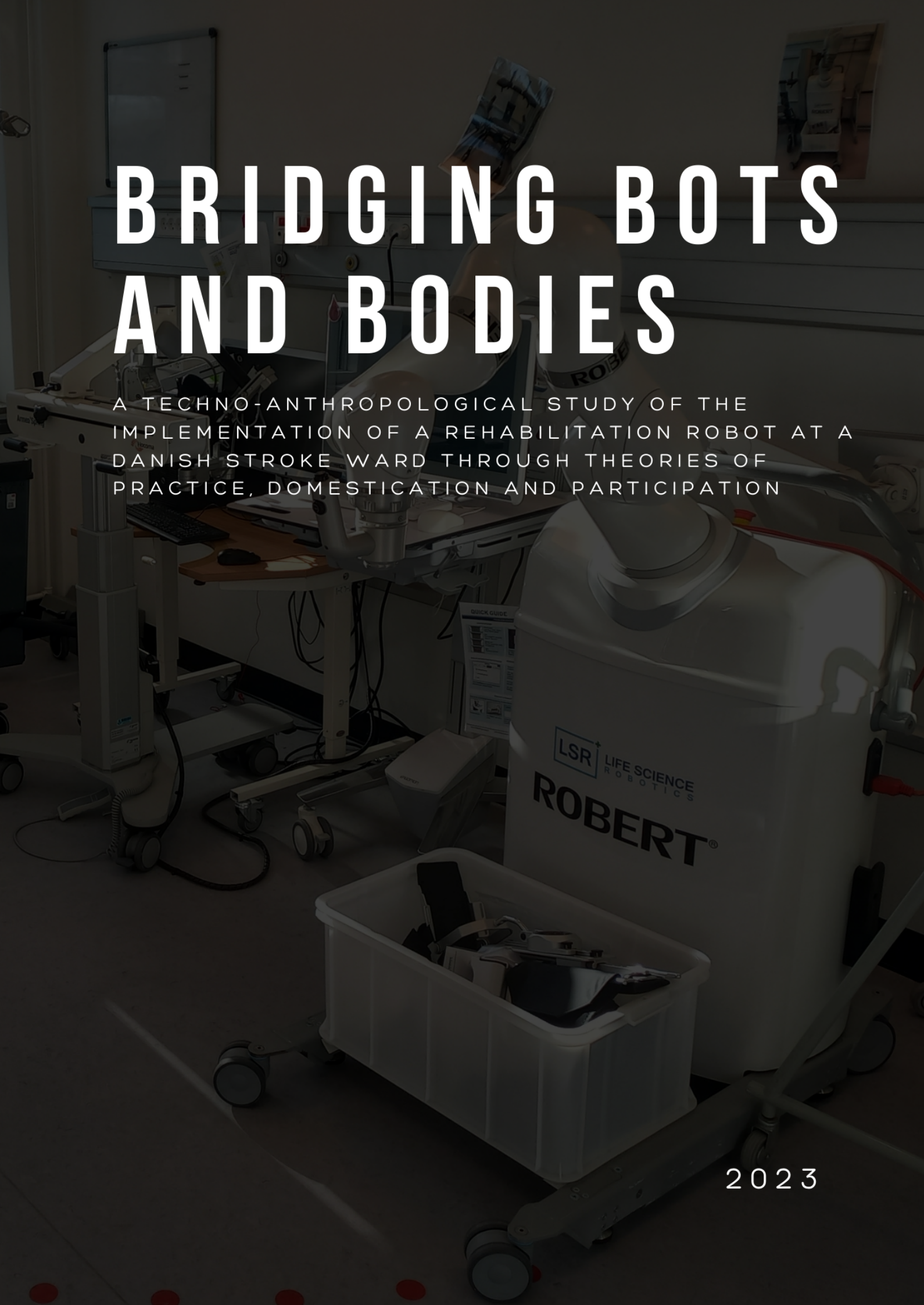
BRIDGING BOTS AND BODIES

A TECHNO-ANTHROPOLOGICAL STUDY OF THE IMPLEMENTATION OF A REHABILITATION ROBOT AT A DANISH STROKE WARD THROUGH THEORIES OF PRACTICE, DOMESTICATION AND PARTICIPATION



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Bridging Bots and Bodies

A Techno-Anthropological Study of the Implementation of a Rehabilitation Robot at a Danish Stroke Ward Through Theories of Practice, Domestication, and Participation

A Techno-anthropological Master thesis

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Abstract

Introduction: The Danish healthcare system is in crisis. Staff shortages and a population which is expanding, ageing, and becoming more sick, result in reduced quality and efficiency in treatment and care, as well as overburdened staff. One type of illness that occurs frequently is stroke. A lot of proposed solutions take the form of new technology such as robots to "lift" the increasing burdens that the healthcare system faces. This study investigates a rehabilitative robot at a stroke ward.

Research question: *How does an emergent robot practice reconfigure therapy and care at a Danish stroke ward, and how can anthropology-driven participatory design be used to generate local as well as general recommendations about implementation of healthcare technology?*

Methods: An ethnographic study was conducted at a Danish stroke ward, where a practice of using ROBERT were investigated through participant observations, shadowing, and ethnographic interviews of occupational therapists, physiotherapists, care personnel, a development therapist and their manager. In addition, a participatory design workshop was facilitated to create local recommendations for future processes. We employed a theoretical framework that combined practice theory, domestication theory and participatory design as a way to understand local practices and their relation to the new robot-practice, and to utilise these understandings as democratic design elements.

Results: We found that the robot in the case has catalysed a number of conflicts surrounding proper use as well as professional boundaries, and that while the technology is broadly considered promising to patients, this has not been sufficient to fully fit it into existing practices, nor fully reconfigure these practices to fit the robot. We argue that the missing piece is the implementation process itself, as it has required more resources than the larger healthcare system has provided, and the ward currently lacks the structural support to fund and facilitate the adoption of complex technology into a complex setting. Further, we show merits of participatory design as a way to create locally meaningful principles for implementing technology, but also shortcomings of participatory methods in a volatile field such as healthcare.

Discussion: We discuss the issues of technology implementation as issues of organisational structures that do not embrace the diversity of professional identities during large changes. Furthermore, we discuss issues of design and implementation processes that do not manage to understand the real needs and practices of the intended users. Finally, we discuss how these issues might relate to a lack of available data and experiences of such implementation processes. We present recommendations to mitigate some of these issues through practice-level democratic engagement with healthcare professionals, as well as through better knowledge sharing in the healthcare system at large, and adopting new ways of conceptualising healthcare change.

Conclusion: The report concludes that the implementation of new healthcare technologies is a very complex matter which is not grasped by the knowledge, structures and organisational support currently available to local sites with specialised needs, which results in resource waste and worker

frustrations, as well as the persistence of the problems that the technology was intended to solve. We conclude that solving the complexities of these challenges requires engaging and involving the local experts who are tasked with adopting new technologies to save the healthcare system.

Keywords: robot-assisted-rehabilitation, domestication, practice theory, participatory design, healthcare ethnography, technology implementation, practice-based change management, techno-anthropology driven design

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Introduction

This thesis investigates the challenges of testing and implementing the rehabilitative robot, ROBERT, at a Danish stroke ward from a techno-anthropological perspective. The inspiration for the study arose during a summer vacancy at the stroke ward in 2022, where one of us experienced a physiotherapist expressing that she struggled to integrate the robot into her practice, although she was aware that she was expected to by management, and also found the robot relevant. This challenge continued throughout the fall, and at the time of choosing a thesis topic, the ward as a whole struggled with integrating the robot, and the case seemed an interesting topic for a techno-anthropological analysis and intervention. We therefore set out to explore how local experiences might be used to discuss wider technology implementation processes in a struggling Danish healthcare system, while at the same time facilitating idea generation from a bottom-up perspective with staff at the stroke ward as active participants.

Our curiosity for robots as technological solutions also originated in larger debates about the struggles of the Danish healthcare system, and the potential of emerging technology and robots as a valuable contribution to solving these challenges. ROBERT is one proposed robot for aiding healthcare professionals to achieve better work conditions, by relieving them of the hard manual labour needed for high-repetition exercise movements of patient legs as part of their rehabilitative needs. Although robot assisted rehabilitation technologies for lower limb training have yet to establish convincing evidence of its effect (Clark, Sivan, & O'Connor 2019), there is evidence of the effect of high-repetition exercises for people with stroke (French et al. 2016). ROBERT is currently being tried out in several Danish rehabilitation settings, for example as a training device aimed at stroke patients (Life Science Robotics 2023a). Most stroke patients require lengthy rehabilitation (Christensen 2022) and stroke is both common and costly for the healthcare system, and potentially life-changing for stroke survivors and their loved ones. Every day, 33 Danes have a stroke, and one in every seven will get a stroke during their life. Annually, stroke costs Danish society 2.03 billion DKK in treatment and care, as well as 2.63 billion DKK in lost labour (Sundhedsstyrelsen & Dansk Råd for Genoplivning 2020), compared to total Danish healthcare costs in 2022 of 265.7 billion DKK (Danmarks Statistik 2022). 85% of stroke patients get stroke from a blood clot; of these 10-15% pass within a month, and 25-30% pass within a year. 15% get stroke from an aneurysm, with a mortality rate about three times higher. Although stroke is common and costly on both a society and individual level, we find it relevant to contextualise ROBERT's potential relevance and our problem statement into even larger challenges of the Danish healthcare system with labour scarcity and issues of patient centred care and treatment safety. This contextualisation presents not only real life issues translated to numbers, but also provides the reader with basic information about which actors argue for technology as a life-line,

and who raise concerns about this discourse. The section also presents recent research into healthcare robots in practice.

Challenges of the Danish Healthcare System

As the general population's life expectancy increases, the need for more healthcare services follows. These needs are highlighted in a forecast analysis of the future of Danish healthcare, which presents five different general tendencies: an ageing population, the growing impact of chronic diseases, information revolution, the clinical technological blessing and curse, and new healthcare consumers. Most important for this thesis is the *clinic technological blessing and curse*, which is a matter of the implementation and integration of digital- and robot technologies to solve the lack of healthcare professionals and automate tasks, while simultaneously creating new work assignments (Butcher 2017). There is a growing imbalance between stagnant birthrates and increasing age. This evolvement of the population, combined with economic uncertainty that challenges the tax funded healthcare system results in several different strains on the Danish healthcare system (Pedersen 2012). The healthcare crisis has been a growing issue for more than a decade, and healthcare professionals are challenged and often overworked on a daily basis. As the Danish population is growing older, there is an accompanying increase of people being diagnosed with one or more diseases that affect both life quality and work ability (Dansk Sygeplejeråd 2015).

According to the Danish Ministry of the Interior and Health, the healthcare system is currently *suffering* from a fall in productivity, a lack of capacity, and an inability to provide care and treatment on time. While the number of total work hours is rising, all of these challenges are connected to staff issues in the form of rapid replacement of staff, less working hours per person, and bottlenecks caused by a lack of specialised skills (Indenrigs- og Sundhedsministeriet 2023). A recent survey found that 57% of Danish physicians experience patients having their treatment delayed due to staff shortages, and 45% say that their wards are able to treat less patients (Lægeforeningen 2023). Another survey found that around 45% of the questioned physicians answered that the lack of time had led to serious adverse incidents with patients. Additionally, 6-9% of the physicians answered that scarce time had been a contributing cause to incidents where a patient died (Lægeforeningen 2021). Kjeldsen (2015) describes a 40% increase of workload for a single healthcare professional from 2001-2015, or in other words: 72 nurses in 2015 have the same total workload as 100 nurses back in 2001. They point to the cause of this increase in workload being new types of tasks that health care professionals did not perform previously (Kjeldsen 2015). The Danish Parliament established the Commision for Robustness in the Healthcare System in 2022, with a purpose of identifying ways to *"ensure more staff and more time for core tasks"*, by way of e.g. potentials for interdisciplinary work and flexible professional boundaries, better coordination of work and influence on one's own work, and possibilities for including short- or uneducated staff in clinical tasks (Indenrigs- og

Sundhedsministeriet 2022, 1). The commission has not yet produced recommendations. A study in 2015 shows that 50% of nurses agree with the sentiment that lack of time has consequences for patient safety. Stress and lack of time are driving factors that impair patient safety, and a common solution suggested to solve the issues is equipment that can save time for healthcare professionals (Kjeldsen 2015). Since patient involvement has been argued as a crucial part of securing quality of treatment and patient safety (Knudsen & Olsen 2012), the Danish Ministry of Health and Senior Citizens made a reform in 2019 which included patient-centred practice (Sundheds- og Ældreministeriet 2019). However, patient-centred practice has been challenged in terms of time; many healthcare professionals experience the difficulties of practising proper patient-involvement due to circumstances of staff shortages and the accompanying time shortage (Jönsson et al. 2013). The organisation of Danish Regions also identifies an acute staff shortage, and suggests among others that it needs to be solved through better conditions and pay, better sharing of knowledge, better interdisciplinary work, and better use of technology (Danske Regioner 2022a).

Technological Initiatives to Solve the Challenges of the Danish Healthcare System

In march of 2022, the Danish Parliament assembled a commision to generate a proposal for a new healthcare reform. At time of writing, the proposal seems to be on the way to be implemented, and will allocate 6.8 billion DKK to initiatives such as: Restructuring the current healthcare system, changing the framework for the healthcare professionals and the education system to balance the workforce, and allocating more funding for new local hospitals with investments in IT and technology for diagnosis, treatment, and care (Indenrigs- og Sundhedsministeriet 2022). In relation to the healthcare reform, the organisations Danish Regions and Danish Industry suggest a fund that focuses on new digital and technological solutions as a way to transform the Danish healthcare system by supporting cooperation between public and private organisations. The fund would aim to support both development, implementation, and scaling of technological solutions that would decrease the challenges of demographics and lack of healthcare personnel nationwide. The initiators emphasise the urgency of political support and involvement in establishing the fund from the Danish government. The fund is not supposed to support daily operation and local solutions (Danske Regioner 2022b). The fund has yet to be established, and time will tell whether and how the fund will contribute to solving the challenges of the healthcare system. In relation to robots as a potential valuable solution, it is noted that although robot technology has been proposed to improve both work environment as well as patient care and treatment, the recent Danish National Robot Strategy describes that Innovation Fund Denmark funded 66 million DKK to the research area *Better Health*, however, the National Robot Strategy also states there are no specific mentions of the allocated money going to robot technology

(Uddannelses- og forskningsministeriet 2020). Lack of government funding is however not the only issue facing implementation and scaling of robot technology.

An analysis on the current status of robots in healthcare from 2022 made by the Danish Technological Institute shows that the development of robots for the Danish healthcare system is accelerating, and that patents for healthcare robots have increased by over 10 times within the last ten years. Despite the heavy increase of interest and development of robot technologies, implementation of robots meets an array of different barriers that prevents the use and adoption of the robots. The analysis identifies some barriers emerging from healthcare professionals, IT and data security, the hospitals' willingness to take risks, sparse time for learning and using new technologies, and finally financial limitations. They elaborate that robots often require a big investment to purchase and implement, and it is difficult to predict the value and turnover (Teknologisk Institut 2022).

Furthermore, we find that although new technology such as robots are proposed as a potential solution to some of the most urgent challenges of the Danish healthcare system, not everyone agrees with the potential of new technologies. Among these voices we see assistant professors of Health and Informatics at Copenhagen University, Gjødsbøl and Langstrup, criticise the idea and ambitions that prevails in the Danish Government that technology will make up for the *maw of death* of staff shortages. They point out that there are many examples of technology failing to provide the expected support, and that the development and implementation of technology is lacking a broader perspective. Within a complex system such as the healthcare system, there is a need for experts educated within the tasks, contexts, and values that the technologies are supposed to solve (Langstrup & Gjødsbøl 2023).

Circling back to our initial inspiration for this thesis, we summarise that implementing new technology and robots is a complex affair with several challenges, as national funding opportunities are limited, and not everyone is convinced of the value of technological solutions such as robots. Although healthcare robots are politically trendy and relevant, they face a number of complex challenges regarding both social and material conditions.

Socio-Technical Perspectives on Implementing Robots in Healthcare

Robots implemented in healthcare settings encounter many difficulties in relation to their human counterparts. This is not new, and has been an interest in several studies of human-robot interaction and uptake of healthcare technologies among healthcare professionals. Local case studies have provided insights to the nuances and variety of uptake and use, and highlight that expectations are rarely met as it is hard to predict how use of technologies in health care practices unfold (Chang, Eriksson, & Östlund 2020; Melby & Toussaint 2016). Melby and Toussaint (2016) present a story of how different kinds of non-use come to challenge an implementation of a new hospital awareness

system, and thereby come to have unforeseen power over the fate of the system (Melby & Toussaint 2016). Others have studied reasons why the implementation of a personal emergency response system implemented in swedish nursing homes did not met expectations, and found that implementation plans did not succeed in catching "*the complexity of the technology integration process*" and argue for the importance of prioritising "*space and time*" for preparing for implementation, as well as facilitating staff in adjusting to new practices (Chang, Eriksson, & Östlund 2020, 14). Bower et al. (2021) conducted a series of focus groups with physio- and occupational therapists. They found that use of technology is influenced by the efficiency and dependability of the technology itself, as well as the ability to embrace varying levels of user receptivity, and availability of organisational resources and support in the lengthy procedures surrounding learning and using new technology. They suggest that sustainable adoption of technology requires awareness and management that is as multi-faceted and context-specific as the clinical decision-making of the intended users (Bower et al. 2021).

Olaronke, Oluwaseun and Rhoda (2017) describe how use of robots has quickly developed from almost exclusively industrial applications, to a variety of healthcare robots, in large part as a response to the same challenges as mentioned previously. They identify a number of general challenges facing healthcare-related human-robot interactions, such as the ethical challenges of patient rights and fair distribution of scarce resources, the social challenges of (non)acceptance, and high technical demands resulting in dormant robots (Olaronke et al. 2017). Turchetti et al. (2014) suggest that adoption of neurorehabilitation robots is very low, based on limited availability of data about market trends, and point to several potential reasons for this: First, medical innovations often entail lengthy and complex training of potential users, taking away time from patient interactions which in turn creates resistance from both staff and patients. Second, innovations often require health professionals to change practices that have been established throughout their careers. They also point to large organisational changes required for adopting new technology as a complex and time-consuming effort, and thus a barrier to implementation (Turchetti et al. 2014).

Hasse (2018) analyses the introduction of a social robot in a Danish rehabilitation center, in which the staff end up rejecting the robot for a number of reasons: staff perceived it as preventing their most important tasks, they struggled to meaningfully include the robot in their practices, and the robot did not live up to their expectations to a degree that justified changing their established practices. She points out an important difference between acceptance of robots as an abstract concept on an institutional level, and acceptance of material robots into everyday staff practices, and it is the latter that determines if robots are meaningful and included (Hasse 2018). Tornbjerg et al. (2021) argue that using robots in hospital practices often entail processes that are much more complex than anticipated, sometimes to a degree where the robot requires more work than it saves. In a different article about the same robot, Tornbjerg and Kanstrup (2021) argue that uses and meanings of robots are created through real practice, and cannot be predetermined; overly high ambitions or simplified *plug and play* descriptions from developers and management might even be detrimental to the

implementation of new robots. The authors suggest practice-based studies of socio-technical factors as a solution to these issues (Tornbjerg & Kanstrup 2021), while Melder et al. (2020) argue for the importance of shared engagement and participation from clinicians and their managers, as well as interdisciplinary experts in clinical improvement work. The suggestions from these studies point towards the research purpose of this thesis; to engage staff at the ward in participatory design activities to build on top of a practice-based study of socio-technical factors of ROBERT at work.

Our study of ROBERT is not the first. ROBERT is at the time of writing part of an RCT PhD study aimed at reporting whether training with the robot has positive outcomes in terms of minimised loss of functional abilities for geriatric patients during admission (CCR Danmark 2021). A feasibility study made through interviews with informants who had operated ROBERT found the robot easy to use, but that it was difficult to transport the robot due to size and weight as well as setting it up in the patient rooms because other things had to be moved to make room. This resulted in more time spent on setting up the robot than usually spent on manual training. Furthermore the robot was described as noisy. The patients overall reported training with the robot as beneficial and safe (Bertelsen et al. 2020). The objective of this thesis however is not aimed at understanding the effects of the robot on functional outcomes for stroke patients since we are not medical professionals, but rather the implementation process and accompanying structures and actions that have influenced the implementation process. Though ROBERT positions itself within larger visions of technological solutions as potential enablers of better healthcare, the feasibility study also reports potential issues with fitting ROBERT into work at a ward. Furthermore, research in the complex interaction and adoption of technology such as robots suggests that the way towards solutions is practice-level socio-technical engagements with those affected by robots in their daily life.

Based on the problems presented in this introduction, we formulate the following problem statement:

How does an emergent robot practice reconfigure therapy and care at a Danish stroke ward, and how can anthropology-driven participatory design be used to generate local as well as general recommendations about implementation of healthcare technology?

To answer this problem statement, we construct a research design that aligns with our professional backgrounds as techno-anthropologists, as well as recommendations from recent robot research. We base this in anthropology-driven design; which combines ethnographic studies with participatory design principles, as well as an understanding of technology as both concrete artefacts, as well as the skills required for competent use, and the broader societal organisation that makes their use meaningful and legitimate (Christensen 2016). We conduct an ethnographic study consisting of a variety of methods, in order to create democratic situations and interventions into the technology.

Reading guide

To guide the reader, the following provides a brief overview of the remaining chapters of the thesis.

The theoretical framework presents our choices and applications of various theories, as well as considerations about this.

The methodology presents our choices and applications of qualitative methods to produce and analyse data with and about the field.

Introducing the field provides a short overview of what stroke is, as well as a description of the organisation of stroke rehabilitation in Denmark. The chapter also presents the stroke ward, its employees and at last a short description of ROBERT.

The analysis is divided into four distinct parts.

The first part, entitled *The Ward as an Ongoing Site for Transformation of Neurotherapy Practices* introduces the field and analyses the skills, meanings, and material arrangements that make up its neurotherapeutic practices. It also contextualises the ward as a complex site for implementation of new technology such as ROBERT

The second part, entitled *The Emerging Practice of Using ROBERT*, analyses how the meanings and uses of ROBERT are constructed at the ward, and highlights ways in which the robot fits established practices, as well as ways in which it challenges or changes these practices.

The third part, entitled *The Commotion of Integrating ROBERT into Everyday Life at The Ward*, analyses the process of acquiring, testing, and fitting in ROBERT at the ward. The section also analyses controversies and confusions that have arisen throughout the process.

The third part, entitled *Building on Lessons From ROBERT*, presents a summary analysis of the construction, facilitation, and outcomes of design workshops with staff to share experiences about the ROBERT process and use these experiences as inspiration to generate principles for future technology implementation at the ward.

The discussion engages with wider literature concerning themes identified in our analysis of the ward, in order to position our research as well as to identify more general recommendations.

Translations

Quotations from both interviews, fieldnotes and Danish-language sources have been translated into english in the report. Likewise, titles of Danish publications have been translated when they are mentioned in the text. Original language versions can be found in appendixes, or in the reference list

It is important to note that the Danish understanding and use of the word rehabilitation is not translated from the Danish word *genoptræning.* The Danish definition of rehabilitation is more extensive than the colloquial use of *training* and includes both personal and public health, and social services. However we apply the english phrase throughout the thesis when talking about training as an activity following stroke with the aim of regaining previous abilities.

Exceptions to translations

Select terms have deliberately not been translated, as they are very locally grounded, and there is no meaningful and comprehensive english translation, the following two words *Vagt* and *Drift* are kept in Danish throughout the report; what they entail will be described in the report.

Common abbreviations

- OT: Occupational therapist
- PT: Physiotherapist
- LT: Lead therapist
- DT: Development therapist
- KQS: Key Quality Supervisor
- POTD: Physio- and Occupational Therapy Department

Theoretical Framework

This chapter accounts for central theoretical understandings and concepts that inform our analysis and discussion. We employ a combination of practice theory and domestication theory to understand the field and its problems, leaning on Frennert's (2018) argument that a fruitful analysis might emerge from combining the "vocabulary" from practice theory and domestication theory when trying to make sense of how people relate to technologies and make changes to everyday life in order to integrate or reject them, and that use or non-use must be understood in its context (372). Further, we employ participatory design to understand and engage with the field as a site of intervention. The following is a description of how the three inform parts of the thesis, as well as a more thorough account of their theoretical concepts, understandings and a small retrospective reflection on the combination of practice- and domestication theory.

Practice Theory

In this thesis we lean on selected works on practice theory by Shove et al. (2007), Shove, Pantzar and Watson (2012) and Shove (2014). The approach of Elisabeth Shove was chosen because her works shares a socio-technical understanding that competencies and agency are *"embodied in humans and in things"* (Shove et al. 2007, 56) and that humans and things coevolve when they interact (Shove et al. 2007). We use the theory to analyse and illustrate how certain elements of existing therapeutic practice relate to the use of the new robot in a training session. The theory also informs parts of our discussion of how a turn to practices might be useful for practitioners and management when planning implementation of new technologies.

Shove (2014) describes practices as "*recognisable entities"* (418) of activities that are continuously performed by a cohort of people in their daily life and how these come to be in a dynamic process of "*constitutive elements of* [...] *meanings, competences, materials*" (419). Beyond specific elements, practices are defined by how and why elements are put together and taken apart, as well as how they affect each other. The symbolic meaning assigned to a piece of technology might for example affect who uses it, or its use might change its physical appearance, which in turn can again change the meanings that are assigned to it. Understanding the repeated circulation of these elements of practices as well as how they are weaved together through time and space, is central to understanding how practices might be intervened in (Shove 2014; Shove, Pantzar, & Watson 2012). In our case this implies exploring how stroke rehabilitation at the ward is performed as a present practice, with the integration of elements such as materials, competencies and meanings and how training with ROBERT might integrate with or reconfigure these. This involves paying attention to how things and actions of doing neurotherapy are associated with certain symbolic meanings and judgements of what

counts as an integral part of professional work, e.g. who uses specific technologies or performs certain tasks and why these might be considered as central to that profession.

The value of practice theory is that it provides a different ontology to that of most behavioural theories, that foreground individual motivations and preferences as the target for intervention in social change (Shove, Pantzar, & Watson 2012; Shove 2014). What individuals do is not a rational nor static process, depending on fixed beliefs, values or motivations, but framed by the dynamic socio-material contexts in which they engage in daily activities (Shove 2014). Practice theorists propose that in order to successfully intervene in what people do, those who wish to steer their trajectory should turn their attention to practices rather than the attitudes of the individuals who perform them, and ask themselves how practices "*emerge, persist and disappear"* over time (Shove 2014, 418). Practices are always in transition by their emergent nature, and have unpredictable trajectories, however, that does not imply that they can not be intervened in (Shove, Pantzar, & Watson 2012).

Transformation of practices can occur based on reconfiguration of elements of practice, e.g. a new therapeutic robot practice might emerge from therapists using a robot instead of their own body to train with patients, thereby gaining new skills and images of shared professional identity. Transformation can also occur as a process of reconfiguring relations or paths between practices (Shove 2014), for example by intervening in socio-material arrangements that steer how and why one practice is performed more persistently than another, such as making changes to material infrastructures at ward or societal level that enhance use of the robot above other ways of doing.

Domestication Theory

Beyond describing the specific reconfiguration of practices and their elements when training with ROBERT, this thesis also seeks to understand the ongoing test process in order to create recommendations for future implementations. In this thesis we draw on the conceptualisation of the word *domestication* as a taming of wild animals (Haddon 2007). Domestication theory is used to understand the reasoning behind the relevance of ROBERT as a new training tool, as well as the different ways that the staff and management tried to 'tame' the robot and make it part of daily life. Domestication theory also served as a way to explore how certain activities or phases in the test process have been experienced as challenging and how these could form the basis for discussion and idea generation at a workshop with employees at the ward. Although domestication has its origin in studies of ICTs in home settings, the theory has also been used to describe technology adoption in work and healthcare settings as a form of professional or social domestication (Pierson 2005; Søraa & Fostervold 2021).

We employ a version of domestication theory as described by Fox (2019), as this iteration of the theory is specifically aimed at healthcare technologies, and because it establishes a series of continua for understanding and acting on specific parts of the process that are particularly challenging

to the people involved. The domestication theory of Fox provides four theoretical constructs, which together form a coherent understanding of the process of implementing a new technology. The four constructs were originally developed by Haddon (Haddon 2011). First, *Appropriation* is the work required to select and acquire a specific technology, such as understanding and desiring the functions and effects it might have, as well as deciding on and then funding and purchasing a specific version of a technology. *Appropriation* exists on a continuum between total certainty of the effects of the technology and total uncertainty, on which new healthcare technologies tend to be uncertain. Second, *Objectification* is the assignment of a role and a place to a new technology, such as appointing a space and designating a role for it. *Objectification* exists on a continuum between a technology fitting into the existing environment, and technology requiring adaptation of the environment. Third, *Incorporation* is the adaptation of existing temporal routines to embrace a new technology, such as deciding on specific times when the technology may or must be used. In a hospital ward, this might involve assigning responsibilities and allocating specific work hours. Similar to *objectification*, *incorporation* exists on a continua between new technology fitting into existing routines, or requiring reshaping of routines to accommodate it. Fourth, *Conversion* is the relation between on one side the technology and its users, and on the other side the wider social world, such as structures for product maintenance and feedback, or hackers who change a technology to serve new purposes. *Conversion* exists on a continuum between users domesticating technologies as supplied, or suppliers adapting changes pioneered by users. A domestication process that exists mostly along the more uncertain and disruptive sides of the various continua will be more demanding and potentially overwhelming to the individuals involved (Fox 2019) hence our suggestion that the affected people should be directively involved as participants in designing better implementation strategies.

Retrospective Reflections on the Combination of Practice Theory and Domestication Theory

Although we initially decided to analyse the test process through domestication theory as a way to explore how making a robot part of daily life might unfold, this choice has also limited our insight to understanding the test process as a precursor for a potential emerging robot practice. However, the chapter about the practice of using ROBERT gives a thorough description of how the practice unfolds in daily life in contrast to what is expected by management and promised by developers. This led us to the relevance of discussing the ways in which the ward approaches change through the lens of practice theory, as a contrast to the understandings that arose from looking at the process solely through domestication theory. We also found it relevant to discuss that although recommendations of using social theories as well as more structured implementation frameworks and methods exist, they too come with limitations. While the use of domestication theory provides a framework for describing efforts and the challenges that domesticating ROBERT entailed for the staff, it might have missed to

account for how the creation of a new robot practice is not just a matter of consumer incentives, such as ideologies of management and individual competencies and technological confidence. Practice theory might provide a different account of the process of the ward's emergent robot practice, as an account of how it emerged as "*new configurations of existing elements or of new elements in conjunction with those that already exist*" (Shove & Pantzar 2005, 61). The origin and ontology of domestication theory as a socio-technical theory to understand what members of a household do to domesticate media technologies into their everyday life (Haddon 2007) might have something to do with this limitation as some of its concepts seems centred on understanding what motivates individuals rather than larger collectives of people through temporally dispersed doings. Shove and Pantzar (2005) point to how domestication theoretical analysis misses the account for "*co-production of practice*" and stress that "*how consumer goods are appropriated and domesticated do not go quite far enough*" (62). As a final reflection, we still see value in our theoretical framework, as our task is to understand ROBERT, and ROBERT exists on several levels which we account for through several theories.

Participatory Design

As part of this thesis we have chosen to employ participatory design (PD) by doing a workshop with the actors of the studied field. It has been suggested that healthcare improvement can benefit from the use of ethnographic methods as a way to "*foster improvement skills and habits such as creativity, learning and systems thinking"* (Black et al. 2021, 274). Innovation in healthcare is adopting principles, concepts and practices from PD due to a vision that its application into healthcare context will result in greater engagement, empowerment and quality, and some even refer to a "*participatory zeitgeist*" in health care improvement (Palmer et al. 2019, 247).

PD is a range of research fields and design practices and principles, which share a common goal of involving people in the design of technologies that affect them. PD is based on two fundamental aspects; the people who will be affected by a technology should be given a voice in its design, and those same people should be provided with tools and structure to understand and communicate what is possible and desirable. PD recognises the people involved in a given domain as experts, and as such seeks to use their lived experiences as expertise in shaping the design of new technologies intended to exist within their domains, with a goal of improving both the process and the final product. This involvement happens in a way that seeks to elevate participants from being mere sources of information to being legitimate participants in the design process, by allowing them to directly engage with, deliberate about, and affect the design process. PD is also fundamentally a group activity; engaging multiple perspectives in a collective 'reflection-in-action' wherein the design process interacts with practical understandings (Simonsen 2013).

PD shares a central worldview with the theoretical frame employed in this report, in that it centres human behaviour and experience, and in that it takes seriously the notion that materials and technologies are fundamental to human experience. From this, PD builds the normative argument that a designer should be accountable for the lived experiences and ways of being they create, and that people should have a right to democratic and emancipatory involvement in affecting design that affects them. PD also shares our socio-technical understanding, in which technologies and technological practices must be understood in their real context, and not only from representations such as technical manuals or guidelines for work practices (Simonsen 2013). The potential benefits of applying PD in healthcare settings, are investigated in a review by Clarke et al. (2017). Generally the authors find benefits of PD in such projects. However, although participation from patients and staff led to generating tangible ideas and suggestions for change, most studies lacked concrete evaluation of the outcomes, and some also reported frustrations from participants that their suggestions never seemed to reach a stage beyond initial discussions as well as difficulties with finding the time to participate during working hours. These challenges were however not reported as outweighing the benefits of joint participation in healthcare innovation (Clarke et al. 2017).

This chapter has outlined our theoretical framework as well as retro-spective reflections on the combination of practice theory and domestication theory. The next chapter will present our ethnographic and participatory methods.

Methodology

This chapter presents the methodological framework for the project. The primary method is an ethnographic field study including participant observations, shadowing, and semi-structured interviews. Additionally, the section describes the sorting and structuring of field data through affinity mapping, and the methodic considerations for a participatory workshop.

As practice theory aims at understanding how specific local elements are put together for specific local purposes, it fits well within the ethnographic approach employed by this project. The materials and skills in a field are understandable through participatory observations, and the underlying images, meanings, symbols, and rules can be understood through ethnographic dialogues. Ethnographic shadowing further allows us to understand in depth a specific element of the practices at the ward; in this case by shadowing the people responsible for using ROBERT, and in turn the robot itself.

As domestication theory seeks an understanding at a longer time-scale than our access to the field, the data for this part of the analysis is mainly gained through interviews.

Entering the Field

One of the authors has a background as an occupational therapist and has worked full time at the ward previously, and still does an occasional shift. Both she and another author have previously conducted a project at the ward; investigating how to include patient perspectives and therapeutic interventions in spatial design. The last author has no previous experience at the ward, but has conducted several projects within healthcare.

We gained access to the field through negotiations with management at the stroke ward, which has implications for our presence in the field. This meant that our early impressions of the case have been largely shaped by management perspectives, and that all methodical considerations have had to include an aspect of diplomacy in regards to what we would be allowed to do, when, and why.

Short-Term Ethnography

We follow an ethnographic approach conceptualised by Pink and Morgan (2013) that uses shorter engagements to create informed interventions, and mention healthcare as an example of a context where such short-term ethnography (STE) may be more appropriate. STE is suited to theories within the so-called ‘turn towards practice’, which fits the approach of this project. We employ several principles of STE.

First, STE is deliberately intense, and the ethnographer tries to be at the centre of action, sometimes by seeking out especially intense, fundamental or significant practices, rather than

‘hanging around’. For this project, this is expressed through interview guides that ask critical questions, as well as ‘shadowing’ to engage intensely with specific participants and situations.

Second, STE is in constant dialogue with its theoretical frame. This often means taking a break from fieldwork to conduct preliminary analysis, to structure and inspire new lines of inquiry. In this project, the fieldwork was structured into separate instances with time in between for analysis and potential redesign of research methodologies: One day of fieldwork was conducted in late January, three days of fieldwork were conducted in march, and a workshop was conducted in april, with time allocated for analysis between. Additionally, we will present results and suggestions from the final report to the field.

Third, STE seeks to produce forms of data that can be re-visited and re-analyzed, such as video recordings. For this project, we used video recordings of the ROBERT training sessions to be able to revisit these especially important moments, as well as during workshops to be able to fully focus on facilitation while it happened.

Participant Observations

One method used for this project is participant observations, which tasks the researcher with being part of the local practice to a certain degree, while maintaining an outsider’s perspective and keeping detailed notes. Participant observation produces data in the form of field notes, as well as potentially photographs and videos, and the participant observer aims at producing *thick descriptions*, which contain both detailed descriptions of events, as well as the researchers impressions of moods, sensory inputs and emotions. Participant observation requires the researcher to maintain a double role of participating and observing, and be explicitly aware of the interplay between the two tasks (Spradley 1980). For this project, three researchers each conducted three days of participant observations at the ward, each corresponding in length to a normal workday for staff. Photographs and brief notes were produced in situ, and immediately fleshed out after leaving the field. Regarding our work in the field, we have engaged with local norms regarding ethically charged procedures, such as taking inspiration from the hospital's consent forms for recording when writing our own, and making sure to deliberate with staff members before and during interactions with patients, to ensure that we did not cross any lines that might not be visible to an outsider.

Shadowing

In addition to participant observations, we generated more focused data through shadowing; characterised as following a specific member of an organisation over an extended period of time. During shadowing, the shadowee is asked to provide continuous commentary about their sayings and doings, to understand actions in their organisational context. Shadowing produces qualitative descriptions about the practice of the shadowed participants both through their own words and

through direct observations that gives access to unarticulated details, as well as values and opinions on things they encounter throughout their day; a holistic description containing both behaviour and opinions that contextualise each other. In addition to the expert knowledge and opinions that can be accessed via shadowing, the method also allows the researcher literal access to spaces that would otherwise be off limits, such as the hospital ward. There are limits and challenges to shadowing. Shadowing requires a large amount of data collection, and a larger amount of post-shadowing processing and analysis, and the shadowing can be mentally, physically, and emotionally straining for both researcher and shadowee. The method requires adjustment on both the researchers and the participant's part, and issues will inevitably arise such as the shadower getting in the way of the participant's tasks or the participant altering their behaviour due to being observed (McDonald 2005). Note taking while shadowing was supplemented with video recordings of training situations.

We planned to shadow the healthcare professionals who were responsible for the use of ROBERT on days when we visited. In practice, the daily responsibles ended up using ROBERT for a few hours per day of fieldwork; we therefore shadowed four total ROBERT sessions of which three are video-recorded.

Ethnographic Interviews

For this project, we employ semi-structured interviews, named as such because they have some amount of predefined questions, as well as time reserved for following new lines of questioning that reveal themselves throughout. This ensures that the interview covers the questions that the researcher set out to ask, as well as allowing informants to steer towards what is meaningful to them. Qualitative interviews provide detailed descriptions of knowledge, experience, and expertise of the informants, as well as opinions and values surrounding interview topics (Tanggaard & Brinkmann 2015).

Ethnographic interviews are distinct, as part of the process is to discover questions that people in the field find interesting. The main way of discovering such questions employed in this project is through *descriptive questions* which serve as a blank canvas that the informant can fill out as they wish, rather than a preconceived frame based on the cultural background of the researcher. Descriptive questions ask an informant to describe a situation or setting in their own words, such as asking a therapist to explain a typical day at the ward. Descriptive questions generate both information about the practices and opinions of the informant, as well as a sample of local terms and phrases. For this project we especially make use of *grand tour questions*, which ask informants to give a verbal tour of the field and practice, and describe e.g. a typical day at work or a specific important event. From this tour, the researcher discovers new lines of questioning, such as asking for examples of something described in native terms, or asking for atypical experiences in specific parts of the practice (Spradley 1979).

Two interview guides were made, one for management and one for staff. Management was mostly asked about processes and structures in the implementation of ROBERT, while staff interviews were mostly focused on daily practice (App 1; App 2). In total, ten interviews were conducted: three with physiotherapists, two with occupational therapists, two with care staff, one with the lead therapist, one with the development therapist, and one with the key quality supervisor.

Affinity Mapping

We conducted affinity mapping as a pre-analytical data structuring method. In its basic form, affinity mapping entails writing fragments of data onto sticky notes, and placing them on an open surface. The data is then grouped and given headlines through plenary discussion about what fits together (Dam & Siang 2022). For this project, we began by producing notes containing insights from interviews, and placing them onto the walls of an office, as shown in fig 1.

Fig 1: Ongoing affinity mapping of interviews

Due to the amount of data, the notes and the categorised groups and subgroups were discussed and altered between every two to three interviews. During the grouping, we formed categories as we gained an overview, and changed them accordingly while exploring the data. This process became an iterative processing of the data that was simultaneously guided by our theoretical perspective. A data group was for example ‘stuff’ with the subgroup ‘physical space’, containing codes that informed of the materials present with potential relation to the practices performed at the ward.

Workshop Methodology

This section describes methods and considerations of facilitating a participatory design workshop at the ward. Results of the workshop are found in the last section of the analysis. A more detailed playbook is found in (App 3).

When planning for the workshop, we had to work with the limited time available. Despite our best efforts, we ended up having to reschedule on the day of the workshop, as well as spontaneously find new participants on a short notice. We also lost several participants in the last leg of the workshop, since they were off the clock and had personal matters to attend to. When coordinating with ward management, the lead therapist initially only booked the therapists for the workshop, however, we decided to try to also include care staff since they had initially been included in, and were affected by, the implementation process.

We decided that the overall purpose of the workshop would be to generate recommendations for future technology implementations based on experiences and expertises gained from the ROBERT case. This meant more freedom for the participants in choosing what to create and why, as well as the option to think outside of the specific case and create more general knowledge that might be useful to the participants beyond ROBERT. We also wished to generate dialogues between staff to identify problems and phenomena we might not have found in the fieldwork, and 'pressure test' our preliminary analysis.

The workshop was designed specifically to reflect on ROBERT at the ward. In practice, this meant a dialogical process in which the workshop was designed simultaneously with the initial analysis, with an ongoing purpose of affording discussions on the issues considering the implementation process that we found to be most relevant in our data; structured by domestication concepts. It also meant a lot of practical considerations about the background of prospective participants, the allocated time and available spaces, as well as the specific language used in workshop materials.

Beyond considerations about the specific case and situation, we found methodical inspiration in *Future Workshops* as defined by Vidal (2006). Future Workshops create situations in which participants first generate shared understandings and critiques of a current situation, then freely generate concepts of desirable futures, and then concretize these futures into realistic plans. We borrow this structure of going from a shared definition of the problem, to shared and realistic recommendations for alternatives. We also borrow the technique of *brainwriting*, in which participants quickly and in silence write down a lot of ideas, and then either share them in plenary or pass them along for another participant to elaborate on (Vidal 2006); brainwriting is used in each step

of the workshop to generate shared understandings, and more extensively in the final activity to build on and concretize participant recommendations for change.

In this chapter we have presented our methodology. In the next chapter we introduce the field of neurorehabilitation.

Introducing the field

This chapter contextualises the study within the field of neurorehabilitation in Denmark, based on desk research as well as field data. As such, descriptions will vary between general and more localised accounts. The chapter will present stroke as well as a brief presentation of the different phases stroke patients go through, followed by a presentation of the phase 2 ward where the rehabilitative robot ROBERT has been implemented. Furthermore we present relevant actors that will be mentioned throughout the thesis. Finally the chapter ends with a brief technical presentation of ROBERT.

Stroke

Stroke is an umbrella term for different kinds of acute neural dysfunctions in the brain, and evidence of stroke may come from either observable symptoms lasting more than 24 hours or from a neuroimaging of the brain (World Neurology 2013). According to WHO, stroke is a major health issue with an annual total of 15 million people diagnosed each year (World Health Organisation 2023). Stroke survivors can experience a range of symptoms or impacts to their bodily abilities such as decrease or loss of vision, speech, swallowing function, motoric control/paralysis in extremities and loss of their usual cognitive abilities such as awareness, memory, concentration, and emotional control. All of these symptoms can influence and alter stroke survivors ability to perform and participate in daily life like they did before the stroke incident.

The Organisation of Danish Stroke Rehabilitation

This section presents a brief overview of Danish stroke rehabilitation. Danish stroke rehabilitation is organised in 4 phases that stretch across public sectors (Fig. 2). The initial treatment is carried out at the site of the stroke incident, and shortly after transporting the person to a specialised unit at a nearby hospital for further diagnostics and acute treatment. This phase is typically described as the acute phase, usually lasting about 24 hours. After the acute treatment the stroke patient can be transferred and admitted to a neurological unit if their overall medical state is stable, preferably at their regional hospital at the subacute phases 1 and 2 (Christensen & Bojer 2022).

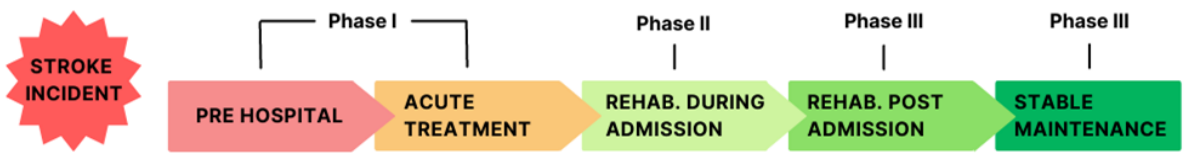


Fig. 2: Stroke rehabilitation phases. Based on (Sundhedsstyrelsen 2011, 8)

Here, the stroke patients are admitted for further medical assessment and treatment, and begin their rehabilitation to regain as much of their physical and cognitive ability as possible. During subacute

phases, the stroke patient is treated by a multidisciplinary team of doctors, nurses, social and health care assistants, physiotherapists (PT), occupational therapists (OT) and speech therapists.

Phase 2 usually lasts from a few days to two-three weeks (Christensen & Bojer 2022). It is essential to begin assessments and training as early as possible to increase chances of recovery, and early mobilisation is important for this, unless there are special medical reasons not to (Christensen & Bojer 2022; Region Sjælland & Region Hovedstaden 2022; Dansk Selskab for Apopleksi 2013). Regional guidelines stress that therapists should strive for the early assessments to be done in collaboration and within 48 hours. The assessment focuses on functional ability prior to the stroke and present abilities such as motor and cognitive abilities impaired by the stroke. The assessment results in plans and goals for further training and assessment during admittance at the ward, as well as serve as documentation when a rehabilitation plan is created for training after discharge. Moreover, training aimed at specific areas such as motor control and cognition can be done through moderated daily activities, repetitive exercises, gait training, training in safe transfers, respiration, eating and swallowing disorders etc. (Region Sjælland & Region Hovedstaden 2022). The volume of early interventions are not based on clinical evidence, but rather in individual assessment; consensus among neurotherapy professionals states that professionals should aspire to provide interventions of 45 minutes to each *focus area* multiple times per week, and preferably multiple times per day (Sundhedsstyrelsen 2020). These interventions are described as both assessment and training, and it is not defined how much priority one has over the other. In relation to training with ROBERT, it should be noted that neurotherapy aims at providing evidence based training for the patients, and the training regime of task specific repetitive training has been found to have positive outcomes for recovering motor control after stroke (French et al. 2016).

When the stroke patient is deemed ready for discharge by the physician, the rehabilitation process continues in phase 3. Phase 3 takes place either in a home setting with additional training sessions from municipal therapists, or at a municipal care and rehabilitation unit with multidisciplinary staff, or at a highly specialised regional rehabilitation unit where stroke patients with massive motor and cognitive dysfunctions are admitted for a longer period for further assessment and training (Christensen & Bojer 2022).

The Stroke Ward

The following section presents the phase 2 rehabilitation ward where ROBERT is tested. Access to the ward, located in an old hospital wing, can be gained from the street as well as the stairwell within the hospital. The ward layout is long and narrow as it can be seen on fig. 3, 4, 5. The pictures below further illustrate this as well as present how floor space is often occupied by various equipment. Pay special attention to Room 9 in the floorplan, as this room is both the home to ROBERT (Fig. 6-7), and a site of many planning meetings and training situations. *The floor* was often referred to as a symbolic

place where daily activities of care and training were going on, and the term *floor staff* describes people who spend their day working on and using the floor (Int6, 1).

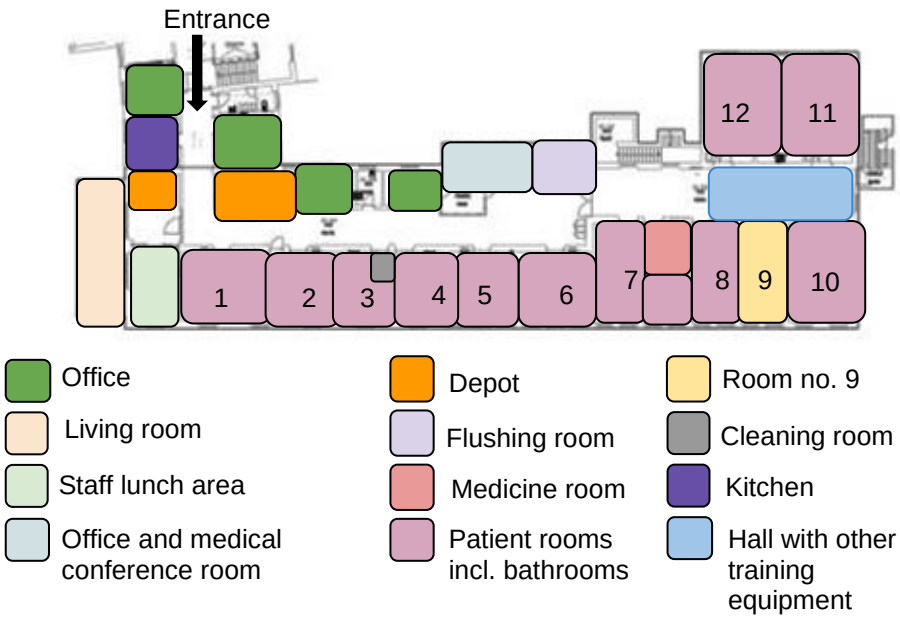


Fig. 3: Floor plan

Fig. 4: Ward hall looking towards the "high end" and the medical office "glasburet"

Fig. 5: Ward hall looking towards the "low end" of the ward and the office space "glasburet"

Fig. 6: Room no. 9, therapeutic office and training room

Fig. 7: Sign designating ROBERTs spot

Just outside room 9, a few pieces of equipment had been installed for use or in lack of other storage spaces (Fig. 8). ROBERT could be found both inside room 9 and sometimes outside with the other equipment (Fig. 9).

Fig. 8: Training equipment placed on the hall in high end of the ward

Fig. 9: Ward hall at the high end

The lead therapist (LT) expresses that in her eyes their finest job is "*to lay a solid foundation for the rehabilitation efforts and interventions that follow the patients after discharge*" (Int5, 6). However she and a staff representative therapist expressed that they lack a detailed description for what phase 2 actually is: *"The requirements are very vaguely defined around what you must do and what you must have in phase 2"* (Int5, 6). This had resulted in staff and management discussing what should be prioritised during the average 12 days the patients are admitted, and how prioritising a training robot like ROBERT was perhaps in contrast to meeting the requirements of the best possible rehabilitative plan.

Both management and staff mention the importance of learning an interesting mix of specialised clinical tasks, and some of the staff express that this mix as well as experiencing the recovery of the patients is something very special: *"You learn a lot from working here. It is a really exciting and rewarding ward because the patients are admitted and you think "what will become of them when they leave?" but then later they come and visit us after they have been to an appointment in the ambulatory, and then they suddenly come walking into the ward, even though they left here in a wheelchair. It's fantastic! You don't see that in many other wards where they have really sick patients"* (Int8, 1-2). Educating patients about what had happened to them and what they could do themselves in training or managing their symptoms, is also a part of what they do.

From the point of view of the staff, the patients and the staff have busy schedules while the patients are admitted, although patients sometimes express that they are bored and spend long periods waiting to receive information about their treatment as well as training interventions. Generally, patients undergo various activities during admittance depending on medical state and severeness of the stroke. Usually patients arrive by ambulance from phase 1 at another regional hospital, some accompanied by loved ones. Upon admittance they are welcomed by a member of the staff, who accompanies them to a room or a temporary place at the hall if no rooms are available. From here on they undergo a range of activities, for most of the patients though only when members of the staff initiate them, as the patients are often not able to do daily activities independently. Most often patients will describe that their day involves long periods of waiting for staff to come help them get up, groomed, fed and ready for training, clinical assessments such as scans, the physician rounds or visits from loved ones. During the approximately 12 days of admittance, patients undergo the necessary assessments, treatments and training that is needed in order for the multidisciplinary team to plan their further rehabilitation in phase 3. Before patients can be discharged, the team needs to prepare certain documents such as a care plan, if the patient needs further assistance in the municipality from care staff, as well as aids such as walkers or wheelchairs. The care plan is used to communicate and plan further courses of rehabilitation with the municipality and is therefore a central document, given much attention from staff. Furthermore the therapists including the speech therapist writes a rehabilitation plan, where they document the rehabilitation needs of the patient by describing past and current physical and cognitive abilities, as well as the living situation of the patient. The rehabilitation plan is also used as a central planning tool as municipalities prescribe therapeutic resources depending on the rehabilitation plan.

The ward recently changed their organisation to make therapists more involved in daily care of patients to provide meaningful interventions while assisting understaffed care staff; this is elaborated on later. The LT described that the most important reason for restructuring the ward was to arrange their working practices in a way where they could spend as much time as possible with the patients; to provide more opportunities for receiving rehabilitation integrated in daily care as well as more focused therapy. Time was a central resource and ‘matter’ in all practices at the ward, which aligns with the general challenges of the healthcare system outlined in the introduction. How to prioritise time became visible through continuous practices that could be experienced on a daily basis. ROBERT had entered in challenging times of change at the ward, with insecurity about tasks and priorities, and by that entering both a symbolic *political space* as certain practices had been reorganised within the last year, as well as physical and biological spaces of medical devices, patient rooms, hallways, office spaces, and the human bodies that occupy them.

Some ward management seems to conclude that following the official definition of rehabilitation is not possible in their context. The “Whitebook for rehabilitation” defines rehabilitation:

> *"Rehabilitation is aimed at people who experience or are at risk of experiencing limitations in their physical, psychological, cognitive and/or social functioning and thus in everyday life. The purpose of rehabilitation is to enable a meaningful life with the best possible activity and participation, coping and quality of life. Rehabilitation is a collaborative process between a person, relatives, professionals and other relevant parties. Rehabilitation efforts are targeted, coherent and knowledge-based, based on the person's perspectives and whole life situation."* (Maribo et al. 2022, 11)

This has led the ward to redefine themselves as a ward with a *rehabilitative approach* instead of a rehabilitation ward. This meant that the physical and cognitive resources of the patients should be activated in relevant situations, e.g. during mobilisations or care, in order to ensure that patients maintained and perhaps regained some sort of autonomy. Informal conversations with the development therapist (DT) during a prior project described the term as something they had coined on their own initiative, since they could not call themselves *a rehabilitation* ward as this would require more extensive services than what they consider to be the point of phase 2, such as engaging with the whole life situation of patients.

People at The Ward

This section presents the relevant employees of the phase 2 rehabilitation ward that are mentioned throughout this thesis. The stroke ward employs a wide range of professionals, of which most of them cover both day and evening shifts from early morning until mid afternoon, or from mid afternoon to late evening. Night shifts are covered by physicians and care staff. As the organisation of staff at the ward often changes, the following numbers are based on what was described during fieldwork. Following is a brief overview of main responsibilities of each profession that plays a significant role in the ROBERT case:

12 physiotherapists (PT) The main responsibilities of the PTs is to contribute to assessments and training of patient's motor and cognitive abilities in relation to making the best possible rehabilitation plans. Moreover they work in *vagt*, to contribute to the rehabilitative approach at the ward.

12 occupational therapists (OT) The main responsibilities of the OTs are as with the PTs to contribute to the development of a rehabilitation plan for all admitted patients, and working in *vagt*. Their area of expertise is how the stroke has impacted activities of daily life, as well as dysphagia (swallowing and eating difficulties related to brain damage of the stroke). OTs do training aimed at

specific disabilities such as arm or cognitive function as well, often PTs and OTs work closely together, and all medical professions at the ward are considered as close partners.

8 Nurses who are responsible for treatment and care of the patients as well as doing the rehabilitative approach when interacting with the patients. One of the nurses has also been hired as an assistant manager and another as a discharge coordinator. They have unique clinical responsibilities depending on their experience, including assisting the physician with certain measurements of vitals, making sure prescribed medicine is given as well as making a care plan for the municipality. They spend a lot of time communicating with patient relatives and the municipality.

12 Social and healthcare assistants (SHA) and one assigned as clinical supervisor for SSA students. Their main responsibility is care work including applying the rehabilitative approach, as well as supporting select tasks of nurses depending on their level of experience and training. Most often, nurses and SSA's are referred to together in the field as "care staff".

3 Physicians with 1 lead physician that also manage the geriatric ward placed above the stroke ward. The responsibilities of the physicians are many and far reaching, but in summary they are the main responsible for the treatment plan of the patients. Their plans depend on information provided by the other healthcare professions; a daily medical conference is used to update the physicians about the state of the patients both medically and emotionally. They prescribe medicine, assessments, treatment, and conduct daily rounds where they provide patients and sometimes their relatives with information about the course of the treatment.

Ward Management. The ward has shared management with a *lead therapist (LT)* with a background as an occupational therapist at the ward, a *lead nurse* and an *assistant manager*, as well as the *lead physician* mentioned earlier. Management meet both in formalised meetings and spontaneous talks during the day to coordinate and plan activities that are important for the daily operation of the ward. As they cannot be everywhere all the time, they rely on staff representatives to provide information. The lead therapist does daily rounds at the beginning of the day shift to get a sense of the tasks of the day, the representation of the different professional groups, and support the employees with handling any emergent issues. The *lead therapist* has been a key contact and gatekeeper to our access to the field.

Patients There are approximately 18-20 patients admitted spread across 11 rooms or the hallways. Describing the patients is for another study, as they are unique persons with their own stories. They also present with a variety of stroke symptoms, but in general they are above 18 years of age when admitted, however most are above 60.

The Development therapist (DT) is part of the physio- and occupational therapy department (POTD), but as there is a close collaboration between the ward and the POTD, he assists with many tasks related to development projects at the ward. He has many tasks within the POTD and is often part of or managing and overseeing many of the projects and scientific studies that the department is conducting or contributing to. He was also the one, who got acquainted with ROBERT at a welfare technology conference together with two therapists from the ward, and has since been sort of a project leader on the test of ROBERT.

The Key Quality Supervisor (KQS) is also part of the POTD. She works in close partnership with the DT and as they also share an office they spare on many tasks. She described herself as having a wide range of responsibilities mainly centred on assuring that the employees and management of the POTD are up to date with regional and national guidelines, as well as assisting with acquiring necessary data from medical journals in relation to quality and assessment. When the POTD is involved in implementing new technologies, her job is often to fill out the application for the regional equipment pool, and she points out that it is also often her, that points to any potential issues of hygiene or data security. In the case of ROBERT she was involved in applying for funds from the equipment pool as well as doing research about data handling of the robot.

The most experienced operator of ROBERT is a PT. She has worked at the stroke ward for little more than 2 years, but has many years of experience as a PT and working within the specialty of neurotherapy. Generally she is very enthusiastic about the robot and the opportunities for training that it provides and she has been given and taken the role up herself of being the one that tries to teach her colleagues about the robot as well as having contact with the developer LSR.

As **ROBERT** is thought of as a new member of the ward, we consider it part of the ward. The following is a brief description of his technical characteristics, based on both technical manual and field observations.

What is ROBERT?

ROBERT is described in its operational manual as rehabilitation equipment intended for use in hospitals and care- and rehabilitation centres, and defines that the intended patients are bedridden after for example trauma, stroke, or ‘existing conditions’. The core function of ROBERT is to repeat training movements recorded by the operator. The manual states that the training can only target the legs, and claims that any patient requiring repetitive training can benefit from the use of ROBERT (Life Science Robotics 2022).

ROBERT has a number of different components (Fig. 10). ROBERT consists of a body with an internal computer cabinet, mounted on top of a base with four wheels and a brake, as well as a touchscreen, a handle for manoeuvring the robot, and the robot arm intended to socket into a special boot and move the body of the patient (Life Science Robotics 2022). The manual describes that the wheels and handle are designed to make ROBERT easy and safe to manoeuvre even in small spaces (Life Science Robotics 2022). However, practical observations show that moving ROBERT can be heavy and clumsy, and it is not uncommon that the robot collides with door frames. One therapist states that driving ROBERT is "*like driving a shopping cart*" (Int9, 14). This is however not unique, and according to another therapist it is not much different than moving a wheelchair. Attached to ROBERTs body is a large red emergency stop button on top, and a "play/pause" button on a long wire for the patient to use during training (Life Science Robotics 2022). In addition to the robot body, the manual for ROBERT describes three pieces of equipment that connect the robot to the body of the patient; two boots and a leg brace (Fig. 11).

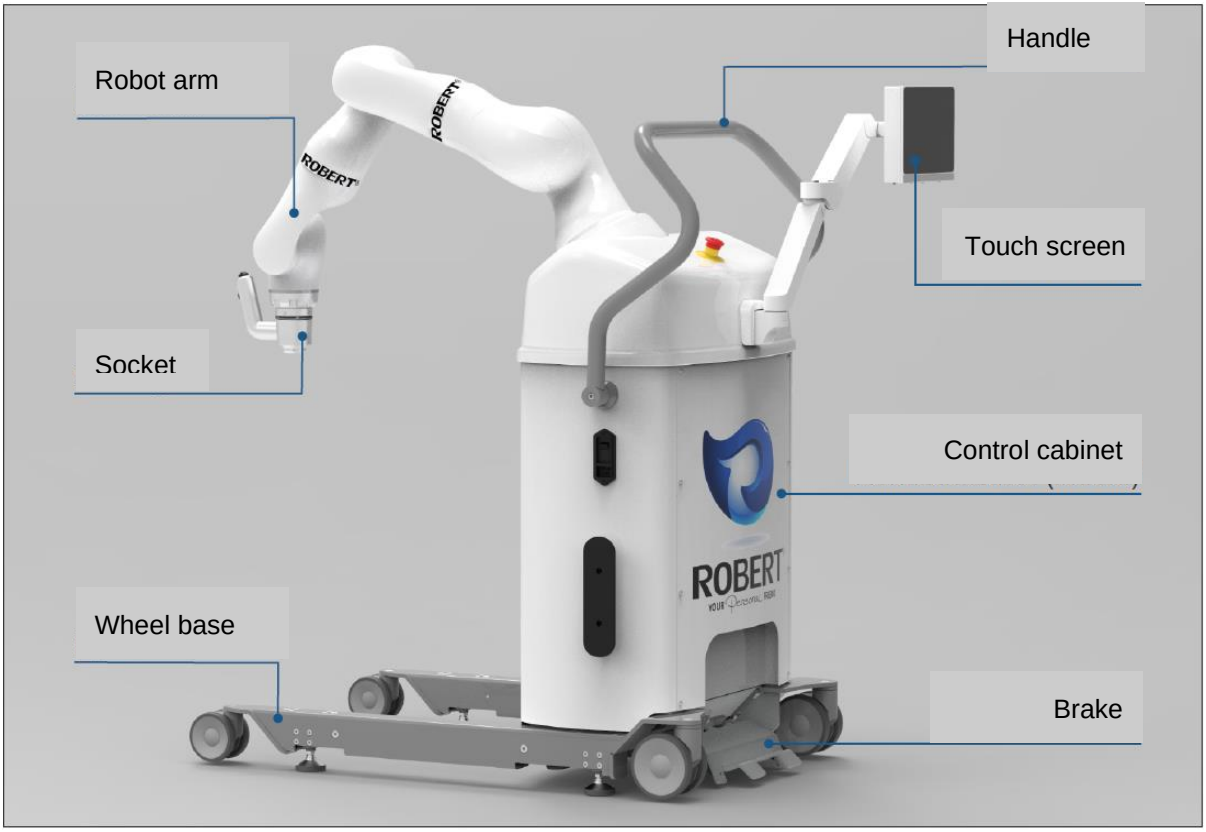


Fig. 10: ROBERT (Life Science Robotics 2022)

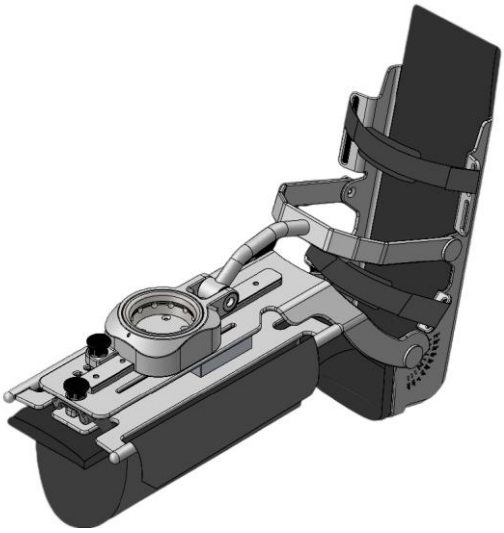


Fig. 11: The ROBERT fixture used most often at the ward (Life Science Robotics 2022)

Having presented the field and its actors, we now proceed into the analysis.

The Ward as an Ongoing Site for Transformation of Neurotherapy Practices

This chapter explores a recent transformation of neurotherapy practices at the ward, as a way to understand how the ward is in a state of reconfiguration of elements of therapy and care, and how the emergent ROBERT practice relates or further reconfigures new ways of practising neurotherapy. The purpose of this chapter is to provide the reader with an understanding of the ward as a construction-site for new ways of working with neurotherapy, as well as basic understandings of how and why present neurotherapy is practised. We account for these practices and their recent reorganisation as these events can be understood as a precursor for the interest in ROBERT and the choice by management and a small number of therapists to test the robot. The section also contextualises why the domestication of ROBERT was experienced as a challenging and unpredictable process as the staff already felt overwhelmed with the recent transformation of their work.

The emergent ROBERT-practice, did not emerge from stabilised grounds but a complex setting of making things, humans and ideals add up in daily doings. In 2022 the ward reorganised their working hours and tasks due to a problem with vacant job positions in the care staff group; consisting of nurses, and social and health care assistants. To resolve this issue, hospital and ward management in collaboration with management from the physio-occupational therapy department (POTD) came up with a new way of organising the employees where the vacant care staff positions were turned into physio- and occupational therapy jobs. This led to hiring a big group of new therapists and rearranging prior work schedules and ways of working. The reorganisation led to therapists being more present at the ward in the hours when patients are awake; primarily between 7.30 and 21, to establish and support a rehabilitative approach to patient care that requires a more intertwined and close collaboration between the therapists and care staff. The ward had for some time aligned their approach to patient care with the understanding that whenever relevant, the physical and cognitive resources of the patient should be activated in daily interactions, through the rehabilitative approach, done by all healthcare professional groups.

The lead therapist (LT) expresses that the process of transforming working practices is still in its infancy and that she has a desire to refine and adjust the organisation to best suit patient needs and the expectations of a phase 2 stroke ward. A nurse described that the ward prior to this change had explored other ways of working, not only due to staff shortage but because staff had an interest in learning new skills, which led to other professional boundaries and tasks being more fluidly resolved during the last years, such as nurses doing traditional physician tasks and social and health care assistants could do nurse tasks. She explained how she saw this as beneficial for the patients as well as

staff since they could provide better treatment and care because there was less traffic and interruptions such as needing to go get another profession to do a task that they were able to do themselves.

A New Way of Being a Therapist at The Ward

Transforming roles, tasks and work schedules, was described as being a therapist in a new way, with some having to adjust to new meanings of what it means to be a physiotherapist (PT) or occupational therapist (OT). Perhaps most noticeably was the initial reconfiguration of working hours of the therapists. With the reorganisation of the therapists, ward management had divided the PTs and OTs in two types of working schemes, one referred to as *drift* that resembles their old way of working, and one named *vagt* which is their new way of working. Prior to the reorganisation, therapists usually worked from 8-15.30 on weekdays and took turns on weekend shifts in the same hours of the day. Their *vagt* schedule is planned over a 10 week period with both day and night shifts. Typically they work 7 day shifts from 7.30-15 and 7 night shifts from 13.30-21 as *vagt*, while the majority of their time is *drift* which for the most part are scheduled from 8-15.30 except for staff working part time. We learned that the therapists in *vagt* did not attend meetings outside of the ward, because they had to stay at the ward and assist with patients. Being on *vagt* meant that two therapists were each assigned to assist care staff with approximately half of the patients each. The reconfiguration of working hours was described by one therapist to have consequences such as resignations and accompanying feelings of work overload for the group of PTs at the ward; who had gone through a stressful period as some had resigned because the new schedule with evening shifts did not fit their family life.

How Meanings Collided and Persisted

The same therapist described that she saw their previous way of working as a luxury, and now they had to get adjusted to the stress of patient calls. She also described how she had experienced overwhelmed colleagues. It had felt like a big change in culture and work that not everybody had an easy time moving past, and left some confusion about the direction of their therapy practices: *"And then I think people just felt that they had more or less landed in something, and then something else comes along, and then you're just like "no, now this has to stop". And if it's something where you're like "oooh, woow, dare I do it" or "Can I do it" or... So I think it's also important to include it in all this, because what kind of work are we supposed to do?"* (Int2, 12). She also explained that the new organisation had consequences in terms of how some people liked to work with the patients in a more *nerdy* manner, spending more time with specific tasks within their own profession, but not everyone felt that way; some were fine with working evening shifts and incorporating their skills more spontaneously. *Drift* was described by some as the type of work where they could focus on prioritised tasks and maintain a closer connection and overview of their assigned patients. A therapist described that they now had to plan around handing over their responsibilities for their assigned patients, to go

do *vagt*: *"Before this, we were used to being very continuously on the patient and suddenly people go in and out of their responsibilities because they have to be on day and evening shifts, so there is a lot to deal with inside people's heads. And I think we are getting there but it will take time"* (Int2, 12). The note below shows a therapist trying to manage this by writing a note for her colleagues (Fig. 12).

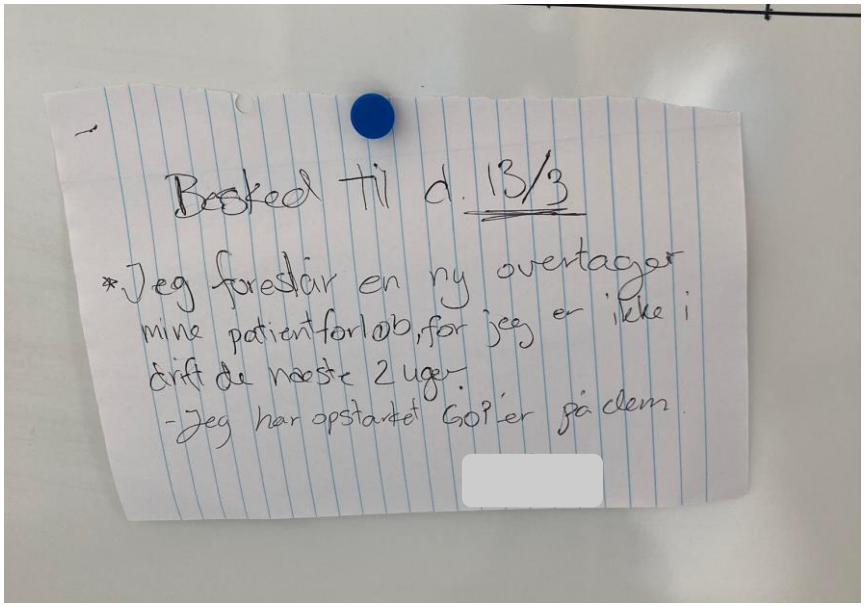


Fig. 12: A therapist note to her colleagues about taking over her patient responsibilities, while she is out of *drift*

The image of the nerdy neurotherapist could also be heard in therapeutic conversations, as it was sometimes expressed that the patients with complex disabilities were interesting, and they would then spare with each other what might be the best approach with the patient. Some therapists expressed understandings of what counted as real therapy and what did not and that this related to their areas of expertise. Some OTs described that assessments and training in daily activities was valued as their area of expertise. The LT and the development therapist (DT) expressed concerns about these strong feelings, since it sometimes resulted in arguments about prioritised tasks that the LT saw as rooted in professional interests rather than needs of the patients. As for the specific association of the nerdy therapist, we will later describe the implications of this image for how ROBERT was perceived.

One central reasoning behind the transformation of working practices (and according to the LT the main reasoning behind all potential transformation to current practices) is that they should result in positive outcomes for the patients. Patient's needs seemed to be a coherent element of their practice even as it changed to a new way of working. We observed the importance of how patient needs left traces in daily doings and sayings. What was meaningful and good for patients was discussed among the therapists in terms of them having to take over responsibility of a patient's training, if their primary therapist were working *vagt* or had the day off: *"I'm worried there might be too many people interacting with the poor man, so does it make sense that I see him too?"* (FN5, 3). It was not

considered as good for patients having to relate to new faces among the therapists all the time, but as they usually had to re-coordinate their resources due to colleagues being absent for different reasons, they often had to reassign responsibilities. On more than one occasion we overheard therapists express concerns about the patients well being when they were told to leave the patients alone, for example by the physician, who for medical reasons might judge that the patients should not receive therapy.

With the transformation of working in *vagt*, also followed a further stabilisation of the practice of the rehabilitative approach, although this practice is not only performed during *vagt*, but occurs throughout the day in interactions with the patients. The rehabilitative approach takes on many forms. A therapist might use a situation where a patient needs to put on pants while laying in bed and then have the patient try to roll from side to side with little assistance, or lift their butt off of the mattress and try to pull up the pants, all while the therapist vocally encourages the patient to keep going. The therapists support the patient in being as independent and active as possible when doing hygiene routines at the bathroom, or eating. A therapist described that even small activities such as sitting in a wheelchair and trying to keep awake while eating could be made into training situations, as any activity can help the patients recover some function.

The staff describe the rehabilitative approach as a different way to perform patient care; requiring a special skill- and mindset that guide them when interacting with patients. Patients should be supported in actively participating in their own care and daily activities, and *"you should always think training"* (Int8, 1). A central meaning of the rehabilitative approach is that it is equal to good care and treatment of the patients, and when applied by care staff and therapists it provides the patients with more training opportunities. The practice also has come to entail a symbolic meaning of quality, efficiency, and innovation, as the LT described how their way of working had caught interest by hospital management as an innovative way of working around staff shortage and providing better treatment. As such the rehabilitative approach is sort of an offspring of traditional care and neurotherapy and by that also another emergent neurotherapy practice.

During *vagt* the therapists coordinated and planned with care staff where their competencies might be best spent assisting with the care of patients, such as assisting with mobilisations, or training daily activities. The difference between the two ways of working also became visible in terms of how many patients they planned to see; in *drift* it was typically 3-5 patients but in *vagt* it could be up to 10 because they often got called to assist with patients all over the ward. Also the way they documented their patient interactions was not quite the same, with the *drift* being more extensive. Although it mostly seemed the reorganisation had large implications for therapeutic practices at the ward, we also learned that one of the newly hired therapists had not experienced the same struggle to adjust, since she did not know how the organisation of work had been before.

As the rehabilitative approach is a combination of neurotherapy and traditional care, it is also associated with traditional meanings of doing patient-safety through clinical tasks such as providing a physical space for treatment and rest, providing medicine, making sure patients are mobilised out of bed daily, preparing and serving meals and tube feeding, assisting with hygiene, and making sure that other staff are aware of life threatening symptoms or disabilities. The practice builds on top of past images of care as providing the necessary and best possible care and treatment of patients as well as reconfigures meanings so that it also came to associate itself as innovative and a possible solution to care staff shortages.

These accounts of the transition from one way of working to another, describes certain elements and their relations to other practices outside work. Some of the staff have experienced reconfiguring material arrangements and their meanings such as working schedules affecting their family life and what it means to be a therapist. They had to adjust to spending more time at the ward with all of its noises and care tasks as well as manoeuvring their patient responsibilities as they shifted back and forth between the two ways of working. It leaves the impression that some therapists at the ward are protective of their professional identity and take great interest in doing very specialised therapy tasks. The next part will describe present ways of doing neurotherapy, that are of importance for the test of ROBERT and how the ROBERT practice came to reconfigure certain elements of therapy and care.

Present Ways of Doing Neurotherapy

This section accounts for present ways of doing certain activities in neurotherapy that we have found to be of relevance to the new robot practice, to provide the reader with an understanding of how the present practice concerns itself with the issue of making ends meet in daily life, and therefore how planning and prioritisation is a central activity. Furthermore, we describe how assessment and training tasks within neurotherapy practices often employ the use of embodied skills of the therapist and within a variety of spaces that might not be suitable for a leg-training robot.

Doing Planning and Prioritisation

Besides reconfiguring meanings of work, the reorganisation of neurotherapy practices had also changed the location of the therapists morning planning meeting. During the first months of their new way of working, it was decided to move the morning planning meeting to the ward instead of the POTD, due to a recognised need for both *drift* and *vagt* therapists to be in reach of each other to plan and coordinate tasks. Despite relocating to the ward, the therapists doing *drift* continued to plan their day separately from care staff as their schedules did not align. The therapists doing *drift* planned their day each morning in room 9.

The relocation of the morning meeting presented some challenges as the choice to use room 9 came with the issue of the small size of the room. The room had a few months before been given up as a patient room because of its small size. Planning their day was observed as an activity entangled with special skills employed within physical and political spaces of using things to make choices and prioritisation of time, things and human bodies. We observed time and time again how things had to be moved around inside the room or put outside to make room for people. The room was also used to store ROBERT as well as their other training robot for upper limbs, ARMEO. As ARMEO is a stable installation, it always maintained its position in the room, while ROBERT was wheeled outside every morning, unless it had spent the night in the hall because the night shift staff had not moved it back. The room was crowded in the morning, when all the therapists were attending, making it almost impossible to hear what everyone talked about, however, the therapists seemed accustomed to this, although we did observe pictures of ears hanging on their whiteboard as a noise reduction reminder (Fig. 13, 14). There seemed to be no strict frame for doing the planning as we observed minor variations in terms of how strict they adhered to go through the patients from day to day.

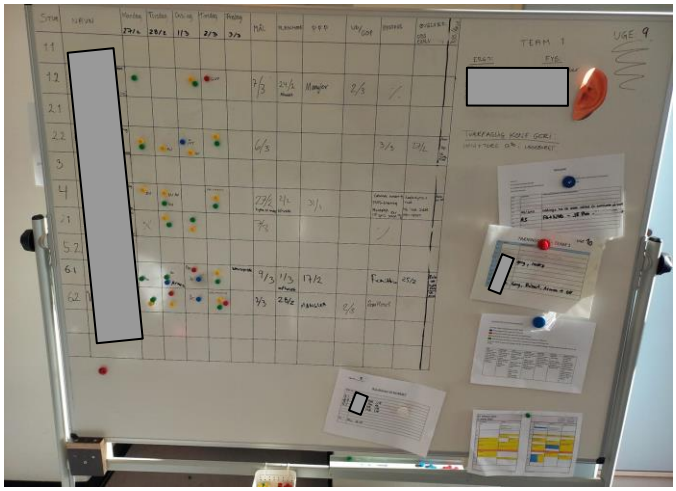


Fig. 13: the whiteboard used for planning by the therapists

Fig. 14: Room no. 9 the therapy office and training room

A big mobile whiteboard previously used in the POTD had been put in room 9. On the board were columns and rows arranged as names of the patients, days of the week from mon-friday, training goals, important dates for discharge/planning meetings, deadlines for rehabilitation or care plans for phase 3, if the patient had dysphagia, if self-exercises had been given, and at last one shared column for ROBERT and ARMEO. On one side of the board, the ROBERT and ARMEO column was very slender; it looked like it had been added to avoid changing other items on the board. The therapists would write in the column what the focus of the robot training was in the given patient's row if they were doing ROBERT or

ARMEO training. On another paper they wrote the names of patients that they assessed as relevant candidates for ROBERT (Fig. 15). Not all initial plans resulted in patient activities, as changes throughout the day such as small delays to interact with the patients were common. Patients could still be doing their morning routines, have scans done outside the ward, have visitors, be in need of rest, or in training sessions taking longer than anticipated, which took time away from seeing other patients.

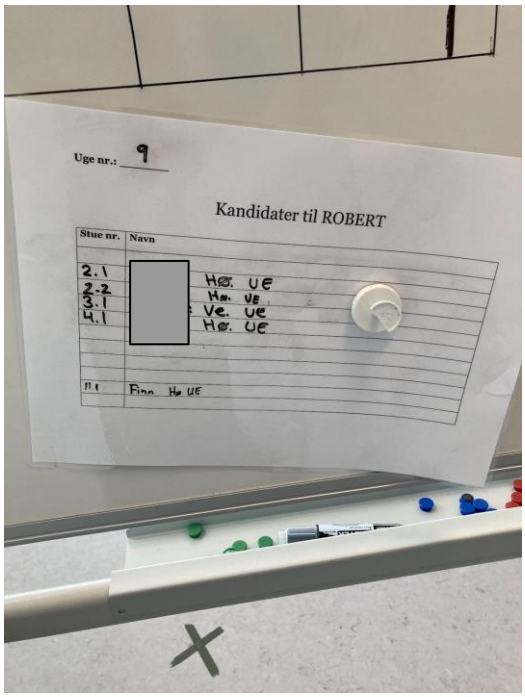


Fig. 15: ROBERT candidates

Prioritising Must-Do Tasks

This section accounts for how therapists at present categorise certain work tasks as must-do tasks, as the difficulty of prioritising essential tasks with learning new technology is a major issue in later sections. The therapists described that must-do tasks included initial assessments and tests of newly arrived patients, including assessing both motor and cognitive function. One OT described that she incorporated whether she should do an intervention together with a colleague when planning and prioritising her day. OTs also assess if the patients have dysphagia. Some patients have severe dysphagia that results in the need for tube feeding. Some patients also required time-consuming respiratory treatment. One therapist described that their assessments of the patients are the most important: "*Assessments are the most important thing in order to create a good rehabilitation plan and contribute to the further training in the municipality*" (Int2, 2). Generally, documentation is a high priority after each therapy session in order to not forget details that could have implications for the course of the patient's treatment and discharge. However, documentation happened throughout the day, as they also had to do therapy sessions back-to-back to make ends meet. This resulted in documentation taking up most of the afternoon and sometimes also being postponed to the next day if

they had been busy the day before. Other important tasks were participating in planning meetings with the patient, their relatives, and other professions working with the patients. At these meetings the healthcare professionals describe to the patient and their relatives what kind of stroke they had suffered as well as treatments, assessments, and training that have been given during their admittance, and relevant plans to set in motion for the patients to be ready for discharge. These meetings only happen once for most patients but do take up a lot of time. We often observed that therapists had to prioritise who should go, as an OT could describe PT interventions and vice versa, and that could save them the scarce resources of time and manpower. For complex patient courses, both groups need to be represented.

When informants were asked to describe their day, most therapists replied by asking what type of working mode they were supposed to describe because *drift* and *vagt* were very different. Some also had a hard time generalising their days, as they were very unpredictable: "*In general, it is very unpredictable what you do.. What I have just described is how it can be but it can also be in all sorts of other ways.. So it is more like you show up for work and see how the day unfolds.. so I don't always know 100 percent what I have to do"* (Int9, 2). While PTs focus primarily on motor skills, OTs focus on how the stroke had affected motor -, procedural - and cognitive function in activities of daily living. One OT mentions that in her experience the PT could begin their trainings faster than the OTs because OTs had to assess the cognition as well in order to create the best possible rehabilitation plan. Overlooking the dysfunctions and failing to describe them in a rehabilitative plan could have unpredictable negative consequences for patients.

It became clear that being able to prioritise and balance the amount of clinical tasks was a very central skill and focus of both staff and management, and finding the best way to do it was an ongoing activity. We often observed how the LT at the end of the morning meeting gave notice that the care staff and therapist doing *vagt* had more tasks taking care of the patients than they could manage. She therefore asked the therapists to have this in mind when they were planning and making their priorities to incorporate a coordination of their plans with the care staff and *vagt* therapists. Especially assisting patients with eating meals and mobilising them out of bed was a recurrent issue that the therapists in *drift* were asked to think about when they planned their day.

Summarising, these descriptions give insights to the complexity and vulnerability of making everyday tasks add up, and leaves the question of how it might not be mundane to incorporate yet another task of testing out a robot.

Embodied Skills of The Neurotherapists and The Variety of Spaces for Doing Neurotherapy

This section describes how therapists and patients engage in therapy by using their bodies in connection to one another, as well as accounting for the numerous spaces for doing neurotherapy that have relevance for the test and use of ROBERT.

We observed ways in which the therapists used their own bodies as tools for guiding and assessing the patients, as well as describing to the patient and each other what they had experienced:

> *"I observed a special relationship and collaboration between the 3, where the 2 therapists take turns explaining the purpose of the intervention and asking patient K how she thinks a given training goal activity was carried out, while at the same time they also turn to each other and on their own bodies explain and imitate what they see as challenging in patient K's activity performance* [...] *When patient K is about to walk, the PT walks very close to her and with one hand she takes hold of the left hip and seems to activate or sense if there is a muscle activation as the leg must be moved up and forward. They go out of the bathroom and out into the hallway of the ward…"* (FN2, 15)

This embodied skill of sensing and explaining to others what is sensed with the use of one's own body could be observed on many occasions, although a PT when asked about this said she did not think about it; it was just a way of being a therapist she had developed over the years. We deem this skill as embodied as the skill of the therapist can be observed by the intertwinement of bodies connecting, but also because the skill was developed by using her body as an instrument for many years, which led her to developing a tacit expertise that she is no longer aware about. She just senses and does it in repeated cycles. Therapy also involves a lot of body-body contact for sensing and moving patients, which is elaborated on later. The interplay between materiality and therapy and care could also be observed by employees' small everyday innovations. We discovered that many of the employees of the ward are innovative in terms of coming up with fast solutions using everyday care and therapy products if they for example have issues with positioning a patient well in a wheelchair or in the bed. They use tape to secure wash cloths, pillows and towels in an effort to support the patient.

Neurotherapy could be done in many different material arrangements. After making plans at the therapy office, the therapists spread out to see patients in their rooms. Facilities and items common to the patient room were integrated into the practices of doing neurotherapy. They used patient beds, different mobilisation aids, the floor, armchairs, as well as the wheelchairs that most patients require to move around the ward. The floor was likewise a special material resource for therapists, and having

to make space for them to do their work was common; many items such as bins, bed tables, room dividers and mobile computers had to be pushed around for them to work. The patient rooms at the ward have different sizes, some were tiny and some were crowded by wheelchairs alongside many gifts from visitors (Fig. 16). At the bathrooms, toilets as well as showers, bath benches and sinks were used in assessments of how patients performed daily activities such as personal hygiene. One of the smallest bathrooms can be seen on fig. 17.

Fig. 16: One of the small patient rooms

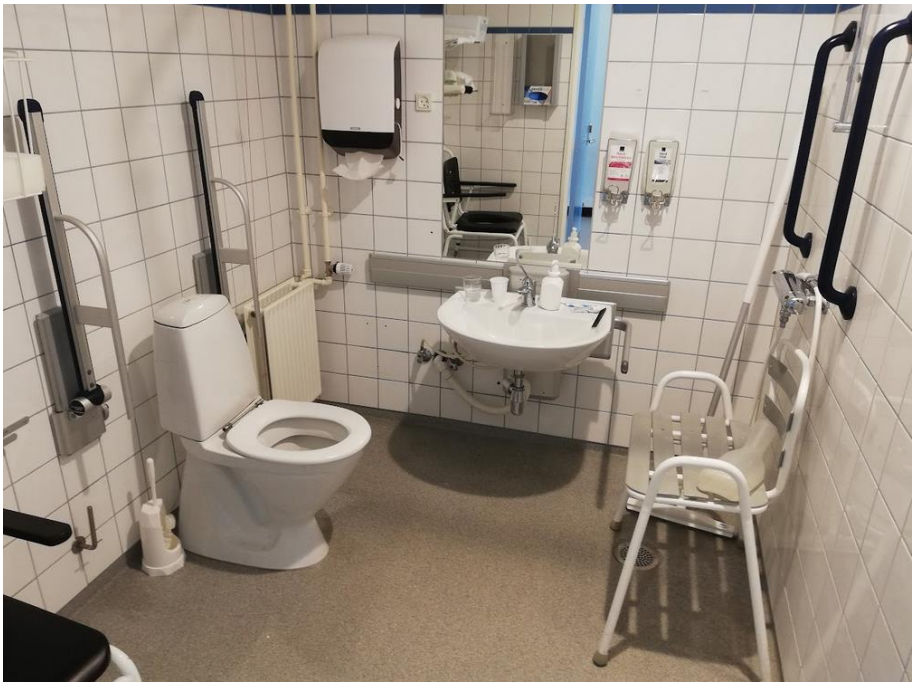


Fig. 17: One of the small bathrooms

Neurotherapy was not restricted to patient rooms. On many occasions, patients were guided by therapists to move out of the room into the hall to do walking assessments and -training. The hall was also used for doing documentation at the mobile computers, which were on some occasions also used in the patient room. Other places for doing neurotherapy were Open Gym and Training Café; two training activities that were down-prioritised if time and staff were limited, and must-do tasks had to be done. They were scheduled for two days during the week if possible. Of those two, we only observed Open Gym during our time there, the Training Café was only noticed through its presence on the big whiteboard and a sign on the entrance door. ROBERT was not part of the Open Gym, since he was meant to contribute with training at the ward. We did observe how some therapists had put ROBERT on the Training Café list as a possibility for training (Fig. 18).

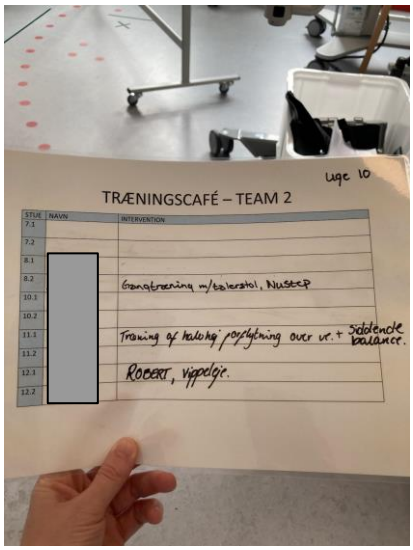


Fig. 18: an overview of patients eligible for the training cafe as well as relevant training

The Open Gym happened outside of ward premises in the downstairs POTD, where an actual training gym was available, described by therapists as better equipped: *"We have some other options for training than we have up here at the ward.. we have more remedies, we have more benches you can set up and you can create a safe environment if you have to do balance training"* (Int9, 4). This points to not only a lack of suitable spaces for training at the ward, which is relevant in terms of understanding that lots of activities and stuff at the ward compete for space as it is.

Summarising this chapter, we have shown that neurotherapy practices are made up of a large number of different symbolic and (bio)material elements, as well as how symbolic meanings and values ascribed to tasks shape practices and organisational changes. Understanding the recent path of these practices and their implications is central to understanding how the emerging practice of ROBERT

reconfigures and relates to present practices and the efforts that staff and management undergo in order to domesticate the robot.

The Emerging Practice of Using ROBERT

This chapter analyses the practice of using ROBERT to train with a patient, by combining technical background knowledge from the manual with observations of three different training situations, and insights from interviews and fieldnotes; attempting to provide a detailed and local description of a 'typical' instance of the ROBERT practice. This part of the analysis seeks to understand what, why, and how elements are engaged during training and possibly reconfigure present ways of doing neurotherapy. The manual is included to illustrate gaps between intentions and practice, as we observed incongruities between the ease of use of the robot that management and the development therapist had been presented with, and the reality of using the robot at the ward.

The developers of ROBERT present the process of using the robot in the following graphic on their website advertising it to potential customers:

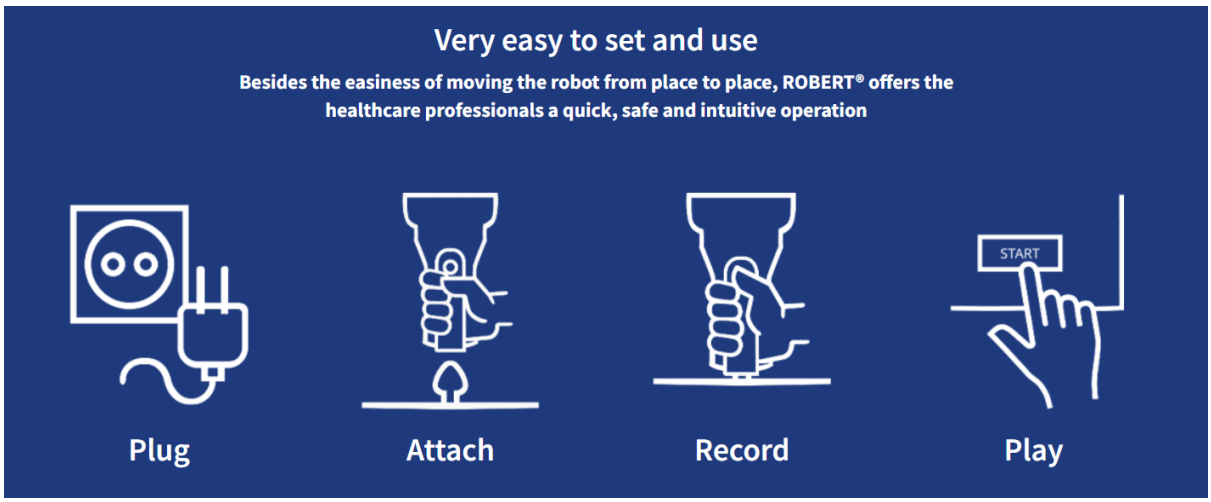


Fig. 19: ROBERT practice as illustrated on the developer website (Life Science Robotics 2023)

Here, ROBERT is presented as *"easy", "quick, safe and intuitive"*, and the entire training session is divided into 4 simple steps. While the manual goes into more detail about these steps, it never describes the numerous struggles experienced by staff, and it is stated that *"no specific technical understand is required to be able to use the equipment safely, as the user interface has been developed with exactly this in mind*" (Life Science Robotics 2022, 4). We, however, are investigating this from a position of socio-technical practice-based ethnography. As such, it is our stance that technology must be understood in the context of real and situated use, an understanding presented in the following sections in an account of using ROBERT which is far more complicated and messy than what is conveyed via marketing materials and technical manuals.

Finding Meaningful Time

The first step of using ROBERT is finding the time, and time is valuable at the ward. One therapist asked: *"What are we prioritising less when we have to prioritise ROBERT more?"* (Int3, 6). In this section we analyse the temporal aspect of ROBERT practice.

On a daily basis, use of ROBERT was mostly structured around a schedule designating daily responsibles that a group of physiotherapists (PTs) had made for themselves. During one visit to the field, the responsible therapist of the day described herself as a *ROBERT lady*, indicating that being appointed by the schedule has both a material and a symbolic effect. Despite issues surrounding the schedule - analysed in a later section - there was an understanding among therapists that planning was necessary if they wanted to use ROBERT more, and a PT who said the schedule can become meaningless did still prioritise ROBERT when it was her turn. While ROBERT was intended to assist both care staff and therapists in daily tasks, we only observed two PTs use it during three days of observation. On the first two days of observation, four patients were marked as ROBERT candidates, and there was enthusiastic discussion among staff about how it might benefit certain patients. On the third day of observation there was no discussion of ROBERT at the morning meeting apart from one therapist mentioning that she was responsible that day, but ROBERT was still used at least once.

Beyond scheduled responsibility, use of ROBERT can emerge spontaneously. Sometimes, patients requested to train with ROBERT, and even asked if they can have "*a ROBERT for the hands*" (FN10, 6). The patients were aware of the existence and function of ROBERT, at least those who have been introduced to him, and some of them have had good experiences and are enthusiastic about using ROBERT and similar equipment more.

Therapists might use ROBERT outside of the allocated responsibility in the schedule. One OT, not covered by the schedule, used ROBERT when she had "*time to kill*" (Int3, 2), and another therapist explained that some patients are just better at training and being active in the evenings; she was sometimes asked to use ROBERT by her colleagues during her evening shifts because they thought it would be meaningful for the patients. The planning schedule was not enough to meet the needs of all patients who could benefit from ROBERT, nor all staff who might want to use it. The schedule only included the PTs, and only covered the dayshift, which misses non-PT, as well as staff and patients who might be better suited for training in the evenings.

Beyond physical relief, ROBERT was reconfiguring the way staff allocated time between patient training and other tasks, because training with ROBERT does not require the hands of the operator to be occupied, and allows the operator to leave the patient alone in the robot while they go somewhere else. Several therapists used the time between programming exercises to do documentation. One

remarked that *"it makes a lot of sense to do patient training while simultaneously doing documentation"* (Int9, 9), and another described that she could do this both in the patient room or outside in the hallway. It is also possible for one therapist to leave the training and have another take over, or to have therapists not trained in ROBERT supervise the training. In one observation, a therapist was planning out loud that she had to do documentation before she could do patient training but then changed her mind when she realised she could do both: *"oh, no, I should remember to be smart. I will of course start the exercise with ROBERT, and then I can write the plan while he works"* (FN2, 22). This shows that ROBERT fit the need to prioritise between several important tasks well, such as training with patients while creating their training plan. ROBERT also creates the possibility for therapists to embody their skills into the robot while they physically go somewhere else.

Finding Meaningful Patient Candidates

ROBERT is not for everyone, and the competences required to identify good patient candidates for training was an important part of the ROBERT practice, which fits more general practices about deciding on what kind of training and tools to use for training. A PT explained that the most important thing is to give patients the best treatment, and that the specific equipment is less important.

According to LSR (2022), the use of ROBERT is not limited to certain conditions but the manual does present a number of indicators and contraindications for use. Indicators for use are a patient above 18 years of age, with a leg weighing below 11kg in need of repetitive training, and the manual stresses that the operator should pay extra attention if the patient is sedated, physically or mentally unstable, spastic, epileptic, cramping, or severely brain damaged (Life Science Robotics 2022). Contraindications are unstable fractures in back, hip or leg, pain during exercise, a leg weighing more than 11kg, a healthcare professional assessing that training is unsafe, or the patient refusing to use ROBERT; it is made explicit that these contraindications are absolute, meaning that training must not be done in their presence. In addition to the indicators, it is stated that the choice to use ROBERT should always be left to the individual operator (Life Science Robotics 2022).

Therapists at the ward described ROBERT as useful to a wide variety of patients. Several therapists described that ROBERT could be used regardless of patient level of function, which made sense in a ward where most patients are bedridden. Another therapist explained that choosing to use ROBERT is chosen based on the needs, cognition, and awareness of the patient, and this assessment happens in relation to other relevant challenges the therapist might want to prioritise, such as cognitive- or dysphagia training. Thus, the choice to use ROBERT is not only a matter of the specific condition that the machine might target but also of prioritising time for training against several other patient needs. Another therapist stated that ROBERT is especially beneficial to the patients who require the most care: *"It makes a lot of sense to be able to do training in bed with those who cannot do much. It makes sense because we have some who are very affected by a stroke or a brain aneurysm*

who are not able to do much but then you can still facilitate something without having to use your own body to do it" (Int9, 17). Here, the therapist highlighted another aspect of their practices in which ROBERT made an important difference: The patients with the most serious damage and highest care needs are also often those who require the most resources. In such cases, ROBERT provided a way to mitigate at least some of this, by reducing the physical demands of caring for these patients.

While the therapists agreed that ROBERT made sense regardless of patient function, they disagreed on cognitive requirements. Two therapists described that ROBERT can be used with patients with decreased cognition and awareness, while another stated that she saw ROBERT as useful for specifically patients who are awake and working towards specific goals. As such, there was not a complete shared understanding of what patients were potential ROBERT candidates.

The staff at the ward mostly explained how they identify patients who would benefit from using ROBERT. The one exception was that a specific patient with disturbed perception was identified as not a good candidate, because he might become upset to the point of wanting to destroy the machine if it touched him for too long.

To sum up, there was a broad agreement that most patients at the ward might benefit from training with ROBERT, but not on when it should be prioritised over all the other available training options. Most therapists seemed to agree that prioritising ROBERT is an individual assessment based on the patient, and against many other options.

Setting up ROBERT

Once a patient candidate for ROBERT has been identified and time is available, the training session can begin. The first step is setting up the machine, physically and digitally. The operator begins setup by turning on and logging into the machine. ROBERT logs out of the interface by itself after some time to protect patient data, and requires a full restart every 24 hours. Upon restart, ROBERT performs a calibration which requires the arm to stretch and move around freely (Life Science Robotics 2022). In an email to LSR, the most experienced operator expressed that she found the time spent on restarts too time consuming. The operator is required to log in to track uses and injuries, although a therapist told us that this was not used as intended; some therapists used the same login. The manual states that a unique login must be created for each operator (Life Science Robotics 2022), which could indicate that the current situation results from a lack of instruction and/or time. The data gathered about patients is more extensive; including the name, gender, date and year of birth, physical height and weight, diagnosis, and severity of impairment (Fig. 20).

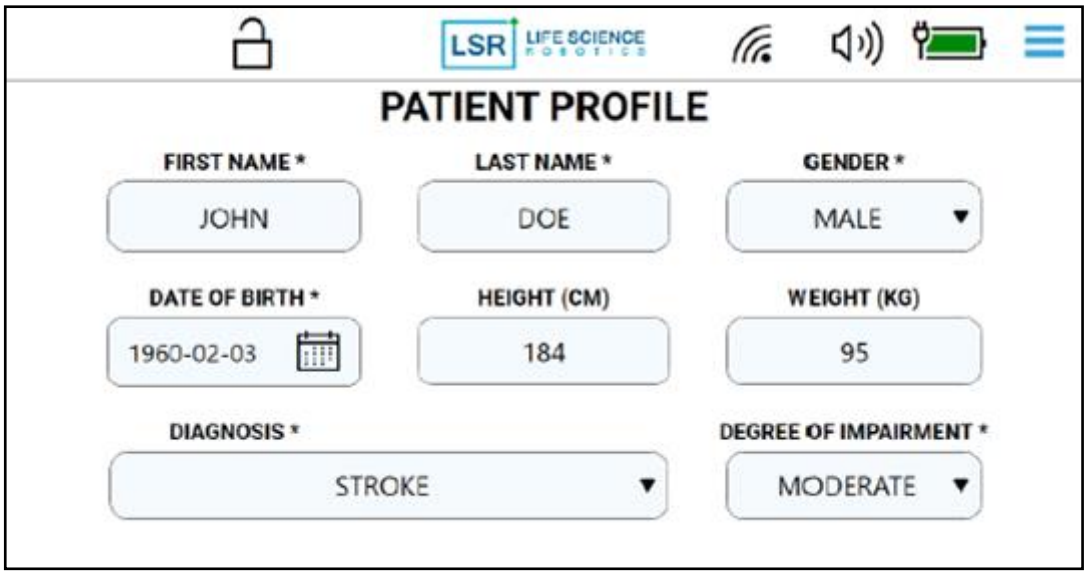


Fig. 20: Interface for providing patient data (Life Science Robotics 2022)

What is meant by 'degree of impairment' was not obvious to the therapists, and they would sometimes end up just picking one seemingly at random because they did not understand the prompt, although a therapist stated that the choice does affect how ROBERT acts during training. In some cases, the operator is not assigned to the patient, in which case two staff members might work together in a constellation where one has the skills to use ROBERT while the other has a skilled understanding of the patient. In situations where the ROBERT-skilled therapist does not know the patient at all and vice versa, this can prove problematic. In one observation, the ROBERT operator asked the therapist responsible for the patient what severity of impairment they should input, and rather than an answer, received a careful question back about whether it matters. This resulted in an exchange in which the ROBERT therapist struggled to explain what was meant; finally they agreed to enter 'moderate' but the therapist responsible for the patient remarked that *"it is hard to assess, because it also involves their age and their pre-stroke function and all sorts of things"* (Vid2, 3). This illustrates that the data prompts that ROBERT requires, and which influence the training provided, do not fit into the skills and language of the therapists; seemingly because it reduces a rather complex assessment with many variables into a 3-step scale with no further explanations. Additionally, the task of translation is not trivial to those who have an understanding of what the question might mean.

The collection of patient data is sometimes used as part of training and assessment. Such a situation is described in a video observation:

> *"THERAPIST 1 turns the screen towards Patient P so he can follow what happens, and says* 'now the machine just needs a little information about you*'. THERAPIST 1 begins asking P his first and last name, and his birthday. P struggles with saying the date, and THERAPIST 2 mentions that he was able to yesterday* [...] *THERAPIST 1 thus has to glance down at his*

> *patient wristband on which his birthday is written, while she types on ROBERTs screen. When she notices that his birthday is in* [month]*, she exclaims, 'is your birthday in* [month]*? That is lovely, it is a lovely month'"* (Vid2, 3)

Here, the operator used the screen as a tool to assess and engage language skills, as the patient had aphasia. The screen contextualised the process, so there was a clear purpose to what was asked and why. When the patient struggled with saying his birthday, the operator used the patient's wristband to supply missing information, and turn the very mundane task of typing a date into a more personal interaction. This use aligns with the approach at the ward in which training situations are found in all aspects of daily activities, and the ability to produce such a situation is not exclusive to ROBERT.

The operator does not need to prepare the patient for ROBERT before arrival; the 'sales pitch' can happen while ROBERT is rolled into the room. A therapist explained that it is important to make the patients first meeting with ROBERT feel down to earth and not dangerous. This might include assigning a role for the patient, "*now you are going to work*" (Int4, 3). The operator might communicate this to the patient even if they are not entirely awake due to severe cognitive brain damage. It is important to ensure that the patient gains the correct understanding of ROBERT; as a mundane and safe thing that is just another part of their rehabilitation. This image also includes tasks for the patient. It was still done even when the therapist is aware that the patient will not be able to receive this message, which is a common practice regarding all sorts of patient interventions.

The placement of ROBERT relative to the patient depends on the intended exercises; measured by eye by the operator. First of all, ROBERT can only work with patients laying down in the hospital bed. Fitting ROBERT with the patient requires some tinkering with the bed, as the operator might prefer doing the setup at a different height than ROBERT requires for its setup. The manual mentions that the wheel base fits under a standard hospital bed (Life Science Robotics 2022), although it is unclear what standard is invoked. One therapist told of an experience in which ROBERT stopped during training and pinned the leg of the patient to the bed, resulting in her adapting a new step to her practice in which she always makes sure to heighten the bed so she can make room to free the patient by lowering it in case it happens again. Using ROBERT thus requires a material arrangement of different bodies - humans, robots, and beds - who each have different requirements in how they are configured relative to each other. The skills involved in doing this require a lot of trial and error, as well as several back and forth adjustments of the bed and the robot, in contrast to the manual which does not mention these adjustments (Life Science Robotics 2022). This contrast illustrates that the actual practice of using ROBERT is more complex than anticipated by the developers, and requires a skillset of the operator that they can only discover the need for and then learn through practical experimentation.

Some operators moved the screen between their preferred working position and facing the patient, while others made the screen face the patient constantly and adjust their own movements accordingly; the latter can result in the therapist going into odd positions such as stretching their body across the patient (Fig. 21).

Fig. 21: ROBERT operator in a strange working position (Vid3)

Building on the previously mentioned configuration of different bodies in the ROBERT practice, the screen becomes a separate entity with its own relations to the other material elements; needing to face both the operator and the patient if the patient is awake, which requires constant reconfiguration of either screen or operator in the already small space available around the patient bed.

Equipping the Boot

Once ROBERT is set up for training, the next step is to fit the patient with the accompanying boot. The boot holds the patient's leg in place so ROBERT can move it, and can be adjusted to allow for movement of the ankle joint (Life Science Robotics 2022). Before mounting the boot, the operator will show it to the patient, and feel their leg to identify possible muscle coordination disturbances, as well as test the patient's leg function without ROBERT to determine what movement should be programmed. If the training is intended to target the ankle, the therapist will assess whether this requires a pillow to support the leg so the foot can move freely. A therapist explained that the boot must be tightly secured, both to ensure that ROBERT translates the movement correctly to the body of the patient, and to avoid injuries. The therapists checked several times that the boot is sufficiently secured, and a therapist told us that she did not feel comfortable using ROBERT because she was afraid that the patient would not be properly secured and their leg would fall out. As such, a ROBERT

training involves a connection between the materials of the robot and the patient, and therapeutic skills and understandings of both patient safety and care, and the specific procedure of securing the boot. Once the boot is secured on the patient's foot, ROBERTs arm must be locked into the boot. Navigating the arm into the socket requires both strength and some trial and error on the part of the operator. Once the arm is locked into the boot, ROBERT will lift up the leg and sometimes weigh it, though the weighing does not always happen, and the therapists do not know why, illustrating another gap between the signals given by ROBERT and the understandings of the trained operators. Once the arm is mounted, a LED ring around the arm will light up green if it is ready to proceed. When switching legs, the procedure is the same.

Recording and Switching Exercises

The operator has to input via the screen how the patient is positioned, what body part is being exercised, and how many repetitions of the recorded movement ROBERT should do (Fig. 22).

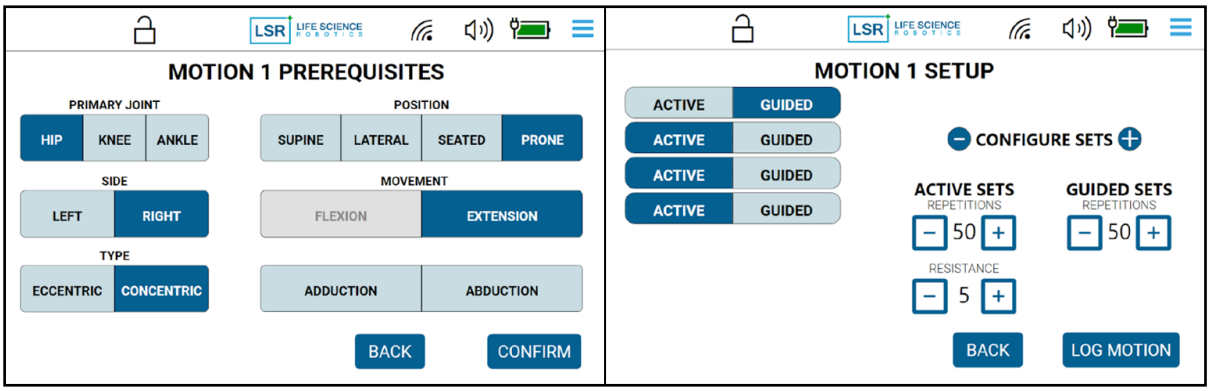


Fig. 22: Interfaces for configuring exercises (Life Science Robotics 2022)

The screen on the left is for inputting information about the position of the patient and the form of the intended exercise, while the screen on the right is for scheduling different sets of exercises, as well as choosing whether they will be guided or active, and how many exercises will constitute a set. The number of repetitions is picked somewhat randomly; in one observation the operator stated that she picked the number based on what she thought she remembered happened last time. In another, a different therapist overheard the operator choose a number of exercises, and butted in from the other side of the patient room to suggest a higher amount. The operator has to input whether the exercise is guided, meaning that ROBERT actively performs the recorded movement, or active, meaning that ROBERT locks the patient into the recorded movement and either requires them to perform the movement by themselves or provides resistance (Life Science Robotics 2022). Therapists at the ward almost always use the guided training mode *"because that is often what the patients are best able to do"* (FN2, 25). Recording happens by performing the physical movement with the patient strapped into the robot while holding down a button on the handle on the arm; it might require several tries to

get a satisfactory movement. Recording the right movement requires "*finding a rhythm*" (Vid1, 2), and the difficulty of the exercise is in part determined by how extensive the movement is.

If the operator and patient agree that the movement is good, ROBERT can be started, otherwise a new one will be recorded. When switching exercises or legs during a longer training session, the procedure is the same. In some cases, the therapist might see a need to move into the bed with the patient to adjust and record an exercise correctly.

Failure to Record

During recording and training, ROBERT may stop functioning and light up the LED ring around the arm with yellow light to indicate that it is not ready to operate (Fig. 23). When this happens, the operator has to identify what part of the setup ROBERT is indicating about, as no information is given beyond the light.

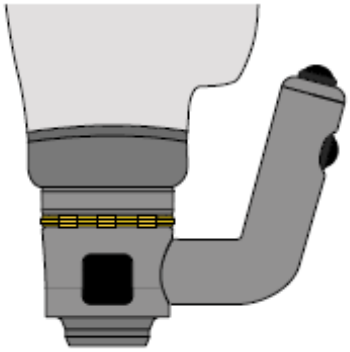


Fig. 23: Light indicator (Life Science Robotics 2022)

According to a therapist, this usually happens when handling ROBERT too powerfully, and a patient described being able to stop the robot by moving in ways that are not expected by the machine, such as moving the leg that is not currently secured in ROBERT, or coughing. This is also described in the manual for ROBERT, and the operators as well as patients usually understand why they happen and are able to solve them. Other times, the operator was unable to determine what the issue was, and ROBERT was unable to provide information beyond the light indicator. The manual provides a guide for troubleshooting, which provides two potential causes and solutions to the yellow light; the weight of the leg is above the limit or the arm of ROBERT is placed too close or too far from the body of ROBERT (Life Science Robotics 2022). In one observation, ROBERT persisted in indicating the yellow light, and the operator went through both of the solutions suggested by the manual, as well as trying to adjust the placement of the bed and the position of the bed railing but none of the attempts succeeded in making ROBERT operate. In the end, the training session was cancelled, and both the therapists, the patient, and a visitor to the patient were left wondering what went wrong. Afterwards, there were several discussions among the involved parties about wishing there was a more detailed explanation for why ROBERT had refused to operate; a therapist thinks that it would be difficult to

provide because every patient is different. This shows a major gap between the functions of ROBERT and the needs of the operator to be able to use the machine. The provided information from both the screen and the manual are insufficient for the operators to understand what is going on and solve the apparent problem, and the tinkering that is often employed during ROBERT setup does not help.

Exercising with ROBERT

Once ROBERT has been secured to the patient's body and a satisfactory movement has been recorded, ROBERT can be set to work. When it works as intended nothing much happens; the arm moves back and forth in the recorded movement, while the operator might express motivating instructions or ask the patient to perform certain movements. This illustrates that exercising with ROBERT has a social component, in which the operator and patient communicate and experiment throughout the exercises, which fits well with existing practices of training with patients regardless of the equipment used.

ROBERT has a "play/pause" button for the patient which can be used to stop or start an ongoing exercise (Life Science Robotics 2022). One therapist explained that she might leave the patients to themselves while ROBERT works but that she has to test if they are able to use the stop button first, as well as making sure they can reach the call button and securing the foldable bed frame. If the patient is unable to use the stop button, she would not leave them alone. A therapist described that the ability to stop ROBERT gives the patients a feeling of ownership over the robot. The skills of the patient being trained with ROBERT are thus highly determining in how the practice of using the robot plays out; a patient unable to use the button means that the operator has to be present throughout the entire session.

During one observation, a patient expressed that she thought that ROBERT had a good effect on her but was also a physically hard training exercise; this made the operating therapist happy. An SHA also expressed that it is hard to train with ROBERT. The patient said that *"it is difficult in the brain to keep up"* (Vid3, 2). She further said that she could tell that the training was helping her, and that she felt safe being in ROBERT because she had the pause button, and she had figured out how to make ROBERT emergency stop by moving in certain ways. ROBERT allows patients to engage in other activities while they are training. During one observation, a patient had a blood test done by a nurse while ROBERT was working with her legs. Neither ROBERT nor the nurse were obstructed by the other. This exemplifies the potential of the ROBERT practice in reconfiguring other practices at the ward, namely taking blood samples during training which is seemingly exclusive to ROBERT.

Emergency Stop During Training

In case of an unexpected movement in the body of the patient, ROBERT is intended to stop operation until the operator or patient either restarts it or ends the session (Life Science Robotics 2022). Working around this mechanical safety feature is integral to operating the robot at all, as emergency stops are fairly common and expected; with one therapist describing that the robot gets scared if the patient moves with too much power. As mentioned before, a therapist made her own counter-safety precaution to be able to free the patient in case of an emergency stop. This illustrates that the safety features of ROBERT can be counterproductive to the way therapists understand and practice safety; although it must be stressed that the emergency stop feature itself is not something that the therapists express any opposition to. Thus, part of the skillset that patients and operators might develop about ROBERT is not about using the machine as intended but about using it incorrectly in calculated ways, such as deliberately provoking a stop.

Feedback and Patient Function Assessment

While ROBERT is running, the machine provides feedback via the screen, as well as sound and lights. The screen has two green bars which fill out when the patient performs the exercise in a way that ROBERT registers as the intended movement; these can be used to engage the patient and set certain goals for them during training such as filling up the bars all the way. The bars have a red back-edge, and ROBERT will stop if the patient moves too powerfully. The bars also register movements aside from the exercise, such as when the patient coughs or laughs, and sometimes it registers movement when the patient is doing their best to not move at all; contrary to how they have been instructed to interpret the screen.

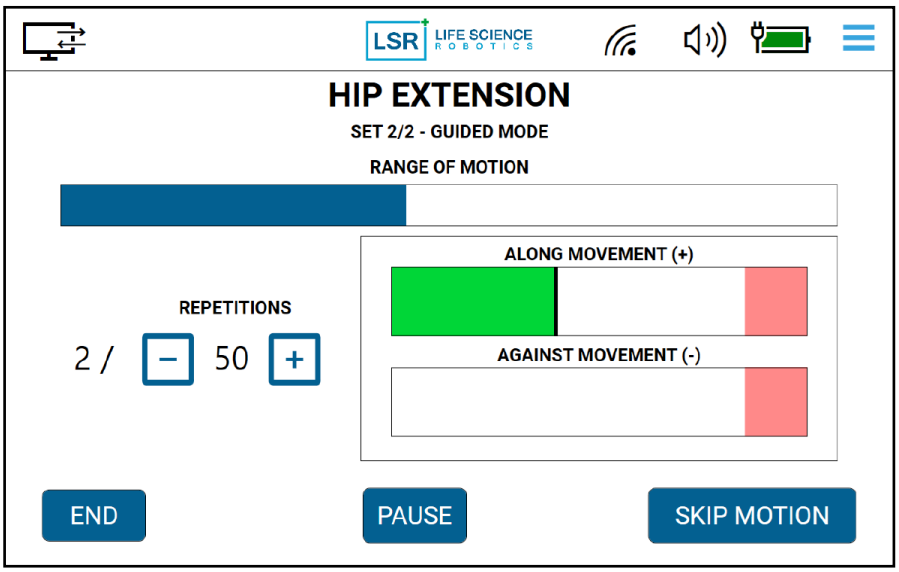


Fig. 24: The screen with bars during guided exercises (Life Science Robotics 2022)

A therapist explained that she was not entirely sure what the bars were measuring, and the patients also did not understand. However, the most important thing to this therapist was that the patient has been active and done some movement, which she could tell was the case from the bars as well as from her own observation of the situation, though it can be difficult to assess whether a movement hits the intended muscles even when physically feeling on the patient's body. Sometimes, ROBERT counted two repetitions of the recorded movement as one; the therapist in the situation was not sure why this happened but she stated that it was not that important as long as there was plenty of repetitive movement happening. A therapist also recalled that a lot of patients had expressed fascination and joy when they were able to follow the feedback during their training.

When training the ankle joint, the boot obstructs access to the patient's body, which means that the operator depends on indicators from the screen to assess whether the correct movements are happening in the patient, which in practice means trusting that the bars are accurate when they signal green, and not red. It was stated by a therapist that the screen did not provide her with full information about the ongoing training but that she was satisfied with being able to tell from the screen that the patient attempted to activate a muscle. However, the same therapist also stated that the screen was not always dependable. Thus ROBERT reconfigures the relation between materials and skills, as therapists become dependent on a less-than-dependent screen to assess training.

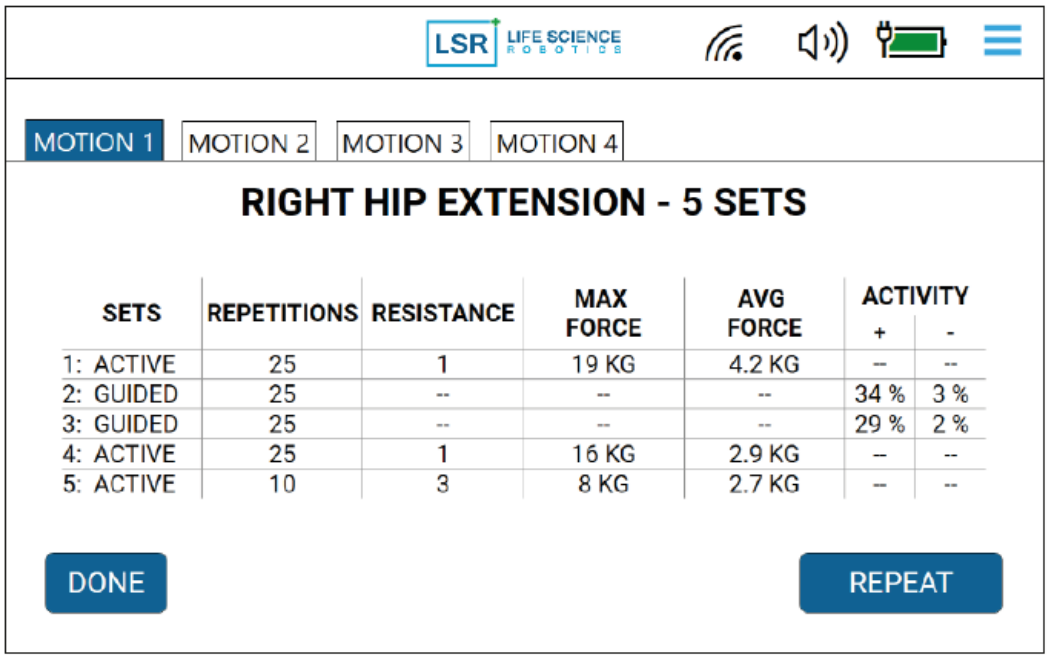


Fig. 25: Overview screen shown when finishing exercise (Life Science Robotics 2022)

When finishing a training session, the screen presents an overview of the finished training (Fig. 25). The overview presented above differs from the one used at the ward, which presents percentile numbers labelled as “excentric” and “concentric”, which a therapist explained did not correspond to her understanding of these words, and also did not always correspond to her understanding of the

training that had happened. This created issues when the operator wanted to involve the patient in their training by explaining the final assessment, because neither the operator nor the patient understood how to interpret them. However, the therapist described that she still managed to use the percentiles to determine if there had been activity from the patient, and she also used them to determine whether the patients level of activity changed between sets of exercises; most patients warm up during the first set and get more active in the following sets. Other therapists expressed similar doubts about interpreting the results on the screen.

The feedback functions of ROBERT do not correspond fully with the skills of the therapists in a way where they are confident in their meaning or utility. However, they do manage to provide enough information for the therapist to determine whether the training is working as intended in providing repetitive movement, which was considered good enough to work but still often brought up as a point of frustration. ROBERT is not always able to provide the operator with the information that they require to fully engage their professional skills during training. As there is no clear answer to how to understand the feedback, as well as instances where the feedback is demonstrably wrong against the experience of operator and patient, using ROBERT is surrounded by a level of uncertainty.

Finishing Training

Once a ROBERT session is finished, the operator has to perform hygiene measures on the equipment. Sometimes, the patient might request to end training before the planned sets are finished, which is accommodated. One patient mentioned being hungry after training with ROBERT, and ordered a larger breakfast than usual. Regarding more general safety and hygiene practices, one therapist described that ROBERT was exactly like all other equipment regarding cleaning, meaning that the procedure was to use a ‘green cloth’ to wipe down contact surfaces that had been touched by the patient and/or operator. According to a different therapist, however, there was a more strict procedure put in place by the hospital’s hygiene nurse, requiring a separate boot for each patient because the cloth is not sufficient. This same therapist explained that this requirement was not something the ward was able to accommodate, as they had neither the money nor the space for that amount of boots, and thus her strategy was to *“fly under the radar”* (FN2, 26). These very different understandings and practices surrounding the hygiene requirements for the ROBERT boot show that it has not been sufficiently assessed whether ROBERT fits into the existing practices at the hospital; in this case the rules and understandings in a practice of hygiene. It is unclear whether the information has been available and communicated to all operators, but the effect is that some therapists mistakenly assumed that ROBERT fits existing rules and practices at the hospital, while others knowingly broke the rules because keeping them was not possible.

Summarising this chapter, we have shown that the emergent ROBERT practice contains a much larger and more complex arrangement of different elements than conveyed via marketing and technical manuals. We have shown the specifics of operating ROBERT as part of neurotherapy practices, as well as specific instances in which ROBERT either fits existing practices or reconfigures ways of doing neurotherapy.

The Commotion of Integrating ROBERT into Everyday Life at The Ward

This chapter continues to analyse the ways in which the emergent robot practice reconfigures neurotherapy and care. While the previous chapter analysed how a typical instance of ROBERT training reconfigured neurotherapy training, this chapter turns the attention towards the test process of ROBERT as a form of domestication at the ward. We analyse ROBERT's introduction and arrival at the ward through domestication theory, to understand the ward's initial meeting with ROBERT, and the decisions and actions taken to test the robot, as well as challenges that have emerged during the process. The analytical points presented here are primarily based on data from interviews, as it has not been possible to follow the entire test via fieldwork observations from the beginning. The analysis will employ the following four constructs and accompanying continua: *Appropriation, objectification, incorporation* and *conversion.*

When entering the field we were curious to know how the process of ROBERT's introduction and arrival had unfolded. Our interview guide therefore simply included the question: *Can you tell me how ROBERT ended up here at the ward?* (App 1, App 2) A majority of the informants answered along the lines of: "*one day he just showed up*", and "*I am unsure of the timeline*". Only a few employees seemed to recall bits and pieces of the process. As we can only access early stages of the process through their recollection, the following is not a complete timeline, but an attempt to understand current challenges.

Discovering ROBERT

One employee who was able to recall parts of the events was the development therapist (DT), who encountered ROBERT at a welfare technology conference in 2021, which he attended with two therapists. They agreed that ROBERT would be interesting to try out at the ward, and after stumbling upon ROBERT at a couple of other occasions, the DT contacted Life Science Robotics (LSR) to ask if they would be able to demonstrate the robot. The two therapists left for maternity leave soon after and have not since been part of the test process. Due to COVID restrictions combined with the robot being large and impractical to transport, the DT and LSR agreed on an online presentation of ROBERT.

The DT did not recall who exactly attended the presentation but recalls that it was different therapeutic teams across the physio- and occupational therapy department (POTD). Here, the decision was made that the stroke ward would be the most relevant for testing Robert, *"because it seemed that ROBERT would contribute to their visions"* (Int1, 6-7). The DT explained how ROBERT would be able to contribute to both a specific training focus at the stroke ward as well as better work

environment: *"There is a focus among the therapists at the stroke ward on the high-repetition training* [...] *which they are often challenged with obtaining because of the many things going on at the ward* [...] *additionally ROBERT would also relieve the therapists in regard to the work environment, which therefore made him interesting for the ward"* (Int1, 7). Furthermore he described how the robot was intended from the beginning to be used by physiotherapists (PTs), occupational therapists (OTs) as well as care staff. The lead therapist (LT) of the stroke ward shared this understanding of ROBERTs relevance and furthermore described how the robot had been debated at managerial meetings:

> *"He* [ROBERT] *has been discussed at all* [managerial] *meetings* [...] *we had to discuss it at management level if it was something that we could financially afford because we had to pay for it ourselves* [...] *But there has been full support from the start, because we can see that it would make very good sense for specifically our patients. But it also makes sense because our constellation at the ward has changed* [...] *how can we take advantage of the fact that we have got other resources into the department by having more physiotherapists and occupational therapists here, which all of a sudden creates an opportunity for something else"* (Int5, 1).

We see that the relevance of ROBERT at first was debated both among management and some of the employees at the POTD. At management level mostly in terms of financial resources and as a contribution to the path of interprofessional work and thereby potential value for the patients. The LT furthermore described to us that it was important that all new additions to the work at the ward should be based on whether it would contribute to positive outcomes for the patients. In order for the ward to decide on testing ROBERT, further research and debate had to be made to see if it would fit the ward and its budget, as both the ward and POTD management chose to fund a leasing period while applying for funds from an equipment pool. A fund application was written with the assistance of the KQP and submitted; this funding process took seven months during which first the POTD paid for the robot and then later on the stroke ward contributed to this expenditure. However paying for a robot is not something that is budgeted with, and the leading therapist of the POTD expressed at some point that she had to take into account how many actual therapists she could have hired for the same amount of money as the cost of the robot. Similar the lead therapist at the stroke ward (LT) reflected on why research was needed and what such research might entail: *"We have a lot of wishes that we talk about and ask the development therapist to research, if it isn't a possibility and there is no gain from acquiring* [technology], *it would easily become a waste of energy for management.* [...] *Whether it is possible to find money for it* [...] *land a deal with the manufacturer and figure out what was needed, how many had to be trained* [and certified][...] *all of these things have to be figured out* [before initiating the test] [...] *otherwise it could become an expensive situation if we didn't think it through*"

(Int5, 3). When talking of things and resources that needed "*figuring out*" the DT and managers attempted to assess whether the robot would fit the ward. Here, we see early aspects of working with objectification and incorporation in the test process; assigning a general purpose as well as resources to the robot.

In addition to this assessment, the LT and lead nurse set out to find employees who would be interested in becoming ROBERT operators for the test by attending a certification course with LSR. To select potential operators, the LT and lead nurse considered who they thought would be able to fit the extra work into their routines as well as choosing different professions as the robot was thought to contribute to the recent transformation of interprofessional work at the ward. It was important for management to find passionate stakeholders, to get certified and facilitate the test process, though it is unclear how they were expected to facilitate the process. It was deemed important that early operators had a passion for the robot, to ensure that they had a solid grasp of the process and the curiosity and energy to facilitate parts of it. Here, two PTs and a social and healthcare assistant (SHA) were selected, and agreed to participate in the course. Appointing operators was an early attempt to fit ROBERT into daily routines; the robot got assigned to potential operators and was deemed suitable for their routines and schedules by management. The robot was also found to be interesting by the operators, the SHA expressed her interest in the course and new role: *"*[...] *I thought it was wildly exciting, and could see that it* [ROBERT] *had a purpose here"* (Int8, 2).

The LT, who has a background as an occupational therapist (OT), imagined that ROBERT had a holistic training potential:

> *"Since I'm an OT I'm seeing this from an OT perspective and I know that without our legs we can't do shit. You need as much stimulation as possible while you are here during a hospitalisation. You need to create the best foundation* [...] *and if I'm taking a patient to the bathroom and I knew the patient had been stimulated in ROBERT beforehand I'd get better results* [...] *In order to do all these other things throughout the day, the prerequisite for eating, for going to the bathroom, is that our core and back muscles are being stimulated by just moving our legs* [...] *A lot of things are affected* [by the training]*"* (Int5, 8)

Furthermore the LT explained that the training with ROBERT could create a better fluid- and diet balance throughout the day as physical activity promotes hunger which is important for recovery.

This illustrates work within both appropriation and conversion; on the appropriation continua between certainty and uncertainty about the expectations for technology she develops an understanding and high level of certainty of ROBERT's relevance; in terms of conversion the LT sees potential for the ward to adapt further into interdisciplinary work by implementing and incorporating ROBERT into the ward's daily tasks. A potential connection between the ward and ROBERT was

gradually developed by the DT and LT. Their certainty of ROBERT's relevance, functionality, and purpose grew gradually after the online presentation. We see the DT and LT going from an uncertain standpoint, where ROBERT had a potential to do exercises with patients, towards certainty by discovering a specific purpose of high-repetition rehabilitative exercises and relieving therapists of physical labour. Note that most floor staff had not yet met the robot.

How to Learn How to Use ROBERT

After finding the potential ROBERT operators, an agreement was made with LSR to do a test period with a leasing contract lasting initially six months. ROBERT arrived at the ward in june 2022, and the three selected operators were sent on a certification course. At the end of the year an additional three therapists took the course because only one of the first three operators was still using ROBERT.

At the beginning of the process, LSR presented the certification course as a requirement for all operators. When asking about the course we were given conflicting answers about its duration; somewhere between half a day and two days. The course consists of learning how to attach, detach and use the software on the screen. After a short period of time practising with the robot back at the ward, an LSR representative would go to the ward and do a short examination where participants would receive their certificate. This course, followed by a practice-period before receiving a certificate, is a requirement set by LSR in order to operate ROBERT, as is reading the manual. Despite attending the course and finding the robot "*genius*" (Int8, 2) and relevant for providing patients with the best possible repetitive training, the SHA did not obtain her certificate because the ward ran into issues with understaffing. This also resulted in her not having time to practise using the robot in a real context, and she explained that since the course and the busy period at the ward, she and management had not discussed how to revive her operator role. By the time of the interview she could not remember how to operate the robot. If she had to do it again, she would want the course to be different: *"I think maybe it should also be aimed at care staff. After all, I was with two physiotherapists* [...] *and they geek out in a different way than I have to.*.[...] *Make it simple. And then maybe some people would say 'oh this is really interesting, could I learn some more about this?' and then they could go do that. But as a rule: make it simple, then everyone could be a part of it."* (Int8, 5). Furthermore she reflected that the course still would not be sufficient for her to operate the robot: *"You need to have things in between your hands and consult your colleagues about it - that's when you learn it* [ROBERT]*"* (Int8, 6). This was also reflected in stories of using ROBERT with the patients, as two PTs who used ROBERT on a regular basis told stories of how they learned about the robot from practical experience. One referred to the situation where ROBERT had stalled and pinned the leg of the patient to the bed, so she had to develop a counter security move and the other PT told stories of how she had found the robot to be useful for patients with muscle coordination disturbances,

and could restore some mobility in the affected area. This function had not been part of the certification course curriculum. Hands-on learning is a common practice at the ward, which has also made a difference for the process of moving from uncertainty to certainty on the *appropriation* continua; for the current ROBERT operators, the ones who are more confident or *certain* about the technology are the ones who have had good experiences pushing the boundaries of their understandings of the functionality and purpose of the robot. Some operators have worked it out for themselves without attending the course, while the SHA even after attending the course does not feel equipped to use ROBERT because she felt a need to learn the robot in practice. This shows that there are various understandings of when one has learnt and become proficient in using ROBERT, and those who have not had the time and experiences to consider themselves proficient operators do not see a clear way to resolve this.

Trying to Make ROBERT Fit

A number of measures have been taken to make ROBERT fit in at the ward, as well as assess whether it fits well enough to become a permanent fixture. First, ROBERT had to fit in at the ward in a very literal sense. It was decided to keep it upstairs close to the patient rooms rather than downstairs in the therapy department, because the machine is used to train with patients in bed, and because there was an ambition to have the robot be part of an interdisciplinary rehabilitative approach including staff who only work at the ward. This also meant that ROBERT was mostly used at the patient rooms while the patients lay in the bed, and thus ROBERT can not be part of the training that goes on in other areas at the ward such as the hall or the bathrooms.

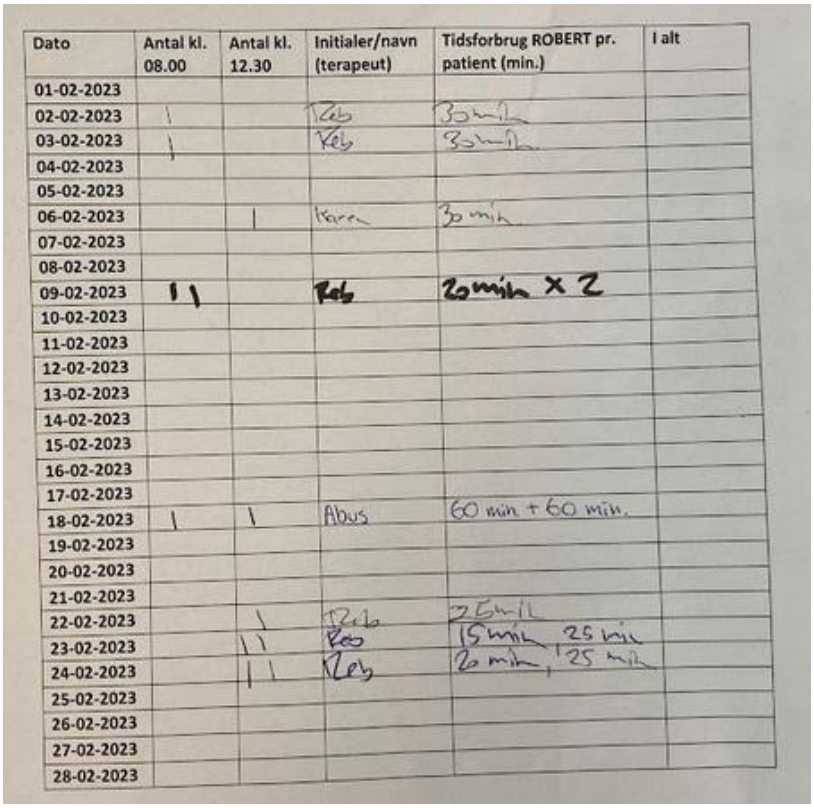
An OT describes that ROBERT makes it possible to perform high-repetition training that would otherwise wear out the staff. She explains how fulfilling patient needs might be obstructed by physical limitations in how the therapist can engage with them. She points out how ROBERT is able to overcome this burden, as the machine is able to perform these exercises with patients while sustaining much less wear and tear than a human body doing the same.

As mentioned, the course and the practice period was a requirement for operating ROBERT, however, this requirement was early on contested by the DT, who argued that this would result in limited use of ROBERT: *"Some of the communication with the manufacturer* [LSR] *has been about the certification process and being able to use ROBERT and* [...] *how this resulted in ROBERT not being used. Then the question became whether the certified operators were allowed to do peer-to-peer training of a colleague.* [...] *We made it clear to the manufacturer that this was necessary in order to keep ROBERT at the ward* [...]" (Int1, 10). The request to allow for peer-to-peer training was accepted. The request shows that the course and practice period did not fit the usual learning procedures at the ward. This exemplifies on the continua of conversion that the manufacturer adjusted and changed their

procedures as a result of pressure by the consumer, to better fit local learning practices in order for the ward to domesticate the robot.

Allowing peer-to-peer training was considered essential to implementing ROBERT. When peer-to-peer training, one therapist will accompany a therapist who is experienced in a technology or method, in order to learn and practise while being supervised. This approach is also used when the therapists do their internships during their education. In-house rational clinics is a different method but still based on the same principle of hands-on learning. A rational clinic is a class set-up where a therapist hosts a class on e.g. learning how to use ROBERT. At this class the participants will usually try out the technology on each other, which gives them the opportunity to both understand how to operate the technology and know what it feels like to use the technology on others and themselves. Peer-to-peer training and in-house rational clinics are some of the most common ways for the ward to work on adopting new technologies. The peer-to-peer training and rational clinics fall under several of the domestication concepts: they are part of the incorporation into their routines, as it is considered a necessity for staff to be able to find time to learn ROBERT. The hands-on experience are a crucial part of staff at the ward coming to consider themselves competent users of new technology, including ROBERT, thus contributing to objectification. Finally, a growing certainty on the appropriation continua of the understanding and functionality emerges during rational clinics and peer-to-peer training, at least for those who are able to attend.

The ROBERT case is not the first experience with technology implementation at the ward. The LT described how she had previously been part of another technology test period, which she compares to the test of ROBERT: *"I see the pattern repeating, and that is why I don't think it is really about ROBERT. I think it is about something else, and I am mega curious about this something else, because I want to break the pattern"* (Int5, 15). This was corroborated by a therapist who recognised the issue with other training devices that now collected dust, and therefore found it highly relevant to have a test of ROBERT before a purchase was made. Since the ward has had previous experiences of failed implementation processes of technologies, the DT tried to get an insight into whether ROBERT would fit the ward. To get an overview of the amount uses, the DT decided to keep track by attaching a list to the robot with a table for keeping track when ROBERT was used, and by who (Fig. 26). In addition, the DT describes a constant pressure to document that newly funded equipment is being used.



Dato	Antal kl. 08.00	Antal kl. 12.30	Initialer/navn (terapeut)	Tidsforbrug ROBERT pr. patient (min.)	I alt
01-02-2023					
02-02-2023	1		TRob	30 min	
03-02-2023	1		Rob	30 min	
04-02-2023					
05-02-2023					
06-02-2023		1	Karen	30 min	
07-02-2023					
08-02-2023					
09-02-2023	11		Rob	20 min x 2	
10-02-2023					
11-02-2023					
12-02-2023					
13-02-2023					
14-02-2023					
15-02-2023					
16-02-2023					
17-02-2023					
18-02-2023	1	1	Abus	60 min + 60 min.	
19-02-2023					
20-02-2023					
21-02-2023					
22-02-2023		1	TRob	25 min	
23-02-2023		11	Rob	15 min, 25 min	
24-02-2023		11	Rob	20 min, 25 min	
25-02-2023					
26-02-2023					
27-02-2023					
28-02-2023					

Fig. 26: Log of ROBERT uses - note that not all uses are logged

During our fieldwork we discovered that the amount of uses did not correspond with the table. A therapist told us how she had used ROBERT every day that week during her *vagt*, but she did not understand how she was supposed to use the table, or what its purpose was. Curiously, her name does appear on the recording table once but it is unknown who put her name there. The same therapist also found it overwhelming that she had yet another place for documenting the training session, and explained how it would be more beneficial to use the table if it was integrated in their digital patient record system. Something the DT and KQP have been working towards for some time and a specific code has since been created for registering a training session with ROBERT in the digital patient journal, similar to the code the therapists use for writing a rehabilitation plan.

Likewise, we observed two therapists who shared a session with a patient - one starting the session and the other ending it; neither recorded the session in the table. During lunch at the ward, we talked to the DT about our discovery of the 'missing' uses, and he was not surprised. The DT reflected on the use of the recording table: "*The danger with calculating the data this way around is always that you could forget* [...] *So that's why the table and the recorded uses isn't really a definitive expression of how often he* [ROBERT] *is really used"* (Int1, 12). Following this, the DT has made plans to interview the floor staff to get insights into ROBERT's relevance to their patients. Thus, one of the major attempts to become certain about the appropriation of ROBERT regarding whether the technology actually provides the value that they expected, is not achieved by the use of the table.

Another action to domesticate ROBERT was that the physiotherapists (PT) scheduled assigned days for the ROBERT operators in their shared calendar. This was a result of a period where ROBERT was mostly dormant; which also clashed with ROBERT breaking down and being inoperable. The scheduling of operators and the recording table were both inspired by ARMEO, which had been integrated in that way. Therapists at the ward usually look through their calendars in the mornings before their planning meeting. According to one of the assigned PTs, the schedule is a good planning tool for setting aside the time needed to learn how to use ROBERT but it does not always correspond to the patients that the given therapist is also assigned, and their needs. She also mentions the schedule seems meaningless when the patients who qualify for ROBERT are not assigned to her, illustrating that the rigidity of the schedule does not align with the changing context of patient needs. Another PT tells that the original plan was for the person assigned responsible in the schedule to use ROBERT between 14-15 but this was changed indicating that there has already been a move away from rigidity because it did not fit the context of the ward. When the person designated in the schedule is ill, the others try to distribute the responsibility among them during the morning meeting. In the long run, several of the therapists who have been certified in using ROBERT and added to the schedule have left the ward; one has quit, one is on a leave of absence, one has gotten a new set of responsibilities as clinical educator, and one has decided to step out of the schedule because she wanted to use her time on other tasks. The therapist who explained the different drop outs describes the situation surrounding ROBERT responsibility as fragile. Likewise the DT and the KQS told us that it is unfortunately common that the local user-experts of a technology leave, and that this often resulted in technology going dormant since no one knew how to use it. Thus, attempts to incorporate ROBERT via its own schedule does not fully succeed in the complex and changing context of the ward.

Making Sense of ROBERT

Domestication of ROBERT also entailed finding out whether it made sense, as our informants often referred to the main point of the test of ROBERT as a matter of being certain about this specifically. The expressions *meaningful* and *does it make sense?* (both in danish: "*mening*") came up in many conversations, both in terms of whether ROBERT *made sense* to keep but also as a more general expression in daily conversations among the staff. Generally, what made sense was related to their overall objective of doing good phase 2 neurorehabilitation, which also affected decisions on changes to their practices. The LT explains: "*Why are we here? We must be at the level of the patients. So when we have to introduce something new, it must be where we can see that it is beneficial for the patients*" (Int5, 5). Exploring the meanings and associations of doing good neurotherapy among the therapists showed that the needs of the patients were central when judging what was meaningful and good, for example regarding what type of intervention they were going to prioritise: *"The most important thing for me is not to use ROBERT.. The most important thing for me is that the patient gets*

the best treatment in here and the best training I can possibly offer, and then I'm sort of indifferent to whether it's a tilting bed or ROBERT or something else entirely [...] *the most important thing is that the patient is motivated and thinks it makes sense, and achieves his goals"* (Int9, 17). An OT reflected on how it was a paradox for them to discuss how much ROBERT should be used, as it did not make any sense to use the robot if no patients currently had a need for the type of training that ROBERT provided but at the same time she also acknowledged that they had to use the robot in order to develop their operator skills and get a sense of whether it fit into the practices at the ward: "*I understand that we need to use it to get familiar with it but I don't think that's how our days work* [...] *it does not make sense if there are no patients*" (Int2, 11). She explained that both the DT and management did not mean to override this but still the talk of ROBERT being an especially high priority during the leasing period had her conflicted, as she at times experienced this talk as very focused on money without taking into account the dynamic reality of the ward.

Patients who found training with ROBERT interesting and beneficial to their rehabilitation contributed to staff acceptance of ROBERT, and to dissolving some resistance towards the robot: "*I am one of those who have changed their attitude along the way, okay, it could well be that it* [ROBERT] *was just something for me"* (Int2, 8). A therapist described how they at one point had a patient that they could not mobilise because one limb was paralysed and the other had a knee brace. After training with ROBERT just once, they observed beginning function in his toes in the paralysed leg, which resulted in making ROBERT a high priority for this patient, and after three weeks the patient could walk with a walking aid "*In that case, for example, he* [ROBERT] *is a high priority, and he made super good sense there*" (Int3, 3). She goes on to call it *"a magical moment!"* (Int3, 4). Likewise, a nurse described that ROBERT made sense to her because she met patients who loved the robot and praised it highly. During a shadowing, a patient enthusiastic about ROBERT asked to train with the robot, but the ROBERT responsible for the day only had time during the morning. They made a deal, as the patient was fine with postponing her breakfast so she could have a morning session. The patient ended up training more than an hour with ROBERT, and was very hungry afterwards - like the LT envisioned as a great effect of ROBERT for recovery.

ROBERTs domestication thus relates to seeing it in use with patients. All of these examples stress that the staff prefer to have first-hand experiences before deciding on whether or not a technology makes sense for them to use. Seeing ROBERT make sense to patients resulted in some change of perceptions of the robot from initial scepticism, to objectifying him as valuable and a high priority that should be incorporated into daily rehabilitation practices.

Locally at the ward, ROBERT is often given personifying characteristics. It is stated that "it seems to have its own life", and it is often referred to as "he", and has different emotions projected onto it such as "being scared", "being naughty", or "being happy to see me". ROBERT's actions are often referred

to as personified actions, such as the robot “protesting” or “feeling where it is”. Sometimes this extends to staff assigning themselves new names in relation to the robot, such as expressing frustration during an operational failure with the words “mom is disappointed”, and during one meeting it even extends to us, the authors, who are referred to as “the robot people”. We are also told that the robot wore a Santa hat over the Christmas holidays. During our last visit to the field before finalising this report, we discover that ROBERT has been given a face and a voice (Fig. 27).

Fig. 27: A note from night staff describing in a first person voice that ROBERT would like to sleep in room 9

Ripples of Domestication

All of the elements of the test process made ripples throughout the ward staff and prompted many reactions as the decision to test ROBERT challenged different perceptions of technological confidence and existing professional structures. Furthermore, the DT informed us shortly before beginning fieldwork that it was decided to prolong the leasing period another six months, as management was unsure that ROBERT had been used enough to determine its relevance.

Even though ROBERT was considered a valuable training option by some therapists, it was also described as the *cherry on top*; not considered first priority since some of the therapists argued that there might be more pressing matters. As for how the ward in general engaged in change practices, the expression *“we pave the road as we walk it”* (Int2, 7) occurred more than once. This approach seemed to influence many elements of ROBERT’s test, as the reality developed to something far more complex than anticipated. It became apparent that although management imagined ROBERT as part of their visions for the ward, this had not gained support and understanding from all employees.

Testing ROBERT was challenged by different levels of trust in the machine and confidence in its use; we were told stories of how ROBERT had been "*naughty*" and scared both some therapists and a patient because he broke and did "*weird things*" before a training session (FN11, 2). The weird movements of ROBERT are not always due to technical failure. Sometimes during startup, ROBERT requires a system check, in which the arm moves around in the room (Life Science Robotics 2022). One therapist describes the check: *"When we turn* [ROBERT] *on, it has to feel itself in the room - it can look a bit wild"* (Vid3, 6). Some patients have described being afraid of these movements, and one tells that she was "*luckily out of reach*" when she saw the calibration (Vid3, 6). One observation note describes that a number of OTs at a meeting about ROBERT *"expressed that they did not feel comfortable with using ROBERT, since they did not quite know how it worked, and at one point had done some funny things in a situation where a patient was going to be attached to the robot and trained with it"* (FN1, 4). This shows that there was still significant uncertainty among staff in their appropriation of ROBERT, who do not always understand nor trust what the robot is doing.

Not everyone had an equal learning and uptake curve when it came to using ROBERT. When asked about reactions to, and opinions of, the new robot, responses were that reactions had ranged from enthusiasm to scepticism, fear and rejection:

> "*I think it is very mixed what the different people think about him* [ROBERT]. *I have the impression that some think that he doesn't fit in here at all, that he is in the wrong place.. and then there are people who are very happy with him. I also think it has something to do with whether you have an interest in technology. If you don't have an interest in technology and think it's a little too spacy, that you're a little uneasy that it's a robot or all that.. I've heard that some of the care staff thinks it's a little dangerous with all that it does when it drives around and restarts"* (Int9, 19)

This was corroborated by the assistant manager, who expressed that it obvious who felt uncomfortable and sceptical about integrating new technologies to their practice, and referred to how some seemed to adapt to new technologies with more ease "*It is very clear to see which of us was born with a phone in our hand and who first got it when they grew up*" (Int6, 9). Some found new technologies interesting, and several therapists state that they see new technologies as potential tools for their toolbox that they would like to learn. One of the most experienced ROBERT operators described how she tried to fit in more ROBERT training for the patients by asking her colleagues to detach ROBERT from the patients, so she could go do other tasks. This was usually received with lack of confidence: "[PT] *tells us that there are some who are nervous about whether they can do it correctly, and thus look slightly scared - 'when I ask they get these BIG EYES' - when she asks if they can help her*" (FN2, 13). She often experiences that her colleagues do not trust their skills to detach the robot, so she spends some

time teaching them how to do it, which helps somewhat. A care staffer disagrees that ROBERT frees up time as it requires a human operator at every step; *"it does not solve the staff shortage, right?!"* (FN5, 4). This illustrates that there are different points of view about how ROBERT might reconfigure cooperation at the ward, as there is a lot of variety in how people understand their own roles in the ongoing objectification of the machine. The diversity in points of view and experiences also became apparent when talking to the SHA, who did not experience that they had to spend a lot of time implementing many new technologies. She felt that the ward was generally enthusiastic about trying new things out but there were times when daily operations were too busy to prioritise new technology: *"Then you have to prioritise the people and the vital things such as food, and getting up, and getting changed, and things like that"* (Int8, 4). A care staffer doing night shifts expressed that she would gladly learn how to use the robot, however, she had a hard time figuring out when she would have the time for learning and using ROBERT since there were usually very few people at the ward during the night. Thus, finding time and motivation to get acquainted with ROBERT was difficult for a lot of staff, who had to prioritise this among many other and more pressing tasks, as well as having no common agreement about whether the robot would be a good addition to their work. These difficulties affected the incorporation and objectification of ROBERT, as there was no consensus among the staff about whether it should be prioritised to learn and use the robot, and the task of allocating time for this was left to staff to figure out; this debate is also described in our workshop results.

The ROBERT test led to conflicts and negotiations about what should count as relevant for purchasing and decision processes. One OT described to us that the test of ROBERT had resulted in wider discussions about priorities, and about what the main focus of phase 2 rehabilitation was. She described that she found it too simple to only discuss new technology in terms of their cost: *"it's difficult when you only talk about one part, where I need us to talk about everything"* (Int2, 8). She also described that it was important that everyone involved could keep up with decision processes. From her perspective it was fine that someone was in charge of changes but the general purpose and plan behind such changes should be discussed in plenary, as it could make things difficult if they later wanted everyone to be involved: *"Every time we want a new tool, I think we should be aware of what our process is. Is it something that few should have something to do with, or is it something everyone should have something to do with? And sometimes I know that we pave the road as we walk it but this now means that it requires a lot of discussion and talking, which I think could have been avoided"* (Int2, 7). The same OT also reflected that it could be a relief that someone just made a decision, saving a lot of time debating whether it should be done or not. She described how the therapists had a culture towards innovation, where ideas usually came from them and not from management, and that she thought there might be an element of frustration that some had experienced ROBERT as an idea coming from the top and not the bottom as it was usually done. It was expressed that some were still

adjusting to having management making decisions on their behalf. The LT described how big changes initially started at the management level and soon found their way to different worksite forums where employee representatives could participate in planning and discussions of new initiatives. An OT mentioned that many people had experienced the decision to test ROBERT as very sudden, and it had reminded them of some of their frustrations with top-down changes into their new way of working. In addition to frustrations about the decision making process, several staff members expressed that the timing of the test period had not been optimal, as they were still settling in their new way of organising work: *"I think that if this* [ROBERT] *had happened in four years, or before we got these evening-day shifts, then it would have been different"* (Int2, 15). She also mentions a recurring restructuring of management, which has created commotion. Thus, processes towards appropriation and incorporation have created conflicting and confusing situations. ROBERT has brought latent issues to the surface regarding uncertainty about priorities in phase 2 rehabilitation, as well as a sort of change-constipation from still having to adjust to new ways of working as a therapist at the ward.

Who Are The ROBERT Users?

ROBERT enters a ward with many different professional groups with distinct competencies, responsibilities, and identities. The LT expresses that ROBERT does not require expertise specific to one professional group, and fits well within the new framework for work at the ward; in which some tasks concerning the patients' treatment, care and training can be done by multiple professionals: "*ROBERT is great for asking 'when does it require a physiotherapist? When can you handle such a technical training equipment as a nurse or as an assistant or as an occupational therapist?"* (Int5, 7-8). Regarding the assignment of responsibilities surrounding ROBERT, the LT tells that she does not see ROBERT as being for a specific professional group: *"In my eyes, he is not a physiotherapy robot. In my eyes, he is a robot. He is a robot where some skills would be really great for putting him into action. I know this because I have seen that you can learn it regardless of professional groups but there are elements of it that are clearly more straightforward for the physiotherapists"* (Int5, 8). Later, she stresses this point by asking *"What profession is a robot vacuum cleaner made for? All professional groups. It is not about professional groups"* (Int5, 15). This perspective has proven controversial at the ward, and ROBERT has sparked debates about professional boundaries; some staff express that ROBERT is not within their professional expertise or interest. As an OT also mentioned in the section above, she and some of her colleagues wished for more shared discussion early on to prevent later conflicts. That some had felt left outside of decision processes and that the resistance towards the robot was for some rooted in professional boundaries, was surprising to the DT and the LT. The resistance was surprising as there had been therapists involved in the early stages, where ROBERT had been discovered at the technology conference and later at the online presentation. But as explained earlier, they had a hard time recalling who attended the conference and

the online presentation and it seems that some of the staff did not consider these events as valid participation among the wider group of employees that were later influenced by the test of ROBERT.

The implementation of ROBERT has therefore provoked broader discussions about professional boundaries, and new ways of working. While ROBERT is not solely responsible for this, it seems to have brought many latent issues to the surface regarding cross-professional task distribution. An OT expressed that the general understanding among staff at the ward is that PT's like ROBERT, while the OT's like ARMEO; aligning with observations that ROBERT is mainly used by PTs, and the schedule for ROBERT use only includes PTs. The OT described herself as contrarian to this common division, as she has chosen to learn and use ROBERT while opting out of ARMEO. Despite this, she has not taken on the same role as the PTs using ROBERT; she is not sought out by colleagues to use the robot with their patients like the PT operators are, and she has not experienced a change to her role at the ward. She reflects on the process: *"From an occupational perspective, I think we have been subconsciously sidelined because the physiotherapists have had such a strong focus on a stable schedule and being taught to use it"* (Int3, 6). She elaborates that the plan for the test process has not involved the OTs, resulting in OTs having to be very proactive if they want a part in the process, and that this has further been made difficult by different opinions in the OT group regarding ROBERT. Thus, PTs have ended up defining much of the use and learning during the test process. This has inadvertently left other professional groups in a vaguely defined position from which it is difficult to begin engaging with ROBERT, and even the OT who has learned how to use the robot has not gained the same status of 'ROBERT user' as some of the PTs. Another OT describes how the two types of therapists are able to prioritise their respective tasks differently: *"It takes more time for us* [OT] *to assess a patient because we have to cover cognition* [...] *I think the physiotherapists can more quickly get started with training, and ROBERT to me is a training equipment"* (Int2, 4). She elaborates that the choice to prioritise ROBERT is more often the right choice for the PTs, while an OT might need to prioritise cognitive training based on their different assessive practice. An SHA similarly explains how she does not see ROBERT as fitting her practice, because the *nerdy* aspect of choosing and designing specific movements for physical training is a PT skill.

We gather that the ambitions of management to have ROBERT be a catalyst for a new interdisciplinary work paradigm have not yet materialised, which further establishes the infancy, vulnerability, and uncertainty of the emergent robot practice as an interdisciplinary ward practice. We show a common understanding of interrelational professional identities in which ROBERT seems most aligned with physiotherapy, and is almost only used by PTs. While the objectification of ROBERT is still ongoing, we show that the visions of management seem to be on the heavy end of the continua as they envision the robot to contribute to large reconfigurations of professional roles, while the staff wants the robot to fall on the lighter end of the continua, and fit into existing professional arrangements.

Despite the different accounts of the challenges of the reconfiguration of the emergent robot practice, we were many times met with positive responses when asking the staff whether they thought ROBERT should stay. A majority of the staff we interviewed were hoping that ROBERT would stay and saw the meaning of ROBERT for the patients, some even expressed that "*of course he fits in*" (Int8, 7). Based on our analysis of the practices at the ward, we reason that our most valuable contribution and intervention towards creating a sustainable solution is to facilitate the conceptualisation of a more coherent implementation process. This leads us into designing a participatory workshop where the staff could discuss experiences with technology implementation and generate ideas for their next technology implementation process.

Building on Lessons From ROBERT

In the preceding chapters we analysed the ways in which the emergent robot practice reconfigured neurotherapy and care at the stroke ward. In this chapter we continue to work our way towards providing recommendations based on our study of ROBERT. In the following we present the results of a participatory design workshop, in the form of a brief reflection about the format, as well as recommendations for future technology implementation at the ward generated by the participants. The results will be presented as summarization of the three groups' discussions with examples from individual groups when relevant.

Workshop Preparation

This section reflects on our challenges of facilitating design situations at the stroke ward. The hours leading up to the workshop brought on many last minute changes due to overlaps in schedules and lack of information. Nonetheless many still were interested in participating, although there was the issue with all the meetings they had to attend. Although an invitation had been sent to the physio - occupational therapy department (POTD), many employees were asking us what the workshop was about. They could see that they were booked in the calendar for a workshop but did not have information on the format and purpose, since the invitation seemed to have drowned on their office wall among all their other information. In addition, some were behind on other tasks. We roamed the halls and offices to get a sense of how many of the staff had time to participate. Initially, we only found a handful of potential participants, but then it was suggested that we move the workshop 30 minutes back to allow people to finish their meetings. That seemed to solve the issue with lack of attendees, and we managed to gather 14 people.

We also had a challenge with preparing rooms for the workshop. We had planned to use the living room, the ice-house (office) and room 9 but the two first rooms were occupied with meetings and the last room was being used for an ARMEO training that we did not want to disturb. We ended up using the living room and the therapeutic office since they were ready first. We decided to have 2 groups in the living room and one group in room 9.

While moving back the schedule resulted in more attendees, we were not aware that many of the participants got off work earlier than we thought; resulting in one group not having time to discuss their suggestions and ideas for future implementation. This indicates the amount of coordination and knowledge it takes to plan and execute even a relatively short event which had been scheduled for months. We find that while participatory design provides valuable tools for many of the problems facing the healthcare system, its methods require a rigidity that is not always possible in practice.

Workshop Results

This section presents a summary analysis of the results of the workshop, as well as selected insights from the discussions throughout the sessions. The first part of the section is a summary of the expressed experiences of the participants in relation to implementing technology at the ward. The second part of this section is a visual presentation of the recommendations that the participants generated at the workshop as well as highlights from their corresponding discussions.

All of the pre-selected topics were debated, however not all of them in every group. Two out of three groups spread across two topics, while the third group spread their choices across three topic (Fig. 28).

The pictures show how the groups expressed their choices on sticky notes. Group 2 and 3 ended up choosing the topic “Choosing new technology for the ward” while group 1 ended up agreeing on the topic “Time for new technology”. The following is a summary analysis of their joint experiences and discussions from doing exercise 1-3 (Fig. 29-31).

	Group 1	Group 2	Group 3
Choosing new technology	3	4	1
Roles in relation to new technology	0	1	2
Time for new technology	2	0	0
The ward’s technology culture	0	0	1

Fig. 28: Votes in numbers spread across the three groups and the provided topics

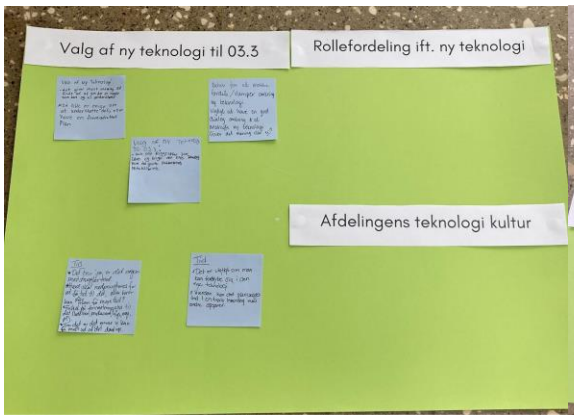


Fig. 29: Group 1 arguments for choice of topic

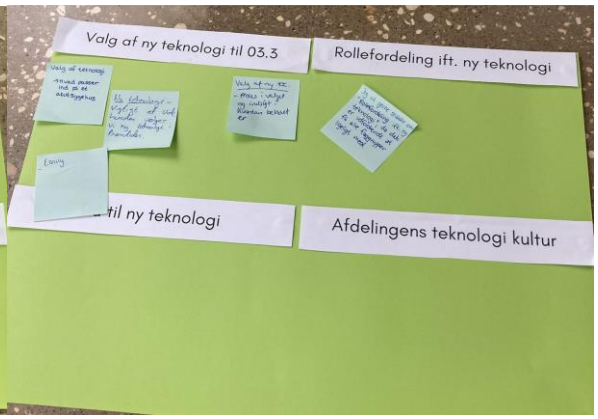


Fig. 30: Group 2 arguments for choice of topic

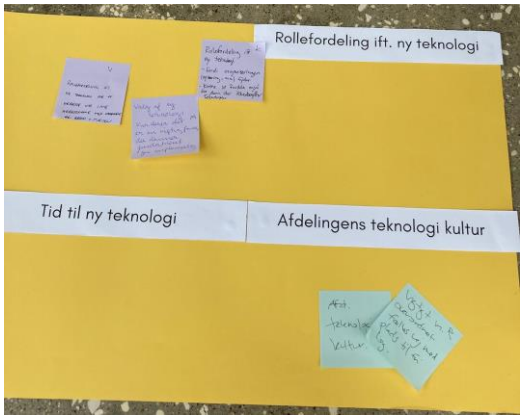


Fig. 31: Group 3 arguments for choice of topic

Understanding Needs and Purposes by Involving Staff

Several participants pointed to how it was important for them to explore what they actually lacked before thinking about acquiring and testing something new. They wished to debate pros and cons of different technologies in order for them to be able to make better and more informed decisions. What might be the best choice according to the patients was also highlighted as important, as it was pointed out that many patients who had tried ROBERT actually had expressed that they liked the training, and asked when they might be able to train with the robot again. The key quality supervisor (KQS) expressed that a more thorough understanding of the initial phase of choosing to acquire something also had to entail making the purpose of looking into something new more explicitly communicated and debated among staff. Such debates should also include expectations of when the new technology is to be integrated, which sparked a comment from one of the therapists, that sometimes you can not plan everything, you just have to give it a go and explore if it might be useful or not to the patients, which was also acknowledged. In terms of ROBERT it was discussed that while there was a purpose with the testing it was perhaps not clear to everyone, and that challenged the test process for some: *"They agree on "choice of new technology for the ward", because the purpose has been clearly lacking in the ROBERT process.* [...] *R notes that there was a purpose from the start but M asks if it was clear to everyone. No, it probably was not. There was talk of having to find a tool for early mobilisation. V notes that it was a bit of a struggle at first, and R adds that it wasn't a joint decision, just a question of whether someone would pay for it"* (WS3, 2). The development therapist also expressed that there should have been more clear communication about "why ROBERT?" and said that in the future they should focus more on exploring and agreeing on needs such as what the ward is missing, and what the ward needs before moving on with acquiring new technology.

During fieldwork it was mentioned that some believed ROBERT to be a bad fit for phase 2, which was also mentioned to one of us during a summer vacancy at the ward last year. During the workshop

the KQS had heard that ROBERT was described as smart and a relevant tool for rehabilitation but still she experienced doubt among some employees, whether ROBERT was a good fit for phase 2 since they had focused more on assessment of the patients than providing training for a long time. A PT responded that they were now also in a process of reframing what the point of phase 2 was: "*Does it* [ROBERT] *even fit into phase 2? R replies that yes but some new things have also happened since ROBERT has entered the house; there has been more focus on training and on considering the overall offer that the ward provides - now there are new perspectives that point more to the fact that it is (also) a training offer. In the past, the focus has been on assessment*" (WS3, 3).
All groups touched upon these concerns and further discussed how the sense of uncertainty should be handled next time a decision was made to test out a new technology.
This led many participants to discuss how greater involvement of the staff in the choices made about what technologies to test could be a way forward in the future. Many participants experienced a need for greater involvement in decisions, since it was thought that it would result in greater commitment even if not everyone was involved. Some also worried about the amount of money being spent on technologies that were not used. One therapist described it as an issue that not everyone was informed and involved equally in decisions about technology that affected their day-to-day operations:

> *"C wants to address the issues that new technology and things are often decided on and being forced through from the top* [management]. *Sometimes the decisions taken by management have only been communicated to one group but not the other, and at times no one seems to be informed. This she feels creates a lot of frustration on a day-to-day basis which could preferably have been avoided, if the floor staff had been included in the decision process about what technology to acquire. What would make sense? After all the therapists and care staff whom these decisions are made for by management are the ones affected by these decisions"* (WS1, 3)

The main takeaway from this part of the participants' discussions was that greater involvement from a wide range of professionals was expressed as a desired element for the next implementation process. The next section presents discussions that centred around needs for more structure and assigning responsibilities.

Making Structured Plans and Agreeing on Responsibilities and Priorities

Several participants expressed that they would have liked ROBERT's test process to have been more structured and thoroughly planned. They expressed a need to know and agree on why ROBERT was relevant, who should be assigned with responsibilities in terms of planning and teaching, as well as how much it should be a priority in relation to other tasks. They pointed to a lack of shared

discussions and agreement of how testing ROBERT should be integrated into their daily priorities. They had experienced challenges when introducing ROBERT because it had been difficult to get everyone onboard, likewise, it had not been clear to some who should have which responsibilities in terms of doing peer-to-peer training and how they should find time to learn about ROBERT among their other tasks. One OT said that she would like to discuss how they could create new workflows and a shared sense of responsibility of applying the technology in their therapeutic practices, in order to maximise their outcome: *"V notices that she has often been in vagt where it could make insanely good sense to use ROBERT but there has been no one present who has been trained - it's a shame"* (WS3, 1). The most experienced ROBERT operator (MEO) expressed that she had found it difficult to get some of her colleagues to take an interest in learning about the robot. She described how she had facilitated rational clinics where people could participate and learn about ROBERT but had experienced that people did not prioritise to participate. Apparently not everyone had been informed about this opportunity as one of the participants in that group said she did not know that she could have participated. MEO believed that confidence in using the robot also involved a personal investment and responsibility in seeking out people like her who could support learning: *"*[MEO] *has experienced having to chase after people to train them but they have rarely made time for it, and she doesn't think that has been okay. If you want to get to know new technology, you have to seek it out"* (WS3, 3). The challenge with prioritising time came up many times, several of the therapists described how they had a hard time making everyday choices about what to prioritise and what not but found it important that they discussed how chosen technology could be integrated into their busy daily schedules, however, they found it difficult to solve this issue which was often a debated topic on their meetings. Two therapists said that they wanted to learn about ROBERT, but that they felt that other work tasks had to take higher priority and that the ward had recently undergone a very busy period. In one discussion it was pointed out that maybe they just had to accept that prioritising learning about ROBERT could mean that other high priority tasks had to wait. However, they were not sure how to get to an agreement and make that actionable: "*Then you have to prioritise training* [in use of ROBERT], *and then everything else has to collapse that day - but maybe that's what it takes. M asks how to get there?"* (WS3,3). As we learned during fieldwork, it was also debated in one group that people had different confidence levels and approaches to learning something new. At the workshop one participant described that she felt comfortable with just trying the robot and then calling for assistance if it did not work but recognised that not everyone felt that way. The MEO agreed to this and said it had been a challenge to handle and plan the teaching since people had such different needs regarding confidence in using ROBERT. In group 2, two PTs, one hired recently and one who had been attending the certification course, also highlighted challenges of allocating time for peer-to-peer training of ROBERT: *"I think you have to focus on when you choose to implement something, whether there is really time to make it work, I want to be trained, but I simply haven't had the time because of all the other tasks"* (WS2, 3). The PT that had attended the certification course

said it was mostly because he did not know how exactly to plan peer-to-peer training because there is no structured plan on how to do it and how long it takes: *"If i had a paper where it said that it would take an hour or something to go through this, instead of the peer-to-peer training now, where I have to figure out how long it is going to take"* (WS2,3). This points to how peer-to-peer training is more challenging than first anticipated and has resulted in both frustrations and minimised use of ROBERT.

Another group debated group priorities in relation to expectations. One therapist said that there seemed to be different expectations that they had to accommodate in terms of how much a technology should be prioritised in a test process, there was one expectation from developers, another from the management, a third from their colleagues, and the patients might have different desires and needs. They struggled to make ends meet in all of this but would like to look into how this might be solved in a more robust way.

One OT also highlighted that when they made plans for testing new technologies in the future, they should be more concerned about how they could incorporate structured analysis of potential benefits for patients: *"Because we haven't measured that* [the effect on the patients]. *It has been more about how much it has been used. I would like for us to measure which patients benefit or not, where do we see progress?* [...] *What is the evidence for its* [new technologies] *effect versus other treatments and other technology? I think that's interesting to delve into"* (WS1,4). All of this seems to point to a clear way forward for the ward to set up a new test and implementation practice, but as some of the participants also highlight there is a conflict between what they would like to do and the lack of available time that is already an issue at their current test of ROBERT.

Overall the participants' discussions seem well aligned with a future approach that would be framed by participatory design principles and elements, and thereby facilitate negotiations of why, who, how and when in relation to future technology implementation.

Workshop Participant's Recommendations

This section presents the recommendations and suggestions that the participants generated on the day of the workshop as well as corresponding discussions from group 2 and 3. As mentioned beforehand the participants from group 1 had to leave before they could discuss their generated recommendations. Group 1's proposals are found in appendix 4. The recommendations are formatted as a broad question about how something might be done differently, which has been elaborated on by the participants before reaching a plenary consensus.

Group 2

In general, group 2 mostly agreed on the recommendations without much discussion, but some suggestions were debated more in depth. Almost all proposals resulted in conversations about assigning responsibilities so that the next test and implementation of a new healthcare technology had one or more project managers as well as a need to prioritise time for knowledge sharing both internally and externally. However, some also expressed that they needed to discuss further how much time should be set aside for the activities that they wanted to do. This also required them to discuss what was actually important for this ward going forward.

The first proposal (Fig. 32) began with the question *"How might we implement ROBERT/new technology in the training process of employees?"*. It sparked a conversation about how introductions to technologies used at the ward could be made part of the introduction program for new employees. The introduction program was an established element of their existing therapeutic practice, when welcoming new employees to the field of neurotherapy. New employees had to go through a list of activities that would introduce them to elements of their new practice. Many of the introductions during the intro-period were meetings or teaching sessions where the new employee would be invited by a person with an assigned responsibility through their outlook calendar, which was also proposed here. The conversation that followed asked again if using certain technologies were something that everyone should do, or only the ones who had an interest, or perhaps only one profession. They agreed that this should be part of the early conversations when they were looking into and choosing a new technology. It was also agreed that introductions to new technologies such as testing ROBERT should not be part of the first two weeks of the introduction since it was too overwhelming for most new employees.

Their second recommendation was based on asking *"How might we ensure that we find the right technology to benefit patients?"* (Fig. 33). This was not contested by anyone in its full format but the therapist presenting it pointed to a need for a more structured plan for test and implementation. Such a plan should contain assigned responsibilities such as conducting a small analysis based on collected data from using the technology with the patients, in order for them to witness its potential benefits.

The third recommendation was based on the question *"How might we share/acquire knowledge about evidence and treatment volume in relation to a new technology?"* (Fig. 34). It resulted in a similar conversation about assigning responsibilities to people, who in a partnership with the DT could find reports and scientific literature that they could debate at a rational clinic or similar. It was argued that the assigned responsibility was essential since having everyone responsible would just result in no one feeling responsible. The issue with prioritising one's time to search for relevant literature about technologies that they could discuss in plenary was also brought up. It was pointed out how they could agree on a person who could be assigned as a project manager and collect data about the use of a technology that they had tested during a period and then present the results to the rest of the ward. This person should also be the one who contacted other neurorehabilitation places to plan visits so they could share experiences of using a new technology.

The last proposal was based on the question *"How might we (get an overview of what opportunities are available within new technology?)"* (Fig. 35). This had to do with how they could get an overview of possible relevant technologies as well as their scientific evidence of effect on patient function. Again it was pointed out that they agreed on the overall recommendation but the DT pointed out that they still needed to agree on the time they would be willing to set aside for these activities, since he knew them as time consuming, which the others agreed to. Unfortunately at this point the time was up and the participants were thanked for their participation and encouraged to continue the interesting and relevant discussions they had initiated at the workshop.

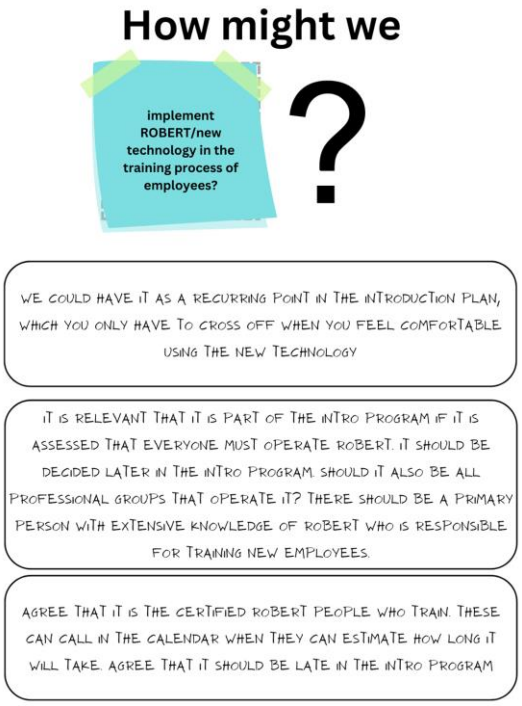


Fig. 32: The first recommendation from group 2

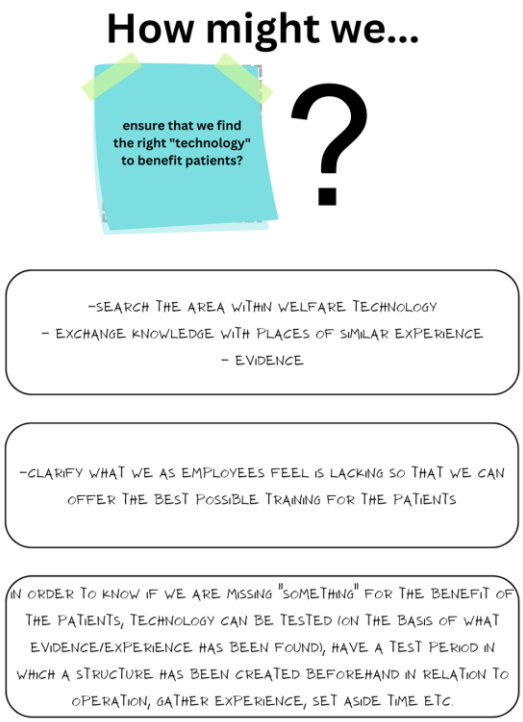


Fig. 33: Second recommendation from group 2

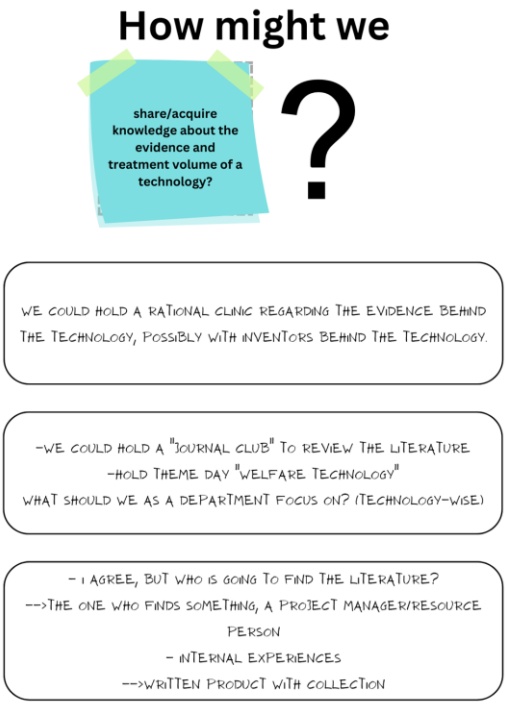


Fig. 34: The third recommendation from group 2

Fig. 35: The fourth recommendation from group 2

Group 3

The first two proposals were based on the questions: "*How might we include many (those who have to work with it) inputs and thoughts about the purpose and use of technology, so that everyone takes ownership?*" (Fig. 36) and "*How might we include conversations on how technologies fit into the patient process?*" (Fig. 37). The participants discussed early involvement of all professions at the ward. Note that the second proposal only has two of the boxes filled, as one participant had to leave to pick up her kids. One therapist expressed that they did involve different professions in the test process of ROBERT but that she still experienced resistance towards ROBERT. They agree that reaching common understandings of purpose and how new technologies correspond to other elements of the treatment activities of the patients, so that everyone can see how new technologies can contribute to the overall quality. The timing of initiating testing periods was also mentioned as something that had been challenging with ROBERT. They proposed some methods such as workshops and surveys among patients and staff to explore how a new technology might fit into and contribute to the ward as a whole, as well as examining how patients might be motivated and experience the effects of using the technology.

The third proposal was based on the question *"How might we get joint commitment in the testing phase?"* (Fig. 38), and sparked a conversation about how to reach greater commitment among employees when new technologies are tested and implemented. It was argued that teaching how technologies work was not enough. In the future they needed to agree who should have which responsibilities and focus areas but that it did not necessarily entail that it was only one profession who should be able to use the technology, and also left the question of how it fit with their new work structure. Some patients had expressed to participants that they were disappointed not being able to train with ROBERT because the therapist at work did not know how to use the robot. They would like to discuss the implications of dividing responsibilities more in the future, since they had experienced it as useful in the past to have guidelines as to which profession had which responsibilities but that this could also be problematic when they worked in *vagt*.

The last proposal was based on the question *"How might we investigate needs in the department versus what the new technology can offer?"* (Fig. 39). An interesting point arose that although ROBERT was described as a device they should only "test" to get a sense if he could be a positive contribution to their ward, they had already used a lot of resources in this process with people who had to get certified and train colleagues, as well as all the discussion that had followed between staff and management. The participants questioned if it was really just a test at this point. The KQS said that in her experiences their test of other technologies had never resulted in them being able to make decisions either, so this was an ongoing issue. It had also been experienced that the decision on whether to keep ROBERT or not had come to a standstill because the test process had been so

challenging. It had been difficult to get everyone on board for the test, and the reasons for these difficulties were still not clear for everyone.

In this chapter we have presented our workshop results, including the recommendations created by the participating staff. In the next chapter we position these as well as findings from the fieldwork observations and interviews in wider literature, to discuss recommendations of technology implementation in the healthcare system from a techno-anthropological perspective.

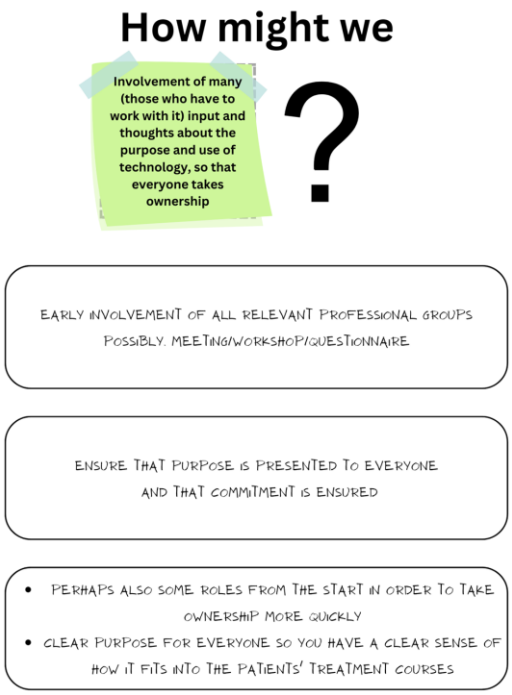


Fig. 36: The first recommendation from group 3

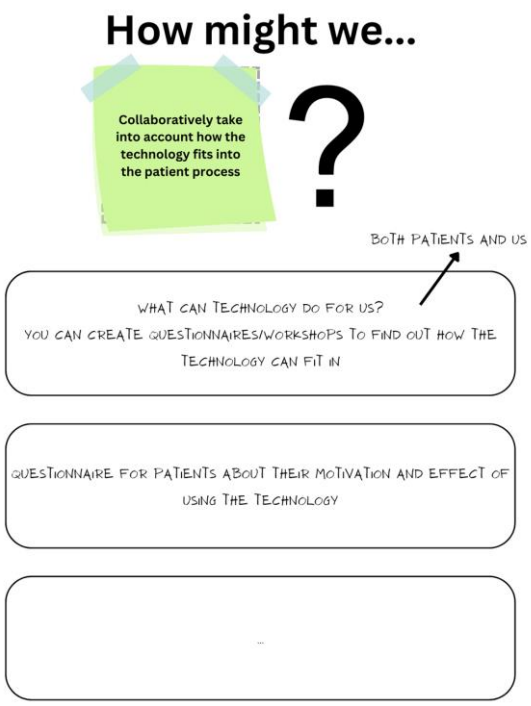


Fig. 37: The second recommendation from group 3

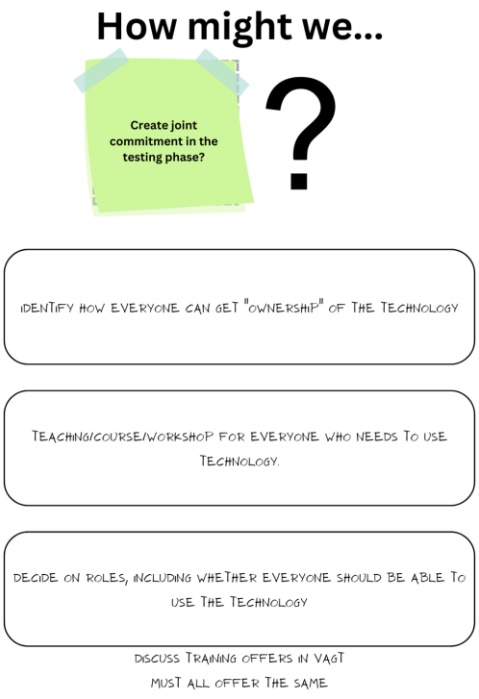


Fig. 38: The third recommendation from group 3

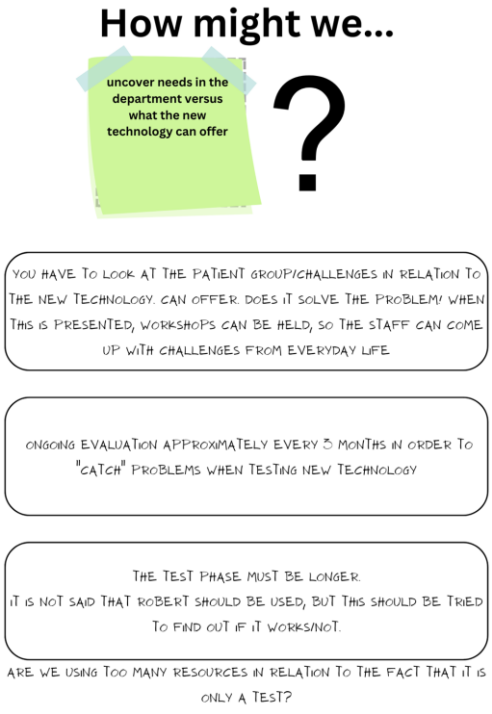


Fig. 39: The fourth recommendation from group 3

Discussions and Recommendations

In the previous chapter we presented the recommendations for technology implementation generated by our workshop participants. In this chapter we discuss thematic findings from the entire analysis with the aim of positioning our findings in relation to prior research and other literature in an effort to provide more general recommendations for implementation of technology such as robots in the Danish healthcare system from a techno-anthropological perspective.

Role Reconfiguration

As we have shown in the analysis, ROBERT has become the focus of a discussion about professional boundaries and ongoing changes to structures of work at the ward. This section of the discussion relates some of our findings into large literature reviews with general findings, and as such we consider our findings as fitting with these general trends. The robot has brought to the surface a number of questions about what groups are responsible for what tasks, as well as who should be responsible. Many of these questions seem to stem from what McNeil, Mitchell and Parker (2013) describe as *Interprofessional practice* (IPP), defined as "*a team-based, patient centred approach to the delivery of health care that synergistically draws on the varying skills and expertise of a range of health professionals so that patients receive optimal care*" (292), a definition that fits well with the long-term managerial ambitions we have shown. In their review of the literature, they find that IPP on one hand enhances innovation and treatment quality, while reducing costs and waiting times; on the other hand its implementation often leads to conflicts and bad experiences for the involved parties. They point to professional identity being a large part of a person's identity, which we see for example when members of staff describe themselves as *"Occupational therapist with a capital O"* (Int2, 2), and that perceived threats to professional identity often lead to defensive and diversive actions. In severe cases, this can lead to professional groups harshly misrepresenting each other to establish their own importance, or refusing to cooperate, a phenomenon which has fortunately not been observed at the ward. Perceived threats often come in the form of managerial decisions resulting in differential treatment and/or not recognising the values of specific groups, such as OT's who felt disregarded in the implementation of ROBERT, or forced to take on tasks that do not align with their professional values. Fortunately, the authors also point towards strategies to mitigate such conflict, at both a managerial and political level: Managers should practice a reflexive challenging of the established norms that lead to some professional identities dominating others in interprofessional work, and they should seek to foster shared team identities across professional groups, in a way that sets common goals while respecting and preserving the individual professional identities involved, for example a shared focus on patient centeredness (McNeil et al. 2013). As we have shown, this is already practised

somewhat at the ward, which might be a reason why these professional differences have not escalated into open conflicts.

While ROBERT seems to have brought some latent conflicts to the surface, we also identify friction directly related to the machine itself. A scoping review by Agreli, Huising and Peduzzi (2021) finds that the transition to interprofessional healthcare work often goes hand in hand with new technology, resulting in a unique renegotiation of complex work divisions and interdependencies. The implementation of new technology alters professional boundaries, and professional roles tend to be altered according to their authority and knowledge relating to the new technology; those who manage to skillfully use new technology tend to have better control over their changing roles (Agreli, Huising, & Peduzzi 2021). We have seen these tendencies play out at the ward, as the PTs, being the professional group who finds themselves most aligned with the affordances of ROBERT, have managed to become the closest thing to an authority over how, why, and when it is used.

The review identifies four distinct ways in which roles can be reconfigured, all of which are present to a degree in the ROBERT case. First is negotiation, in which work practices are reconsidered in the light of new technology, including but not limited to changes in tasks, coordination, power dynamics, and perceived expertise. As mentioned, ROBERT is seen by some as a catalyst for new ways of working and cooperating, and by others as a threat to their professional identity. While the final form of ROBERT is yet unknown, its entry at the ward is already shown to generate conflict about negotiation of roles. Second is clarification, in which previously invisible work practices are brought to light. We observe this in relation to ROBERT when management sees the robot as a universal tool while some professional groups see it as not within their expertise; pointing to a lack of common understanding of what different professions do and do not work with, and provoking new debates about these professional boundaries. Third is enlargement, in which certain roles gain new power by becoming experts in new impactful technology. In the ROBERT case, the PTs have developed expertise and structures that enable them to consistently use the robot, and in turn the current negotiations about other professional groups seem to be largely centred around how they can assist the PTs rather than develop expertise and structures of their own. While this is not necessarily a bad outcome, it is contrary to the early ambitions of having ROBERT be used fully by all professions, and might point to a need to reconsider these ambitions. Lastly is restriction, in which tasks or roles are made automatic or redundant. While ROBERT requires a health professional operator, its main function is automating a large portion of physical training. This is not necessarily a bad thing; the automation of the repetitive movements enables the operators to use their hands and professional expertise elsewhere. It does however leave the question of what might be lost or changed in such a process, in ways similar to the one already seen in which the robot changes the way operators assess patient function during training, from direct therapist-to-patient contact into interpreting not always accurate representations on the screen.

The review goes beyond characterisation, and presents four recommendations for anticipating and addressing the challenges brought on by technological role reconfiguration: First is a task analysis, in which the reconfiguration of tasks is proactively identified so it can be properly facilitated, including recognising new tasks and skills in concrete forms such as titles and salaries, and identifying the implications of changing the tasks of a job for both the worker and their patients. This echoes recommendations from workshop participants to identify needs before purchasing solutions, and to have deeper discussions about responsibilities when implementing technology. Second is to support collective learning opportunities that allow for the formation of new interdependencies between roles, and synthesising professional knowledges into ways to improve healthcare service quality. This is also reflected in recommendations generated at workshops. Third is distribution of expertise, in which knowledge and support is balanced between all affected groups; avoiding power imbalances and encouraging collaboration. While this is not directly mentioned in workshops, we have seen much talk about the ROBERT-process leading to an uneven and adverse distribution of responsibilities. Fourth is to expect and address resistance to change early on, in ways such as involving staff in the design and implementation of new technologies and the role reconfigurations that they entail (Agreli, Huising, & Peduzzi 2021). This, too, is reflected by many different people involved in the ROBERT-process, such as management being surprised about the impact of the conflicts, or staff being distressed that they have to keep testing the robot. Ways to make these recommendations more concrete are shown in later sections.

Gaps Between Design and Practice

As we presented in our analysis, the ROBERT operators from the ward went through many steps in order to operate ROBERT. Compared to the explanations both advertised on LSR's website and in the manual for ROBERT, we found that the *plug and play* operation was far from what happened in real-life practice at the ward. Besides the observations of ROBERT in practice, we also argue that the unspoken complexity of ROBERT is reflected in the requirement for a several day long certification course, and the finding that even the course is not always sufficient to begin operating ROBERT.

Tornbjerg & Kanstrup (2021) underlines this problem as more than a gap between the developer and user, and emphasises how the development of "*the use and meaning of robots are created in practice and cannot be designed in advance"* (70). The simple presentation of ROBERT from its developer did not line up with how the operators at the ward received and perceived the robot. This gap between the developer and user also became clear in the situations of interpreting the information and feedback on ROBERT's screen. Another perspective of using robots in practice comes from Hasse (2018) who shows the influence of the institutional culture that the user is embedded into: "*The person who creates an artefact perceives it in one way; whereas the people who use it learn how to perceive in relation to their own activity settings and local institutional practices."*

(2). Similarly, we see that the early plans for ROBERT were challenged in the face of the ward's practices, as the staff rejects these plans as they do not align with their understanding of their own tasks and practices. In the same manner as meaning and meaningfulness appeared repeatedly in our fieldwork, Hasse explains that part of the institutional culture that affects the use and adoption of a technology is the user's connection between the practices with the technology and meaningfulness: "*What matters is what is found to be of importance for upholding these activities. What matters, matter because the practices are meaningful to those that practice them. Meaningful to think with and engage with.*[...] *it is the overarching motives of the everyday work of the staff that in the end decide if we should include materials in our activities as meaningful or exclude them as meaningless"* (Hasse 2018, 13-14). Klecun and Cornford (2016) shares the same perspective of the institutional culture affecting how the health care professionals perceive possibilities of new technology, and showcases the same issue of: *"*[...] *lack of correspondence between the design of technological properties and the culture of professionals"* (221). We see the need for correspondence between what a technology can do and what is meaningful to local practice, as several therapists at the ward tell us that ROBERT only began making sense to them when they saw patients benefit from the training.

For all three articles there is one a clear and detectible thematic: the need for informing the development of technology with deep and *practice-near* user expertise. We strongly encourage more and deeper user involvement when developing new technology for the healthcare field. Similarly, healthcare organisations should to a greater extent consider how they make plans to test and implement technologies. The ward in this study keeps questioning *"does ROBERT make sense for phase 2 rehabilitation at this site?"*. We argue that answering this question requires ongoing study and discussion of the robot's impact on ward practices, as well as the impact that the staff and patient have on the robot through use. Furthermore, we argue that in the context of a hospital ward, there is a both practical reason to take seriously the perspectives of employees and patients when considering what technology to implement and how as this results in more robust and coherent practices, as well as a normative argument that people affected by the decision to implement a given technology should be allowed to take part in deciding what, why and how implementations happens. While user participation is a promising tool for such involvement, it is not trivial when dealing with large challenges such as those facing the healthcare system. Zahlsen, Parmiggiani, and Dahl (2022) argues that scaling participatory design might come with challenges that "*risk core PD principles*" (143) such as our struggles with engaging all affected people and groups when these same people have very busy schedules, and giving power and voice to these same people in actual decision making. However the authors propose to use these challenges as "*important opportunities to explore the plurality of participation in the context of applying PD on a large scale* [...] *Having the ambition to do so can nevertheless still yield results that are fruitful from a democratic and emancipatory perspective"* (Zahlsen, Parmiggiani, and Dahl 2022, 151). We have shown that ROBERT is not fully ready for use upon arrival, but rather requires a period of familiarisation to be embraced by specific practices; a

requirement which is not accommodated by instructions, certifications, implementation plans, or budgets. We argue that this gap can only be bridged by a strong practice-level understanding of this learning period. As such, we recommend further research and practice to better understand and engage healthcare spaces as participatory design spaces.

Processes of Change

Our account of ROBERT's test process described how it was both envisioned by some of the management and the development therapist (DT) as a valuable contribution to their vision of cross disciplinary work at the ward, as well as a way of providing the necessary high-repetition training that patients needed. Yet ROBERT stirred up commotion about the content of work, and how to value and prioritise working practices. This debate influenced to some extent the amount of usage and potential benefits that the robot could have provided to the patients. We argue that expectations and visions of robots as agents of change to the working conditions of healthcare professionals, comes with some nuances, as it seems that the on-site implementation of the robot also has a great deal to say about the potential value that the robot in itself can generate. This section discusses potential ways to engage with these issues in technology implementation processes.

The ward seems to have a somewhat random and fragmented approach to change initiatives, which some of the staff pointed out as confusing and conflicting at the workshop, and they wished for a more structured and participatory plan in the future. This corresponds with the review by Melder et al. (2020) that points to a lack of *how to*-guidance for implementation and improvement in the healthcare sector, and a need for more rigorous and pragmatic approaches. For this, they propose the learning health system (LHS) as a fruitful combination of implementation science (IS) and the more pragmatic field of healthcare improvement (HCI), since it "*involves processes that generate and apply the best available evidence and use data to support collaborative healthcare decision-making with patients and clinicians*" (Melder et al. 2020, 1175). Although the LHS is proposed as having the potential "*to address evidence practice gaps more rapidly*" (1175) it is not a how-to guide either, and states on its website that "[...] *there is no model for building an LHS that can be 'lifted and shifted'. LHSs are complex by nature, and must be co-designed with local stakeholders*" (The Learning Healthcare Project 2023). We too find it questionable that universal guides can be applied with positive outcomes without acknowledging and accommodating local needs and practices; this position originates from an anthropological understanding of how social and technical elements are entangled in a continuous process of becoming, and as such predetermined and linear steps and models often fall short. The lead therapist and DT in our study also described how the test process had developed in surprising and at times irrational ways, since some of the staff asked for participatory elements that they believed had been available to the staff from the beginning. This divergence of perception points to a greater need

for shared co-production of knowledge and action plans, as it appears that they disagree on what counts as participation. There also seems to be a general lack of agreement and understanding of how changes to existing practices could and should be transformed into new practices of using new technology, such as ROBERT or the many other pieces of equipment collecting dust in the corners of the ward.

We argue that the practices of doing phase 2 neurotherapy is a collective endeavour, entangled with institutional ideals, regulations, and guidelines, as well as the wicked challenges of the wider healthcare sector whose organisation is constantly under scrutiny and change. We propose that management and practitioners can benefit from a practice-based approach to managing change. Noticeable is however that practice theory does not aim to provide *how-to* instructions about implementation of technologies, but to present an opposing perspective on the role and the ways in which we can frame problems and plan interventions in daily life, in a way that takes into account what is: "*deemed possible, plausible or worthwhile*" (Shove, Pantzar & Watson 2012, 416).

A practice-based approach would perceive the emergent practice of ROBERT as a process that can not be understood solely as a question of whether individual employees find it relevant and interesting enough for them to change their existing practices. Practices are connected as bundles through time and space, which is exactly why they are so challenging to change. We argue that this does not mean that individual wards or hospitals are unable to create change at organisational levels, but it does highlight that change initiatives that focus solely on individual or local behaviour are likely to fall short, as individuals are part of more complex modes of action. This implies that hospitals and wards should consider making changes based on a theoretical understanding that practices of people are not stationary and isolated activities steered solely by individual intention and motivation for uptaking new things. As the staff at the ward also proposed more extensive involvement of their experiences, we suggest involving them in exploring how they collectively shape and maintain ways of working with technology, and how this data can be utilised to create better treatment and care for patients. The request for more extensive involvement made by the therapists corresponds to the basic position of participatory design about the relevance and right to participate in design and decisions about technologies that will have an impact on daily life. As we have described ROBERT had a noticeable impact on their daily practices even though it was presented as just a test period. Their efforts to domesticate it were experienced by some as very challenging, for example regarding teaching colleagues how to use the robot. The challenge of peer-to-peer training could perhaps have been avoided or minimised if the therapists that attended the certification course had been given the opportunity to discuss, create and test a flexible plan on how to develop skills among colleagues that could support different levels of becoming a ROBERT operator. How employees at the ward identify and create shared images of who they are as professionals and what the objective of their work is, seem to be central to figuring out how to plan a robust test of ROBERT, as well as implementation of

other healthcare technologies they might decide to embark on. Incorporating all these considerations into an education plan is not an easy task, and will likely be a time consuming activity in itself. However, it seems central to prioritise and explore ways to engage different stakeholder's experiences in such processes and objectives.

The proposed involvement can be done by empirical studies, with staff as co-researchers such as it is done in participatory action research (Baum, MacDougall, & Smith 2006) and healthcare action research (Bradbury & Lifvergren 2016). Having staff as co-researchers, also seems in this case to be well suited with their perception of themselves as innovative and with a history of initiating change initiatives on their own, rather than something coming from the top. The understanding of how practices change, might be useful for how we plan and enact transitions from past ways of working into new ways of being and doing healthcare with new technology. However these co-creation activities involve political negotiations in which investigation of social norms and cultural images of the employees should be considered as an important aspect of something even as simple as testing out a possible new addition to the toolbox. The history of the past as well as established formal and informal roles are very relevant for foreshadowing how certain actors might react in times of change and how conflicts of interest might be used as guiding tools for planning tests and implementation of new technologies.

The experience of struggling with maintaining the use of certain technologies at the ward is an example of how practices are constantly in a stage of emergence, and as such the ward must find ways of keeping certain technological practices alive. The ward often referred to this challenge as one based on a loss of skills, which does seem to be a central element. However, the maintenance of gaining and having knowledge of use does seem to be rooted in other elements of the practice as well, as they had only a fragile and rigid plan for keeping the ROBERT-practice alive. Practice are indeed very vulnerable over time if only a few people are performing it. Though practice theory does provide a wider angle to understand the trajectory of practices and how the people who perform them can potentially shape this trajectory, it also has its shortcomings. As stated in the beginning, research on implementation in healthcare points to the lack of how-to guides (Melder et al. 2020), which leaves healthcare professionals and their managers with little support of actually doing implementation without having to learn a theory or new research tradition first. As time is limited it is likely they will continue business as usual and either skip trying new technologies to save time or go through many struggles to implement the use of the new technologies. This points to how healthcare professionals need to develop new competencies and hybrid roles as both clinical experts and improvement leaders, and potentially team up with external implementation experts (Melder et al. 2020). We propose that techno-anthropologists could be a suitable interactional partner and assist healthcare personnel, their managers, decisionmakers and technology developers with more robust implementation processes now and in the future.

Like our informants and participants discussed during our fieldwork and workshop, there is a paradoxical issue with prioritising exploring the potential value of something new when everyday life is already packed with more important tasks than they have time for. It seems that there is a larger number of important tasks than employees can manage, and therefore adding extra just to see if it might be useful and beneficial to the patients becomes yet another important task that they do not have time for. This point of view has implications for the premise and promise of the great potential of robots and other emerging healthcare technologies as solutions to the scarcity of resources in the healthcare sector. To potentially overcome this, there is a need for broader discussions among all stakeholders of what should be prioritised in order to do innovation, so that the burden does not rest solely on individual employees or managers. Innovation and implementation requires resources to develop a sufficient understanding of the practices that will undergo changes, and how to harness these understandings in planning robust change processes.

The ambition for this discussion is not to sell any theory or method over the other, but solely to highlight that future change activities should be informed by shared understandings of how to utilise situated as well as tacit knowledge. This requires engaging with questions of what counts in a practice, and how this is connected to not only attitudes of the individual but a sense of meaning collectively created over time, related to physical things, bodies, places, rules, and regulations. As for ROBERT, we suggest that the staff and management take a step back and collectively discuss and create a shared image of the present and future of the ward, and from there collectively design the details of daily operation as an expression of this shared image through use of things, bodies, time, and skills. As Clarke et al. (2017), we too highlight the need for prioritising evaluation of activities in order for participants to see outcomes as well as providing data to potential adjustments. One fruitful approach might be the one recommended by McNeil, Mitchell and Parker (2013), which is to work more systematically with the already existing common goal of fulfilling patient needs. This seems well aligned with our study of ROBERT as we were told several stories of how some had experienced the use of the robot for training as very beneficial for the patients, and that these experiences contributed to making sense of the robot as valuable for training. However, there was no structure set up for making these experiences accessible and widely visible among all employees at the ward. This might have delayed acceptance of the robot, as some explained that they had to experience the benefits of the robot for their own patients first hand before seeing its potential and relevance.

In summary, we position our findings within recommendations of the wider literature and highlight the importance for participatory and practice-based processes of change, but at the same time point to the challenges of this approach in healthcare systems that are already under pressure. Although new technologies such as robots do seem to have some potential for providing better care of patients, their

implementation might require more resources than they will initially save; this should be considered as part of robust implementation plans in the future.

Policy Implications

Many of the observed frictions in the ROBERT case seem to stem from issues of project management; specifically that the process has stirred up surprises regarding time and cost, as well as previously discussed professional conflicts. We argue that these problems do not originate from local management not understanding such a process, but rather at a higher level from a lack of available support and data. From previous work, one of the authors has been part of developing a map of health robot implementation projects in Denmark, which was met with strong enthusiasm from actors working with robots that someone was finally building an overview. Another author has been part of facilitating workshops asking high-level healthcare stakeholders about desirable futures for the healthcare system, in which almost all answers contained the establishment of national databases of both patient-specific data and innovation project experiences. Further, as shown in the analysis, there seems to be very little data collected about the ROBERT process, and the data that is collected does not reflect real practice; resulting in the experiences from yet another implementation project being lost. This is a major issue as new technology has been politically designated as one of the most promising ways to save the Danish healthcare system. However, there seems to be no coherent plan for *how* this salvation is supposed to come to be. Hasse (2018) critiques such technological determinism; the expectation that technological progress such as robots are an inevitable future part of the healthcare system, and thus healthcare staff might as well comply with the situation. She identifies this position as deriving from a lacking understanding of the inter-related impact that technologies and humans have on each other. Tech implementation projects (and health projects in general) often live and die locally, without coherence or coordination on a larger scale about how to foster successful implementation of new technology, especially in terms of complex socio-technical interactions. In the ROBERT case we see consequences of this: A research phase that underestimates the cost, time, and difficulty of implementing a new technology, and barely manages to document the process or learn from previous failures. We argue that the immediate problem is that the healthcare system fails to learn from their mistakes, and the larger problem is that these implementations fail to save the healthcare system.

Based on this, we recommend paving the way for better understanding of the real requirements and real benefits of the implementation of new healthcare technology. This might take the form of something like Reference Class Forecasting; a project management technique that builds estimates for cost, time, benefits, and potential risks based on previous projects in the same class. The main challenge to such management is that it requires a large amount of data about similar projects, which is often not available (Batselier & Vanhoucke 2016). We have seen first-hand that *if* such data

exists for a case like ROBERT, it is not known or available to those made responsible of tech implementation, and most likely it does not exist. While there might be huge benefits to gain from a shared national (or beyond) knowledge bank about healthcare technology implementation, the road to a useful database is most likely long and costly.

Conclusion

This thesis has investigated the problem statement: How does an emergent robot practice reconfigure therapy and care at a Danish stroke ward, and how can anthropology-driven participatory design be used to generate local as well as general recommendations about implementation of healthcare technology?

We conclude that the ward is a complex, vulnerable, and ever-changing context for technology implementation, and that reactions to previous changes have an influence on new changes. The core practices are complex bundles of socio-technical elements, and potential reconfiguration of these practices has a lot of large implications that are not fully understood.

We conclude that the actual practice of using ROBERT is more complex than anticipated, and requires a skillset that can only be fully mastered through time consuming experimentation. We have shown that the robot does not fully fit into existing practices, such as the way activities are usually planned, or the way hygiene is usually performed. We have also shown a number of elements of ROBERT that do not make sense to its users; data prompts require entry of patient characteristics that do not fit therapeutic understandings, the feedback provided during and after training does not make sense to the operators and is sometimes demonstrably wrong, and the meaning of error messages is often insufficient and unclear.

We have shown that ROBERT reconfigures a number of therapeutic practices. The relation between the patient and the therapist is circumvented and changed by the physical presence of the robot, both in ways that obstruct tasks such as function assessment, but also in ways that support and enable tasks such as heavy lifting. We also show that ROBERT helps to solve one of the largest challenges currently facing the ward, as it enables therapists to prioritise training interventions and writing rehabilitation plans at the same time. In addition, we show that ROBERT affects other practices that had not been considered, such as enabling blood samples to be drawn while the patient is training. We also show that ROBERT has a potential to mitigate the high resource demands of patients with the most severe symptoms, however the ability to prioritise this alongside other tasks is highly dependent on certain functions of the patient. We conclude that there is a broad agreement that ROBERT is beneficial to the patients at the ward, but a concurrent disagreement about when and why to prioritise this training, as well as who should be responsible.

Regarding the domestication of ROBERT, we conclude the following: The decision and reasoning for testing out ROBERT included a narrow group of mostly managerial staff. We still see uncertainty and distrust towards the robot among staff, albeit there seems to be a slow switch towards an idea of the robot as a good fit for patients at the ward. Attempts at creating a more systematic understanding of potential benefits of ROBERT, such as the timetable, do not seem to succeed.

Rather, what seems to be working is staff having positive first-hand experiences of the robot which leads to it *making sense*. Furthermore, we have shown that processes attempting to appropriate ROBERT have led to confusion by surfacing latent issues regarding overall values and priorities, as well as rekindling conflicts from previous change processes. We show what seems to be a major disagreement between on one hand managerial ambitions for ROBERT to catalyse an entirely new interdisciplinary work structure, while floor staff on the other hand wants the robot to fit into existing professional arrangements in which it mostly aligns with physiotherapy. The way forward seems to be an alignment of values across professional groups and managerial levels. We also show that there is a wide variety of different concepts of what exactly entails a *user* of the robot, as well as different levels of receptivity to its use. These differences also have implications for the reconfiguration of cooperation across professional boundaries, as most staff barely seem to understand their own role in relation to the robot, let alone the robot-relations of their differently educated colleagues. Finding the time and incentive to learn ROBERT seems to be left up to the individual staffers, and it is difficult for staff who have to prioritise this task against direct patient care and training. We also show that the loss of local technology expertise is a common occurrence at the ward, and has resulted in other implementation processes "failing". The current procedures seem unfit for the context of the ever-changing ward, and we suggest a number of principles for more robust implementation processes in this and similar cases, such as recurring practice-based participatory activities.

We conclude that the ROBERT case fits within current literature about challenges that might arise during establishment of interdisciplinary work flows and implementation of new interdisciplinary technology, and have presented recommendations accordingly. We have shown that ROBERT requires a process of familiarisation to fit into local practices which is not accommodated by existing structures and procedures for implementation, and based on this shown a need for further research and practice to better understand and engage healthcare spaces as participatory design spaces. We argue that the ROBERT case has implications for potential solutions to larger healthcare system challenges, as it illustrates that there is a lack of systemic mechanisms to learn from experience regarding implementation of new healthcare technology.

List of appendices

Appendices containing field data are referred to with abbreviations that explain their form, in order to maintain transparency about the kind of knowledge being used. Appendixes containing materials produced by us are marked as just “App X”, as these are not used analytically.

Interviews

- Int1: Development Therapist
- Int2: Occupational Therapist
- Int3: Occupational Therapist
- Int4: Physiotherapist
- Int5: Lead Therapist
- Int6: Assistant Manager
- Int7: Key Quality Supervisor
- Int8: SSA
- Int9: Physiotherapist
- Int10: Physiotherapist

Field notes

- FN1: 31/01
- FN2: 02/03
- FN3: 02/03
- FN4: 02/03
- FN5: 09/03
- FN 6:09/03
- FN7: 09/03
- FN8: 10/03
- FN9: 10/03
- FN10: 10/03
- FN11: 08/03

Video notes of patients with ROBERT

- Vid1
- Vid2
- Vid3

Workshops

- WS1
- WS2
- WS3

Materials

- App 1: Interview Guide 1: Staff
- App 2: Interview Guide 2: Management
- App 3: Workshop Playbook
- App 4: Group 1 workshop recommendation

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