighted in *Figure 4*):

- Acceptability, adoption, appropriateness, and feasibility as implementation outcomes
- Safety, timeliness, and costs as service outcomes
- Symptomatology (in the form of clinical outcomes and patient reported outcome measures) as client outcomes

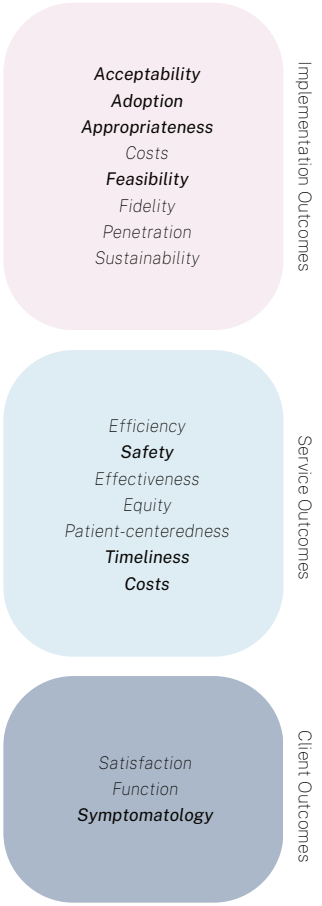
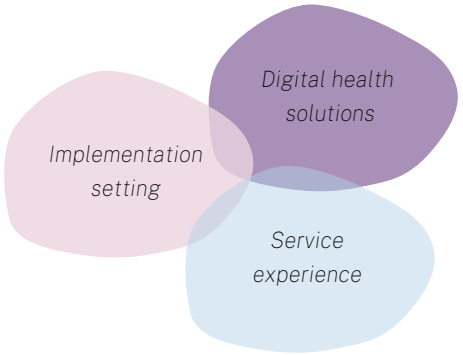


Figure 4: Types of outcomes measures
Made by Julia Broos, categorizarion based on Proctor et al. (2010)

Besides this relatively new study design in the medical field, the goal of TeleNeo is not only to improve the care for an individual patient but for parents and healthcare professionals as well (which is also quite unique as most meausures are for patients). These characteristcs contribute to the complexity of the TeleNeo pilot project.

What's next?

There are three settings that will be further explored with a literature review. To start with, there are the (complex) digital health solutions. Next, there is the implementation setting. It will be reviewed how the implementation of digital health solutions differs from other solutions and what factors influence their implementation. Since TeleNeo is a new service delivery between two hospitals, it's important to also delve into design literature on service experience.



2.2 Digital Health Solutions

Technology plays a pivotal role in the global provision and delivery of healthcare services (Lewis et al., 2012). The face of healthcare as we have known it is undergoing a profound transformation, driven by advancements in digital health (van Lettow et al., 2019). As defined by the World Health Organization (WHO), digital health encompasses ''The cost-effective and secure utilization of information and communication technologies in various health-related domains" (WHO, 2024). For healthcare services, digital health encompasses a wide array of information and communication technologies (ICT), such as health promotion apps, screening platforms, assessment tools, and therapist video-chat sessions (Stevens et al., 2019). In recent times, there has been a significant surge in the utilization of these technologies globally, driven by their numerous beneficial effects, including cost reduction and the substitution of traditional face-to-face healthcare interactions and communications (Stevens et al., 2019). This also applies to the Netherlands, where digital health has been a catalyst for change by creating digital innovations that converge care pathways with technological solutions (Wouters et al., 2019).

Within the overarching domain of digital health, we can distinguish the field of Telehealth (Bitar & Alismail, 2019). This is defined by Kruse et al. (2017) as ''The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers in all the interests of advancing the health of individuals and their communities''. This part of digital health solutions is more focused on patient delivery, including innovations such as video conferencing consultations and patients uploading images of conditions for review (Bitar & Alismail, 2019). The TeleNeo pilot project lies within this component of digital health, offering expertise about newborn infants in an audio-visual communication setting.

> *''Digital health 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 healthcare locally, regionally, and worldwide by using information and communication technology.''*
>
> *– Eysenbach (2001)*

While there is general consensus regarding the significance and potential advantages of digital health solutions, the realization of these benefits has frequently lagged behind expectations (Wachter, 2016). In reality, many Telehealth projects that introduce a complex digital health solution remain at the pilot stage and struggle to achieve sustainability within healthcare organizations (Abimbola, 2019). Complex digital health solutions contain a variety of components, including multiple behavorial, technological and organizational aspects that may act independently or interdependently (May, 2006). This distuingishes them from other solutions in healthcare. As a result, strategic design challenges are often encountered during implementation, where conflicting values of the many involved stakeholders can emerge (Norman & Stappers, 2015) and ensuring alignment with both the direct users of the digital health solution and the broader healthcare system becomes paramount (Ross et al., 2016).

2.3 Issues with Implementation

Implementation has been defined as “Any deliberately initiated attempt to introduce new or modify existing patterns of collective action in healthcare” (May et al., 2007).

2.3.1 Shift towards Implementation Science

In recent years, a notable shift has occurred in the landscape of clinical research, marked by a broader focus that extends beyond traditional considerations of internal validity (Bauer & Kirchner, 2020). Traditionally, clinical research prioritized internal validity, aiming to isolate and maximize potential treatment impact through efficacy studies (Andrade, 2015). However, the emphasis on internal validity alone fails to address the broader question of whether interventions are applicable and effective in real-world settings of health services (Curran et al., 2012). Therefore, the focus of clinical research broadened beyond solely internal validity, to also include considerations of effectiveness studies, focusing on external validity by assessing the interventions to diverse practice settings (Bauer et al., 2001).

Recognizing the limitations of effectiveness studies in ensuring routine usage of clinical innovations, the field of implementation science has emerged as a crucial bridge between research and practice (Bauer & Kirchner, 2020). As defined by Eccles and Mittman (2006), implementation science is ''The scientific study of methods to promote the systematic uptake of research findings and evidence-based practices (EBP) into routine practice to enhance the quality and effectiveness of health services''. This field incorporates a scope broader than traditional clinical research, focusing not only at the patient level but also at the provider, organization, and policy levels of healthcare (Rabin & Brownson, 2012). Hence, implementation research necessitates transdisciplinary teams comprising individuals not typically involved in standard clinical trials, such as health services researchers, designers, economists, sociologists, anthropologists, organizational scientists, and operational partners, which may include administrators, frontline clinicians, and patients (Grol et al., 2005).

In contrast to clinical research, which typically centers on assessing the health impacts of an EBP, implementation studies usually prioritize examining the rates and quality of EBP utilization rather than its effects (Woltmann et al., 2012). Within digital health, these EBPs can range from relatively straightforward interventions, such as using wearable technologies like smartwatches and fitness trackers, to more intricate strategies like digital tools to remotely monitor patients' health status (Bauer & Kirchner, 2020). Additionally, they may encompass complex interventions like digital therapeutics or integrating AI algorithms and machine learning models into digital health systems (Grol et al., 2005).

The integration of theories, models, and frameworks is fundamental to the advancement of implementation science (Straus et al., 2009). These tools serve three overarching aims: describing and guiding the translation process, understanding the factors influencing implementation outcomes, and evaluating implementation efforts (Sales et al., 2006).

Across five categories—process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks—implementation science draws upon diverse theoretical foundations to inform and guide implementation strategies.

2.3.2 Implementation Strategies

Implementation strategies constitute the "how to" of changing healthcare practice (Proctor et al., 2013) and can be defined as ''Methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical program or practice'' (Curran et al., 2012). They are typically (a) multi-component and (b) must adapt to local contexts, comprising specific means or methods for adopting and sustaining interventions. Common examples encompass strategies aimed at the provider level, such as education/training, audit-feedback, and performance incentives (Kirchner et al., 2014). At the team or clinic levels, strategies may involve Quality Improvement (QI) techniques or other efforts in systems redesign, team-based performance incentives, learning collaboratives, or community engagement (Waxmonsky et al., 2014).

A well-designed implementation strategy becomes particularly crucial for complex interventions, such as digital health solutions, as they involve multiple behavioral, technological, and organizational components that may act independently or interdependently, and it is often difficult to tease out the relationships between them (May, 2006). By addressing potential barriers and enablers, implementation strategies can facilitate the integration of innovations into practice settings, ultimately enhancing patient care and outcomes (Ross et al., 2018).

2.3.3 Service Experience

As outlined in *Section 2.1*, the initiated TeleNeo project by the research team aims at delivering a new service between two hospitals within Dutch healthcare. How the new TeleNeo service is experienced by the users (healthcare prefessionals from EMC and Amphia) and other stakeholders will play an important role in the implementation. In the field of service design, a service experience refers to ''The overall journey and interaction that a customer or user has while engaging with a particular service.

It encompasses every touchpoint and interaction, from initial awareness or need recognition through the actual delivery of the service and any follow-up or support provided afterward'' (Zomerdijk and Voss, 2010). Within the service experience, touchpoints represent the moments of interaction between a service provider and its customers, shaping the customer's perception of the offering (Lusch & Vargo, 2004). Throughout their journey, customers engage with various touchpoints, often in different combinations. These touchpoints play a central role in crafting the overall customer experience and delivering value. As highlighted by Clatworthy (2012), touchpoints serve as the stages where this value is exchanged, being the points of actual utilization and therefore emerging as key elements of service design. In addition to incorporating every touchpoint and interaction, a service experience also extends beyond individual exchanges to incorporate the entirety of the customer journey (Fortini-Cambell, 2003). This includes pre-service interactions such as marketing and advertising efforts that shape customers' expectations and perceptions before they even engage with the service.

Furthermore, post-service interactions, such as customer support and follow-up communication, are crucial components of the service experience as they contribute to customer satisfaction and loyalty. Moreover, the emotional aspect of the service experience plays a significant role in shaping customers' perceptions and memories of the service encounter (Umasuthan et al., 2017). Positive emotional experiences, such as feeling valued or understood, can enhance customer satisfaction and loyalty, while negative emotions, such as frustration or disappointment, can lead to dissatisfaction and attrition.

In service design, there is a focus on understanding and optimizing every aspect of the service experience to ensure that it meets the needs and expectations of users while also aligning with the goals of the service provider (Penin, 2018b). This may involve research, user testing, prototyping, and ongoing evaluation to continuously improve and refine the service experience over time. In the context of healthcare, hospitals are increasingly embracing the service design field as a means to comprehend and enhance the patient experience (Foley, 2018).

The principles of service design provide a framework for enhancing the service experience by creating user-centered, holistic, and value-driven solutions (Stickdorn et al., 2018). Key principles include:

- **Human-centered**: the experience of all the people that are affected by the service is considered
- **Collaborative**: stakeholders of various backgrounds and functions are activaly engaged in the service design process
- **Iterative**: service design is an adaptive, exploratory and experimental approach, iterating toward implementation
- **Sequential**: the service is visualized and orchestrated as a sequence of interrelated actions
- **Real**: needs are researched in reality, integaible values are evidenced as physical/digital reality and ideas are prototyped in reality
- **Holistic**: the service sustainably addresses the needs of all stakeholders through the entire service and across the business

In summary, service design is a strategic approach that guides the creation of user-centric services, aiming to deliver value, foster innovation, collaboration, and positive outcomes for all stakeholders involved. The research team is piloting new outcome measures in the medical field to enhance the care experience for patients, parents, and healthcare professionals, making the transition from pilot to implementation crucial and demanding a different approach. This is where my contribution as a strategic designer comes into play. By taking a service design perspective and applying human-centered principles, collaborative methodologies and iterative processes, I can contribute to the TeleNeo pilot from the strategic design field by supporting the research team in creating a service that enhances the experience of care delivery with TeleNeo for newborn infants, parents and heathcare professionals from EMC and Amphia.

2.3.4 Influencing Factors

To start with, literature on digital health solutions was reviewed for factors that influence their implementation. Next, I looked into their implementation from a design perspective.

As a result, design literature from Bolton et al. (2018) and Wong (2004) on the experience of a service and my own field as a strategic designer were taken into account for reviewing influencing factors on service experience and creating changes within existing services/systems. This resulted in in the creation of *Figure 5* on the following page, outlining influencing factors on the implementation of digital health solutions by combining the three distinct streams. For categorization, I referred to the work of Ross et al. (2016), who distinguish between: Intervention Characteristics, Inner Setting, Outer Setting, Process, and Characteristics of Individuals. By critically reviewing these categories, there was a need for adding an extra category for ''Technology'' to enhance the depth of the analysis. Moreover, a category for ''Experience'' was added to capture factors that resulted from design literature on service experience. Additionally, some of the original categories were rephrased so they connect more with the fields of service experience and strategic design. This resulted in the following adjustments:

- Intervention Characteristics ⟶ Type of Design
- Outer Setting ⟶ Context
- Process ⟶ Implementation Process

The influencing factors from each stream — implementing digital health solutions, service experience, and strategic design — are incorporated into my own map and labbeled under the appropriate category.

Stream 1: Implementing Digital Health Solutions

In work from Ross et al., (2016), factors that influence the implementation of digital health solutions are examined, utilizing five distinct factor categories. The resulting determinants for digital health implementation are supported by work from other researchers, such as Greenhalgh et al. (2017).

Stream 2: Service Experience

A service experience is shaped by various factors. This includes not only the tangible elements such as the physical environment where the service is delivered, but also the digital interfaces through which interactions occur, and the quality of engagement with service personnel, as highlighted by Bolton et al. (2018). Moreover, intangible aspects such as the ease of use, perceived value of the service, emotional connection, and ultimately, the overall outcome or result achieved by the user, all collectivaly contribute to the holistic experience of a service (Wong, 2004).

Each of these components interact dynamically to influence the overall impression and effectiveness of the service, underscoring the multifaced character of service experiences.

Stream 3: Strategic Design Field

In my experience with design projects aimed at service or system changes, key factors included:

- Current trends and developments in and outside the product/service domain
- Stakeholder engagement throughout the design process
- Broader contextual analysis, including potential conflicts or integrations with existing services/systems
- User-centered focus on perceived needs, values, and risks
- Prototyping to communicate ideas to stakeholders
- Utilization of available resources, knowledge, and partnerships
- Ethical considerations like privacy, sustainability, and inclusivity
- Organizational readiness for change

Figure 5: Map of factors influencing the implementation of digital health solutions
Made by Julia Broos

2.3.5 Determinants for Implementing TeleNeo

Within the domain of factors that influence the implementation of digital health solutions, the created map of *Figure 5* calls for an converging analysis on TeleNeo as a digital health solution and its specific determinants for implementation. "Determinants" is a widely recognized term in implementation, referring to factors that can either facilitate or hinder the process of implementing a specific intervention, policy, or program (Waltz et al., 2019). Since the TeleNeo pilot is the first use case with TeleNeonatology in the Netherlands, implementation determinants from other countries served as guidelines. This resulted in the first stream of determinants, combining work from Fang et al. (2018), Jagarapu & Savani (2021) and Makkar et al. (2021). Next, determinants from design literature on implementing digital services in healthcare were reviewed, combining work from (Nadav et al., 2021b) and (Shaw et al., 2018b). This resulted in the second stream of determinants. The determinants from both streams were incorporated in the created map of *Figure 6*, using revised and specified categories of the map of *Figure 5*. The ''Technology and ''Experience'' categories were covered by the renamed categories.

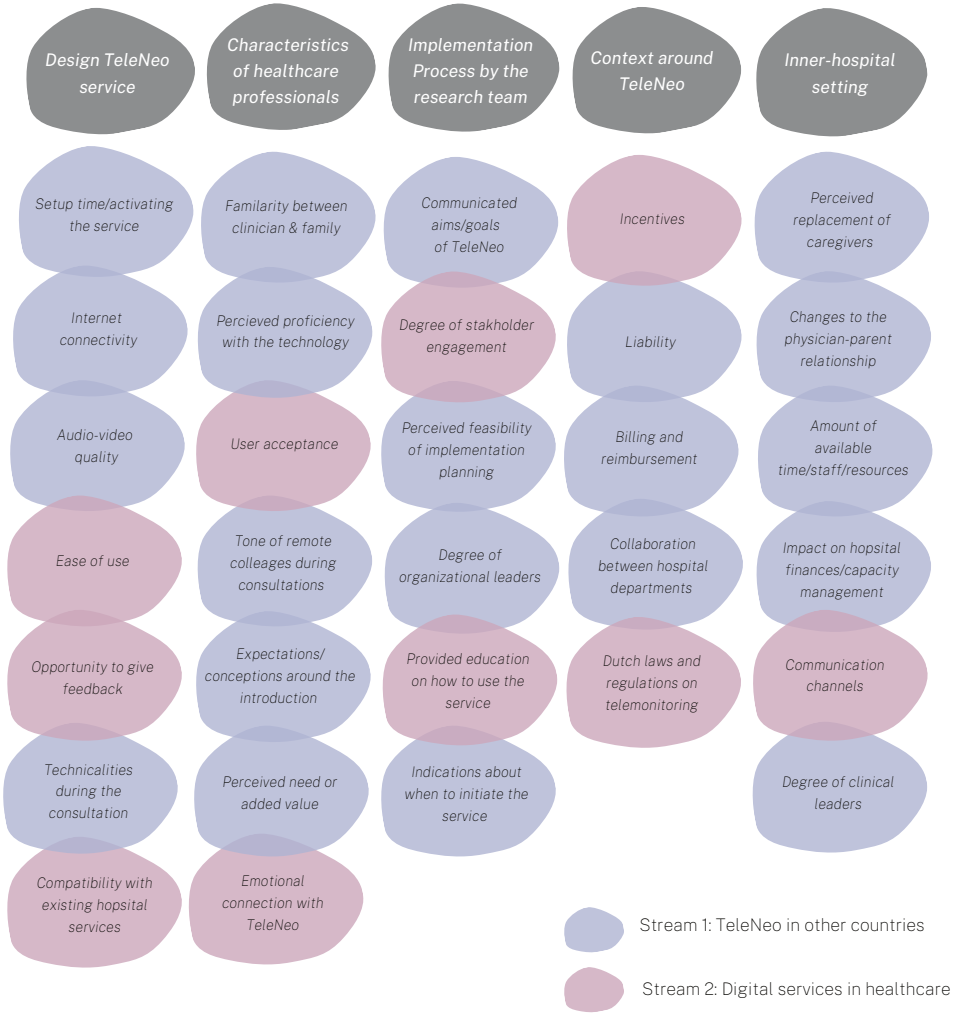


Figure 6: Determinants for TeleNeo implementation
Made by Julia Broos

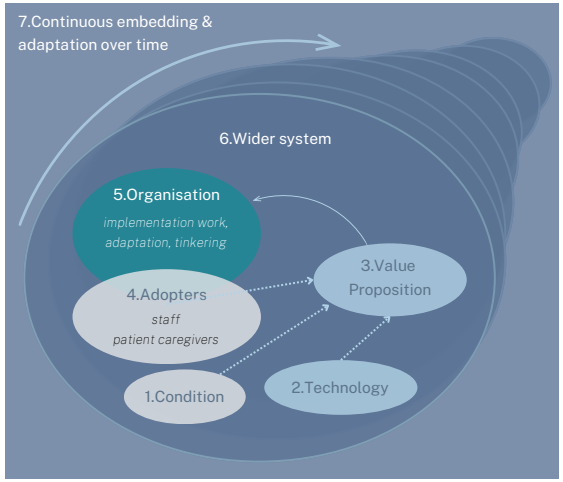
2.3.6 NASSS

A well-established framework used in implementation science is the NASSS framework for considering influences on the nonadoption, adoption, scale-up, spread and sustainability of patient-facing health and care technologies (Greenhalgh et al., 2017). This includes a list of questions in the following domains: the condition or illness, the technology, the value proposition, the adopter system, the organization(s), the wider (institutional and societal) context, and the interaction and mutual adaptation between all these domains over time.

To get a better understanding of the TeleNeo pilot and add an exploratory analysis to the literature review, a member of the research team and I filled out the list of questions provided by NASSS. The key insights per domain are presented in *Figure 7*.

7. EMBEDDING & ADAPTATION OVER TIME

Domains 1-4 are likely to change significantly within the next 3-5 years in terms of a new way of neonatal care delivery in The Netherlands, new technological add-ons of the device, more use-cases with TeleNeo, proof of validity, and integration of TeleNeo into workflows



6. WIDER SYSTEM/CONTEXT

Reaching full potential of TeleNeo (providing NICU level III care at level II centers under supervision/guidance from NICU level III) is limited by official Dutch guidelines

5. ORGANISATION

Mainly financial obstacles; what will TeleNeo do to our hospital finances/capacity management?

4. ADOPTERS

The clinicians can have a feeling of "being looked on their fingers" by the video consultations

1. CONDITION/ILLNESS

The provided care at the NICU will become more specialized, with for instance the expected shift to caring for >23 weeks instead of >24 weeks

2. TECHNOLOGY

The technology of TeleNeo will probably improve/evolve and new functionallities could be added to the service

3. VALUE PROPOSITION

- *Validity of efficacy + efficiency in international literature to the pilot setting is unclear*
- *New potential use-cases can be developed*

Figure 7: Scanning NASSS domains for the TeleNeo pilot
Made by Julia Broos

2.4 Opportunity for Design Practice

One prominent issue with implementing digital health solutions that is noted by Greenhalgh et al. (2017) is the lack of adaptability and insufficient proof of concept often stemming from inadequate prototyping. This failure to thoroughly test and refine digital health solutions within real-world contexts can hinder their usability and effectiveness. In response, there is an opportunity for design practice to play a pivotal role (Karlsson et al., 2024). Among design practices, ''Interaction Design'' and ''Service Design'' are particularly relevant for scaling up TeleNeo. As previously mentioned, the quality of a service experience is influenced by several factors: the physical environment, digital interfaces, interactions with service personnel, ease of use, perceived value, emotional connection, and the overall outcome achieved by the user. Interaction Design specifically focuses on creating engaging and intuitive user experiences, ensuring that digital health solutions like TeleNeo are user-friendly and effectively meet the needs of all stakeholders (Löwgren & Stolterman, 2007).

Service Design, on the other hand, focuses on creating cohesive and comprehensive service experiences, which is essential for the successful implementation of TeleNeo in the healthcare system (Secomandi & Snelders, 2011). Both Interaction Design and Service Design incorporate prototyping as a fundamental aspect of their design process, allowing designers to create tangible representations of their ideas and concepts.

Complex interventions like TeleNeo, also decribed as ''wicked'' problems by May (2006), present challenges that traditional scientific methods struggle to address (Rittel & Webber, 1973). The unique project setting of the TeleNeo pilot (combining different types of outcome measures, together with striving for an improvement in care of an individual patient, parents and healthcare professionals) is asking for a different approach compared to other innovations in Dutch healthcare. Design practices, supported by Cross (1982) and Buchanan (2009), offer a means to approach these complexities by envisioning how solutions should ideally function and integrating them into existing healthcare systems.

In the realm of digital health implementation, this involves not only developing the solution but also navigating the changes it brings to the healthcare landscape (Simon, 1996) and understanding the nuanced contexts of systems, which is essential for efective implementation (Norman & Stappers, 2015). This underscores the potential of integrating prototyping as a part of design practice into digital health implementations like TeleNeo to address challenges, envision the new service and navigate changes to the existing healthcare system (Camburn et al., 2017). Therefore, prototyping will be discussed in the upcoming section to further explore its potential for TeleNeo implementation.

2.4.1 Prototyping

A prototype is "An artifact that approximates a feature (or multiple features) of a product, service, or system" (Otto & Wood, 2000). An overview of different types of prototypes used in design practice is presented in *Figure 8,* based on my own experience as a designer and work from Lim et al. (2008b) and Wensveen & Matthews (2014b).

Type	*Purpose*
Low-Fidelity	Simple and rough representations of a design to explore ideas, concepts, and layout
High-Fidelity	Closely resembles the final product in terms of appearance, functionality, and interaction
Interactive	Allows users to interact with the design and simulate real-world interactions and behaviors
Functional	Simulates the functionality of a product or system
Visual	Focuses on the visual aspects of a design, such as layout, typography, and branding
Physical	Tangible representations of a product or system
Proof-of-Concept	Demonstrates the feasibility of a design concept or technology
Virtual Reality (VR) or Augmented Reality (AR)	Simulates the user experience in a virtual or augmented environment

Figure 8: Prototypes in design practice
Made by Julia Broos

Prototypes serve as tools for exploring various functionalities, user interfaces, and interactions in a controlled environment before full-scale implementation (Houde en Hill, 1997). They facilitate early identification of potential issues and shortcomings, allowing designers to make necessary adjustments and improvements before significant resources are invested in implementation. By creating tangible representations of solutions, designers can test and refine their designs iteratively (Wensveen & Matthews, 2014). This iterative approach enables rapid experimentation and refinement, addressing usability and proof of concept concerns as raised by Greenhalgh et al. (2017). Moreover, prototyping fosters collaboration and co-creation among multidisciplinary teams, including healthcare professionals, engineers, and end-users (Rodríguez-Calero et al., 2020). By involving stakeholders in the prototyping process, designers can leverage their expertise and insights to inform design decisions, ultimately leading to solutions that are more aligned with stakeholder needs and workflows (Coulentianos et al., 2022).

2.4.2 Potential of Visualizations

One notable area within prototyping with untapped potential for addressing barriers in implementation is the utilization of visualizations (Karlsson et al., 2024). Prototyping and visualization are closely intertwined aspects of the design process, each serving distinct yet complementary purposes. Just as physical prototypes offer tangible representations of product designs, visualizations provide concrete depictions of service concepts and interactions (Padilla et al., 2018). Interactions within the context of prototyping and visualization refer to the dynamic exchanges that occur between users and a product or service (Holmlid, 2007). These interactions are essential as they define how users engage with and experience a design, ultimately influencing its usability, effectiveness, and satisfaction. In the realm of services, interactions extend beyond digital interfaces to include human-to-human and human-to-environment interactions. Visualizations in service design prototypes can map out entire service ecosystems, showing how users interact with different touchpoints, what their experiences look like at each stage, and how various components of the service are interconnected.

Through prototypes and visualizations, designers aim to translate abstract ideas into tangible forms that can be understood and evaluated by others. Prototypes, as explained in the previous section, serve as concrete manifestations of design concepts, providing stakeholders with tangible examples of how a product or service will work in practice. Visualization, meanwhile, helps designers communicate their ideas effectively, using visual elements such as diagrams, sketches, and renderings to convey complex concepts and design decisions (Gebhardt & Krause, 2015). Moreover, differentiating between boundary objects within the context of prototyping and visualization can further enhance the design process. A boundary object is defined as ''An entity shared by several different communities but viewed or used differently by each of them, being both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites'' (Star and Griesemer, 1989). In general, any artifact that is shared between two or more actors at the border of two social worlds can be regarded as a boundary object.

In the context of prototyping, boundary objects may include physical prototypes that allow designers, engineers, and end users to collaborate and communicate effectively (Subrahmanian et al., 2003). These prototypes serve as common reference points that facilitate shared understanding and alignment among stakeholders. Similarly, in the realm of visualization, boundary objects may take the form of visual representations such as diagrams or sketches that help bridge gaps between different stakeholders' perspectives or requirements (Klerkx et al., 2012). These visual artifacts provide a common language for communication and collaboration, enabling stakeholders to contribute their insights and perspectives (Cronan et al., 2022).

Given this transformative potential of visualizations, employing them as a method for service prototyping during the transition from the TeleNeo pilot to full implementation becomes a strategic approach. Integrating visualization into this process offers healthcare professionals a fresh perspective on their daily engagement with the current system.

By facilitating stakeholder discussions, visualizations enable exploration of potential system changes and assessment of the new service's impact. Interactive visualization practices further enhance this process by simulating real-world scenarios. This hands-on approach allows stakeholders to directly experience and analyze the effects of proposed changes. Such engagement not only identifies areas for improvement but also deepens understanding of the system's dynamics. In fostering a collaborative and interactive environment, visualization empowers healthcare professionals to proactively identify and mitigate risks early on, with support from the research team. This proactive approach ensures that potential issues are addressed preventively, enhancing the overall effectiveness of the TeleNeo implementation process.

2.4.3 Existing Visualization Techniques

By looking at well-established existing visualization techniques for mapping services/systems, an overview is created including a description, purpose, required input, and resulting output for each of the techniques (*Figure 9*). After completing the research phase of the project, this overview will be used to decide whether an existing visualization technique (or elements) fit the unique setting of the pilot and can be used as a starting point for designing the visualization guided co-design technique.

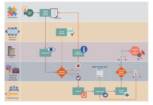
	Description	*Purpose*	*Input*	*Output*	
Journey Mapping *(McCarthy, 2020)*	Illustrating the step-by-step experiences and interactions a customer or user has with a product, service, or brand over time	Understanding the customer experience by highlighting painpoints, moments of delight and identifying opportunities for improvement	The steps, interactions, and emotions experienced by users as they engage with a product, service, or process	A holistic view of the steps and interactions that is experienced throughout the journey with a product, service, or organization	
Service Blueprinting *(Bitner et al., 2008)*	A detailed depiction of the end-to-end service delivery process, encompassing both front-stage and back-stage activities	Design seamless service experiences, align internal processes with customer needs, and identify opportunities for innovation or service enhancements	Scenario, customer/user steps, touchpoints, front-end actions, back-end actions, other supporting processes	Interactions between service providers, customers, and support systems across various touchpoints	
Ecosystem Mapping *(Nahuelhual et al., 2016)*	Visualizing the interconnected network of actors, entities, and elements that constitute a particular ecosystem	Gaining a holistic understanding of complex systems, fostering collaboration and informing strategic decision-making	Exchanges of goods and services, financial transactions, data sharing, knowledge transfer, and communication channels	The interactions and flows of resources, information, and value within the ecosystem.	
Process Mapping/Modelling *(Jun et al., 2009)*	Visualizing the sequence of activities, tasks, and workflows involved in completing a specific process or operation	Understanding a process to identify areas of improvement and help document existing or planned processes to ensure a shared understanding	Activities and their sequence, decision points, inputs, outputs, roles, and dependencies within the process	An overview detailing all activities encompassed within a specific process, showing their interconnections and dependencies	
Metro Mapping *(Stiggelbout et al., 2023)*	Mapping out the complexity of a medical care pathway with the use of co-design, inspired by a Metro Map	Design and optimize care pathways by assisting with value creation, shared decision making and multidisciplinary collaboration	5 layers: Metro, Information, Companies, Context, Experience	An overview of steps in the care pathway, information for the patient, involved healthcare professionals, environment and the experiences of patients	

Figure 9: Overview visualization techniques for mapping services/systems
Made by Julia Broos

In addition to this overview, a perceptual map is created to assess the existing visualization techniques (*Figure 10*). In this map, distinction is made between the focus of the visualization technique (internal vs. external) and level of user experience (detailed vs. holistic).

On the horizontal axis, internal focus pertains to the method's concentration on internal aspects of an organization like processes, structures, and resources, aiming to optimize internal operations. Conversely, external focus involves looking outward to factors such as customer needs, market dynamics, and ecosystem interactions to understand the broader context in which the organization operates and interacts with its environment.
On the vertical axis, detailed user experience focuses on understanding specific aspects of the user journey, like individual touchpoints and interactions, to analyze and improve them thoroughly. In contrast, holistic user experience considers the entire user journey, encompassing multiple touchpoints, interactions, and stakeholders to comprehend the overall user experience .

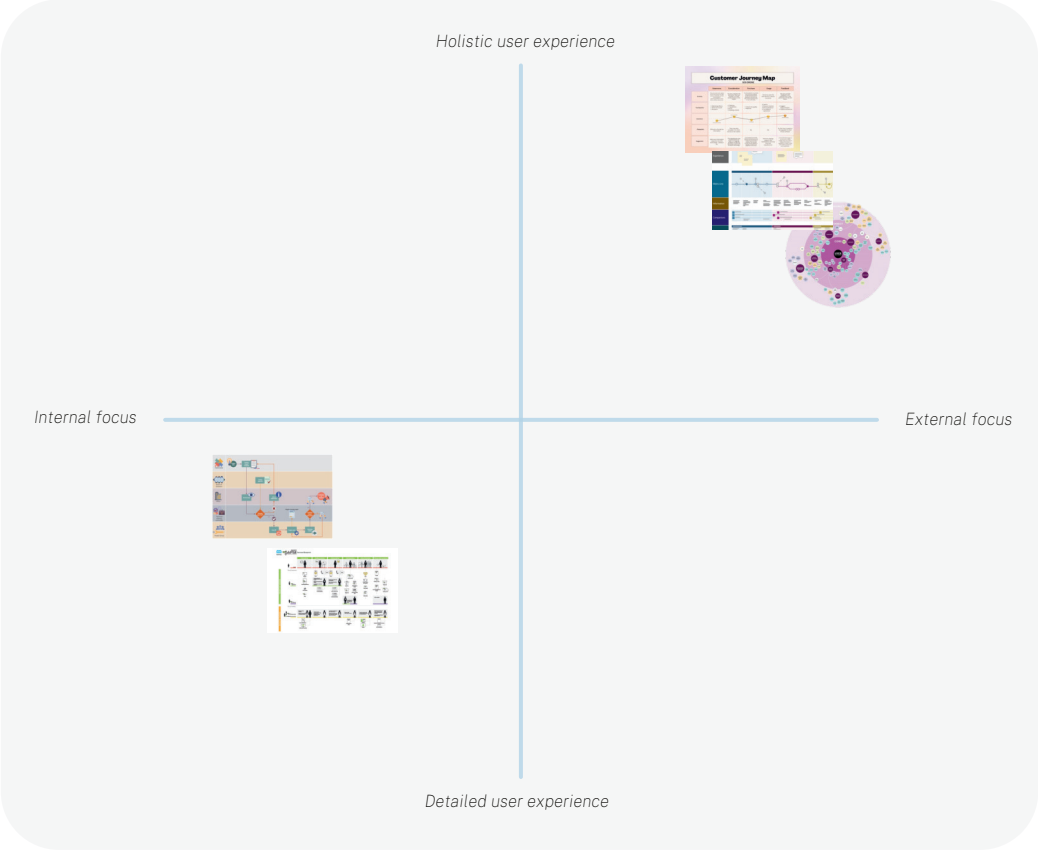


Figure 10: Perceptual map visualization techniques
Made by Julia Broos

2.4.4 Visualizations in Practice

Visualizations are powerful tools used across various disciplines to make complex information more understandable and accessible. They can be applied in both static contexts and dynamic, interactive settings such as co-design sessions (Mahajan & Gokhale, 2018). In static contexts, visualizations serve as tools to present information clearly and concisely. They are commonly used in reports, presentations, and dashboards to convey data to stakeholders in a way that is easy to interpret. This capability enhances communication and understanding among stakeholders, ensuring that complex information is presented clearly and comprehensibly. In interactive settings, visualization guided sessions leverage the interactive and participatory nature of visualizations to engage participants in collaborative problem-solving and decision-making processes (Heer et al., 2010). Actively engaging stakeholders in co-design sessions promotes ownership and buy-in, fostering a strong sense of commitment to the outcomes among participants. This involvement increases the likelihood that stakeholders will support and implement decisions made during the sessions.

Furthermore, co-design sessions utlizing visual mediums serve as effective platforms for problem-solving, enabling participants to collectively address concerns and brainstorm solutions (Bresciani & Eppler, 2009). The interactive nature of visual tools in these sessions can uncover practical insights that might otherwise be overlooked in static presentations. Ultimately, co-design sessions supported by visual aids not only enhance decision-making processes but also strengthens teamwork and alignment among participants.

2.5 Conclusion

As a result from the desk research, it became clear that for the project setting of the TeleNeo pilot, the research team is combining implementation, service, and client outcome measures, a relatively new study design to the medical field. Next to this, they are not only striving for an improvement in care delivery of an individual patient, but for parents and healthcare professionals as well. Therefore, the transition from pilot to implementation is crucial and needs to be approached differently compared to other innovations in Dutch healthcare.

During the literature review, the settings of digital health solutions, implementation and service experience were explored. This revealed that complex interventions, such as digital health solutions, consist of a variety of independently or interdependently acting components, setting them apart from other solutions in healthcare. They often remain at the pilot stage and struggle to achieve sustainability within healthcare organizations. This is mainly due to conflicting values among the many stakeholders and misalignment with both the direct users of the digital health solution and the broader healthcare system.

Next, factors that influence the implementation of digital health solutions were incorporated into a map by combining the streams of implementing digital health solutions, service experience, and strategic design. A categorization of *Type of Design, Characteristics of Individuals, Technology, Implementation Process, Context, Inner setting, and Experience* was used. Looking at the implementation of TeleNeonatology in other countries and design literature on implementing digital services in healthcare, specific determinants for the implementation of TeleNeo were identified as an converging analysis. Additionally, an exploratory analysis was conducted by filling out the list of questions by NASSS, considering influences on the nonadoption, adoption, scale-up, spread, and sustainability of TeleNeo.

Although the emerging field of implementation science offers strategies to respond to these factors influencing digital health implementation, I saw an area with untapped potential in implementation: designing visualizations as protoypes for systems/services.

Visualizations hold promise in simplifying complex information, enhancing understanding, and fostering communication among stakeholders. They serve as powerful tools in both static contexts, such as reports and presentations, and dynamic, interactive settings like co-design sessions. In co-design sessions, visualizations actively engage participants in problem-solving and decision-making, promoting ownership and consensus-building while improving communication and understanding among stakeholders. This approach not only enhances healthcare professionals' understanding of service design opportunities but also facilitates the identification of areas for improvement. By serving as a reflective tool to identify and address potential issues early on, visualization in an interactive setting has a potential role in supporting stakeholders' uptake of TeleNeo implementation.

Chapter 3: Stakeholder- & Context Analysis

This chapter starts with an overview of the involved stakeholders for the TeleNeo pilot. Next, their relationships and interactions were mapped in two different stakeholder maps and it was decided which stakeholders needed to be interviewed. Additionally, to immerse myself in the context of the pilot, I visited the NICU at Erasmus Medical Center in Rotterdam and the HC at the Amphia hospital in Breda. The chapter ends with providing information on the interviews, followed by a Thematic Analysis on the obtained data and offers direction to the visualization guided co-design technique based on insights from the analysis.

3.1 Identifying Stakeholders

Identifying stakeholders within the context of the TeleNeo pilot project is an important step to recognize all individuals, groups, or organizations that may have an interest or influence in its implementation and outcomes. A combination of input from the research team and desk research resulted in the initial clustering of involved stakeholders for the TeleNeo project as presented in *Figure 11*. To be able to see their relationships and interactions, stakeholder mapping will be conducted in the upcoming section.

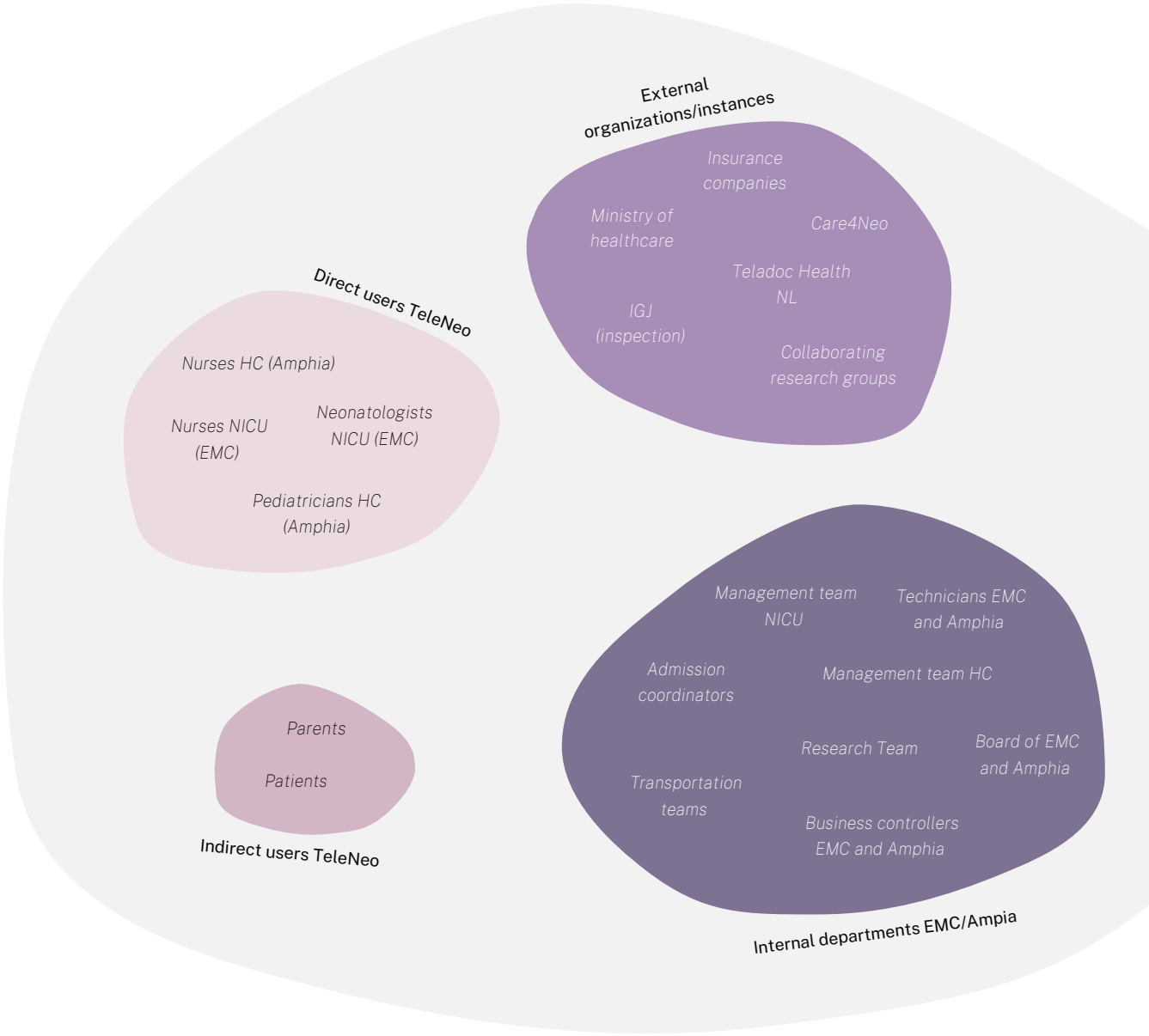


Figure 11: Overview involved stakeholders TeleNeo pilot
Made by Julia Broos

3.2 Stakeholder Mapping

Stakeholder mapping involves identifying the enablers and barriers of stakeholder participation (Mainardes et al., 2012). By using the stakeholders that were pointed out in *Figure 11*, I created my own stakeholder map for the TeleNeo pilot that is presented in *Figure 12*. In this map, three layers are included to reveal the participation in the TeleNeo pilot of the different stakeholder goups:

- Core Team: direct users of the digital health service and/or driving force behind the project
- Involved: no direct users of the digital health service, but highly involved in the TeleNeo pilot due to their important role within hospital departments or external organizations
- Informed: no direct users of the digital health service and not really involved in the TeleNeo pilot. However, these organizations/instances are informed about the project and have an influence on the implementation

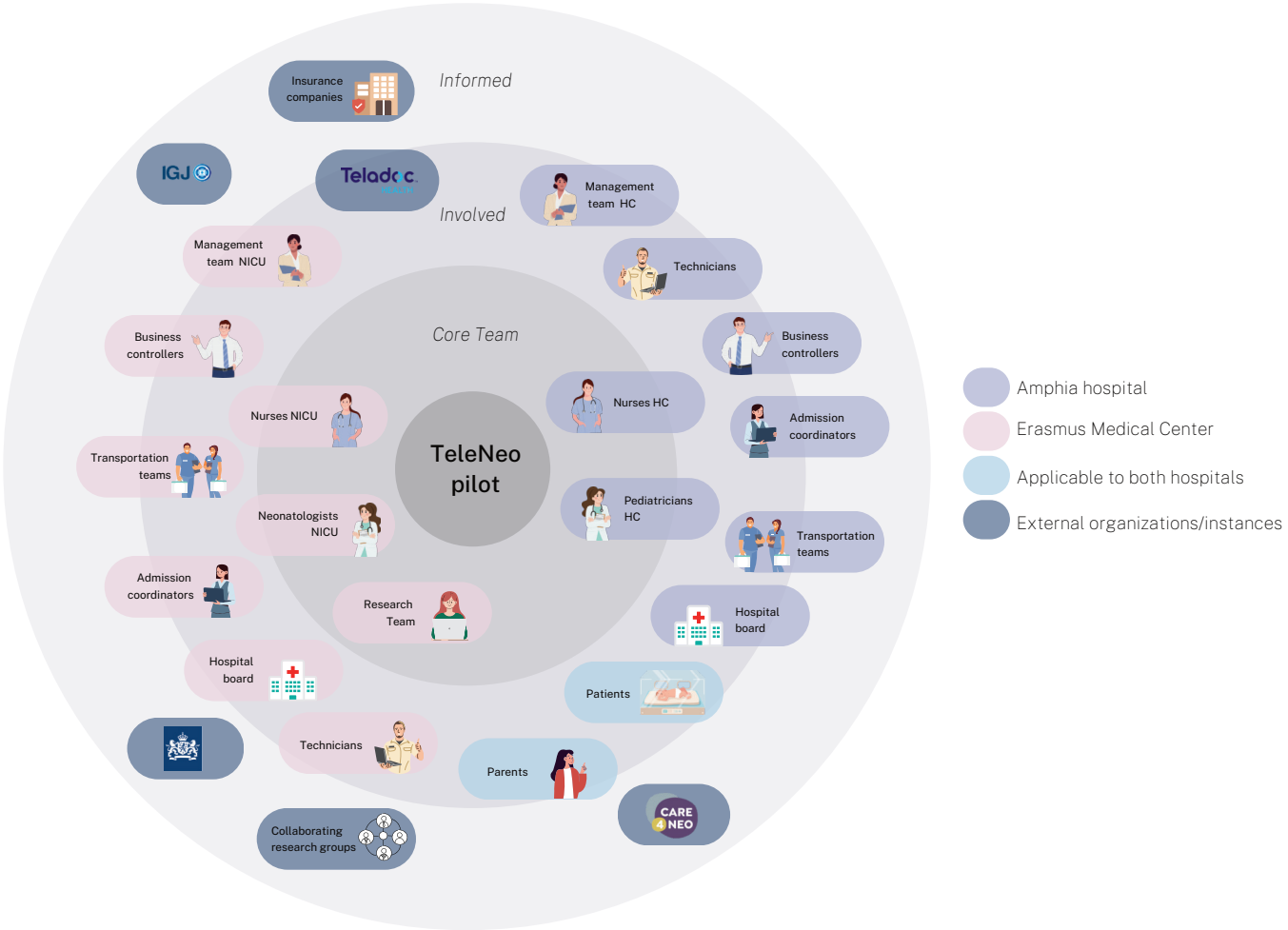


Figure 12: Stakeholder map 1
Made by Julia Broos

As an addition to the stakeholder map of *Figure 12*, I looked into well-established models for mapping stakeholders in literature. A framework that supports the analysis of the stakeholders' power while recognizing their legitimacy and urgency (all of which are relevant in healthcare prioritization), such as the salience stakeholder analysis framework, provides a more comprehensive analysis compared to other existing stakeholder mapping frameworks (Kapiriri & Razavi, 2021). Therefore, I also applied the salience stakeholder analysis framework for the TeleNeo project to create a comprehensive overview of the involved stakeholders.

This model was introduced by Mitchell et al. (1997), who organize stakeholders based on three key attributes: legitimacy, power, and urgency. This framework defines the following attributes:

- Legitimacy as the perception that an entity's actions are appropriate and acceptable within a given social context
- Power as the ability of one actor to influence the actions of another, often to compel them to act in a way they otherwise would not
- Urgency as the extent to which stakeholder claims require immediate attention, whether due to time sensitivity or criticality

Salience, which refers to the prioritization of conflicting stakeholder demands, is determined by these attributes. Within this framework, a typology was devised that classifies stakeholders based on whether they possess one, two, or all three attributes, facilitating the recognition of latent, expectant, and definitive stakeholders. The identified stakeholders of the TeleNeo pilot in *Section 3.1* are labeled under the corresponding typology in *Figure 13*.

Stakeholder class	***Typology***	*Attributes*	***Stakeholder TeleNeo pilot***
Latent	***Dormant*** ***Discretionary*** ***Demanding***	Power Legitimacy Urgency	***Ministry of healthcare, IGJ, Insurance companies*** ***Collaborating research groups, Transportation teams*** ***Parents, Patients***
Expectant	***Dominant*** ***Dangerous*** ***Dependent***	Power & Legitimacy Power & Urgency Legitimacy & Urgency	***Board of EMC & Amphia, Management team NICU & HC*** - ***Admission coordinators, Care4Neo, Business controllers EMC & Amphia, Technicians EMC & Amphia, Teladoc Health NL***
Definitive	***Defintive***	Power, Legitimacy, Urgency	***Neonatologists NICU, Nurses NICU, Pediatricians HC, Nurses HC, Research Team***

Figure 13: Salience stakeholder framework for TeleNeo pilot
Made by Julia Broos

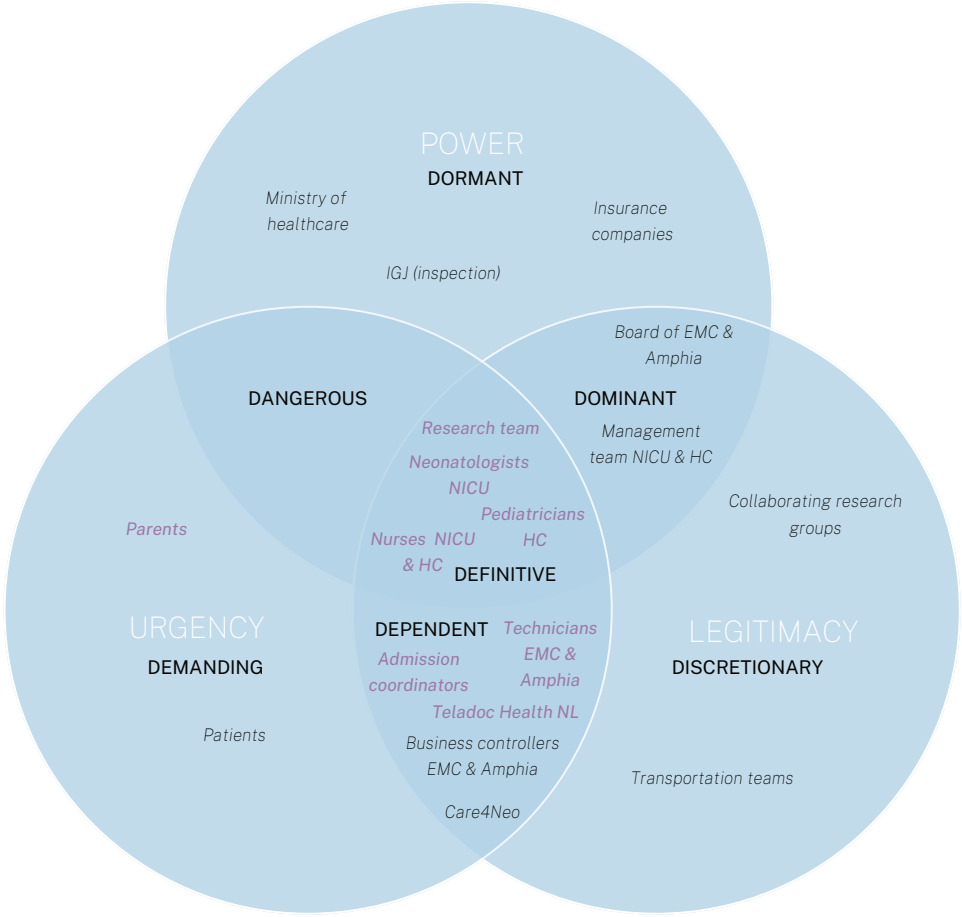


Figure 14: Stakeholder map 2
Made by Julia Broos

After labeling the involved stakeholders with the corresponding typology of the salience stakeholder framework, a second stakeholder map was created as presented in *Figure 14.*

3.3 Looking ahead to Stakeholder Interviews

Arnett et al., (2003) states that the definitive stakeholders should be prioritized as they tick all the boxes of legitimicay, power and urgency. For the pilot, those stakeholders are: **Neonatologists NICU (EMC), Nurses NICU (EMC), Pediatricians HC (Amphia), Nurses HC (Amphia) and the Research Team.** Next, it's recommended to look at other categories where important stakeholders might be hidden away. For the pilot, those stakeholders are: **Admission Coordinators, Technicians EMC & Amphia, Parents and Teladoc Health NL.**

These stakeholder groups (highlighted in purple in *Figure 14*) play an important role in the transition from pilot to implementation due to their legitimacy, power and/or urgency. Additionally, they are all present in either the ''Core Team'' or ''Involved'' layer of *Figure 12*, which confirms their contribution to the project. Therefore, these stakeholders will be interviewed in *Section 3.6* about their experiences, expectations and paintpoints regarding TeleNeo to reveal specific determinants for implementation.

3.4 On-Site Visit EMC

With permission from the involved healthcare professionals and parents of the newborn infant, I was able to attend a TeleNeo consultation at EMC. This improved my understanding of how the Teladoc Health Lite 4 Boom device functions and how the related service is executed between healthcare professionals at EMC and Amphia.

3.4.1 Attending a TeleNeo Consultation

The newborn infant was initially treated on the NICU at EMC and was then transferred to the HC at Amphia. The main reason for this was that the Amphia hospital was closer to home and therefore a better care location for the infant and parents. One week after the newborn infant was being transferred, the treating Neonatologist from EMC attended the daily round at Amphia by executing the TeleNeo service (*Figure 15*). By starting the Teladoc application on his PC, the Neonatologist called the Teladoc device that was positioned in the room of the patient. After the call was accepted by the healthcare professionals at Amphia doing the daily round, the audio-video connection was established. In this way, the Neonatologist at EMC was able to check how the infant was doing with his own eyes and ask + answer questions on the recovery progress while both the parents and new treating healthcare team were present. The service pathway of this TeleNeo consultation (joint daily round) is visualized in *Figure 16* on the following page. Attending the joint daily round consultation gave me an impression of how the Neonatologist used the cameras to zoom in and out on the desired image. He alternated between the healthcare professionals, infant, medical equipment and parents, which went smootlhy. I was positively surprised by the high quality of the cameras and possibility to switch between screens.

Figure 15: Pictures attended TeleNeo consultation
Made by Julia Broos

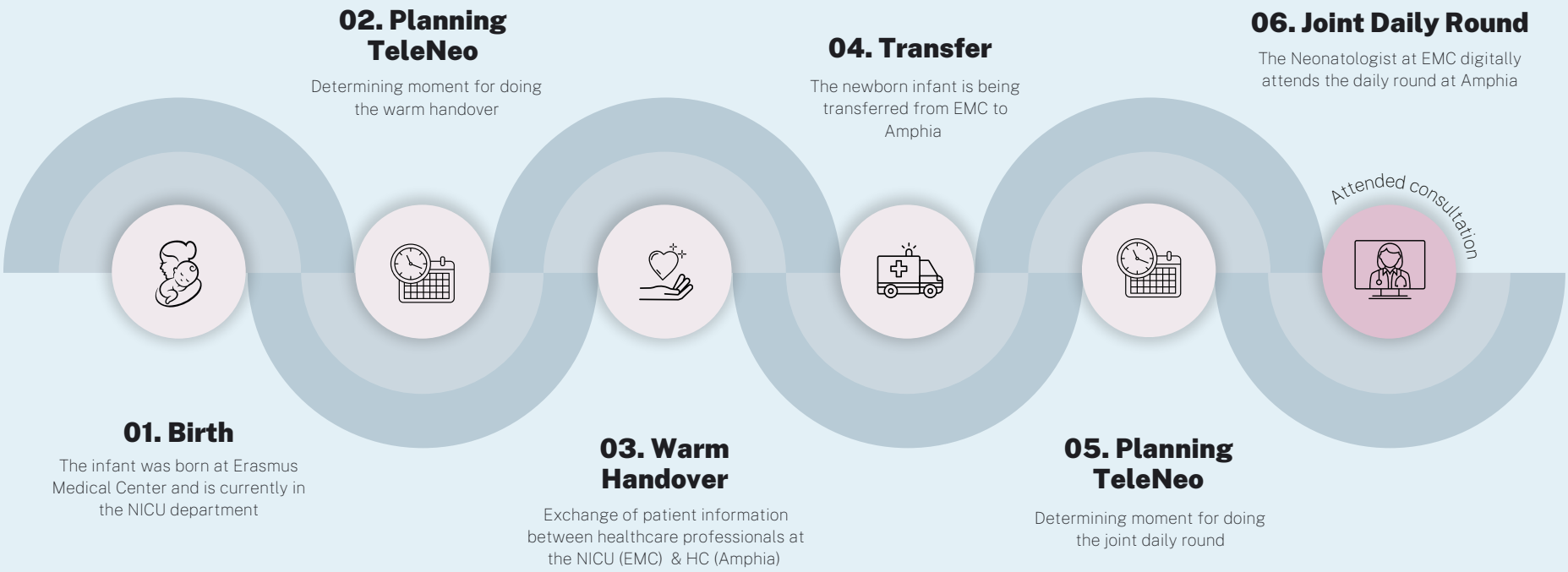


Figure 16: Service pathway joint daily round
Made by Julia Broos

3.5 On-Site Visit Amphia

To gain more knowledge on the functionalities of the TeleNeo service, I visited the Amphia hospital in Breda to take a closer look at the device in real life. Next to this, I was able to have some first conversations with stakeholders. An overview of the people I talked with is presented in *Figure 17*.

3.5.1 Studying the Device

At the HC in Amphia, the device is stored in a bordered corner of a separate room (*Figure 18*). All the necessary equipment to perform special procedures or surgeries is available in this room, so the device does not need to be moved for this purpose. These special procedures have only been executed a few times during the pilot as stated by a member of the research team. Most of the time, the healthcare professionals at Amphia retrieve the device and relocate it to the family suite where the TeleNeo service is being executed. During the consultation, healthcare professionals from Amphia, parents and healthcare professionals from EMC communicate via video-audio connection.

Who	*What*	*Where*
Member Research Team	Functionalities TeleNeo device	Storage room device
Parent	Experience TeleNeo consultations	Family suite Amphia
Three Neo-Nurses	Perceived added value, technology and adoption of TeleNeo	Meeting room Amphia

Figure 17: Overview conversations at Amphia

Figure 18: Pictures studying the TeleNeo device at Amphia
Made by Julia Broos

During the site visit, I have thoroughly studied the functionalities of the Teladoc Health Lite 4 and had the opportunity to ask additional questions to a member of the research team. This has enabled me to gain a comprehensive understanding of what the device precisely can accomplish and how it operates. An overview of these functionalities is presented in *Figure 19*.

3.5.2 Parent Conversation

After studying the TeleNeo device, I got the opportunity to talk to a mother of whom her newborn infant was transferred from EMC to Amphia and ask her about this experience. For her, TeleNeo was instrumental in facilitating a guided tour of the room at Amphia prior to this transfer. The feedback from the mother was overwhelmingly positive. She expressed how valuable it was to gain an insight into the environment her child would be moving to. This allowed her to mentally prepare and feel more at ease knowing what to expect. Additionally, she appreciated the familiarity of seeing a nurse's face upon arrival at Amphia.

Figure 19: Functionalities TeleNeo device
(Teladoc Health, 2024)

During the warm handover (a verbal handover between healthcare professionals from EMC and Amphia preceding a patient transfer), TeleNeo was again utilized. However, the mother provided feedback suggesting areas for improvement. She emphasized the need for a more comprehensive transfer of information from EMC, not limited to medical details but also encompassing specific aspects about the baby such as behavior, preferences, and reactions to different stimuli. This would spare parents from being surprised by questions from Amphia's nursing staff about what is considered "normal" for their child, as they may not be aware due to not being with the child at EMC constantly. Furthermore, the mother suggested a more child-centric approach, urging for a deeper understanding of the individual child's needs and characteristics. To enhance the warm handover process, she proposed a structured approach with predetermined topics to ensure essential information is effectively communicated between EMC and Amphia. This would ultimately help mitigate uncertainties for parents and promote smoother transitions for the child.

3.5.3 Nurses Conversation

On the day of my visit to Amphia, the Neo-nurses' staff meeting took place as well. Here, I was allowed to ask questions about their experiences with TeleNeo so far and received an initial indication of what could be improved. Three of them had experience with using TeleNeo so far. The relevant NASSS domains of *Figure 7* were used as a guideline for the questions.

Feedback Value Proposition

After working with TeleNeo for 2/3 months, the perceived added value is evident for both staff and parents. During information sessions, parents receive virtual tours of the facility and meet nursing staff, providing them with a sense of familiarity and comfort upon arrival at Amphia. The flexibility of videocalls eliminates the need for parents to travel for these sessions, allowing for convenience in scheduling. Nurses appreciate the presence of expert physicians during consultations, particularly Neonatologists, which enhances the quality of care provided. Moreover, videocalls create a more intimate and personal connection compared to traditional phone calls, making communication smoother and more effective. Additionally, the improved image quality enables quicker decision-making and action, as opposed to waiting for a Neonatologist to arrive on-site. Feedback from parents also indicates a positive experience with TeleNeo. They appreciate the familiarity of seeing familiar faces from previous consultations and feel more engaged and informed throughout the process.

Feedback Technology TeleNeo

Regarding the technology aspect of TeleNeo, staff members have found the training and explanation process to be effective. They feel adequately supported and guided through each step, with important information being reiterated verbally and through visual aids like posters. In terms of proficiency in using TeleNeo for consultations, staff members feel skilled. They find the device easy to operate and maneuver, but ask for agreements on when and how often it should be used.

The clarity of the camera enhances their ability to conduct consultations effectively. Overall, the execution of TeleNeo consultations is smooth, with staff encountering minimal difficulties. While occasional sound issues arise, particularly when the volume is maximized, these are manageable. Additionally, using a headset by the Neonatologist at EMC improves the sound quality, which addressed this encoutered challenge.

Feedback Adoption

Before and during the pilot, the research team provided information on TeleNeo through various channels such as newsletters, videos and on-site visits. Nurses found reaching out with questions, instructional videos, and repetitive reinforcement to be particularly beneficial. It is highlighted by nurses that it is unclear to them when and how often they need to use the device. Especially concerning the amount of post-transfer observations by physicians after the infant is being transferred from EMC to Amphia and to what extent parents need to be involved in the TeleNeo process. Their advice is to create clear agreements on this as the pilot phase progresses towards potential full implementation.

However, communication with the research team has been smooth so far, with two members from the research team readily available for assistance. Overall, while the pilot process has been relatively smooth, establishing clear protocols on TeleNeo usage and ensuring effective communication channels between the two hospitals are highlighted as key priorities for successful integration of TeleNeo into the workflow of the nurses.

In addition, it is suggested to position the device at the delivery room so that expertise from the EMC is immediately available in acute situations. Currently, the device is only located in the family suites to ensure accessibility and easy retrieval. However, this means that an additional person is needed to retrieve and connect the device during emergencies when it is used in the delivery room. Furthermore, the "Jip and Janneke" form can be used to capture additional information about the child, as indicated by parents during discussions. To end with, nurses who have not yet worked with the service are open to using it.

''Video calling instead of using the phone feels very different, much closer and more personal.''

"Using the device is very easy, but we need clear agreements about when and how often to use it."

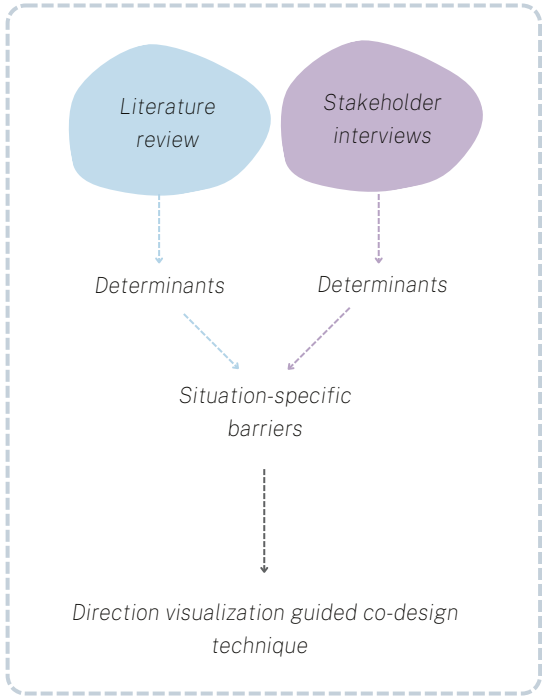
''You can also be more proactive yourself, as you can collaborate much better and share your own ideas during the videocall.''

''It would be better if the device is located in the emergency room, so that in case of an acute situation, expertise from EMC can easily be received.''

– Amphia nurses (2024)

3.6 Stakeholder Interviews

After gaining a better understanding of the context and selecting stakeholders who significantly impact the transition from pilot to implementation, in-depth stakeholder interviews were conducted, leading to key determinants for TeleNeo implementation from interview data. By comparing these findings with determinants found in the literature, situation-specific barriers were identified and served as the foundation for developing the visualization guided co-design technique.



3.6.1 Participants

The conducted stakeholder analysis resulted in the selection of the following participant groups:

- *Neonatologists NICU (EMC)*
- *Nurses NICU (EMC)*
- *Pediatricians HC (Amphia)*
- *Nurses HC (Amphia)*
- *Research Team*
- *Admission Coordinators*
- *Technicians (EMC & Amphia)*
- *Parents*
- *Teladoc Health NL*
- *Pediatrician HC (Albert Schweitzer)*

For additional insights on implementing TeleNeo in other hospitals in the Netherlands after the pilot, a Pediatrician from the Albert Schweitzer hospital in Dordrecht was also added to the list of participants.

3.6.2 Interview Guides

Semi-structured interviews are commonly regarded as one of the most effective tools when doing qualitative research (Smith, 1995). They can be useful in exploratory research to better understand a new service or market and this approach is recommended for discovering areas for improvement and refining existing designs.

Since the visualization technique will serve as an additional qualitative analysis in preperation for the implementation, focusses on beter understanding a new service for Dutch healthcare and aims to discover areas for improvement in the system, semi-stuctured interviews have been selected as an appropriate method for conducting the stakeholder interviews. The semi-structured interview guides were developed according to the guidelines for qualitative interviews (Patton, 2002), which means developing a flexible interview guide that includes open-ended questions to explore participants' experiences and perspectives. This allows for gaining a deeper understanding of complexity through ''how'' and ''what'' questions (Dorst, 2015). The participants were first given a brief introduction to the research topic without revealing future research goals. Subsequently, questions regarding opinions, values, knowledge, and emotions concerning TeleNeo were posed. The overarching research question for the interviews was: ***What are the main determinants for a successful implementation of TeleNeo service drawing on the real-life case learnings in the project setting of the pilot?***

To cover all fields of implementation during the interviews, I selected the relevant domains of NASSS from *Section 2.3.6* as topics for each stakeholder group, depending on their role within the pilot. For example, nurses were asked about how TeleNeo would change their workflow (Domain; Adopters), while the research team was asked how Dutch regulations could influence implementation (Domain: Wider System/Context). This resulted in the following interview topics:

- *Condition* (Goal: Expectations towards the delivered care at the NICU/HC)
- *Technology* (Goal: Experiences TeleNeo consultations)
- *Value Proposition* (Goal: Perceived added value TeleNeo)
- *Adopters* (Goal: Changes in workflows & potenital barriers for adoption)
- *Organisation* (Goal: Effect of TeleNeo on the organisation)
- *Wider System/Context* (Goal: Influence of the context on implementation)
- *Embedding & Adaptation over Time (Goal:* Ideas for improving the implementation process)

The flexible approach of the interviews allowed for the exploration of additional relevant questions during the conversation. Additionally, with consent obtained in writing, the interviews were recorded and notes were taken. All participants gave permission for recording and each interview took about 35 minutes to complete. All interviews, except for 4, were conducted online using the platform Microsoft Teams.

An overview of the participants within the stakeholder groups can be found in *Figure 20* on the following page, which provides further information on the context, focus of the interviews and covered domains from NASSS. In total, 12 participants were interviewed. Important to highlight here is that in the right column, the notation of the participants for the analysis is already presented. If there are two notations, so for example [Doctor 1] and [Member 1 RT], it depends on whether a question was asked from their perspective as a healthcare professional [Doctor 1] or a member of the research team [Member 1 RT].

3.6.3 Ethics

Delft University of Technology prioritizes ethical protection for participants in scientific research. Consequently, the TU Delft Human Research Ethics Committee (HREC) exercises caution in human subject involvement (Human Research Ethics, 2019). This graduation project adheres to the HREC ethics code, with the mandatory checklist available in ***Appendix B***. To ensure respondent privacy and safety, all research data and interview transcriptions have been anonymized.

3.6.4 Data Analysis

To impose structure on the excessive amount of information, a data processing method is applied. For this project, **Thematic Analysis** is the selected methodology as it is an appropriate method for seeking to understand thoughts, experiences or behaviors across a data set, which is essential for answering the research questions on determinants for TeleNeo implementation. Thematic Analysis, as outlined by Braun & Clarke (2006), involves examining qualitative data to identify, analyze and document recurring patterns within the dataset.

Hospital	Stakeholder group	Single occupation	Gender	Focus of the interview	Covered domains NASSS	Contact	Notation in Analysis
Amphia	**Pediatricians + Research Team**	*High-Care Pediatrician + Member Research Team*	**Male**	*Experiences TeleNeo as pediatrician, opinion on stakeholders, context influence*	Technology, Value Proposition, Adopters, Wider System	*Offline*	*[Doctor 1] or [Member 1 RT]*
Amphia	**Nurses + Research Team**	*High-Care Nurse + Member Research Team*	**Female**	*Experiences TeleNeo as nurse, changes to HC, communication, implementation process*	Condition, Technology, Value Proposition, Adopters, Organisation, Embedding & Adaptation over Time	*Online*	*[Nurse 1] or [Member 2 RT]*
Amphia	**Pediatricians**	*High-Care Pediatrician*	**Female**	*Experiences TeleNeo as pediatrician, workflow, changes to HC*	Condition, Technology, Value Proposition, Adopters	*Online*	*[Doctor 2]*
Amphia	**Nurses + Research Team**	*High-Care Nurse + Member Research Team*	**Female**	*Experiences TeleNeo as nurse, implementation process, challenges research team*	Condition, Technology, Value Proposition, Adopters, Embedding & Adaptation over time	*Online*	*[Nurse 2] or [Member 3 RT]*
EMC	**Admission Coordinators**	*Bed Occupancy Coordinator*	**Female**	*Experiences TeleNeo as coordinator, workflow, challenges/opportunities NICU*	Condition, Value Proposition, Adopters	*Online*	*[Admission Coordinator]*
EMC	**Technicians**	*Medical Technician TeleNeo pilot*	**Male**	*Deepdive technology TeleNeo*	Technology	*Offline*	*[Tech-department]*
EMC	**Neonatologists + Research Team**	*NICU Neonatologist + Member Research Team*	**Male**	*Experiences TeleNeo as neonatologist, changes to NICU, context influence*	Condition, Technology, Value Proposition, Adopters, Organisation, Embedding & Adaptation over time	*Online*	*[Doctor 3] or [Member 4 RT]*
EMC	**Neonatologists + Research Team**	*NICU Neonatologist + Member Research Team*	**Male**	*Experiences TeleNeo as neonatologist, changes to NICU, implementation process*	Condition, Technology, Value Proposition, Adopters, Organisation, Embedding & Adaptation over Time	*Offline*	*[Doctor 4] or [Member 5 RT]*
EMC	**Nurses**	*NICU Nurse*	**Female**	*Experiences TeleNeo as nurse, changes to NICU*	Condition, Technology, Value Proposition, Adopters	*Online*	*[Nurse 3]*
Albert Schweitzer	**Pediatricians**	*High-Care Pediatrician*	**Female**	*Implementation Albert Schweitzer, grant application*	Value Proposition, Adopters, Wider System	*Online*	*[Doctor 5]*
	Parents	*Mother*	**Female**	*Experience TeleNeo consultations (before and after transfer EMC --> Amphia)*	Value Proposition, Adopters	*Offline*	*[Parents]*
	Teladoc Health NL	*Principal IT Program Manager*	**Male**	*Technology development TeleNeo, changes to healthcare system, support*	Technology, Organisation, Wider System, Embedding & Adaptation over Time	*Online*	*[Teladoc]*

Figure 20: Participants interviews

While primarily focused on data description, this method also encompasses interpretation through the selection of codes and development of clusters and themes. I followed Braun & Clarke's (2006) 6-step process approach for conducting Thematic Analysis and did it by hand on paper. It's essential to recognize that Clarke and Braun's Thematic Analysis is structured as a recursive process, not a linear one. I started the process by transcribing the interviews. Next, I printed and re-read them to highlight the most important parts in answering the research question. In this way, I familiarized myself with the data. The highlighted parts were cut-out and during the coding process, I assigned descriptive terms (codes) to these highlighted segments of the transcripts. The research question was kept in mind along the way. Additionally, I predefined seven categories to structure the process a bit before initiating the development of actual themes. These categories are the domains from NASSS which I also used as topics for the interview guides. By using post-it notes, I assigned a different color to each category for ease of identification.

As a result, I did not only assign codes to the cut-outs, but I wrote them down on one of the seven corresponding post-it color notes of the categories. This supported me in efficiently scanning and identifying the relevance of a code and its correspondence with aspects of the research question. Although this doesn't define the themes yet, it narrows the context down to the most relevant fields which I found helpful. Once I completed the coding process, which resulted in 237 codes, I sorted the codes into themes by identifying similarities and congruences. I focused on internal connections within the themes, while maintaining differences between them. This was an iterative process. To make the overall process a bit less abstract, a visualized overview of the conducted Thematic Analysis is presented in *Figure 21*.

1. Familiarzing Myself
Reading transcripts and highlighting

2.Generating inital Codes
Written on the category colors

3.Searching for Themes
Resulting in four main themes

4.Reviewing Themes
Resulting in sub-themes

5.Defining and Naming Themes
Resulting in four main themes & eleven sub-themes

Figure 21: Process pictures Thematic Analysis
Made by Julia Broos

3.6.5 Results

As a result from the Thematic Analysis, I generated four main themes regarding the determinants for the implementation of TeleNeo: *Technical issues and support of the digital health service, Integration of the digital health service into user workflows and hospital processes, Inter-hospital communication and collaboration between teams of healthcare professionals, and Navigating legal and financial landscapes within the Dutch healthcare system*. Within each main theme, I introduced sub-themes to capture more specific aspects. This resulted in the Thematic Tree that is presented in *Figure 22,* which shows how the main themes unfold into sub-themes and which participants contribute to each of these sub-themes. From the following page, describing the results, all themes start with an introduction, followed by key qoutes and explanations on how the participants perceive this determinant to play a role in the implementation.

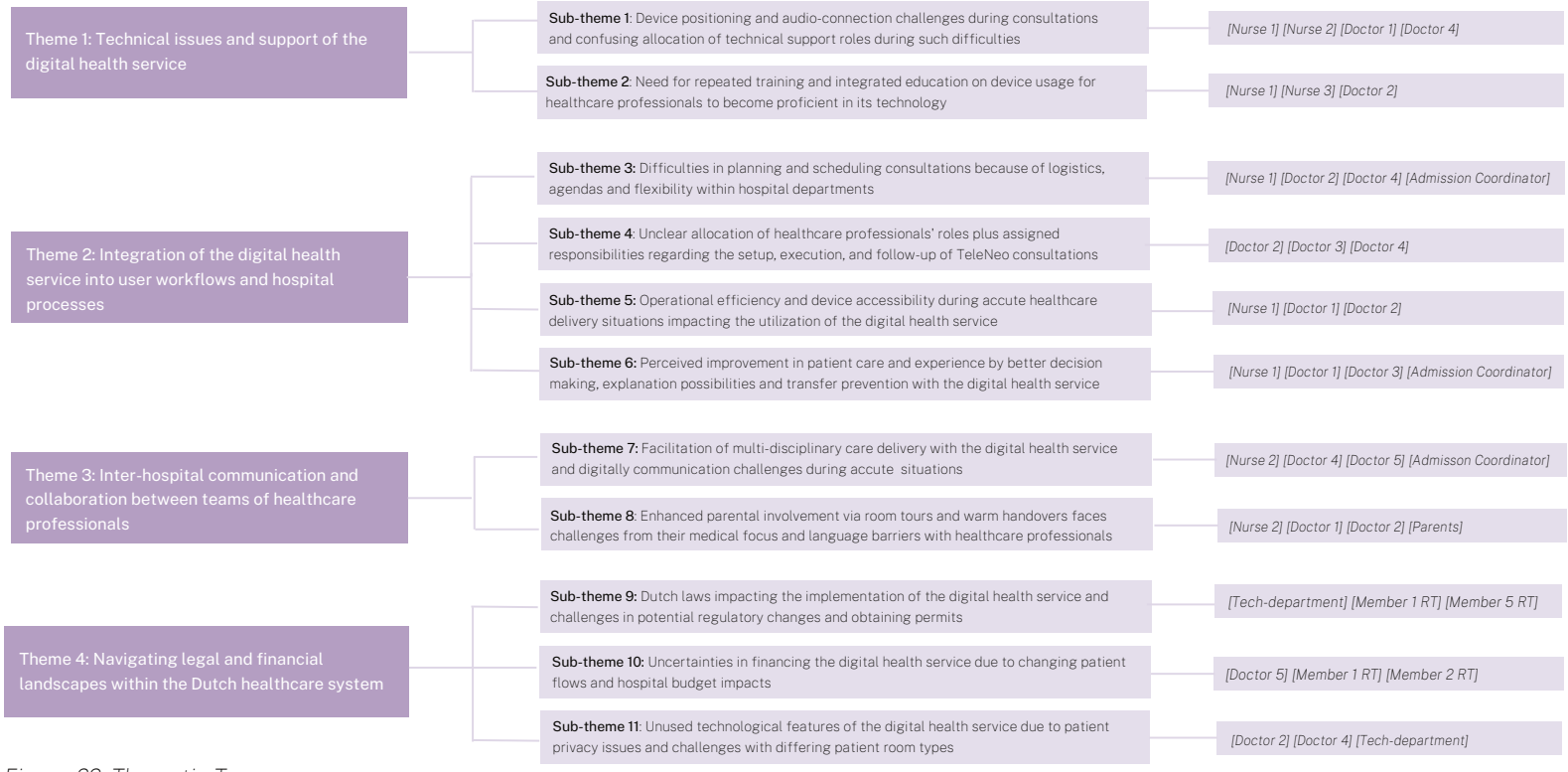


Figure 22: Thematic Tree
Made by Julia Broos

Theme 1: Technical issues and support of the digital health service

Within the context of TeleNeo utilization by healthcare professionals, the theme "Technical issues and support of the digital health service" underscores the critical role of seamless technical infrastructure and assistance in optimizing its effectiveness. This theme unfolds into two interconnected sub-themes, explaining the various challenges and requirements involved in ensuring the smooth functioning and uptake of TeleNeo.

Sub-theme 1: Device positioning and audio-connection challenges during consultations and confusing allocation of technical support roles during such difficulties

The first sub-theme explores the technical issues faced by healthcare professionals during TeleNeo consultations and highlights the need for clear technical support.

Healthcare professionals encounter various technical challenges with the device, such as sound quality discrepancies, internet connectivity problems, and device positioning challenges, as noted by [Doctor 4]: *"I've noticed that when we talk, we have to not stand too far from the device. Because otherwise, for those on the other side in Rotterdam, we sound far away. So we have to pay attention to that."* Additionally, the need for round-the-clock technical assistance is emphasized, and there is confusion about whether to contact the hospital's medical technician or Teladoc for support.

This is highlighted by [Nurse 1]: *''I heard that our medical technician can check the device if there are problems. And then I spoke to one of the medical technicians and they said, "Oh no, there's a number on it and you can always call that.'' So what is the role of the medical technology department in our hospital regarding TeleNeo? ''*

In conclusion, this feedback emphasizes the need for addressing technical and support issues to ensure the seamless operation of TeleNeo, thereby preventing any disruptions in patient care.

Sub-theme 2: Need for repeated training and integrated education on device usage for healthcare professionals to become proficient in its technology

The second sub-theme emphasizes the importance of thorough training and educational efforts designed specifically for healthcare professionals using TeleNeo.

Training and education are often mentioned as crucial components by healthcare professionals for the successful integration of TeleNeo into their workflows. They value real-life training on the device, but highlight the need for repeated training. It is therefore adviced to incorporate TeleNeo into existing training programs like Neonatal Life Support (NLS) and Advanced Pediatric Life Support (APLS), as decribed by [Doctor 2]: *''And maybe more frequent post-training sessions would be beneficial. And perhaps incorporating the Teleneo into our APLS or NLS scenario training, showing how to use it and how to adjust the camera to the monitor and such. I think there could be more investment in that area.''*

In conclusion, regular training sessions, educational materials, and integration into current training programs are important for healthcare professionals to achieve proficiency in using TeleNeo, supporting its adoption and enhancing confidence in its usage.

Theme 2: Integration of the digital health service into user workflows and hospital processes

In ''Integration of the digital health service into user workflows and hospital processes'', there is a focus on the incorporation of TeleNeo into clinical practice: healthcare professionals' workflows and hospital processes. This theme unfolds into four interconnected sub-themes, from consultation planning and scheduling to the delineation of roles and responsibilities among healthcare professionals. Moreover, it delves into the operational efficiency and resource accessibility of the TeleNeo service and ends with the potential change to patient care and experience.

Sub-theme 3: Difficulties in planning and scheduling consultations because of logistics, agendas and flexibility within hospital departments

The third sub-theme delves into the challenges encountered in scheduling TeleNeo consultations and addresses concerns about timing and planning.

Healthcare professionals note that utilizing TeleNeo often takes more time than traditional rounds, mainly because of the logistical and coordinating tasks involved. Moreover, healthcare professionals describe that finding a suitable moment to execute a TeleNeo consultation is difficult because of multiple agendas and irregular shifts of the involved caregivers, as explained by [Nurse 1] *''But yeah, timing is still very much a search, because just recently the Neonatologist from EMC called and said, I want to do a handover for a child coming tomorrow. So who can do that today? I can do that today, but I won't be here tomorrow.*

:

Ideally, it would be that parents have already seen me and if they see me again tomorrow. But with all the irregular shifts, that's not always possible either. '' Next to this general scheduling issue, it is pointed out that the difference in flexibility between the hospital departments also hinders scheduling.

In conclusion, the successful integration of TeleNeo consultations into hospital workflows requires attention to planning and scheduling logistics, thereby ensuring that TeleNeo can be effectively incorporated into healthcare professionals' routines.

Sub-theme 4: Unclear allocation of healthcare professionals' roles plus assigned responsibilities regarding the setup, execution, and follow-up of TeleNeo consultations

The fourth sub-theme focuses on the importance of clear roles and responsibilities regarding the use of TeleNeo within healthcare settings at Amphia and EMC.

Healthcare professionals experience the current process of facilitating a TeleNeo consultation as being not really structured. There is a need to define guidelines or agreements on who handles various aspects of the consultation, as highlighted by [Doctor 4]: *''It should actually be falicitated by the admission coordinator or by the nursing staff themselves I believe, so you don't have to start up the Teladoc service yourself. That shouldn't be necessary anymore. That is how I envision it, but there are no strict rules for that yet.''* It was also questioned whether TeleNeo should become something voluntary or mandatory (standard care), highlighting that there should always be a dedicated Neonatologist at EMC reachable for TeleNeo videocalls.

In conclusion, the successful implementation of TeleNeo requires clear allocation of roles and responsibilities among healthcare professionals within the NICU and HC departments.

Sub-theme 5: Operational efficiency and device accessibility during accute healthcare delivery situations impacting the utilization of the digital health service

The fifth sub-theme delves into the efficiency and accessibility of using the TeleNeo service, particularly during critical moments and accute situations of healthcare delivery.

Healthcare professionals at Amphia explain that retrieving the TeleNeo device during acute situations is not a priority because it is stored on another floor, consuming valuable time and manpower. This is described by [Doctor 2]: *''However, for example, in a poor start, well, usually we resuscitate here without involving the Neonatologist from Rotterdam, but then the Teleneo has to go down another floor. And it's not available in the operating room either. And we sometimes have emergency C-Sections, of course. Yeah, then I don't have the Teleneo here within a minute.''*

Moreover, [Nurse 1] highlights the struggle inherent in the current setup, wherein obtaining the device requires diverting attention from immediate patient care to request assistance from a colleague:

''I definitely think the part of the setup is a bit of a struggle, that you really have to ask a colleague to bring the device. Because your first focus is on attending to the child, and then you have to remember to bring the device as well. Now it's on the ward, so it's doable, but it's not on the delivery rooms or the operating rooms.''

In conclusion, the operational efficiency and accessibility of the TeleNeo device during acute healthcare delivery situations are critical factors that impact its utilization. Addressing these challenges by ensuring the device is readily available in key locations and streamlining the setup process can enhance the effectiveness in urgent scenarios.

Sub-theme 6: Perceived improvement in patient care and experience by better decision making, explanation possibilities and transfer prevention with the digital health service

The sixth sub-theme explores how TeleNeo influences patient care trajectories, including decision-making, the potential for early stabilization and changing transfer processes.

Healthcare professionals describe the value of seeing the patient and that having an image tells much more about their condition than over the phone and supports them in explanining things to each other, as described by [Doctor 1]: *''I find it advantageous that the doctor on the other end can see how the patient is doing. It's always different when I say, you know, he has 80% oxygen. When you see a child struggling to breathe like that, it's different. Well, I find that very valuable.''* Next, it is highlighted by [Admission Coordinator] how TeleNeo can prevent unnecessary transfers between Amphia and EMC, which is highly valuable for patients and their parents: *''Besides the parents, it's very nice for the child too, if there's no heavy transport process involved that causes stress. But also in terms of bed pressure and because you can admit other patients instead of having to refuse them, it's super nice. That gives me a much nicer feeling.''*

In conclusion, TeleNeo is perceived as a significant enhancement to patient care and experience. By facilitating better decision-making, providing clearer communication, and reducing unnecessary transfers, TeleNeo contributes to more efficient and effective healthcare delivery.

Theme 3: Inter-hosptial communication and collaboration between teams of healthcare professionals

Since the TeleNeo service is applied between two hospitals, this theme looks at the significant role that communication and collaboration play in its implementation. The theme unfolds into two interconnected sub-themes, where a closer look is taken on the effect TeleNeo brings to the communication between teams from Amphia and EMC, collaboration between nurses and doctors within the same hospital and the involvement of parents during TeleNeo consultations.

Sub-theme 7: Multi-disciplinary care delivery by the digital health service and communication challenges during (acute) situations

The seventh sub-theme examines how TeleNeo affects collaboration between healthcare teams from Amphia and EMC, noting both positive and negative impacts.

Healthcare professionals expect that TeleNeo can result in improved coorporation and connection between EMC and Amphia, as noted by [Doctor 5]: *''Yes, I think the bigger goal is that the cooperation will be beneficial and that there will be fewer differences in the way of working between the academy and peripheral center, because you will be looking at each other over and over again, so that you can connect much better with each other.''* Moreover, nurses highlight that TeleNeo improves their involvement in care processes by allowing them to participate in conversations between doctors from Amphia and EMC, enhancing multidisciplinary neo-care.

Finally, concerns are raised by healthcare professionals about the digital communication challenges with TeleNeo between Amphia and EMC, especially with parents present, and particularly during acute situations when you need to reach the healthcare professionals on the other side.

In conclusion, while TeleNeo offers significant benefits for enhancing multidisciplinary care and collaboration, it also presents new challenges in terms of how to behave digitally.

Sub-theme 8: Enhanced parental involvement via room tours and warm handovers faces challenges from their medical focus and language barriers with healthcare professionals

The eighth sub-theme examines parents' involvement in the TeleNeo process, such as room tours, warm handovers, and transparent communication between healthcare teams about their child's care.

Healthcare professionals describe using TeleNeo to give parents a room tour at Amphia before transfer, which parents found positive as it helped them prepare and see familiar faces upon arrival, according to [Parents]: *''I experienced the tour of the room preceding our transfer with TeleNeo very positively. It was really nice to create an image of the room where you will go to and in this way prepare yourself for this. Seeing a familiar face of a nurse upon arrival at Amphia also gave me a good feeling.''* Next, healthcare professionals highlight TeleNeo's warm handovers as valuable for building trust, familiarity, and confidence with parents. However, parents feel that the current information transfer between hospitals via TeleNeo is overly medical-focused.

In conclusion, while TeleNeo enhances parental involvement through room tours and warm handovers, there are areas needing attention, such as making the information transfer more focused on the patient's behavior.

Theme 4: Navigating legal and financial landscapes within the Dutch healthcare system

In this fourth and final theme of the Thematic Analysis, ''Navigating legal and financial landscapes within the Dutch healthcare system'' focusses on contextual factors regarding laws and moneyflows that have an impact on the implementation of TeleNeo in the Netherlands. This theme unfolds into three interconnected sub-themes, where a closer look is taken on the effect of Dutch regulations in healthcare, financial implications and patient privacy issues.

Sub-theme 9: Dutch laws impacting the implementation of the digital health service and challenges in potential regulatory changes and obtaining permits

The ninth sub-theme delves into Dutch laws and regulations for delivering (NICU) care in the Netherlands and therefore having an impact on the implementation of TeleNeo.

Healthcare professionals who are also part of the Research Team of the TeleNeo pilot highlight that in the current legislation, it is not allowed to provide NICU care at the Amphia hosptial. This restriction is described by [Member 1 RT]: *''Well at the moment, we have those laws, where are you allowed to provide NICU care? In the legislation, it's stipulated that NICU care takes place in 10 NICUs in the Netherlands and not outside of that. So it's not allowed at the moment and that needs to change if you want to use TeleNeo in a broader sense.''* It is also explained that for implementing TeleNeo, a difficult permit change is required that needs to be approved by the Minister of Healthcare.

Next, it is pointed out that TeleNeo is currently not classified as medical advice, simplifying regulatory compliance. However, [Tech-department] notes this might change after implementation, requiring attention: *''Well, the boundary between whether or not it was a medical device was a bit challenging in that sense. But it isn't right now and this made it easier because you don't have to comply with certain regulations. But those boundaries are crossed quite quickly, so that's something to watch out for in the future and someone needs to be sharp on that. If the doctor here is going to diagnose based on the camera images from that device, then it essentially becomes a medical device and you would have to submit a whole bunch of paperwork.''*

In conclusion, while TeleNeo offers significant potential for improving neonatal care, its broader implementation faces regulatory challenges. Changes in Dutch legislation, permit approvals, and potential reclassification as a medical device are areas that require attention.

Sub-theme 10: Uncertainties in financing the digital health service due to changing patient flows and hospital budget impacts

The tenth sub-theme delves into the uncertainties about financial consequences of implementing TeleNeo.

Healthcare professionals emphasize financial considerations in TeleNeo's implementation and sustainability. They discuss how patient flows change between Amphia and EMC due to medical advice given at EMC while the child remains at Amphia, prompting questions about funding allocation, as raised by [Member 1 RT]: *''Yes, I think the technology isn't the barrier. That won't be the obstacle, but implementing will actually mean that our patient flow will change, which has financial consequences for both hospitals. Because you are hopefully not moving the patient anymore, so who gets the money from the large pot?''*

These uncertainties about financial consequences for hospital budgets are the main driver behind the fair of hosptial boards. Although there are concerns about the hospital budget of EMC resulting from the implementation, positive perspectives on financing TeleNeo by other hopitals from outside the pilot exist. This is highlighed by [Doctor 5] from the Albert Schweitzer hospital: *''Well, I think at the moment that we would write a good business case, that there is a listening ear. And that it is not that I expect that nothing at all could be brought in to finance that. Because I think that, of course, we have not been doing well in the last year when it comes to post-IC. So that if we would tackle that well and thus be able to attract more of that kind of care to us, that the Board of Directors is sensitive to that.''*

In conclusion, while TeleNeo offers significant potential for improving neonatal care, its implementation is facing financial uncertainties. The redistribution of patient flows between hospitals, budget impacts, and the necessity of a comprehensive business plan are key issues that need addressing. However, there is optimism that with a well-crafted business case, the financial sustainability of TeleNeo can be achieved.

Sub-theme 11: Unused technological features of the digital health service due to patient privacy issues and challenges with differing patient room types

The eleventh sub-theme explores healthcare professionals' and the tech department's concerns about patient privacy during TeleNeo implementation, including new technological add-ons and differences in patient room types between Amphia and EMC.

Healthcare professionals describe that current functionalities of the TeleNeo service are not being used yet due to patient privacy, such as recording and taking screenshots during consultations. Next, it is highlighted by the [Tech-department] of EMC that it is possible to integrate these unused technological functionalities in the future: *''Yes, the question about patient data is still quite interesting. It's been put aside for now since we're not recording anything, so it's not saved. But I do hear that there is a need for taking screenshot of images and streaming patient files during TeleNeo consultations, which is not possible with the current privacy impact assessement.''*

It was also explained how the difference in type of patient rooms between Amphia and EMC influence safely use of TeleNeo, as noted by [Doctor 2]: *''Well, what I find difficult is, at Amphia we do rounds in the family suites with Teleneo. And Rotterdam has wards where multiple children are located with a curtain in between, so to speak. So their Teleneo rounds are done in a doctor's office, where we log in to observe the rounds in Rotterdam, we don't see the child due to patient privacy.''* Conversely, it was explained that despite these differences in patient room types, verbal explanations are not always necessary when using TeleNeo for observation on the wards.

In conclusion, patient privacy considerations and differences in patient room types present challenges for fully utilizing TeleNeo's technological features. Despite the potential for integration, existing privacy impact assessments and variations in room setups need to be addressed to ensure safe and effective use of the digital health service.

3.6.6 Discussion

The conducted Thematic Analysis identified implementation determinants specific to the TeleNeo pilot project setting from interview data. By comparing these determinants (*Figure 22*) with those identified during the literature review (*Figure 6*), unique barriers for the Dutch project setting were identified, referred to as situation-specific barriers. These barriers are highlighted in *Figure 23* and include:

- Difficulties in planning and scheduling consultations because of logistics, agendas and flexibility within hospital departments
- Unclear allocation of healthcare professionals' roles plus assigned responsibilities regarding the setup, execution, and follow-up of TeleNeo consultations
- Unused technological features of the digital health service due to patient privacy issues and challenges with differing patient room types

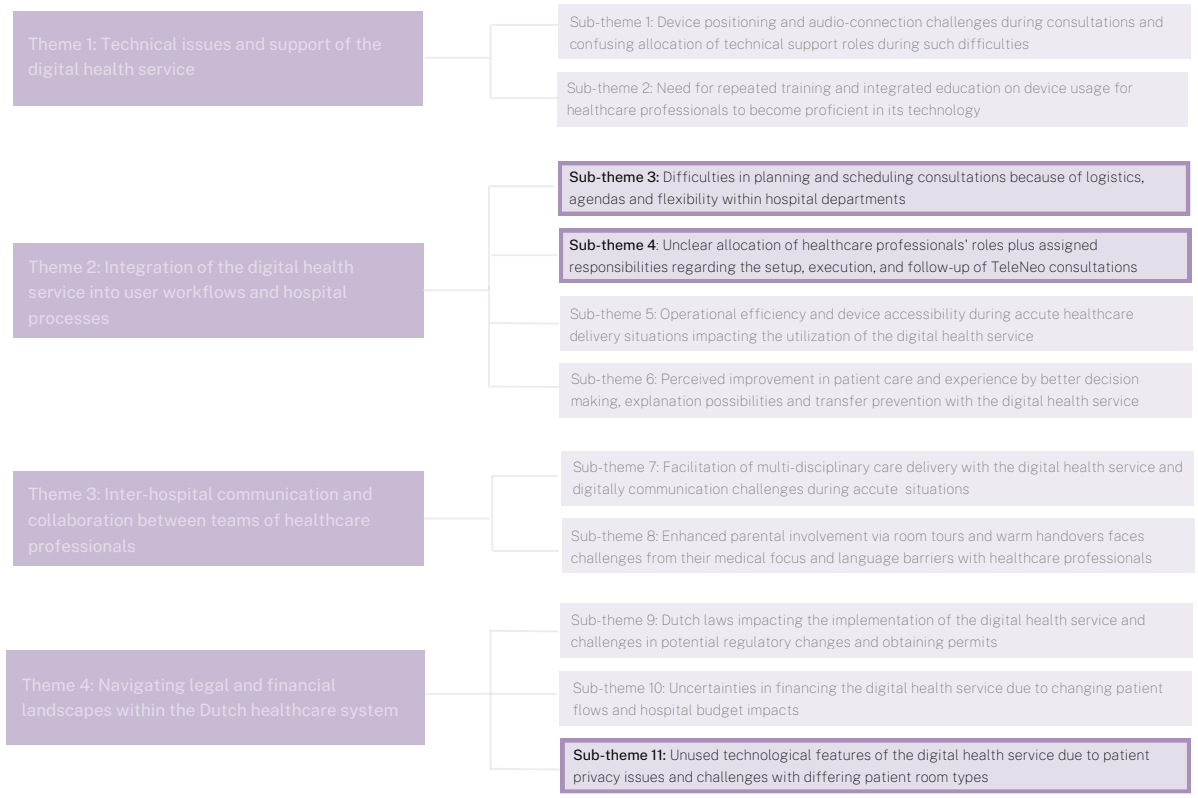


Figure 23: Identified situation-specific barriers
Made by Julia Broos

Conclusion on Design Direction

Having identified the situation-specific barriers for the TeleNeo pilot, the next step is to develop the visualization guided co-design technique to address them through design practice. Focusing on the possibilities to create impactful visualizations and taking my own skills as a strategic designer into account, I see most potential in focussing on the following two barriers as the foundation for developing the visualization guided co-design technique:

- Difficulties in planning and scheduling consultations because of logistics, agendas and flexibility within hospital departments
- Unclear allocation of healthcare professionals' roles plus assigned responsibilities regarding the setup, execution, and follow-up of TeleNeo consultations

These barriers are well-suited for visualization because they involve complex processes, varying stakeholders, and logistical challenges that can be effectively represented visually.

Visualizations can clarify timelines, identify bottlenecks in scheduling, illustrate role allocations, and highlight dependencies among different responsibilities and departments. By visualizing these aspects, healthcare professionals can gain a clearer understanding of the challenges and collaborate to develop solutions during the co-design session. The excluded barrier—unused technological features of the digital health service due to patient privacy issues and challenges with differing patient room types—has the least potential for visualization and is therefore excluded. The complexities involved with privacy regulations and the variability in room types are not easily conveyed through visual means, making this barrier less suitable for effective visual representation compared to the others.

To successfully utilize the technique to be designed with healthcare professionals during a co-design session, I consulted design experts from various companies for their advice on co-design sessions, with a specific focus on addressing the selected barriers. Additionally, I sought insights into their experiences with creating visualizations and utilizing existing visualization techniques. The details and insights from these expert conversations will be detailed in the following chapter.

Chapter 4: Experts on Visualization & Co-Design

After selecting promising unique barriers for the Dutch project setting to design for, this chapter delves into expertises from different perspectives on visualization and co-design sessions. Employees from Flatland Agency and Deloitte, plus a Graduate Student from TU Delft were asked for their advice based on past experiences. The chapter concludes with an approach for the design phase of the project.

4.1 Flatland Agency

To start with, a visual consultant from Flatland Agency was approached. This agency makes use of visual thinking, co-creation and design thinking to design new strategies, activate change and accelerate innovation within companies. After explaining the focus and goal of my project to the visual consultant, we continued with a brainstorm on the possibilities for using the technique to be designed during a co-creation session with healthcare professionals. I asked for tips on how to make visualizations interactive in order to start fruitful discussions among stakeholders, how to deal with differences in hierarchy between stakeholders and balancing information in visualizations. The following insights resulted from this brainstorm:

- Organize multiple pre-sessions to practice the session and develop the concept
- The 3 30 300 rule could be an inspiration for balancing information in the visualizations
- Add playful elements to make the visualizations interactive (assigning roles, elements to be positioned on it)
- Be creative in creating groups for the session (1:1, small groups, mixed)

4.2 Deloitte

Next, a strategic design lead at Deloitte was approached who has experience with visualizing for implementation within this consultancy. Therefore, he was asked on his thoughts about existing visualization techniques from *Figure 9* that could have potential for this project. He also suggested new directions to explore. The following insights resulted from this conversation:

- Service blueprints and ecosystem maps are good techniques to visualize the current system healthcare professionals work with
- Using value flow models within ecosystem maps can be helpful for visualizing flows of information, value and money between stakeholders
- Take a look at Metro Mapping to explore whether this technique has potential
- Visualizing the workflows of healthcare professionals from EMC and Amphia can be valuable for identifying interactions with associated conflicts and barriers. What is their current agenda and how does the TeleNeo intervention impact this?
- Look at what healthcare professionals need from each other to integrate TeleNeo into their current workflow

4.3 Graduate Student TU Delft

To end with, the advice from the strategic design lead at Deloitte was followed on exploring the Metro Mapping technique. Therefore, a Graduate Student from TU Delft who graduated on Metro Mapping was approached. She explained what parts of Metro Mapping can be helpful in getting the information I need and how you can involve stakeholders during the presentation of a visualization. The following insights resulted from this conversation:

- The different layers of Metro Mapping can be used as a guideline to create a clear picture of who is involved, what information each stakeholder needs and what recourses are needed
- Keep in mind that a big part of Metro Mapping focusses on the care path of the patient
- I can use an existing visualization technique, such as Metro Mapping, as a starting point and destract the elements I need for creating my own visualization technique
- Post-its are a good instrument for involving stakeholders in the process
- When looking at workflows, do not only focus on the sequence of steps but also on their level of priority

The insights gained from the expert interviews with Flatland Agency, Deloitte and TU Delft, combined with my own experience as a designer, have been used to create the map depicted in *Figure 24*, showcasing the determinants in both visualizations and co-creation. The following domains have been distinguished: *Audience, Co-design Session, Feedback and Iteration, Data Characteristics, Context/Environment,* and *Interaction*.

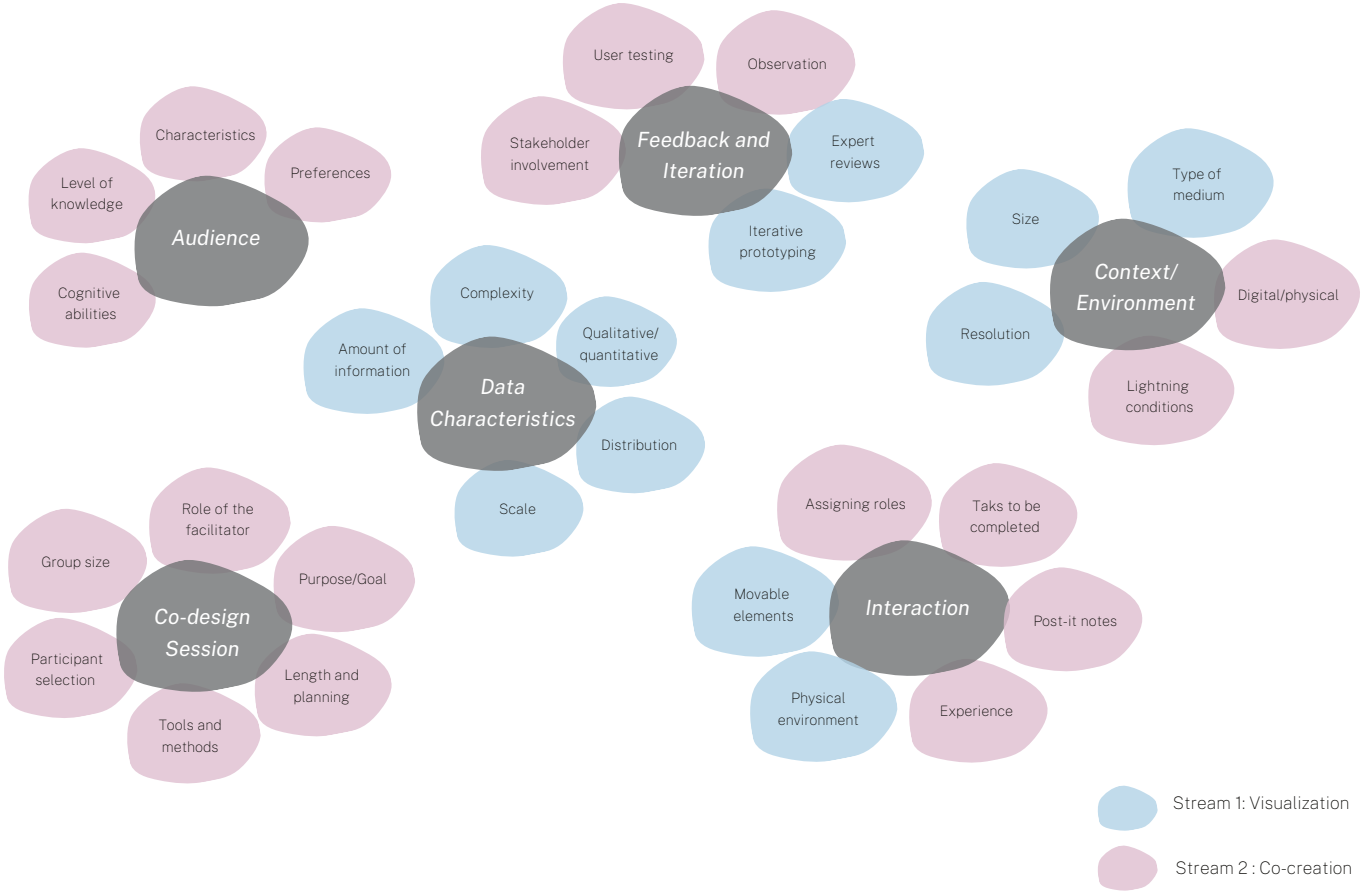


Figure 24: Determinants in visualizations and co-creation
Made by Julia Broos

4.4 Conclusion

Insights and ideas exchanged with experts in visualization and co-creation, combined with reflections on practical applications of visualizations, indicate that incorporating visualizations during a co-design session can effectively address the specific challenges related to the scheduling and responsibilities of TeleNeo consultations. This approach facilitates active engagement, stimulates discussion, and fosters consensus-building among healthcare professionals directly involved in the TeleNeo service. While static visualizations provide a valuable overview, they lack the dynamic interaction and feedback mechanisms that co-design sessions offer. These interactions are crucial for envisioning potential changes within the current system and aligning processes between the NICU and HC departments. Therefore, the upcoming co-design session focused on engaging healthcare professionals from both hospitals using visual means to reflect on and discuss the integration of TeleNeo consultations into their existing workflows and to assign responsibilities. Consequently, the current workflows and different elements of the TeleNeo services must be visualized and incorporated into a co-design technique for the session.

In the forthcoming chapter, the project transitions from the research phase to the design phase. The focus is twofold: developing the visual content of the co-design technique and outlining the process of the session. Therefore, the following elements are explored in the forthcoming chapter:

Boundaries for the visualization guided co-design technique in terms of service focus
Establish the scope of the technique, specifically regarding the targeted aspect of the digital health service.

Differentiation between roles and responsibilities
Clarify the distinction between roles and responsibilities and establish definitions for each.

Specifics for the session
Define goals for the session and determine the appropriate healthcare professionals to invite, along with its setting and planned activities.

Current roles and responsibilities at the NICU and HC departments
Identify and document the current roles and responsibilities of healthcare professionals working at the NICU and HC.

Current workflows of healthcare professionals at the NICU and HC
Gain insight into the existing workflows followed by healthcare professionals at the NICU and HC departments.

Required TeleNeo responsibilities
Define the necessary responsibilities concerning the preparation, execution, and follow-up of TeleNeo consultations.

Chapter 5: Developing the Visualization Guided Co-Design Technique

This chapter delves into the development of the visualization guided co-design technique and the session during which it will be utilized. It begins by setting the scope and defining relevant terms, followed by outlining the session's objectives and design approach. Next, it presents the required information for designing the visual content and explains decisions regarding participants and setting. The concept is then tested, resulting in refinements to the content and process. The chapter concludes by outlining the agenda and materials of the developed technique.

5.1 Setting the Scope and Definitions

The research phase of the project uncovered the various purposes for which TeleNeo consultations between EMC and Amphia are utilized, specified into two distinct groups:

- **Acute** situations entail scenarios where the Neonatologist at EMC is sought for immediate medical guidance and assistance during critical healthcare delivery circumstances, such as surgery or resuscitation
- **Planned** situations pertain to patient transfers from EMC to Amphia and involve the provision of TeleNeo services for pre-transfer room tours, warm handovers before transfer and post-transfer medical advice

Given that the identified situation-specific barriers primarily revolve around challenges in scheduling and planning consultations, as well as uncertainties regarding the roles and responsibilities of healthcare professionals, these issues mainly align with the second category: planned situations. Consequently, the inital boundary for the co-design session is that its design specifically supports planned TeleNeo consultations.

In addition to defining the scope, I delved into the concepts of roles and responsibilities of healthcare professionals at the two hospitals. Roles and responsibilities serve as foundational pillars of organizational structure and operations, providing a structured framework for individuals to contribute effectively towards shared objectives (Crawford et al., 2004). Initially, roles refer to the distinct positions or functions that individuals hold, each accompanied by a specific set of duties, tasks and expectations. Following this, responsibilities outline the precise obligations and accountabilities associated with these roles, detailing the actions or outcomes individuals are tasked with delivering. Tasks meanwhile, represent the specific activities or actions that individuals perform as part of their roles and responsibilities. Together, roles, responsibilities and tasks establish clarity, accountability and coherence within teams and departments, enabling smooth coordination, effective task allocation and perfomance management.

5.2 Objectives

To address the situation-specific barriers for the pilot setting, I formulated the following objectives for the co-design session:

1. Foster discussion among healthcare professionals to determine the optimal common day and time for integrating the three planned TeleNeo consultation types into existing NICU and HC workflows
2. Clarify the new responsibilities and assigned roles of healthcare professionals regarding the setup, execution, and follow-up of planned TeleNeo consultations, including room tours, warm handovers and joint daily rounds

These objectives can be seen as steps towards the main objective, which is to: *"Co-create revised NICU and HC workflows that effectively integrate the three planned TeleNeo consultation types and in which the allocated roles are clearly presented."*

With this objective, my aim is to deliver a document to the research team outlining TeleNeo responsibilities and roles for planned consultations. It will also specify the optimal days and times for each TeleNeo consultation type, guiding the next steps in the implementation.

5.3 Design Approach

Referring to the objective of the co-design session *(Co-create revised NICU and HC workflows that effectively integrate the three planned TeleNeo consultation types and in which the allocated roles are clearly presented)*, I developed the approach presented in *Figure 25* to design the visual content and process of the co-design technique. This results in **CoVisioning**: my developed interactive co-design technique that utilizes visualization guided activities during a session to address implementation barriers related to role allocation and scheduling difficulties. The following sections outline the three phases of the design approach—static visualizations, dynamic visualizations, and the co-design session—along with their designed content.

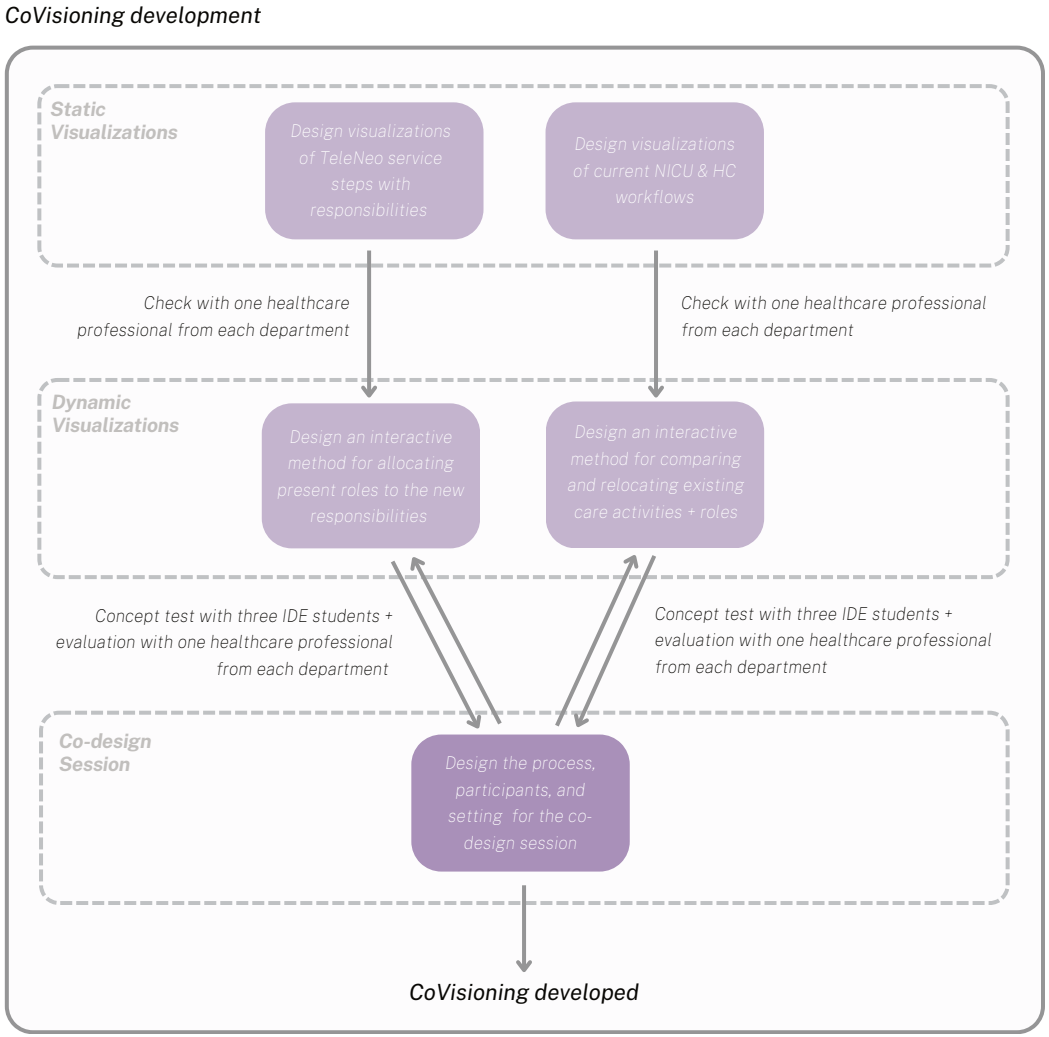


Figure 25: Design approach CoVisioning
Made by Julia Broos

5.4 Required Information to Design its Visual Content

To start the design process, the following areas are explored:

Current roles and responsibilities of healthcare professionals at the NICU and HC (*Section 5.4.1*)

Understanding the existing roles and responsibilities helps identify which roles can take up the new TeleNeo responsibilities.

Required responsibilities for planned TeleNeo consultations (*Section 5.4.2*)

Defining TeleNeo responsibilities ensures that the necessary tasks are covered and helps allocate these new responsibiities among the current staff.

Current workflows of healthcare professionals at the NICU and HC (*Section 5.4.3*)

Analyzing existing workflows provides a baseline for understanding current care activities, enabling the identification of suitable moments for integrating the new TeleNeo consultations.

5.4.1 Current Roles and Responsibilities

This section offers an overview of the existing roles and responsibilities within the NICU (EMC) and HC (Amphia) departments. The comprehensive overview is presented in *Figure 26*, beginning by delineating the six distinct roles currently identified by talking to one member of the research team and two healthcare professionals from each department. Subsequently, the figure highlights the healthcare professionals capable of fulfilling each role (since some roles can be fulfilled by multiple individuals), along with their associated responsibilities. All information in *Figure 26* applies to both the NICU and HC, unless otherwise specified. The main differences between the existing roles within the NICU and HC are as follows: the HC department does not have Physician assistants, Nurse-supporters, or Admission coordinators. The role of a Pediatrician does not exist within the NICU department.

	Nurse	Nurse-supporter*	Nurse practitioner/Physician assistant	Medical resident	Supervisor	Coordinator
Role						
Who can fulfill the role	Nurses	Medical students Care assistants Paramedics	Nurse practitioners Physician assistants*	Medical residents	Pediatricians* Pediatric neonatologists	Nurses Team managers Admission coordinators*
Responsibilities	• Support medical procedures • Daily patient care • Coordination of patient schedules • Administration	• Support nurses	• Performing medical procedures • Making medical decisions regarding the patient • Administration	• Performing medical procedures • Making medical decisions regarding the patient • Administration	• Final responsibility for patient decisions • Coordination of bed capacity • Collaboration with other hospitals	• Coordination of bed capacity • Collaboration with other hospitals

*not present at HC
*not present at NICU

Figure 26: Current roles and responsibilities at the NICU and HC
Made by Julia Broos

5.4.2 New Responsibilities TeleNeo Consultations

The provision of planned TeleNeo services between the NICU and HC facilitates one of the following three types of consultations (Wagenaar et al., 2024):

- **Pre-transfer room tour:** virtual tour of the new room facilities at Amphia conducted via TeleNeo for parents before the actual transfer of their child
- **Warm handover before transfer**: virtual meeting between medical teams from EMC, Amphia and parents just before the patient transfer to Amphia occurs
- **Post-transfer joint daily round**: remote consultation and guidance by allowing the Neonatologist at EMC to participate in the daily round at Amphia via TeleNeo

The introduction of these new services for the NICU and HC brings additional responsibilities. *Figure 27* clarifies each planned TeleNeo consultation type, including purpose, content, and new responsibilities. Additionally, the complete service pathway for the three types of consultations is presented on the following page *(Figure 28)* to provide clarity on the start and end points of the services. This expands upon *Figure 16* in the analysis phase of the project.

	Room tour	Warm handover	Joint daily round
Purpose	To familiarize parents with the new room and team of healthcare professionals at Amphia, setting their expectations and improve their understanding	To facilitate a smooth transition of care by ensuring seamless communication and information exchange between medical teams from EMC and Amphia	To provide ongoing support and guidance to the receiving hospital's medical team at Amphia in managing the patient's care effectively after transfer
Content	Virtual tour in real time showcasing the patient's designated room at Amphia. Explanation of facilities, services and getting to know the new care team Average duration: • Set-up: 5 min • Execution: 10 min • Post-consultation: 5 min	Detailed discussion of the patient's medical history, current condition, care plan, and any specific needs or concerns. There is also room for behavioral-related patient information Average duration: • Set-up: 5 min • Execution: 20 min • Post-consultation: 5 min	Review of the patient's progress since transfer, discussion of upcoming care milestones, follow-up appointments, and recommended interventions Average duration: • Set-up: 5 min • Execution: 15 min • Post-consultation: 5 min
Responsibilities	• Contacting parents • Scheduling room tour appointment • Retrieving the Teladoc • Initiating the Teladoc call • Conducting the room tour • Concluding the service • Returning the Teladoc	• Contacting parents • Scheduling warm handover appointment • Retrieving the Teladoc • Initiating the Teladoc call • Receiving patient information • Transferring patient information • Concluding the service • Returning the Teladoc	• Scheduling moment for attending the daily round • Communicating with parents • Retrieving the Teladoc • Initiating the Teladoc call • Conducting the daily round • Concluding the service • Returning the Teladoc

Figure 27: New TeleNeo responsibilities
Made by Julia Broos

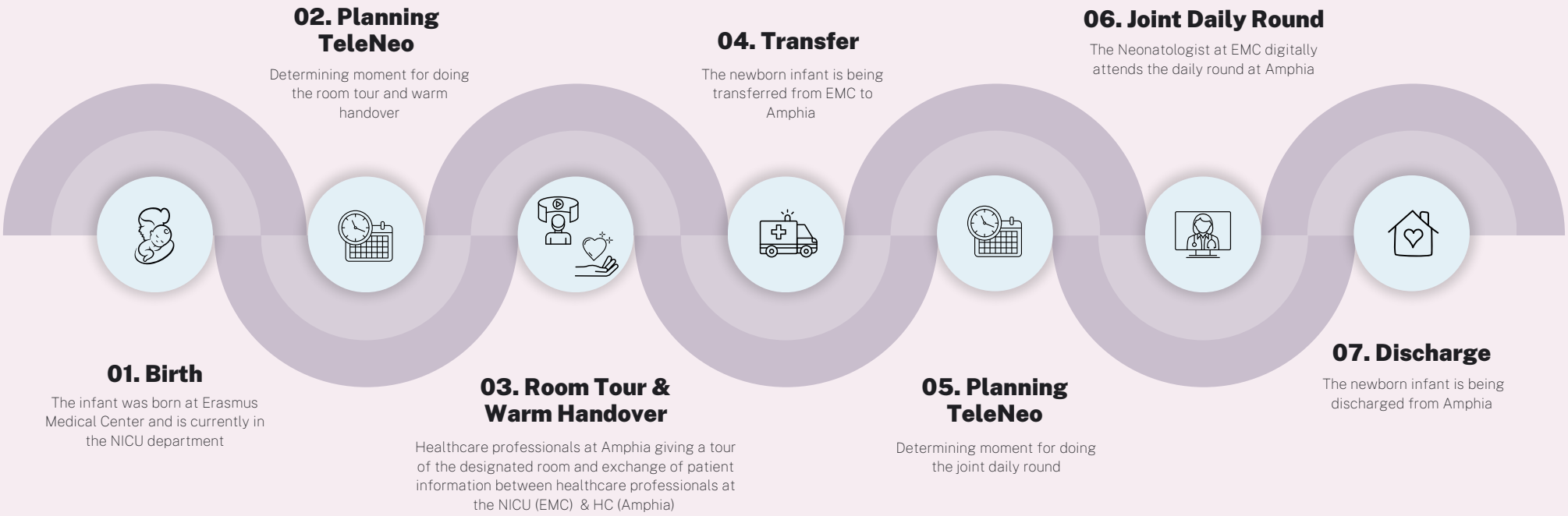


Figure 28: Complete service pathway planned TeleNeo consultations
Made by Julia Broos

5.4.3 Current NICU and HC Workflows

To gain knowlegde on the current workflows of the NICU and HC departments, one supervisor from each department has been approached to share the weekly planning of routine care activities (regular, daily activities or tasks performed by healthcare professionals) at their department. These weekly plannings of routine care activities for the NICU and HC are presented in *Figure 29*.

	Maandag	*Dinsdag*	*Woensdag*	*Donderdag*	*Vrijdag*
***NICU** (EMC)*	07:00-07:15 Overdracht VPK 08:30-09:00 Overdracht kinderartsen 09:00-09:10 Dagstart 09:10-11:00 Patiëntvisites 15:00-15:30 Overdracht VPK 17:00-17:30 Overdracht kinderartsen	07:15-08:00 Overdracht VPK 08:00-08:15 Overdracht 08:15-09:00 Protocol 10:30-12:00 Patiëntvisites 12:00-12:30 Röntgenbespreking 13:30-15:30 Grote visite 16:30-17:00 Overdracht 17:00-18:00 Perinataal overleg	07:15-08:00 Overdracht VPK 08:00-09:00 Overdracht + Onderwijs 10:30-12:00 Patiëntvisites 12:00-12:30 Röntgenbespreking 12:30-13:30 Onderwijs 13:00-14:00 VS/PA overleg 15:15-16:00 Research meeting 16:30-17:00 Overdracht	07:15-08:00 Overdracht VPK 08:00-09:00 Overdracht + Onderwijs 09:00-09:30 Keek op de week VPK 10:30-12:00 Patiëntvisites 12:00-12:30 Röntgenbespreking 15:00-15:30 Infectie/hematologie 16:30-17:00 Overdracht	07:15-08:00 Overdracht VPK 08:00-08:45 Grand Round Sophia 08:45-09:00 Overdracht 10:30-12:00 Patiëntvisites 12:00-12:30 Röntgenbespreking 14:00-14:30 Keek op de week AA 15:30-16:30 Weekendverdracht
***HC** (Amphia)*	07:15-08:00 Overdracht VPK 08:00-09:00 Weekendoverdracht artsen 10:30-12:00 Patiëntvisites 12:00-12:30 Röntgenbespreking 13:00-14:00 Staf/VS overleg 14:00-15:00 MDO (MFR) 16:30-17:00 Overdracht	07:00-07:15 Overdracht VPK 08:30-09:00 Overdracht kinderartsen 09:00-09:10 Dagstart 09:10-11:00 Patiëntvisites 15:00-15:30 Overdracht VPK 17:00-17:30 Overdracht kinderartsen	07:00-07:15 Overdracht VPK 08:30-09:00 Overdracht kinderartsen 09:00-09:10 Dagstart 09:10-11:00 Patiëntvisites 15:00-15:30 Overdracht VPK 17:00-17:30 Overdracht kinderartsen	07:00-07:15 Overdracht VPK 08:30-09:00 Overdracht kinderartsen 09:00-09:10 Dagstart 09:10-11:00 Patiëntvisites 13:15-16:00 Röntgenbespreking, Grote visite, Refereermoment, Vergadering 15:00-15:30 Overdracht VPK 17:00-17:30 Overdracht kinderartsen	07:00-07:15 Overdracht VPK 08:30-09:00 Overdracht kinderartsen 09:00-09:10 Dagstart 09:10-11:00 Patiëntvisites 15:00-15:30 Overdracht VPK 16:30-17:00 Overdracht kinderartsen

Figure 29: Weekly planning routine care activities NICU & HC
Made by Julia Broos

5.5 Static Visualizations

Visualizations TeleNeo service steps with responsibilities

Using the information from the previous section, I created a visualization of the TeleNeo service steps for a room tour, warm handover, and joint daily round to map their new responsibilities. As inspiration, I looked at *Journey Mapping (McCarthy, 2020)* from *Figure 9* for its purpose of understandng the user experience with a service and used the following elements for creating my own visualization: sequence of service steps, touchpoints and phases. This resulted in the visualization of *Figure 30*, highlighting responsibilities, touchpoints between EMC and Amphia, and three service phases: preparation, execution, and post-consultation. An inital check with a healthcare professional from each department did not result in any adjustments to the outlined responsibilities.

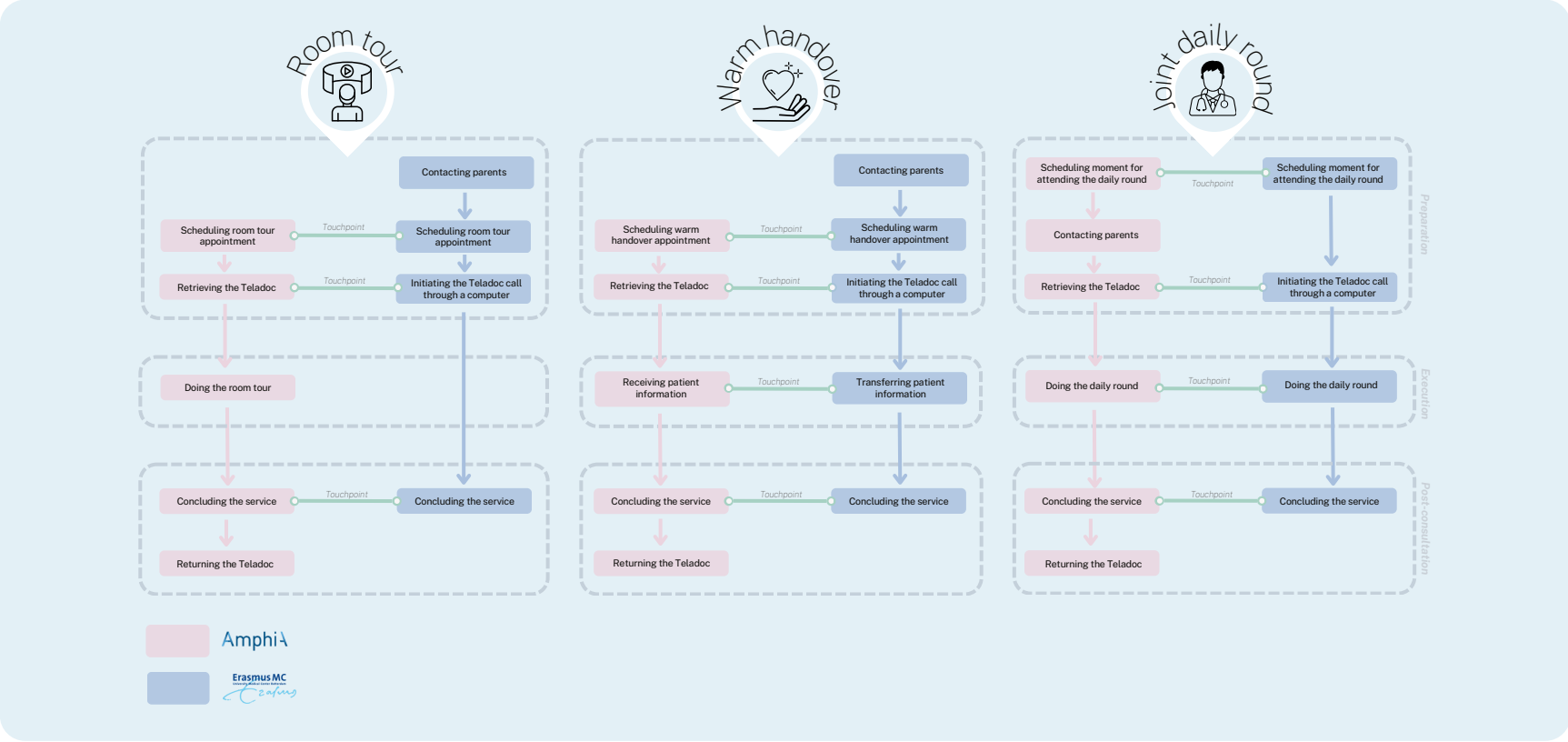
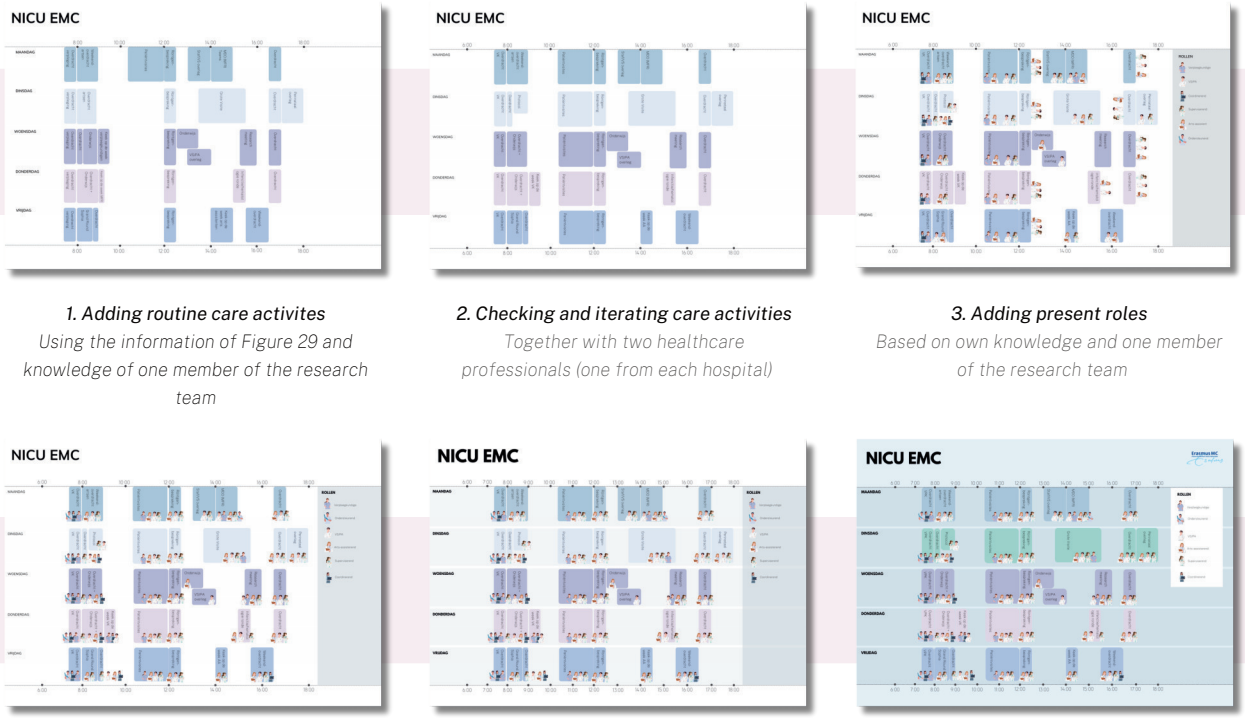


Figure 30: Static visualizations TeleNeo service steps with responsibilities
Made by Julia Broos

Visualizations current NICU & HC workflows

From *Figure 9*, which depicted existing visualization techniques for mapping services and systems, I drew inspiration for designing the NICU and HC workflow visualizations. I found Process Mapping/Modeling (Jun et al., 2009) particularly useful for workflow creation due to its purpose of documenting existing or planned processes to ensure a shared understanding and used the following elements for creating my own visualization: activities and their sequence with present roles. The iterative process is visualized in *Figure 31*, utilizing the NICU workflow as example. Both workflow visualizations were reviewed by a healthcare professional from each hospital department. This led to one adjustment in the HC workflow regarding roles and one adjustments in the NICU workflow concerning the duration of a routine care activity. Each day's schedule shows routine care activities along a timeline, indicating the corresponding roles present at each activity. Weekends and evening/night hours are excluded to streamline visualization, focusing on planned TeleNeo consultations when parents are usually available and when the NICU and HC departments have sufficient capacity. Consequently, I only included weekdays and daytimes.



1. Adding routine care activites
Using the information of Figure 29 and knowledge of one member of the research team

2. Checking and iterating care activities
Together with two healthcare professionals (one from each hospital)

3. Adding present roles
Based on own knowledge and one member of the research team

4. Checking and iterating present roles
Together with two healthcare professionals (one from each hospital)

5. Iteration on readability
Typography, time axis, scaling

6. Iteration on visual appeal
Color, transparancy, contrast

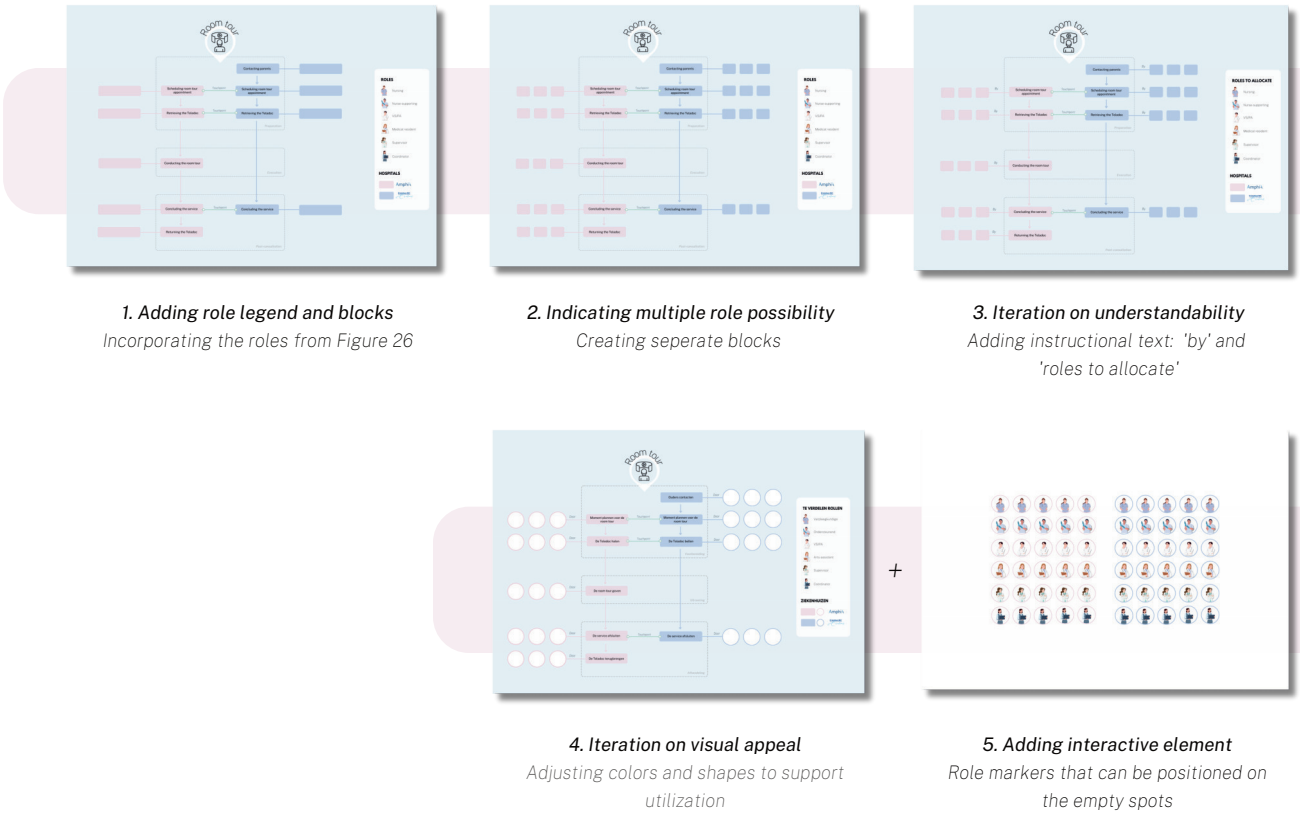
Figure 31: Static visualizations current NICU & HC workflows
Made by Julia Broos

5.6 Dynamic Visualizations

Interactive method for allocating present roles to the new TeleNeo responsibilities

To transform the static visualizations of the TeleNeo service steps with responsibilities into a dynamic format, I created the interactive method that is presented in *Figure 32* for allocating roles to the TeleNeo responsibilities, utilizing the room tour consultation as example and illustrating its iterative process. As outlined in step 4, the visual method comprises a template highlighting the responsibilities, with space provided for adding a maximum of three roles from each department alongside (as this is the expected maximum according to the research team). The interactive element introduced in step 5, 'role markers' allows healthcare professionals during the session to place and replace small markers of current roles on the empty spots.

In ***Appendix C***, the full-size templates and role markers for all three consultation types *(Figures 55-58)* are presented in Dutch, aligning with the language used during the co-design session by participants.



1. Adding role legend and blocks
Incorporating the roles from Figure 26

2. Indicating multiple role possibility
Creating seperate blocks

3. Iteration on understandability
Adding instructional text: 'by' and 'roles to allocate'

4. Iteration on visual appeal
Adjusting colors and shapes to support utilization

5. Adding interactive element
Role markers that can be positioned on the empty spots

Figure 32: Interactive method creation for allocating roles
Made by Julia Broos

Interactive method for comparing and relocating existing care activities + roles

To transform the static visualizations of the NICU and HC workflows into dynamic ones, I first added a priority layer to the routine care activities, incorporating advice from the expert interviews in *Chapter 4*. High priority (100% fixed) indicates that the activity must occur at the specified time with designated roles, while low priority (100% flexible) means it can occur on alternate days and/or times, and not all indicated healthcare professionals need to be present. This addition enables the creation of an interactive method by allowing reflection on the feasibility of relocating routine care activities in terms of day, time, and/or roles to accommodate the new TeleNeo consultations during the co-design session.

In ***Appendix C***, the iterated full-size workflow visualizations for the NICU and HC departments, including their priority layers (*Figures 59-60*), are presented in Dutch.

Next, I translated the introduced care activities for TeleNeo services between the NICU and HC (room tour, warm handover, joint daily round) into three new routine care activity blocks, maintaining a consistent visual style with the workflow visualizations (*Figure 33*). This approach aims to facilitate a comparison of the NICU and HC workflows during the session, enabling discussions on the best day and time for integrating the new TeleNeo consultations. Each consultation type has different responsibilities (and roles), so I created three separate blocks with widths corresponding to their average duration. Since the TeleNeo activities are new and do not yet have specified days, times, or roles, and there is no priority distinction among the three consultation types, I used another color (green) to represent the TeleNeo care activities instead of pink.

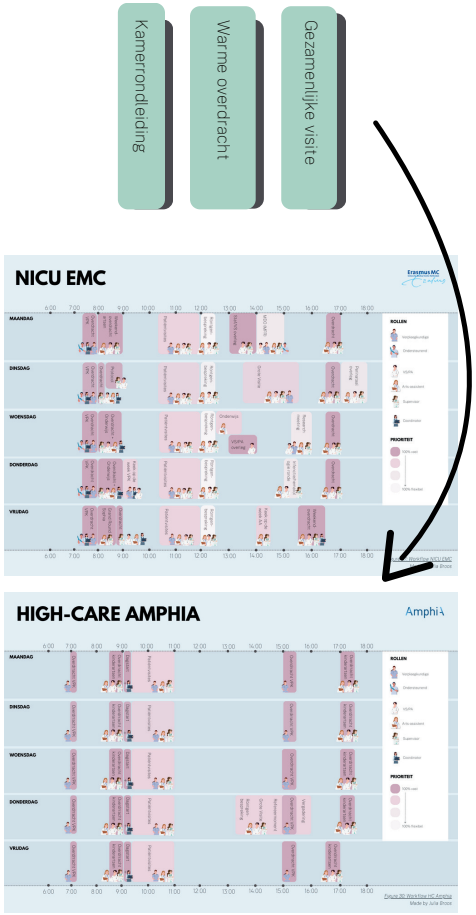


Figure 33: New TeleNeo care activity blocks
Made by Julia Broos

The next step in the design process involved making all care activity blocks within the existing NICU and HC workflows movable, except for the blocks having the highest priority (100% vast) since those are fixed regarding their specified day, time, and roles. This is visualized in *Figure 34*, where the blocks that are not 100% fixed are seperated from the visualized workflows and positioned alongside their initial days. By doing so, an interactive method is created because this allows healthcare professionals participating in the co-design session to freely rearrange the blocks, fostering discussion on the necessity of relocating certain activities to accommodate the introduction of a green TeleNeo consultation block. The research team anticipated each TeleNeo consultation occuring up to maximum three times weekly, resulting in nine TeleNeo blocks that are presented on top to be integrated into both workflows. This doesn't imply a TeleNeo consultation must always occur during these time blocks; however, the option is available, allowing for decisions to be made based on necessity.

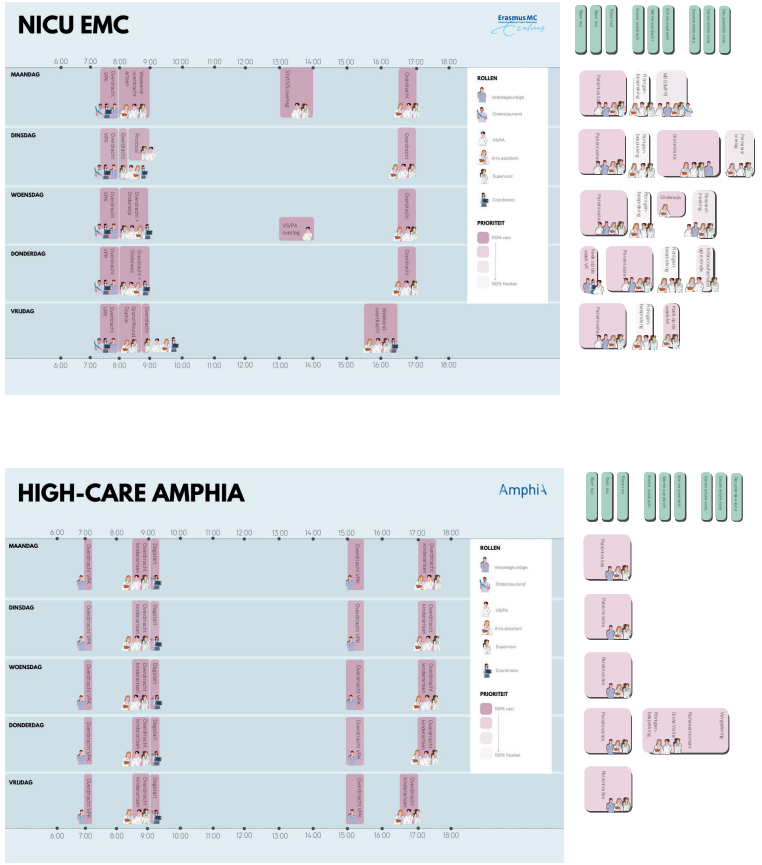


Figure 34: Interactive method creation for TeleNeo integration
Made by Julia Broos

5.7 Co-design Session

During the session, participants work towards the main objective by first collaborating in small groups, followed by collaborating all together. To facilitate this process, I have devided the session into three phases (*Figure 35*):

1. In the first phase, participants start by filling in the role allocation templates in small groups, using the role markers to assign roles to the TeleNeo responsibilities
2. In the second phase, based on the filled-in role allocation templates, participants position the assigned roles onto the corresponding green TeleNeo blocks of the template they have been working on. In ***Appendix C***, these blocks are presented in full- size *(Figure 61)*.
3. In the third phase, participants work all together on integrating the green TeleNeo blocks into the NICU and HC workflows. By providing the possibility to relocate flexible routine care activities and/or roles, participants can discuss their optimal common day and time

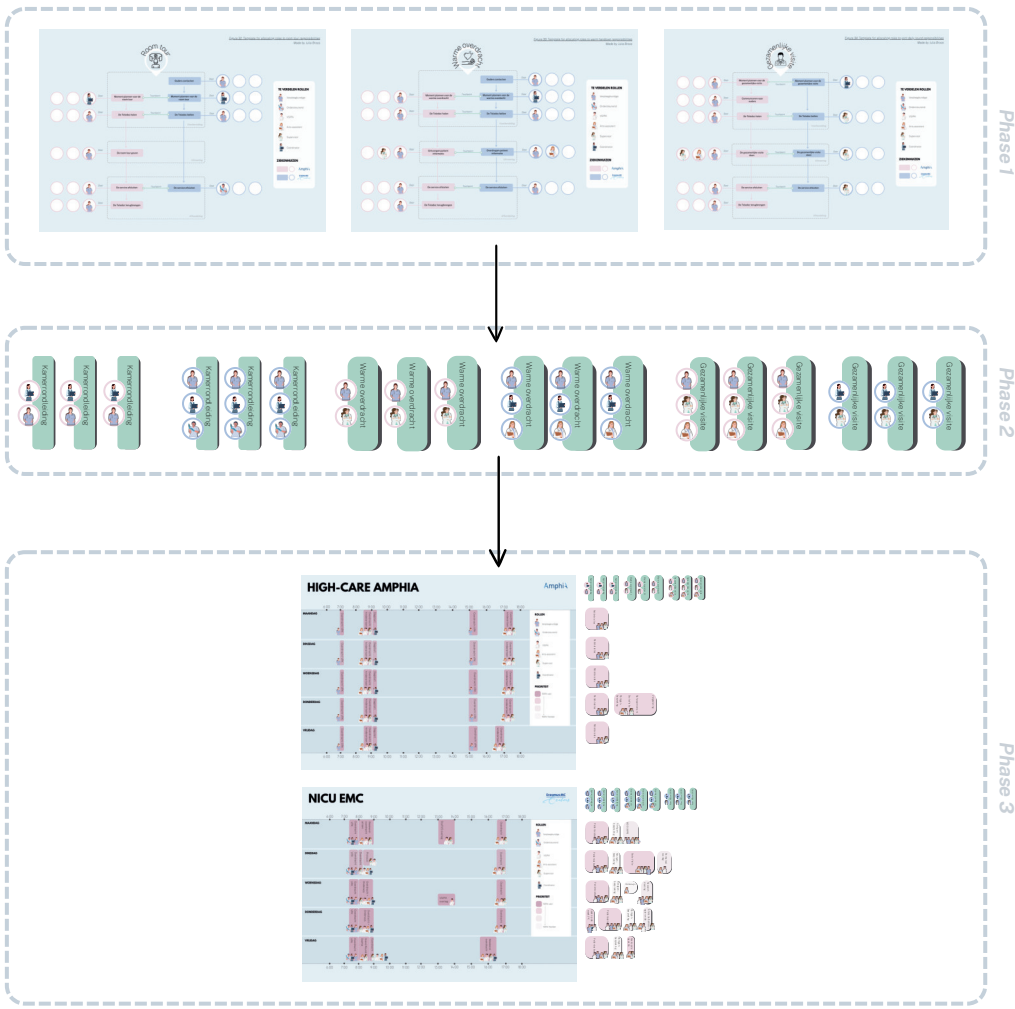


Figure 35: Overview co-design session process
Made by Julia Broos

5.7.1 Participants and Setting

For the co-design session, my goal was to bring healthcare professionals from both hospitals together. Since the TeleNeo services involve both the NICU and HC department, it is important to discuss their new responsibilities and optimal common day and time with healthcare professionals from both hospitals.

Returning to the roles present at the NICU and HC departments outlined in the visual content of the session (Nurse, Nurse-supporter, Nurse practitioner/physician assistant, Medical resident, Supervisor, Coordinator), I intended to ensure a representation of each role in the co-design session, except for the Nurse-supporter role, since this role has only one fixed responsibility in the workflow visualizations and can be considered an allrounder, adapting to the needs of nurses. The other roles possess knowlegde about whether a relocation of their presence in the workflows is feasible, making their input important. Additionally, I revisited the created stakeholder maps of *Figure 12* and *Figure 14* to verify whether the individuals representing these roles also have a high impact on the implementation.

This was confirmed, as all roles belong to stakeholder groups positioned in the core team, involved, definitive and/or dependent parts of the maps. During the participant selection, I aimed to ensure a balanced representation of individuals/roles and hospitals to create an equal and colloborative environment. This balance is highlighted as important by Sanders & Stappers (2008) for achieving comprehensive insights and fostering a sense of joint ownership. Due to the availability of healthcare professionals at the NICU and HC departments and a last-minute cancellation by a Pediatric Neonatologist from EMC, I was able to invite the outlined participants in *Figure 36* for the session. This resulted in the participation of two healthcare professionals from EMC and four healthcare professionals from Amphia.

Considering the setting for the co-design session, I decided to host it physically at one of the hospitals. This choice was driven by the interactive focus of the co-design session and the benefits highlighted by Serrat (2017), which emphasizes that a physical gathering offers greater collaboration between participants and enhanced interactivity with the materials compared to an online format. Organizing the co-design session at one of the hospitals also meant that only individuals from the other hospital would need to travel, increasing the likelihood of participation. The Amphia hospital, with its spacious meeting rooms, was considered the most suitable location. Therefore, the co-design session is held in one of the meeting rooms at Amphia. Two hours were allocated for the co-design session and catering was included.

Fulfilling the Role	*Role*	*Hospital*
Specialized nurse HC	Nurse	Amphia
Nurse HC	Nurse	Amphia
Medical resident NICU	Medical resident	EMC
Pediatrician HC	Supervisor	Amphia
Admission coordinator NICU	Coordinator	EMC
Team manager HC	Coordinator	Amphia

Figure 36: Participants co-design session

5.8 Concept Testing with IDE Students

For an initial concept testing round, three Industrial Design Engineering (IDE) master students were invited to provide feedback on the visual content and process of the visualization guided co-design technique from a designer's perspective. They were not asked about their knowledge of the medical content, as this will be addressed in the next round of testing with healthcare professionals. Instead, the focus was on the following aspects:

- Identifying points for improvement in the visualizations to enhance their usability and understandability
- Determining the most suitable way for making the care activity blocks movable, including testing poster buddies and Velcro stickers
- Assessing whether the process of using the two parts/methods during the co-design session follows a logical sequence of activities and how this can be improved

Figures 37-42 present the concept testing conducted with the IDE students. A comprehensive description of their feedback and iterations can be found in ***Appendix D***.

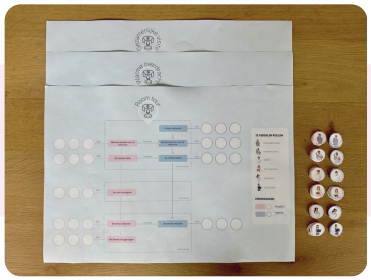


Figure 37: Content for testing the first method

Figure 38: IDE students testing the first method

Figure 39: Content for testing the integration of the first and second method

Figure 40: IDE students testing the integration of the first and second method

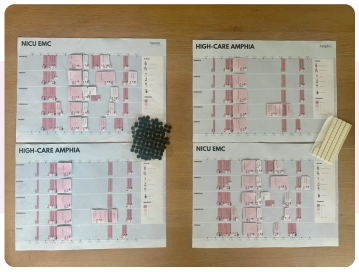


Figure 41: Content for testing the second method (left: Velcro stickers, right 2: poster buddies)

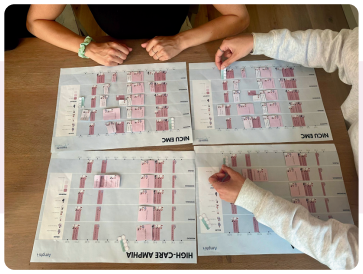


Figure 42: IDE students testing the second method

5.8.1 Iterations based on Feedback from IDE Students

After gaining valuable feedback from the concept testing with three IDE master students, I used the insights to iterate the concept. A summary of these iterations is visualized in *Figure 43* and their iterated full-size versions are presented in ***Appendix E***.

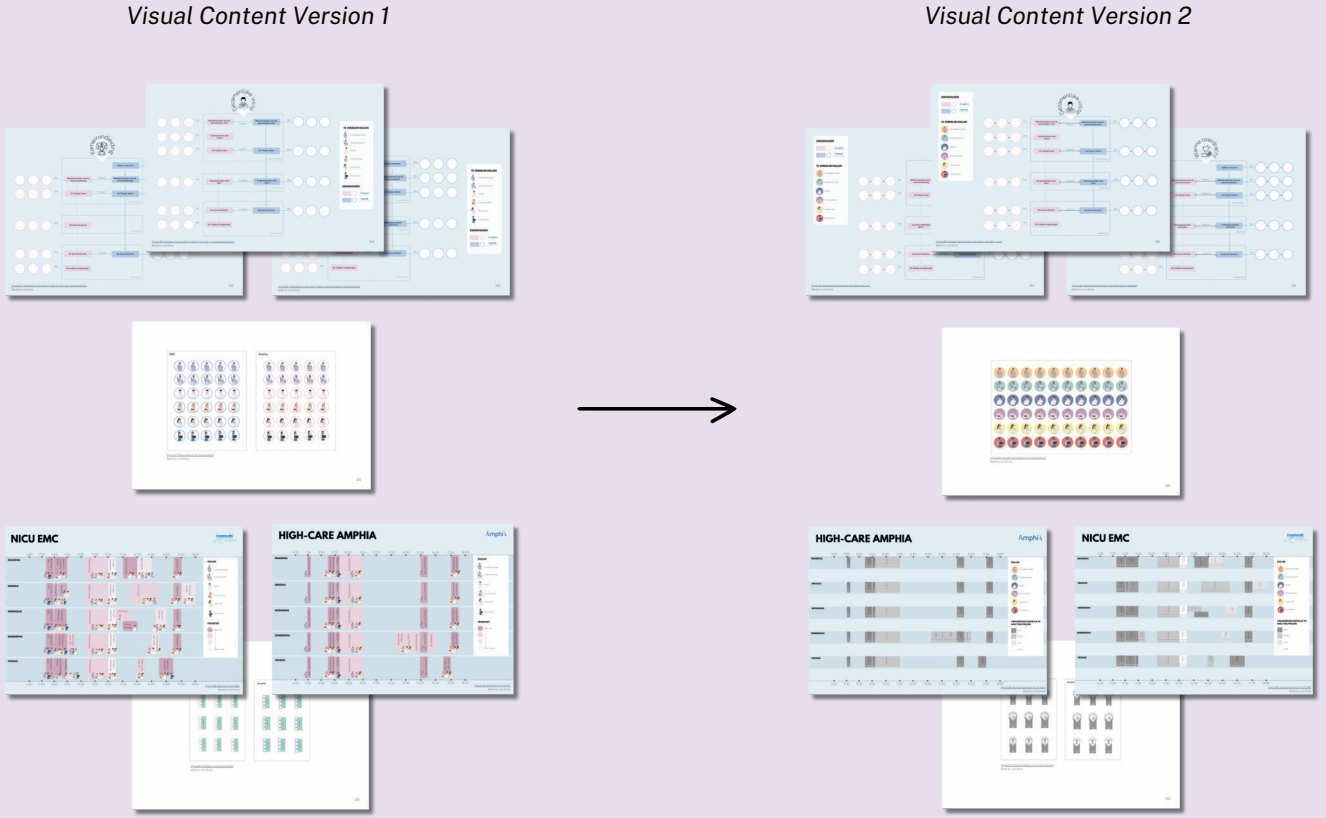


Figure 43: Iterations resulting from concept testing with IDE students

5.9 Concept Evaluation with Healthcare Professionals

After refining the concept based on feedback from IDE students, I evaluated the the iterated concept with healthcare professionals. This evaluation did not focus on the design's understandability or usability, as this was the aim of the first concept testing round, but on evaluating the visual content and co-design session process by using the expertise of healthcare professionals. For this second round of concept testing/evaluation, I invited two supervisors (one from each hospital department that has been interviewed) who will not be present at the co-design session. This decision ensures that all participants in the co-design session start with the same level of knowledge about the session's content, taking the determinants outlined in *Figure 24* for co-creation into account.

The concept evaluation involved a joint Microsoft Teams meeting with the healthcare professionals about the following aspects:

- Do the healthcare professionals agree with the necessary steps (responsibilities) for each type of TeleNeo consultation in the role allocation templates?
- Do the healthcare professionals agree with the three different phases of preparation, execution and follow-up in the role allocation templates?
- Is there a need to split the TeleNeo consultation blocks into the three different phases (preparation, execution, follow-up) to improve their integration possibilities as was questioned by the IDE students?
- What is their opinion regarding the number of planned TeleNeo consultations that need to be integrated into the NICU and HC workflows? Is it feasable to integrate three of each type, as anticipated by the research team?
- What is their advice regarding the formation of small groups for the first part of the co-design session? Is there a hierarchy I need to consider?

Figures 44 presents the concept evaluation with the healthcare professionals. A comprehensive description of their feedback and iterations can be found in ***Appendix F.***

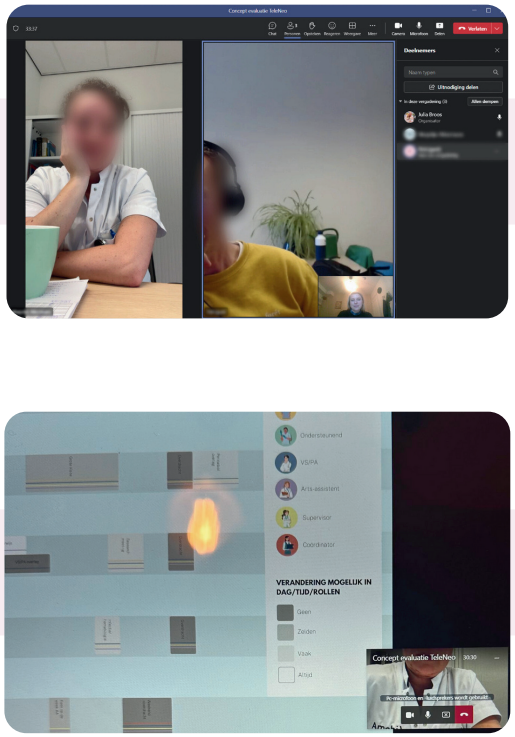


Figure 44: Healthcare professionals evaluating the visual content

5.9.1 Iterations based on Feedback from Healthcare Professionals

After gaining valuable feedback from the concept evaluation with two healthcare professionals, I used the insights to further refine the concept. A summary of these iterations is visualized in *Figure 45* and their iterated full-size versions are presented in ***Appendix G***.

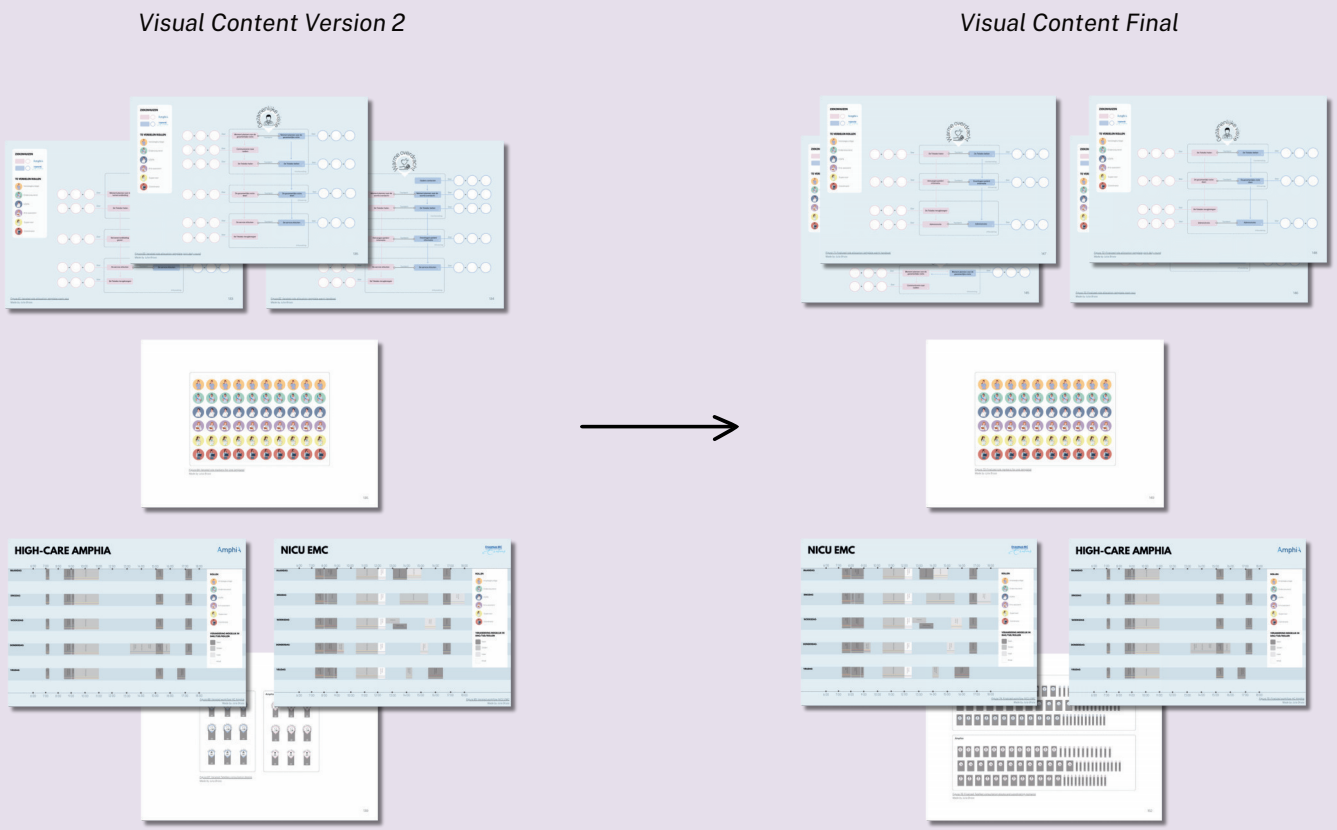


Figure 45: Iterations resulting from concept testing with healthcare professionals

5.10 CoVisioning Developed

Agenda and Planned Activities

The co-design session takes place at a meeting room at Amphia from 11:00-13:05 and catering is included. I created the planning that is presented in *Figure 46*. The co-design session starts with an introduction from my side, including providing information on my findings, goals and structure of the session. There is also room for getting to know each other and questions. Afterwards, the first part of the co-design session begins with the participants working in two small groups on the role allocation templates. At the end, the groups present the results to each other and there is room for discussion. Next, I included a break for the participants and position the allocated roles on the TeleNeo blocks to make the shift towards the second part of the co-design session. During the second part of the co-design session, the participants work all together on discussing the optimal common days and times for the three consultations by using the NICU and HC workflows and movable blocks. At the end of the co-design session, the particpants are asked for their feedback. On the following pages, a detailed description for each activity is provided.

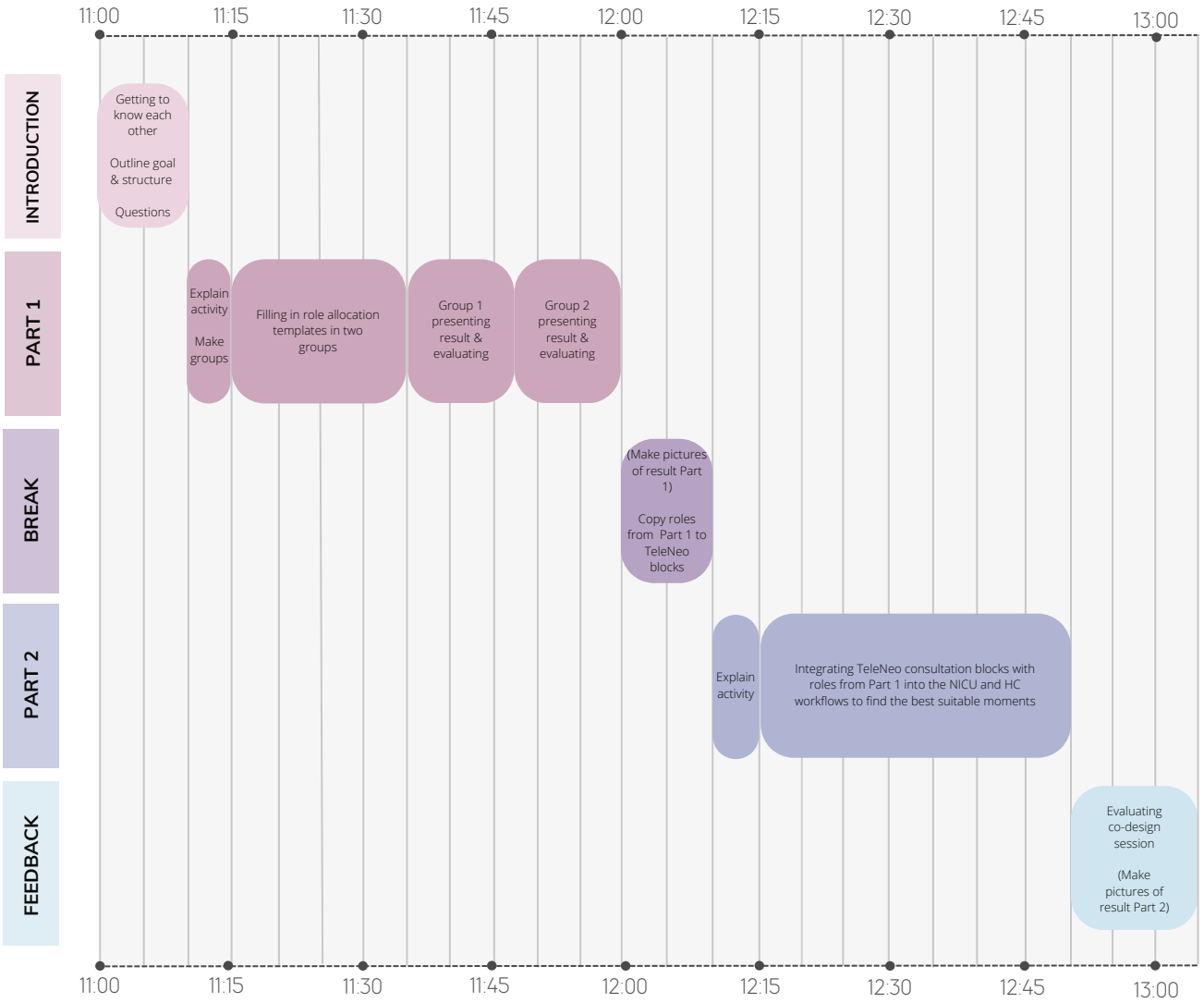


Figure 46: Planning session
Made by Julia Broos

Introduction (11:00-11:10)

Ten minutes are reserved for the introduction of the co-design session, starting with initiating an introduction round so the participants can get to know each other. Next, I continue with a short explanation of my project (purpose, goal, contribution) and share my findings on situation-specific barriers for the implementation of TeleNeo. The goal and structure of the co-design session are also outlined and the participants are asked whether they have any questions regarding my project, findings or the co-design session itself. Finally, it is emphasized that they are free to say or ask anything they want to foster a safe co-design session environment. Their permission to take pictures is also asked.

Part 1 (11:10-12:00)

Fifty minutes are reserved for the first part of the co-design session. Beginning by outlining the goal of the activity, which is to allocate the present roles at the NICU and HC to the new TeleNeo responsibilities, including a room tour, warm handover, joint daily round and coordination of these consulations in two groups. Next, the materials for the activity are provided and it is explained how to use the templates and role markers.

The two groups are then introduced, together with the templates:

Group 1: Medical resident NICU, Specialized nurse HC, Team manager HC *(room tour and joint daily round templates)*

Group 2: Pediatrician HC, Nurse HC, Admission coordinator NICU *(warm handover and coordinating consultations templates)*

As described above, Group 1 works on the role allocation templates for a room tour and joint daily round. This decision was initially made to include the Neonatologist from EMC in this group due to their critical role in the joint daily rounds. However, following a last-minute cancellation, I reassigned the Medical resident to this group to ensure as much of the specialized knowledge as possible. Group 2 works on the role allocation templates for a warm handover and coordinating the consultations, given the presence of the admission coordinator in this group and the involvement of this role in coordinating consultations. The templates were paired based on their anticipated difficulty to ensure that each group has an equally challenging set of activities.

Before the groups begin the activity, it is asked if there are any questions or unclearities. The guiding question to start the activity is: ***Who do you think should become responsible for the outlined TeleNeo responsibilities in the templates?*** Both groups have 20 minutes to work on their two role allocation templates simultaneously. During this activity, I am available for questions and monitor their progress. Once the groups have completed the activity, Group 1 presents their results, followed by a Q&A session with the other participants. Then, Group 2 present their results, followed by another Q&A session. The goal of this evaluation is to reach an agreement on the completed templates and have disucssion on the content. During the evaluation, I focus on the vertical perspective of the allocated roles within the templates and ask the following guiding question: ***By taking a vertical perspective on the allocated roles, is it possible to reduce the splitting of tasks?*** The objective of this question is to minimize the number of handovers within each TeleNeo consultation, fostering flexibility and self-direction within the NICU and HC departments.

Break (12:00-12:10)

Ten minutes are reserved as a break for the participants in between the first and second part of the co-design session. During this break, pictures are taken of the filled in templates for the documentation of the co-design session and the second part of the co-design session is prepared. This includes copying the allocated roles that resulted from the role allocation templates to the TeleNeo blocks and putting the visual method (workflow visualizations with movable blocks) on the table.

Part 2 (12:10-12:50)

Forty minutes are reserved for the second part of the co-design session. Beginning by outlining the goal of the activity, which is to collectively determine the optimal common day(s) and time(s) for the three planned TeleNeo consultations and their coordination. The provided materials have already been arranged during the break and its is explained how to use the workflows and movable care activity blocks. Whiteboard foil and magnets are used for this purpose.

To structure the activity, the following guidance is provided to the participants:

1. Search together for as many possible moments for coordinating and executing a room tour (seven minutes)
2. Search together for as many possible moments for coordinating and executing a warm handover (seven minutes)
3. Search together for as many possible moments for coordinating and executing a joint daily round (seven minutes)

The guiding question to start the activity is: ***Is it possible to integrate the TeleNeo consultations into existing routine care activities by considering the present and required roles?*** The objective of this question is to avoid unnecessary creation of new routine care activities for healthcare professionals at the NICU and HC. If participants conclude that integration is not possible, the follow-up guiding question is: ***How can the TeleNeo consultations be integrated into the workflows (by reallocating existing routine care activity blocks and/or roles if needed)?***

To provide material for reallocating roles, the flexible routine care activity blocks for both departments without predefined roles are printed. During the co-design session, changes can be made in the current roles within a department's routine care activity by using the process similar to the one that is used for integrating the first and second parts of the co-design session. After collectively identifying as many possible moments for each type of consultation, participants spend another fifteen minutes discussing the best suitable moments from the identified options. They are guided with the following question: ***Now that you have identified all the possible options for the TeleNeo consultations, what are the best options from these identified ones?***

Feedback (12:50-13:05)

The last fifteen minutes are reserved for evaluating the process and impact of the co-design session with the participants. First, the participants are thanked for their valuable contribution and ask for their feedback on the following aspects:

Process of the session

- How did you experience the co-design session?
- How do you feel about using the visual medium during the co-design session to have discussions?

Potential impact on determinants and current situation

- Do you feel the first part of the co-design session created clarity about the new TeleNeo roles and responsibilities?
- Do you feel the second part of the co-design session supported you in discussing the best suitable moments for TeleNeo consultations?
- How does this new division of responsibilities and scheduling compare to the current situation?

Back-up questions

- Do you think the results of the co-design session have the potential to be successfully implemented?
- Were the objectives of the co-design session clearly defined and met?
- What did you find most valuable about the co-design session?

Visual Content

The finalized visual content and supporting materials of CoVisioning are presented in *Figure 47* and consist of the following elements:

Figure 47: Materials CoVisioning

Role Allocation Templates and Role Markers (1)

Both printed on A3-sized paper with pre-cut role markers. Using Velcro stickers (which have already been placed on the empty spots and role markers), the role markers can easily be positioned on the empty spots during the co-design session. Each template is accompanied by an envelope containing role markers.

Colored Pencils (2)

Matching the role markers, these pencils are used to integrate the first and second part of the co-design session by copying the allocated roles to the corresponding TeleNeo consultation and coordination blocks.

NICU and HC Workflows (3)

The workflows, including their fixed routine care activities, are printed on A2-sized paper and positioned on whiteboard foil. The flexible routine care activity blocks are excluded from these visualizations and are printed on a separate A2-sized sheet. Using magnets, the flexible routine care activity blocks are placed in their initial positions within the workflows and can be moved around during the co-design session.

TeleNeo Consultation and Coordination Blocks (4)

Printed on A2-sized paper to be positioned on the workflows. For instances where role reallocation is necessary, versions of the flexible routine care activities without predefined roles are printed.

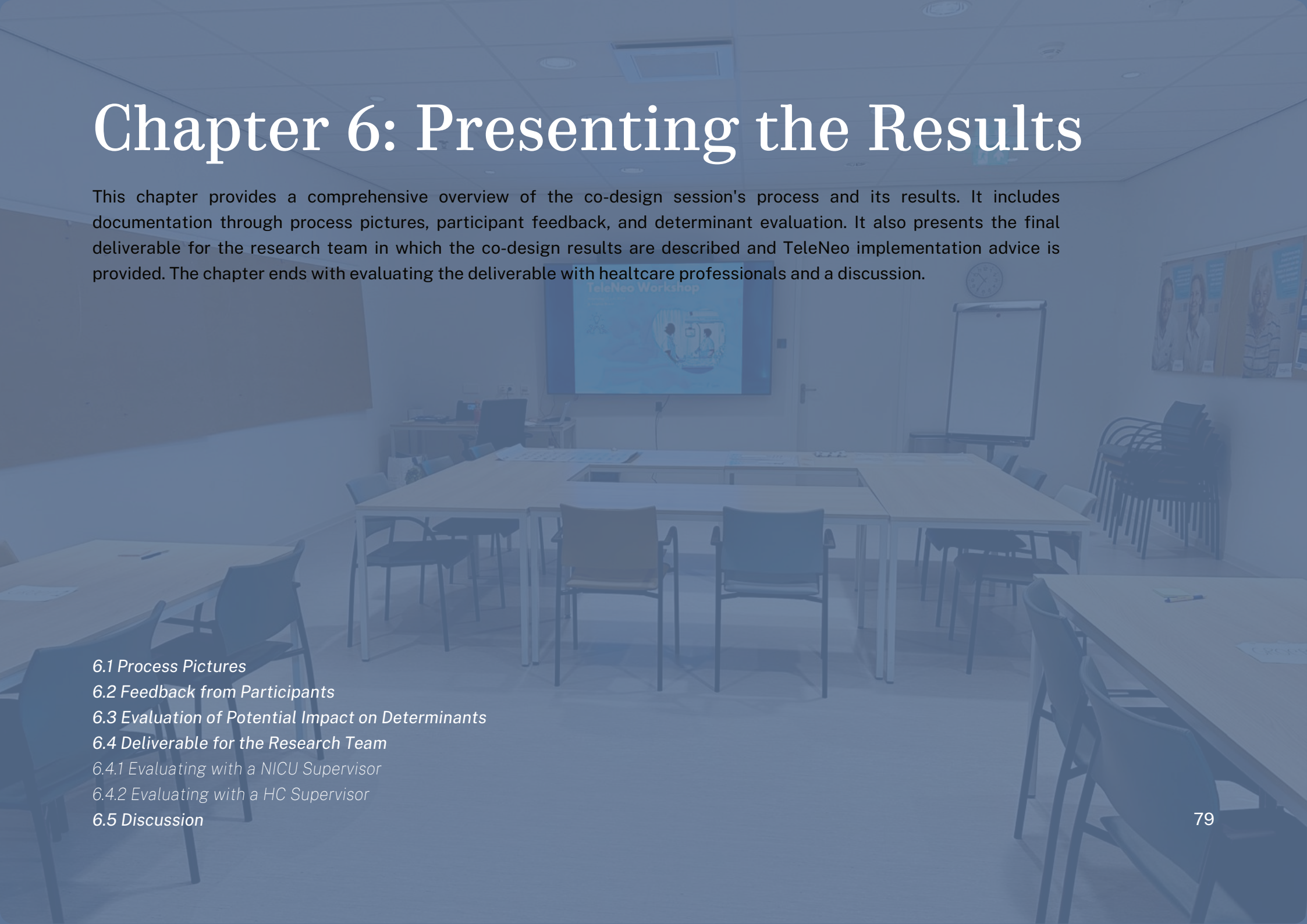
Slide Deck (5)

A slide deck is prepared to support the co-design session process, providing visual aids and structured guidance.

The following chapter presents the result of the co-design session.

Chapter 6: Presenting the Results

This chapter provides a comprehensive overview of the co-design session's process and its results. It includes documentation through process pictures, participant feedback, and determinant evaluation. It also presents the final deliverable for the research team in which the co-design results are described and TeleNeo implementation advice is provided. The chapter ends with evaluating the deliverable with healtcare professionals and a discussion.



6.1 Process Pictures

When preparing for the co-design session, I decided to rearrange the room at Amphia to foster an optimal environment for the session. The primary adjustment I made was the creation of a central collective island directly facing the presentation screen. This served as the central point for the co-design session's introduction, explanation of its activities and closing. After explaining the first activity, the group was devided into the two smaller groups, each stationed at tables positioned on opposite sides of the meeting room. This arrangement facilitated focused group work during the first part of the co-design session. Transitioning into the second part of the co-design session, participants regathered at the main table to collaboratively engage with the material. Before starting, I asked the participants' consent to capture moments of the co-design session. Below, the captured moments are presented (*Figures 48-53*).

Figure 48: Room setup

Figure 49: Participants working on the first activity

Figure 50: Group 1 working on their templates

Figure 51: Group 2 working on their templates

Figure 52: Participants evaluating the first activity

Figure 53: Participants working on the second activity

6.2 Feedback from Participants

At the end of the co-design session, time was allocated to gather feedback from the participants regarding the process of the co-design session and the utilization of visualizations as a medium for having discussions. Their feedback has been recorded and analysed.

Question 1: How did you experience the co-design session?

Participants found the co-design session insightful and valuable for understanding the workflows and responsibilities from both sides. One participant remarked, *"I found it very insightful to gain a better understanding of both sides in terms of how roles currently opperate and how and when care activities are executed''.* Another participant highlighted the importance of discussing workflow details, stating, *"It's nice to think about and discuss workflows in a way we are not used to."* Furthermore, participants noted the variability across the hospital departments and value of gaining awareness of the diversity of approaches across different settings, with one saying, *"It's funny to see that things can still change and that it's arranged differently in all hospitals."*

Moreover, there was recognition of the importance of understanding workflows and roles, with a participant mentioning, *''These are things you should really talk about. Understanding the workflow on both sides. "What are we doing? What are you doing? Who is needed for it? It's nice to discuss that like this."*

Question 2: How do you feel about using the visual medium during the co-design session to have discussions?

Participants found the visual tools easier and more insightful than verbal or digital discussions. One participant expressed, *"For me, those visualizations made it easier to have a conversation and more insightful than just talking or digital."* Additionally, the ability to manipulate visual tools was appreciated. They valued the ability to move things around in order to engage in conversations and address key points, with a participant saying, *"When you're working on it, I find it easier. Being able to move things around and see the effect, I like that. And then have a conversation together."* Furthermore, participants valued the quick pace facilitated by visual tools, as mentioned by one participant: *"I also liked the quick pace. Right away to doing something and talk about it by seeing it.''* Moreover, participants found discussing scheduled moments for TeleNeo consultations by using visualizations beneficial, with one mentioning, *"Discussing fixed moments was great because it was already prepared and structured. Therefore, we could immediatley talk about the core issues.''*

To conclude, the co-design session was highly appreciated by participants, who found it insightful and valuable for understanding workflows and responsibilities from both sides. The session highlighted the importance of discussing workflow details and recognizing the variability across hospital departments. Moreover, the use of visual tools proved to be more effective than verbal or digital discussions. Participants appreciated the ease and clarity provided by visualizations, which facilitated more engaging and insightful conversations. The ability to manipulate visual tools to explore different scenarios and address key points was particularly valued and the quick pace allowed for immediate and focused discussions on core issues.

6.3 Evaluation of Potential Impact on Determinants

In addition to gathering feedback from participants on the co-design session process and the use of visualizations as a discussion medium, the potential impact on the two situation-specific barriers (determinants) was evaluated with them:

- Determinant 1: Unclear allocation of healthcare professionals' roles plus assigned responsibilities regarding the setup, execution, and follow-up of TeleNeo consultations
- Determinant 2: Difficulties in planning and scheduling consultations because of logistics, agendas and flexibility within hospital departments

Their feedback has been recorded and analysed.

Impact on Determinant 1

To evaluate the impact on the first situation-specific barrier for TeleNeo implementation, the participants were asked the following question: *Do you feel the first part of the co-design session created clarity about the new TeleNeo roles and responsibilities?*

The first part of the co-design session helped participants start thinking about the new roles and responsibilities, even if the final decisions were not yet made. One participant noted, *"It has at least started us thinking about it. How we exactly divided it might not be final yet. But at least who has which role"*, indicating an initial step towards clarifying responsibilities. This demonstrates that the co-design session effectively began the process of defining roles, even if further refinement is needed. Participants also recognized the importance of including various roles in the implementation planning, such as Nurse Practitioners, which had previously been overlooked by the departments, as one participant noted: *"For me, it's about the Nurse Practitioners. We don't involve ours in this at all."* This suggests an created awareness of the need to consider a diverse range of roles in defining responsibilities. Moreover, there was discussion about the balance between training and expertise, with one participant stating,

"Especially for younger children, you miss someone who's always there, who has a lot of experience. They could be trained for it, but it's still being held back." This reflects consideration of the necessary skills and experience required for different tasks. Furthermore, participants highlighted the need for feedback mechanisms and documentation, as mentioned by one participant: *"We need a sort of feedback moment, it can also be digital or something like a half-hour feedback session. A work document to be read by several people might be the easiest"*, suggesting an acknowledgment of the importance of clear communication and documentation in assigning the responsibilities before implementing them.

To conclude, the evaluation revealed that the first part of the co-design session made significant progress in addressing the issue of unclear role and responsibility allocation among healthcare professionals regarding the setup, execution, and follow-up of TeleNeo consultations.

Additionally, it has highlighted the importance of diverse role inclusion, training, expertise, and effective communication. This initial step is crucial for overcoming the barrier and sets the stage for more detailed and refined decision-making by the research team.

Impact on Determinant 2

To evaluate the impact on the second situation-specific barrier for TeleNeo implementation, the following question was posed to the participants: *Do you feel the second part of the co-design session supported you in discussing the best suitable moments for TeleNeo consultations?* Participants responded positively to the interactive nature of the second part of the co-design session, emphasizing its practicality in addressing scheduling challenges. They appreciated the ability to manipulate visual elements to explore integration possibilities, with one participant noting, *"I found it very supportive. Very handy. Because it's interactive/movable, it made it nice to discuss the possibilities for integrating the consultations. You could see what could be changed or not."*

Moreover, participants valued the comparative aspect of the technique, which enabled them to analyze differences between hospital departments regarding scheduling practices. This comparative view was essential for identifying potential challenges and aligning schedules across different disciplines, as one participant explained, *"It was helpful to see the differences between hospitals, seeing everything at a glance what a group does compared to another was beneficial. It provided clarity on how to coordinate schedules effectively."* Furthermore, the session facilitated interdisciplinary collaboration, which participants recognized as crucial for addressing scheduling difficulties. By involving various departments early on and allocating roles strategically, participants could navigate the scheduling challenges more effectively. One participant highlighted this by stating, *''By gaining insights into who needs to be present during TeleNeo consultations and having different disciplines together, we could have meaningful discussions on the best consultation possibilities for the NICU and HC.''*

In conclusion, the second part of the co-design session effectively facilitated discussions where participants identified and agreed upon the best suitable moments for each type of TeleNeo consultation for the departments. The interactive and comparative approach enabled thoughtful decision-making regarding scheduling processes across the involved hospital departments. Participants appreciated the opportunity to visualize and adjust schedules collaboratively, ensuring that logistical challenges related to planning and flexibility were addressed. This outcome underscores the session's success in directly addressing the second situation-specific barrier by fostering consensus among stakeholders and strategically aligning schedules to accommodate TeleNeo consultation moments.

Impact on the Current Situation

Finally, the impact of the new division of responsibilities and scheduling on the current situation was evaluated by posing the following question to the participants: *How does this new division of responsibilities and scheduling compare to the current situation?* Participants discussed that the structured nature of the new responsibilities and fixed moments emerged as a significant improvement over the previous arrangement where the research team handled all aspects of the consultations. One participant stated, *"That the function will have a role is better than having the research team doing all necessary stuff for the consultations. And that they ultimately can step out."* Reflecting on their experiences, participants valued the discussions around integrating the new responsibilities and consultations into existing routines. They recognized the importance of not only scheduling fixed moments but also ensuring effective execution within daily workflows: *"We have discussed a lot about how to build it into the routine, not just the moments but also how to execute them, which is a good thing because routine works best for most things."*

Furthermore, there was recognition of the importance of regular communication and documentation between the two hopsital departments, with one participant mentioning, *"When moving forward with this new division of responsibilities and scheduling, regular communication about coordinating consultations is essential and we need to think about how to document and register them."*

Overall, participants perceived the new division of responsibilities and scheduling as a structured improvement that enhances clarity and efficiency compared to the current approach during the pilot phase. They highlighted the advantages of integrating these changes into routine practices and emphasized the importance of effective communication and documentation across the NICU and HC departments to sustain their successful implementation.

6.4 Deliverable for the Research Team

Based on the outcomes from healthcare professionals at EMC and Amphia utilizing CoVisioning, a comprehensive deliverable was developed for the research team (***Appendix H***). This document presents the results of the co-design session, detailing the roles assigned to healthcare professionals at the NICU and HC for the new TeleNeo responsibilities. Additionally, it provides recommendations on the most suitable times for planned TeleNeo consultations, supported by both textual explanations and visualizations.

The purpose of this deliverable is to equip the research team with a document that can be distributed across the NICU and HC departments and presented to the staff to facilitate the next steps in the TeleNeo implementation process. This document is evaluated with supervisors from both the NICU and HC departments who were not present at the session. This approach ensures an unbiased review and evaluation of the co-design session results and the potential impact on the situation-specific determinants.

6.4.1 Evaluating with a NICU Supervisor

To start with, the deliverable was evaluated with a supervisor from the NICU, who is also a member of the research team. The key points discussed are summarized below:

Usefulness and Helpfulness

The deliverable was deemed useful and helpful by the supervisor to support the next steps in the implementation. It was recommended to add a summary, highlighting the outcomes and advisory points for each type of TeleNeo consultation, because this structure allows for quick insights without delving into the detailed content, addressing time-constrained readers. From the perspective as a member of the research team, the deliverable was appreciated to inform the staff and present the best suitable moments and roles resulting from the study. Additionally, it was noted that the action points outlined in the deliverable have already been discussed and adopted by the research team.

Visualizations

The revised workflows with integrated consultations and roles were highly valued, allowing healthcare professionals to gain insights into the routine care activities and roles of the other department, fostering a collaborative and informed approach to patient care and tasks. The supervisor appreciated the visualizations for their clarity and the comprehensive understanding they offer on the effect of allocating responsibilities and integrating TeleNeo consultations into current workflows. There was no need for additional visualizations to be added to the deliverable.

Impact on the Situation-specific Barriers

The deliverable is anticipated to positively impact the situation-specific barriers. It was highlighted that the clear visual representations of responsibilities and roles can address uncertainties among staff, ensuring that roles are well-defined. Moreover, the revised workflows can streamline planning processes, making it easier to manage schedules effectively. The supervisor noted a significant increase in awareness and proactive engagement among staff following the session, which has led to noticeable improvements in communication and planning of consultations. Specifically, based on the session's results, there has been a structured implementation of regular consultation planning meetings, now scheduled every Monday.

This regular contact moment enhanced coordination and ensured that upcoming consultations are efficiently planned and communicated among team members.

Additional Notes

Action points and detailed arguments should be separated from the main summary to maintain clarity and focus on essential information.

Conclusion

To conclude, the deliverable was positively received. The addition of a summary can highlight outcomes and advisory points for TeleNeo consultations, offering quick insights for busy readers and guiding staff on the upcoming implementation steps. The clear visualizations of revised workflows were particularly appreciated for enhancing collaboration and clarifying roles among staff members. The supervisor also observed improvements regarding the communication and planning of TeleNeo following the session, including the establishment of a regular consultation meeting, which has boosted team coordination and operational efficiency. Moving forward, maintaining clarity by separating detailed arguments can strengthen the deliverable's impact.

6.4.2 Evaluating with a HC Supervisor

Next, the deliverable was evaluated with a supervisor from the HC. The key points discussed are summarized below:

Usefulness and Helpfulness

The deliverable was considered valuable and insightful by the supervisor in comprehending the results of the co-design session and the potential impact on the healthcare departments and their roles as supervisors. It was again recommended to include a summary that emphasizes the outcomes and advisory points for each type of TeleNeo consultation to ensure it will be read by healthcare professionals at the HC.

Visualizations

The supervisor expressed particular enthusiasm about the role allocation visualizations for the warm handover and joint daily round, highlighting their effectiveness in providing a comprehensive overview of the departmental impact and contact points during each phase of the consultation. The supervisor recommended including the optimal timing suggestions at the top of the templates to incoporate all relevant information into a single overview for each consultation type.

The visualizations can then be included in the operational instructions as supportive material. No further visualizations were deemed necessary to improve the deliverable.

Impact on Situation-specific Barriers

The supervisor expects that the outcomes of the co-design process, as presented in the deliverable, will effectively address the situation-specific barriers. On the one hand, the clear allocation of responsibilities and roles can help staff understand their duties and identify the appropriate points of contact for specific tasks, thereby reducing the current confusion within TeleNeo service delivery. On the other hand, the supervisor emphasizes that implementing a weekly planning meeting at the start of each week to discuss TeleNeo consultations will aid in integrating them into routine practices. Moreover, communicating the optimal timing for each type of TeleNeo consultation by the research team, identified through sessions with healthcare professionals, is anticipated to be positively received by staff, promoting successful adoption and effectively addressing scheduling challenges.

Additional Notes

The proposal to create a video to replace the room tour consultation is regarded as highly advantageous for saving time. The supervisor confirms that integrating it during the warm handover until that time is feasible.

Conclusion

The supervisor found the deliverable valuable for understanding the co-design session results and their impact on healthcare departments. It was suggested to add a summary highlighting outcomes and advice for each TeleNeo consultation type. In particular, the role allocation visualizations for warm handovers and joint daily rounds were appreciated, recommending the integration of optimal timing suggestions into these templates for clarity in operational instructions. The supervisor expects that the co-design outcomes will effectively address the situation-specific barriers by clarifying roles and implementing weekly planning meetings for TeleNeo consultations. The proposal for a time-saving video for replacing the room tour consultation was also supported.

6.5 Discussion

Returning to the main objective of the co-design session, which was to *''Co-create revised NICU and HC workflows that effectively integrate the three planned TeleNeo consultation types with clearly presented allocated roles''*, it can be concluded that the co-creation was successful.

Firstly, the role allocation templates were useful for clarifying the new responsibilities and roles of healthcare professionals regarding the setup, execution, and follow-up of planned TeleNeo consultations, including room tours, warm handovers, and joint daily rounds. However, final decisions have yet to be made. Secondly, the interactive elements of the workflow visualizations fostered discussions among healthcare professionals. These discussions focused on determining the optimal common day and time for integrating the three planned TeleNeo consultation types into existing workflows. As a result, revised NICU and HC workflows were generated that effectively integrate the three planned TeleNeo consultation types, with clearly presented allocated roles.

Reflecting on the planned activities described in *Section 5.10* and my experience during the co-design session, I believe it would have been more effective to adjust the duration of the first and second activity. Less time was required for filling in the role allocation templates than initially anticipated. However, during the evaluation round, discussions took longer than expected, and I encountered challenges in redirecting participants, resulting in lengthy and sometimes tangential conversations. During the second activity, participants had sufficient time to identify the most suitable moments for TeleNeo consultations, but an additional round of discussion/evaluation would have been beneficial. Therefore, I propose allocating forty minutes for the first activity and extending the second activity to fifty minutes. Next, the division of groups worked smoothly, and each group possessed sufficient department-specific knowledge to complete the role allocation templates effectively. Although I wasn't able to include the roles of a Neonatologist and Nurse practitioner/Physician assistent during the co-design session, it would have been valuable as their significance within the departments was discussed multiple times.

Moreover, unexpected outcomes arose from the first activity. During the evaluation round on role allocation, participants concluded that executing a room tour every time was not desirable as it was experienced as inefficient and time-consuming. Instead, they suggested creating a video that could be shared with parents to showcase the designated room at Amphia. Until then, the room tour will be executed during the warm handover. This decision led to the exclusion of discussing the room tour role allocation template and integrating the room tour consultation blocks into the workflows. Additionally, I was pleasantly surprised by the interaction among participants during the second activity. When discussing optimal moments to integrate TeleNeo consultations into existing workflows, there were instances where participants demonstrated a willingness to meet halfway. Even when integration was possible but not strongly desired, there was room for negotiation and compromise. This interactive approach highlighted the flexibility and collaborative spirit among the participants involved.

As previously explained, the revised NICU and HC workflows with integrated TeleNeo consultations and roles are not yet definitive. Therefore, participants suggested that the departments need a working document to be reviewed by several people. This aligns with the deliverable for the research team I created. In addition to my evaluation of this document with a supervisor from each department, I recommend that the research team will use it to schedule a feedback session (digital or physical) to discuss the suggested roles and timings for the implementation planning.

Chapter 7: Exploring Transferability

This chapter delves into the exploration of transferability in the context of visualization guided co-design techniques. Through comprehensive guidelines and evaluations, it aims to explore how the designed technique for this project can be applied across different contexts—from scaling-up TeleNeo to other hospitals beyond EMC and Amphia to broader applications in diverse fields such as PreViS and Oncology. It ends with a general conclusion on the transferability of CoVisioning.

7.1 Evaluating Guidelines

The created guidelines for developing a similar visualization guided co-design technique and utilizing it during a session with healthcare professionals can be found in ***Appendix I***. The evaluation of these guidelines focused on two main aspects: the transferability of the technique to the specific context of TeleNeo and its applicability to other contexts within digital health solution implementation.

7.1.1 Transferability to the Same Context

To explore the transferability to the same context (Neonatology) but a different hospital, I had a conversation with a Pediatrician from the Albert Schweitzer Hospital in Dordrecht. This hospital, which is next in line for TeleNeo implementation after the pilot, is comparable to the Amphia Hospital. Like Amphia, Albert Schweitzer is a peripheral hospital offering high-care neonatal services and would receive patients from EMC to address the capacity issues at the NICU in Rotterdam. In this conversation, the main objective was to discuss the potential of organizing a similiar co-design session for the Albert Schweitzer Hospital to support the implementation. I recorded and analysed the conversation, resulting in the following insights:

The Pediatrician from Albert Schweitzer expressed strong support for organizing a similar co-design session in preparation for the implementation of TeleNeo. Emphasizing the importance of interdisciplinary collaboration, the supervisor noted, *"It is super valuable to bring different disciplines together in such a way because it typically doesn't happen like this; usually, decisions are made and then executed without this level of discussion."* Furthermore, the Pediatrician highlighted the potential of such a session to foster staff participation and ownership in the implementation process, stating, *"It's crucial to give people the feeling that they can contribute their ideas and thoughts, especially for nursing staff, to involve them much more in the implementation."* The Pediatrician believes that adopting an inclusive approach can lead to better adoption of TeleNeo by ensuring that staff understand their roles and responsibilities within the new framework. Regarding staff readiness to participate in such a co-design session, the Pediatrician expressed confidence, suggesting that transparent and inclusive planning would collect sufficient interest among their team, highlighting,

"Having these discussions out in the open helps everyone see how their roles fit together and how they can support each other, and it's crucial that everyone understands how these changes will affect their daily work and the overall workflow."

The Pediatrician acknowledged that while some roles at Albert Schweitzer might differ from those at Amphia, the basic structure of the responsibilities could be adapted similarly. The Pediatrician felt that reviewing the role allocations and workflows determined in the initial session would still be beneficial for their context. Adjustments might be necessary, but the foundational work would provide a good starting point. Therefore, the deliverable for the research team is shared with the Pediatrician.

In conslusion, organizing a similar co-design session at Albert Schweitzer offers a promising approach to enhance the implementation in Dordrecht after completing the pilot. Given that Albert Schweitzer's role in the TeleNeo service is similar to that of Amphia, the structure from Amphia can be adapted (regarding care activities and roles) and customized for the session to fit the context of Albert Schweitzer.

PreViS

To explore the transferability to another context within digital health solution implementations, I had a conversation with a service designer about the PreViS project. PreViS, known as "Prehospital Video in Collaboration," aims to enhance emergency medical services through real-time video technology, improving communication and decision-making processes among healthcare providers during emergencies (PreViS - Prehospital Video I Samverkan, n.d.). The conversation highlighted the significant potential of visual methods in clarifying roles and responsibilities within complex service environments. It was noted that visualizing roles and tasks that may otherwise be ambiguously defined can greatly benefit project clarity and execution, saying *"You might think that a healthcare professional does it but they do not, so define tasks that no one owns. Roles and responsibilities are a great thing to visualize."* Additionally, there was an emphasis on the importance of clear communication in familiar language and the strategic timing of using visual methods in projects like PreViS.

Regarding implementation challenges, the designer mentioned the shift towards co-creation in task assignment, stating, *"Giving tasks without co-creation, most often. But we are moving towards co-creation"*, which aligns with the collaborative approach of the visualization guided co-design technique. The direction of the approach was acknowledged as positive, noting, *"Your way of visualizing it is a step in the right direction."* Moreover, organizational capacity emerged as a critical factor for sustaining such initiatives, with an acknowledgment of the need for sufficient internal resources and expertise to ensure ongoing success beyond initial implementation phases. In terms of practical application, it was highlighted that visualizations could improve understanding of processes before and after each stakeholder's involvement in the service. There was expressed interest by the designer in leveraging this concept in future projects, particularly in scenarios like scheduled calls within PreViS, where efficient communication and workflow optimization are paramount.

In conclusion, the interview provided valuable insights into leveraging visualization guided co-design techniques across diverse projects, underscoring their potential to enhance stakeholder collaboration and optimize service delivery in other digital health implementations like the PreViS project.

Oncology

To delve deeper into the applicability of a visualization guided co-design technique in contexts beyond TeleNeo, I engaged in a discussion with a designer involved in implementing digital health solutions, specifically focused on shared decision-making tools in oncology at a hospital in Zaragoza. During our conversation, the designer expressed insights on the potential of applying the co-design technique: *"We didn't really map the service, but we are also looking into how to implement decision support tools, which are also digital tools. I think it could be quite valuable for a hospital in Zaragoza, even though it's an oncological service. They are strict with their times and activities, but I think this could definitely work."*

Here, the designer highlighted the applicability of the co-design technique beyond its original context, suggesting that despite differences in service mapping and digital tool implementation, there is potential value in using such methods for oncology-related decision-making processes. By following the guidelines, the service steps for this type of digital health solution can be outlined to map the service responsibilities

The designer also highlighted potential applications of the co-design technique within the context of creating visual representations and clarifying task distributions: *"It might be used to create a visual map of all the tasks that need to happen within the same consultation. This could help address their current implementation issues, particularly in clarifying responsibilities from doctors to nurses."* Regarding the implementation of this digital health service, the designer emphasized that employing the co-design technique could facilitate decision-making on who should be involved at different stages: *"Deciding when to dedicate time for different tools like decision support tools, metaphor menus, and metro mapping is crucial. We also need to consider how much training is necessary for healthcare staff to effectively use these tools in their roles."*

Next, enthusiasm and familiarity with co-design methodologies among participants were identified as key factors influencing their willingness to engage in such activities. The designer emphasized that stakeholder readiness and leadership support play crucial roles in determining the success of the session. Regarding the collaborative nature of the co-design approach, the designer emphasized its added value: *"I think there is added value in doing it together. They need to feel like part of the process; otherwise, there's tension about imposing something without considering their needs."* Here, the designer underscored the importance of inclusivity and stakeholder involvement in decision-making processes to avoid potential resistance or tension. By involving stakeholders in the co-design process, there is an opportunity to align objectives and ensure that the proposed solutions meet the actual needs and expectations of the users. Regarding the logistical challenges of organizing such sessions, the designer mentioned: *"It can be complicated to conduct these sessions as a single 2-hour process. We might need to split them into manageable sub-tasks to accommodate the busy schedules and operational demands of healthcare settings."*

The designer's experience underscored the need for adaptable scheduling strategies and careful consideration of participants' availability to facilitate effective engagement and participation. When discussing the optimal timing for utilizing this approach, the designer suggested: *"It would work best at a very early stage of the project. We could gather initial insights about the service from key informants to understand its nuances before hosting the co-design session.''*

In conclusion, the interview with the designer highlighted the potential benefits of adopting visualization guided co-design techniques in the implementation of a digital service in Oncology settings. While acknowledging the unique challenges and complexities of healthcare environments, particularly in different geographical contexts like Zaragoza, the designer emphasized the importance of tailored approaches that consider local dynamics, stakeholder readiness, and collaborative activities to enhance decision-making services in Oncology.

Conclusion

When implementing digital health solutions, applying CoVisioning is particularly advantageous due to the unique characteristics of this context. In healthcare, there are numerous distinct roles and strict regulations determining who is allowed to perform certain tasks, necessitating clear agreements on new responsibilities. Additionally, multiple actors are often involved in a digital solution, requiring the alignment of various workflows to integrate new processes effectively. Reflecting on the transferability of CoVisioning to other contexts, the following conclusions can be drawn:

1. **Static Visualizations:** these can be utilized in any organizational context, including those outside the domain of digital health solutions, to create clarity on responsibilities, roles, and workflows.
2. **Dynamic Visualizations in a Co-design Session:** these are particularly beneficial for engaging multiple stakeholders. Utilizing the interactive role alocation templates and workflows during a physical session with stakeholders working with the new service helps achieve alignment, fosters meaningful discussions among participants, and explores potential changes to existing systems due to new responsibilities and processes. This setting provides a structured yet interactive environment that is favorable for collaborative problem-solving and innovation.

Chapter 8: Discussion & Conclusion

In this chapter, the discussion and conclusion of the study are explored. It starts with an interpretation of the results. Following this, the limitations encountered throughout the study are addressed, offering a critical perspective on the challenges and constraints faced. Additionally, directions for future research are proposed. Highlighting the significance of the thesis, its contributions to the field are examined, emphasizing its impact on current knowledge and practice. Concluding this chapter, the key insights and outcomes of the study are summarized.

8.1 Interpreting Results

The study addressed two main research questions:

1. RQ1: What are the main determinants for a successful implementation of TeleNeo in the pilot project setting?
2. RQ2: How can visualization support the transition from pilot to full implementation of TeleNeo?

What are the main determinants for a successful implementation of TeleNeo in the pilot project setting?

Based on a literature review on determinants to TeleNeo implementation in other countries and twelve stakeholder interviews, the following two situation-specific barriers have been identified as the main determinants for a successful implementation of TeleNeo in the pilot project setting:

Determinant 1: Difficulties in planning and scheduling consultations because of logistics, agendas and flexibility within hospital departments

Determinant 2: Unclear allocation of healthcare professionals' roles plus assigned responsibilities regarding the setup, execution, and follow-up of TeleNeo consultations

Upon reviewing the literature on barriers to TeleNeo implementation in other countries, as examined by Fang et al. (2018), Jagarapu & Savani (2021) and Makkar et al. (2021), several common challenges were anticipated. These typically included technological issues, resistance among healthcare providers to adopt new practices while also not recognizing the added value, and insufficient training. However, this study revealed distinct barriers centered on scheduling logistics and role unclarity within hospital departments, which were not featured in the reviewed literature, highlighting unexpected focus on the internal processes of the involved hospital departments.

The absence of these specific barriers in prior studies can be attributed to the different contexts in which they were conducted, which varied significantly from our setting. This study focused on specific hospital departments at Erasmus Medical Center (EMC) in Rotterdam and Amphia Hospital in Breda, both in the Netherlands. This setting represents a developed country with strong healthcare infrastructures and regulatory frameworks. In contrast, the other studies encompassed diverse contexts including large urban hospital networks, multiple rural healthcare facilities in developing countries, and large regional hospital networks in developed countries. These varied settings might have influenced the types of barriers identified, with this study emphasizing localized operational challenges while others addressed broader systemic issues. Moreover, the absence of these specific barriers in prior studies can also be attributed to differences in service focus. This study concentrated on planned consultations, where scheduling and roles are crucial, whereas the others focused on acute consultations, where these aspects are less important. Additionally, this study employed stakeholder interviews mainly within specific hospital departments, guided by NASSS. This approach facilitated an in-depth exploration, uncovering nuanced barriers beyond the traditional themes of regulation, technology, and infrastructure. The other studies, however, utilized varied methodologies, including mixed-methods research, qualitative fieldwork, and regulatory analysis. These methodologies aimed to capture a broad spectrum of barriers across diverse healthcare contexts, emphasizing generalizability.

How can visualization support the transition from pilot to full implementation of TeleNeo?

Based on a literature review concerning challenges in implementing digital health solutions and insights from three expert interviews, it is evident that visualization can significantly support the transition from pilot to full implementation by applying CoVisioning: a tailored visualization technique used during a co-design session with healthcare professionals involved in the service. This innovative approach to digital health implementation addressed the two situation-specific barriers through visually guided activities, serving as a method of service prototyping and has proven effective in supporting TeleNeo's scale-up. Facilitating a physical session to employ CoVisioning enabled healthcare professionals from EMC and Amphia to collaboratively identify, discuss, and tackle primary implementation challenges regarding scheduling and role allocation through interactive design practices. This collaborative approach has fostered alignment regarding TeleNeo's impact on their workflows and roles, significantly increasing awareness and proactive engagement among staff.

The session resulted in revised co-workflows for the involved hospital departments (NICU and HC), integrating the three planned TeleNeo consultation types with clearly defined roles. Following this session, noticeable improvements in communication and consultation planning have been observed, underscoring the effectiveness of visualization in supporting the scale-up. Specifically, structured regular consultation planning meetings are now held every Monday. This established routine has enhanced coordination among team members and supports efficient planning and communication for upcoming consultations.

Reflecting on specific success criteria, it can be stated that a co-design session involving multiple healthcare professionals actively engaged in the service, rather than relying solely on a static visual representation, was essential for the CoVisioning's success. This session with dynamic visualizations fostered active engagement, facilitated discussion, and promoted consensus-building among healthcare professionals within the NICU and HC departments.

These interactions were crucial for envisioning potential changes within the current system and aligning processes between the NICU and HC departments to integrate TeleNeo into their routine.

In conclusion, this study has provided valuable insights into the situation-specific barriers to a successful implementation of TeleNeo in the Netherlands, as well as the potential of employing interactive design practices to overcome these barriers. The findings emphasize the importance of addressing scheduling complexities and defining clear roles and responsibilities among healthcare professionals within the NICU and HC departments. This was effectively achieved through utilizing a tailored visualization guided co-design technique during a session with healthcare professionals involved in the new TeleNeo services.

8.2 Limitations & Future Research

This study represents the first use case of TeleNeonatology in the Netherlands, presenting a unique set of challenges. Firstly, there was limited available literature specific to TeleNeonatology in the Netherlands, which made it challenging to draw on established knowledge and best practices relevant to the local context. Consequently, this limitation may have restricted the depth and breadth of insights obtained during the literature review. To mitigate this, I adopted an exploratory approach by reviewing determinants from TeleNeo literature in other countries and applying the NASSS framework. This allowed me to gather insights from international literature while recognizing the uncertainty in their direct applicability to the Dutch healthcare context. Secondly, the study was dependent on the busy and often unpredictable schedules of healthcare professionals, which affected their availability and participation. Coordinating interviews and a co-design session with professionals who have demanding and variable schedules posed a significant challenge, potentially impacting the comprehensiveness of the collected data and the overall conclusions drawn from the study. In response, efforts were made to extend interview and co-design session invitations well in advance, providing multiple scheduling options and allowing for remote participation when feasible. Thirdly, the co-design session was physically organized at the Amphia hospital, which reduced the possibilities for healthcare professionals from the Erasmus Medical Center (EMC) to participate. This arrangement may have limited the diversity of perspectives and input, as it potentially hindered full participation from all involved stakeholders. To mitigate this, I decided to include catering, compensate travel expenses, and offer online participation options to ensure that all stakeholders could contribute to the session regardless of their availability or location constraints.

Based on my experiences during the study, I derived several recommendations for future research. These include providing the research team with guidance on the next steps after the pilot and outlining areas for further investigation to advance the application of the visualization guided co-design technique across different contexts.

To start with, this study focused on a single-center setting, including two hospitals in the Netherlands. However, when scaling up to a multi-center setting after the pilot, it is important to consider the next implementation phase involving the Albert Schweitzer Hospital in Dordrecht. This hospital, which is planned to be the next in line for TeleNeo implementation, is comparable to the Amphia Hospital. If the research team plans to organize a similar co-design session at Albert Schweitzer prior to the implementation, it is crucial to account for the fact that healthcare professionals at Amphia had prior experience with the TeleNeo service. Therefore, a thorough introduction and explanation of the various types of TeleNeo services should be provided to healthcare professionals at Albert Schweitzer to ensure they have sufficient knowledge to actively participate in the session. The guidelines developed from the initial session can be used to customize the visual content and process for the potential subsequent co-design session.

Next, expanding the application of the developed guidelines to facilitate similar co-design sessions for a broader range of digital health solutions can help address implementation challenges related to scheduling and role allocations. This approach has shown promise in two distinct healthcare contexts focusing on implementing a digitial health solution. However, further exploration is necessary to evaluate its transferability to other settings facing similar challenges. By doing so, we can better understand the adaptability and scalability of this method. Lastly, when organizing this type of co-design session across diverse geographical locations in future scenarios (long-distance healthcare delivery), logistical difficulties in bringing people together may necessitate transitioning from a physical co-design session format to a digital version. While digital co-design sessions can help overcome logistical constraints and facilitate remote participation, it is essential to recognize that the quality of interactions may differ from in-person sessions. Physical co-design sessions offer richer interaction, clearer communication, and a more creative atmosphere. They foster stronger ownership, quicker problem-solving, and build trust among participants, which significantly enhances collaboration. Therefore, when exploring the possibilities of a digital version of the co-design session, careful consideration of the format is crucial to effectively achieve project goals and outcomes.

8.3 Thesis Contribution

The contribution of this thesis is multifaceted, with implications for both the research team and the broader field of digital health services implementation. For the research team, the development of the visualization guided co-design technique represents a valuable addition to their qualitative analysis for implementation preparation. The co-design session offers a structured approach to understanding and addressing the complexities inherent in transitioning from pilot to full implementation of TeleNeo. To begin with, the completed role allocation templates offer an initial understanding of the responsibilities assigned within the TeleNeo services. This information can be used for planning the implementation process, including assigning responsibilities to healthcare professionals and establishing communication channels. Additionally, the role allocation templates can serve as a foundation for developing training programs for healthcare professionals involved in the digital health service. Next, the revised workflows of the involved departments, highlighting the optimal moments for planned TeleNeo consultations, provide a fresh perspective on the current system.

These insights can facilitate the integration of the digital health service into healthcare professionals' daily routines, establishing it as a standard practice. There have already been improvements in communication and consultation planning following the session, evidenced by the establishment of a regular consultation planning meeting. Additionally, the research team received a document outlining the next steps for implementation across the NICU and HC departments, along with recommendations to replicate the co-design session when scaling TeleNeo to a multi-center setting.

Looking to the future, the potential integration of the findings of this study into the scientific article on TeleNeonatology implementation in Dutch healthcare holds promise for further utilization of the research outcomes. Moreover, the creation of guidelines for developing similar visualization guided co-design techniques by (strategic) designers represents a valuable resource for supporting the implementation of digital health services across diverse contexts.

These guidelines offer a structured approach for designers seeking to utilize visualization techniques to improve the adoption and integration of digital health solutions. On the following page (*Figure 54*), CoVisioning is incorporated into the overview and perceptual map of existing visualization techniques that I created during the research phase of the project. This introduction of CoVisioning presents a novel approach to mapping services/systems in the field. Expanding beyond digital health, the developed visualization guided co-design technique has broader applicability than initially anticipated. Its static visual content can be effectively utilized in any organizational context where there is a need to clarify responsibilities, roles, and workflows. Such co-design sessions with dynamic visual means are particularly beneficial for engaging multiple stakeholders to achieve alignment, foster meaningful discussion among participants, and explore potential changes to existing systems. They provide a structured yet interactive environment that is favorable for collaborative problem-solving and innovation.

	Description	*Purpose*	*Input*	*Output*	
Journey Mapping *(McCarthy, 2020)*	Illustrating the step-by-step experiences and interactions a customer or user has with a product, service, or brand over time	Understanding the customer experience by highlighting painpoints, moments of delight and identifying opportunities for improvement	The steps, interactions, and emotions experienced by users as they engage with a product, service, or process	A holistic view of the steps and interactions that is experienced throughout the journey with a product, service, or organization	
Service Blueprinting *(Bitner et al., 2008)*	A detailed depiction of the end-to-end service delivery process, encompassing both front-stage and back-stage activities	Design seamless service experiences, align internal processes with customer needs, and identify opportunities for innovation or service enhancements	Scenario, customer/user steps, touchpoints, front-end actions, back-end actions, other supporting processes	Interactions between service providers, customers, and support systems across various touchpoints	
Ecosystem Mapping *(Nahuelhual et al., 2016)*	Visualizing the interconnected network of actors, entities, and elements that constitute a particular ecosystem	Gaining a holistic understanding of complex systems, fostering collaboration and informing strategic decision-making	Exchanges of goods and services, financial transactions, data sharing, knowledge transfer, and communication channels	The interactions and flows of resources, information, and value within the ecosystem.	
Process Mapping/Modelling *(Jun et al., 2009)*	Visualizing the sequence of activities, tasks, and workflows involved in completing a specific process or operation	Understanding a process to identify areas of improvement and help document existing or planned processes to ensure a shared understanding	Activities and their sequence, decision points, inputs, outputs, roles, and dependencies within the process	An overview detailing all activities encompassed within a specific process, showing their interconnections and dependencies	
Metro Mapping *(Stiggelbout et al., 2023)*	Mapping out the complexity of a medical care pathway with the use of co-design, inspired by a Metro Map	Design and optimize care pathways by assisting with value creation, shared decision making and multidisciplinary collaboration	5 layers: Metro, Information, Companies, Context, Experience	An overview of steps in the care pathway, information for the patient, involved healthcare professionals, environment and the experiences of patients	
CoVisioning *(Broos, 2024)*	Visualizing the sequence of service responsibilities and roles, along with the workflows involved in integrating these responsibilities	Clarify the impact of a service on current roles and workflows, emphasizing the importance of collaboration and alignment to support integration into daily routines	Current roles and workflows, service steps and their responsibilities, and activity blocks of the new service.	An overview detailing the assignment of new service delivery responsibilities to existing roles, complemented by revised workflows that integrate the new service.	

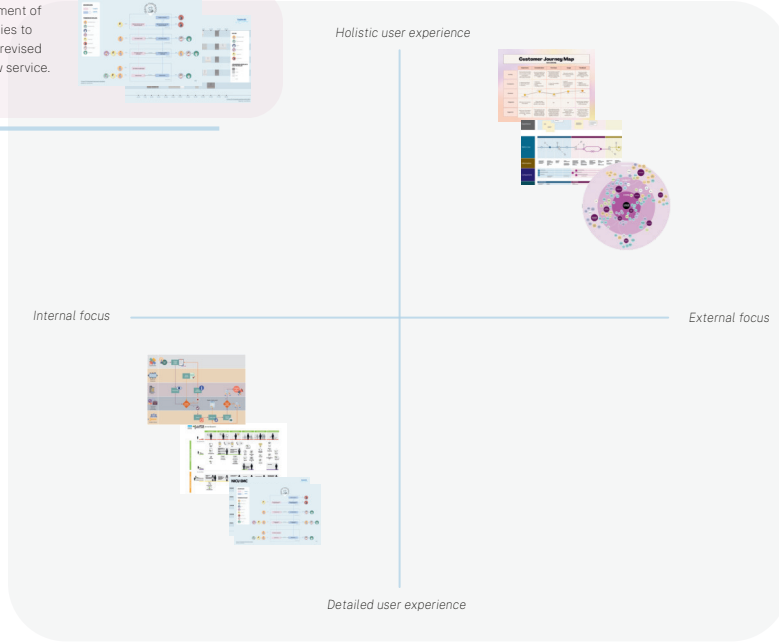


Figure 54: CoVisioning incorporated into overview and perceptual map existing visualization techniques
Made by Julia Broos

8.4 Final Conclusion

In conclusion, this thesis emphasizes the importance of addressing challenges in implementing digital health solutions, as demonstrated through the TeleNeo pilot. It thoroughly examines these challenges and identifies an opportunity for design practice to contribute through the use of visualizations as service prototypes. The TeleNeo pilot project stands out in the realm of Dutch healthcare innovation for its aim to enhance care not only for patients, but also for parents and healthcare professionals. This unique setting necessitated an innovative approach tailored to its specific needs. The project identified two situation-specific barriers to successful implementation, notably challenges in role allocation and consultation scheduling. Addressing these barriers effectively involved the strategic use of CoVisioning: a customized visualization guided technique during a co-design session with healthcare professionals involved in the TeleNeo services. Moving forward, integrating this co-design technique into broader implementation planning holds promise for enhancing role clarity and improving consultation scheduling in (digital health) services implementation.

Chapter 9: Personal Reflection

This final chapter provides a critical reflection on the outcomes of the project, focusing on the newly co-designed workflows that integrate planned TeleNeo consultations and defined roles of healthcare professionals at the NICU and HC. The reflection is structured around three key dimensions: feasibility, desirability, and viability. By evaluating these dimensions, I aim to uncover the strengths and potential impact of the project on neonatal healthcare delivery.

Feasibility

Reflecting on the feasibility of the project's result, it is evident that the co-designed workflows and allocated roles of healthcare professionals are strategically aligned with the existing resources and operational capabilities of the service delivery in the NICU and HC departments. This alignment is reinforced by the establishment of routine consultation planning meetings following the co-design session, which has improved team communication and streamlined planning processes. By effectively addressing situation-specific barriers to TeleNeo implementation and integrating changes into current workflows and roles, the project enhances operational efficiency within TeleNeo service delivery processes without compromising service quality or patient care outcomes. This streamlined approach enables healthcare professionals to conduct timely and effective TeleNeo consultations, optimizing the efficiency and effectiveness of the digital health service across both departments.

Desirability

Stakeholder engagement played an important role in ensuring the project's desirability. Twelve stakeholder interviews were conducted to comprehensively capture the situation-specific barriers for the implementation from various stakeholders. By actively involving healthcare professionals in the co-design session, diverse perspectives and needs were considered regarding how to overcome these barriers. This collaborative approach not only facilitated stakeholder buy-in but also fostered a sense of ownership among participants. Next, the project created new value for stakeholders by improving the efficiency and effectiveness of TeleNeo consultations. The revised workflows and assigned responsibilities provide more healthcare options for patients and their parents, while healthcare professionals can benefit from clearer roles and streamlined workflows. On a broader scale, the project's result has the potential to disrupt traditional healthcare delivery, making TeleNeo consultations a standard practice in Dutch healthcare.

Viability

Finally, I considered the sustainability of the project's result to assess its long-term viability. To start with, the project was integrated into the implementation planning of the research team. This incorporation ensures that there is sufficient time for follow-up activities inherent to the full implementation, essential for sustaining and refining the project's outcome. Next, ensuring the proficiency of healthcare professionals in conducting TeleNeo consultations is essential for sustained success. The project initially assigned responsibilities to existing roles within the NICU and HC departments, forming the basis for customizing the current training programmes provided by the research team. As these roles become established, continuous training will be essential for maintainting high standards of TeleNeo care and to adapt to the evolving healthcare system. By integrating TeleNeo consultations into existing care activities and workflows, the project aims to establish TeleNeo as a routine practice. This approach not only ensures consistent service delivery but also strengthens the sustainability of the project's result.

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Appendix A

Approved Project Brief

TU Delft

DESIGN FOR our future

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Broos	7030	
Initials	J		
Given name	Julia		
Student number	4659015		

IDE master(s) IPD ☐ DfI ☐ SPD ✔

2nd non-IDE master

Individual programme *(date of approval)*

Medisign ☐

HPM ☐

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Lianne Simonse	dept./section	DOS, section c
mentor	Fredrik Karlsson	dept./section	DOS, section c
2nd mentor	Josephine Wagenar		
client:	Erasmus MC		
city:	Rotterdam	country:	The Netherlands
optional comments	Complimentary capabilities from my chair and mentor of the same section are needed. Chair: strategy & design background, provides knowledge in the field of mapping. Mentor: academic & research background, provides knowlegde and materials on implementation.		

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Lianne Simonse — Digitally signed by Lianne Simonse Date: 2024.02.20 11:56:25 +01'00'

Name Lianne Simonse Date 20 feb 2024 Signature

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total ____ EC

Of which, taking conditional requirements into account, can be part of the exam programme ____ EC

★	**YES**	all 1st year master courses passed
☐	**NO**	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Robin den Braber — Digitaal ondertekend door Robin den Braber Datum: 2024.03.04 08:58:53 +01'00'

Name Robin den Braber Date 4 mrt 2024 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO	☐	Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
☐	**NOT** allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen — Digitally signed by Monique von Morgen Date: 2024.03.07 09:34:09 +01'00'

Name Monique von Morgen Date 7 Mar 2024 Signature

DESIGN FOR our future

TUDelft

Personal Project Brief – IDE Master Graduation Project

Name student Julia Broos **Student number** 4,659,015

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title To design a visualization technique for the implementation of health monitoring newborn infants.

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Neonatology is a medical subspecialty that focuses on the care of newborn infants, particularly those who are ill or born prematurely. In the region of Rotterdam in the Netherlands, Neonatology is facing challenges due to capacity issues. Therefore, a team from Erasmus MC is setting up a pilot together with Amphia in 2024 called 'TeleNeo' (Erasmus MC, 2023). This technology is a service that is already used in other countries in which healthcare professionals apply their expertise remotely to make better estimations of the most appropriate care location for newborn infants (Fang, 2021). As a result of the pilot, the team is striving for:

- Improvement in patient outcomes (additional support in care, prevention of unnecessary transfers to NICU, care closer to home when possible)
- Positive impact on capacity (reduction in the number of NICU admissions, shortened length of stay for both NICU and HC, reduced transports, cost reduction from a societal perspective)
- Enhancement of the experience of the infant, parent(s) and healthcare professionals (my focus)

After completing the pilot, which is the first use case in The Netherlands, the project team will decide if 'TeleNeo' will be implemented in Erasmus MC, Amphia, Maasstad Hospital, Franciscus Gasthuis & Vlietland & Albert Scheitzer Hospital.

The added value of my Graduation Project lies in the development of the visualization technique for the project setting of the team that is conducting the pilot. It will serve as an additional qualitative analysis in preparation for implementation, thus not being part of the primary project. The results may be incorporated into a scientific article with my approval and utilized for subsequent implementation.

→ *space available for images / figures on next page*

introduction (continued): space for images

image / figure 1 Healthcare professionals using TeleNeo

image / figure 2 The technology of TeleNeo

DESIGN FOR our future

TU Delft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

The design challenges of complex sociotechnical systems, such as in healthcare, often arise at implementation when values clash (Norman & Stappers, 2015). The same goes for implementing digital health solutions that must fit with both the users of the technology and the healthcare system as a whole (Ross, 2016). Many health solutions are "proven effective" in enhancing patient care (survival rates, reduced diseases). TeleNeo is (still) not proven effective, and the fact that the team from Erasmus MC is conducting a pilot with 'feasibility' as the outcome measure is unique. Next, the goal of TeleNeo is not only to improve the care for an individual patient but for parents and healthcare professionals as well. These factors contribute to the resistance the team is already encountering: "What does it add?" "Is it truly necessary?" "We've always done it this way". Therefore, using design/visualization could make the transition from pilot to implementation a success by creating more understanding among healthcare professionals, experience enhancements from the perspectives of parents, healthcare professionals and/or management of the department, identifying areas to improve, and gathering more input from end-users on how the service should be designed. The transition from pilot to implementation is crucial here and needs to be approached differently because it's challenging to measure the impact of TeleNeo on survival/diseases.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for.
Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence)
As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design and evaluate a new visualization technique to support healthcare professionals in the uptake of the implementation of telemonitoring newborn infants.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

I will start with a literature review to understand the issues with the implementation of digital health solutions. Next, I will conduct stakeholder mapping, by identifying who are involved with TeleNeo and conduct in-depth interviews with them. As a result, I will be able to reveal their perceptions, expectations and needs towards TeleNeo. After that, I will identify guidelines for the new visualization technique and conduct expert interviews on visualization for implementation. I will continue with the use of co-creation together with healthcare professionals to create concepts for the new visualization technique. Finally, I will further design, evaluate and iterate the new visualization technique with teams of healthcare professionals to make sure it fits their needs for implementing TeleNeo.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	19 feb 2024
Mid-term evaluation	18 apr 2024
Green light meeting	18 juni 2024
Graduation ceremony	18 juli 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

I am looking forward to start this project because my passion lies within the field of healthcare. Previously, I did a student job at the Franciscus Gasthuis Hospital in Rotterdam where I experienced the pressure of capacity issues and changes within the system myself. I hope to further develop expertise in healthcare and implementation during my graduation project. I would like to prove my competencies in conducting in-depth interviews and visualization. I would like to further develop my academic writing, my collaboration with various stakeholders by involving them at multiple stages during the design process, and hope to gain knowledge on digital health innovations. Also, I would like to experience how it is to work as a researcher and designer in a new work environment at Erasmus MC. My personal learning ambition is to use co-creation in designing the visualization technique during the project because I believe this is a crucial step for a succesful implemenation: designing with them, not for them.

Appendix B

HREC Documents

Delft University of Technology
HUMAN RESEARCH ETHICS
PROJECT AMENDMENT FORM
(Version: January 2022)

This project amendment form can be used to request approval for **amending or extending** research which already has recent HREC approval. If you are seeking approval for a new project **related to** an existing approval, then you should submit a standard HREC application as normal.

If you have any questions about your applying for HREC approval which are not dealt with on the Research Ethics webpages, please contact HREC@tudelft.nl

I. **Please provide the following information:**

Submission number of existing HREC approval	3454
Title of existing HREC approval	Visualizing implementation
Date of existing HREC approval	07-Sep-2023
If the amendment is simply a change in personnel, please provide: • the name/s and function/s (eg: researcher with access to confidential data) of the existing personnel • the name/s and function/s of the new personnel • the reason for these changes.	We are adding one person, Julia Broos, graduation student She will have access to the data that she collects. She is added to the HREC as she is doing a graduation project on the same topic.
If the amendment is simply an extension of the original, please provide: • the old end date • the new end date • the reason for this extension	The same timeline applies for the entirety of the HREC. Julia will leave on the 30th of July.
For any other amendment/s please summarise:	
• What exactly you are proposing to change compared to your original application	I am adding one researcher (Julia Broos)
• What are the reasons for these changes	She is added to the HREC as she is doing a graduation project on the same topic.
• How these changes will affect the potential risks to your participants	It is the same as before, but with another person. The data is not sensitive and the same procedure for storage will be followed.
• What steps you will take to mitigate against these risks	Keep to the same approved steps for storing the data.
• How you will address these changes in your DMP and/or Informed Consent	We will add Julias name on the informed consent. Everything else will be the same.

II. **Signature/s**

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) (print)

Julia Broos

Signature of Corresponding Researcher: Julia Broos (Feb 28, 2024 16:59 GMT+1)

Date: Feb 28, 2024

Name of Responsible Researcher (print)

Fredrik Karlsson Fredrik Karlsson

Signature (or upload consent by mail) Responsible Researcher:

Date: 2024-02-28

Delft University of Technology
HUMAN RESEARCH ETHICS
CHECKLIST FOR HUMAN RESEARCH
(Version January 2022)

IMPORTANT NOTES ON PREPARING THIS CHECKLIST

1. An HREC application should be submitted for every research study that involves human participants (as Research Subjects) carried out by TU Delft researchers
2. Your HREC application should be submitted and approved **before** potential participants are approached to take part in your study
3. All submissions from Master's Students for their research thesis need approval from the relevant Responsible Researcher
4. The Responsible Researcher must indicate their approval of the completeness and quality of the submission by signing and dating this form OR by providing approval to the corresponding researcher via email (included as a PDF with the full HREC submission)
5. There are various aspects of human research compliance which fall outside of the remit of the HREC, but which must be in place to obtain HREC approval. These often require input from internal or external experts such as Faculty Data Stewards, Faculty HSE advisors, the TU Delft Privacy Team or external Medical research partners.
6. You can find detailed guidance on completing your HREC application here
7. Please note that incomplete submissions (whether in terms of documentation or the information provided therein) will be returned for completion **prior to any assessment**
8. If you have any feedback on any aspect of the HREC approval tools and/or process you can leave your comments here

I. Applicant Information

PROJECT TITLE:	**Visualizing implementation**
Research period: *Over what period of time will this specific part of the research take place*	**September 2023 – September 2025**
Faculty:	**Industrial Design Engineering**
Department:	**Design, Organisation and Strategy**
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	**PhD**
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	**Philips Experience Design**
Name of Corresponding Researcher: *(if different from the Responsible Researcher)*	
E-mail Corresponding Researcher: *(if different from the Responsible Researcher)*	
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	
Name of Responsible Researcher: ***Note:*** *all student work must have a named Responsible Researcher to approve, sign and submit this application*	**Fredrik Karlsson**
E-mail of Responsible Researcher: *Please ensure that an institutional email address (**no Gmail, Yahoo, etc.**) is used for all project documentation/ communications including Informed Consent materials*	**k.f.karlsson@tudelft.nl**
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	**PhD Candidate**

II. Research Overview

NOTE: *You can find more guidance on completing this checklist here*

a) Please summarise your research very briefly (100-200 words)
What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbreviations)

This is the HREC for two longitudinal case studies. In these case studies I will interview and have workshops/focus groups with multiple different types of stakeholders. The core stakeholders are patients, healthcare professionals, project managers, insurance providers, PhD Students, IT professionals and supporting staff. If patients will be involved in the research, they will be recruited via a nurse or doctor at Leiden University Medical Center. The contact details for the other involved stakeholders will be provided by LUMC and contacted by me. Patients will be expected to discuss the use of technology. The other partners will be expected to discuss the implementation of digital health. Some (not patients) might also be expected to draw a map of a system.

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbreviations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

III. Risk Assessment and Mitigation Plan

***NOTE**: You can find more guidance on completing this checklist here*

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alignment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that **you're much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] [1] *If yes, please include the graduation agreement in this application*	X		The risk with involving the current partner is that they might not want to continue the project any more and then I do not have a case study to follow. The collaborating partner might also be busy and therefore take longer time then expected.	The plan is to foster the relationship with the collaborating partner and discuss what the potential results can be so both parties can benefit from the research. To mitigare busyness, I intend to start early.		
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		X				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		X				
B: Location						
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?	X		Swedish parties can potentially be involved in interviews or workshops. Risk can be that data will be on another language and cannot be understood by the entire research team. These parties might retract their participation. The context is different than the on in the Netherlands.	The responsible researcher speaks the language of the country. I will nurture the collaboration and create a situation where both parties will benefit. There will be transparance about the difference of the context.		
5. Will the research take place in a country or countries outside the EU?	X		UK parties can potentially be involved in interviews or workshops. These parties might retract their participation. Same data laws might not apply. The context is different than the on in the Netherlands.	Data will only be stored on my computer and on surf-drive. I will nurture the collaboration and create a situation where both parties will benefit. If other data laws till apply, then both EU law and UK law will be applied. If that is not possible, UK parties will not be included. There will be transparance about the difference of the context.		
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		X				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		X				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?	X		Patients with cronic disease will be included to discuss the use of technology. The patients might not speak English.	They do not have to share anything personal. The key is to talk about experience with technology. The patients will be contacted though Leiden University Medical Center to ensure that they are fit to be interviewed.		
				Leiden University Medical Center will help to find patients who speak English.		
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		X				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	X		It is possible to piece interview material together and know who is involved in the project(s). This refers to the experts, not healthcare professionals and patients, for them it will not be possible to identify as their role is more general.	The participants will be informed about what will be done with the data, and that they should now share something that they are not comfortable with being published. Company names will not be included. The data that is shared from the parties that are not patients and healthcare professionals are about struggles and potential strategies for implementing digital health from their point of view. These struggles will probably be quite general and not specified on a certain person. If the stakeholders were to be ideantified, then only their views on digital health implementation would be found wich is expected to be similar among the same type of stakeholder in general in the same country.		
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups	X		I will contact the stakeholders that are not patients, nurses and doctors myself.	The interviews and workshops will not be about them personally but about the project and how to improve things. This is a kind of information that they are already sharing in their own publications.		
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		X				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		X				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?	X		Might give giftcards to patients that participate. And getting financial compensatin might make them more inclined to be positive and/or be more open.	The intention of the interview is to bring forward potential issues not their general view on things and thus a bit more positive view is fine. I will center the interviews around technology usage and stear away from personal remarks.		
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		X				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		X				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		X				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		X				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		X				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)	X		It is possible, depends what the stakeholders want to share in the interviews.	The interview subjects will be informed that they should not share things that cannot be published.		
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		X				
22. Does your research investigate causes or areas of conflict? *If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.*		X				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		X				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		X				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		X				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		X				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		X				
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed **device report***						
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*						
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	X			**I will consider the current Covid considerations at the present time of the interviews.**		
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or** b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?		X				
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	X		**Storing informed consent.**	**They will be scanned and uploaded to Surfdrive and the physical copy will be disposed.**		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?		X				
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		X				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	X		Publish at conferences and journals, and thus make the information public.	The informants will be informed that they should not share information that cannot be published. Company names and names of individuals will not be shared in the publications.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		X				

H: More on Informed Consent and Data Management

NOTE: You can find guidance and templates for preparing your Informed Consent materials) here

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) (print)

Signature of Corresponding Researcher:

Date:

Name of Responsible Researcher (print)

Fredrik Karlsson

Signature (or upload consent by mail) Responsible Researcher: Fredrik Karlsson

Date:

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

12M Report

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

My faculty data steward, Jeff Love, has reviewed this DMP on 12th of April 2023.

2. Date of consultation with support staff.

2023-04-12

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Audio from interview	mp4	Recording of conversation	Transcribing	SURF drive	Fredrik Karlsson
Transcription from interview	text file	From interview audio file	Qualitative analysis	SURF drive	Fredrik Karlsson, Valeria Pannunzio, Maaike Kleinsmann, Dirk Snelders
Data from digital health systems	.xlsx	Re-used: LUMC sharing the data. They will have the data and I will have a copy of what I need.	Quantitative analysis	SURF drive	Fredrik Karlsson, Valeria Pannunzio, Maaike Kleinsmann, Dirk Snelders
Data from questionnaires	.xlsx	Re-used: LUMC sharing the data. They will have the data and I will have a copy of what I need.	Quantitative analysis	SURF drive	Fredrik Karlsson, Valeria Pannunzio, Maaike Kleinsmann, Dirk Snelders

4. How much data storage will you require during the project lifetime?

- < 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- Methodology of data collection

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- SURFdrive

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, ask your Faculty Data Steward for advice. You can also check with the privacy website or contact the privacy team: privacy-tud@tudelft.nl

- No

The intention is not to use identifiable data of the interviews subjects, but as the subjects are a part of a group of around 200-400 patients they therefore can be identified if they chose to share data about themselves. As personal information is currently not seen as something that might benefit the study, that kind of information will be removed in the transcription.

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- Yes, I work with other types of confidential or classified data (or code) - please explain below

I will use data from healthcare such as data from use of digital products. It is data that are not accessible by the public and if certain types of data leak out it can harm individual people. The harm of this type of data is seen as minimal.

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

The transcription of the data till be owned by me, but there will be one more copy owned by a researcher at Leiden University Medical Center. The data from the other sources are owned by Leiden University Medical Center who I collaborate with.

V. Data sharing and long-term preservation

26. What data will be publicly shared?

- Not all data can be publicly shared - please explain below which data and why cannot be publicly shared

The data that will be shared is the anonymized data used in the project. I am also not the owner of all the data used, and can thus not decide how it will be published.

28. How will you share your research data (and code)?

- All data will be uploaded to 4TU.ResearchData

The data that will be shared will be uploaded to 4TU.ResearchData

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- At the end of the research project

32. Under what licence will be the data/code released?

- Other - Please explain

I do now know as I am not the owner of the majority of the data. The data that I will own is the transcriptions.

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- No - please provide details of the lead institution below and TU Delft's role in the project

I will collaborate with researchers at Leiden University Medical Center and therefore we will share the data that is produced.

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

Valeria Pannunzio, Dirk Snelders and Maaike Kleinsmann

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

4TU.ResearchData is able to archive 1TB of data per researcher per year free of charge for all TU Delft researchers. We do not expect to exceed this and therefore there are no additional costs of long term preservation.

Appendix C

Visual Content Version 1

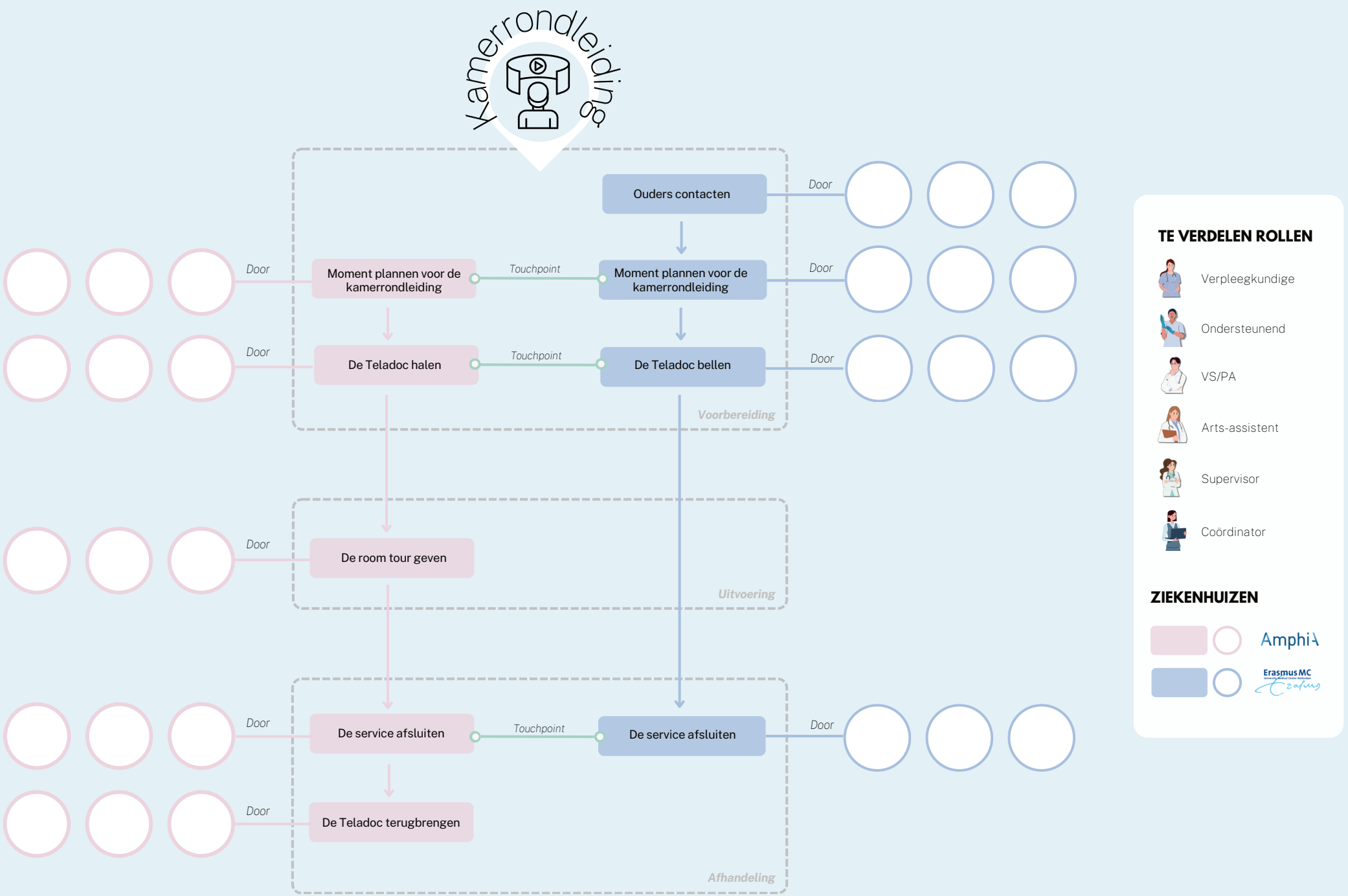


Figure 55: Template for allocating roles to room tour responsibilities
Made by Julia Broos

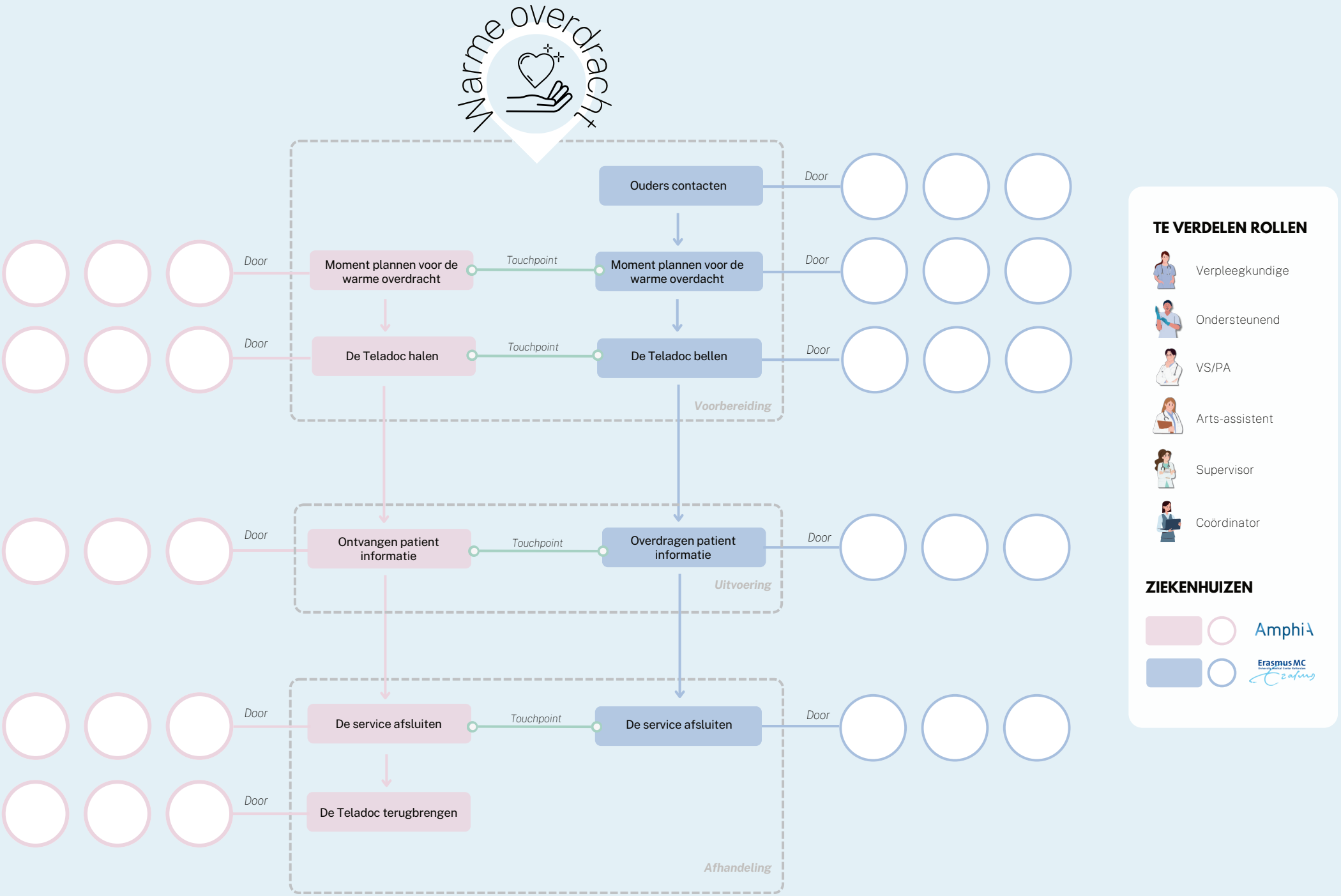


Figure 56: Template for allocating roles to warm handover responsibilities
Made by Julia Broos

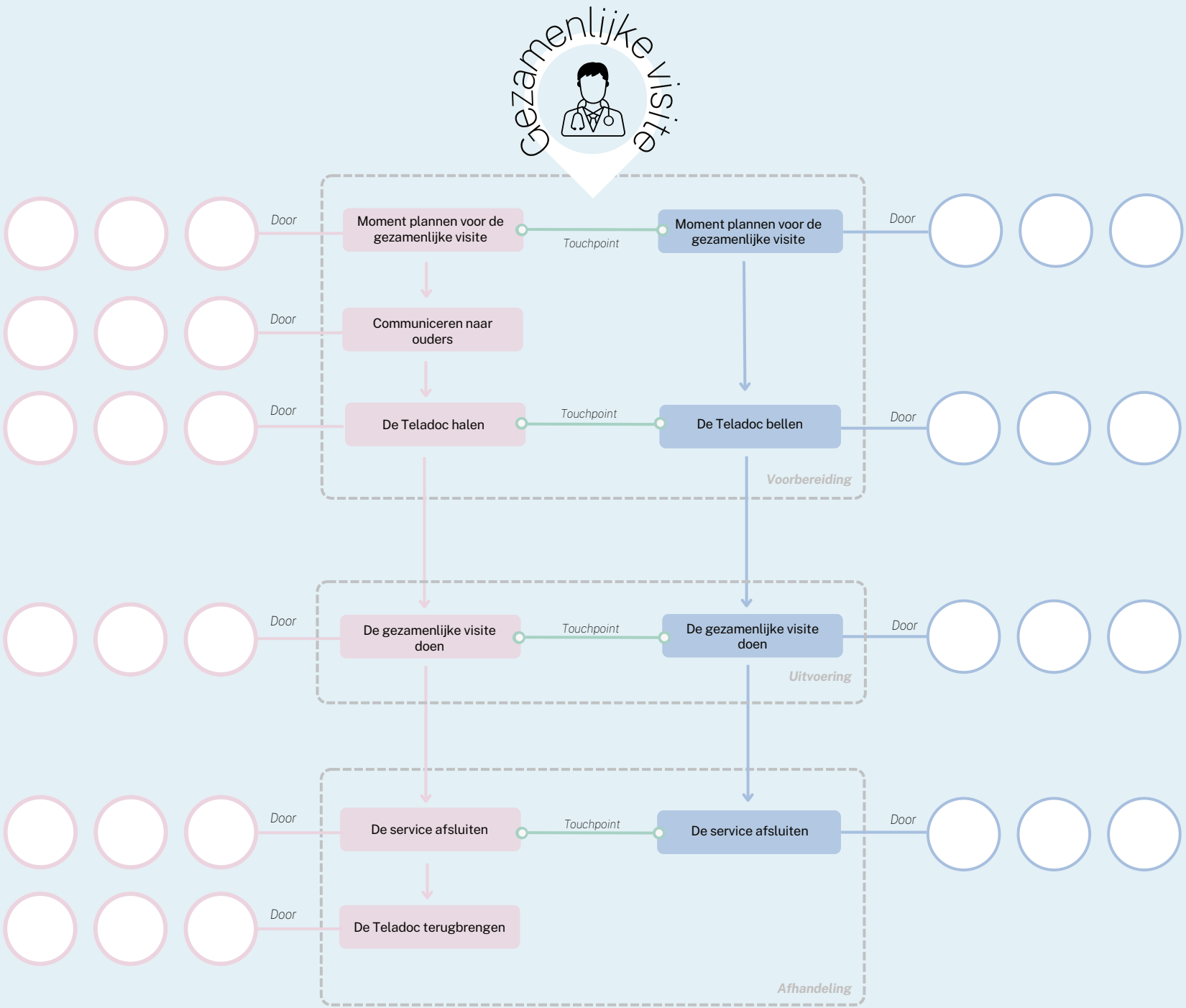


Figure 57: Template for allocating roles to joint daily round responsibilities
Made by Julia Broos

Figure 58: Role markers (for one template)
Made by Julia Broos

NICU EMC

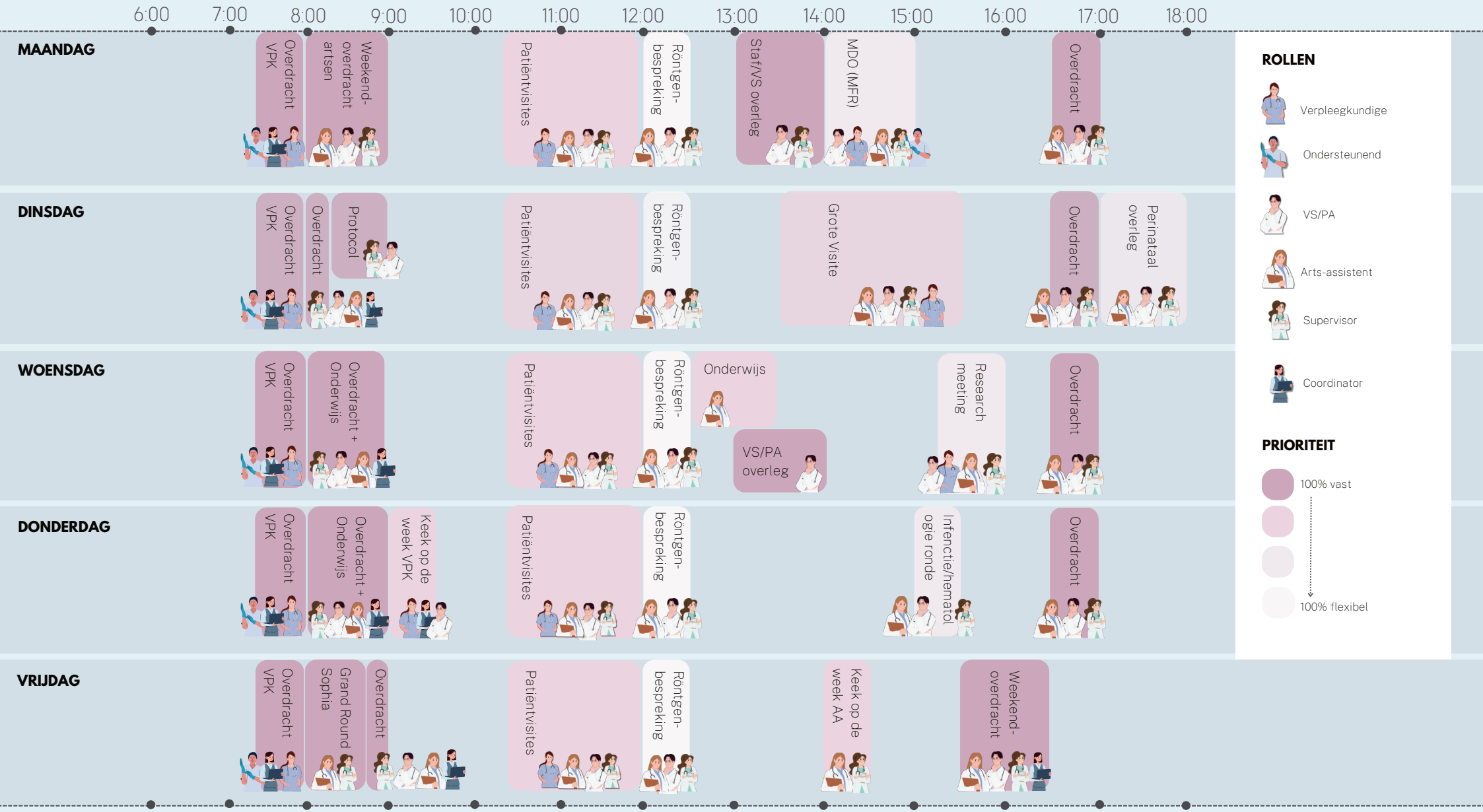


Figure 59: Workflow NICU EMC

Made by Julia Broos

HIGH-CARE AMPHIA

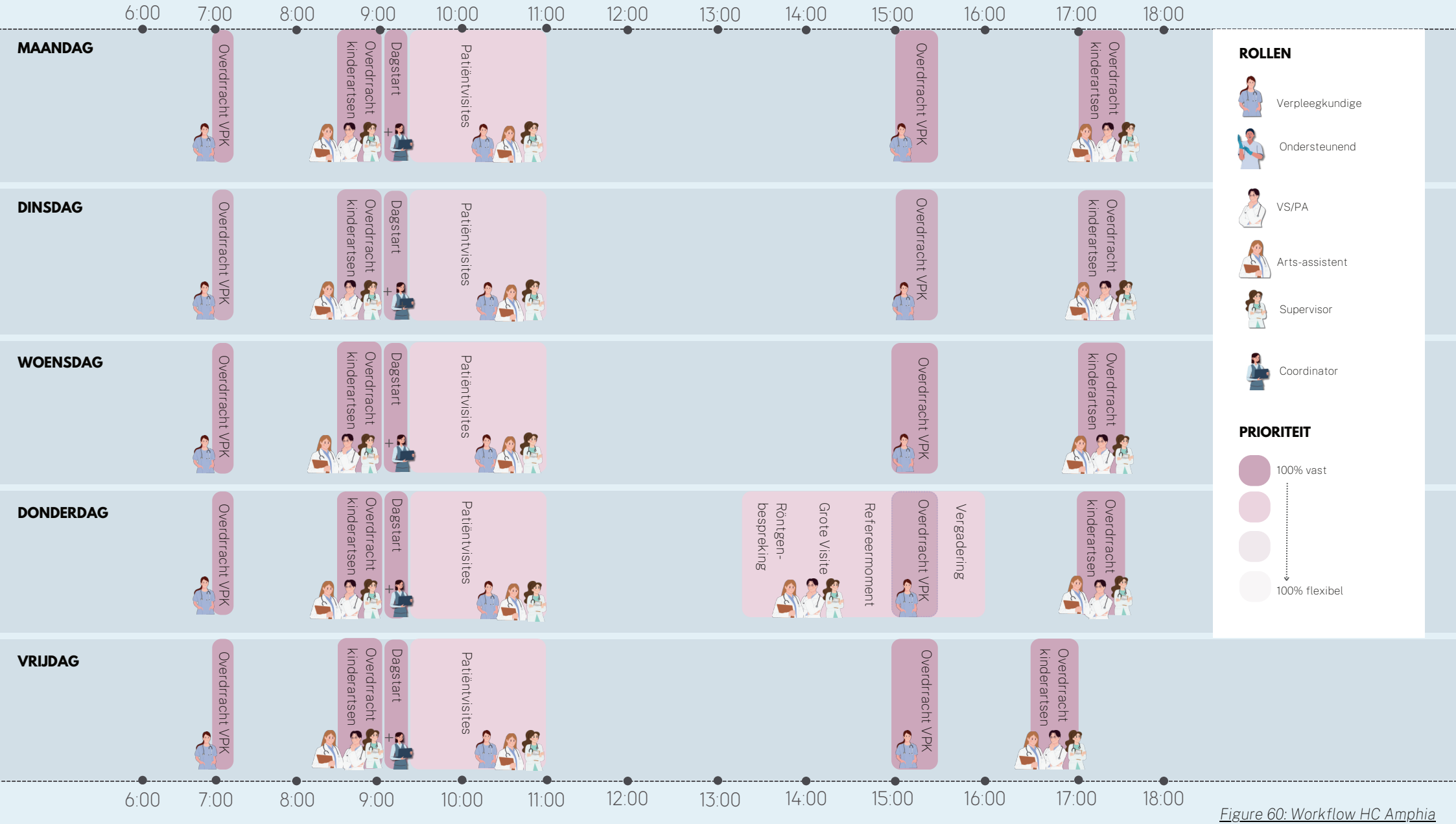


Figure 60: Workflow HC Amphia

Made by Julia Broos

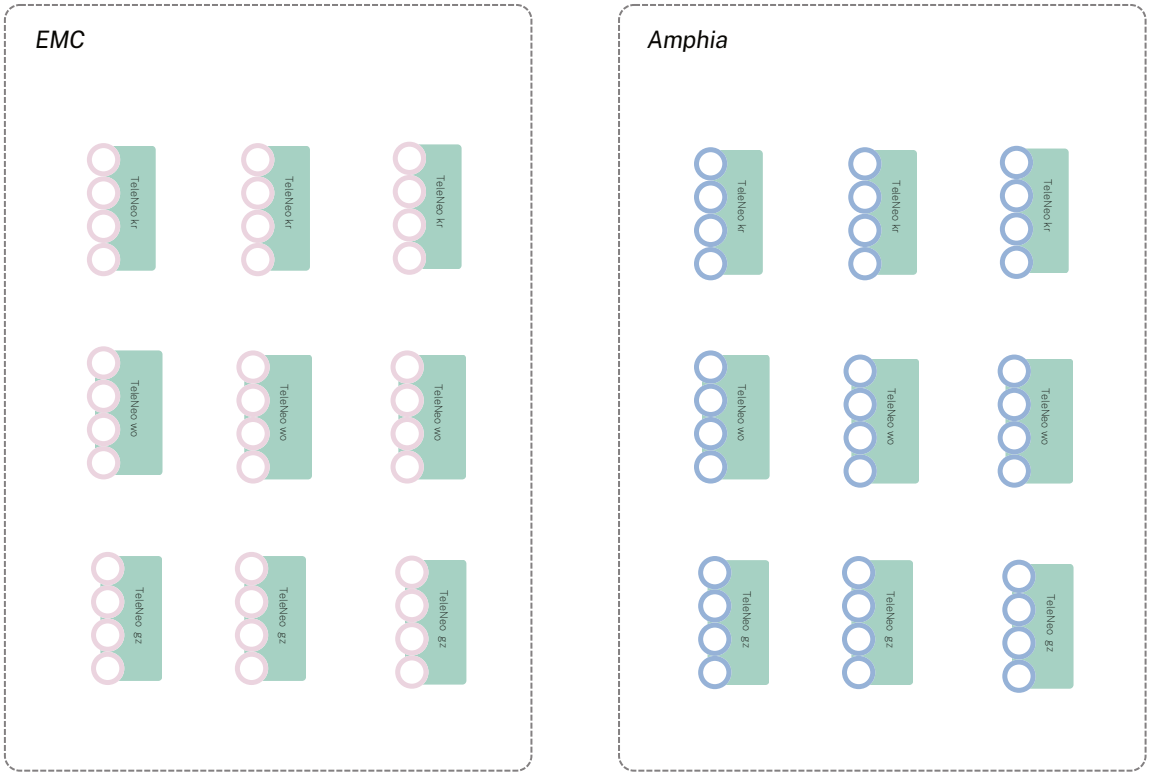


Figure 61: TeleNeo consultation blocks
Made by Julia Broos

Appendix D

Feedback + Iterations IDE Students

For an initial concept testing round, three Industrial Design Engineering (IDE) master students were invited to provide feedback on the visual content and process of the visualization guided co-design technique from a designer's perspective. They were not asked about their knowledge of the medical content, as this is addressed in the next round of testing with healthcare professionals. Instead, the focus was on the following aspects:

- Identifying points for improvement in the visualizations to enhance their usability and understandability
- Determining the most suitable way for making the care activity blocks movable, including testing poster buddies and Velcro stickers
- Assessing whether the process of using the two parts/methods during the co-design session follows a logical sequence of activities and how this can be improved

First, a brief introduction to the project was provided, outlining the goal of physically using the visualizations during a co-design session. The students were informed that they would use the visual content in two phases, as intended for the actual session.

The first part involved allocating roles to TeleNeo responsibilities, while the second phase involved integrating TeleNeo consultation blocks with these allocated roles into workflows. To test the first part/method, the templates and role markers (*Appendix C*) were printed on A3 paper (*Figure 37*). The students were given a common task to allocate roles to all outlined responsibilities by positioning the role markers on the empty spots, starting on top (*Figure 38*). They were not required to consider the feasibility of the allocations, as the primary aim of this concept testing was to gather their inisghts as designers. After completing the first part, the students were assigned the task of mapping the resulting roles onto the corresponding green TeleNeo blocks. With this task, my goal was to decide whether the participants or I will perform this task during the co-design session. To facilitate the process, the green TeleNeo blocks with corresponding size-fitting markers were printed (*Figure 39*). The execution of testing this way of integrating the first and second method by the students is presented in *Figure 40*.

Next, the concept testing shifted to the second part/method, where the students worked on integrating the TeleNeo consultation blocks into the NICU and HC workflows. In this phase, the students tested two versions: moving the existing care activitiy blocks to make room for TeleNeo blocks with Velcro stickers, followed by poster buddies. Before testing, I removed all flexible (not 100% fixed) blocks and repositioned them on the visualizations using either Velcro or poster buddies (*Figure 41*). The students were given a common task to compare the NICU and HC workflows and rellocate existing blocks in both workflows to accommodate the TeleNeo blocks. This process is illustrated in *Figure 42*. As before, feasibility did not play a role.

After the students also completed using the second part of the co-design technique, they were asked for their feedback on the previous highlighted three bulletpoints. Additionally, they were given the opportunity to share any other thoughts on the process and visual appearance of the visualizations.

Feedback on points for improvement in the visualizations to enhance their usability and understandability

Templates for allocating roles to the TeleNeo responsibilities

- The students suggested moving the legend to the top left corner for clarity, as it was unclear the templates pertained to two different hospitals
- They recommended adding "start" at the top of the first responsibility and numbering all responsibilities to clarify the order of activities
- The division of responsibilities into three phases was well-received; students suggested using a darker color for even more clarity.
- Three empty spots for allocating roles gave the impression that roles should be approached sequentially, but it should indicate that multiple roles can be responsible simultaneously
- The roles in the legend and role markers should be better connected, perhaps by using colors and added text like 'Sup' for Supervisor

Visualizations NICU and HC workflows

- Students suggested adding colors to indicate where roles are present in the workflows for better clarity
- They found the distinction between TeleNeo consultations unclear and recommended different colors or "bubbles" with names on top of blocks.
- The meaning of "100% fixed" and "100% flexible" in the legend was unclear, as was the significance of blocks in between
- They suggested increasing the workflow size from A3 to A2 for better visibility in group sessions
- Different phases of TeleNeo blocks (preparation, execution, post-consultation) could be separated to clarify roles
- Roles on the sides of TeleNeo blocks made it hard to see consultation duration; placing roles inside/underneath or adding duration text was recommended
- Leave space under care activity blocks for TeleNeo blocks to show simultaneous occurrences

Feedback on the most suitable way for making the care activity blocks movable

- Velcro stickers were preferred because they left the original position visible when moved, while poster buddies left residue
- Magnets were suggested as an alternative for easier removal and flexible placement on a whiteboard

Feedback on the process of using the two parts/methods

- The sequence of the two methods was logical and supportive towards the session's end goal
- Students suggested a coffee break while integrating the methods, with the facilitator placing the role markers
- Role markers for TeleNeo blocks were too small and fiddly.
- Starting with one block of each type of TeleNeo consultation in both workflows before prioritizing additional placements was recommended
- Arranging workflows vertically instead of horizontally was confirmed for better timeline comparison

Based on this feedback from IDE students, I iterated the concept. The iterations on the legend, text and/or colors of the role allocation templates, role markers, NICU and HC workflows and TeleNeo consultation blocks are described in *Figure 62*.

	Role allocation templates	Role markers	NICU and HC workflows	TeleNeo consultation blocks
Adjustments in legend	I relocated the legend to the top left corner and began with the hospitals to make it clearer that the information in the role allocation templates pertains to two different hospitals	None	I revised the priority section of the legend to better explain the meanings of "fixed" and "flexible," as well as the purpose of the blocks that fall in between	I removed the roles from the sides of the blocks to avoid confusion. Instead, I will personally draw the horizontal colored stripes during the session's coffee break after the participants completed the role allocation templates
Adjustments in text	I included numbers in the bottom right of all responsbilities to further clarify the order of the activities. I decided to leave out "start" because this became redundant after numbering the responsibilities I added "+" between the roles to be allocated to make it clear that multiple roles can be assigned to one responsibility, and they do not indicate a priority or sequence	None	None	I added the duration of each type of TeleNeo consultation to the blocks to clearly indicate how long each one lasts I added the name of each TeleNeo consultation type on top of each block to better distinguish them
Adjustments in colors	For the boxes and text indicating the three different phases (preparation, execution, post-consultation), I used a darker color to further enhance the structure of the templates I added colors to the roles in the legend of the templates and role markers to improve their connection. As a result, I changed the initial green color indicating the touchpoints into grey because green was now used to indicate the nurse-supporter role	I applied the new colors from the legend in the role allocation templates to the role markers. Consequently, I removed the pink and blue borders from the role markers, as including colors for each role made the borders visually overwhelming. As a result, a distinction between EMC and Amphia for the role markers is not necessary anymore, so one sheet will be used	I incorporated the new colors from the role allocation templates into the legend and correpsonding horizontal colored stripes on the care activity blocks, making it clearer where certain roles are present. I also included room for TeleNeo blocks within the scheduled routine activities I changed the initial pink color gradients of the care activity blocks to grey. With the roles now indicated by colored lines, the original gradients became visually overwhelming	I added pink (Amphia) and blue (EMC) from the role allocation templates to the TeleNeo blocks. This differentiation will help me distinguish between the two hospitals when writing the colored stripes on the blocks during the integration of the first and second parts of the session Additionally, I changed the initial green color of the blocks to the darkest grey of the legend to indicate that the consults will be executed on fixed moments (since this is the goal)
Tested concept with students	*Figures 55-57*	*Figure 58*	*Figure 59 & Figure 60*	*Figure 61*
Iterated concept	*Figures 63-65*	*Figure 66*	*Figure 67 & Figure 68*	*Figure 69*

Figure 62: Iterations resulting from concept testing with IDE students

Appendix E

Visual Content Version 2

Iterations based on concept testing with IDE students

Figures 63-65: Role allocation templates
Figure 66: Role markers
Figure 67-68: Workflow visualizations NICU and HC
Figure 69: TeleNeo consultation blocks

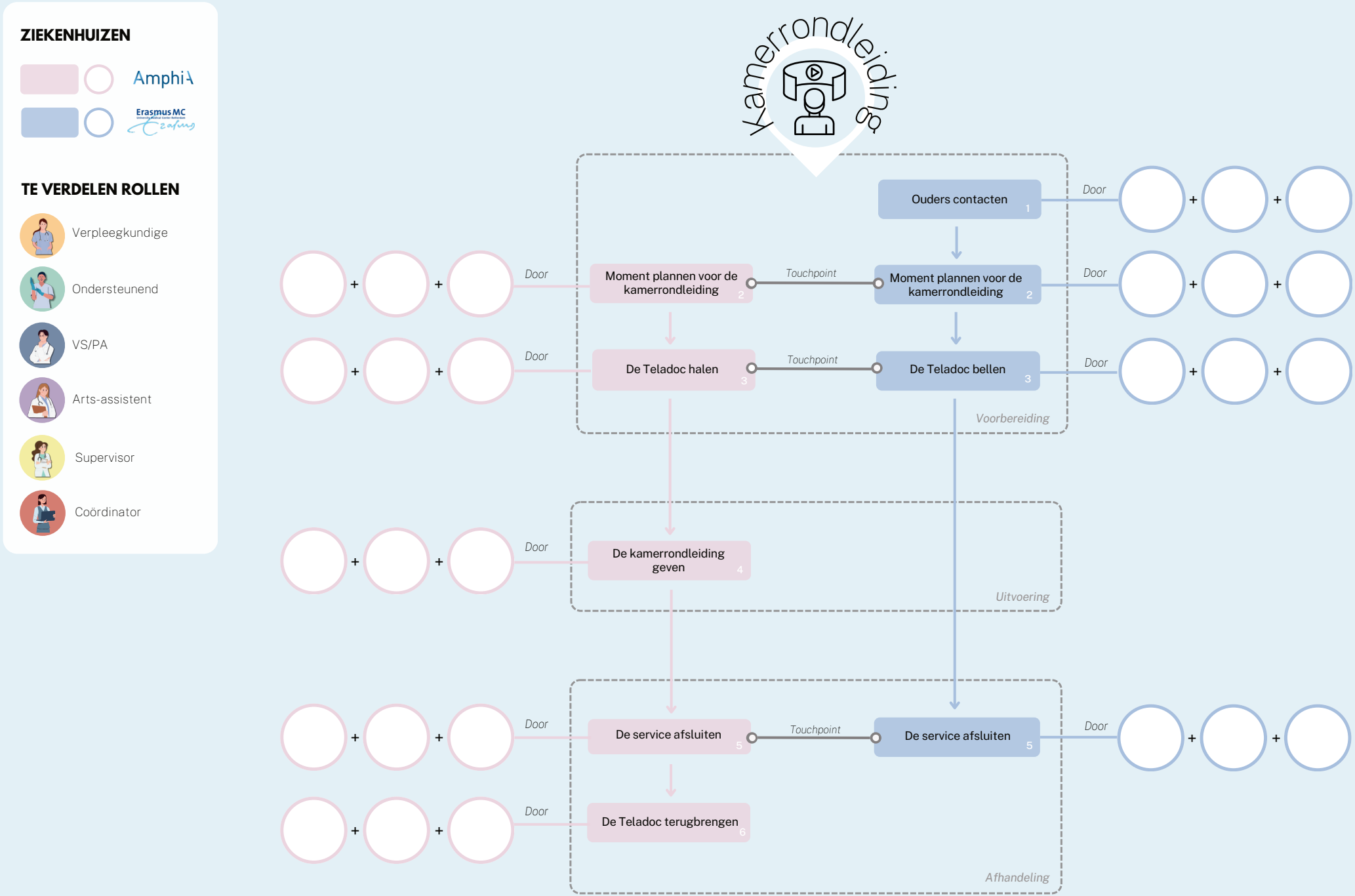


Figure 63: Iterated role allocation template room tour
Made by Julia Broos

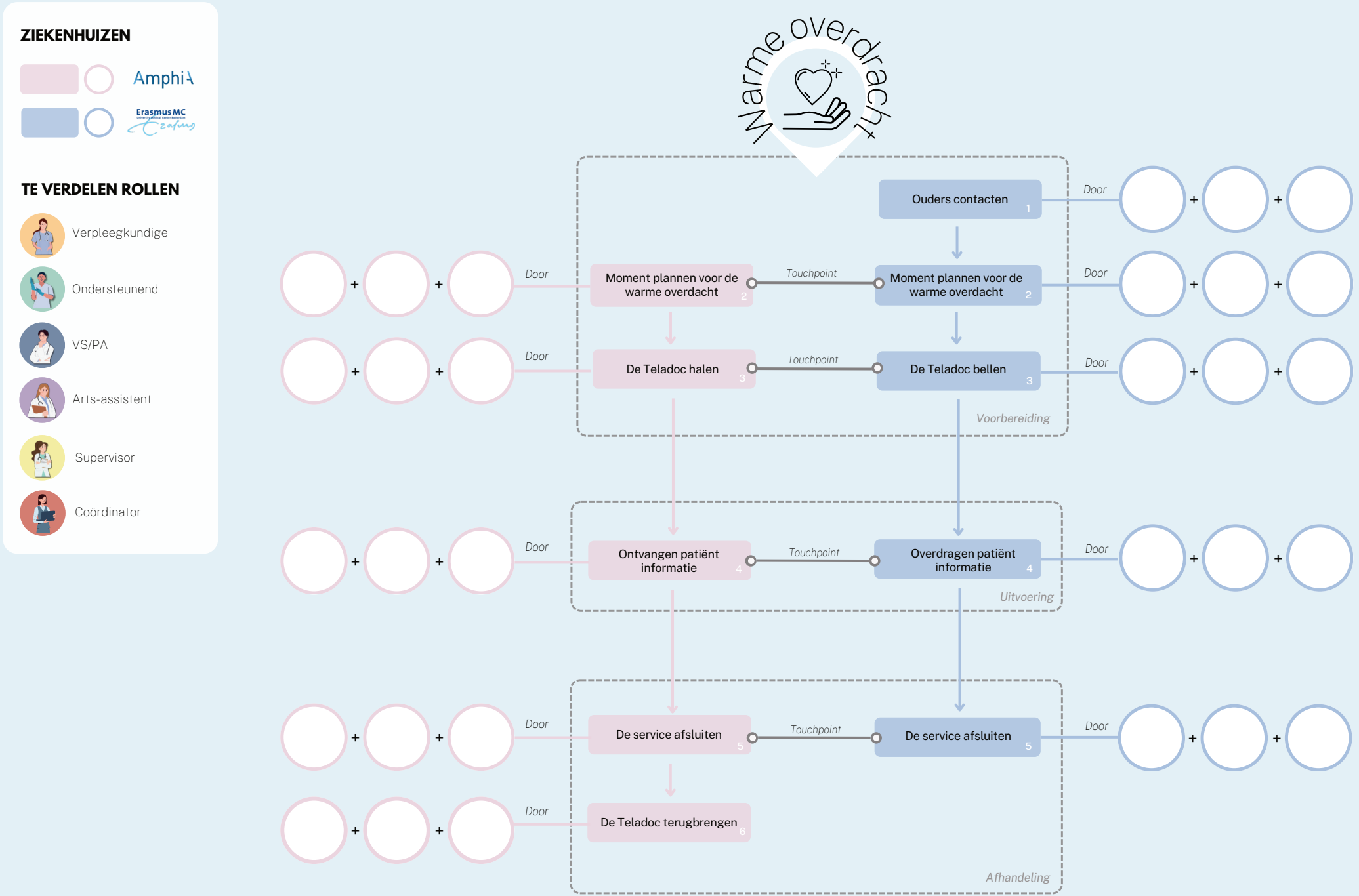


Figure 64: Iterated role allocation template warm handover
Made by Julia Broos

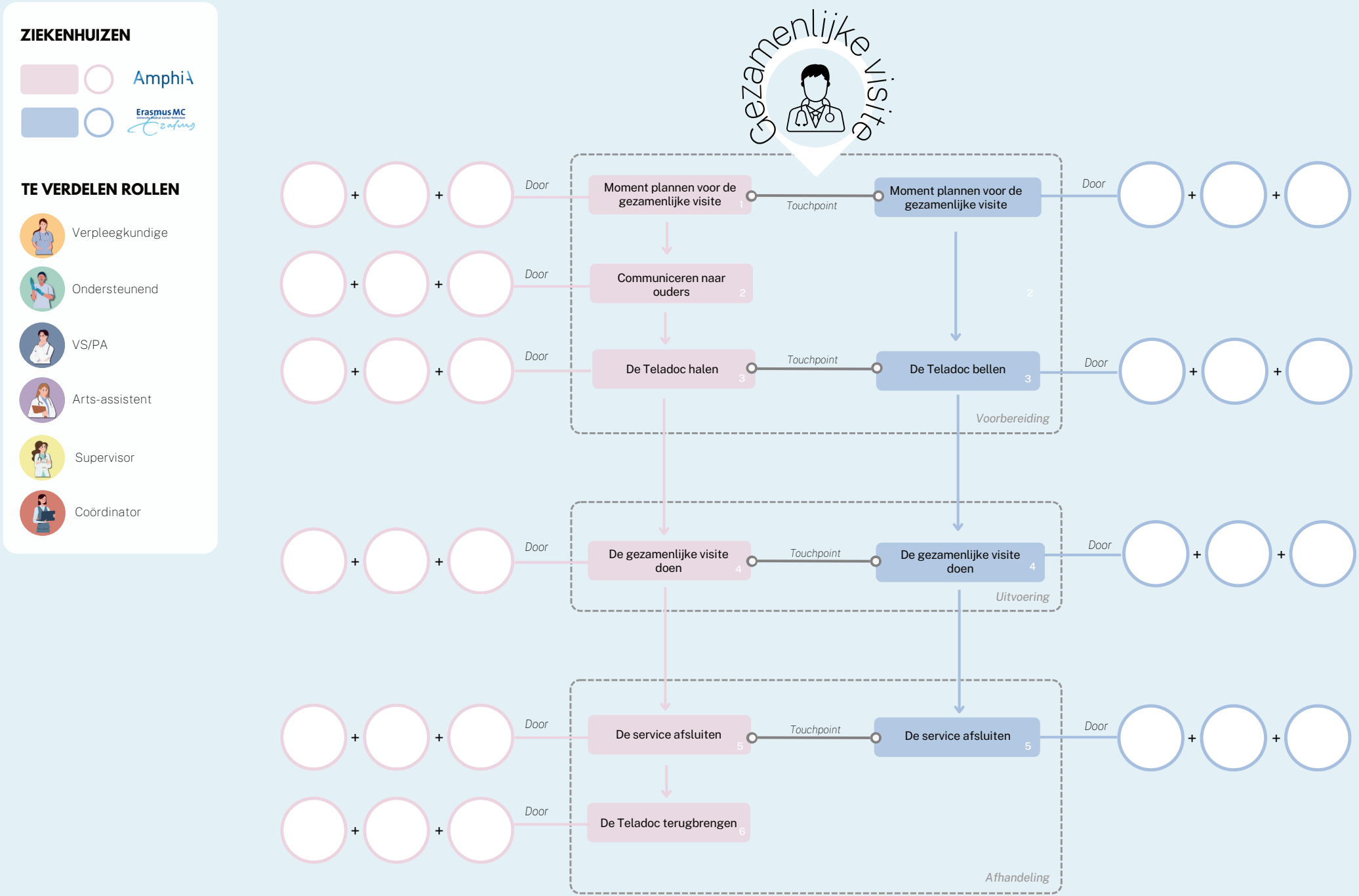


Figure 65: Iterated role allocation template joint daily round
Made by Julia Broos

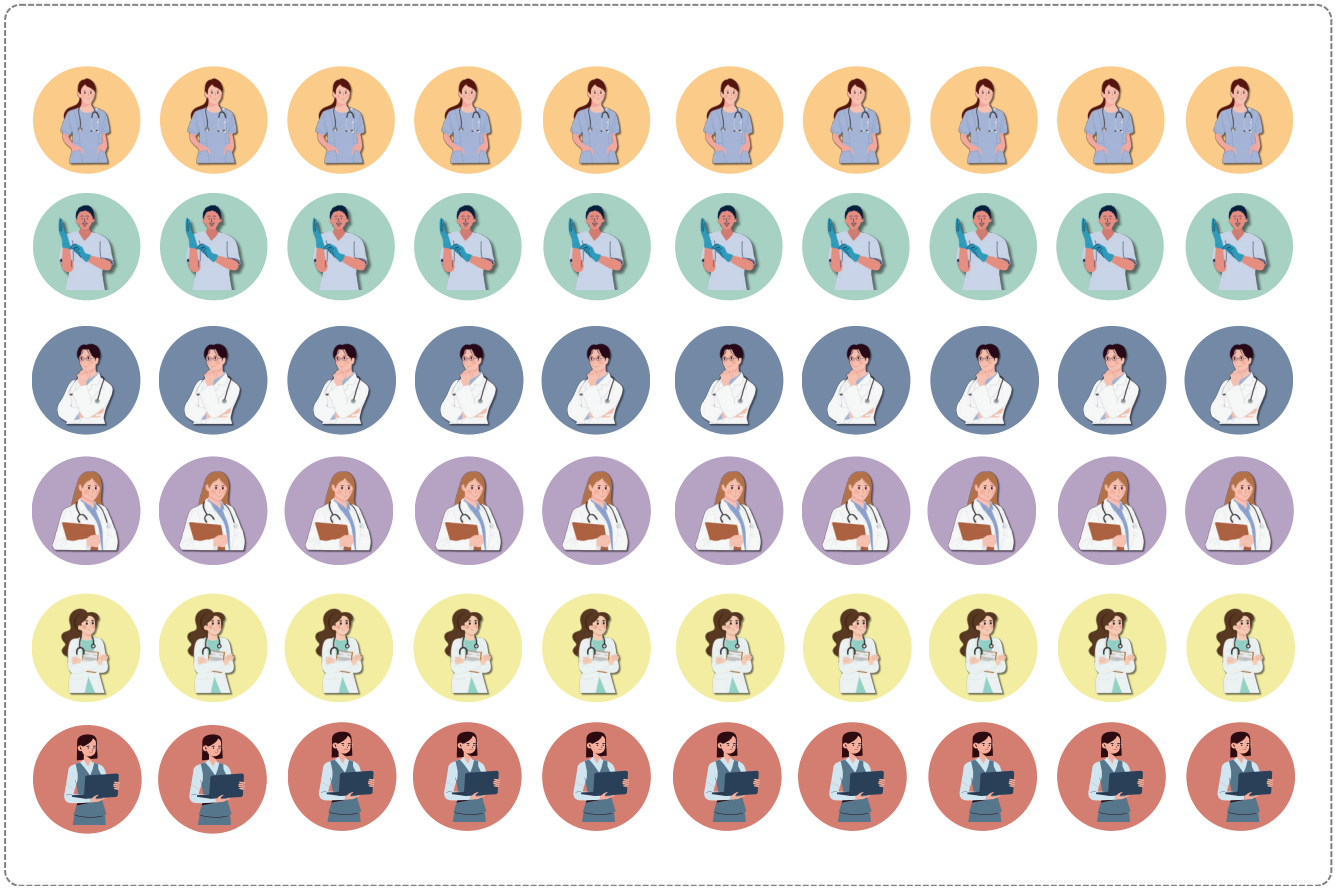


Figure 66: Iterated role markers (for one template)
Made by Julia Broos

NICU EMC

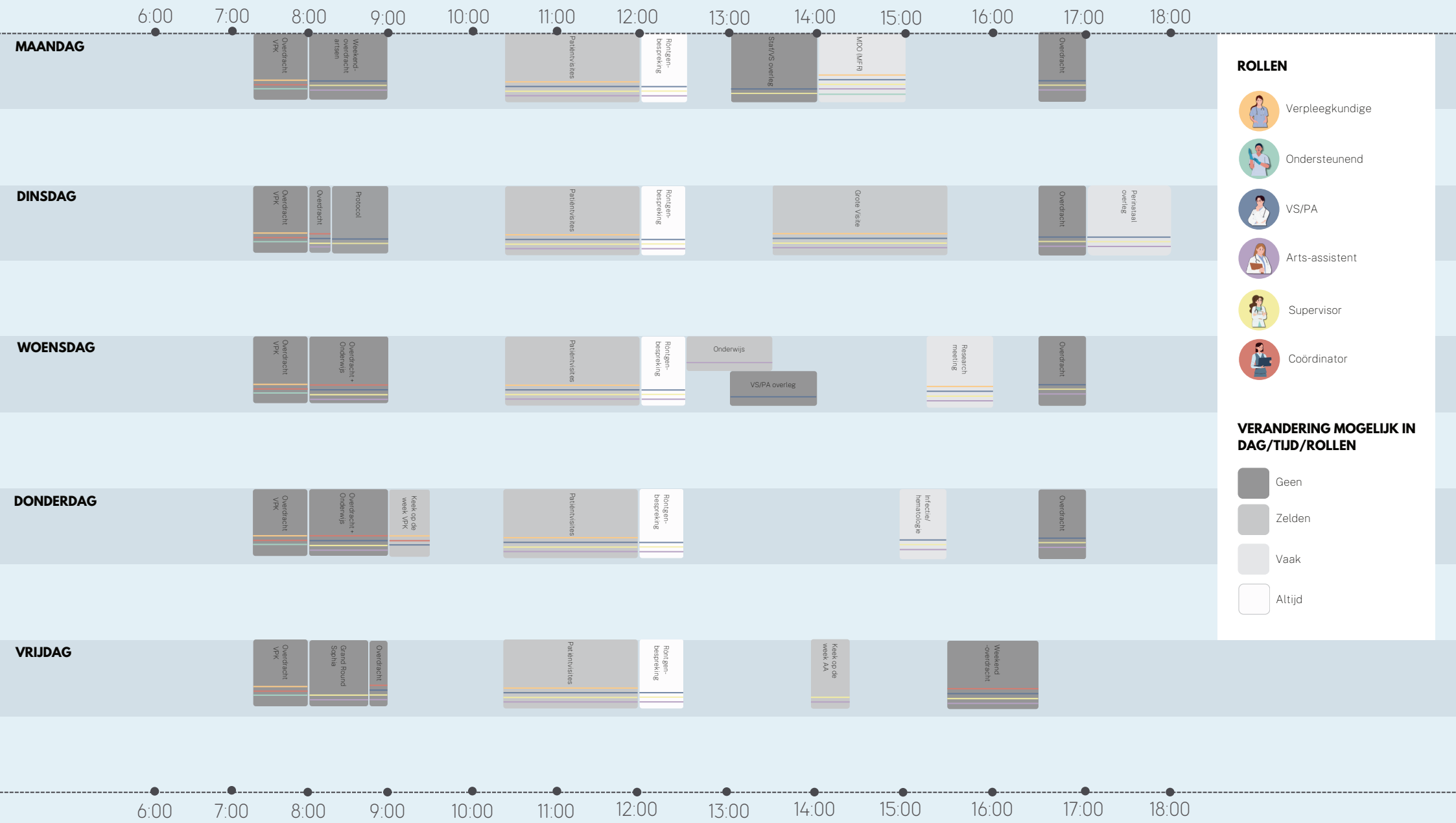


Figure 67: Iterated workflow NICU EMC

Made by Julia Broos

HIGH-CARE AMPHIA

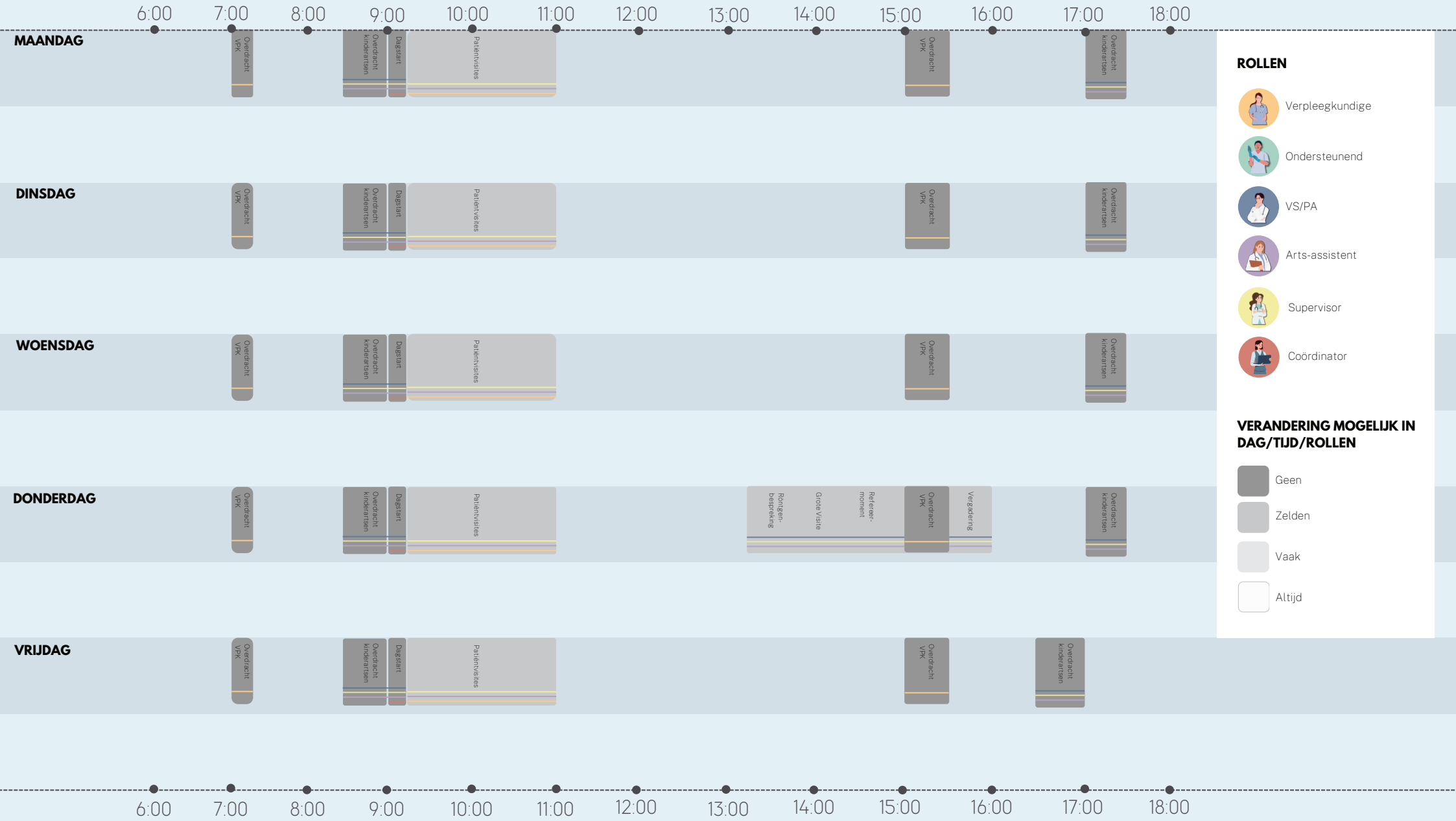


Figure 68: Iterated workflow HC Amphia

Made by Julia Broos

Figure 69: Iterated TeleNeo consultation blocks
Made by Julia Broos

Appendix F

Feedback + Iterations Healthcare Professionals

The concept evaluation involved a joint Microsoft Teams meeting with the healthcare professionals. During this meeting, I firstly explained the process and goal of the co-design session. Next, it was outlined that they would start by reviewing the role allocation templates, followed by the TeleNeo consultation blocks and workflows to assess their content. The following aspects have been evaluated:

- Do the healthcare professionals agree with the necessary steps (responsibilities) for each type of TeleNeo consultation in the role allocation templates?
- Do the healthcate professionals agree with the three different phases of preparation, execution and follow-up in the role allocation templates?
- Is there a need to split the TeleNeo consultation blocks into the three different phases (preparation, execution, follow-up) to improve their integration possibilities as was questioned by the IDE students?
- What is their opinion regarding the number of planned TeleNeo consultations that need to be integrated into the NICU and HC workflows? Is it feasable to integrate three of each type, as suggested by the research team?
- What is their advice regarding the formation of small groups for the first part of the co-design session? Is there a hierarchy I need to consider?

Feedback on the necessary steps (responsibilities) for each type of TeleNeo consultation

Both healthcare professionals agreed with almost all responsibilities outlined in the role allocation templates and suggested some small points for improvement. To start with, they explained that the responsibility of 'concluding the service' is primarily about closing the call, so it does not need to be a separate responsibility. Next, they suggested adding 'administration' as the final responsibility for all consultations as this was an important activity and currently missing in the templates. Additionally, the healthcare professionals noted that planning a consult (contacting parents and coordinating available times between EMC and Amphia) functions more like a contact loop rather than the currently presented linear process. Finally, they suggested that the roles from EMC and Amphia that will become responsible for 'plan moment for X' also become head of contact for their departments in this planning loop, as it is currently unclear to them who is responsible for coordinating the contact between EMC and Amphia when planning a consultation.

Feedback on the three different phases of preparation, execution and follow-up

Both healthcare professsionals agreed with the distinction of the three different phases and the corresponding responsibilities. They recommended creating an extra phase for 'planning' at the start of the templates, as this differs significantly from the 'preparation' phase and the corresponding responsibilities in their point of view.

Feedback on whether to split the TeleNeo consultation blocks into the three different phases (preparation, execution, follow-up)

I asked the healthcare professionals whether it would be better to split the TeleNeo consultation blocks into the three distinct phases or not. This suggestion was questioned during the concept testing with IDE students, but they lacked medical expertise. Reflecting on their experience with planned TeleNeo consultations, the healthcare professionals adviced distinguishing the 'planning' phase (which they suggested to add) from the other phases.

They noted that the planning of the TeleNeo consulations often occurs quite some time before the actual consultation, whereas the other three phases happen in quick succession. Using the example of a room tour, it would be best to create seperate blocks for 'planning TeleNeo room tour' and ' TeleNeo room tour' according to the healthcare professionals.

Feedback on the number of TeleNeo blocks that need to be integrated into the NICU and HC workflows

Based on input from the research team, I asked the healthcare professionals for their advice on integrating three TeleNeo blocks for each consultation type. They recommended to discuss three fixed times per day (one for each consultation type) during the co-design session, as this would better support adoption compared to having different times spread over five days. They also explained that having these fixed times (e.g., a room tour every day from 10:00-10:20) would help with communication to parents in terms of expectations.

Feedback on the formation of small groups for the first part of the co-design session

I asked the healthcare professionals for their advice on forming groups for the first part of the session, where small groups will work on the role allocation templates.

They were not concerned about the perceived hierarchy among participants, noting that everyone is open to collaboration and communicates easily. Their only advice was to devide the doctors, nurses and coordinators among the groups to ensure comprehensive knowledge about the departments. Additionally, they emphasized the importance of maintaining a balance between EMC and Amphia representatives within each group.

After gaining valuable feedback from the concept evaluation with two healthcare professionals, I used the insights to further refine the concept. *Figure 70* outlines the adjustments in the visual content and co-design session process.

	Role allocation templates	TeleNeo consultation blocks	Co-design session process
Adjustments	I removed the responsibility of 'concluding the service' in all templates as it was considered too minor to be outlined as a seperate responsibility I added 'administration' as the final responsibility for all consultations as this important activity was currently missing in the templates I changed the linear process of planning a consult (contacting parents and coordinating available times between EMC and Amphia) into a contact loop in all templates to align more closely with reality. This involved replacing the touchpoint and adding two-sided arrows I added an extra phase for 'planning' to the start of the templates to establish a clearer differentiation between planning and preparing for a TeleNeo consultation. Additionally, I rephrased 'planning' to 'coordinating' as it better aligns with the responsibilities involved in this phase I created a separate template for the 'coordinating' phases of all three consultation types, resulting in four role allocation templates in total. This approach allows for two groups to work on two templates during the co-design session, enhancing the knowledge within each group, rather than having three very small groups working on one template each (the initial plan).	I distinguished the 'coordinating' phase from the other phases because the coordination of the TeleNeo consulations often occurs quite some time before the actual consultation. This splitting allows for integrating the 'coordinating' phase as a seperate block into the NICU and HC workflows during the co-design session. I chose to create a small line indicating this phase and changed the initial TeleNeo consultation blocks into the following ones to improve the integration possibilities: • Coordination TeleNeo room tour • TeleNeo room tour • Coordination TeleNeo warm handover • TeleNeo warm handover • Coordination TeleNeo joint daily round • TeleNeo joint daily round	I revised the number of TeleNeo consultation blocks that will be integrated during the second part of the co-design session. Initially, the research team advised integrating three blocks for each consultation type. After discussing this with two healthcare professionals and one member of the research team, I decided on the following approach: first, the participants will search for as many moments for each TeleNeo consulatation type and coordinating moments. Next, they will decide on the best suitable moments from the options identified. With this approach, I aim to maximize the number of viable options rather than restricting them to a specific number. I created 12 blocks of each type. This number was chosen randomly to ensure participants have a sufficient quantity to work with To ensure comprehensive knowledge about the departments, I will include a doctor, nurse and coordinator in each group during the first part of the co-design session. Aditionally, I will ensure a balanced representation from both EMC and Amphia within each group

Figure 70: Iterations resulting from concept evaluation with healthcare professionals

Appendix G

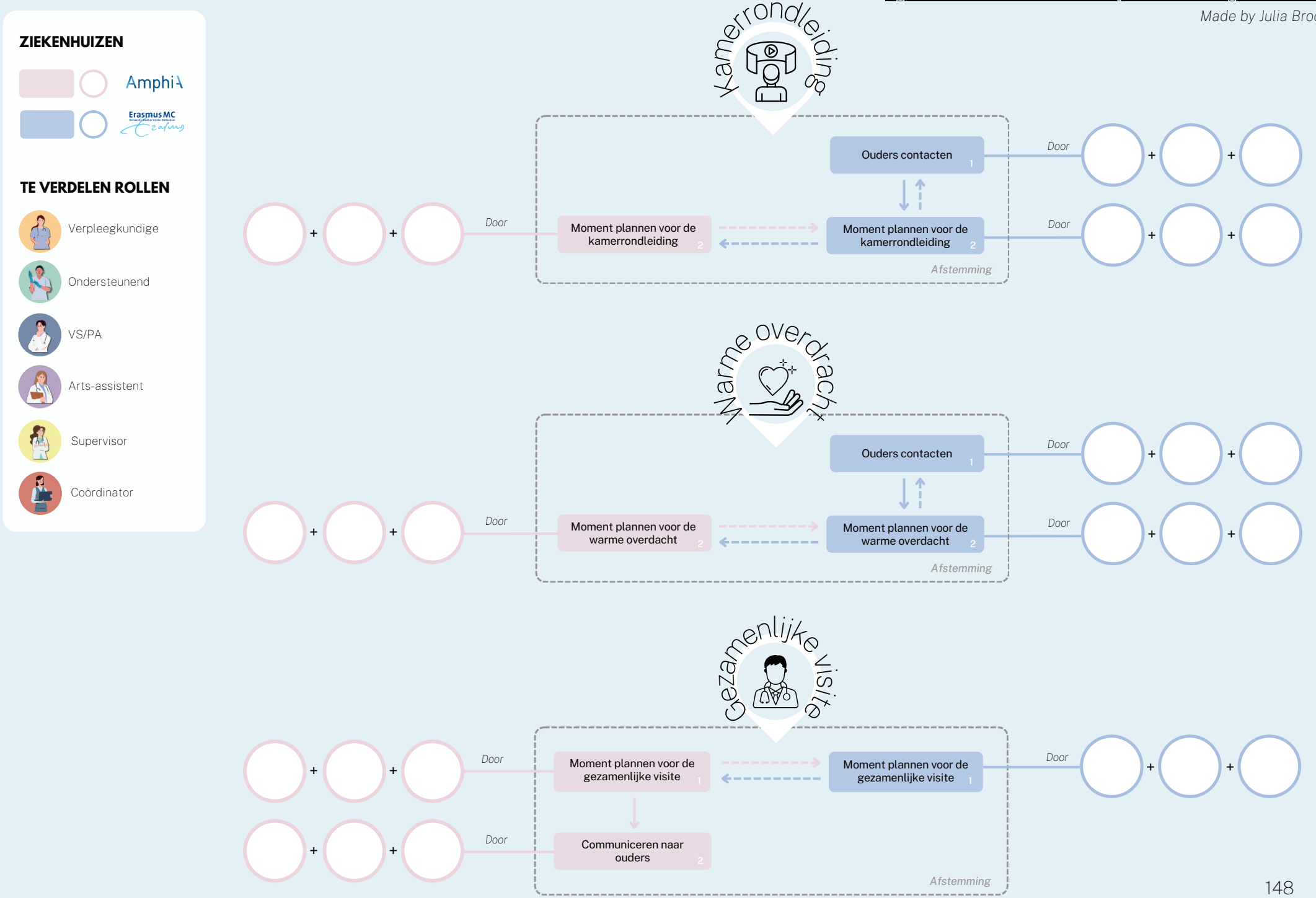
Visual Content Final Version

Iterations based on concept evaluation with healthcare professionals

Figures 71-74: Role allocation templates
Figure 75: Role markers
Figure 76-77: Workflow visualizations NICU and HC
Figure 78: TeleNeo consultation blocks

Figure 71: Added role allocation template coordinating consultations

Made by Julia Broos



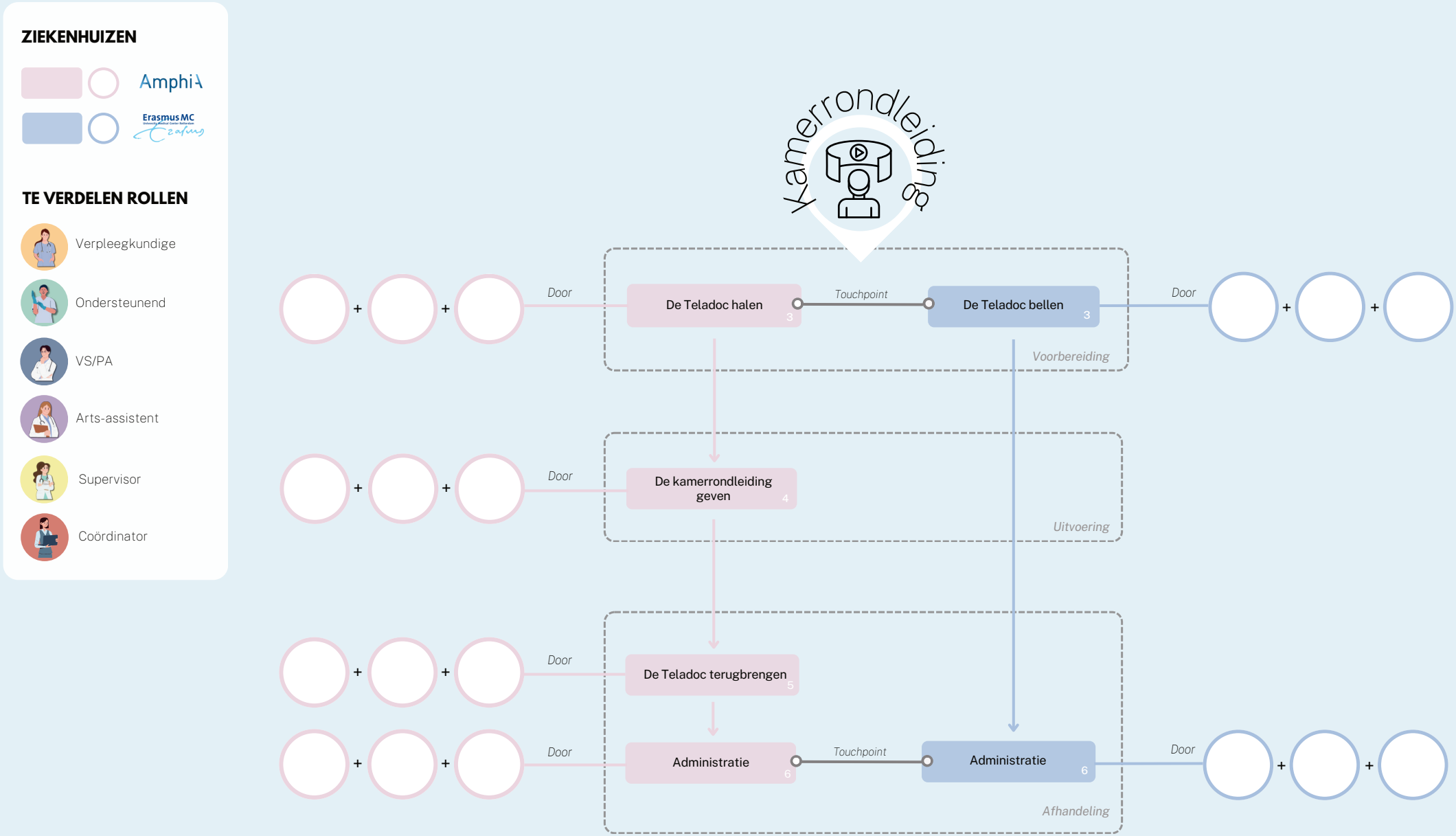


Figure 72: Finalized role allocation template room tour
Made by Julia Broos

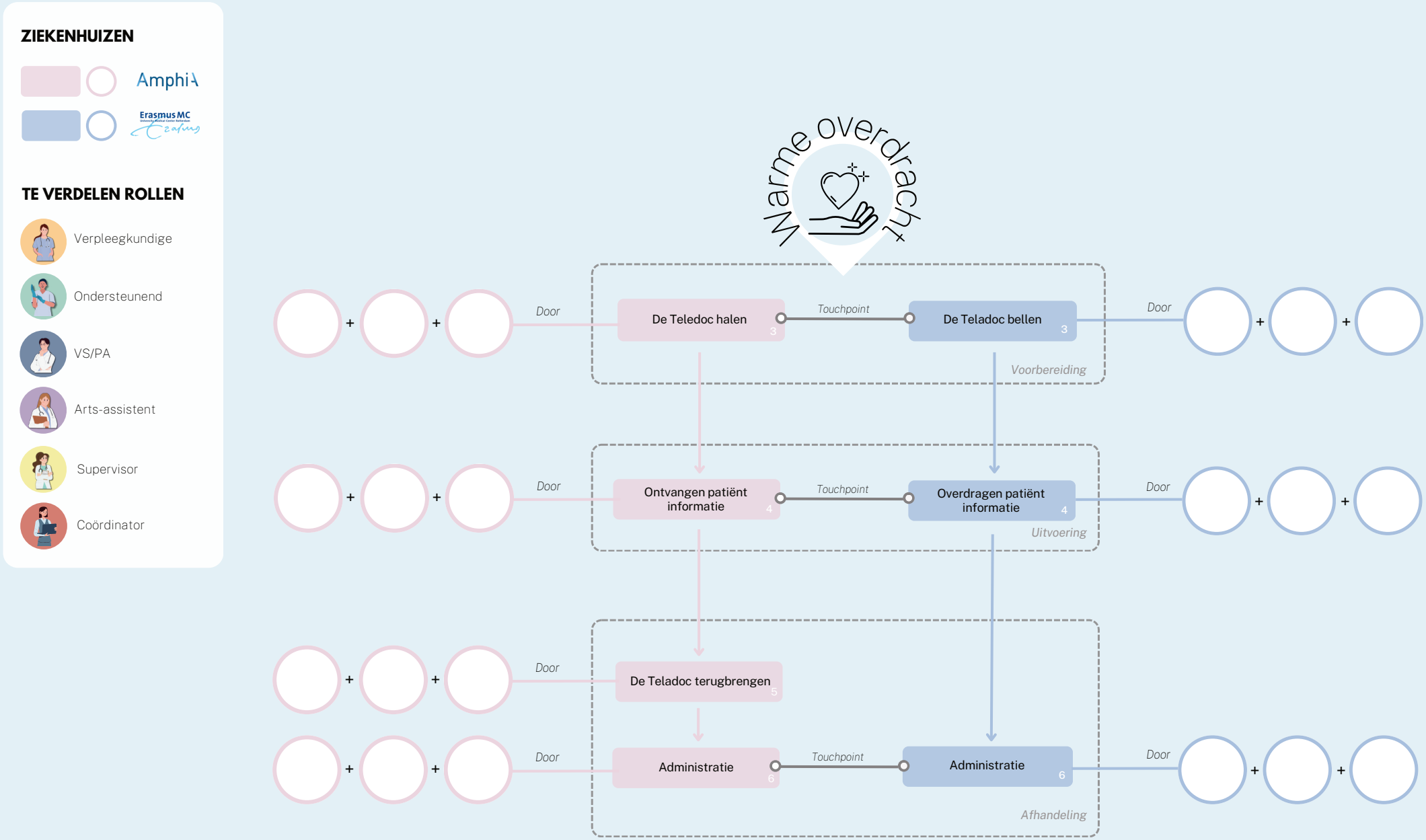


Figure 73: Finalized role allocation template warm handover
Made by Julia Broos

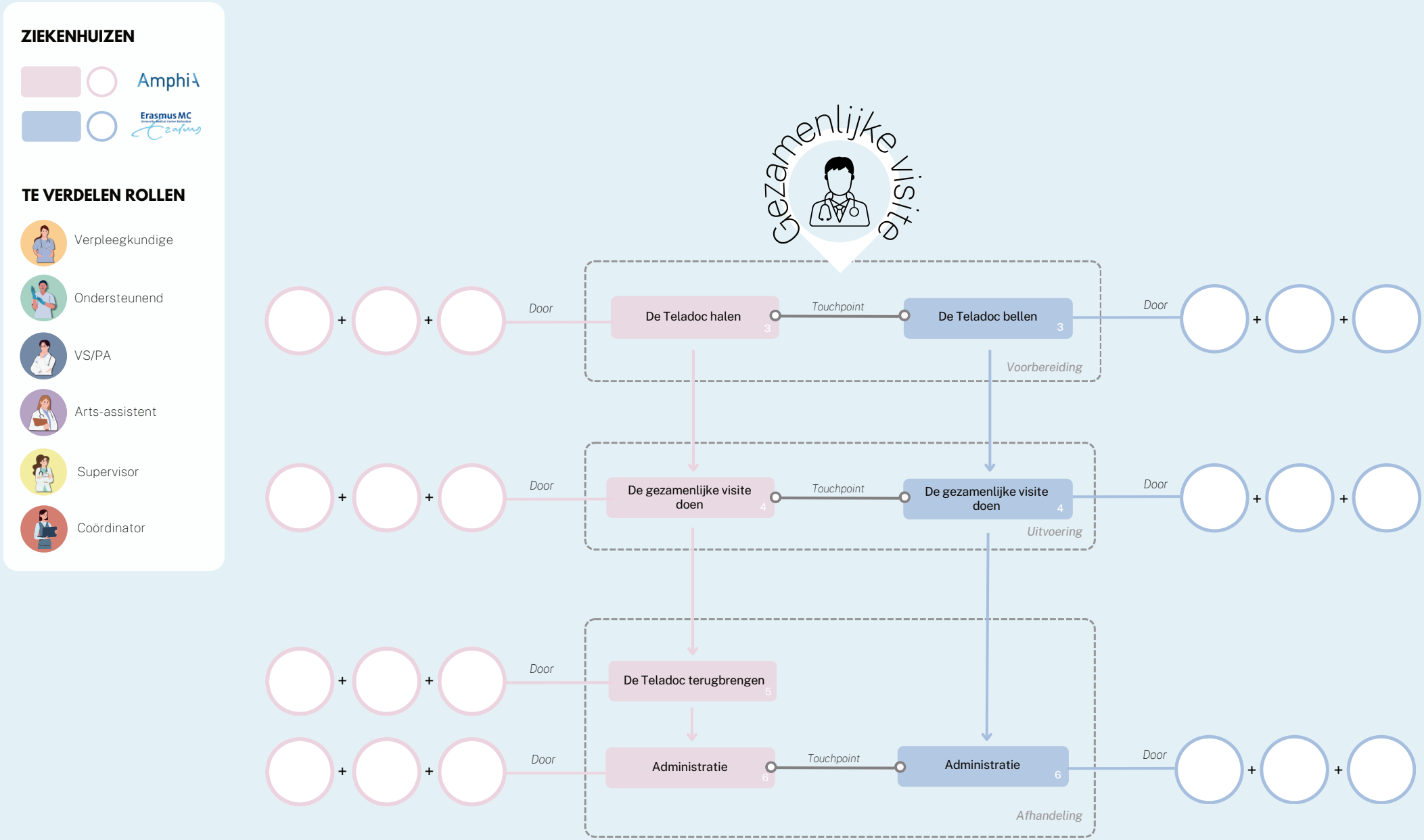


Figure 74: Finalized role allocation template joint daily round
Made by Julia Broos

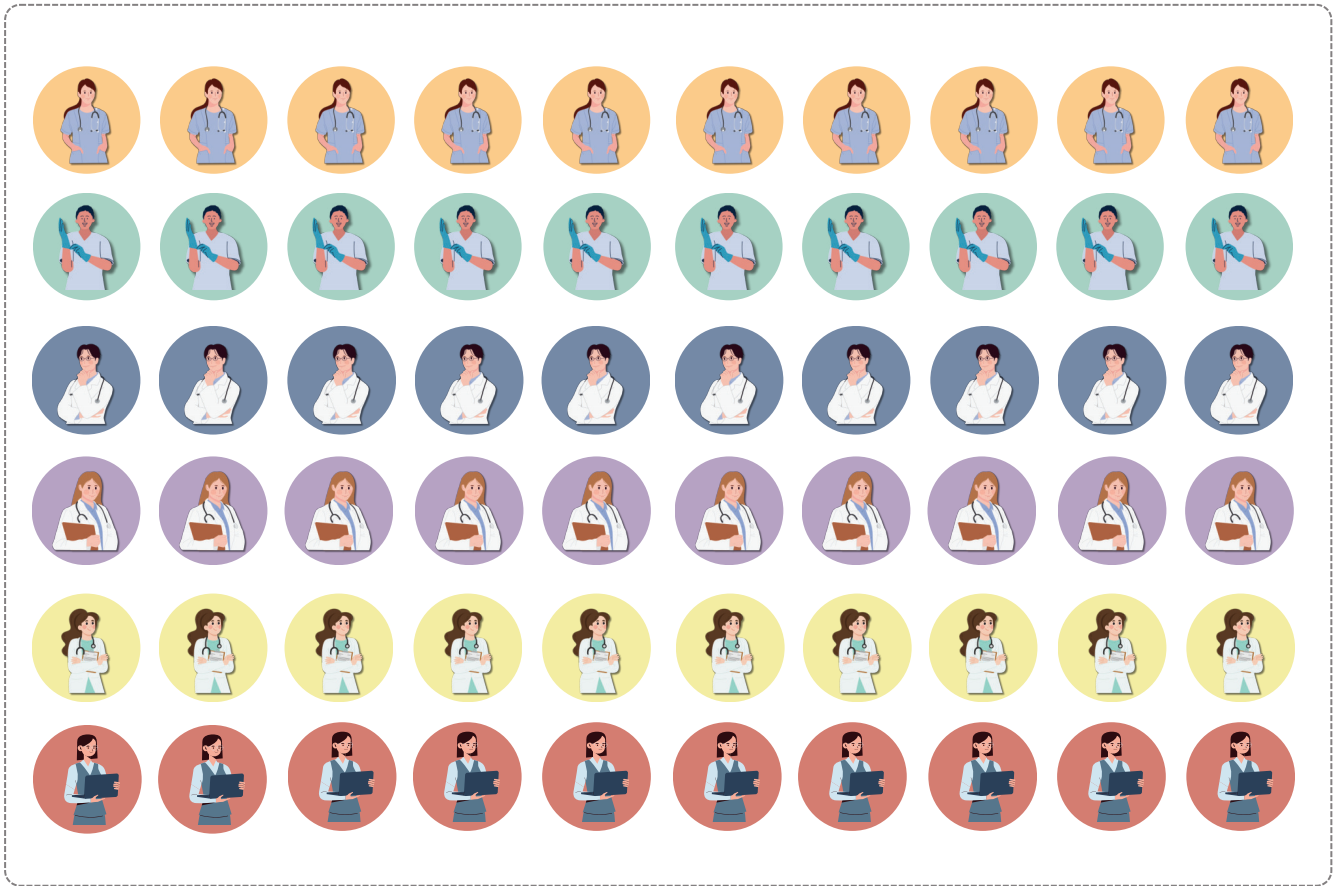


Figure 75: Finalized role markers (for one template)
Made by Julia Broos

NICU EMC

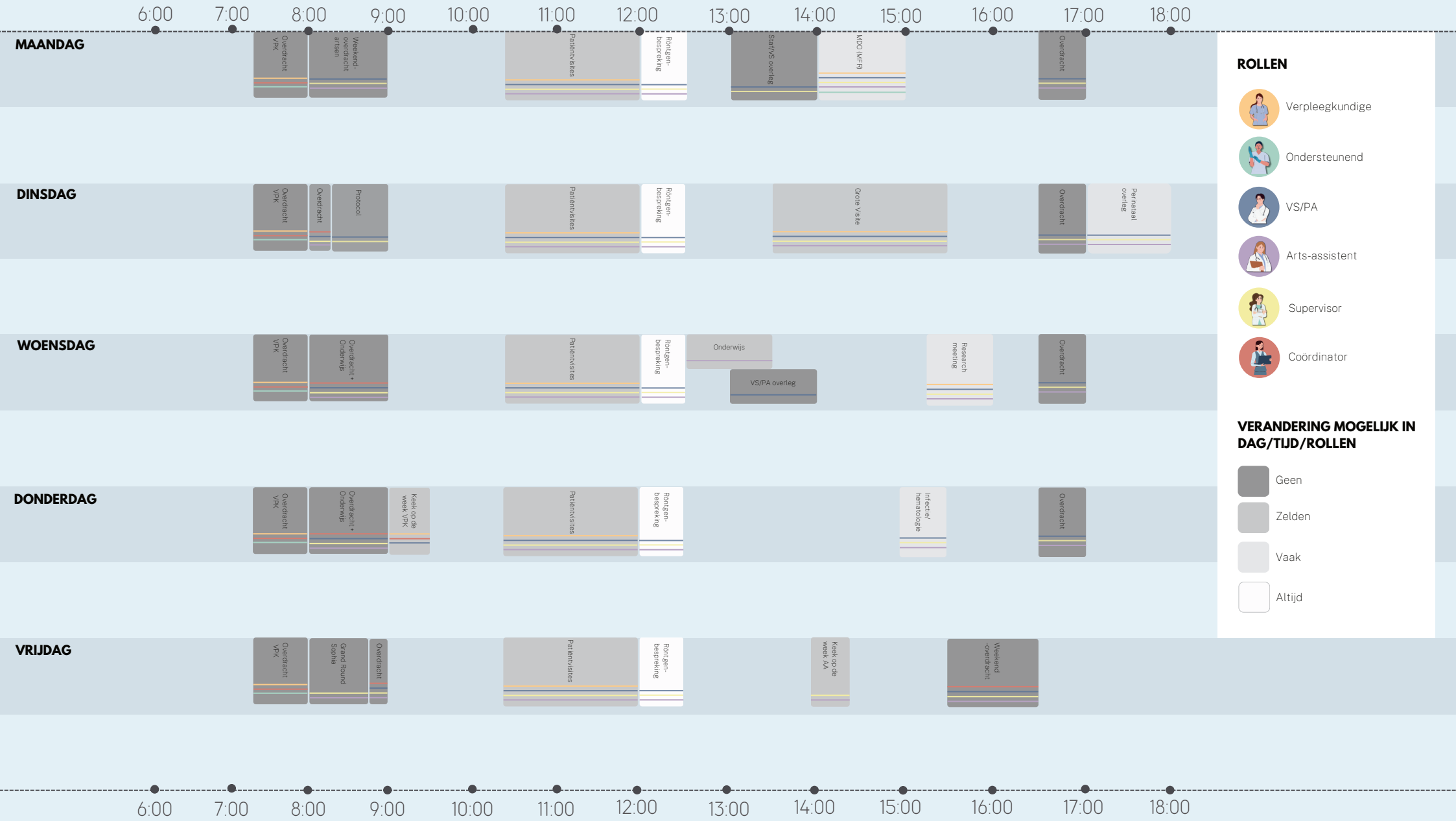


Figure 76: Finalized workflow NICU EMC

Made by Julia Broos

HIGH-CARE AMPHIA

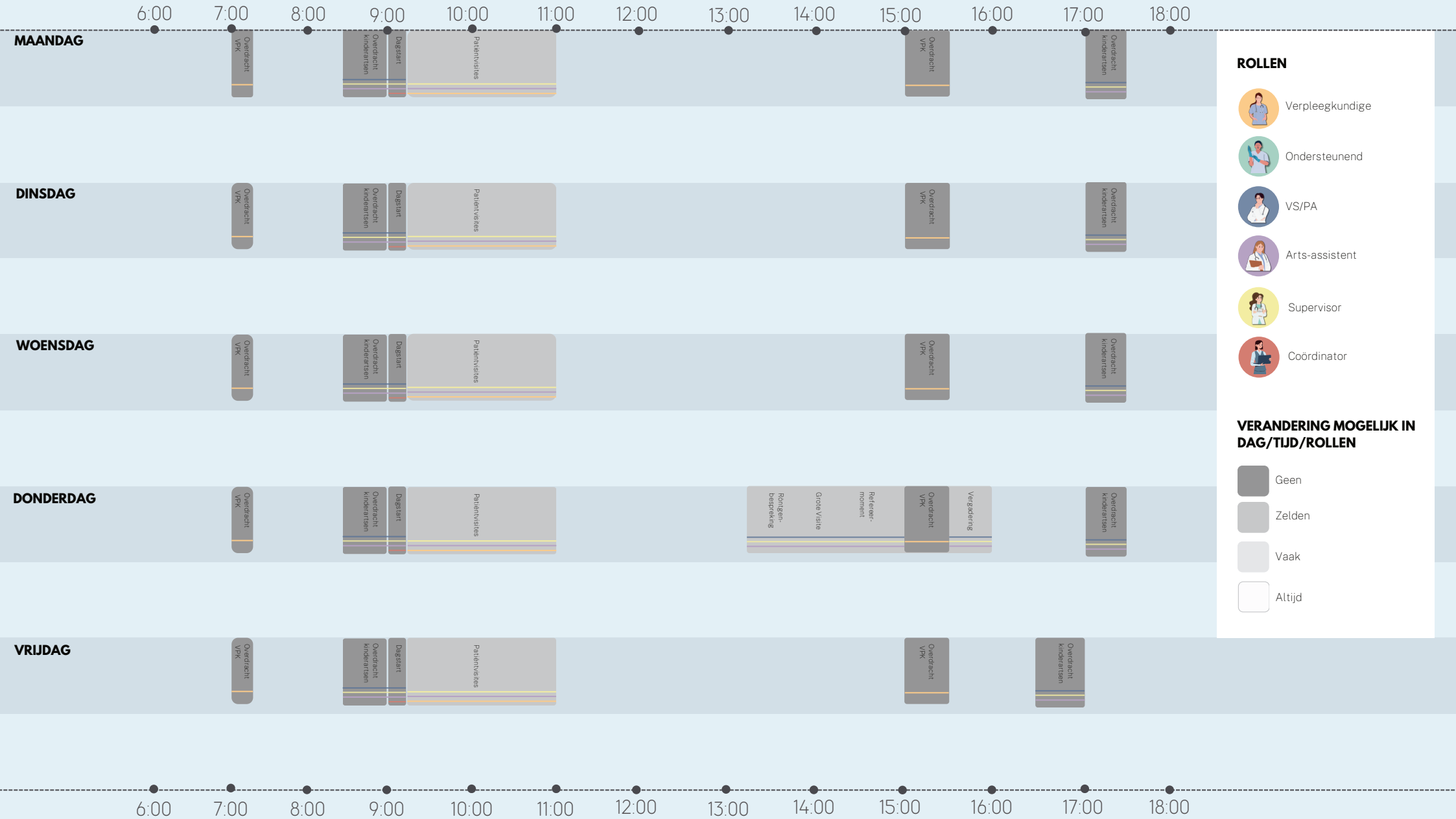


Figure 77: Finalized workflow HC Amphia

Made by Julia Broos

Figure 78: Finalized TeleNeo consultation blocks and coordinating moments

Made by Julia Broos

Appendix H

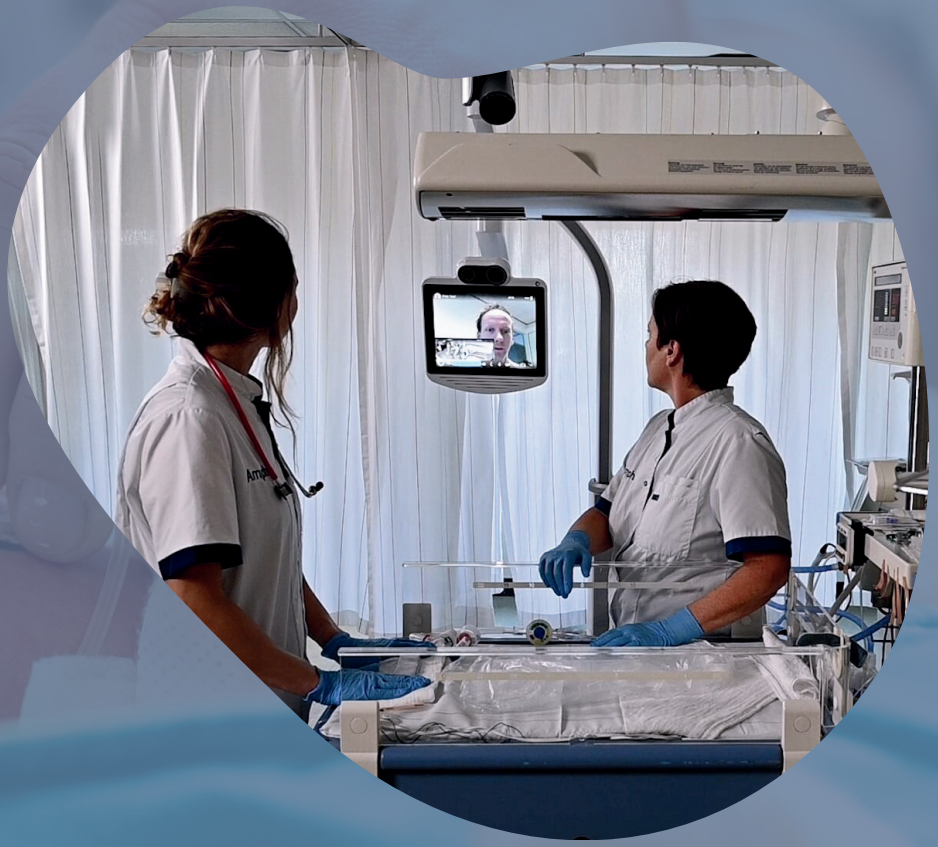
Deliverable Research Team

TeleNeo - vervolgstappen

Door: Julia Broos

Master Thesis TU Delft

Juli 2024



Erasmus MC

TU Delft

AmphiA

Introductie

Voor mijn afstudeeropdracht van de master *Strategic Product Design* aan de TU Delft heb ik de afgelopen maanden onderzoek gedaan naar de determinanten (obstakels en bevorderende factoren) met betrekking tot de implementatie van TeleNeo. Mijn focus was hierbij om te kijken naar hoe ik door middel van visualisaties het proces van pilot naar implementatie kan ondersteunen. Na literatuuronderzoek en 12 interviews met stakeholders heb ik de volgende twee unieke knelpunten gevonden voor de TeleNeo pilot:

1. Onduidelijke toewijzing van de verantwoordelijkheden van TeleNeo consulten aan zorgprofessionals op de NICU en HC met betrekking tot de opzet, uitvoering en opvolging van consulten
2. Moeilijkheden bij het plannen en roosteren van TeleNeo consulten vanwege logistiek, agenda's en flexibiliteit binnen de NICU en HC afdelingen

Het gaat hierbij om de planbare TeleNeo consulten van een kamerrondleiding, warme overdracht en gezamenlijke visite voorafgaand of na overplaatsing van het EMC naar het Amphia.

Na het identificeren van de knelpunten heb ik me gericht op het ontwerpen van visuele middelen om deze samen met zorgprofessionals van de NICU en HC in een co-design sessie te gebruiken. Deze sessie heeft plaatsgevonden in het Amphia op 12 Juni 2024 met de volgende personen:

- Kinderarts HC
- Verpleegkundig specialist HC
- Verpleegkundige HC
- Arts-assistent NICU
- Opnamecoördinator NICU
- Team Manager HC

Aan de hand van twee verschillende activiteiten ondersteund door visualisaties hebben de deelnemers van de co-design sessie gewerkt aan het toebedelen van rollen aan de nieuwe TeleNeo verantwoordelijkheden en gekeken naar wat de meest geschikte momenten zijn voor de drie typen planbare TeleNeo consulten voor de NICU en de HC.

Dit document is opgesteld voor het research team om de volgende stappen in de implementatie van TeleNeo te verspreiden onder de staf op de NICU en HC. Hierbij wordt ingegaan op de toebedeelde rollen van zorgprofessionals op de NICU en HC aan de nieuwe TeleNeo verantwoordelijkheden en worden de gekozen momenten voor de drie typen TeleNeo consulten en hun coördinatie/afstemming uitgelicht. Op de volgende pagina volgt een samenvatting van de resultaten, ondersteund door visualisaties en een uitgebreidere onderbouwing verderop in het document.

Afstemming van planbare consulten

Wat betreft de afstemming van de planbare consulten (communicatie met ouders, zorgprofessionals op de eigen afdeling en zorgprofessionals op de andere afdeling) geldt het volgende:

- TeleNeo zal worden opgenomen in de dagstart vragenlijst in Breda om na te gaan of er die week TeleNeo visite nodig is en of er overplaatsingen komen voor een warme overdracht
- Elke maandag belt de superviserend kinderarts in Breda na de dagstart naar de opnamecoördinator van de NICU om af te stemmen wat er die week op de planning staat qua TeleNeo consulten
- Verder belt de superviserend kinderarts in Breda op de andere dagen na de dagstart naar de opnamecoördinator van de NICU wanneer er bijzonderheden zijn voor de TeleNeo

Kamerrondleiding

- De kamerrondleiding zal vervangen worden door een standaard video die ouders kunnen bekijken voorafgaand aan de overplaatsing
- Tot die tijd wordt de kamerrondleiding gecombineerd met de warme overdracht en tijdens dit type consult uitgevoerd

Warme overdracht

- Standaard momenten: Maandag, Dinsdag én Woensdag om 15:30, als extra mogelijkheid kan er ook worden uitgeweken naar Dinsdag om 13:00
- Er zal een handleiding komen voor het doen van een warme overdracht
- De indicatie voor het doen van een warme overdacht ligt nu bij <32 weken en >7 dagen opname. Het is nader te bepalen of deze indicatie verruimd zal worden naar alle overplaatsingen
- NICU specifiek: het is nader te bepalen bij wie de verantwoordelijkheid komt te liggen op de NICU voor het doen van een warme overdracht, waarbij onderscheid wordt gemaakt tussen <27 wekers en >27 wekers
- HC specifiek: het is nader te bepalen of een warme overdracht ook in EPIC gedocumenteerd kan worden, in plaats van op papier

Gezamenlijke visite

- Standaard momenten: Dinsdag én Vrijdag om 9:30, geïntegreerd in de huidige patiëntvisite, als extra mogelijkheden kan er ook worden uitgeweken naar Woensdag om 9:30 en Dinsdag/Vrijdag om 11:30
- HC specifiek: er zullen snelteksten komen voor de kinderartsen om de consulten te documenteren

Op de volgende pagina's worden visualisaties gepresenteerd van deze uitkomsten. Eerst wordt weergegeven welke rollen zijn toebedeeld aan de warme overdracht en gezamenlijke visite. Vervolgens wordt een vernieuwde versie van de NICU en HC weekplanningen gepresenteerd, met daarin de meest geschikte momenten en uitwijkmogelijkheden (aangegeven met 'extra') voor de drie typen TeleNeo consulten en hun afstemming. Hierin worden ook de benodigde rollen weergegeven die zijn toebedeeld tijdens de co-design sessie.

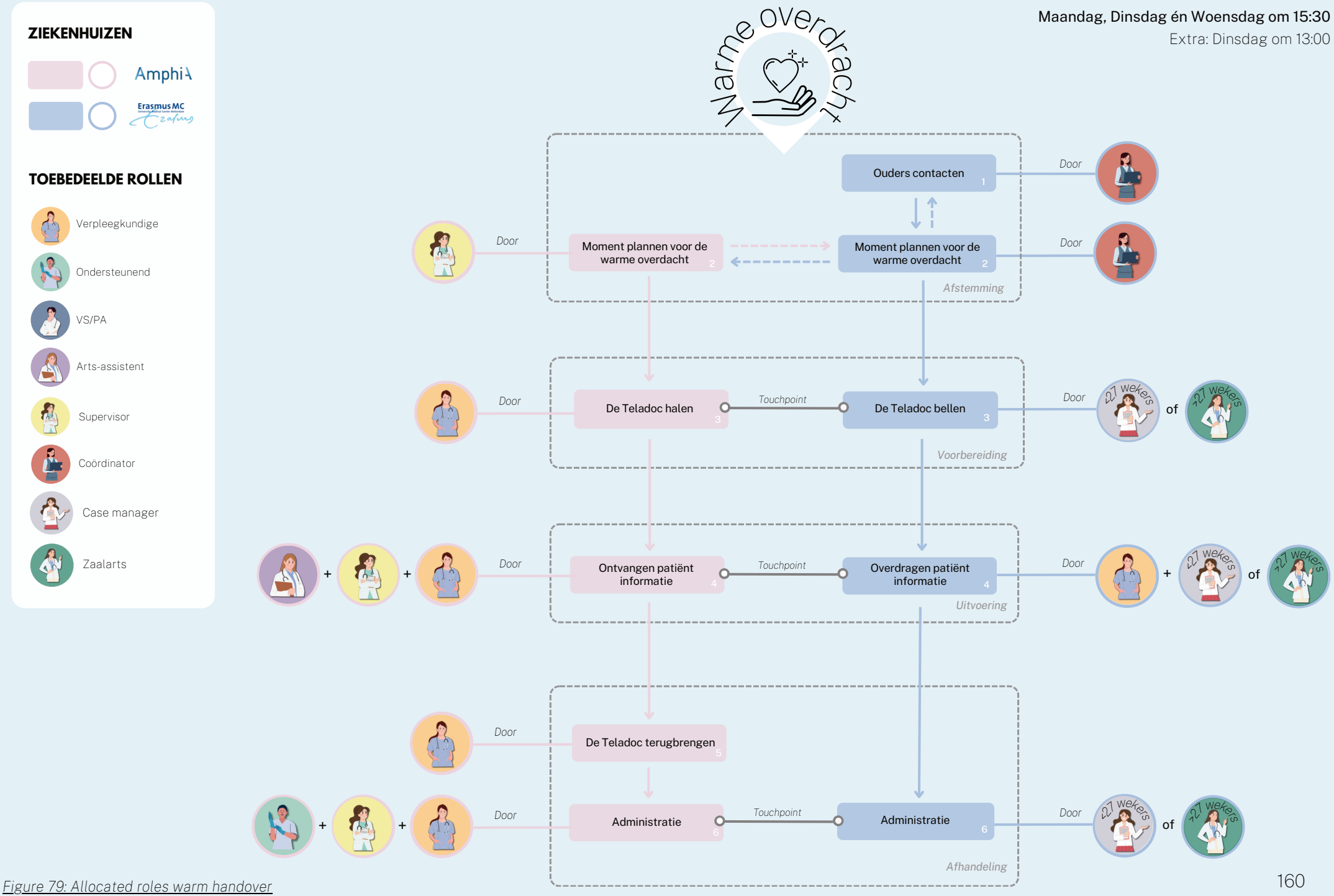


Figure 79: Allocated roles warm handover

Made by Julia Broos

ZIEKENHUIZEN

Amphia

Erasmus MC

TOEBEDEELDE ROLLEN

- Verpleegkundige
- Ondersteunend
- VS/PA
- Arts-assistent
- Supervisor
- Coördinator
- Case manager
- Zaalarts

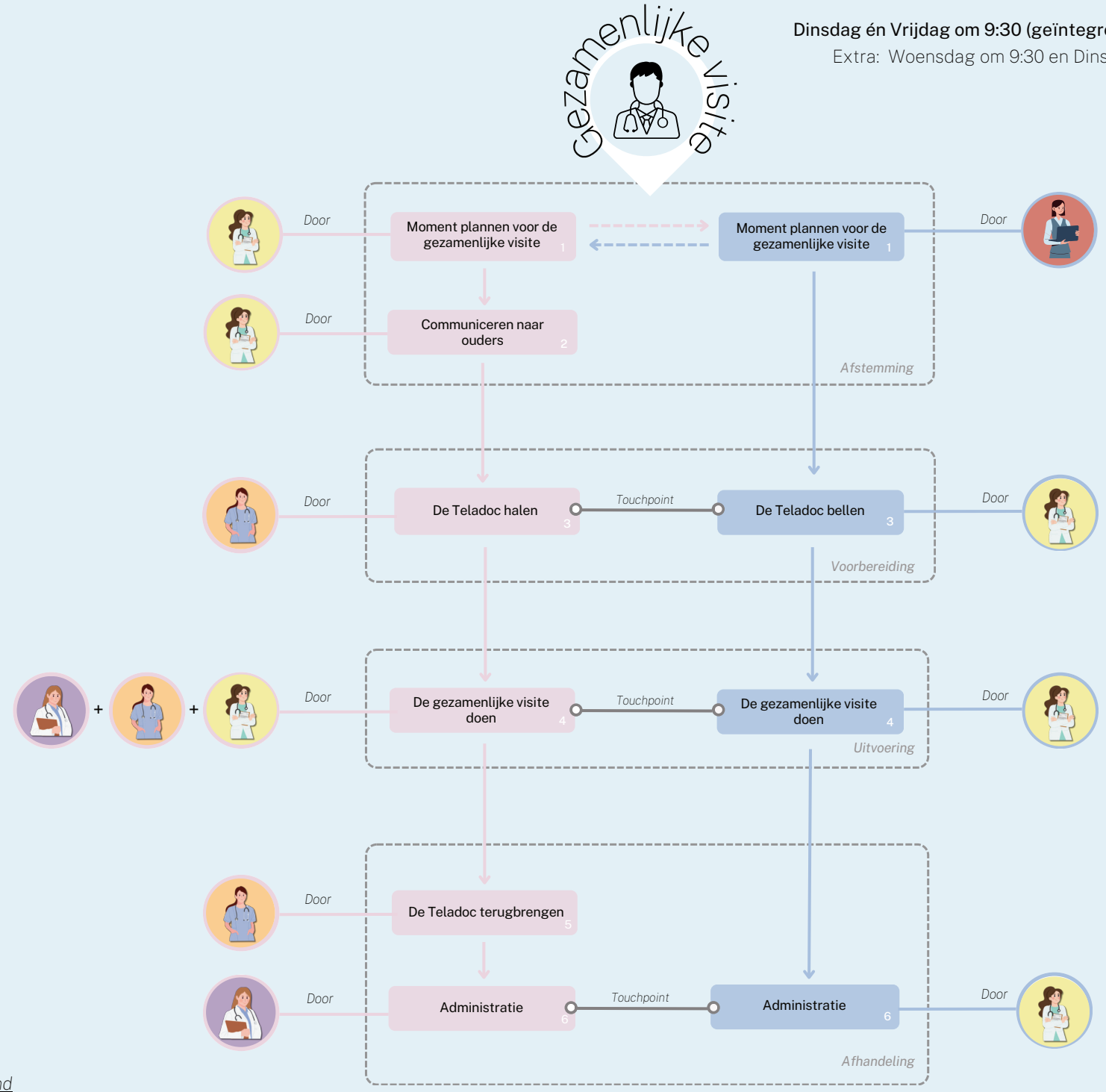


Figure 80: Allocated roles joint daiy round
Made by Julia Broos

WEEKPLANNING NICU

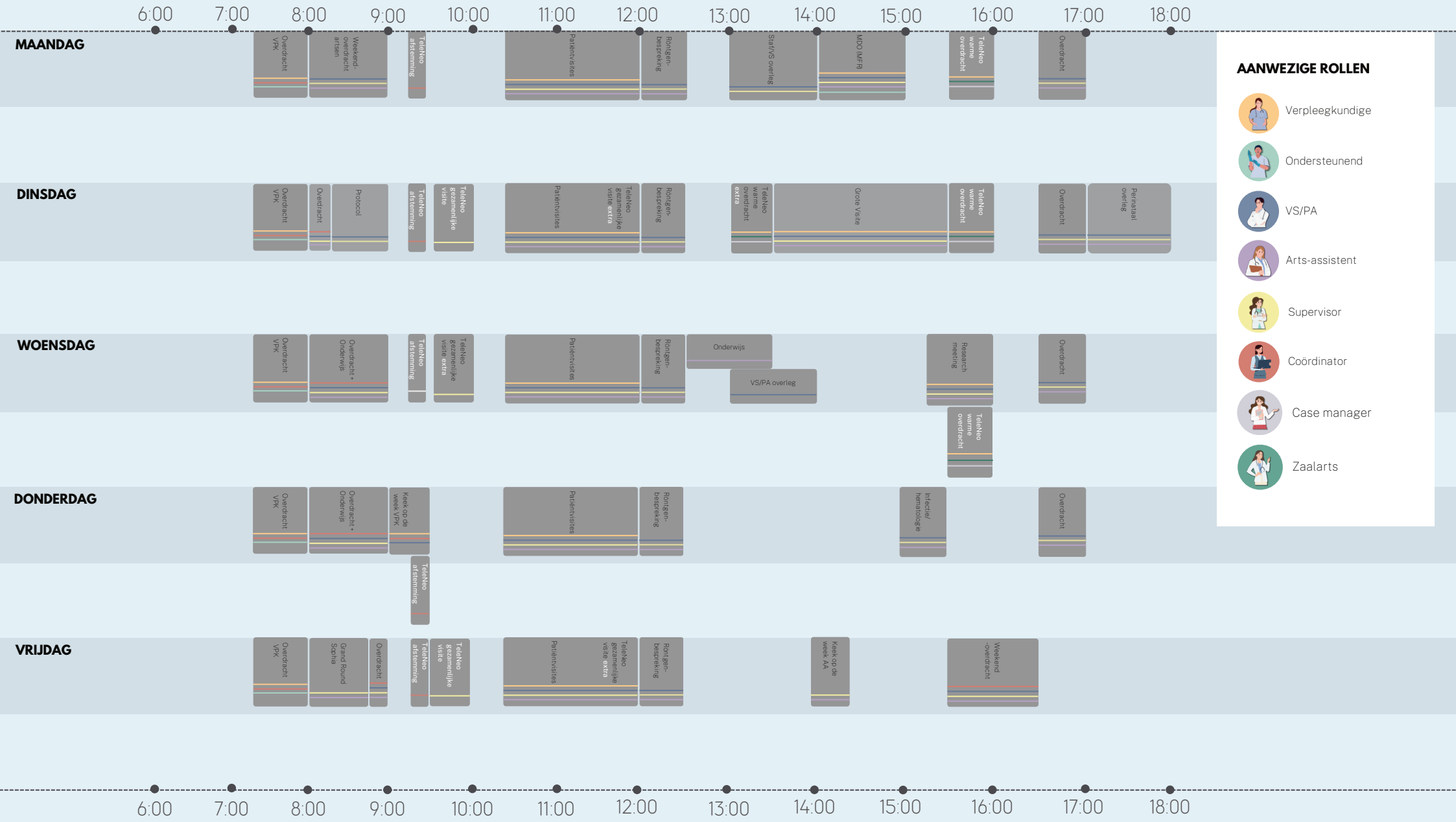


Figure 81: Revised NICU workflow

Made by Julia Broos

WEEKPLANNING HC

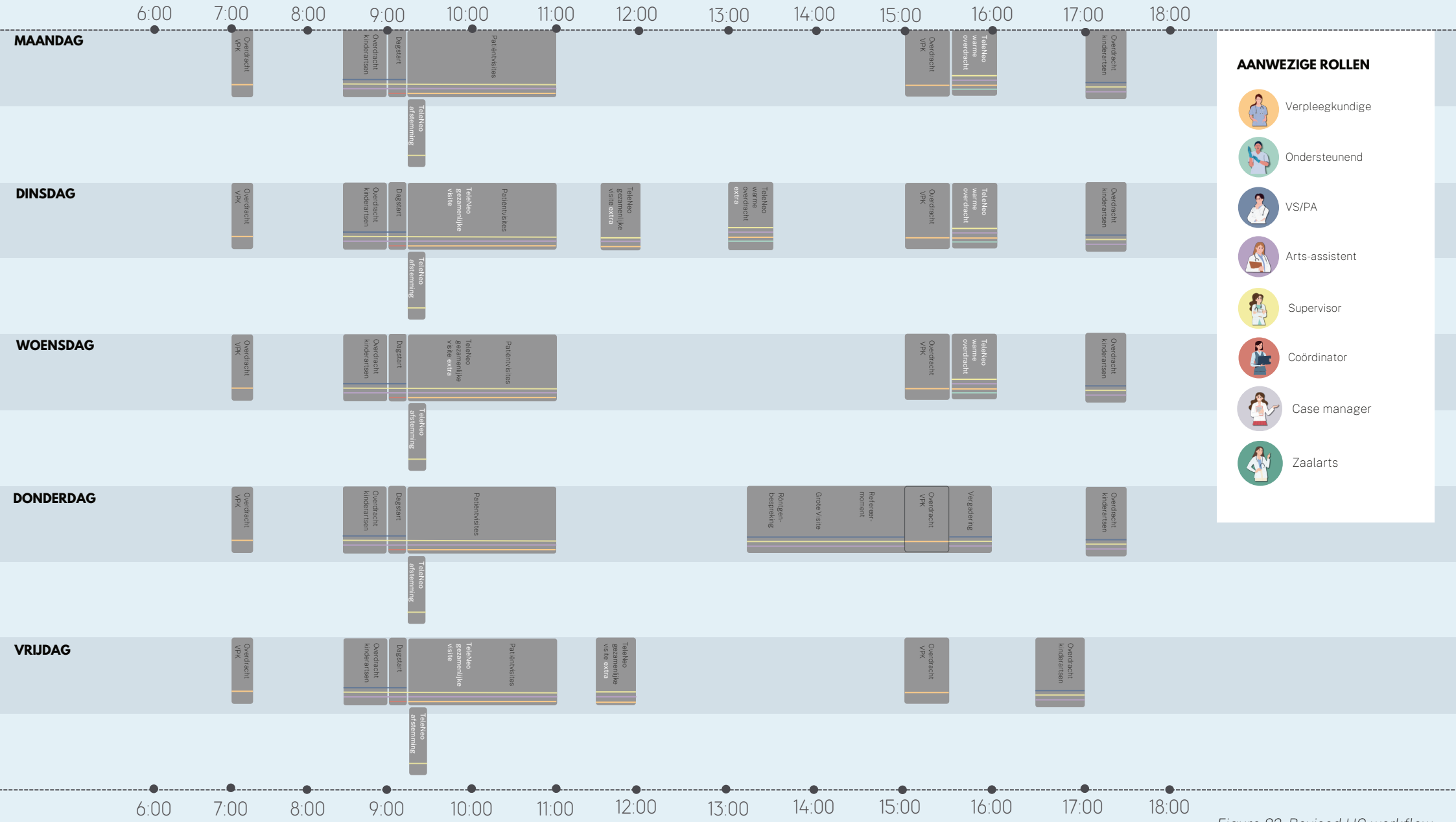


Figure 82: Revised HC workflow

Made by Julia Broos

Uitgebreide uitleg van de resultaten

Tijdens het toebedelen van rollen aan de geplande TeleNeo consulten (kamerrondleiding, warme overdracht, gezamenlijke visite en hun afstemming/coördinatie) en het bepalen van hun meest geschikte momenten voor de NICU en HC zijn verschillende inzichten naar voren gekomen. Deze worden hieronder beschreven:

Afstemming van geplande consulten

Wat betreft de afstemming van geplande consulten (communicatie met ouders, zorgprofessionals op de eigen afdeling en zorgprofessionals op de andere afdeling) is geconcludeerd dat de opnamecoördinator van de NICU hier een belangrijke rol in speelt. Tijdens het toebedelen van rollen en zoeken naar de meest geschikte momenten met betrekking tot de afstemming/coördinatie zijn de volgende suggesties gedaan:

- Het gebruiken van de dagstart van de gezinsssuites in Breda om na te gaan of er die week TeleNeo visite nodig is en of er overplaatsingen komen en dus behoefte is aan een warme overdracht. Daarom zal TeleNeo worden opgenomen in de dagstart vragenlijst
- Elke maandag belt de superviserend kinderarts in Breda na de dagstart naar de opnamecoördinator van de NICU om af te stemmen wat er die week op de planning staat qua TeleNeo consulten
- Verder zal de superviserend kinderarts in Breda op de andere dagen na de dagstart bellen naar de opnamecoördinator van de NICU wanneer er bijzonderheden zijn voor de TeleNeo

Kamerrondleiding

Tijdens het toebedelen van de rollen aan de kamerrondleiding en evaluatie hiervan kwamen de deelnemers van de co-design sessie tot de conclusie dat het niet wenselijk is om de kamerrondleiding steeds opnieuw te doen voorafgaand aan een overplaatsing naar Breda, omdat dit als nu tijdrovend en inefficiënt wordt ervaren. Daarom zijn de volgende suggesties gedaan:

- Het vervangen van de kamerrondleiding door een standaard video die ouders kunnen bekijken voorafgaand aan de overplaatsing. Het research team zal hiermee aan de slag gaan
- Tot die tijd wordt voorgesteld om de kamerrondleiding te combineren met de warme overdracht en tijdens dit type consult uit te voeren

Warme overdracht

Meest geschikte momenten

Tijdens het zoeken naar de geschikte momenten voor de NICU en HC voor een warme overdacht (en kamerrondleiding totdat er een vervangende video is) zijn de volgende standaard momenten als meest geschikt naar voren gekomen:

- **Maandag, Dinsdag én Woensdag om 15:30**
- Als extra mogelijkheid kan er ook worden uitgeweken naar Dinsdag om 13:00

Indicatie voor een warme overdracht

Daarnaast is er een vraag naar voren gekomen met betrekking tot de huidige indicatie voor het doen van een warme overdracht. Deze ligt nu bij <32 weken en >7 dagen opname. De vraag hierbij is of deze indicatie verruimd moet worden naar alle overplaatsingen. Het research team zal dit bespreken met de NICU staf/VS.

Verantwoordelijkheid

Tijdens het toebedelen van NICU rollen aan de verantwoordelijkheden van een warme overdacht is de vraag naar voren gekomen of hierbij onderscheid gemaakt moet worden tussen lange liggers vs. minder lange liggers en of deze grens bij de 27 wekers moet liggen. Als resultaat zijn de volgende suggesties gedaan:

- <27 wekers --> verantwoordelijkheid ligt bij case manager (VS/Neonatoloog) + verpleegkundige van de zaal
- >27 wekers --> verantwoordelijkheid ligt bij zaalarts (VS/AA) + verpleegkundige van de zaal

Het research team zal dit bespreken met de NICU staf/VS.

Handleiding

Tijdens de co-design sessie is naar voren gekomen dat er behoefte is aan een handleiding voor de inhoud van de warme overdracht. Het research team zal hiermee aan de slag gaan.

Documentatie

Daarnaast is er besproken dat het voor het Amphia ideaal zou zijn als de warme overdracht ook in EPIC gedocumenteerd kan worden, in plaats van op een papiertje op het bord.

Daarom zal er vanuit het Amphia worden gekeken naar wat de mogelijkheden zijn voor het aanmaken van een dossier en zal een structuur worden uitgedacht om goed bij te kunnen houden welke patiënten geweigerd worden.

Gezamenlijke visite

Meest geschikte momenten

Tijdens het zoeken naar de geschikte momenten voor de NICU en HC voor een gezamenlijke visite zijn de volgende momenten als meest geschikt naar voren gekomen:

- **Dinsdag én Vrijdag om 9:30, geïntegreerd in de huidige patiëntvisite**
- Als extra mogelijkheden kan er ook worden uitgeweken naar Woensdag om 9:30 en Dinsdag/Vrijdag om 11:30

Documentatie

Tijdens de co-design sessie is naar voren gekomen dat het voor het Amphia wenselijk is om de gezamenlijke visite eenvoudig en snel te documenteren. Daarom zal het research team snelteksten voor de Amphia artsen maken om de consulten te documenteren.

Appendix I

Guidelines

Indications

In the TeleNeo pilot project, interviews with stakeholders revealed barriers to implementation, particularly regarding the planning and scheduling of consultations due to logistical issues, conflicting agendas, and the flexibility within hospital departments. Additionally, there was a lack of clarity in the allocation of roles and responsibilities for healthcare professionals in the setup, execution, and follow-up of planned TeleNeo consultations (room tours, warm handovers, and joint daily rounds). Therefore, it is important to first determine whether these barriers exist in other hospitals where you plan to apply this visualization guided co-design technique (**CoVisioning**) for TeleNeo implemenation. If so, these guidelines can be adopted to support the scale-up.

Purpose of Interactive Design Practice

A visualization guided co-design technique is utilized during an interactive session where participants use visual aids to explore and address implemenation challenges. The primary purpose of a visualization guided co-design technique is to enhance understanding, foster collaboration, and generate insights by making information more accessible and engaging through visual means. Participants are encouraged to actively participate in using visual representations, which can lead to deeper insights, improved communication, and more effective problem-solving. In the TeleNeo context, a visualization guided co-design technique involves creating interactive visualizations of the entire TeleNeo service process, including steps from beginning to end, roles, responsibilities, and workflows. These visualizations help stakeholders better understand the service implementation process, identify potential challenges or develop strategies for addressing them. Overall, a visualization guided co-design technique serves as a powerful tool for facilitating discussion, fostering creativity, and driving alignment among participants towards achieving a succesful implementation of TeleNeo.

Participants and Setting

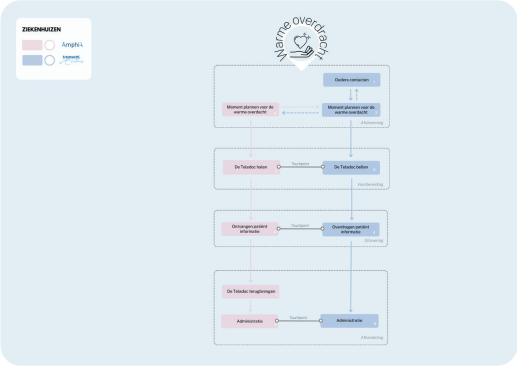
When organizing a session for utilizing CoVisioning, it is crucial to invite healthcare professionals from the departments involved in providing the TeleNeo service. For the pilot, this involved healthcare professionals from the NICU department at EMC and the HC department at Amphia. To foster meaningful discussions on the impact of TeleNeo and ensure a comprehensive understanding, it is neccessary to form a group for the session comprising 6 to 10 participants. Additionally, aiming for a physical gathering, such as at one of the hospitals, rather than a digital one, is needed for enhancing the dynamics and collaboration among participants. This approach aligns better with the interactive nature of a visualization guided co-design technique, fostering more effective engagement and communication.

The first part of the technique focuses on assigning roles to the new TeleNeo responsibilities arising from the digital health service between two hospitals. This aims to address the barrier of unclear role allocation for healthcare professionals in the setup, execution, and follow-up of planned TeleNeo consultations. These consultations include a room tour, a warm handover, and a joint daily round. By detailing the necessary steps and supporting them with examples, guidelines have been created for designing the visual content for the first part of the technique, using a 'warm handover' consultation to exemplify the design process.

Step 1. Identify the actors involved in the TeleNeo service and outline the different phases of the service. For the pilot, the involved actors are the NICU and HC departments. The phases for each TeleNeo service include the coordination, preparation, execution, and follow-up, and can be replicated. This highlights that the services are not solely about their execution but also emphasize the importance of coordinating the consultations as the starting point of the TeleNeo services.

Step 2. Determine the responsibilities within each phase of the TeleNeo service for the involved actors.

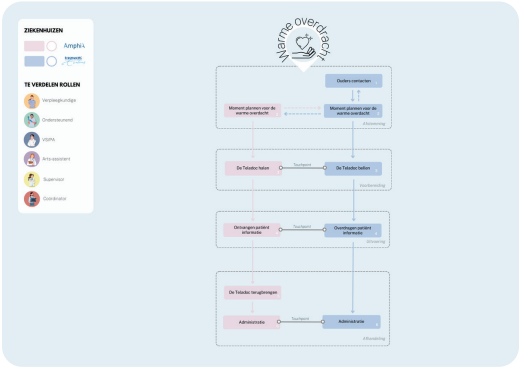
Step 3. Create a visualization in which the responsibilities of *Step 2* are outlined in chronological order and use the identified service phases of *Step 3* as a framework to structure the visualization. Include a legend and assign a color to each involved actor and use these colors to distinguish between their responsibilities. Also highlight touchpoints when there is an interaction between the involved actors in the service.



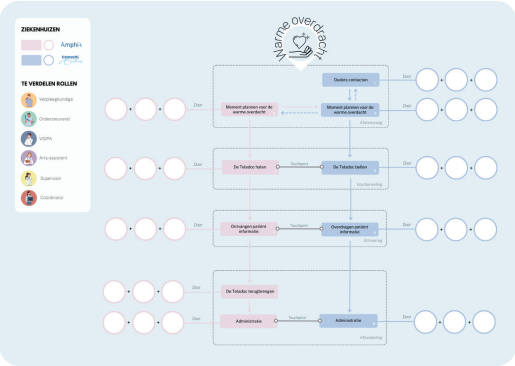
Step 4. Identify the present roles within the involved actors of *Step 1*. For the pilot, the roles present at the NICU and HC departments (the actors) include the role of a Nurse, Nurse-supporter, Nurse practitioner/Physician assistant, Medical resident, Supervisor, and Coordinator. Within the overarching domain of roles, multiple individuals can fulfil a role. Using roles instead of individuals enables you to make a comparison between actors at the same level.

Step 5. Add the identified roles from *Step 4* to the legend by using an icon, name, and assign a colored circle (distinct from the actor colors) to each role. For example:

Nurse - orange
Nurse supporter - green
NP/PA - dark blue
Medical resident - purple
Supervisor - yellow
Coordinator - red

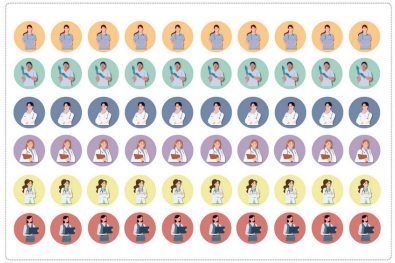


Step 6. Add empty spots in the visualization created in the previous steps next to the outlined responsibilities, placing a '+' between each spot to indicate that multiple roles can be assigned to a single responsibility. The purpose of these empty spots is to position the identified roles from *Step 5* during the co-design session. Ensure the size of the empty spots matches the size of the roles in the legend. The number of empty spots should correspond to the maximum number of roles that can be assigned to each responsibility, which varies depending on the involved departments. The resulting visualization is referred to as a **'role allocation template'.**



Step 7. To finalize your role allocation template, validate the outlined responsibilities and roles with healthcare professionals from the involved departments, and iterate as necessary based on their feedback.

Step 8. As additional visual content for utilizing the role allocation template during the session, create a separate sheet with multiple copies of the identified roles from *Step 5*. These will be referred to as **'role markers.'**



Step 9. Finally, print the role allocation template along with the role markers on A3-sized paper. Cut out the role markers and place Velcro stickers on the empty spots in the template and on the role markers so that the roles can be positioned and repositioned as needed during the co-design session.

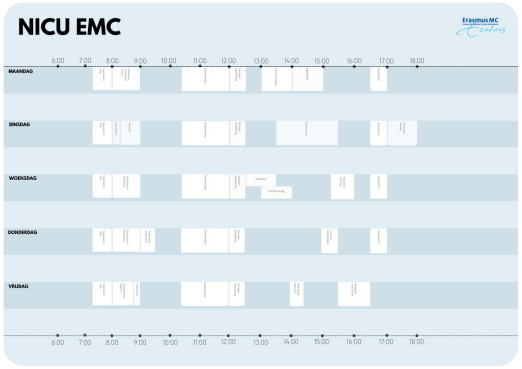
Following these steps will result in the visual content for the first part of CoVisioning, specifically customized for allocating roles to the new responsibilities introduced by the TeleNeo service. This process can be replicated to create role allocation templates for additional TeleNeo services as needed.

Designing the Technique Part 2

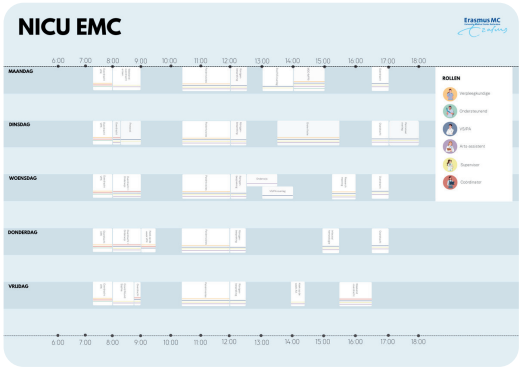
The second part of the technique focuses on integrating TeleNeo into the current workflow of healthcare professionals. This aims to address the barrier of difficulties in planning and scheduling consultations due to logistical issues, conflicting agendas, and the flexibility within hospital departments. By detailing the necessary steps and supporting them with examples, guidelines have been created for designing the visual content for the second part of the technique.

Step 1. Identify the current routine care activities for the involved actors in the TeleNeo service(s) and define a timeline for when the service(s) will be used. In this case, I examined routine care activities at the NICU and HC departments and created a timeline spanning from Monday to Friday with daytime hours.

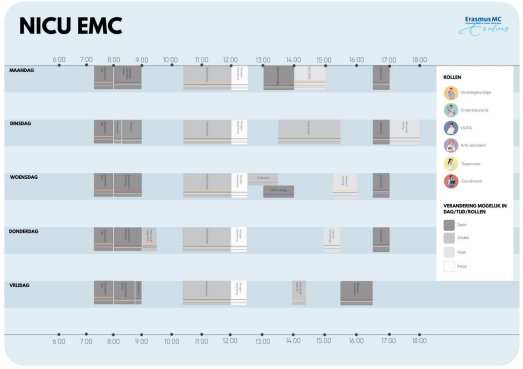
Step 2. Create blocks representing the identified routine care activities from *Step 1* and place them within the selected timeline.



Step 3. Add horizontal stripes in the routine care activity blocks and a legend to represent the roles that are present during each activity. These roles should correspond with the identified roles from *Step 4* and the role markers from *Step 8* used in designing the visual content for the first part of the technique.



Step 4. Include a priority layer for the routine care activities to enable the possibility of reallocating current activities and/or roles to accommodate the TeleNeo consultations. Distinguish between whether it is possible to make changes within a routine care activity in terms of day, time, and/or present roles and use different gradients of the same color to indicate the priority layer. The resulting visualization is referred to as a **'workflow visualization',** in this example specifically for the NICU department.



Step 5. To finalize your workflow visualization, validate the content with healthcare professionals from the involved department, and iterate as necessary based on their feedback.

Step 6. Create new routine care activity blocks to represent the TeleNeo consultation types you want to integrate. The width of the blocks should correspond with the duration of the consultation types and use the appropraite color gradient of the legend to indicate the prioritites. Since the goal of the visualization guided co-design technique is to integrate the TeleNeo services into the workflow created in *Step 4*, there may be no changes possible in terms of day, time, or roles for the new digital health service, resulting in the darkest color gradient indicating the highest priority. The number of blocks to be created depends on the amount of moments you want the TeleNeo services to take place within the timeline.

Step 7. Finally, remove the flexible routine care activity blocks (those that do not have the highest priority and can be adjusted in terms of day, time, and/or roles) from the workflow visualization and create a separate sheet with these flexible blocks. Additionally, create another copy of this sheet, but this time remove the present roles as well. Print the workflow visualization, flexible routine care activity blocks with and without present roles, and TeleNeo consultation blocks on A2-sized paper.

Cut out the flexible routine care activity blocks and the TeleNeo consultation blocks. Finally, place the workflow visualization on whiteboard foil and position the flexible routine care activity blocks with small magnets on their initial positions within the workflow.

Following these steps will result in the visual content for the second part of CoVisioning, specifically customized for integrating TeleNeo consultation types into current healthcare professionals' workflows. This process should be repeated to create workflow visualizations for all involved actors. In this case, I created NICU and HC workflow visualizations and new care activity blocks for the TeleNeo consultation types of a room tour, warm handover, and joint daily round.

The Co-design Process

As previously described, the visualization guided co-design technique comprises of two distinct parts and takes place in a physical setting. For this, a room with seating space for all participants, along with multiple tables, and a presentation screen are essential requirements. To effectively structure the interactions and ensure time management, I recommend creating a slide deck and using a timer. This section outlines your role as a facilitator of the session, including an explanation of how to use the designed visual content and when participant interactions should occur.

Introduction

Begin the session by introducing yourself and providing an overview of the session's objective: to co-create revised workflows for the involved departments that effectively integrate the planned TeleNeo consultation types and clearly present the allocated roles. Then, initiate a round of introductions to allow participants to introduce themselves and become acquainted with one another. Conclude by giving participants the opportunity to ask any initial questions or express any concerns they may have.

Part 1: Allocating roles

After the introduction, proceed with the first part of the session. Begin by outlining the goal of the activity: to allocate roles to the new TeleNeo responsibilities. Show the provided materials (the role allocation templates and role markers) and explain that the activity involves assigning roles to the outlined responsibilities by placing the role markers on the empty spots in the templates. Before starting, divide the participants into small groups, depending on the number of templates and participants. In this scenario, I divided the six participants into two groups and assigned each group two role allocation templates. Ensure that each group has a balanced representation of roles and organizations to ensure diverse perspectives and effective collaboration throughout the activity. To support the interaction between participants, provide the following guiding question: *''Who do you think should become responsible for the outlined TeleNeo responsibilities in the templates?''* The groups will work simultaneously on different templates and will briefly present their results to the other group(s) at the end.

The aim of this presentation round is to ensure alignment on the completed templates and to discuss any necessary adjustments with all participants. As the co-design session facilitator, your responsibilities include managing time, being available to address questions, providing support to groups encountering challenges, and posing a critical question during the evaluation round. This question involves assessing the quantity of assigned roles and exploring the possibility of reducing roles: *''By taking a vertical perspective on the allocated roles, is it possible to reduce the splitting of tasks?''*

Break

Include a short break between the first and second part of the co-design session to allow participants to refresh their minds. Utilize this break to prepare for the second part of the session, which includes transferring the assigned roles from the templates onto the corresponding TeleNeo consultation blocks designed for the second part of the co-design session. To represent the assigned roles, write horizontal colored lines on the TeleNeo blocks, using the style of the workflow visualizations.

Finally, position the workflow visualizations along with their flexible routine care activity blocks on the table. I recommend positioning the flexible blocks within the workflows using magnets before the co-design session begins.

Part 2: Integrating TeleNeo consultations

Start by outlining the goal of the second activity, which is to determine the optimal common moments to integrate the TeleNeo consultations into workflows of healthcare professionals involved in the service. Next, show the provided materials (the workflow visualizations, movable routine care activity blocks and TeleNeo blocks with assigned roles from the first part of the session) and explain that the flexible routine care activities can be moved around the visualizations by repositioning the magnets. During this activity, participants will work all together on integarting the TeleNeo consultations. As the facilitator of the co-design session, your responsibilities during the second activity include keeping track of time, being available to address questions, and guiding the participants.

To structure the activity and support interactions, provide the following guidance to the participants:

1. Search together for as many possible moments for coordinating and conducting a room tour
2. Search together for as many possible moments for coordinating and conducting a warm handover
3. Search together for as many possible moments for coordinating and conducting a joint daily round

The guiding question to start the activity is: *''Is it possible to integrate the TeleNeo consultations into existing routine care activities by considering the present and required roles?''* The objective of this question is to avoid unnecessary creation of new routine care activities for healthcare professionals at the involved departments. If participants conclude that integration is not possible, the follow-up guiding question to ask is: *''How can the TeleNeo consultations be integrated into the workflows (by reallocating existing routine care activity blocks and/or roles if needed)?''* Repeat that participants can use the magnets and whiteboard foil to move the flexible routine care activities across the workflows.

To provide material for reallocating roles, you can use the printed flexible routine care activity blocks for the departments without predefined roles of *Section 7.5.1 (Step 7)*. During the second activity, you can assign roles as needed, similar to the process used for integrating the first and second parts of the technique, whenever changes are required in the current roles within a department's routine care activity. After collectively identifying as many possible moments for each type of consultation, guide the participants with the following question: *''Now that you have identified all the possible options for the TeleNeo consultations, what are the best options from these identified ones?''*

Closing

At the end of the co-design session, thank the participants for their contribution and allocate time for reflection and evaluation. This may entail reviewing the outcomes of both activities and inviting participants to share their thoughts and experiences from the co-design session. You can use the following questions to evaluate the wo

The Final Product

Utlizing CoVisioning during a session with healthcare professionals results in the following two outcomes:

1. Completed role allocation templates, detailing the assignment of roles to the new responsibilities related to the TeleNeo services
2. Revised versions of healthcare professionals' workflows, integrating the consultations at the most suitable moments for the involved departments

By sharing these outcomes with the research team, they can effectively support the implementation planning and scaling up of TeleNeonatology in hospitals beyond Amphia Breda and Erasmus Medical Center. This includes educating staff on their specific roles and responsibilities, refining workflows to integrate TeleNeo consultations at optimal moments, identifying areas for improvement to ensure high-quality service delivery, and promoting clarity among healthcare professionals regarding their responsibilities and the overall process.

To end with, *Figure 83* presents an overview of the guiding questions for supporting interactions between the participants.

First activity
Who do you think should become responsible for the outlined TeleNeo responsibilities in the templates?
By taking a vertical perspective on the allocated roles, is it possible to reduce the splitting of tasks?
Second activity
Is it possible to integrate the TeleNeo consultations into existing routine care activities by considering the present and required roles?
How can the TeleNeo consultations be integrated into the workflows (by reallocating existing routine care activity blocks and/or roles if needed)?
Now that we have identified all the possible options for the TeleNeo consultations, what are the best options from these identified ones?

Figure 83: Guiding questions co-design session

Erasmus MC
University Medical Center Rotterdam
Erasmus
TU Delft

Master Thesis by Julia Broos
Strategic Product Design
TU Delft, July 2024

Chair: Dr. ir. Lianne W.L. Simonse
Mentor: MSc. Fredrik K. Karlsson
Company Mentor: MD. Josephine H.L. Wagenaar