The use of eHealth in rehabilitation after stroke

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The patient perspective on the use of information and communication technologies and e-health in rehabilitation

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Abstract

Introduction: Success of e-health relies on the extent to which the related technology, such as the electronic device, is accepted by its users. However, there has been limited research on the patients' perspective on use of e-health-related technology in rehabilitation care.

Objective: To explore the usage of common electronic devices among rehabilitation patients with access to email and investigate their preferences regarding their usage in rehabilitation.

Methods: Adult patients who were admitted for inpatient and/or outpatient rehabilitation and were registered with an email address were invited to complete an electronic questionnaire regarding current and preferred use of information and communication technologies in rehabilitation care.

Results: 190 out of 714 invited patients completed the questionnaire, 94 (49%) female, mean age 49 years (SD 16). 149 patients (78%) used one or more devices every day, with the most frequently used devices were: PC/laptop (93%), smartphone (57%) and tablet (47%). Patients mostly preferred to use technology for contact with health professionals (mean 3.15, SD 0.79), followed by access to their personal record (mean 3.09, SD 0.78) and scheduling appointments with health professionals (mean *3.07, SD 0.85)*.

Conclusion: Most patients in rehabilitation used one or more devices almost every day and wish to use these devices in rehabilitation.

Introduction

In The Netherlands, approximately 90,000 persons are admitted to specialized rehabilitation each year due to illness, an accident or a congenital disease [1]. Multidisciplinary inpatient and outpatient rehabilitation is one of the most expensive health care sectors in the Netherlands [2]. Rising healthcare costs and decreasing number of health professionals [3] as well as the increasing number of patients having access to and using the Internet warrant the need for innovative and efficient rehabilitation strategies.

E-health allows cost-effective disease management as well as patients' empowerment and health promotion [4]. The definition of e-health is "the use of new Information and communication technologies (ICT), mostly internet technology, to improve or support health and health care" [4]. Examples of e-Health in rehabilitation include virtual reality, computer games, assistive technology and online communication tools. Especially, long-term medical care needs could be addressed at significant lower expenditures [5], by means of improved accessibility to rehabilitation programs for clients with mobility impairments [6–8], expanded continuity of care and increased self-management by promoting personalized care, choice and personal autonomy [9]. Indeed, a number of studies showed that e-health is acceptable for subgroup of patients in rehabilitation care [9–11] and has the potential to support management of chronic conditions such as Alzheimer's/ dementia [12], diabetes [13,14] and COPD [15,16].

Despite the many advantages, limited uptake and non-use of ehealth interventions is still a common problem in health care [7,8]. The Normalization Process Theory explain problems with embedding an innovation in practice by the complex interplay between the new technology, individual actions and context [17]. In line with the Diffusion of Innovations theory of Rogers, the fit between the

needs of individuals and groups and the e-health services is of utmost importance [18]. Thus, identifying patients' preferences is required before development and implementation of e-health [18–20]. Indeed, in previous studies it was found that adoption of ehealth was associated with a persons' positive attitude toward technology, self-efficacy and perceived usefulness [19–21]. Moreover, Vankatesh's Unified Theory of Acceptance and Use of Technology (UTAUT) explains current performance and use behaviour explain a large proportion of the variance in the intention to use a new technology [22,23]. In addition, a few studies identified patients' preferences for e-health in rehabilitation by using a qualitative research design [7,24,25]. These studies found that patients with cancer and diabetes were willing to use ICT in (rehabilitation) care for self-monitoring of symptoms, web-based physical exercise programs [7], communication with peers [24,25] and access to their health record [7]. However, a lack of studies with a quantitative design impaired generalization of results and so far it is unclear what usage preferences are for other patient

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groups in rehabilitation care.

In summary, for the rehabilitation setting specifically it is unclear which ICT devices are most commonly used by patients in rehabilitation and what their needs and preferences are regarding e-health services needs to be delivered.

This paper aims to contribute to future research and use of ICT tools in rehabilitation care. Therefore, we aim (1) to explore usage of ICT devices among rehabilitation patients and (2) to investigate patients' perspective to incorporate this technology in the rehabilitation process.

Methods

Study design

This cross-sectional study, involving a one-time online survey, was conducted between March 2014 and May 2014 among (former) patients who had been admitted to a Rehabilitation Centre in The Netherlands. The study protocol was presented to the Medical Ethical Committee of the Leiden University Medical Center. They judged the study as non-medical research according to the Medical Research Involving Human Subjects Act.

Patients

Patients were invited to participate in the study if they met the following criteria: (1) 18 years and older, (2) admitted for inpatient and/or outpatient rehabilitation between 2008 and 2013 and (3) being registered with an email address to select patients with access to and using ICT. Potentially eligible patients were first identified by searching the electronic patient registers of the rehabilitation centre. All eligible patients received an email with information about the study and an invitation to fill in the survey by using the digital link.

Survey

An online questionnaire was developed in collaboration with patient representatives in order to measure usage preferences of electronic devices in rehabilitation health care. The self-developed questionnaire comprised a maximum of 61 questions that aimed to identify current possession and use of ICT devices (maximum of 27 questions) and desired usage of ICT devices in the rehabilitation process in the future (maximum of 15 questions).

In addition, 19 questions were about following socio-demographics and disease characteristics: gender, age, living status (living alone or living with partner/family), educational level (low: up to and including lower technical and vocational training; medium: up to and including secondary technical and vocational training; and high: up to and including higher technical and vocational training and university) [26] and occupational

status (student, employed, unemployed and disabled of retired).

For 27 out of 61 questions, patients were able to select one or more answers from a given set of options questions (a minimal of two and a maximum of eight options), 14 questions required an open answer and 10 questions required the answer "Yes" or "No". Moreover, 10 questions that were used to examine user preferences were initially measured on a 4-point Likert scale (1 ¼ totally disagree, 2 ¼ disagree, 3 ¼ agree and 4 ¼ totally agree). These items were used to calculate the mean per item in order to make a ranking from highest till lowest preference.

The questionnaire was pilot tested among 59 patients from the rehabilitation centre for completeness, feasibility, readability and presentation (e.g., perceived question difficulties, response errors, screen layout, etc.). The pilot testing lead to minor changes in the wording and format of the final questionnaire.

A total of three reminders were sent for participation in the study. Patients received the first reminder 2 weeks after invitation. The second reminder was sent 1 week after the first reminder. All data from the online survey were collected anonymously.

Statistical analysis

Patient characteristics, possession and use of ICT devices and user preferences of ICT in rehabilitation were analyzed using descriptive statistics and presented as numbers with percentages, means with standard deviations (SD) or medians with ranges (Inter Quartile Range; IQR), i.e., 25th percentile–75th percentile) where appropriate. Results about possession and use of ICT devices were presented for the total group and for different age categories based on the 25% percentile distribution of age. Age was divided in four categories: (1) 18–36 years, (2) 37–51 years, (3) 52–61 years and (4) 62 > years. The group of eligible patients was compared to the group of responded patients regarding their age and gender using the independent ttests and the Mann Whitney U test, the Chi-square test. All statistical analyses were performed using Statistical Packages for the Social Sciences (IBM SPSS 22.0 for Windows).

Results

According to the registers, 714 patients who were aged 18 years old, received outpatient or inpatient rehabilitation between 2008 and 2013 and were registered with an e-mail address, were identified and invited to participate in the study by email (Figure 1). A number of 233 patients filled in the questionnaire, from which 43 questionnaires were incomplete, resulting in a total of 190 completed questionnaires out of 714 invited patients (27%).
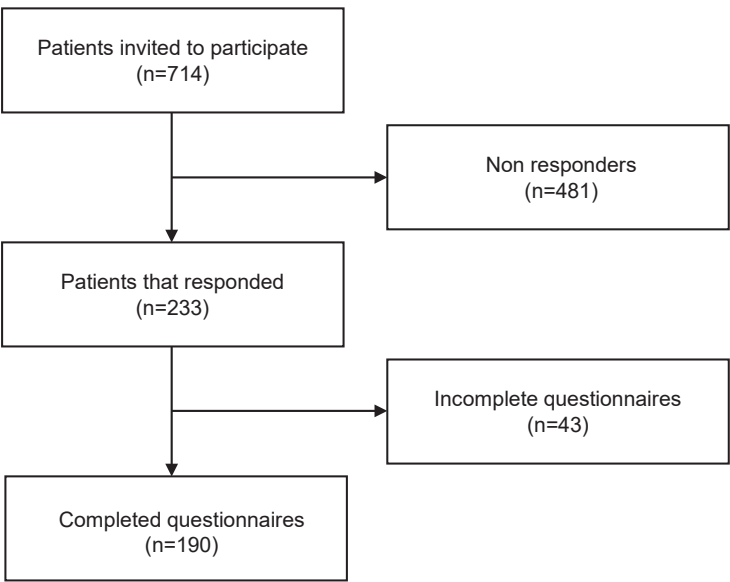
Figure 1. Flow of patients.

Patient characteristics

Table 1 shows that the 190 patients who completed the questionnaire had a mean age of 49 years (SD=16), 94 (49%) were female and 52 (27%) were living alone. The majority of patients followed either a "higher education" (41%) or "middle education" (41%) and 19% received "lower education". Most patients were diagnosed with "acquired brain injury" (42%), followed by "neuromuscular disease" (13%) and "orthopaedics" (6%). The majority of the patients (73%) had outpatient rehabilitation treatment, 20 patients (10%) had inpatient rehabilitation, 26 patients (14%) had had both and two patients (1%) received a short rehabilitation program for heart rehabilitation.

The eligible patients had a mean age of 44 years (SD=19) and 341 (49%) were female. No significant differences were found for age and gender between the group of eligible patients and group of responded patients.

Table 1. Patient characteristics of 190 patients in rehabilitation care who participated in this cross-sectional study.

Characteristics	
Age in years (mean, SD)	49 (16)
Female gender (number, %)	94 (49)
Living status (number, %)	
Living alone	52 (27)
Living with partner/family	138 (73)
Educational level (number, %)[a]	
Lower	36 (19)
Middle	77 (40)
Higher	77 (40)
Type of rehabilitation (number, %)	
Inpatient	20 (10)
Outpatient	142 (73)
Both	26 (14)
None[b]	2 (1)
Diagnostic group (number, %)	
Acquired Brain Injury (stroke, tumour, trauma)	79 (42)
Cardiological	5 (3)
Chronic pain	9 (5)
Hand injury	4 (2)
Neuromuscular disease	24 (13)
Orthopaedics	13 (6)
Spinal cord injury	12 (6)
Trauma surgery (amputation)	4 (2)
Other	40 (21)

[a] Low: up to and including lower technical and vocational training; medium: up to and including secondary technical and vocational training; and high: up to and including higher technical and vocational training and university.
[b] A short heart rehabilitation program.

Possession and usage of ICT devices

Possession and use of ICT devices among the 190 patients who responded to the questionnaire are shown in Table 2 for the total group and four categories of age. The most frequently possessed ICT device was a computer/laptop (93%), followed by a smartphone (57%), tablet (47%), game console (16%), smart TV (15%) and e-reader (14%). Five patients (3%) possessed no ICT device at all. The mean number (SD) of possessed ICT devices per patient was 2.8 (SD ¼ 1.5).

In the first age category (1st quartile of patients between 18–37 years old), the mean number (SD) of possessed ICT devices was 3.1 (SD ¼ 1.6). The most possessed ICT devices

were the laptop (75%) and smartphone (75%). In the second age category (38–51 years old), the mean number of ICT devices was 2.9 (SD 1.5), with most possessed ICT devices being the smartphone (62%), the tablet (62%) and the pc (62%). In the third age category (52–61 years old), the mean number of ICT devices was 3.2 (SD 1.5). The two most possessed devices were the laptop (75%) and the pc (71%). In the fourth age category (62 > years old), the mean number of possessed ICT devices was 1.9 (SD 1.1). The two most possessed ICT devices where the pc (57%) and the laptop (47%).

A number of 149/190 (78%) responded to use their ICT devices all 7 days of the week, whereas two patients (1%) reported to use their devices less than once a week. From the patients who used their ICT device all 7 days a week, 36 patients (77%) were from the first age category (18–37 years old), 38 patients (91%) from the second age category, 37 (77%) from the third age category (52–61 years old) and 38 (75%) from the fourth age category (62 > years old).

The computer/laptop was the most frequently used ICT device by patients for e-mail (166/190 patients, 94%), to search for information (162/190 patients, 92%), for support (e.g., scheduling, banking and route planning) (137/190 patients, 78%) and social media (104/190, 59%). For physical and mental exercise the PC/ laptop was used by 39 patients (22%), followed by a tablet by 21 patients (24%), a smartphone by 12 patients (11%) and a game console by 8 patients (26%).

Table 2. Usage of ICT devices among 190 patients in rehabilitation care[a].

	All age categories	18–36 years	37–51 years	52–61 years	>62 years
Possession of ICT devices:[b]					
PC/Laptop	176 (93)	46 (98)	37 (88)	47(98)	46 (87)
Tablet	89 (47)	19 (40)	26 (62)	27 (56)	17 (32)
Smartphone	109 (57)	35 (76)	29 (69)	20 (63)	15 (28)
E-reader	27 (14)	5 (11)	9 (21)	8 (17)	5 (9)
Game console	31 (16)	18 (38)	5 (12)	7 (15)	1 (2)
Smart TV	29 (15)	9 (19)	5 (12)	11 (23)	4 (8)
No one of above	5 (3)	1(2)	0 (0)	1 (2)	3 (6)
The frequency of use of any ICT device:					
Less than once a week	2 (1)	0 (0)	1 (2)	0 (0)	1 (2)
1–3 days per week	11 (6)	4 (9)	1 (2)	3 (6)	3 (6)
4–6 days a week	26 (14)	7 (15)	2 (5)	8 (17)	9 (18)
7 days per week	149 (78)	36 (77)	38 (91)	37 (77)	38 (75)

Table 2. Continued.

	All age categories	18–36 years	37–51 years	52–61 years	>62 years
Use of ICT device to search for information:[b]					
PC/Laptop	162 (92)	40 (87)	36(87)	44 (94)	42 (91)
Tablet	73 (82)	11 (58)	23 (86)	25 (93)	14 (82)
Smartphone	76 (40)	27 (77)	18 (62)	20 (67)	11 (73)
Use of ICT device for email:[b]					
PC/Laptop	166 (94)	42 (91)	36 (97)	45 (96)	43 (93)
Tablet	62 (70)	11 (58)	18 (69)	19 (70)	14 (82)
Smartphone	84 (77)	27 (77)	22 (76)	24 (80)	11 (73)
Use of ICT device for social media:[b]					
PC/Laptop	104 (59)	37 (80)	26 (70)	24 (51)	17 (37)
Tablet	47 (53)	14 (74)	10 (39)	13 (48)	10 (59)
Smartphone	61 (56)	29 (83)	14 (48)	14 (47)	4 (27)
Use of ICT device for physical and mental exercise:[b]					
PC/Laptop	39 (22)	12 (26)	8 (22)	13 (28)	6 (13)
Tablet	21 (24)	6 (32)	5 (19)	6 (22)	4 (24)
Smartphone	12 (11)	5 (14)	5 (17)	2 (7)	0 (0)
Game console	8 (26)	5 (14)	2 (7)	0 (0)	1 (2)
Use of ICT device for support (e.g., scheduling, banking, route planning):[b]					
PC/Laptop	137 (78)	34 (74)	31 (84)	37 (79)	35 (76)
Tablet	56 (63)	9 (47)	17 (65)	19 (70)	11 (65)
Smartphone	91 (83)	28 (80)	25 (86)	26 (87)	12 (80)

[a] Indicated as the number of patients possessing the device (%).
[b] Patients could give more than one answer to each question.

Usage preferences of ICT devices in future rehabilitation

A top 10 of usage preferences of ICT devices for rehabilitation in the future are shown in Table 3. It was found that patients (highly) prefer to have digital contact with a health professional (mean 3.15, SD 0.79). Second, patients want to have digital access to their personal record in which both the patient and the health professional can make notes (mean, 3.09, SD 0.78). Third, digital scheduling of appointments with a health professional was highly preferred by most patients (mean 3.07, SD 0.85).

About 108 out of 190 patients (58%) agreed they want to fill in digital questionnaires about quality of care (mean 3.03, SD 0.84). Moreover, 93 patients (49%) agreed and 49 patients (26%) highly agreed they want to do exercises at home using a computer (mean 2.97, SD 0.80). 79/190 patients agreed (42%) and 34/190 patients (18%) highly agreed they

want to use ICT for self-measurement of health status (e.g., blood pressure) and forwarding the results to a health professional, while 62 patients (33%) disagreed and 13 patients (7%) highly disagreed. Contact with other patients (peers) was a preference of 90/190 patients (47%), but not for 55/ 190 patients (29%).

Less important user preferences for future rehabilitation were digital participation in group therapy under supervision of a health professional (mean 2.36, SD 0.86), receiving information and latest news from the rehabilitation centre (mean 2.56, SD 0.91) and getting support from health professionals at home (mean 2.61, SD ¼ 0.80).

Table 3. Patients' ranking of usage preferences of ICT devices in future rehabilitation[a].

Factor	Totally disagree	Disagree	Agree	Totally agree	Mean (SD)
1. Having contact with a health professional	9 (4.7)	19 (10)	95 (50)	65 (34)	3.15 (0.79)
2. Access to health record to make notes	9 (4.7)	22 (11.6)	101 (53.2)	56 (29.5)	3.09 (0.78)
3. Schedule appointments with health professional	12 (6.3)	26 (13.7)	87 (45.8)	63 (33.2)	3.07 (0.85)
4. Fill in questionnaires about quality of care	11 (5.8)	21 (11.1)	108 (56.8)	48 (25.2)	3.03 (0.84)
5. Exercises to do at home	8 (4.2)	38 (20)	93 (48.9)	49 (25.8)	2.97 (0.80)
6. Self-measurement and forwarding results to a health professional	13 (6.8)	62 (32.6)	79 (41.6)	34 (17.9)	2.71 (0.84)
7. Contact with other patients	18 (9.5)	55 (28.9)	90 (47.4)	25 (13.2)	2.65 (0.83)
8. Support from health professionals at home	15 (7.9)	65 (34.2)	86 (45.3)	22 (11.6)	2.61 (0.80)
9. Information and latest news from the rehabilitation centre	18 (9.5)	30 (15.8)	52 (27.4)	15 (7.9)	2.56 (0.91)
10. Participating in group therapy under supervision of a health professional	28 (14.7)	85 (44.7)	55 (28.9)	20 (10.5)	2.36 (0.86)

[a] Data are presented as the number with percentages (%) unless indicated otherwise.

Discussion

This cross-sectional survey explored the usage of ICT devices and usage preferences to incorporate ICT devices in rehabilitation treatment among 190 adult rehabilitation patients from a rehabilitation centre in the Netherlands with access to email. We found that more than 90% of the responded patients used at least one ICT device, from which a computer/ laptop most frequently, followed by a smartphone and then a tablet. Younger patients were found to use more devices than older patients, but older patients use their ICT devices with the same frequency as younger patients. Patients used their devices for e-mail, finding information, support (e.g., scheduling, banking, route planning), social media and physical

and mental exercises. Patients' usage preferences of ICT devices in rehabilitation were: having contact with health professionals (telecommunication), have access to their health record and scheduling appointments with health professionals.

Population based studies by the Dutch Central Agency for Statistics (2015) showed that in 2014 80% of the households in The Netherlands were possessing a laptop, 65% a PC, 63% a tablet and 74% a smartphone [27]. Comparing these data to the current study, possession of a computer/PC (93%) is slightly higher, although possession of a tablet (47%) and smartphone (57%) is lower among the responded patients in rehabilitation. Purposes of using ICT devices found in the current study were almost similar compared to the general population [28]. A more recent study amongst patients with multiple sclerosis showed that 86% (44/51) used a mobile phone [29]. From patients with cardiovascular disease, Buys et al. found most patients (97%) had a mobile phone, from which 64% owned a smartphone [30]. In the current study, possession of a smartphone was slightly lower (57%).

A few studies investigated patient preferences for use of ICT in (rehabilitation) health care using a qualitative research design [7,24,25]. Therefore, frequency data found in the current study could not be compared to other literature. First, this study showed that 101 out of 190 patients (53%) highly prefer to have insight in their personal record and also want to use it to make notes for health professionals. Although growing patient demand to online personal health record (PHR) access was already recognized in other studies [25,31–33], it is still not widely adopted. A study among 283 individuals over the age of 18 found that individual factors (satisfaction with provider, belief of the tool to be empowering) and environmental factors (communication tactics, technology characteristics and management support) influence intentions to use a PHR [34]. These aspects should be taken into account with the implementation of PHRs. Moreover, development of such systems should focus on patients and their families as well as on physicians and other healthcare professionals [33].

Second, communication with peers was identified as patient preference among 90/190 patients (47%) and also found in other studies [24–25]. Available evidence suggests that online peer-topeer support interventions might be beneficial for users [35]. More research is needed to further investigate how ICT tools can be used to fulfil to patients' preferences for peer support. Third, we found a group of patients in rehabilitation preferred to use ICT to schedule appointments with their clinicians. This was not identified as a preference in previous studies. Moreover, a sub group of patients wanted to use ICT for self-monitoring and physical exercises, which is in line with preferences of patients with cancer [7] and cardiac patients [30].

Transferability of the findings for usage of devices to other contexts might be impaired, because participants were a subgroup from the general population of patients in rehabilitation and their treatment process might have influenced their preferences for e-health in future rehabilitation. More importantly, participants were from two rehabilitation

centres in one region in one country. There may be large differences in access to and usage of ICT among countries, hampering the generalizability. As an example, the highest proportion of households with internet access in Europe in 2016 was recorded in the Netherlands and Luxembourg (97%). By contrast, the lowest rate was found in Bulgaria (64%) [36].

A limitation of the current study is that only patients with an email address were invited to fill in the electronic questionnaire. However, we aimed to identify usage and preferences in patients who have access to ICT and having an email address suggests the latter. Future studies should also include patients in rehabilitation with low level of access to ICT [10], lack of ICT experience [10,22,37] and personal traits for ICT utilization (e.g., age and health condition) [38] in order to better understand how to enable all patients to benefit from of e-health.

In addition, only 190 out of 714 patients responded (27%) and data about possession and usage of ICT devices is approximately 2.5 years old. However, we compared it with data from 2015 and the availability of data like ours is scarce in health care and rehabilitation in particular. Moreover, to the best of our knowledge, this is one of the few studies investigating the use of ICT devices and usage preferences amongst patients in rehabilitation. Since a quantitative study design was used a high number of patients participated in the study (n ¼ 190).

This study found that the majority of patients in rehabilitation with a registered email address used one or more ICT devices every day of the week (younger patients more often than older patients). The most frequently used devices were a computer/laptop, smartphone and tablet. According to patients, e-health in rehabilitation needs to include online access to their health record, communication with peers and scheduling appointments with health professionals. To better assist patients with e-health in rehabilitation care in the future, further research is needed about how the preferences identified in the current study could be implemented in rehabilitation care by using the most commonly used ICT devices (computer/laptop, smartphone and tablet).

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Disclosure statement

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