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Health Professional's Experience Of Telehealth Usability In The Care Of Patients With Non-Communicable Diseases (NCDS), From The COVID-19 Pandemic Onwards: A Cross-Sectional Study Protocol

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Abstract

Introduction: *Even with the increased use of telehealth from the COVID-19 pandemic onward, there needs to be more knowledge about its usability for patients with non-communicable diseases from the point of view of the health professional, which is the main objective of this study. The secondary objectives will be to describe the user's profile, discuss the usability of telehealth in different contexts and correlate it with the characteristics of the user's profile.*

Methods: *Protocol of the cross-sectional, prospective, multicenter, international study involving Brazil, Ghana, Honduras, and the United Kingdom. We will evaluate the usability of telehealth systems with an electronic form with the usability questionnaire of the Usability Scale System (SUS). The study has obtained ethical approval in each country and will be carried out independently. This analysis will consider the use context, such as country and geosocial conditions, age, gender, profession, and user experience. We will analyze usability (continuous dependent variable) with simple statistics with measures of central tendency. We will use ANOVA/Kruskal Wallis to analyze the usability difference between countries. If there are differences, we will use Bonferroni post hoc tests ($p<0.05$). We will use the Pearson/Spearman correlation coefficient to correlate the characteristics of the user's profile with usability. If the dependent variable data are normally distributed, we will use linear regression to correct for known confounders.*

Discussion: *Studying the usability of a system allows for understanding the subjective factors that determine its practical use, improving the experience of human-computer interaction.*

Introduction

Rationale

The new coronavirus 19 disease (COVID-19) pandemic caused by the new SARS-CoV-2 corona-virus has had tremendous effects on the daily lives of most individuals from the first half of 2020 (Garfan et al., 2021; Kichloo et al., 2020; Smith et al., 2020; Wosik et al., 2020). The generalized blockade, social isolation measures, and physical distancing necessary to reduce the spread of the virus and reduce people's illness negatively impacted the right to health, especially for people with non-communicable diseases (NCDs) who need continuous and prolonged follow-up (Bitar & Alismail, 2021; Elamin et al., 2018). According to the Office of the United Nations High Commissioner, the right to health can be listed in six critical aspects: accessibility, availability, participation, responsibility, acceptability, and good quality (Kichloo et al., 2020). In this context, telehealth has

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emerged as one of the great alternatives to the pandemic to ensure efficient and universal care.It has become a widely used strategy in the world (Dorsey & Topol, 2016; Flodgren et al., 2015; Garfan et al., 2021; Nadav et al., 2021; Smith et al., 2020; WMA, n.d.; Wosik et al., 2020).

Telehealth is a service delivery model that uses information and communication technology to alleviate many of the traditional environmental barriers that prevent patients from accessing adequate health services, with high power to provide efficient health care despite geographic distances (Bitar & Alismail, 2021; Dorsey & Topol, 2016; Flodgren et al., 2015; Garfan et al., 2021; Nadav et al., 2021; Smith et al., 2020; WMA, n.d.; Wosik et al., 2020; Zhang et al., 2021). Through Telehealth, patients can become active and more efficient participants in their health and well-being and become involved in educational programs that aim to promote well-being in the comfort, convenience, and safety of their own homes, an essential focus for patients with DNCs (Dorsey & Topol, 2016). However, to obtain the potential benefits of Telehealth, it must be usable by patients and healthcare professionals (Kruse et al., 2017; Nadav et al., 2021; Nepal et al., 2014; Sauro, 2015; Zhang et al., 2021).

If on the one hand, telehealth has clear benefits, on the other, it can be disruptive and complex, requiring a specialized strategy to manage its use and support health professionals with limited experience with this tool (Nadav et al., 2021; Zhang et al., 2021). There are latent factors, technological and administrative, that can impair its usability, leading to operational failures, such as long waiting times for platforms to work and low connectivity (Nepal et al., 2014). Besides this, among healthcare professionals, there is significant variability in levels of knowledge with digital tools and even different levels of training in telehealth, leading to varying levels of satisfaction with the strategy (Nepal et al., 2014). Thus, not all healthcare providers were satisfied with telehealth´s usability, even before the COVID-19 pandemic (Nepal et al., 2014; Smith et al., 2020). Preliminary reports from the early stages of the pandemic suggest that the reluctance of health professionals is one of the barriers to implementing telehealth in practice (Nepal et al., 2014). However, the discussion about the use of telehealth to manage chronic diseases has been growing, and studies have shown similar or better results with telehealth than with traditional care for some chronic conditions (Flodgren et al., 2015; Kichloo et al., 2020).

Despite the challenge of evaluating the usability of telehealth, especially in real-life scenarios, this is an essential strategy to leverage the tool's many advantages, pointing out weaknesses and strengths (Zhang et al., 2021). Studying usability allows us to understand the subjective factors that determine the effective use of a system that can enhance the human-computer interaction experience (Kruse et al., 2017; Nepal et al., 2014; Sauro, 2015).

Based on the above, our research question is to understand how health professionals who care for patients with NCDs assess the usability of telehealth from the COVID-19 pandemic onward. Studies evaluate the human-machine interaction in creating telehealth systems (Zhang et al., 2021). Studies assess telehealth from the patient experience perspective (Kruse et al., 2017; Nepal et al., 2014; Sauro, 2015; Zhang et al., 2021). However, it is equally important to assess the usability of telehealth from the health professional's point of view, a topic less explored in the studies (Monaghesh & Hajizadeh, 2020; Nadav et al., 2021). No studies assessed health professionals' experience with telehealth's usability for the care of NCD patients from the COVID-19 pandemic onward. We hypothesize that the usability of telehealth for the care of patients with NCDs from the COVID-19 pandemic onwards was considered good.

The topic of interest Study

The main topic of interest in this study is the usability of telehealth from the health professional's point of view.

Telehealth refers to "the use of telecommunications and information technology to provide access to health assessment, consultation, diagnosis, intervention, supervision and information at a distance" (Kichloo et al., 2020; Monaghesh & Hajizadeh, 2020). It includes technology that collects and transmits patient data, such as telephones, email, and remote-control patient monitoring devices to provide health education or ancillary health services (Kichloo et al., 2020). A broader definition of telehealth considers the entire range of activities that support the patient and the public in health: prevention, promotion, diagnostics, self-care, and treatment. It is this broader definition endorsed by World Medical Association (WMA).

The range of possibilities includes the use of chatbots, video consultations, web-based video conferencing, E-mail, WhatsApp, telephones, educational videos, mobile applications, sensors, websites, a collaboration between healthcare professionals discussing and sharing patient information through telecommunication channels, data collection, and remote monitoring of patient health outcomes through digital wearables, electronic transmission of prescriptions to pharmacists (electronic prescribing), and the diagnosis and treatment of patients through telecommunication technologies (Kichloo et al., 2020; Monaghesh & Hajizadeh, 2020). Telehealth has been used in urgency and emergency, for dispensing medication and assisted treatment, such as telenutrition, telenursing, tele-pharmacy, teledentistry, teleradiology, teleneurology, teleneuropsychology, telerehabilitation, teletrauma, telecardiology, tele ECG, telepsychiatry, teleradiology, telepathology, teledermatology, teleophthalmology, telesurgery and even teleabortion in countries where this practice is allowed.

The usability of telehealth depends on the Human-Machine interface (Kruse et al., 2017; Nepal et al., 2014; Sauro, 2015). The term Human-Computer Interaction came up with the proposal of harmony in action exercised mutually between two phenomena: one human and the other artificial. Human Interaction - Machine is characterized by studies of people on the one hand and computer-based systems on the other, including the interactions and influences one exerts on the other (Kruse et al., 2017; Nepal et al., 2014; Sauro, 2015).

According to the ISO 9241-part 11 definition (ISO, 1998), usability is defined as the extent to which specific users can use a product to achieve efficacy specified goals, efficiency, and satisfaction in a specific usage context (Monaghesh & Hajizadeh, 2020). It comprises a combination of user actions and attitudes so that the quality of a system depends on the degree to which the system satisfies the stated and implicit needs of its various stakeholders, providing value (Lopez et al., 1998; Sauro, 2015).

Efficacy is "the accuracy and completeness with which users achieve specified goals." For efficacy metrics, task completion rates and error rates are widely used. Efficiency refers to "the use of resources about the accuracy and completeness with which users achieve goals" (for example, time, effort, physical and cognitive) (Lopez et al., 1998; Sauro, 2015). Efficiency is usually measured by the time taken to perform a task, and metrics deviate from the task flow. The task flow deviation is "the ratio of the ideal number of steps to complete a task with the average number of steps to complete the task" (Garfan et al., 2021). User satisfaction comprises "freedom from discomfort and positive attitudes towards product use" (Lopez et al., 1998; Sauro, 2015). In this way, usability is composed of the following characteristics:

- Adequacy reconciliation,
- Learning,
- Operability,
- Protection against user errors,
- User interface aesthetics, and
- Accessibility (Lopez et al., 1998; Sauro, 2015).

Objectives

Primary objective: This study will investigate the usability or "ease of use" of telehealth from the point of view of health professionals who cared for patients with NCDs from the COVID-19 pandemic onwards.

Secondary objectives: To describe the profile of the user, to describe telehealth usability in different countries, to correlate some user profile features with usability.

Materials and Methods

Study design

Multicentric, international, prospective cross-sectional study with a quantitative and qualitative approach.

Ethical considerations

The study will follow the ethical standards of each country. The study will be conducted independently on each side, with recruitment starting with the approval of the research ethics committees. The researchers declare no conflict of interest in carrying out this study. In Brazil, the research protocol was approved by the Federal University of Minas Gerais (UFMG), approval opinion CLM 007-2022, and by the ethics committee in research involving human beings (CEP-UFMG CAAE: 56604122.5.0000.5149), approval opinion number: 5.380. 538. Approved in Honduras registration N° IRB 00003070. Approved in Ghana ID N°: GHS-ERC 04/19/22. Approval in United Kingdom (UK ERGO/Ethics number: 72962).

Financing source

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Setting

We will recruit primary care health professionals in four different countries: Brazil, Ghana, Honduras, and the UK. Collections started in August 2022.

Participants

Inclusion criteria: All categories of health professionals involved in primary care and who used telehealth from the COVID-19 pandemic onwards be included in this study.

Exclusion criteria: Not having worked during the pandemic.

Sources and Methods of Selection of Participants

The recruitment strategy will be health care provider (target).

Each participating country will provide a list of institutional email addresses of all primary care health professionals at their university. All professionals on these lists will receive an invitation to the survey through the institutional email. The primary research information will be provided in the email, such as the study title, objectives, methods, guarantee of confidentiality of identifying data, and the Informed Con-sent Form (ICF). If the volunteer accepts to participate and signs the ICF, he will be directed to an e-survey with ten questions with questions related to the user's profile (Figure 1). After answering these questions, he will receive the System Usability Scale (SUS) by mobile phone. Identifying data such as name, professional registration, and personal records will not be collected for this research.

Variables

The variables of interest in the study will be telehealth (independent variable - predictor) and usability (dependent variable - outcome).

Usability determines the success of a system. Usability testing allows you to describe features of a given product, that is, if it is easy to use, easy and quick to learn, if it does not cause errors (and if they do occur, if they are quickly resolved), and if it offers a high degree of satisfaction for its users. Poorly designed interfaces, especially for systems that work with information, can be responsible for disinterest or dis-crediting the user, causing damage and losses, among other factors. Measuring usability requires awareness and knowledge of the user, goals, and environments. Identifying which user characteristics, tasks, and environmental aspects influence usability is called usability context analysis (Klaassen et al., 2016).

Measuring instrument

The research will consist of two surveys. Surveys allow for quickly assessing a system on end-users, requiring minor specialization in the assessment method compared to other methods. They are easily distributed and customizable. Therefore, surveys are an assessment method for various telehealth systems and end-users.

The System Usability Scale (SUS) will be distributed via mobile phone. An e-survey (electronic questionnaire via google forms - administered by email) will be included in the data to describe the health professional user profile. It will take five to ten minutes to complete each questionnaire. The e-survey in google docs will consist of the following questions, as shown below.

The "age" variable is numerical, and the professional variable and which digital tool(s) you use for telehealth are dissertation. The other variables are nominal or binary categorical (yes/no). The categorical variables will be reported in absolute (n) and relative (%) frequencies.

SUS will be used to assess the primary outcome, usability. Created by John Brooke in 1986 and developed by Digital Equipment Co (DEC) was defined as a method of ascertaining the usability level of a system that can be evaluated in terms of efficacy, efficiency, and satisfaction (Brooke, n.d.). It is one of the most used instruments to assess usability (Brooke, n.d.). It is a validated, reliable, easy, and fast tool that can be used on small samples (Bangor et al., 2008). SUS has no copyright, making the cost recommendable (Bangor et al., 2008). SUS can provide the user's point of view about the topic studied and reliable results unlinked to the system used or its actions (Padrini-Andrade, 2019).

The SUS is a technologically agnostic instrument that can evaluate various products and services (Bangor et al., 2008; Brooke, n.d.; Martins et al., 2015; Padrini-Andrade, 2019). Since its inception, the SUS has been considered a one-dimensional (Bangor et al., 2008; Brooke, n.d.; Martins et al., 2015; Padrini-Andrade, 2019). However, the SUS has two factors: 1º: Usability - as shown in questions 1, 2, 3, 5, 6, 7, 8, and 9. 2º: Learning - as shown in questions 4 and 10.

For participants agree or disagree with questions after reading and not just on impulse, the organization of questions oscillates between positive and negative terms to avoid interference in the answer (Bangor et al., 2008; Brooke, n.d.; Martins et al., 2015; Padrini-Andrade, 2019). Therefore, a low level of correlation is observed if the items are used separately, even if it has an appropriate correlation between the entire questionnaire and the separate items (Brooke, n.d.). For this reason, we will follow the recommendation to evaluate the questionnaire following its traditional form.

It rates the user-friendliness of the site, application, or environment being tested, consisting of a 10-item questionnaire on a Likert scale, with five response options for respondents; from Strongly Agree to Disagree (Figure 2) Field Strongly(Brooke, n.d.). Participant scores for each question are converted to a new number, added together, and then multiplied by 2.5 to convert the original scores from 0-40 to 0-100 (Brooke, n.d.). Although the scores range from 0 to 100, these are not percentages and should only be considered regarding your percentage rank (Bangor et al., 2008; Brooke, n.d.; Padrini-Andrade, 2019). The SUS scale score will be viewed as a continuous quantitative variable. The SUS survey was translated, adapted, and validated for Portuguese in Brazil (Martins et al., 2015) (Figure 2).

To calculate the (SUS) score, the score will be used on a digital calculator (System Usability Scale (SUS) Score Calculator (Stu-art-cunningham.github.io), so that the score will be generated as soon as the participant completes the questionnaire. The electronic calculator generates the total score in a single number (continuous numeric variable). This calculation was based on the process initially developed by John Brooke (Brooke, n.d.). The score is calculated in 3 steps: 1 point is taken from the score received in items 1, 3, 5, 7, and 9; 5 points are deducted from the grade received in items 2, 4, 6, 8, and 10; and finally, the sum of the results is multiplied by 2.5 to obtain the total value of the SUS. The sum of all scores is how the total SUS value is obtained (Padrini-Andrade, 2019). A total score of over 68 is considered above average (Bangor et al., 2008; Brooke, n.d.; Martins et al., 2015; Padrini-Andrade, 2019). To avoid data loss for the SUS survey, it will be constructed to only evolve to the following alternative when the previous one is completed.

Quantitative variables

The normality of data distribution will be evaluated graphically. The Kolmogorov-Smirnov test will be used to test the adherence of numerical variables. It will be described using mean, standard deviation (SD), minimum, maximum, median, and interquartile range. The measures of central tendency and variability of the variables with normal distribution will be mean and SD. For variables with non-normal distribution, median and interquartile ranges will be used.

Data sources / measurement

One of the potential confounding factors in a study is measurement error, which can increase the residual risk of confounding. To avoid this error, we use a validated questionnaire, self-completed by the participant, whose score will be automatically calculated by an electronic calculator.

1-Age.	……years
2-Sex.	( )Male ( )Female ( ) I prefer not to declare
3-Profession.	
4- What digital resources (applications, software, among others) do you use for telehealth?	
5- How do you rate the quality, status or ability to be connected for telehealth (connectivity)?	( )Bad ( )Good ( )Excellent
6-Do you think you waste a lot of time and effort to perform a telehealth task?	( )Yes ( )No
7-Do you need to go to the hospital/university for telehealth?	( )Yes ( )No
8-Do you started using telehealth only from the COVID-19 pandemic onwards?	( )Yes ( )No
9-If you had a choice, you would continue to use telehealth even after the COVID-19 pandemic?	( )Yes ( )No
10-Have you received prior training in telehealth?	( )Yes ( )No

Figure 1: *Electronic questionnaire via Google forms.*

The SUS is a highly robust and versatile instrument for assessing usability. SUS measures usability with high global reliability (0.92), high sub-constructs usability, and high construct reliability (0.91), according to Brooke, 1996 (Brooke, n.d.).

This analysis will consider the country (site), age, use of telehealth since the COVID-19 pandemic (considered as recent or old), and, if possible, the type of system for telehealth. A possible confounding factor in the study may occur because covariates, such as country (site), age, use of telehealth since the COVID-19 pandemic (considered current or old), and different systems to offer telehealth can be investigated. Linear regression will adjust for confounders and explain the linear relationship between the predictor and outcome variables.

We will also perform a correlation test between the variables used for the sample profile and the result of the SUS score. We will analyze whether characteristics such as gender, age, telehealth connectivity, time spent performing the task, and previous training are associated with better usability.

Bias

To avoid selection bias and ensure internal validity, all health professionals on the list sent by universities will receive the email invitation. In this way, all health professionals will be equally likely to participate in the study. The first responders who accept to participate in the survey until completing the sample provided for each site will be included in the study. It will, therefore, be a probabilistic sampling. Explanatory folders about the research will be posted on the three sites.

To avoid attrition bias due to loss of adherence when filling out the SUS questionnaire, 20% more will be added to the sample calculation value in each location.

Study size

A challenge for usability studies is to establish the sample size. Usability studies often describe 5 participants are enough to detect 80% of usability problems (Alroobaea & Mayhew, 2014; Chandran et al., 2017; Lewis, 1994). Nielsen, Lewis, and Virzi claim that five users are enough to identify 80% of usability issues. This fact is known as the "magic number" (Lewis, 1994). This sample number is used to find out the usability issue. According to the authors, the first user can discover almost a third of all problems; the second, in addition to perceiving repeated problems, discovers new issues; the third, fourth, and fifth users discover few new problems. Then many problems keep repeating, and new issues are not revealed.

Other researchers, such as Lindgaard, Chattratichart, Spool, Schroeder, Hwang, and Salvendy, disagree with this statement (Spool & Schroeder, n.d.). They criticize using small numbers that can cause a loss of reliability and usability problems. So, they suggest a more significant number of users. They reported that eleven users were used to reach an 80% usability discovery percentage. They reported that nine users, eight reviewers, and eleven reviewers, in order, were required to discover 80% of usability flaws in Think Aloud (TA), Heuristic Evaluation (HE), and Cognitive Walkthrough (CW). Thus, they suggest a sample size of 10±2 is recommended for the assessment (Dorsey & Topol, 2016). The authors have found that a sample of ten participants will reveal at least 82% of usability issues. This study aims not to discover usability problems but to assess usability in general.

AlRoobaea and Mayhew argue that at least twenty users may be needed for quantitative studies and say that some properties interfere with the sample size (Alroobaea & Mayhew, 2014):
• Usability period in which the item is evaluated.
• Quality of methodology summative or formative used to conduct the assessment
• Specific tasks selected.
• Matching the assessment and the context of use in the real world.

Item	Item correspondente em português
1	Acho que gostaria de utilizar este produto com frequência
2	Considerei o produto mais complexo do que o necessário
3	Achei o produto fácil de utilizar
4	Acho que necessitaria de ajuda de um técnico para conseguir utilizar este produto
5	Considerei que as várias funcionalidades deste produto estavam bem integradas
6	Achei que este produto tinha muitas inconsistências
7	Suponho que a maioria das pessoas aprenderia a utilizar rapidamente este produto
8	Considerei o produto muito complicado de utilizar
9	Senti-me muito confiante ao utilizar este produto
10	Tive que aprender muito antes de conseguir lidar com este produto

Source: Martins et al. 2015 [28].

Figure 2: *Portuguese Version of the System Usability Score (SUS).*

• Representativeness of users of the assessment.
• Assessor's skillfulness.
• Participant's individuality (introverts or extroverts).

Thus, they conclude that the sample size relates to the study context.

AlRoobaea and Mayhew conclude that a robust sample size must be used to find usability issues. A group size greater than or equal to twenty users is considered for studies seeking statistically significant results or comparative purposes (Alroobaea & Mayhew, 2014).

The sample size calculation in the present study was performed based on the primary outcome to accept or reject the null hypothesis that telehealth usability is not good. We considered good usability the values established in the study by Bangor, Kortum, and Miller, 2009 with the SUS scale, which considered a mean of 71.4 and a standard deviation of the mean of 11.6 (Bangor et al., 2009). The required sample was calculated with Reset info for an estimated population of 500, an average SUS score of 71.4 ± 11.6, a Type I error rate (α) of 5%, a 95% confidence interval, and an expected frequency of 30%. The result was a sample of 66 participants per country, totaling 196 participants.

Statistical methods

For the result of the primary outcome, telehealth usability from the point of view of the health professional, the quantitative analysis of the result of the SUS scale was used, with simple statistics, with the results presented as the mean and standard deviation of the mean for data with normal distribution, or median and interquartile range for data with non-normal distribution.

To adjust for known confounding factors and explain the linear relationship between the predictor variable and the outcome variable, linear regression will be used if the dependent variable's data present normal distribution. Will be considered for this analysis: country (location), age, use of telehealth since the COVID-19 pandemic (considered recent or old), and, if possible, type of telehealth system.

User profile characteristics collected in the electronic questionnaire will be correlated with SUS scores on the following variables: gender, age, telehealth connectivity (about time spent in the task and quality of connectivity), alternatives 5 and 6 of the e-questionnaire, and training was carried out to provide telehealth (alternative 10).

The Pearson correlation coefficient (if the two variables have a normal distribution) or the non-parametric equivalent test, Spearman's correlation, will be used to analyze the correlation between the SUS score and the numerical variables. The test will be the student's t-test, ANOVA (normal distribution), or Mann-Whitney (non-normal distribution) when the categorical variable is dichotomous. Finally, analysis of variance or Kruskal-Wallis for more than two categories, depending on adherence to the normal distribution. If there are differences, we will use Bonferroni post hoc tests ($p<0.05$).

Reports

The protocol followed the recommendations of the STROBE Statement —a Checklist of items that should be included in reports of cross-sectional studies.

Discussion

Key Expected Results

To our knowledge, this will be the first study that will bring results on health professionals' perception of the usability of telehealth systems to treat non-communicable diseases from the COVID-19 pandemic onwards, when there was a massive expansion of telehealth in the world. The results of this study will bring results from high-income countries, developing countries, and low-income countries. These results will expand knowledge about telehealth, presenting barriers and potentialities. These results can strengthen the dissemination of telehealth as a strategy to expand quality health care to more people and populations.

Limitations

One of this study's limitations is comparing countries' usability results. Different professions, countries, contexts of use, levels of telehealth experience, telehealth systems, and modalities can make comparison difficult. Therefore, if it is impossible to statistically compare the usability results of the telehealth systems in different countries, we will describe the results with the different contexts of use. We hope the results contribute new knowledge to strengthen telehealth and generate new hypotheses.

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Conflicts of Interest

The authors declare no conflict of interest.

References

- Alroobaea, R., & Mayhew, P. J. (2014). How many participants are really enough for usability studies? Proceedings of 2014 Science and Information Conference, SAI 2014, 48–56 https://doi.org/10.1109/SAI.2014.6918171
- Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An Empirical Evaluation of the System Usability Scale. https://doi.org/10.1080/10447310802205776
- Bangor, A., Kortum, P. T., & Miller, J. T. (2009). Determining what individual SUS scores mean: adding an adjective rating scale. Journal of Usability Studies Archive. https://www.semanticscholar.org/paper/Determining-what-individual-SUS-scores-mean%3A-adding-Bangor-Kotum/3399f83ff6149dc65b52600f52ed372be5a6aa86
- Bitar, H., & Alismail, S. (2021). The role of eHealth, telehealth, and telemedicine for chronic disease patients during COVID-19 pandemic: A rapid systematic review. Digital Health, 7. https://doi.org/10.1177/20552076211009396
- Brooke, J. (n.d.). SUS-A quick and dirty usability scale.
- Chandran, S. K., Forbes, J., Bittick, C., Allanson, K., & Brinda, F. (2017). Sample Size in the Application of System Usability Scale to Automotive Interfaces. SAE Technical Papers, 2017-

March(March). https://doi.org/10.4271/2017-01-1383
- Dorsey, E. R., & Topol, E. J. (2016). State of Telehealth. The New England journal of medicine, 375(2), 154–161. https://doi.org/10.1056/NEJMra1601705
- Elamin, W., Hannis, D., Nnyanzi, L., & Ells, L. (2018). To study the impact of mHealth interventions on chronic diseases management: A systematic over-view of systematic reviews protocol. Clinical EHealth, 1(1), 17–20. https://doi.org/10.1016/J.CEH.2018.08.001
- Flodgren, G., Rachas, A., Farmer, A. J., Inzitari, M., & Shepperd, S. (2015). Interactive telemedicine: effects on professional practice and health care outcomes. The Cochrane Database of Systematic Reviews, 2015(9). https://doi.org/10.1002/14651858.CD002098.PUB2
- Garfan, S., Alamoodi, A. H., Zaidan, B. B., Al-Zobbi, M., Hamid, R. A., Alwan, J. K., Ahmaro, I. Y. Y., Khalid, E. T., Jumaah, F. M., Albahri, O. S., Zaidan, A. A., Albahri, A. S., Al-Qaysi, Z. T., Ahmed, M. A., Shuwandy, M. L., Salih, M. M., Zughoul, O., Mohammed, K. I., & Momani, F. (2021). Telehealth utilization during the Covid-19 pandemic: A systematic review. Computers in biology and medicine, 138, 104878. https://doi.org/10.1016/j.compbiomed.2021.104878
- Kichloo, A., Albosta, M., Dettloff, K., Wani, F., El-Amir, Z., Singh, J., Aljadah, M., Chakinala, R. C., Kanugula, A. K., Solanki, S., & Chugh, S. (2020). Telemedicine, the current COVID-19 pandemic and the future: a narrative review and perspectives moving forward in the USA. Family Medicine and Community Health, 8(3). https://doi.org/10.1136/FMCH-2020-000530
- Klaassen, B., Van Beijnum, B. J. F., & Hermens, H. J. (2016). Usability in telemedicine systems-A literature survey. International Journal of Medical Informatics, 93, 57–69. https://doi.org/10.1016/j.ijmedinf.2016.06.004
- Kruse, C. S., Krowski, N., Rodriguez, B., Tran, L., Vela, J., & Brooks, M. (2017). Telehealth and patient satisfaction: a systematic review and narrative analysis. BMJ Open, 7(8), e016242. https://doi.org/10.1136/BMJOPEN-2017-016242
- Lewis, J. R. (1994). Sample sizes for usability studies: Additional considerations. Human Factors, 36(2), 368–378. https://doi.org/10.1177/001872089403600215
- Lopez, C. M. R., Lopez, J. E. C., Buchely, A. B., & Lopez, D. F. O. (1998). ISO 9241-11 Ergonomic requirements for office work with visual display terminals (VDTs) —. https://doi.org/10.3403/02478696
- Martins, A. I., Rosa, A. F., Queirós, A., Silva, A., & Rocha, N. P. (2015). European Portuguese Validation of the System Usability Scale (SUS). Procedia Computer Science, 67, 293–300. https://doi.org/10.1016/J.PROCS.2015.09.273
- Monaghesh, E., & Hajizadeh, A. (2020). The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. BMC Public Health, 20(1). https://doi.org/10.1186/S12889-020-09301-4
- Nadav, J., Kaihlanen, A. M., Kujala, S., Laukka, E., Hilama, P., Koivisto, J., Keskimäki, I., & Heponiemi, T. (2021). How to Implement Digital Services in a Way That They Integrate Into Routine Work: Qualitative Interview Study Among Health and Social Care Professionals. Journal of Medical Internet Research, 23(12). https://doi.org/10.2196/31668
- Nepal, S., Li, J., Jang-Jaccard, J., & Alem, L. (2014). A framework for telehealth program evaluation. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 20(4), 393–404. https://doi.org/10.1089/tmj.2013.0093
- Padrini-Andrade, L. et al. (2019). Evaluation of usability of a neonatal health information system according to the user's perception evaluation of usability of a neonatal health information system according to the user's perception. Rev. Paul. Pediatr., 37(1). https://doi.org/https://doi.org/10.1590/1984-0462/;2019;37;1;00019
- Sauro, J. (2015). SUPR-Q: A Comprehensive Measure of the Quality of the Website User Experience. Journal of Usability Studies, 10(2), 68–86.
- Smith, A. C., Thomas, E., Snoswell, C. L., Haydon, H., Mehrotra, A., Clemensen, J., & Caffery, L. J. (2020). Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). Journal of telemedicine and telecare, 26(5), 309–313. https://doi.org/10.1177/1357633X20916567
- Spool, J., & Schroeder, W. (n.d.). Testing Web Sites: Five Users Is Nowhere Near Enough. Retrieved September 22, 2022, from http://www.useit.com/alertbox/20000319.html
- WMA, W. M. A. (n.d.). WMA Statement on Guiding Principles for the Use of Telehealth for the Provision of Health Care – WMA – The World Medical Association. Retrieved September 22, 2022, from https://www.wma.net/policies-post/wma-statement-on-guiding-principles-for-the-use-of-telehealth-for-the-provision-of-health-care/

- Wosik, J., Fudim, M., Cameron, B., Gellad, Z. F., Cho, A., Phinney, D., Curtis, S., Roman, M., Poon, E. G., Ferranti, J., Katz, J. N., & Tcheng, J. (2020). Telehealth transformation: COVID-19 and the rise of virtual care. Journal of the American Medical Informatics Association : JAMIA, 27(6), 957–962. https://doi.org/10.1093/jamia/ocaa067
- Zhang, T., Mosier, J., & Subbian, V. (2021). Identifying Barriers to and Opportunities for Telehealth Implementation Amidst the COVID-19 Pandemic by Using a Human Factors Approach: A Leap Into the Future of Health Care Delivery? JMIR Human Factors, 8(2). https://doi.org/10.2196/24860