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Evaluating the Usability of a Telehealth System for People with COPD: A Cross Sectional Study

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Abstract. Pulmonary Disease (COPD) exacerbations. However, the effect of telehealth for COPD remains uncertain, which may be due to a lack of attention to usability during the development of telehealth solutions. The aim was to evaluate the usability of a telehealth system for COPD using the Danish Telehealth Usability Questionnaire. A total of 96 people with COPD, who were already using a telehealth system consisting of weekly measurements of physiological parameters and symptom-related questionnaires, were included. The D-TUQ was used to assess the usability of the telehealth system. The overall experience with the usability of the telehealth system was mainly positive, but there was room for improvement.

Keywords. telehealth, usability, chronic obstructive pulmonary disease, telehealth usability questionnaire, cross sectional study

1. Introduction

COPD has become a significant global health challenge and is one of the leading causes of morbidity and mortality, which has led to an increase in the economic and social burden for societies worldwide [1]. One of the main causes of COPD mortality is acute exacerbation of the disease [1].

Telehealth solutions are increasingly used for early detection of COPD exacerbations [2]. Some studies indicate that the use of telehealth combined with usual care reduce dispensable emergency room visits, exacerbations, and hospitalizations [3,4]. However, disagreement about the effect of telehealth remains, as other studies found no statistically significant improvements in health status [5,6]. The disagreement underlines the need for further research.

The limited impact of telehealth solutions may stem from a lack of attention to usability during the development of telehealth systems. Usability minimizes the risk of end-users encountering difficulties in using the equipment, as unusable systems can frustrate users, causing difficulties in learning to use the system, and ultimately leading to disuse [7,8]. Therefore, it is important to be aware of usability when developing and

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implementing new technologies [8]. The Telehealth Usability Questionnaire (TUQ) is one of the most used questionnaires evaluating the usability of telehealth systems [9] and can be used to evaluate different types of telehealth solutions [10].

The present study aimed to evaluate the usability of a Danish telehealth system for COPD using the Danish version of TUQ (D-TUQ).

2. Methods

2.1. Study Design and Setting

The present study was a part of evaluating the patient perspective in a randomized controlled trial (NCT05218525), approved by the Regional Committee on Health Research Ethics in Northern Denmark Region (N-20200076), and described in detail elsewhere [11]. This study was a cross sectional study conducted between May 2022 and November 2022 in Denmark. Participants were recruited by COPD community health professionals (mainly nurses). The inclusion criteria for participation were the following: people aged \geq 18 years, having a COPD diagnosis, already using the telehealth system, and residing in Aalborg municipality, Denmark. The telehealth system involved home measurements of oxygen saturation three times a week, as well as blood pressure, pulse, weight, and completion of symptom-related questionnaires once a week. The equipment included in the system consisted of: a tablet (Galaxy TAB 2, 10.1, Samsung Electronics, Seoul, South Korea), a fingertip pulse oximeter (Nonin, Onyx II% SpO2, A and D Medical, Tokyo, Japan), a blood pressure monitor (Model UA767, plus BT-C, Nonin Medical, MN, USA), and a scale (Precision Health Scale, UC-321PBT-C, A & D Medical, Tokyo, Japan). Healthcare professionals monitored the wirelessly transferred measurements weekly to detect exacerbations. The D-TUQ was sent by mail to 137 trial participants to examine the usability of the telehealth system. The questionnaire consists of 21 questions divided into five subscales [10,12]: usefulness, ease of use and learnability, effectiveness, reliability, satisfaction and future use. The options ranged from 1 (disagree) to 7 (agree), with "not applicable" (N/A) also being an option. The participants answered the questionnaire at home and was subsequently reviewed by three authors (JE, SHL, and LH) to ensure correct understanding of the questionnaire.

2.2. Data Analysis

Descriptive statistics of answers from the D-TUQ was calculated using Excel (Microsoft 365, 2310, (16.0.16924.20202)). The median score a long with interquartile ranges (IQR) was calculated for all answers in each subscale. Four out of five questions in the subscale *effectiveness* (question 11-14) were related to video interaction quality [10] and excluded as this was not a part of the telehealth system [10]. Therefore, *effectiveness* consisted solely of question 10.

3. Results

Of the 137 included trial participants, 96 (70.1 %) completed all items of the D-TUQ and was used in the analysis, while 41 either did not complete or only partially completed the questionnaire. Table 1 provides the baseline characteristics of the 96 participants.

Variable		Participants (n=96)
Gender	Female Male	57 (59.4) 39 (40.6)
Age		72.3±7.2
Civil status	Married/domestic partnership Single Widow/widower	53 (55.2) 30 (31.3) 13 (13.5)
Employment status	Employed Unemployed	7 (7.3) 89 (92.7)
Highest educational level	Primary school High school Higher education Trade school/Apprenticeship	38 (39.6) 2 (2.1) 12 (12.5) 44 (45.8)
Years since COPD diagnosis		13.6±7.2

 Table 1. Baseline characteristics of participants. The numbers are means (SD) or number (proportion %).

The median score of the D-TUQ subscales based on responses from all participants are presented in Figure 1. Overall, the median score was 7 in *easy to use and learnability* (IQR 6-7), *effectiveness* (IQR 5-7), and *satisfaction and future use* (IQR 6-7). The lowest median score was attached to *usefulness* with a median of 5 (IQR 2-7), whilst *reliability* had the second lowest median score with a median of 6 (IQR 3-7).



Figure 1. The median score and interquartile ranges (IQR) of each of the five D-TUQ subscales: *usefulness, easy to use and learnability, effectiveness, reliability,* and *satisfaction and use.*

4. Discussion

The present study evaluated the usability of a Danish telehealth system for people with COPD using the D-TUQ. The participants rated the usability of the telehealth system high, as three out of five subscales had a median score of 7 with a small IQR. The high median score indicate that the participants overall experienced the telehealth system to have a high degree of usability, which mirrors the findings from previous studies [3]. Since the participants rated *usefulness* and *reliability* lower, they might prefer usual care to telehealth which could negatively impact the effectiveness of the telehealth solution [10,13]. However, Koh et al. [14] found that telehealth solutions should be considered as a supplement to usual care, since telehealth system should perhaps be considered as a supplement to usual care to increase the effectiveness of telehealth solutions in reducing the increased burden on healthcare systems [14].

Although the participants generally rated the telehealth system relatively high on a 7-point Likert scale, there is still room for improvement, as *usefulness* and *reliability* had a large IQR. Most of the participants were older adults with a low level of education, which can make it difficult to adapt to telehealth solutions due to the physical, mental, and social changes associated with aging [15]. However, more older adults than ever before use the internet and thus utilize technologies daily. It should be noted that there is still digital inequality among older adults, as greater control in dealing with digital technology is associated with a younger age and a high level of education [16]. This clearly indicates that there is still need for further development of telehealth solutions with high usability tailored to the needs of people with lower digital literacy.

TUQ was used to investigate the usability of the telehealth system, as it is a robust, solid, and commonly used questionnaire [9]. However, findings from a previous study indicate that a reduction in the number of questions is needed [12]. We also experienced that some of the questions were irrelevant, as they assumed, that video was an option in the telehealth system used, even though it was not. This resulted in confusion among the participants and might affect the results. A possibility to only select questions related to the specific telehealth system being investigated, may reduce this confusion, and increase the validity of the results.

5. Conclusions

In conclusion, the participants generally evaluated that the Danish telehealth system had a high degree of usability even though it involved several devices and with three weekly measurements. However, the evaluation of the usefulness and reliability of the telehealth system varied, resulting in the lowest usability score. This highlights the need for future studies to delve deeper into the Danish telehealth system's usefulness and reliability. Moreover, it could be relevant to explore the possibility of adjusting the TUQ by reducing the number of questions.

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