

Telerehabilitation to reduce hospitalization of patients with chronic obstructive pulmonary disease in Denmark

Overview

In 2005, chronic obstructive pulmonary disease (COPD) was ranked the third greatest cause of disability adjusted life years (DALYs) in Denmark, after low back or neck pain and ischemic heart disease.¹ COPD placed a significant burden on the Danish health system and providing care for COPD consumed a large amount of health resources, mostly due to high rates of hospital admissions, frequent readmissions and lengthy stays. In response an alternative services delivery model was proposed by researchers specializing in e-health solutions and telemedicine at Aalborg University. A pilot programme to reduce hospital readmissions for patients with COPD by promoting home-based rehabilitation was designed. During an initial planning year, patients, health providers, researchers and

private technology companies collaborated to design a user-focused telerehabilitation intervention for patients with COPD. Patients participating in the study were required to self-manage their disease at home for four months using telemedicine services. To enable this, patients received education on COPD self-management and a monitoring device allowing them to collect and upload health data, such as blood pressure, oxygen saturation and lung function. Patient data was uploaded to a joint web portal for health providers to share information. District nurses regularly monitored patient data through the portal so they were able to provide personalized feedback on results and initiate referrals or treatment when necessary. Results from a control trial found a 54% reduction in hospital readmissions compared to

standard treatment, as well as self-reported improvements in patients' quality of life. Results from this study provided the necessary evidence to scale up the study across the North Jutland region and both the regional government and all 11 municipal governments signed on to the project, now known as TeleCare North. Aalborg University continues to oversee the initiative, with the regional government assuming operational management. A study on the impact of TeleCare North is due to be completed in 2015 and the results from Telekat and the TeleCare North are expected to inform a national model for telehomecare in Denmark as part of the National Telemedicine Action Plan.

Problem definition

Chronic obstructive pulmonary disease (COPD) places a significant burden on the health system in Denmark (Box 1). In 2010, COPD was the fourth highest cause of mortality, attributable to 7% of all-cause mortality that year.¹ COPD is one of the five most resource-intensive diseases in Denmark, accounting for

a fifth of all hospital admissions.² A quarter of all patients with COPD are admitted to hospital within the first month of a diagnosis.³

A key factor in managing COPD is ensuring consistent monitoring and rehabilitation following patients' discharge from hospital. Lack of continuation in patient information,

in part a result of each institution operating according to separate electronic databases, was attributed in part to this fragmentation. Further, the limited involvement of patients in the care process, coupled with their lack of knowledge on how to effectively manage their condition, increased the chance of deterioration.

Box 1

What problems did the initiative seek to address?

- High COPD disease-specific burden straining health system resources.
- Incompatible electronic medical record systems causing fragmentation of providers and reduced continuity of care.
- Limited capacity of patients to self-manage COPD symptoms leading to deterioration in their condition and frequent hospital readmissions.

Health services delivery transformations

Timeline of transformations

In 2008, researchers at Aalborg University in northern Denmark launched the Telekat project to design and test a telerehabilitation intervention for patients with COPD (Table 1); 111 patients with COPD were recruited into the study, which ran over a period of two years. Upon its completion in 2011, results showed a positive clinical and economic impact of the intervention, supporting the project's scale-up to the regional level. All 11 municipalities within the North Jutland region signed on to participate in the project, now known as TeleCare North. TeleCare North, currently ongoing since 2013, aims to test the viability and benefit of providing telerehabilitation for all patients in North Jutland with moderate to severe COPD. The project is due to be completed in 2015, at which time permanent adoption of the initiative will be considered.

Description of transformations

Selecting services. The Telekat pilot provided all patients with moderate to severe COPD residing in Aalborg and Hjoerring municipalities with standard COPD care. In addition, eligible patients

received instructions on how to take clinical measurements, including blood pressure, weight, oxygen saturation and lung function, using the equipment provided. Patients also received specialized education on self-managing their condition and performing preventive exercises, such as stretching neck muscles, exercising the chest cavity and walking, to improve their symptoms. Patients are monitored by health providers across sectors and receive personalized feedback on their condition via telephone or email. If complications arise or symptoms worsen, patients receive more frequent contact and monitoring. Further treatment is initiated as needed and patients may be digitally prescribed penicillin or hormones to help avoid unnecessary hospitalization.

Designing care. An extensive literature review led by Aalborg University helped inform care pathways used in the intervention. Health providers and patients contributed to the design of care pathways to ensure they were user-focused and practical. A traffic

light system is used to code clinical measurements recorded by patients as green (normal), yellow (potential concern) and red (cause for concern). Patients' monitoring devices contain information and guidelines on handling their condition and come with software that automatically guides patients through an exacerbation. Instructional guidelines for home-based exercises developed by the Danish Lung Association are used by the initiative. The level of support provided to participating patients is personalized based on individual needs, capabilities and stage of their condition.

Organizing providers. Patients are enrolled by hospitals, health care centres or their general practitioners. Once enrolled, patients become active care partners and take on many functions previously carried out by health providers. Patients now receive care in their own homes, easily accessing providers through the web portal, email or telephone as needed. While not physically present, providers regularly monitor patients' clinical data via the web portal and initiate contact if reported indicators

Table 1

What were the chronological milestones for the initiative?

2008	Telekat research project launched to develop and test a telehomecare rehabilitation intervention for patients with COPD to address concerns over fragmented services delivery and poor management of the condition.
2011	Telekat research project concludes; results show positive clinical and economic impact of the intervention.
2013	TeleCare North research project launched as a regional scale version of Telekat; project aims to test operational viability and impact of providing telehomecare for patients with COPD on a larger scale.
2014	Start of iTrain study, a multicentre randomized controlled trial between Denmark, Norway and Australia with a focus on long-term telerehabilitation of COPD patients.
2015	Planned evaluation of TeleCare North project; permanent adoption of the programme rests on results.

fall outside normal limits, symptoms worsen or patients' experience an exacerbation. Despite having less physical contact with providers, patients in the Telekat study reported feeling secure and cared for.

Extensive collaboration and effective communication between health providers across traditional institutional boundaries including hospitals, general practices and

community health centres, and across disciplines is required for effective delivery of the telerehabilitation programme. A shared web portal connects health providers (including general practitioners, specialists and nurses) directly to patients and their relatives. Monthly videoconference meetings between health providers involved with the project help coordinate activities and provide an opportunity

to collectively review patient cases. This new concept is encouraging health providers to learn "to play new roles and. ... to collaborate and share information in new ways."

Managing services. The initiative has been co-financed by Aalborg University, national government funds and contributions from all cooperating partners. All participating patients were provided

Table 2

How was the delivery of health services transformed through the initiative?

Before	After
Selecting services	
Patients with severe COPD receive disease management education via courses offered away from the home; frequent complications, exacerbations and co-infections cause patients with COPD to consume a high number of hospital services.	Patients with moderate to severe COPD receive disease management education at home; patients collect clinical measurements which are digitally monitored by health providers who then provide personalized feedback; oxygen, antibiotics and hormone therapies are available to patients at home.
Designing care	
Standardized care pathways for COPD exist for treatment in primary care and hospital settings; exercise guidelines for patients available from the Danish Lung Association.	New care pathways and guidelines informed by a literature review with input from providers and patients; care personalized to patient needs; traffic light system indicates to providers when to initiate additional treatment; software guides patients through handling exacerbations.
Organizing providers	
Patients receive care for COPD from multiple providers across different settings; lack of provider communication and collaboration leads to fragmented care; "patients experience having to engage in dialogue with many different health care professionals: hospital staff, general practitioners, home care nurses. ... Not everyone is equally knowledgeable of patients' situation or disease progression."	Web portal connects participating providers enabling shared access to comprehensive patient information; providers work as a multidisciplinary team across institutional boundaries with monthly videoconferences facilitating coordination; nurses closely monitor patient data and initiate contact with patients or make referrals when needed; patients have electronic access to providers.
Managing services	
Small-scale telemedicine projects piloted across the region, but no use of this technology on a large scale.	Project is co-financed by multiple partners and development funds; Aalborg University oversees research project with operational activities managed by regional and municipal governments; all necessary equipment provided for patients.
Improving performance	
Individualistic culture limits opportunities for shared learning.	Trainings for providers led by Aalborg University; shared learning and innovation driven by increased communication between providers and patients.

with the necessary resources to support home-based management of COPD, including a telehealth monitor. Patients were also provided with other necessary resources such as a pedometer and oxygen equipment.

The TeleKat research project was overseen by Aalborg University with operational activities managed by regional and municipal governments. Consolidation of the web platform helped to improve the management capacity of regional and municipal governments. Greater access to data and the increased emphasis on patient monitoring supports initiative managers in ensuring services delivery are being effectively delivered.

Improving performance. Trainings for health providers on telemedicine and promoting patient self-management were delivered by experts at Aalborg University and the initiative “used a lot of resources in education”. Additionally, close partnerships between health providers and patients have created opportunities for mutual learning.³

Engaging and empowering people, families and communities
Patients participating in Telekat have been educated and empowered to self-manage their COPD. Patients are no longer passive recipients of care, but active partners who play a central role in the care process. Digitally guided and supported by health providers, patients use monitors and devices in the comfort of their own homes to collect clinical measurements, monitor health indicators and treat arising symptoms. Patients received training to enable them to carry out their new role and can also access a wide range of informational materials on COPD through the web portal. Additionally, patients can also interact with peers through an online forum.

Seeing data presented in simple graphics, receiving feedback from health providers and sharing

knowledge with other patients have proved to be important factors for increasing patient involvement and motivation in their care. While it took time to convince health providers that patients could be empowered to self-manage care, seeing the success of patients and their motivation for the programme has helped build true partnerships between patients and providers. Providers in the Telekat study noted that they felt like coaches for patients, rather than carers. As one provider put it, “I feel that the COPD patients are getting to be more active and motivated to do training at home. I feel like a coach for them.”

Health system enabling factors

In Denmark, the national government has gradually increased the role of information technology in all public services, including health (Table 3). Legislation to support e-health is in development, helping to drive innovation and promote the use of available technology. Exchange of health care documents is now almost fully electronic, with each of Denmark’s five regions operating their own standardized electronic system, connected by a central web portal accessible by patients and providers. Private technology companies were vital partners in developing the necessary infrastructure for the portal; companies competed for contracts which helped drive innovation and reduce costs. Almost all health providers may access patient information through the portal; however, patients may choose to restrict access if they wish. A log is automatically generated each time patient data is accessed, helping to promote transparency and increase accountability of providers. The national government is working to expand health information held in the portal and considerable investments have recently been made to update infrastructure in hospitals across Denmark.

The Ministry of Health is guiding development of telemedicine through the National Action Plan for Dissemination of Telemedicine. Launched in 2013, the Plan aims to explore potential applications of telemedicine in the Danish health system and build knowledge in this area. Several large-scale telemedicine initiatives, including TeleCare North, are contributing information to the Plan and Ministry support is helping guide the initiation of large-scale telemedicine projects at the regional level. Government funds, such as the Public Welfare Technology Foundation, also make financing available for promising telemedicine initiatives. Aalborg University has helped develop a local pool of experts in telemedicine to support this evolution of the health system through offering a master and doctoral research degree in Medicine, Biomedical Science and Technology and housing the Transatlantic Telehealth Research Network (TTRN).

Outcomes

Telekat provided evidence that offering telerehabilitation to patients with COPD has a positive impact on health outcomes (Box 2). Hospital readmission rates of patients were 54% lower when telerehabilitation was implemented. Furthermore, interviews held with Telekat participants found that patients enjoyed learning about their condition, felt empowered by new knowledge, were secure receiving treatment at home, experienced a greater sense of control over their COPD and were motivated to perform recommended preventive exercises. As one patient said, “seeing my data on the web portal gives me a better understanding of how to exercise and interpret the development of my symptoms.” While implementation of TeleCare North is ongoing and outcomes are not yet available, it is expected to have a similarly positive impact.

Table 3

How has the health system supported transformations in health services delivery?

System enablers	Example
Accountability	<ul style="list-style-type: none"> Legislation concerning e-health is relatively accommodating, allowing most health providers access to electronic medical records if medically necessary. Logs document access to electronic medical records, ensuring transparency and responsible use.
Competencies	<ul style="list-style-type: none"> Higher education opportunities exist within the telemedicine field, including a doctoral degree in Medicine, Biomedical Science and Technology.
Information	<ul style="list-style-type: none"> National medical communication standards introduced in 1994; medical document exchange now almost completely electronic. Electronic medical records accessible through a secure central portal; system is being expanded to provide more complete information.
Innovation	<ul style="list-style-type: none"> National Action Plan for Dissemination of Telemedicine supporting innovation in health technology. National funds help support innovative health projects. Telemedicine research conducted by Aalborg University.

Box 2

What were the main outcomes of the initiative?

- Hospital readmission rate for COPD patients was 54% lower in Telekat participants compared to the control group.
- Majority of patients expressed a higher quality of life and felt positively about telehomecare; patients reported feelings of trust, security, empowerment and improved knowledge.

Change management

Key actors

Design of the initiative was led by Aalborg University in close collaboration with stakeholders; the

first year of the project was spent engaging stakeholders and creating a shared vision. “We started having workshops. Patients, district nurses, hospital providers, researchers, general practitioners and private technology companies were developing concepts for the project. This was a very good start. The project came through this dialogue.” The involvement of researchers helped mobilize participants and private technology companies ensured the focus remained on building a cost-effective solution. While for some health professionals collaborating with patients “was a challenge,” eventually they “saw how patients had good ideas and it was worthy to finally listen to them, exchange ideas and develop ideas together.” Paying for providers’ attendance at the workshops was

important for incentivizing their participation. Despite the initial communication challenges, the overall result of these collaborations was the design of a user-centred programme with improved understanding of other stakeholders’ views. Implementation of the resulting Telekat project was led by Aalborg University, who had the necessary expertise and experience in conducting telemedicine research. As Telekat evolved into the TeleCare North regional project, both regional and municipal governments have taken on an increasing role in the management of the programme, with Aalborg University providing oversight and guidance (Box 3).

Box 3

Who were the key actors and what were their defining roles?

- Aalborg University.** Initiated development of Telekat, oversaw the project and led its evaluation; key partner in the development and implementation of TeleCare North; major funding contributor for both initiatives.
- Regional Government of North Jutland.** Manage operational delivery of TeleCare North.
- Municipal governments.** Support delivery of TeleCare North; all 11 municipalities in North Jutland signed on to support the project.

Initiating change

A number of small-scale telemedicine trials conducted in North Jutland and other Danish regions provided starting ideas for the initiative. At the time, e-health in Denmark was expanding and there was considerable interest in telemedicine research. This context provided the necessary conditions to spark change. The personal motivation of a district nurse undertaking a PhD in telemedicine at Aalborg University

brought attention to the problem of “COPD patients going in and out of hospital the whole time” and pushed for an initiative which would “avoid them going to hospital so much”.

Implementation

Implementation of Telekat was led by Aalborg University and was described as being dynamic. As a pilot project, all stakeholders had to learn as they went along. Patient motivation for the project was noted as a key factor for its success and in turn served to motivate providers. However, some patients failed to fully engage with the service, highlighting that telehomecare may not always be the best treatment option for some patients. Initiative leaders hope to explore this further to improve services for these patients or determine a method for identifying and targeting suitable candidates.

Design of TeleCare North built on the lessons learned through Telekat and scaled up activities to

the regional level. The high cost burden of treating COPD, general national interest in telemedicine and prior success of Telekat helped secure the necessary regional and municipal government support.

Aalborg University continues to support implementation of TeleCare North, however the project is now managed by regional and municipal governments.

Moving forward

The TeleCare North study is due to be completed in 2015. At this

time, all patients enrolled in the study (including those in the control group) will have the opportunity to use telehomecare services for their COPD moving forward. Results of TeleCare North will add to the evidence base on telemedicine and provide information on its clinical and economic effectiveness. If successful, the TeleCare North model will be adopted as the national care standard for COPD.

Highlights

- The political environment and recent changes to legislation provided a platform for the development of e-health and telemedicine.
- Partnering with stakeholders outside the health sector supported the development of telemedicine and helped drive transformations in services delivery.
- The initiative focused on providing patients with a more active role in care and created new collaborative partnerships between patients and providers.

1 Institute of Health Metrics and Evaluation. (2015). *Global burden of disease: Cause patterns*. Retrieved from <http://vizhub.healthdata.org/gbd-compare/>

2 Udsen, F. (2013). *Health economic effects of telemedicine for chronic obstructive pulmonary disease: Findings from the Danish TeleCare Nord cluster randomized trial*. Aalborg: Danish Centre for Healthcare Improvements. Retrieved from http://www.dchi.aau.dk/digitalAssets/62/62153_fwu---uk-projektbeskrivelse.pdf

3 Dinesen, B., Andersen, SK., Hejlesen, O., & Toft, E. (2011). Interaction between COPD patients and healthcare professionals in a cross-sector telehealth-rehabilitation programme. *Studies in Health technology and Informatics* 169: 28-32