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USABILITY OF DIGITAL MEDIA IN PATIENTS WITH COPD: A PILOT STUDY

Amy Cheung
Department of Information, Communication and Medical Technology, Catharina Hospital, Eindhoven, The Netherlands

Anton Janssen
Biomedical Sensor Systems, Philips Research Laboratories, Eindhoven, The Netherlands

Oliver Amft
Department of Electrical Engineering Signal Processing Systems, Eindhoven University of Technology

Emiel F. M. Wouters
Dept. Respiratory Medicine, Maastricht University Medical Centre (MUMC+), Maastricht, The Netherlands

Martijn A. Spruit
Program Development Center, CIRO+, Center of Expertise for Chronic Organ Failure, Horn, The Netherlands

Background: Digital media can be integrated in tele-monitoring solutions, serving as the main interface between the patient and the caregiver. Consequently, the selection of the most appropriate digital medium for the specified target group is critical to ensure compliance with the tele-monitoring system.
Objectives: This pilot study aims to gather insights from patients with chronic obstructive pulmonary disease (COPD) on the ease-of-use, efficacy, effectiveness, and satisfaction of different types of digital media.
Methods: Five off-the-shelf digital media devices were tested on nine patients at CIRO+ in Horn, The Netherlands. Usability was evaluated by asking patients to use each device to answer questions related to their symptoms and health status. Subsequently, patients completed a paper-based device usability questionnaire, which assessed prior experience with digital media, device dimensions, device controllability, response speed, screen readability, ease-of-use, and overall satisfaction. After testing all the devices, patients ranked the devices according to their preference.
Results: We identified the netbook as the preferred type of device due to its good controllability, fast response time, and large screen size. The smartphone was the least favorite device as patients found the size of the screen to be too small, which made it difficult to interact with.
Conclusion: The pilot study has provided important insights to guide the selection of the most appropriate type of digital medium for implementation in tele-monitoring solutions for patients with COPD. As the digital medium is an important interface to the patient in tele-monitoring solutions, it is essential that patients feel motivated to interact with the digital medium on a regular basis.

Keywords: COPD, User-computer interface, Mobile phone, Computer

The prevalence of chronic diseases is on the rise (1). Coupled with healthcare staffing shortages, the economic and healthcare burden of chronic diseases to society is escalating, in particular for chronic obstructive pulmonary disease (COPD) (2). To reduce the healthcare resource burden, a paradigm shift is emerging, in which certain aspects of care from the hospital setting is being transferred to the home environment (3;4). Consequently, there is an increasing reliance on the use of information communication technologies (ICT) to the support the change in the management of care.

Little attention has been paid to identify the most suitable type of digital medium for the patient to use on a daily basis. In tele-monitoring solutions, the digital medium is an important interface for the patient as it serves as a channel to acquire and send information, such as questionnaire responses or advice, to and from the caregiver. It is, therefore, essential that patients feel motivated to interact with the digital medium on a regular basis to ensure compliance. We conducted a pilot study to gather insights from patients with COPD on the usability of five different types of digital media.

METHODS

Nine patients (six men; mean age: 60.6 years, range: 43–75 years), one with persistent asthma and eight with mild to very severe COPD, each with varying education levels, were recruited from CIRO+ (Horn, The Netherlands) (5). None of the patients used long-term oxygen therapy and all patients were clinically stable. Participants consented to volunteer and de-identified pilot data were used for analyses. The intention of the study was primarily to gather preliminary insights; therefore, Institutional Review Board approval was not obtained. Five different devices from three categories (one netbook, three tablet PCs, and one

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Table 1. Characteristics of Digital Media Tested

Type of device	Netbook	Tablet PC #1	Tablet PC #2	Tablet PC #3	Smartphone
Brand name	Acer Aspire One D255	iPad 1	Galaxy Tab P1000	Icarus T701	HTC Desire
Manufacturer	Acer	Apple	Samsung	Icarus	HTC
Screen (inches)	10.1	9.7	7	7	3.7
Resolution (pixels)	1024 × 600	1024 × 768	1024 × 600	800 × 480	480 × 800
Controllability	Touch pad and mouse	Capacitive touch screen	Capacitive touch screen	Capacitive touch screen	Capacitive touch screen
Dimensions (mm)	185 × 259 × 24	190 × 243 × 13.4	120 × 190 × 12	115 × 193 × 13	60 × 119 × 12
Weight (kg)	1.250	0.700	0.380	0.400	0.135

smartphone) were used in the usability test (table 1). At least two researchers were present during testing.

To evaluate the devices' usability, patients were asked to answer questions related to their symptoms and health status. The questionnaire was implemented in a temporary Web site that could be accessed by all devices. A Web browser interface was selected to enable the questionnaire to be automatically scalable to the resolution and screen size of the device under test, which ensured that the look and feel of the questionnaire was consistent across all devices. The patients were informed that the answers to the questionnaire were not important and that the usability of the device was the key criterion for assessment. The order of the devices was alternated to prevent any learning effect. An instruction sheet was available for each device to provide guidance in switching the device on and navigating to the Web site. Once patients had answered questions using the device, they completed a paper-based device usability questionnaire, comprising thirteen questions designed to gather information on previous experience with digital media, usability, and overall satisfaction. After testing all devices, the patients were asked to rank the devices according to their preference. The patients' answers were erased directly after completing the protocol.

RESULTS

Device Usability Questionnaire

Seven patients were experienced laptop users, two of tablets, and four of smartphones. Various aspects of device usability were tested (Table 2). The majority of patients considered the netbook (using the external mouse), tablet PC #2 and the smartphone to be easy, good or very good to hold, while the tablet PC #1 and #3 were regarded as inconvenient to grasp. Tablet PC #3 was deemed to be on the large side, while the smartphone was judged to be too small. All patients perceived the netbook and tablet PC #2 to be easy and (very) good to control. The smartphone was reported to be (very) inconvenient to use. All patients agreed that the screen of the netbook and tablet PC #3 to be sufficient. The netbook and tablet PC #1 scored the highest in terms of response speed, while others were to be slower in response to commands. The majority of patients found the devices to be easy or intuitive to use when answering the symptoms and health status questionnaire. The user interface of all devices was perceived to be either comfortable or easy to use. Patients felt most motivated using the netbook or tablet PC #1 or #2. Almost all patients would like to own and use the netbook. Moreover, the netbook was ranked as most favorable device four times, the Galaxy Tab twice, and all remaining devices once.

Observations

The researchers noted several observations during the testing of the devices:

- Many patients had difficulty obtaining a reaction from touchscreen based devices and often required several attempts before the device responded. The lack of response to commands were due to two key reasons:
  1) Large fingers: This made it difficult to select the desired answer, especially when the screen size was small.
  2) Cold/dry fingers: The touchscreen devices under test all used capacitive-based touchscreens, which require good skin conductivity to complete the circuit with the screen. As a result, lack of moisture and salt will inhibit the ability of the touchscreen to operate effectively.
- If the response speed of the touch screen was slow or no reaction to commands was received, patients reacted in two ways:
  1) Pressing the touch screen multiple times; this often resulted in incorrect answers to questions being selected.
  2) Losing motivation to give the intended answer; patients would accept any answer that received a reaction.

DISCUSSION

This is the first pilot study to gather important insights from COPD patients on the ease-of-use, efficacy, effectiveness, and satisfaction of different types of digital media. The netbook was identified as the most favorable device for COPD patients to interact with. Moreover, the netbook was considered to have a faster response and better readability, both of which are essential aspects of usability, regardless of prior experience with the device.

Previously, the usability and quality of health-related services on the Internet were studied (6). Furthermore, research

Table 2. Patient Responses to the Device Usability Questionnaire

Patients perception of the device usability					
	Acer Aspire (Netbook)	iPad1 (Tablet PC #1)	Galaxy (Tablet PC #2)	Icarus (Tablet PC #3)	HTC (Smartphone)
This device was convenient to hold	7/9	6/9	8/9	5/9	8/9
This device was the perfect size	8/9	7/9	8/9	6/9	6/9
This device was good to control	9/9	7/9	9/9	8/9	5/9
The screen was readable	9/9	8/9	8/9	9/9	8/9
The device reacted to my commands in timely manner	9/9	7/9	5/9	4/9	5/9
The questions were easy to answer on the device	9/9	9/9	9/9	9/9	8/9
The interface was comfortable to use	8/9	7/9	7/9	6/8	7/9
Patients overall satisfaction with the devices					
	Acer Aspire (Netbook)	iPad1 (Tablet PC #1)	Galaxy (Tablet PC #2)	Icarus (Tablet PC #3)	HTC (Smartphone)
This device was motivating to use	7/9	7/9	6/8	4/8	4/8
Would you like to own and use this device	8/9	5/9	6/9	4/9	4/9

Some patients forgot to answer several questions when assessing tablet PC #2 and #3 and the smartphone; hence only eight responses were obtained for some questions.

has focused on the development of an appropriate user interface for the patient to facilitate accessibility (7;8). The usability of commercially available netbooks, tablet PCs, or smartphones, however, have never been studied in patients with COPD. These pilot data provide the first evidence that patients with COPD are able to use digital media, in particular a small netbook with an external mouse. This may, at least in part, be explained by previous experience with the same device, its ease of use, and the size and the readability of the screen. Indeed, a sufficiently sized screen is required if patients are expected to interact with the screen. The smartphone was judged by patients to be the most difficult device to control, as many had problems pressing the correct buttons due to the small screen size. Good device controllability is an important aspect to consider as it can influence how patients answer the questionnaire. Devices with poor controllability can result in inaccurate answers to the questionnaire and/or lead to frustration, which may cause the patient to cease using the device. Interestingly, the touchscreen devices all used capacitive-based touch screens, which require good skin conductivity to interact with the screen. This most probably explains the less favorable usability scores for these types of devices. Future trials should consider using resistive-based touch screens. Moreover, providing immediate feedback (e.g., clicking sound if the touch was successful) could be worthwhile to ensure accurate and reliable answers are obtained.

Most patients were familiar with the use of the netbook, which could be an important factor to account for when selecting a digital medium as minimal disruption to a patient's daily routine. This may also enhance acceptance of the device by the patient and residing family members. Whether and to what extent the current scores will improve for the other devices after a familiarization period remains currently unknown, but seems an interesting question to address in future studies.

This pilot study is fairly small-sized, which may limit external validity. Consequently, a larger study would be required to corroborate these findings. Moreover, device usability also needs to be tested in COPD patients who are suffering from an exacerbation, as tele-monitoring systems are suggested to be used to prevent COPD exacerbations or to start its early treatment to avoid hospitalization (9). Finally, physicians may have different preferences concerning user interfaces for doctor-patient communication, which warrants further studies (10).

To conclude, the pilot study has provided important insights into the most appropriate choice of digital medium for patients with COPD to operate with. Evidently, the netbook tested in the study is the device that patients believed most comfortable and satisfied using as it was easy to control, fast to respond to commands and text was easily readable, making it the clear favorite for the preferred device to own and use.

CONTACT INFORMATION

Amy Cheung, PhD, Department of Information, Communication and Medical Technology, Catharina Hospital, Eindhoven, The Netherlands

Anton Janssen, Biomedical Sensor Systems, Philips Research Laboratories, Eindhoven, The Netherlands
Oliver Amft, PhD, Assistant Professor, Department of Electrical Engineering Signal Processing Systems, Eindhoven University of Technology
Emiel F.M. Wouters, PhD, MD, Professor, Dept. Respiratory Medicine, Maastricht University Medical Centre (MUMC+), Maastricht, The Netherlands
Martijn A. Spruit, PhD, Program Development Center, CIRO+, center of expertise for chronic organ failure, Horn, The Netherlands

CONFLICTS OF INTEREST

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