Finnish Journal of eHealth and eWelfare

SCIENTIFIC PAPERS

VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Combining end-user recruitment methods for usability testing of eTriage Service

Marja Ylilehto[1], Paramedic (Master), BSc, RN, Eini Saarivesi[2] B.Eng, Jarmo Reponen[3,4], MD, PhD, Pia Liljamo[1], RN, PhD.

[1] Oulu University Hospital, Department of Administration, Health Village, Oulu, Finland; [2] Helsinki University Hospital, HUS IT Management, Health Village, Helsinki, Finland; [3] Research Unit of Medical Imaging, Physics and Technology, Faculty of Medicine, University of Oulu, Oulu, Finland; [4] Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland

Marja Ylilehto, Oulu University Hospital, P.O. Box 10, FI-90029 OYS, FINLAND. Email: marja.ylilehto@ppshp.fi

Abstract

The Finnish national eHealth and eSocial strategy emphasizes citizens' active role in promoting their own well-being by improving information management and implementing self-management and online services. In the Emergency Hub, part of the Finnish online health portal (Health Village), an eTriage Service is being developed by ICT experts and healthcare professionals. To make the eTriage Service available to the public, the user interface must comply with relevant quality and safety regulations. The aim of this paper is to describe the recruitment methods used for eTriage Service usability testing and the feasibility of those methods. The results of the actual usability testing are not discussed in this article. Two different recruiting methods were combined: online recruiting with remote testing and organized on-site testing occasions. A total of 219 volunteer end-users were recruited and 115 (52.5%) of them performed the usability testing. A better participation rate was achieved with organized on-site testing occasions, but the method consumed significantly more time and effort on the part of developers. A sufficient number and variety of end-users were recruited by combining different recruiting methods. Online recruiting with remote usability testing helps reduce the costs and effort of developers but may require a longer period of time to achieve a sufficient number of testers. A complex or highly novel, self-performing test process without any support might affect negatively the number of testers available by the online recruitment. It also seems that usability testing for digital health services can be more attractive to healthcare professionals than to persons with no healthcare education background.

Keywords: emergency health services, telehealth, information systems, software validation, usability testing

Introduction

The current trend in Finland is to centralize the emergency health care services. Because of this, distances increase between the units providing emergency care and the areas where people live. There is a need for new methods to guide citizens to the right health care services at the right time and to support remote and home care [1], so that emergency units serving an expanding population base can deliver their services with quality outcome and patient safety in mind [2]. The Finnish Health Care Act (1326/2010) [3] and the Emergency Regulation (583/2017) [4] oblige municipalities to provide the services needed to assess the need for care

and the urgency of treatment. The service can be arranged as a telephone service and can be supplemented by other electronic services. The purpose of emergency counseling is to provide the client with a healthcare professional's view of the need for care, the urgency, and the choice of place of care [3,4]. Electronic health services are also seen to have an impact on the future development of emergency medical services. Decision-supportive systems and e-health portals for citizens can help reduce the number of non-urgent Emergency Medical Service missions and emergency department visits [5]. Citizens appreciate electronic tools that make it easier for them to choose the right health care services [6]. The perceived usefulness and ease of use of e-services, with savings in time and money, have a positive effect on attitudes towards using e-services and the intention to use them [7,8]. According to a Finnish survey [6], citizens use e-health services mostly to find general health information. The use of an electronic service channel was estimated to have saved on average 5.3 traditional contacts with health care per year. However, the report did not address the impact of the use of electronic service channels on the number of emergency department (ED) visits [6]. A Swedish study [9] found that Internet data can be used to forecast the number of ED visits. The correlation between the number of website visits between 6 pm and midnight on an online health care guide (Stockholm Health Care Guide) and the number of ED attendance the next day was significant [9]. It is likely that citizens use different kinds of eHealth portals to evaluate the cause of symptoms and need for treatment. This is in line with the goals of the Finnish national eHealth and eSocial Strategy 2020; one of its objectives is to support the active role of citizens in promoting their own well-being by improving information management and implementing self-management and online services [10].

Recruiting end-users for usability testing in e-health development projects

The Finnish Emergency Hub is a digital health service for citizens and emergency department customers [11]. The Emergency Hub was built around the Health Village concept, which was part of the national Virtual Hospital 2.0 Project [12] funded by the Ministry of Social Affairs and Health. The project took place between the years 2016–2018 and the service is now maintained and developed further by university hospital districts [13]. The primary focus in developing the Emergency Hub is to support citizens' own decision-making in acute health problems [11]. One upcoming service in the Emergency Hub is an eTriage Service, which is a nationally operated digital tool for assessing the need for emergency treatment. The eTriage Service, an electronic database that contains 170 symptom- or injury-based recommendations, is being developed by healthcare professionals from Finnish university hospitals and the ICT department of Helsinki University Hospital. The main purpose of the eTriage Service is to ensure that people suffering from an acute health problem are directed to the right place at the right time [11].

As a result of digitalization, there are many different players and manufacturers on the market that bring healthcare applications to people [14]. In the EU, action has been taken to curb the system to ensure that the applications to be published are reliable, clinically and technically tested, and function as intended. The system requires CE marking for all medical applications classified as medical devices [15] and compliance with the ISO13485 quality system [16]. To ensure that the eTriage Service user interface scores high in usability, meets the requirements set by EU regulations, and can be labeled as CE-marked medical software, usability testing by the real end-users of the service is needed. Usability testing by end-users has an important role when developing decision support systems for citizens even though testing with traditional methods is often found to consume resources, such as time, money and effort, on the part of the system developers [17,18]. When testing e-health services such as eTriage Service, the ability of the end-users to understand health information or use different electronic services must be taken into account [6,17,19,20]. If the service is being tested only by experts it may cause bias in the usability problems that are related to the understanding of clinical terms. It is also important to pay sufficient attention to sample size to achieve a diversity of testers that corresponds to reality [17].

According to current literature, there is no single methodology for performing usability testing for health information technology solutions: the methods chosen vary between the technologies being tested [17,21,22]. Testing with a sufficient sample size in a controlled environment using conventional testing methods may prove impossible if the costs become too high. Reducing costs to an acceptable level without compromising the quality of testing [23] forces e-health service developers to consider new ways to recruit testers and conduct testing, often by combining different methods [17,22]. Recruiting enough end-users to participate in software usability testing and keeping the cost low enough can be challenging. One solution can be crowdsourcing, which has been found to reduce the obstacles related to resource constraints [18]. The key is that crowdsourcing system [24] enlists a crowd of humans to help solve a problem defined by the system owners. According to crowdsourcing principles, people can be recruited online among ordinary service users. Online recruitment and remote testing has been used when conducting usability testing [17,20,23,25], and also in controlled randomized trials of self-management health interventions [26].

From the viewpoint of quality and usability requirements for electronic services [15,16], it is challenging that software development has not generally been the responsibility of health care professionals [27]. Implementing the digitalization of public services [28] requires the involvement of healthcare professionals in the development of digital health services, as was done in the Virtual Hospital 2.0 project [12]. In order to comply with the Regulation for Medical Devices [15], the healthcare professionals involved in the development of services such as the Health Village will continue to be involved in the design and implementation of service platforms and user interface usability testing [12,14]. The aim of this paper is to describe the recruitment methods used for eTriage Service usability testing and the feasibility of those methods. The observations made can help healthcare professionals to understand the resources required by end-user recruitment for usability testing. The results of the actual usability testing are not discussed in this article.

Methods

To test the eTriage service for usability and safety, a cost-efficient usability testing method was designed. To recruit voluntary eTriage Service end-users, two different recruiting methods were combined, online recruiting and remote testing and organized on-site testing occasions. As the end-users testing the service had to represent the actual target group of the eTriage Service, all end-users willing to perform the testing were accepted as usability testers. Testers were not compensated for participating in the testing. A target was set that 50% of testers should use the eTriage Service for the first time and testers should represent all age groups (16 to over 60 years of age) among the real end-users of the eTriage service. The background variables inquired were age, gender, and status of healthcare professional or student. Testing took place anonymously and no personal or identifier information from the testers was stored. Before testing, it was assumed that the recruitment of end-users at an older age would be challenging and therefore, on-site test occasions were prepared to recruit more people of a certain age group. For the eTriage Service usability testing, a total of ten different test cases were created based on the user interface product requirements and service risk assessment. Only one test case was given to each tester. In order to perform the test, the end-user was asked to find a recommendation for the test case using the eTriage Service and to indicate the content of the recommendation and the time it took to find it.

Online recruitment and remote testing

For online recruiting, an open invitation was published in the Emergency Hub's own newsfeed and the Health Village's social media channel (Facebook). To participate in the testing, end-users had to send an e-mail to the eTriage Service developers or register by leaving their email address with the Hotjar survey tool on the Emergency Hub website. After registration, the tester was sent an e-mail that included instructions for performing the testing, the testing material, and an electronic test form. The electronic test form was implemented using the Questback survey tool. In order to

perform the testing, the end-user had to have a working Internet connection and a terminal (smartphone, tablet or computer) suitable for testing. The e-mail was in most cases sent to testers within 1–4 days of registration. The recruitment of testers lasted 49 days and ended when the limit of 100 testers was reached.

Testers performed the test remotely and independently with the production version of the eTriage service user interface. The e-mail sent to the testers contained a direct link and a QR code (abbreviated from Quick Response Code) [29], to the user interface of the eTriage Service and the electronic test form. The QR code was designed to help the testers using a mobile device (smartphone or tablet). The e-mail sent to the testers reported a personal tester identifier (ID) to select a specific test case for the electronic test form. However, the individual tester could not be identified by the ID. The testers performed the testing on the terminal of their choice. After performing the testing, the testers completed the electronic test form and returned it to the service developers.

On-site recruiting and testing

In addition to the online recruiting and remote testing we carried out five different on-site test occasions in different parts of Finland, where service developers were on site to recruit testers and to conduct testing by end-users. The end-users were recruited in public places such as a shopping center, hospital lounges or waiting areas (Table 1). Developers provided the terminal (smartphone, tablet or computer) to be used in the testing, or testers could use their own device. The usability testing was carried out at the on-site test occasions the same way as the testing performed remotely by using the production version of the eTriage service user interface and the electronic test form. At the on-site test occasions, the testers could fill out the electronic test form themselves, or they could think aloud and the developer would fill out the form based on what the tester said. Developers gave the testers the same information that was sent in the e-mail in remote testing. After beginning the testing, the tester was not provided with any extra guidance on performing the testing. To maintain the voluntary nature of the testing, testers were allowed to stop the testing at any time. After completing the given test case, the tester sent the electronic test form to the developers.

Table 1. Testing occasions and the number of end-users recruited on site.

Site	Testing occasions (n)	Duration (h)	Developers on-site (n)	End-users recruited (n)	Completed test forms (n)	Response rate (%)
Oulu	1	4	2	19	17	89
Tampere	1	3.5	2	16	16	100
Turku	2	7	1	19	19	100
Helsinki	1	1.5	3	11	9	82
Total	**5**	**16**	**8**	**65**	**61**	**94**

Ethics

The end-user testers were asked to consent to the testing and were informed about the voluntary nature of the participation and the intended use of the results. The principles on the guidelines of the Finnish Advisory Board on Research Integrity [30] were followed.

Results

A total of 219 end-users were recruited for the eTriage service usability testing and 115 volunteer end-users participated in the testing. Two of the returned test forms had to be discarded due to inaccuracies in completing the test form. The overall response rate was 52.5%. Of those who performed the testing, 82.0% reported using the eTriage user interface for the first time. Of the testers, 54.0% reported having performed the test on a computer, 27.4% on a smartphone, and 18.6% on a tablet. Of those recruited, 154 were recruited with the online method. The test material and the electronic test form were sent to all end-users recruited online. The test form was returned by 54 (35.1%) online testers. The number of end-users recruited at on-site test occasions was 65. However, not all of them completed the testing. The test form was returned by 61 (93.8%) end-users recruited on-site. The time spent by developers on conducting the testing was on average 9 minutes per returned test form with the online method and on average 26 minutes per returned test form at the on-site occasions.

Of those who correctly performed the eTriage service user interface testing (N=113), 72.6% were women and 27.4% were men. More than half of those who performed the testing were 40 years or older (63.7%). There was some difference in the age distribution of testers recruited by different recruitment methods. More testers less than 30 years of age were recruited on-site than with the online method. Similarly, the proportion of over 60-year-olds was higher among on-site recruits than those recruited by the online method. By combining recruitment methods, a sufficient number of end-users was recruited from all age groups. It would have been possible to target the selection of testers at a certain age group by the on-site recruiting method, but this was not necessary in this case. More detailed figures on the gender and age distribution of testers by different recruitment methods are shown in Table 2.

Table 2. Distribution of age, gender and professional status of testers in different recruitment methods.

	Age groups					
	16–29 years n (%)	**30–39 years** n (%)	**40–49 years** n (%)	**50–59 years** n (%)	**over 60 years** n (%)	**All testers** n (%)
Online method	**6 (11.5%)**	**15 (28.8%)**	**11 (21.2%)**	**15 (28.8%)**	**5 (9.6%)**	**52 (46.0%)**
Men	2 (15.4%)	4 (30.8%)	3 (23.1%)	3 (23.1%)	1 (7.7%)	13 (25.0%)
Women	4 (10.3%)	11 (28.2%)	8 (20.5%)	12 (30.8%)	4 (10.3%)	39 (75.0%)
Professional or student	6 (18.8%)	11 (34.4%)	7 (21.9%)	6 (18.8%)	2 (6.3%)	32 (61.5%)
Layman	0 (0.0%)	4 (20.0%)	4 (20.0%)	9 (45.0%)	3 (15.0%)	20 (38.5%)
On-site occasions	**13 (21.3%)**	**7 (11.5%)**	**20 (32.8%)**	**8 (13.1%)**	**13 (21.3%)**	**61 (54.0%)**
Men	3 (16.7%)	2 (11.1%)	4 (22.2%)	4 (22.2%)	5 (27.8%)	18 (29.5%)
Women	10 (23.3%)	5 (11.6%)	16 (37.2%)	4 (9.3%)	8 (18.6%)	43 (70.5%)
Professional or student	11 (30.6%)	2 (5.6%)	18 (50.0%)	4 (11.1%)	1 (2.8%)	36 (59.0%)
Layman	2 (8.0%)	5 (20.0%)	2 (8.0%)	4 (16.0%)	12 (48.0%)	25 (41.0%)
All testers	**19 (16.8%)**	**22 (19.5%)**	**31 (27.4%)**	**23 (20.4%)**	**18 (15.9%)**	**113 (100%)**

Of those who performed usability testing (N=113), 60.2% were healthcare professionals or students. The proportion of healthcare professionals was higher than the proportion of laymen (people with no healthcare education) with both recruiting methods. Professionals and students were more often recruited with the online method (61.5%) than on site (59.0%). Detailed figures on distribution of healthcare professionals or students and laymen by different recruitment methods are shown in Table 2.

Discussion

A total of 219 volunteer end-users were recruited, of whom 51.6% performed the usability testing of the eTriage service. However, the response rate of end-users recruited by the online method was rather low (33.8%). Conclusions on the reasons that led to the disappearance of registered end-users cannot be made on the basis of the results. Whether the content of the e-mail sent to the testers was too massive or the testing too difficult for end-users recruited by the online method who were not familiar with the idea of detailed testing of a software interface remains to be considered. Testing the usability and safety of the user interface might require more activity than just commenting on the features of the software. According to Emergency Hub's user statistics, over 75% of the monthly users of the Emergency Hub use the online service on a mobile device. However, in the eTriage service usability testing, more than half (54.0%) of all testers reported having used a computer for testing. On a mobile device, performing the testing required transition between two open tabs: the eTriage service user interface and the electronic test form. This may have made testing too challenging for mobile users. In order to identify the reasons for opting out of testing, it would be necessary to send a questionnaire to those recruited by the online method to find out how the respondents perceived testing the service with the selected methods.

With the selected recruiting methods, enough end-users were recruited to test the eTriage service usability, and the target for the age distribution was also achieved. The proportion of testers at the extreme ends of the age range, under 30 and over 60, was sufficient. In testing digital health services, it is important to consider usability factors also for older people, not just for average users of electronic services [19,20]. Monthly user statistics for the Emergency Hub show that women are generally more active users than men. The difference in gender activity was also reflected in the results of eTriage usability testing recruitment. However, in a survey of the use of electronic services in Finland, the participation rate of women was not significantly different from that of men [6]. The majority of end-users participating in the testing reported using the eTriage service user interface for the first time. For usability testing [31], the application to be tested must not be too familiar to the testers.

More than half (60.2%) of the end-users who performed the testing reported that they were healthcare professionals or students. In addition to a shopping center, on-site occasions were held in lobbies and waiting areas for hospital customers. Likewise, the online recruitment focused on the Health Village website, the content of which is primarily targeted at laymen, i.e. ordinary citizens [6]. The result may be explained by a phenomenon specific to the crowdsourcing method, whereby people commit more to a task that is meaningful to them [24]. For healthcare professionals, testing new health innovations can be more natural than for laypeople. As users, healthcare professionals are familiar with the background and can more easily concentrate on the workflow matters in the user interface. On the other hand, they do not necessarily see the obstacles and possibilities for misunderstanding that a layman may encounter [19,20].

The benefits of online usability testing [32] are that there are no costs for the venue, traveling or support personnel and it is a fast and easy way to deliver the testing materials and collect results [17,18,24]. Theoretically, online testing is scalable and enables increasing the size of the test population without additional costs. On the other hand, online testers are left without active support and their motivation is not supported. The diversity of users is also sporadic. At testing occasions with a selected test population, the diversity of users is more controlled. The testers can be supported directly

and their motivation is augmented. As a disadvantage, the cost of organizing testing sessions is higher and due to time constraints, only a limited population can participate at a time. In the eTriage Service usability testing, the on-site recruiting consumed more than twice the time on the part of the developers than the online recruiting.

Conclusion

The development of e-health services requires the involvement of healthcare professionals in the development of services together with ICT experts. To ensure high-quality and safe services, healthcare professionals should understand the details of service usability testing. Service developers often have to choose recruitment and testing methods according to the available resources (time, money, and effort). A sufficient number and variety of end-users can be recruited by combining different recruiting methods. Online recruiting and remote testing helps reduce costs and effort but may require a longer period of time due to the low participation rate. A complex or highly novel, self-performing test process without any support from the developer might affect negatively the number of testers available by the online recruitment. It also seems that usability testing for digital health services can be more attractive to healthcare professionals than to persons without healthcare education background. The effectiveness of the online method could possibly be improved by optimizing the test material in use, for example through a partially automated testing form, which reduces the amount of work remaining for the tester and increases the attractiveness of participating in the testing.

Conflict of interest statement

The first two authors have been involved in the developing process of the eTriage Service, P.L has worked with the Virtual Hospital 2.0 project, and J.R. has followed the project from a research perspective, not in an active role.

References

[1] Hautala M, Ervasti M, Pikkarainen M, Reponen J, Daavittila I, Raatiniemi L et al. Future connected health technology opportunities in non-urgent emergency care actions. FinJeHeW 2019;11(1–2):139–149. https://doi.org/10.23996/fjhw.70242

[2] STM, Sosiaali- ja terveysministeriö. Valtioneuvoston asetus kiireellisen hoidon perusteista ja päivystyksen erikoisalakohtaisista edellytyksistä. Sosiaali- ja terveysministeriön muistio 22.8.2017 [Cited 5.5.2019]. Available from: https://stm.fi/documents/1271139/5228951/VNA_p%C3%A4ivystys_PM_22.8_2.pdf/c38ca925-a195-48a4-97d5-34935c16938c/VNA_p%C3%A4ivystys_PM_22.8_2.pdf

[3] Terveydenhuoltolaki (1326/2010) 2015. Available from: https://www.finlex.fi/fi/laki/alkup/2010/20101326

[4] Päivystysasetus 583/2017. Valtioneuvoston asetus kiireellisen hoidon perusteista ja päivystyksen erikoisalakohtaisista edellytyksistä 583/2017. Available from: https://www.finlex.fi/fi/laki/alkup/2017/20170583

[5] Ervasti M, Hautala M, Pikkarainen M, Reponen J, Tuukkanen J, Daavittila I et al. Tuhansia turhia kuljetuksia? Uudet teknologiaratkaisut ja toimintatavat ensihoitoon ja päivystykseen. Suom Lääkärilehti 2019;74(24–31):1584–87.

[6] Hyppönen H, Pentala-Nikulainen O, Aalto AM. Sosiaali- ja terveydenhuollon sähköinen asiointi 2017. Kansalaisten kokemukset ja tarpeet. [Electronic services in the social welfare and health care sector 2017. Citizens' experiences and needs. Abstract in English]. Report 3/2018. Helsinki: National Institute for Health and Welfare (THL); 2018. Available from: http://urn.fi/URN:ISBN:978-952-343-103-4

[7] Saranto K, Kivekäs E, Kuosmanen P, Kinnunen UM. Electronic Health Services in the Patients' Daily Activi-

ties – Willingness to Use Health Village Services. Stud Health Technol Inform 2018;247:586–590. Doi: 10.3233/978-1-61499-852-5-586.

[8] Hyppönen H, Aalto A-M. Citizens experiences of e-health and e-welfare services. In: Vehko T, Ruotsalainen S, Hyppönen H (Eds.). E-health and e-welfare of Finland. Check Point 2018. Helsinki: National Institute for Health and Welfare (THL); 2019. p. 148–167. Available from: http://urn.fi/URN:ISBN:978-952-343-326-7

[9] Ekström A, Kurland L, Farrokhnia N, Castrén M, Nordberg M. Forecasting Emergency Department Visits Using Internet Data. Ann Emerg Med. 2015 Apr;65(4):436-442.e1. https://doi.org/10.1016/j.annemergmed.2014.10.008

[10] Ministry of Social Affairs and Health. Information to support well-being and service renewal. eHealth and eSocial Strategy 2020. Finland: Edita Prima; 2015 [Cited 15.5.2019]. Available from: http://urn.fi/URN:ISBN:978-952-00-3548-8.

[11] Ylilehto M. New innovations in arranging emergency care and first visit. In: Holopainen A, Kouri P, Kontio E, Ahonen O, Reponen J (eds.). eHealth2019. The 23th Finnish National Conference on Telemedicine and eHealth "Health communities facing cyber transformation" 15.3.-17.3.2018, Helsinki, Tukholma. Finnish Society of Telemedicine and eHealth (FSTeH) publication 1/2018. Kuopio: Finnish Society of Telemedicine and eHealth; 2018. p. 75. Available from: https://www.telemedicine.fi/images/pdf/julkaisut/978-952-68112-8-4.pdf

[12] Arvonen S, Lehto-Trapnowski P (eds.). We are getting there – Virtual Hospital 2.0 project summary. Hospital District of Helsinki and Uusimaa Helsinki; 2019. Available from: http://www.virtuaalisairaala2.fi/file/190

[13] Virtual Hospital 2.0. Health Village. Health Village; 2019 [Cited 15.5.2019]. Available from: https://www.virtuaalisairaala2.fi/en/health-village

[14] Terveyskylä.fi (Health Village). Lääkinnälliset laitteet ja CE-merkintä Terveyskylässä. Terveyskylä.fi; 2019 [Cited 5.5.2019]. Available from: https://www.terveyskyla.fi/tietoa-terveyskylästä/lääkinnälliset-laitteet-ja-ce-merkintä-terveyskylässä

[15] Regulation (EU) 2017/745 of the European parliament and of the council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC [Cited 15.2.2019]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0745&from=FI

[16] Medical devices Quality management systems. Requirements for regulatory purposes ISO 13485:2016. [Cited 23.5.2019]. Available from: https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/iso_13485_medical_devices_2016.pdf

[17] Marco-Ruiz L, Bønes E, de la Asunción E, Gabarron E, Aviles-Solis JC, Lee E et al. Combining multivariate statistics and the think-aloud protocol to assess Human-Computer Interaction barriers in symptom checkers. J Biomed Inform. 2017 Oct;74:104-122. https://doi.org/10.1016/j.jbi.2017.09.002

[18] Bruun A, Stage J. New approaches to usability evaluation in software development: Barefoot and crowdsourcing. J Syst Softw 2015;105:40–53. https://doi.org/10.1016/j.jss.2015.03.043

[19] Luger TM, Houston TK, Suls J. Older adult experience of online diagnosis: results from a scenario-based think-aloud protocol. J Med Internet Res. 2014 Jan 16;16(1):e16. https://doi.org/10.2196/jmir.2924

[20] Son H, Nahm ES. Older Adults' Experience Using Patient Portals in Communities Challenges and Opportunities. Comput Inform Nurs. 2019 Jan;37(1):4-10. https://doi.org/10.1097/CIN.0000000000000476

[21] Yen PY, Bakken S. Review of health information technology usability study methodologies. J Am Med Inform Assoc. 2012 May-Jun;19(3):413-22. https://doi.org/10.1136/amiajnl-2010-000020

[22] Moody L. User-centered health design: reflections on D4D's experiences and challenges. J Med Eng Technol. 2014;39(7):395-403. https://doi.org/10.3109/03091902.2015.1088086

[23] Sauer J, Sonderegger A, Heyden K, Biller J, Klotz J, Uebelbacher A. Extra-laboratorial usability tests: An empirical comparison of remote and classical field testing with lab testing. Applied Ergonomics 2019;74:85–96. https://doi.org/10.1016/j.apergo.2018.08.011

[24] Doan A, Ramakrishnan R, Halevy AY. Crowdsourcing Systems on the World-Wide-Web. Communications of the ACM 2011;54(4):86-96. https://doi.org/10.1145/1924421.1924442

[25] Abbass-Dick J, Xie F, Koroluk J, Brillinger SA, Huizinga J, Newport A et al. The Development and piloting of an eHealth breastfeeding resource targeting fathers and partners as co-parents. Midwifery. 2017 Jul;50:139-147. https://doi.org/10.1016/j.midw.2017.04.004

[26] Price A, Vasanthan L, Clarke M, Liew SM, Brice A, Burls A. SMOOTH: Self-Management of Open Online Trials in Health analysis found improvements were needed for reporting methods of internet-based trials. J Clin Epidemiol. 2019 Jan;105:27-39. https://doi.org/10.1016/j.jclinepi.2018.08.017

[27] Tilastokeskus. Ammattiluokitus 2010. Helsinki: Tilastokeskus; 2019 [Cited 25.6.2019]. Available from: https://www.tilastokeskus.fi/meta/luokitukset/ammatti/001-2010/index.html

[28] Valtiovarainministeriö. Digitalisoidaan julkiset palvelut. Helsinki: Valtiovarainministeriö; 2019. [Cited 25.6.2019]. Available from: https://vm.fi/digitalisoidaan-julkiset-palvelut

[29] Walsh A. Quick response codes and libraries. Library Hi Tech News 2009;26:7–9. https://doi.org/10.1108/07419050910985255

[30] Finnish Advisory Board on Research Integrity. Responsible Conduct of Research and Procedures for Handling Allegations of Misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity. Helsinki: Finnish Advisory Board on Research Integrity; 2012 [Cited 27.6.2019]. Available from: https://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf

[31] Russ AL, Saleem JJ. Ten factors to consider when developing usability scenarios and tasks for health information technology. J Biomed Inform 2018;78:123–133. https://doi.org/10.1016/j.jbi.2018.01.001

[32] Albert W, Tullis T, Tedesco D. Beyond the usability lab: conducting large-scale online user experience studies. Burlington, MA: Morgan Kaufman; 2010. https://doi.org/10.1016/B978-0-12-374892-8.00009-0