Exploring Early-Stage Implementation of Digitally Enabled Remote Care

Case Studies from Norway and China

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Abstract
The onset of COVID-19 has the accelerated adoption and diffusion of remote care services to address the challenges of postoperative follow-up and support patients receiving care at home. Despite the great importance of this emerging technological solution, the field is still in its infancy. This paper presents findings based on feedback from an early-stage implementation of digitally enabled remote care in Norway and China, respectively. The same solution has been implemented in the two countries with a particular focus on patients with chronic conditions and postoperative rehabilitation.

Keywords
Remote care, digital technology, case study, early-stage implementation

1 INTRODUCTION

In this paper, we report from ongoing research on the implementation of digitally enabled remote care. We refer digitally enabled remote care to the integration of digital technologies into work practices of remote care that not only focuses on monitoring an individual's vital signs, mobility and general safety in the home [5], but also puts value on training an individual to utilise relevant skills to control or reduce the impact of disease on physical health status [7]. Despite the realm represents an exciting empirical field and it is becoming of the utmost importance to the world at large, digitally enabled remote care has proved to be challenging to successfully implement and use by healthcare organisations [6]. Digital technologies for remote care are collaborative tools supporting the communication and coordination of patients and health professionals. Their use fundamentally changes the traditional interactions between patients and health professionals [3][4], and should be designed to support a variety of user needs [32]. They are also tools that transform the role of patients from care receivers to active data generators [10] co-producing meaningful data [19]. Current literature on digitally enabled remote care has studied the design and use of these technologies for specific group of patients with specific health conditions. However, we still have limited insights into the challenges that emerge from the transformation of organisational practices and technology in use in remote care.

This work encompasses an existing digitally enabled remote care solution (see Figure 1), which was initially developed in Norway to offer remote primary care for patients with chronic diseases. It consists of a web-based patient monitoring portal for health professionals to handle digital home follow-up, and a mobile application specifically designed for patients with a set of integrated measuring devices. The same solution has been implemented in Norway and China. Several pilots are currently carried out in the two countries in specialised care offering remote care services to hospital patients. The aim of our research is to understand what are the lessons learned from the early-stage implementation of digitally enabled remote care in Norway and China. Thus, we address the following research question: what challenges emerge when implementing the same digital solution for remote care services in Norway and China?

This paper is structured as follows. Firstly, we position the study in relation to relevant literature on digital technologies for remote care. Secondly, we present our conceptual lens of sociotechnical perspectives on remote care and argue how our study can address the research gaps. Thirdly, we describe the research methodology, followed by the study setup in Norway and China, respectively. Then, we reveal findings based on some early feedback we have received from the early-stage implementation in the two countries. Lastly, we conclude the paper with a brief summary and our future work.

2 SOCIOTECHNICAL PERSPECTIVES ON REMOTE CARE

Digital solutions are considered as a key enabler to promote health, prevent diseases, and provide patient-centred care that meet citizens' needs [15]. International strategies have called for a paradigm shift in the way healthcare is organised [33]. In particular, the need for new models that enable patient-centred services and a shift from hospital-centred systems to more integrated care structures have been highlighted. The use of remote care technologies is considered a promising solution for person-centred health services and has increasingly been used for people with

The 18th Scandinavian Conference on Health informatics, Tromsø, Norway, August 22-24, 2022. Organized by UiT The Arctic University of Norway. Conference Proceedings published by Linköping University Electronic Press at https://doi.org/10.3384/ecp187.

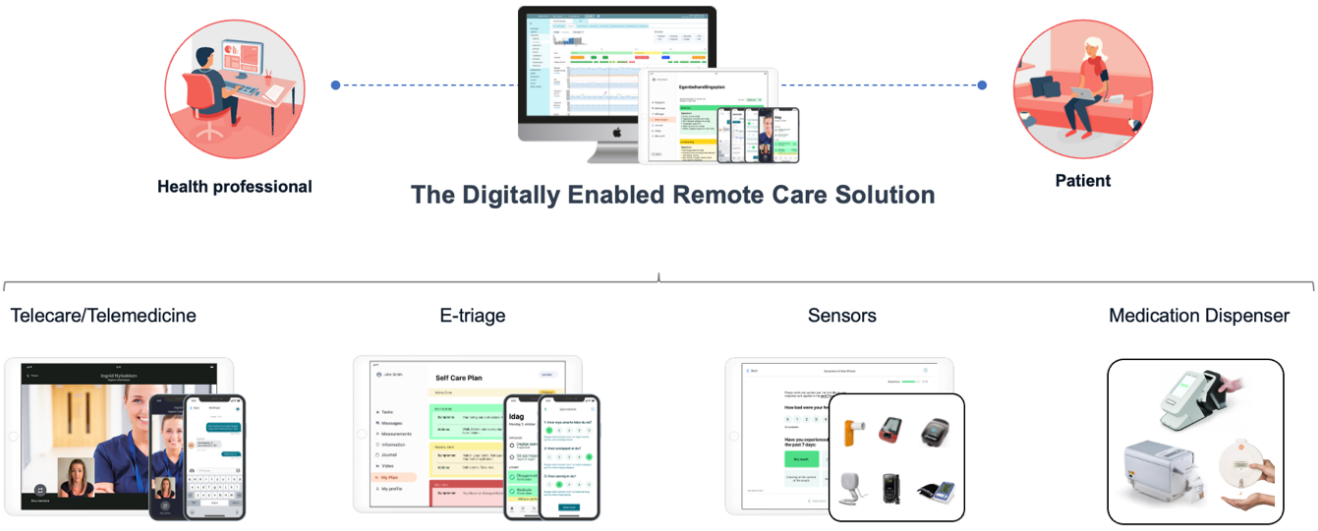

Figure 1. Overview of the digitally enabled remote care solution (image source: [12]).

chronic diseases. Studies on remote care are diverse and have increased considerably in recent years. A systematic review and meta-analyses have showed promising results in effectiveness and cost-effectiveness of e-health interventions to patients with somatic diseases [14]. However, several of the studies included in the review also showed inconsistent evidence. Similar studies have pointed out the challenges of implementing telehealth programmes in daily practice [31] and the need to theorising the distinct processes required to achieve widespread adoption [22]. It is beyond doubt that the use of digital technologies has the potential to improve health services for patients with chronic diseases. Nevertheless, several studies have identified that the uptake of digital remote care in daily practice is slow [6][13][31] and highlighted the need for a better understanding of the mutual relationship between technology and organisational practice [17].

Furthermore, current health data infrastructures are typically segregated in silos, differing in purposes, data sharing methods, regulatory compliance practice, and the users' roles. The trend of preventive and personalised healthcare implies that health data increasingly can be sourced from nonconventional health data sources, such as patients' personal devices, living environment, and Internet industry. Remote care solutions represent early examples of this. Even though some research have validated the potential significance of using patient-generated health data (PGHD) for improving healthcare performance [11] [26], most of these PGHD have not yet been widely used in a well-organised and structured way.

In this study, we draw on the sociotechnical approach to Health Informatics that has emphasised the contextual nature of health information [8] and consider design and implementation as an iterative, incremental change process [9]. Several studies in this tradition have highlighted the contextual aspect of translating new interventions in health care [24], co-creation of health services [16], and cultivation strategies that includes process-orientation, user mobilisation, and learning [18]. Moreover, Greenhalgh et al. have argued that we need to study the mutual relationship between human actions and the wider organisational and system context [17]. They have further developed a theory-informed framework that can be used to identify the degree of complexity of a technology programme and to identify potential challenges of adoption and implementation in real-world settings [17].

Overall, there are substantial gaps between the potential capabilities of digital remote care technologies to provide more efficient healthcare and the current adoption in daily practice. Previous studies have identified some of the challenges of implementing digital remote care and highlighted the need to explore the dynamic interaction between organisational practices and technologies in use. We attempt to address these gaps by unfolding lessons learned during the early-stage implementation of digitally enabled remote care in relatively large-scale pilot studies in Norway and China.

3 RESEARCH DESIGN

3.1 Research methodology

The research is designed as multiple case studies over three years (2021-2024) to investigate how digital technologies can be scaled, adapted, and evaluated to ensure high-quality remote care in Norway and China. The intention is to use the cases for contrasting key decisions about the sociotechnical set up of the pilots in the different hospitals in Norway and China. In this paper we focus on the early stage of this process. Overall, both the pilot implementations and our research activities have been delayed due to the COVID-19 pandemic.

In the early stage, empirical data have been collected from documents and interviews. As illustrated in Table 1, we have reviewed relevant documents such as publicly available documents, internal project reports, policies, and strategies at national level. In addition, we have also carried out ten interviews so far with our key stakeholders, for instance, health professionals from the hospitals and staff from the vendor organisation. In the next phase of the research, we will carry out observation in the hospitals to unfold how the solution is used by the health professionals and patients in the two countries

Country	Case study	Level of care	Patient type	Source of the empirical data so far
China	A hospital	Tertiary care	Postoperative thoracic patients	• Internal project report written by the hospitals (2) • Semi-structured interview with a project coordinator from the vendor organisation (1)
	B hospital		Postoperative cardiac patients	
Norway	1 municipality	Primary care	Patients with chronic conditions	• Publicly available documents (3) and videos (4) • Internal project documents (2) • Semi structured interview with nurses (3), project manager (1), vendor (2), IT-department (3)
	3 hospitals	Secondary care		

Table 1: Current status of the ongoing case studies.

Notes and recordings from the interviews have been reviewed and transcribed to identify key patterns and themes. We have followed the general qualitative coding principles [27] and the guidelines of thematic analysis [20] for data analysis. Ethical approval has been granted by the Norwegian Centre for Research Data (Ref. 600335). Participation is voluntary and written informed consent has been obtained from all research participants. All data have been anonymised and securely stored.

3.2 Ongoing case studies

Table 1 shows our case studies from Norway and China that represent different cultural, organisational, and clinical settings. For instance, the Chinese case has a particular focus on postoperative remote care and rehabilitation of thoracic and cardiac surgery patients. On the other hand, the Norwegian case has a broader scope and includes patients with chronic conditions who need follow-up by health professionals.

3.2.1 The Norwegian case studies

Digitally enabled remote care in Norway has mainly been driven by national strategies and the need for sustainable care services in the future. The use of digital technologies is considered a key measure for realising more coordinated and person-centred services [30]. A national programme for the use of welfare technologies was established and a total of six municipalities in Norway participated in the programme for the use of digital remote care. The participation involved the design of a new digital service that was carried out in collaboration amongst municipalities, suppliers, hospitals, service designers, and project managers from the Norwegian Directorate of Health. A cooperation agreement with GPs and staff at the hospitals was established in the municipalities. During the project period, workshops were organised with local actors to develop guidelines, procedures, and adjustment of the digital solution.

The overall goal of the national programme was to gain knowledge about the use of digital remote care to provide national recommendations for further implementation of the service. The target group for digital remote care has mainly been patients suffering from chronic diseases, such as chronic obstructive pulmonary disease, heart disease, diabetes, mental disorders, and cancer. The aim of the national programme was to gain more knowledge about the effects and benefits of the use of digital remote care and the evaluation was carried out as randomised clinical trials. A total of 735 patients were recruited for the study and the evaluation showed promising findings such as increased safety and coping for patients, as well as increased insight into the course of the disease. Overall, the experience gained from the national programme has provided useful knowledge and experience that will be continued in further scaling of digital remote care to new user groups and health services across organisational units in Norway.

3.2.2 The Chinese case studies

The Healthy China 2030 blueprint has been established as a national strategy since 2016 [28], which has fast-tracked the development of digitally enabled remote care. Against the backdrop of COVID-19, a digital health care boom has been sparked in China. The solution for remote care is considered a timely proposal and has been implemented in two hospitals in Shanghai, China since 2021. The goal of the pilots was to enrol 1,000 patients who are undergoing thoracic and cardiac surgery rehabilitation, and establish a corresponding database for patient follow-up. By November 2021, A hospital has enrolled a total of 190 postoperative thoracic surgery patients, of which 79 cases in the control group and 111 cases in the experimental group, accounted for 38% of the overall plan. B hospital has enrolled a total of 194 postoperative cardiac surgery patients, of which 103 cases in the control group and 91 cases in the experimental group, accounted for 38.8% of the overall plan. According to the types of disease, there were 108 cases (55.8%) of coronary artery bypass graft, 77 cases (39.5%) of various aortic replacement operations, 9 cases (4.8%) of aortic endovascular repair operations, and 65 cases (33.3 %) of combined heart valve surgery. All the above-mentioned patients have completed the informed consent before discharge. In terms of the project personnel, A hospital invested twelve medical doctors, specifically, two of them had senior professional titles, one had a junior professional title, and the rest of them were medical interns, namely, six master students, two doctoral students, and one postdoctoral resident doctor. The medical interns participated in the data collection, follow-up, data analysis, equipment management, and other matters of the patients enrolled in the project. B hospital also invested twelve personnel, including five doctors and seven nurses. Additionally, there were one doctor, three nurses, and three

technicians invested by its cooperative unit to help with professional interpretation of the electrocardiogram results.

4 FINDINGS AND DISCUSSION

In this section we present the findings about the early-stage implementation of the solution. This is a critical stage where key decisions shaping the long term of the implementation process are taken.

4.1 Early feedback from the Chinese cases

4.1.1 The experience so far from the Chinese hospitals' perspectives

Our findings show that there are differences pertaining to the feedback from the two hospitals in China where the solution had been implemented. We noted several factors that might have influenced their respective user experience. The factors are related to organisational and leadership level, which is in line with the factors that have been reported in the previous studies [1][6]. The purpose of enabling the solution for remote care is to bring patients and clinicians closer together. Nevertheless, the digital technology itself is merely a tool to support and enhance the two hospitals' existing healthcare services. What is ultimately provided to their patients is health care service per se, which needs their own clinical teams to deliver. Therefore, it is crucial that the two hospitals equip themselves with the competencies needed for delivering high-quality health care services to their patients and are proactive in investing time and effort to learn, use, and implement the digital technology.

B hospital had a relatively stronger clinical team and was acting proactively in implementing the solution. The hospital had invested sufficient manpower and time to learn the technology, and consequently mastered it and managed to use it in a flexible and creative way. As a result, their experience and feedback with regard to the implementation of and experience with the solution turned out to be positive. For example, it was remarked by their clinical team that a healthy and harmonious doctor-patient communication model was built while accumulating experience in patient rehabilitation. The solution allowed their patients to enjoy health care without having to leave their homes, which not only saved the cost of inpatient treatment, but also saved time for patients who were using the outpatient services; and hence it enhanced their patients' user experience. From B hospital's perspective, the medical resources can be saved for patients who are more urgently in need of hospitalisation, which ultimately saves the country's medical expenditures. On the other hand, the user experience of and feedback from A hospital tended to be less satisfying. One representative of the vendor organisation commented that this was partly due to having a weaker clinical team on the A hospital side. The solution was used by medical interns, who did not have rich clinical experience, rather than the senior doctors in A hospital. Moreover, in comparison to B hospital, they did not invest enough manpower and time to cultivate their staff to use the solution properly.

4.1.2 The experience so far from the Chinese patients' perspectives

According to an internal report written by the Chinese hospitals [29], the majority of the patients were satisfied with the solution and several patients showed their interest in extending the duration to use the application. With the popularisation of smartphones, most patients—even some elderly patients—could master the use of the remote monitoring mobile application after getting an easy hands-on training. For postoperative cardiac surgery patients, some of them would choose to be transferred to secondary hospitals or rehabilitation hospitals to continue treatment for a period of time after being discharged, which might add another cost to them. Using the remote monitoring application could give the patients a sense of security, making it possible for patients who did not unnecessarily need to continue treatment in the hospital to be able to recover at home. Meanwhile, this can also reduce the risk of cross-infection in the hospital. For postoperative thoracic surgery patients, by pushing notifications of the rehabilitation plan via patients' end device and urging them to complete it through daily exercise tasks, a result of lung function recheck conducted by B hospital indicated a better recovery for patients. This shows that there is a need for remote monitoring, and it is positive in saving medical expenses and helping patients to recover.

Interestingly, one key challenge regarding the use of end devices was revealed. In the Norwegian context, a tablet with one application specifically designed for patients would be handed over to them. In this case, patients would have the same end device with a single application mode. However, patients in the Chinese context had to download the application for patients on their own end device, which was often a smartphone with multiple applications. This can be problematic, for example, for senior patients who are less tech savvy, especially when the application is not supported on the smartphone operating system version on their end devices. Furthermore, when the application for patients is not the only application on an end device, it will not function in a purpose-driven mode where nonessential applications and device settings are rendered inaccessible. This can cause distractions and increase data security risks which ultimately minimise the optimum use of the application for patients.

4.1.3 The major challenges that the vendor is facing in the Chinese market

Developing suitable business models that can adapt to a variety of market needs in different contexts has been suggested to be one of the key factors to succeed in scaling up digital remote care technologies [1][6]. Similarly, the digital technology solution in question needs a business model to make it commercialisable and sustainable in China. The project coordinator from the vendor organisation explained that the architecture of the system was standardised except offering different operating languages. It requires customisation and localisation to scale the infrastructure and service of the solution in China and make it adaptable to the Chinese market.

Another challenge was that the digital technology supplier in China was short-staffed due to a lack of financing. When a technical issue is discovered, it often cannot be fixed in a timely manner. The issue must be reported to the head quarter first, and then the staff based in Norway will try to solve the problem. The time zone difference between Norway and China makes it longer to solve a problem, and the user experience is therefore influenced by this.

Furthermore, the staff in the head quarter mainly come from Norway or other European countries, and hence might have difficulty understanding the Chinese needs due to the cultural differences.

4.2 Early feedback from the Norwegian cases

4.2.1 The experience so far from the Norwegian patients' perspectives

Digital remote care has been introduced into municipal health services as part of a national trial in Norway. The target group in the national trial has been patients with chronic diseases, such as diabetes, chronic obstetric diseases, and heart diseases. The evaluation of the national trial shows promising results, for instance, increased patients' safety and abilities to manage their chronic diseases; furthermore, the digital solution is perceived to be user-friendly and easy-to-use by the enrolled patients after receiving a short training [30]. The digital platform has built-in functionality that facilitates self-management of patients' chronic diseases, that is, 'the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and life style changes inherent in living with a chronic condition' [7] (p. 178). Some key features in the mobile application used by patients are a set of integrated medical measurement devices, a questionnaire to report symptoms, and a self-treatment plan that provides an overview of measures that the patient needs to perform based on vital measurements and symptoms. Self-reported data in the patient app becomes available in the digital platform and the nurses employed at the follow-up centre provide feedback to patients based on self-reported data. However, sharing information among the actors involved in the follow-up of patients remains a challenge that needs to be addressed in the further implementation of digital remote care. GPs and specialists at the hospital usually do not have access to the digital platform for remote care, and this interaction can be demanding as commented by an employee in the municipal health service: 'For the patients, it is often very demanding that they have to retell everything, the whole history since the last time they were at a check-up, so it is difficult for them to remember everything (...) Many patients bring their own tablet to the GP or to the hospital to show the history (...) It would have been very beneficial if the GP and the hospital could have access to patients' measurement history in a graphical representation'. Consequently, there are ongoing activities to facilitate more seamless interactions among the actors involved in the service.

4.2.2 The experiences so far from the Norwegian primary and secondary healthcare servises

Overal, the healthcare professionals in the Norwegian cases are satisfied with the digital solution. Scaling the solution to more users and user areas has been part of the ongoing activities. Telemonitoring centres, who had been involved in the national trial, have been established in the municipality. Nurses employed at the the telemonitoring centres are responsible for the daily follow-up of the patients. Furthermore, a collaboration agreement was made with some GPs and specialists at the hospital who had provided professional advice on the follow-up of the patients during the national trial. The new service thus facilitated improved coordination of the service and a nurse at a telemonitoring centre stated that digital remote care has filled a gap that previously existed among the home care service, the GP and the hospital. Nevertheless, it is still a challenge to share information among all actors involved in the digital follow-up of patients. The digital remote care platform works well as a standalone system, but the integration with existing systems used in the health service is a challenge. First and foremost, there is a lack of integration between the digital solution for remote care and EPRs used in the municipality. All information related to the patient's health care must be available in the EPR and the lack of integration means that information from the digital remote care solution needs to be transferred manually into the EPR. This entails a risk of incorrect registration as well as duplication of work for nurses at the telemonitoring centre. The digital remote care platform is not available to all employees in the home care services and relevant information about patient's health condition needs to be available in the EPR to provide justifiable health services. Patients with chronic diseases often need follow-up from the specialist health service and lack of integration with EPRs used at hospitals is also a challenge. Thus, seamless interaction between different actors has become a challenge and a nurse stated that 'the benefits are not achieved if only the municipality works on this and if not doctors and outpatient clinics and all are connected'.

Some of the issues outlined above include interdisciplinary collaboration and ongoing work on integration and reconfiguration of the digital solution has been initiated to implement digital remote care both in the municipality and at hospitals. For example, there is ongoing work to develop standardised interfaces between the digital remote care solution and the EPR systems. However, this is not only a technological issue, but also to decide what information is appropriate to share with whom and in what situation. For example, patient generated information can be valuable to clinicians in the hospital; however, they do not have the ability to follow up daily measurements for all patients. There is thus ongoing work to adapt the digital solution to different needs, roles, and responsibilities in a new integrated solution.

Lessons learned from participation in small scale projects have shown how digital remote care can be useful for several user groups and during the pandemic the digital solution was adapted to digital follow-up of COVID-19 patients. Furthermore, several hospitals have ambitions to offer home-based services and digital follow-up of patients have also been scaled to new care settings such as digital outpatient clinics. Ongoing activities involve digital follow-up of patients who need long-term follow-up, such as patients with diabetes, lung diseases, epilepsy, cancer and so on. These patient groups need regular follow-up by health professionals and are traditionally performed by physical attendance at the nearest hospital. Digital remote care is considered an opportunity for more person-centred follow-up for these patients, and it is expected that self-monitoring of vital sign and symptoms will provide more continuity in the follow-up of the patients. However, the digital platform needs to be reconfigured to meet needs and requirements in a new clinical context.

The case briefly outlined above illustrates the sociotechnical complexity of digital remote care and the

need for different levels of integration between health and social care depending on the type of services being offered [6]. Several studies have shown how digital technologies such as digital remote care enable innovation in the context of patient-centred care [2][23]. The notion of recombinability has been highlighted by [23] to shed light on how digital resources can be combined and recombined in various ways to enable flexibility and adaptability in digital infrastructures. We will use these theoretical perspectives as analytical lenses by following the further implementation of digital remote care in different clinical settings.

4.2.3 Sharing experience amongst the Norwegian health communities

Implementation of digital solutions for remote care in Norway in general are still at an early stage, and the processes so far have been a step by step, iterative process. Local projects have been established to facilitate further implementation of digital remote care. National and local communities for the development of remote care have also been established where regular meetings and/or webinars are organised to share experience and expertise. A variety of projects have enrolled motivated users who have gradually improved the solution based on the experience gained with regard to how digital technologies can enable better health care services. This strategy can be characterised as bootstrapping which emphasises the importance of identifying motivated users, learning from simpler areas before moving into more complex one, and motivating more users through successful demonstrations [21]. Moreover, the strategy for scaling the solution has been based on experiences from small-scale pilot projects. As stated by [25], 'the temporariness of pilot implementation is central to their role in infrastructure evolution because it enables experimentation and learning' (p. 446).

5 CONCLUSION

We have reported lessons learned from the early-stage implementation of digitally enabled remote care in Norway and China. Our findings revealed the key stakeholders' feedback regarding their experience so far with the solution for remote care in the two countries. We have illustrated some challenges that need to be solved in the further scaling of digital remote care to new patient groups and user areas. However, seamless interaction across organisational units remains a challenge and requires integration among different systems and measuring devices. We further argue that this is a socio-technical issue, where the digital solution needs to be adapted to different needs, roles, and responsibilities in the digital service. Investigating the early stages of the implementation process in Norway and China to understand how early decisions on the sociotechnical setup affect scaling the solution and the services at a later stage in the two contexts is considered as our future work. We hope our ongoing case studies in the two countries will inspire diverse research communities that are keen on developing digital technologies for remote care in different contexts, as we believe that digitally enabled remote care will open a new era of health care which is underway.

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7 ACKNOWLEDGEMENT

The DigiRemote project (No. 310137) has received funding from an IKTPLUSS-IKT and digital innovation grant from the Research Council of Norway.