

A Case Study of the Technology Use and Information Flow at a Hospital-driven Telemedicine Service

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Abstract. Health care services face the challenge of providing individualised treatment to a growing ageing population prone to chronic conditions and multi-morbidities. The research project *Patients and Professionals in Productive Teams* aims to study health care services that are run with a patient-centred teamwork approach. In this context, a case study was made of a hospital-driven telemedicine service for chronic obstructive pulmonary disease patients after hospital discharge, with a focus on information flow and technology use. The methods used were observation and interviews with key informants. The results showed that the technology was perceived as well-functioning for telemedicine support, but the technology used was a standalone system and not integrated with the electronic health record of the hospital. In addition, there was lack of support to provide the patients at home with written instructions on advices of medical treatment and care. The electronic information used for this telemedicine services, allowed shared access of information for teamwork between professional only within the hospital.

Keywords. Patient-centred care, telemedicine, videoconference, information technology

1. Introduction

Demographic changes demand the health care services to face the challenge of individualising treatment to a growing ageing population that is prone to chronic conditions and multi-morbidities [1]. The World Health Organization (WHO) has emphasised that there is need to focus on patient-centred health care service models [2]. There is a need to understand how to operationalise patient-centred care with technology that efficiently supports team collaboration, where quality of care and patient outcomes are central. In this context, the research project *Patients and Professionals in Productive Teams* (3P) aims to study health care services that are run with a patient-centred teamwork model [3][4]. 3P is a 4-year long project (2016-2020), approved by the Research Council of Norway and funded through Helseforsk, a program for national funding from the Regional Hospital Trust Funds of Norway to cross-regional health care services research projects [5]. The 3P project involves four innovation arenas in Norway and Denmark, that are included in the research of models

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for patient-centred health care teams. This paper presents a case study made in one of the innovation arenas, which is a hospital-driven telemedicine service for chronic obstructive pulmonary disease (COPD) patients after hospital discharge. The focus was on information flow and technology use within a teamwork setting. The research questions (RQs) stated for the case study were:

RQ1: *How does information technology support the communication and work processes at a telemedicine service?*

RQ2: *What are the benefits and constraints of the telemedicine technology for patient-centred care?*

2. Methods

Qualitative research methods were used in the case study [6][7]. A field study with observations was made at the telemedicine service together with individual- and focus group interviews to gain an understanding of the technology interactions and information flow within the patient-centred procedures of the involved health care team. A total of 12 informants contributed to the study during the spring of 2017. The group of informants included health care professionals, patients, technicians and administrators.

The data collection, consisted of audio-video recorded interviews and field notes from observations and demonstrations of the technology.

The Norwegian Centre for Research Data (NSD) approved the study, with project number 53771 [8]. The participation in the study was voluntary and the informants received written information about the project and signed a consent form.

3. Results

The collected data were categorised into two main topics: 1) organisation and workflow and 2) technology interactions and information flow.

3.1. Organisation and Workflow

The telemedicine service was organised as a separate unit at a hospital, with two nurses that were responsible for running the daily operations. New patients were enrolled into two categories: 1) a randomized controlled trial (RCT) with a protocol to follow for 10 telemedicine consultations [9], 2) telemedical follow up in sustainable operational services as long as the medical conditions required or 14 days [10]. The nurses at the telemedicine service made phone calls to eight wards at the hospital every day and visited one local ward, to identify patients with COPD that would benefit from the remote monitoring procedure. In addition, General Practitioners (GP) could refer patients on short notice for telemedical service. For the 10 telemedicine consultations, there was a guide with 10 topics, such as inhalation techniques, nutrition and physical activity, to go through in order to give adequate training and support to the patient. For the telemedical consultations the nurse collaborated with physiotherapist, occupational therapist, and nutritionist as a part of the team at the hospital, and they also had individual telemedical consultations with the patients. The primary medical responsible for the patient's treatment was the GP. In addition, there was a local doctor at the hospital that was

available for medical advises. During the period when a patient was enrolled into the telemedicine service, it worked as a one-point-of-contact for the patient. The nurse could assist with contacting or sending referral to health care professionals and related services when needed due to medical circumstances. At day-time the nurses were present at the telemedicine service, and during evening, night and weekends there was a nurse on duty in a ward that patients could contact by phone. When a patient in the RCT category was discharged from the service, an appointment was made for a six month follow up consultation.

3.2. Technology Interactions and Information Flow

Two technical systems were used at the service: the hospital electronic health record (EHR) from the vendor DIPS and a solution for the telemedicine consultations by the vendor Imatis. Both systems were used simultaneously. The time appointment system and medical notes were made in the EHR system. The telemedicine consultations were made through the Imatis web-based system where transmission to cloud-based server storage was made through Hypertext Transfer Protocol Secure (HTTPS). For this system, the patient's administrative information had to be manually registered, see description of the information flow and technology use in Figure 1.

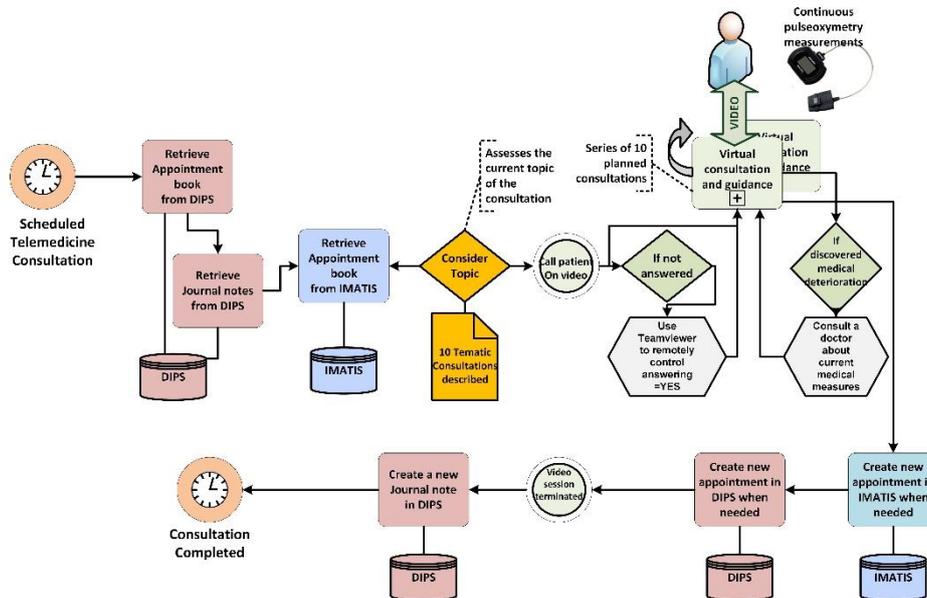


Figure 1. The information flow and technology interaction in the telemedicine service.

For the telemedicine consultation, the nurse used a desktop with an external web-camera and two screens, one for each system, see Figure 2 (left). The patient at home used a tablet with a stand, provided in a small suitcase, and with a pulse oximetry using Bluetooth for communication with the system, see Figure 2 (right). During consultation, the pulse and peripheral capillary oxygen saturation (SpO₂) results were shown live on screen for the telemedicine system.



Figure 2. Telemedicine nurse preparing consultation (left) and tablet with a stand for patient's home (right).

When enrolling a new patient to the telemedicine service, an inclusion letter was sent electronically to the patient's GP. During the first telemedical consultation the nurse created a journal note in the patient's EHR and during the following consultations, the pulse oximetry results were manually transferred to journal note in the EHR from the information observed in the telemedicine system. This note was finally signed when the patient was discharged from the service, meaning that all measurements and medical notes were documented in the same journal note for the whole period. At discharge from the service, the nurse wrote a discharge letter (epicrisis) sent electronically to the patient's GP. When needed for technical reasons, as if the patient were not able to answer the video call, the nurse could remotely control the tablet with the Teamviewer program and accept the video conference on behalf of the patient. For privacy reasons, such remote control was agreed on during a phone call in advance.

During the field study, it was stated that being able to see the patient on the screen was beneficial for evaluating the respiration pattern and colour of the skin. In addition, it was expedient for instructions of inhalation technique for medication, as the actions of the patient could be observed. It was not a systematic use of written instructions for temporary changes in medication and an electronic message could not be sent to the patient's tablet.

4. Discussion

This paper has presented a case study of the technology interactions and information flow at a telemedicine service driven with a patient-centred team model. The research questions (RQs) formulated at the beginning of this paper are answered based on the results.

For RQ1, asking about how the technology supported the communication and working processes at the telemedicine service. The study showed that the technology was perceived by the informants as well-functioning for telemedicine consultations between health care professionals and patients at home. Phone was used for communication to identify COPD patients within the hospital for the telemedicine service. Phone was also used for contacting the patient's GP. The telemedicine system was a standalone technology and not integrated into the EHR of the hospital organisation, which created some double work with manual registrations in two separate systems. The

telemedicine service used one journal note for the patient in the EHR, covering the entire period of enrollment, to ease the overview.

RQ2 asked about benefits and constraints of the telemedicine technology for patient-centred care. The study identified both strengths and weaknesses with the technology used. With focus on patient-centred care, it was beneficial being able to see the patient on the screen compared with phone consultations, especially regarding respiration and inhalation technique as the nurse could continuously measure pulse oximetry data online during the video consultation. The telemedicine service worked as one-point-of-contact as long as the patient was enrolled, but also after the telemedicine service period this group of chronic patients would need a permanent one-point-of-contact, as recommended in [10]. It was observed that written instructions could not be sent to the patient after a telemedicine consultation, due to lack of technology support. The server storage for the telemedicine system was made abroad, which raises some concerns on privacy and security as the access to medical information in Norway is very restricted [11]. The actual technical solution used for the telemedicine service was not suited for teamwork except that incorporated personnel at the hospital could log on to the stand-alone system and get access to information. In addition, the important journal notes were made in the EHR normally used at the hospital; however, without any integration to the telemedicine system.

This study has some limitations, such as including only one innovation arena. Nevertheless, the study had a number of participants with different professions and backgrounds that meaningfully represented the user groups at telemedicine services.

Future work would include similar studies of the other three included innovation arenas in the project, and in a final phase make comparisons of technology support in patient-centred team settings.

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