Original Paper

Birthe Dinesen 1*, MSc, PhD
Helle Spindler 2*, MSc, PhD
1Laboratory of Welfare Technologies - Telehealth & Telerehabilitation, SMI,
Department of Health Science and Technology, Aalborg University, Aalborg, Denmark
2Department of Psychology and Behavioral Sciences, Aarhus University, Aarhus,
Denmark

*All authors contributed equally

Corresponding author
Birthe Dinesen, MS, PhD
Laboratory of Welfare Technologies - Telehealth & Telerehabilitation, SMI
Department of Health Science and Technology
Aalborg University
Fredrik Bajers Vej 7
DK-9220 Aalborg
Denmark
Phone: +45 2051 5944
Fax: +45 9815 4008
E-mail: bid@hst.aau.dk
Rethinking interorganizational co-operation between healthcare professionals: how telerehabilitation technologies for cardiac patients can improve rehabilitation activities and unify organizations

Abstract

**Background:** Cardiovascular diseases are the leading cause of death globally, causing 31% of all deaths worldwide. The Danish healthcare system is characterized by fragmented delivery of healthcare services and rehabilitation activities. In order to rectify fragmentation and improve the quality of care, the Teledialog Telerehabilitation Program for cardiac patients was developed and tested. The Teledialog program was based on the assumption that a common communication platform shared by healthcare professionals, patients and relatives could reduce or eliminate the fragmentation in the rehabilitation process and improve co-operation between the healthcare professionals.

**Objective:** The aim of this study was to assess the interorganizational co-operation between healthcare professionals across sectors (hospitals, healthcare centers in municipalities) in a cardiac telerehabilitation program.

**Methods:** Theories of networks between organizations, the sociology of professions and the “community of practice” approach were used in a case study of a cardiac telerehabilitation program. A triangulation of data collection techniques was used, including documents, participant-observation (n=76 hours) and qualitative interviews with cardiac patients (n=37). Data was analyzed using NVivo 11.0.

**Results:** The following key themes were identified: (1) shared e-rehabilitation plan integrates the workflow between the organizations and reduces fragmentation, (2) a community of practice in telerehabilitation was established, and (3) the telerehabilitation program became a joint program across hospitals, healthcare centers and municipalities.

**Conclusions:** The Teledialog Telerehabilitation Program was a new innovative cardiac telerehabilitation program that was tested in large scale across hospitals, healthcare centers and municipalities. Assessments showed that the Teledialog program and its associated technologies helped improve interorganizational cooperation and reduce fragmentation. The program helped integrate the organizations and led to the creation of a community of practice. Further research is needed to explore long-term effects of implementation of telerehabilitation technologies and programs.


**Keywords:** Telerehabilitation; heart diseases; workflow; co-operation; professional practice; community of practice
Introduction
Cardiovascular diseases (CVD) are the leading cause of death globally [1]. It is estimated that 17.5 million people died from CVDs in 2012, equal to 31% of all global deaths [1]. Cardiovascular diseases can be prevented by addressing behavioral risk factors such as unhealthy diet, obesity, physical inactivity, tobacco use and excessive alcohol consumption. Cardiac rehabilitation (CR) programs include interventions such as exercise and patient education on risk factors in order to encourage the patient to pursue and maintain a healthy lifestyle. However, effective implementation of cardiac rehabilitation after CVD has been inadequate, with participation rates under 50% over recent decades, despite international recommendations [2,3,4,5]. A review of the literature highlights several factors that impede patients’ participation in cardiac rehabilitation programs: inadequate access to healthcare services, fragmentation of the organization of rehabilitation efforts between hospitals and local centers, the patient’s own motivation and management of their disease, lack of individualized rehabilitation programs and transport difficulties to the clinic [4,6,7].

Rehabilitation of cardiac patients in Denmark has evolved from a formerly hospital-based system to a cooperative arrangement bringing together hospitals, health centers and municipalities [8,9]. Rehabilitation of cardiac patients is now divided into more specialized rehabilitation activities carried out at hospitals and while the general rehabilitation activities are carried out under the guidance of healthcare centers linked to municipalities [8,9]. The Danish healthcare system is characterized by fragmentation of its delivery of healthcare services and rehabilitation activities [10,11,12,13]. This fragmentation generates and reproduces knowledge gaps between healthcare professionals in hospitals and municipalities, loss of information regarding the patient’s status after patients are discharged from hospital and referred to a healthcare center and lack of cross-sector coordination in concrete rehabilitation activities. The fragmentation has been ongoing for years, and in a recent survey from the Danish Heart Association, cardiac patients stated that fragmentation remains an organizational barrier for their successful rehabilitation [14]. A new solution to meet the challenges of this fragmentation is the use of telerehabilitation for cardiac patients. Telerehabilitation is defined as the delivery of rehabilitation services via information and communication technologies [15]. A review of alternative models of cardiac rehabilitation points out that there is no need to rely only on hospital-based strategies. Community and home-based programs can be used to design a more individualized rehabilitation tailored to the patient’s specific needs and abilities [16,17,18].

Evaluations of cardiac telerehabilitation programs conclude that studies tend to be heterogeneous with respect to patients, intervention, use of technologies and outcome measures; moreover, the cardiac telerehabilitation programs often lack nutritional counseling or psychosocial management [19,20]. Studies focusing solely
on exercised-based cardiac telerehabilitation have been shown to be at least as effective as center-based rehabilitation for improving functional capacity and reducing cardiovascular risk factors [21]. At present, we have found no studies that have focused on the degree to which telerehabilitation technologies affect coherence within the cardiac rehabilitation process or co-operation across sectors, i.e., between healthcare professionals in hospitals and healthcare centers in municipalities.

From 2012 to 2014, the Danish Teledialog Telerehabilitation Program for cardiac patients was developed and tested in a multicenter randomized controlled trial (RCT). The target group of patients in the study consisted of patients diagnosed with heart failure, myocardial infarction, angina pectoris, and who had undergone coronary-artery bypass surgery. The overall aim of the Teledialog project was to develop a more individualized rehabilitation process, engage more cardiac patients to participate in rehabilitation, increase patients’ quality of life, avoid organizational fragmentation and facilitate coherence in the rehabilitation process, i.e., improved coherence between patients, hospital staff and the healthcare professionals in the municipalities. Within the Teledialog Telerehabilitation Program, the rehabilitation program was carried out in close collaboration between the cardiac patients, hospitals, healthcare centers and a call center. Multimedia Appendix 1 shows a video describing the Teledialog project.

Reference: [https://www.youtube.com/watch?v=gegto_B0YRA](https://www.youtube.com/watch?v=gegto_B0YRA)

The aim of this paper is to explore the interorganizational co-operation between healthcare professionals across hospitals and municipalities in the Teledialog Telerehabilitation Program and its associated technologies.

We define ‘co-operation’ as an arrangement in which two or more parties engage in a voluntary and mutually beneficial exchange instead of competing between each other [22, p. 16].
Methods

Design
The case study, inspired by Robert Yin [23] is the overall method for this study.

Cardiac Telerehabilitation Program
The Teledialog Telerehabilitation program was developed from May 2011 to March 2012 based upon user-driven innovation [24] in workshops in which the participants included healthcare professionals from hospitals and healthcare centers, cardiac patients, relatives, representatives from companies and researchers from disciplines such as nursing, medical engineering, psychology and organizational sociology. A cardiology ward at a regional hospital, a thoracic ward at a university hospital, four healthcare centers located in two municipalities and a call center took part in the CTP. Figure 1 below presents the Teledialog Network, which is centered around a web portal called “ActiveHeart”.
Figure 1. The Teledialog Telerehabilitation Network.

The small grey square in each “house” represents a tablet device that patients have close by and which they use to transmit information or communicate with healthcare personnel from home, from work or during leisure activities.
The program was tested in 2012–2014 in a multicenter randomized controlled trial. A total of 151 patients participated in the testing. The patients were divided into a control group and an intervention group. The intervention group tested the telerehabilitation program for 12 weeks. The control group followed a traditional rehabilitation regime based upon national guidelines for cardiac rehabilitation [8,9]. Table 1 provides an overview of the technologies used in the Teledialog project.
Table 1. Overview of the technologies used in the Teledialog project.

<table>
<thead>
<tr>
<th>Technology/device</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tablet</td>
<td>Each patient had an Android tablet (Samsung) to access data. The patients had use of the tablet for three months.</td>
</tr>
<tr>
<td>ActiveHeart.dk</td>
<td>Is an interactive web page or toolbox for cardiac patients with information on rehabilitation issues (medicine, smoking, mental well-being, diet, physical exercises, etc.). The information was available on a 24/7 basis. The information was communicated in text, video and audio and designed to suit patients' preferred style of information-seeking. The videos contained instructions about how to do exercises and short narratives by patients and relatives about their experiences with daily life after being diagnosed with heart disease or after cardiac surgery. The portal contains 80+ videos lasting between 1-3 minutes each. On the ActiveHeart web page, the patients had the possibility to call a heart patient hotline administered by a health provider. The phone service was open daily between 9:00 to 16:00 hours, and within this time frame, nurses were available to answer patients' questions. The patients also had access to chat functions via the portal, enabling them to chat with health personnel online.</td>
</tr>
<tr>
<td>Shared Care Platform (e-rehabilitation plan)</td>
<td>This platform was developed by IBM and called the “e-rehabilitation plan” in everyday use between healthcare professionals, patients and relatives. The e-rehabilitation plan provided an overview of patient data, including medications, goal and plan for rehabilitation, diary, appointments at hospital or healthcare center and monitored values (blood pressure, pulse, weight and steps).</td>
</tr>
<tr>
<td>CareConnect</td>
<td>CareConnect is a data platform provided by KMD for integrating and connecting the different systems in the project. CareConnect received data from Medcom correspondence (Danish national standards), MyMedic, Fitbit, and the e-rehabilitation plan.</td>
</tr>
<tr>
<td>Triage Manager</td>
<td>Is a software module used to administer data on the patients being monitored. The module was provided by Tunstall Healthcare A/S and used by healthcare professionals at the hospitals, healthcare centers and call center.</td>
</tr>
<tr>
<td>Telehealth monitor</td>
<td>Data was transmitted using MyMedic, a telehealth monitor produced by Tunstall Healthcare A/S that transfers data via a mobile Internet connection to a central server. Devices such as the sphygmomanometer, digital weight scale and ECG transmitted data via the telehealth monitor.</td>
</tr>
<tr>
<td>Sphygmomanometer for measuring blood pressure</td>
<td>Approved for medical use. The meter was paired with the telehealth monitor in advance.</td>
</tr>
<tr>
<td>Digital weight scale</td>
<td>Approved for medical use. The weight scale was paired with the telehealth monitor in advance.</td>
</tr>
<tr>
<td>ECG</td>
<td>The ECG was approved for medical use. It measured the first derived ECG scan for 40 seconds and transmitted the measured values to the telehealth monitor via a wireless Bluetooth connection.</td>
</tr>
<tr>
<td>Fitbit Ultra</td>
<td>Fitbit Ultra is a digital pedometer that registered the number of steps. The patients had access to their step data and could view how the data fit into their e-rehabilitation plan.</td>
</tr>
</tbody>
</table>

Prior to being discharged from hospital, a project nurse enrolled the patients in the program, and randomizations was performed automatically via a generated list. The
randomizations were performed in blocks of varying sizes (10, 20 and 14) in order to ensure equal numbers of patients in the intervention and control groups. For patients in the intervention group, the project nurse performed an individual interview with each patient before discharge in order to identify the patient’s need for rehabilitation and desired type of rehabilitation program (hospital, healthcare center, or call center). An individualized rehabilitation plan was then designed in dialogue with the patient, following current guidelines for cardiac recommendations as developed by the Danish Health Agency [8,9,25]. After formulating the rehabilitation plan, the patient was registered as a user in the information technology platforms and was given a tablet computer, enabling full online access to the ActiveHeart web portal and their individual e-rehabilitation plan described in table 1.

The patients received training in the use of the various rehabilitation devices, use of the ActiveHeart portal and in interpreting and using the e-rehabilitation plan. A physician prescribed the frequency in which the patient needed to measure their blood pressure, pulse, and weight (usually twice a week). Steps were measured every day. All data were transmitted to the e-rehabilitation plan database via a secure transmission line. Nurses at a call center recalibrated the measured values so that the healthcare professionals in the municipalities could then assess the monitored values each week. If the healthcare personnel saw monitored values that they considered abnormal, patients would be contacted, and the healthcare professional would discuss rehabilitation activities and possible revisions of targets with the patient.

Preparation of healthcare professionals
Prior to implementation of the Teledialog Telerehabilitation Program all the cooperating parties held workhops to agree on the allocation of tasks and responsibilities between the healthcare professionals. All the healthcare professionals involved in the telerehabilitation program participated in the development of the vision and content of the program and training in using the technologies prior to implementation.

Meetings between healthcare professionals
During the telerehabilitation program, the healthcare professionals held five meetings of two hours each to specifically discuss current telerehabilitation issues for the cardiac patients and how to co-operate and coordinate their activities.

Theory
Theories of networks between organizations [22], the sociology of professions [26] and learning theory [27] constitute the theoretical framework for this study. The combination of these theories has helped to identify the dynamics of co-operation
and learning processes between healthcare professionals across hospitals, sectors and municipalities in the Teledialog Telerehabilitation Program.

A network is defined as: “the basic social form that permits inter-organizational interactions of exchange, concerted action, and joint production. Networks are unbounded or bounded clusters of organizations that, by definition, are non-hierarchical collectives of legally separate units” [22 p. 46]. A network constitutes a systemic network, and the parties make up the resources of the network. Trust between the parties is an essential part of sustaining a network. The Teledialog Telerehabilitation Program was the joint vision for the network. Planning and coordinating the individualized rehabilitation processes for the cardiac patients was the focus for the healthcare professionals in the Teledialog Network. Regular meetings between the healthcare professionals and the e-rehabilitation plan constituted the platform for knowledge-sharing, coordination and joint problem-solving between members of the participating organizations.

Inspired by Abbott (1988), the sociology of professions has been applied in order to help focus on the dynamics and interplay between healthcare professionals from hospitals, call center and healthcare centers. This theory focuses on professional work, social relations and internal struggles between occupational groups in an inter-professional context. Abbot’s approach highlights inter-professional actions and is applicable in an inter-organizational landscape. Inspired by Etienne Wenger, learning theory [27] has been applied in order to focus on “communities of practice”. The strategy here was to investigate how the learning process between the participants was affected by the technologies in the Teledialog network. Wenger (2009) has defined “communities of practice” as groups of people who share a concern or passion for something they do and who interact on a regular basis. Wenger sees learning as a social practice centered around knowledge-sharing; hence, learning is both a social and an individual cognitive process. Learning takes place in interaction with others, with whom one has a common interest. In order for a community of practice to function, it needs to generate and appropriate a shared repertoire of ideas, commitments and memories. According to Wenger, a community of practice involves more than the technical knowledge or skill associated with undertaking some task. Relationships will evolve over time, and a community of practice will be organized around some particular area of knowledge and activity that endows participants with a sense of joint enterprise and identity. Wenger emphasizes that in so far as the community is bound together, members’ engagement and joint practices can help facilitate and maintain the relationships of trust on which all communities are built and maintained [27].

**Data collection techniques**
In this study, a triangulation of data collection techniques was used in order to validate the collected data.
Document analysis
First, documents and reports on strategies, policies and homepages were studied as background for the study. The aim of this background documentation was to obtain basic knowledge of the context for the case study.

Participant-observation
Participant-observation [28] was carried out in order to observe and explore how co-operation took place between healthcare professionals from hospitals and healthcare centers in the municipalities and their relations with the patients participating in the telerehabilitation program. The observations took place at meetings, at discharge of patients and during daily task-solving by healthcare professionals across sectors and in interactions with patients and relatives.

Participant-observation was carried out for a total of 76 hours. Field notes were recorded as MS-Word files and then analyzed using the qualitative data analysis program NVivo 11.0.

As part of the participant-observation, we studied the communication between healthcare professionals and the enrolled patients in dealing with the e-rehabilitation plan. The following three themes were in focus: 1) planning and coordination of the rehabilitation program, 2) communication between healthcare professionals and 3) communication with patients and relatives. Notes were taken and documented in a MS-Word file.

Qualitative interviews
Finally, inspired by Kvale and Brinkmann [29] semi-structured qualitative interviews were conducted with representatives from all healthcare organizations involved in the telerehabilitation of the cardiac patients. Purposive sampling of healthcare professionals was based on the criterion of their direct contact with patients who were in the Teledialog telerehabilitation program.

The interviews were conducted in two phases. During phase I (November-December 2012), healthcare professionals were asked to describe how they experienced the cross-sectoral co-operation within cardiac rehabilitation. The aim was to obtain a basic understanding of the context of the case study. The interviewees in phase I were selected based on two criteria: (1) that they were working within the team of cardiac rehabilitation at a hospital or healthcare center for more than a year, and (2) that they were involved in practical cardiac rehabilitation.

In phase II (December 2013-January 2014), interviewees were asked to explore the interorganizational cooperation within the Teledialog Telerehabilitation Program and specifically, how they experienced co-operation across sectors using the digital platform. The interviewees in phase II were selected based on their having been...
directly involved with cardiac patients participating in the telerehabilitation program at hospital, healthcare center or call center.

The interviews in both phases lasted from 55-90 minutes. An overview of the interviewee characteristics is shown in table 2 below.

**Table 2.** Overview of interviewee characteristics.

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Phase I November-December 2012</th>
<th>Phase II December 2013-January 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Physicians</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Physiotherapist</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Healthcare center staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Physiotherapists</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Call center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurses</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Totals</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

**Data analysis**

All interviews were transcribed by a research assistant. The transcribed interviews, notes from participant-observation and notes on studies of communication between healthcare professionals in the e-rehabilitation plan was coded using NVivo 11.0 software and analyzed in steps inspired by Kvale and Brinkman 2014. All data were analyzed using a combination of deductive and inductive approaches. The code tree was formed on the basis of central definitions and concepts derived from the theoretical framework and from interviews. Condensation of data was carried out in dialogue amongst the researchers of this study, since using a software program to analyze data may decontextualize the analysis of data.

**Ethical considerations**

The Teledialog project was approved by the Danish Ethical Committee (N-20120051), and the project was registered at ClinicalTrials.gov (ClinicalTrials.gov Identifier: NCT01752192). The study was performed according to the Declaration of Helsinki, and the guidelines in the Act on Processing of Personal Data were followed.
Results

The aim of this study was to assess the interorganizational co-operation between healthcare professionals across hospitals and municipalities in the Teledialog Telerehabilitation Program and its associated technologies. Table 3 shows the results from the analysis of the data.

Table 3. Findings from interorganizational co-operation in the Teledialog Telerehabilitation Program.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sub-themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared e-rehabilitation plan integrates the workflows between the organizations</td>
<td>New way of sharing clinical data (blood pressure, pulse, weight, steps and rehabilitation plan for the patients) between the participating healthcare organizations</td>
</tr>
<tr>
<td></td>
<td>Facilitate communication between healthcare professionals</td>
</tr>
<tr>
<td></td>
<td>Increased possibility to perform interdisciplinary decision-making on rehabilitation issues that leads to more coherence and continuity in the patient rehabilitation process and reduces fragmentation</td>
</tr>
<tr>
<td></td>
<td>Feeling of being a single organization</td>
</tr>
<tr>
<td>Community of practice in telerehabilitation</td>
<td>Relations between healthcare professionals are strengthened</td>
</tr>
<tr>
<td></td>
<td>Knowledge-sharing on rehabilitation issues</td>
</tr>
<tr>
<td></td>
<td>Joint vision on telerehabilitation for cardiac patients across sectors and municipalities</td>
</tr>
<tr>
<td></td>
<td>Possibility to plan more individualized rehabilitation programs for the patients</td>
</tr>
<tr>
<td></td>
<td>Patients becomes collaborators with healthcare professionals rather than passive clients</td>
</tr>
<tr>
<td>Telerehabilitation as a joint program across hospitals and municipalities</td>
<td>Mutual use of healthcare professionals’ know-how and manpower across municipalities (administrative rules and budgets) and hospitals.</td>
</tr>
</tbody>
</table>

**Shared e-rehabilitation plan integrates the workflows between the organizations**

Throughout the interviews, healthcare professionals expressed the view that the e-rehabilitation plan across hospitals and municipalities enabled them to share data on each patient’s rehabilitation program and to communicate with each other and with patients and relatives on a continuing basis. The joint e-rehabilitation plan made it possible for the parties to create a high level of coherence and continuity in
their activities and in the patient rehabilitation process, to perform interdisciplinary decision-making for the benefit of the patients, and to reduce fragmentation. For example, one healthcare professional stated:

_The digital platform makes it possible for us to share data on the patients between hospital and municipalities. Sharing data prevents adverse events and increases the quality of planning for rehabilitation after patients are discharged from hospital. I think we reduce fragmentation._

The healthcare professionals felt that the shared e-rehabilitation platform integrated the workflows and organizations across sectors and municipalities. For example, one professional stated:

_It’s more easy for us to communicate via the digital platform. It makes us feel like a single organization, but it’s important to have the meetings face-to-face._

**Community of practice in telerehabilitation**

The healthcare professionals expressed the view that their relations were strengthened during their work within the Teledialog Telerehabilitation Program. Besides having a shared digital platform, the healthcare professionals met with each other regularly in order to discuss issues within telerehabilitation. In the interviews, they expressed the view that the meetings were effective channels for knowledge-sharing, creating a joint vision for telerehabilitation of cardiac patients and for effectively individualizing and stratifying the patient’s rehabilitation programs. Observations identified engagement and knowledge-sharing between the healthcare professionals from the cardiology ward and the healthcare centers. Examples of these views are the following:

_The meetings we’ve had during the project and the [use of the] digital platform have strengthened relations between our teams._

_We’ve had the possibilities to exchange knowledge about the challenges of rehabilitation of cardiac patients and to make a joint vision together…. I feel like we are working in the same organization._

_Not all patients can participate in the telerehabilitation program, so we need to discuss with each other which patients are capable of taking part in the telerehabilitation program._

A community of practice within telerehabilitation has been created and the findings showed that it developed over time.
The healthcare professionals stated that most of the patients followed their data very closely and engaged actively in their rehabilitation process in order to return to everyday life more quickly. The healthcare professionals in the municipalities described the patients as collaborators rather than passive clients.

**Telerehabilitation as a joint program across hospitals and municipalities**
In geographic terms, the Danish telerehabilitation program covered two hospitals and four healthcare centers in two municipalities and a call center. The telerehabilitation program and its associated technologies made it possible to offer a new joint rehabilitation service on a large scale, to benefit from pooling resources and know-how and to offer patients in remote areas the possibility to carry out their rehabilitation in their local community healthcare centers and in their own homes, thus reducing disruption so as not to disrupt their everyday routines. Health professionals’ comment:

*By having the digital platform, we can substitute for each other during vacation periods and give the same service to the patients.*

*Telerehabilitation is a new way of working as a team and of bringing synergy between our disciplines, know-how and manpower and municipalities.*

**Discussion**

**Principal Findings**
The aim of this study was to assess how interorganizational co-operation between healthcare professionals across hospitals and municipalities would be affected by the implementation of the Teledialog Telerehabilitation Program and its associated technologies. The findings showed that in the view of the healthcare professionals, the shared e-rehabilitation plan had improved co-operation and had helped integrate the organizations in which they worked. In their view, a community of practice in telerehabilitation had been created, and a new, innovative telerehabilitation program had been established on a large scale across hospitals, healthcare centers and municipalities; patients had now become collaborators in their rehabilitation.

**Shared e-rehabilitation plan integrates the organizations**
The results indicate that the healthcare professionals found that via the e-plan, they were able to share data about the individual rehabilitation plans amongst each other and with the patients. In the view of the healthcare professionals, the e-plan
facilitated communication, coordination and interdisciplinary decision-making and reduced fragmentation in the patient rehabilitation process. The professionals also emphasized that in having the shared e-plan, they felt like a unified organization. The e-rehabilitation plan can be compared with a Personal Health Record (PHR), which is an electronic application where individual patients can access, manage and share health information with anyone whom they grant access [30]. The adoption, acceptance and use of PHR requires a culture of adaptation, user-friendly technology and a governance structure [31,32]. The governance structure in the Teledialog Telerehabilitation Program, including content, vision and distribution of tasks and responsibility between the healthcare professionals across sectors, was negotiated and developed in workshops between the healthcare professionals prior to implementation of the program. Barlow et al. [33] support these findings by emphasizing that implementing complex innovations in an interorganizational context with many stakeholders requires that all parties have had sufficient room to share views and to have an open dialogue on values. We have not identified cardiac telerehabilitation studies exploring a shared care platform in an interorganizational context.

Community of practice in telerehabilitation
A community of practice was established, cooperative relations and knowledge-sharing between the healthcare professionals were strengthened, and the healthcare professionals stated that they gained the possibility to plan and perform individualized rehabilitation for the patients in co-operation with colleagues. These findings are in alignment with the Wenger’s community of practice theory. The healthcare professionals in the Teledialog Telerehabilitation Program had face-to-face meetings as a supplement to their on-line contact through the digital platform. Through the meetings, the healthcare professionals had the opportunity to exchange views on rehabilitation and learning, such that dialogue became a natural part of the co-operation between the healthcare professionals for the benefit of the planning and coordination of the cardiac patients’ rehabilitation activities. The development of a community of practice based upon a digital platform across sectors has been identified in a study of telerehabilitation of patients with chronic obstructive pulmonary diseases [34].

A review by Rolls et al. [35] concluded that health care professionals use social media to develop virtual communities to share domain knowledge. However, these healthcare professionals often exhibit tribal behaviors between each other in order to limit knowledge-sharing. We have not identified this kind of issue in our study, even though we have utilized the sociology of professions approach as part of the theoretical framework for this study. Rolls et al. highlight that further research is needed in order to evaluate the effects of social media on knowledge distribution in clinical practice and, equally important, to assess whether patient outcomes are significantly improved.
In the view of the healthcare professionals, patients became collaborators within the cardiac telerehabilitation program and were active in the planning and coordinating activities in the rehabilitation process. This view is supported by a sub-study in the Teledialog project, where the patients expressed engagement and motivation in using the step-counter and the possibility to follow their own progress in the e-rehabilitation plan [36,37]. We have not identified studies with this finding, and in their review of the state-of-the art on telerehabilitation. Peretti found that future research needs to focus more on healthcare professionals and patients feedback in order to develop the kind of telerehabilitation technologies and programs that can meet patients’ needs [20].

The telerehabilitation program as a multi-center service across hospitals, healthcare centers and municipalities

The innovation elements of a cardiac telerehabilitation program on a large scale, across hospitals, healthcare centers in municipalities and a call center, have not been identified in the literature. One study has been identified: on telerehabilitation for cardiac patients in Belgium by Frederix et al. [19]. However, this study was not conducted on a significantly scale, nor were the organizational issues explored or evaluated. A review of telerehabilitation for cardiac patients [19] states that while cardiac telerehabilitation is at an early stage, it appears to be an effective strategy to increase both patients’ participation in CR programs and long-term adherence to recommendations on rehabilitation for cardiac patients.

Mandell et al. [38] highlight the fact that for interorganizational innovations to be successfully implemented in a complex context, management/project management must be made aware of the impact of contextual factors, such as the history of relationships, relative power of the actors in the network, imposition of rules, impact of political/cultural context and culture of the actors. By using a triangulation of data collection techniques, our interdisciplinary team brought in the contextual factors as part of the preparation for the trial. By identifying the contextual factors prior to implementation of the cardiac telerehabilitation program, implementation became possible within the timeframe and the budget of the project. Moreover, we were able to overcome those factors that typically impede or derail the implementation of e-health systems, such as insecurity, uncertainty, a sense of not being part of the implementation process, etc. [39,40].

Strengths and Limitations

A case study is circumscribed by the possibilities for generalization [41]. A triangulation of data collection techniques has been used in order to collect sufficient and varied data and to ensure validation of different perspectives. A longitudinal study of the co-operation among healthcare professionals across sectors would have strengthened the results, as would a larger RCT study with more patients enrolled so that healthcare professionals would gain more experience working with telerehabilitation. We are aware that a potential limitation of this study is that it reflects specific elements of the Danish context where all health care services are public and free of charge.
Conclusions
The Teledialog Telerehabilitation Program was a new innovative cardiac telerehabilitation program that was tested in large scale across hospitals, healthcare centers and municipalities. Assessments showed that the Teledialog program and its associated technologies helped improve interorganizational cooperation and reduce fragmentation. The program helped integrate the organizations and led to the creation of a community of practice. Further research is needed to explore long-term effects of implementation of telerehabilitation technologies and programs.

Acknowledgements
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Conflict of interest
The authors declare they have no competing conflicts of interest.

Multimedia Appendix
Appendix 1: Video on the Teledi@log project at Youtube at
https://www.youtube.com/watch?v=gegto_BOYRA

References


