Investigating Barriers for the Implementation of Telemedicine Initiatives: A Systematic Review of Reviews

Completed Research

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Abstract

Telemedicine is said to change the way care is delivered. Nevertheless, it still faces barriers to overcome the pilot stage and reach a majority of patients in regular care. Although research widely exists on telemedicine barriers in isolated settings, a systematic overview to summarize key scientific contributions is missing. This paper aims to close this gap with a systematic review of already existing reviews. In sum, 98 barriers for telemedicine implementation were found and categorized depending on the factors triggering the barriers. These factors include patient, healthcare provider, culture and disease (people-related); health sector, standards/guidelines, legal framework, finance, organization and methodology (process-related); and technology (object-related). Recommendations for researchers and practitioners were drawn to overcome the barriers identified.

Keywords

Implementation, telemedicine, use, barriers.

Introduction

With its use of information and communication technology (ICT), telemedicine represents an empowering aspect in the digital transformation in healthcare (Watson 2016). Telemedicine uses ICT to deliver healthcare services and/or medical education over distance (Sood et al. 2007). It allows for securing care especially for individuals in medically underserved areas (Bashshur et al. 2000; Jang-Jaccard et al. 2014). Although telemedicine has been subject to research and practice for over 50 years (Singh et al. 2002), it seldom overcomes the pilot stage to reach regular care (Boonstra and van Offenbeek 2010; van Dyk 2014). Whilst still in the pilot stage, very few patients benefit from telemedicine and its promise of advanced access to healthcare (Brauns and Loos 2015).

The success of telemedicine initiatives is influenced by a number of factors related to the initiative itself and the environment where it is supposed to be implemented (Ly et al. 2017), which can hamper the progress as barriers if not considered sufficiently. "Barrier" thereby is defined as "a circumstance or obstacle that keeps people [...] apart or prevents [...] progress" (Oxford Dictionaries n.d.). Up to now, plenty of studies address barriers to telemedicine initiatives in different methodological settings (Bashshur et al. 2016; Tanriverdi and Iacono 1998), or focus on isolated medical settings (Rogers et al. 2017) as well as special geographic areas (Helitzer et al. 2003). Nevertheless, most of these studies draw different conclusions, leading to a heterogeneous field of research, and, to the best of our knowledge, no summary of key scientific contributions exists that consolidates prior work. Furthermore, the interaction between barriers related to people, processes and objects involved in telemedicine implementation remains unknown (Hastall et al.

2017). To address existing barriers and overcome them successfully, knowledge about the barriers themselves and possible support strategies for addressing them is highly important.

We therefore conducted a systematic review of reviews (Aromataris et al. 2015) and used Mayring's proposed procedure for a qualitative content analysis to categorize the barriers for the implementation of telemedicine initiatives (Mayring 2000).

With our research we aim to derive recommendations for those planning telemedicine programs, be they researchers, telemedicine project managers or healthcare providers, to overcome existing barriers.

The remainder of this paper is structured as follows: In the next section, we explain the method applied to reach our aim, before we present the results. Afterwards, we discuss the results and their implications for research and practice before we can draw a conclusion.

Research Method

We conducted a systematic review of reviews, also called "umbrella review". Focusing on a large amount of already existing reviews helps to summarize key scientific contributions and understand the different facets of a vast and heterogeneous field (Aromataris et al. 2015). Searching for already published reviews heightens the reliability of the included research, as the barriers are not only published in a primary study but have also been proven to be reliable in a review.

We refrained from a focus solely on publications in leading journals and instead searched by topic across relevant databases to avoid bias (Webster and Watson 2002). Accordingly, databases covering diverse fields were chosen: PubMed/Medline, as it is the largest and most inclusive database in the medical field; Cochrane Library, because it focuses on reviews; APA PsycNET, as behavioral research on individual technology acceptance (and therefore people-related barriers) is assumed to be found in a database for psychology; and Academic Search Complete (EBSCOhost), as it is expected, due to its interdisciplinary character, to cover the research areas not included in the previous databases.

The search string was combined as follows: "((telemedicine OR telehealth OR ehealth OR "e-health") AND (barrier* OR obstacle* OR gap* OR challeng* OR difficult*) AND (rural OR underserved) AND (review))".

As Bashshur, Shannon, and Sapci (2005) stated, the term "telemedicine" is not used consistently, which is why we also included related terms (Otto et al. 2018). Synonyms for the word "barrier" were tested for results, which led to an inclusion of the terms stated above. The focus lied on telemedicine solutions for individuals who have little or no access to care, which refers to people in rural or underserved areas.

An overview of the selection process can be seen in Figure 1**,** according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart (Moher et al. 2009).

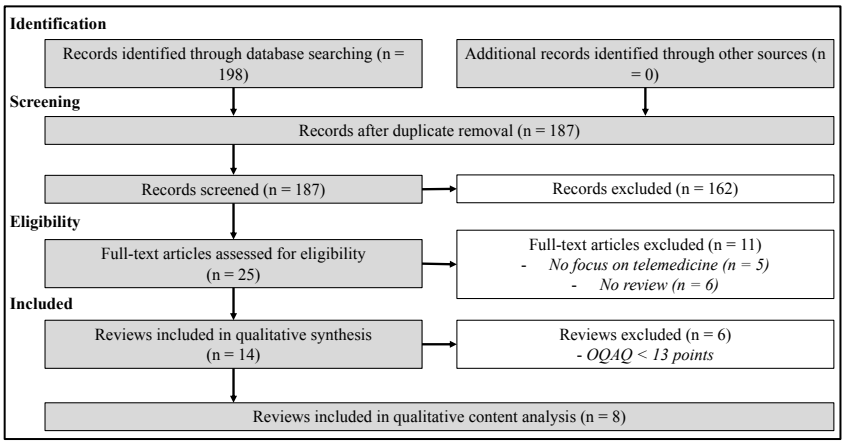

Figure 1: Flow of information according to PRISMA (Moher et al. 2009)

Conducting the search in January 2018 led to 198 hits (PubMed: 41, Cochrane Library: 83, APA PsycNET: 4, Academic Search Complete: 70). After duplicate removal, titles and abstracts were read to ensure that the studies met the inclusion criteria. Studies were included if they met the purpose of our aim, referring to

studies that reviewed telemedicine or related technologies (telehealth/eHealth) in terms of barriers for their implementation in rural or underserved areas. Afterwards, the remaining full texts were also checked for meeting the inclusion criteria. Due to the inclusion of all kinds of reviews, a quality assessment was conducted to include only methodologically sound reviews. The Overview Quality Assessment Questionnaire (OQAQ) developed by Oxman and Guyatt (1991) is a method to evaluate the scientific quality of reviews. The OQAQ consists of ten items rating different aspects of scientific quality with zero, one or two points per item (Greaves et al. 2011). As the questionnaire originates from the medical field, we modified the scale in a way that the item focusing on comparative effectiveness studies was left out. In our modified version, 16 points could be reached at maximum. Therefore, transferring the percentage share of the original scale, all studies with a minimum of 13 points were included in our assessment (see detailed score in Table 1). All authors read and assessed titles, abstracts and full texts and did the quality assessment independently from each other. Inconsistencies between the ratings were resolved through discussion, until consensus was reached.

Further analysis of the included full-text articles regarding barriers was done by qualitative content analysis as described by Mayring (2000). All barriers identified were categorized inductively (in collaboration between all authors) and are reported in detail in the results section. Inductive categorization describes the process of examining the reviews for underlying patterns, without using pre-existing categories. The final categorization was done using the three overarching topics "people", "process" and "object" (Mettler et al. 2010).

Results

Eight articles from different journals were identified as relevant and being of adequate quality for extracting barriers. All articles were published between 2012 and 2016. The reviews comprised 262 studies (163 quantitative, 55 qualitative, 11 mixed method designs, 33 without reported methodological approach) in total (see Table 1).

Authors, Date	No. of incl. studies	OQAQ score	Reported barrier categories
Fitzner and Moss (2013)	12	13	**People** (Patient, Healthcare Provider), **Process** (Finance, Legal Framework, Organization)
Govender and Mars (2016)	23	16	**People** (Patient, Healthcare Provider, Disease-related), **Process** (Finance, Standards/guidelines, Methodology), **Object** (Technology)
Gros et al. (2013)	26	14	**People** (Patient, Healthcare Provider, Disease-related), **Process** (Finance), **Object** (Technology)
Hage et al. (2013)	51	16	**People** (Patient, Healthcare Provider), **Process** (Legal Framework, Finance, Organization), **Object** (Technology)
Jang-Jaccard et al. (2014)	18	13	**People** (Patient, Healthcare Provider, Culture), **Process** (Health Sector, Standards/guidelines, Legal Framework, Finance, Organization, Methodology), **Object** (Technology)
Kruse et al. (2016)	15	14	**People** (Patient, Healthcare Provider, Culture), **Process** (Finance), **Object** (Technology)
Saliba et al. (2012)	94	16	**People** (Patient, Healthcare Provider, Culture), **Process** (Health Sector, Legal Framework, Finance, Organization, Methodology), **Object** (Technology)
Simpson & Reid (2014)	23	15	**People** (Patient, Healthcare provider, Disease-related)

Table 1: Characteristics of included studies (in alphabetic order of authors)

Data extraction from the eight studies resulted in 98 different barriers which will be evaluated concept-centrically (Webster and Watson 2002) in the following. The barriers were first categorized inductively,

depending on what factor triggers the barrier. In a second step, all categories were assigned to the three overarching topics "people", "process" and "object". The resulting categories are: patient, healthcare provider, culture and disease (people-related); health sector, standards/guidelines, legal framework, finance, organization and methodology (process-related); and technology (object-related). Please see Table 1 for coverage of barriers per author. Some barriers are related to more than one category as they are triggered by various factors. The interdependencies between the factors (where barriers are related to more than one factor) are shown by lines connecting the factors in Figure 2.

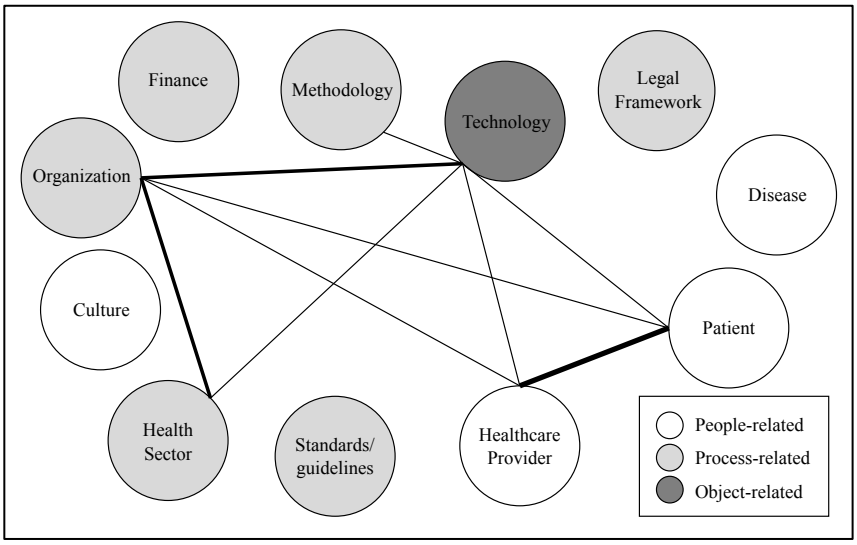

Figure 2: Interdependencies between barrier categories (Strength of the lines depending on no. of connections)

Especially the connecting lines between organization, technology and health sector, as well as the connection between patient and healthcare provider, are proof that the factors are highly interrelated. As some barriers are triggered by individuals and their organizations as well as the technology itself, the analysis is proof that neither barrier group can be viewed independently. Furthermore, patients and healthcare providers share the same problems as both are potential user groups. These user groups are, among others, influenced by technological and organizational issues as well: Organizational constraints such as workforce shortage or limited technological support can hamper individuals' acceptance/adoption and therefore the implementation success of telemedicine initiatives. Factors related to the legal framework or culture, all of whom can be unsupportive for telemedicine implementation on a hierarchically higher level, did not share any barriers with other categories and are therefore not interconnected. This does not imply that they cannot affect user acceptance or organizational readiness negatively. If, for example, technology skepticism is part of the pertinent culture in a rural community, individual acceptance was found to be hampered as well (Hage et al. 2013). Also, missing financial support turned out to be a crucial point for telemedicine implementation in rural communities (Jang-Jaccard et al. 2014).

To create a better understanding of the barriers identified, inductive subcategories (displayed in italics) were used to structure the results. All in all, 69 barriers are related to the people, 60 to the processes and 29 to the objects involved (see Figure 3 and Figure 4 for all subcategories and corresponding shares).

Barriers regarding the **people** include patient-, healthcare provider-, culture- and disease-related ones (see Figure 3). Barriers for patients are related to his/her *individual characteristics*, *resources* and *expectations* as well as his/her *social support* (e.g. unsupportive societal structure (Hage et al. 2013)) and *interaction* or the *usability* of the telemedicine initiative (e.g. complex use (Govender and Mars 2016)). The healthcare provider is less influenced by his/her environment but rather, for example, by his/her *negative associations* with technology use (e.g. fear of loss of system/patient control (Jang-Jaccard et al. 2014; Saliba et al. 2012)). Moreover, cultural and disease related issues influence all people involved, like culturally inappropriate communication (Jang-Jaccard et al. 2014; Kruse et al. 2016) or special demands for group therapy (Simpson and Reid 2014).

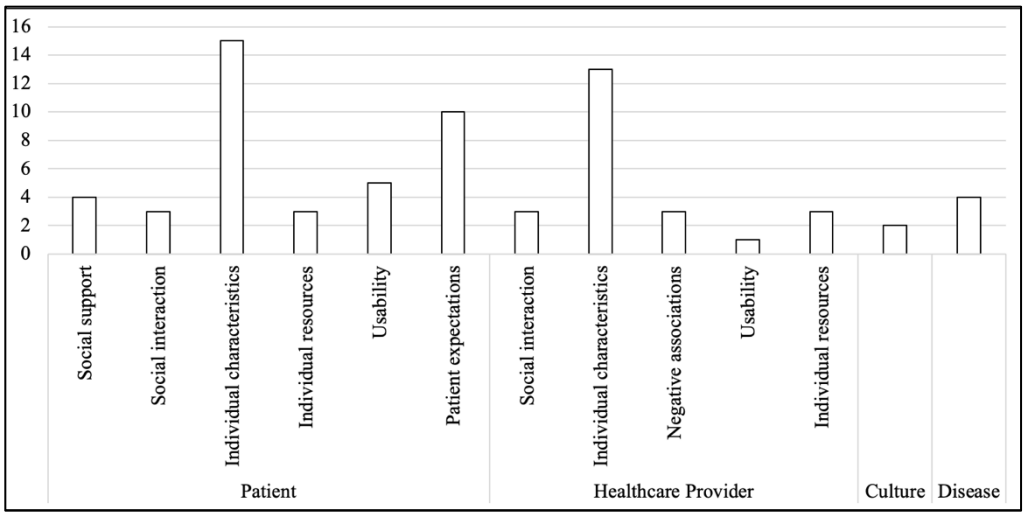

Figure 3: Number of barriers per category and subcategory for people-related barriers

Other barriers are mainly affected by **processes** in the societal system surrounding the telemedicine initiative itself (health sector, standards/guidelines or legal, financial, organizational and methodological issues – see Figure 4). Barriers related to the health sector include the missing *integration* of telemedicine initiatives into existing processes (e.g. technology isolated from care processes (Fitzner and Moss 2013)) and inadequate *workforce* (e.g. workforce shortage (Jang-Jaccard et al. 2014)). *Standards* and *guidelines* are another important point raised by three of eight authors (Govender and Mars 2016; Jang-Jaccard et al. 2014; Saliba et al. 2012). Missing guidelines (Jang-Jaccard et al. 2014; Saliba et al. 2012) as well as standardized protocols or procedures (Govender and Mars 2016) are a few examples of these categories. Legal barriers encompass *regulatory issues* (Hage et al. 2013) or unclear *responsibilities* (Jang-Jaccard et al. 2014), while financial barriers contain missing *benefits* (Jang-Jaccard et al. 2014), high *costs* (e.g. Saliba et al. 2012), and lack of *funding* and *reimbursement* strategies (e.g. Fitzner and Moss 2013; Gros et al. 2013; Hage et al. 2013). Organizational barriers, like low *accessibility* (Hage et al. 2013), inadequate *workforce* (e.g. high turnover of medical staff (Jang-Jaccard et al. 2014)), missing *cooperation* (e.g. conflict potential (Hage et al. 2013)) or *planning* (e.g. lack of strategy for scaling up (e.g. Saliba et al. 2012)) are further reasons for the missing success. The same is true for methodological barriers, where missing clinical evaluation, proof of cost-effectiveness (Saliba et al. 2012) or lack of reliability (Jang-Jaccard et al., 2014) hamper the initiative's success.

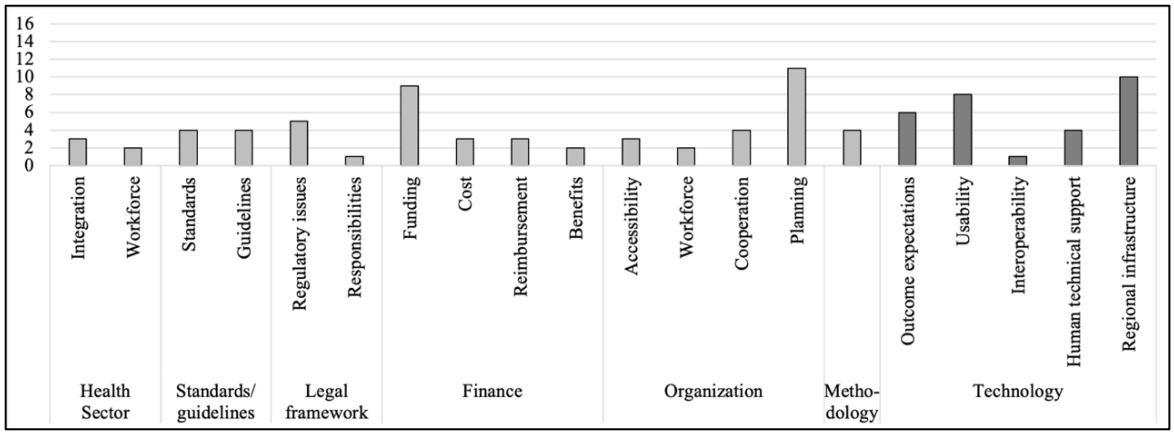

Figure 4: Number of barriers per category and subcategory for process- (light grey) and object-related (dark grey) barriers

Object-related barriers include the technological ones (see Figure 4), containing barriers like *outcome expectations* (e.g. missing functionalities (Govender and Mars 2016; Gros et al. 2013)), missing *usability* (Kruse et al. 2016) and *interoperability* (Jang-Jaccard et al. 2014), lack of *human technical support* (e.g. lack of skilled information technology maintenance workforce (Jang-Jaccard et al. 2014)) and *regional infrastructure* (e.g. no granting of broadband access (e.g. Hage et al. 2013)). In summary, non-interoperable and hard to handle technology are factors hampering the development and implementation of telemedicine initiatives. Those, too, are highly related to the end user's perspective on the technology.

All in all, it can be said, that the individual characteristics of patients and healthcare providers as well as the patient's expectation account for most of the people-related barriers (40.6%). The same is true for planning and funding within the process-related barriers (52.6%) and the rural infrastructure within the object-related ones (34.5%).

Discussion

The presented systematic review of reviews provides an overview of barriers related to the implementation of telemedicine initiatives into regular care. The umbrella review as a method was proven useful to draw a conclusive picture on that topic. With studies originating e.g. in the United States (Fitzner and Moss 2013), Africa (Govender and Mars 2016), Australia (Simpson and Reid 2014) and Europe (Gros et al. 2013), the implementation of telemedicine has been proven to be hampered worldwide, regardless of the political system, legal framework or development status. With reviews focusing on a wide range of diseases, e.g. diabetes mellitus (Fitzner and Moss 2013), hearing loss (Govender and Mars 2016) or psychological disorders (Gros et al. 2013), we could also show that barriers do not solely originate from the treatment requirements of a particular disease (only four of the 98 identified barriers were unambiguously disease related).

Furthermore, as the barriers are highly interrelated, a holistic approach in overcoming the barriers is necessary. Especially the patient has to be studied in relation to his/her direct and indirect environment, with a special focus on his/her individual technology assessment. As previously described, especially the individual characteristics and skills of patients and healthcare providers, processes of planning and funding as well as a sufficient regional infrastructure are (quantitatively) the most important barrier categories identified. This quantification of barriers included within each category suggests a higher importance of people- and process-related barriers, yet no further quantitative assessment was applied as it is uncommon to qualitative research. Therefore, on the "people"-level, usability research (Bergmann and McGregor 2011) and, on the "process"-level, the creation of a financially favorable environment (Dantu and Mahapatra 2013) are crucial fields of action. Only if barriers are seen in combination with others, an improvement of the implementation process is a realistic goal.

Limitations

The presented research is limited due to the selected databases and search terms. Only eight studies were finally included for qualitative content analysis. This is due to very strict in- and exclusion criteria, which ensure high quality evidence. Furthermore, Mayring's (2000) qualitative content analysis is a subjective method, as the results depend on the person executing the analysis. To avoid bias, every categorization and matching was done by all authors in discussion.

The evaluation of barriers was done according to the quantity of findings, and no barrier was weighted higher than another. Therefore, all results regarding the importance of categories and factors relate to the numeric share of associated barriers.

Contribution

Our work contributes to research and practice. To research, we contribute with the first review of reviews in this field. This has, to the best of our knowledge, never been done before. Thus, we provide results with a high reliability as they are based on reviews instead of primary studies. By identifying barriers related to telemedicine implementation, we generated a basic understanding of what categories of barriers should be considered when supporting successful telemedicine implementation into regular care (esp. patients and healthcare providers as involved individuals as well as organization, finance and technology).

An important finding from our work is the interrelation between different barrier categories. The barriers are not caused merely by the individual and his/her expectations, but also by the processes s/he is surrounded with and directly affected by, as well as by technological features and their assessment by the end user. Only with a holistic view on the barriers identified can they be overcome. As evidence on implementation barriers is scattered in previously existing literature, our research is, to our knowledge, the first to provide a holistic framework for telemedicine implementation research. The recommendations therefore contribute equally to research and practice – in the form of areas for future research and a guideline for future implementation processes.

All 98 barriers for telemedicine implementation identified in this research could be categorized into three overarching categories, labeled people, processes and objects. The latter refers to the telemedicine as a technological entity. For further telemedicine development, we recommend taking all three broad categories into account. The following measures can help overcoming barriers within each of the three categories:

People-related barriers: The needs and expectations of the end user, be it patients or healthcare providers, should be considered within the planning process of every telemedicine innovation. In this context, considering the individual as part of a larger societal structure, i.e. the meso-layer of the implementation process, is crucial (Hastall et al. 2017). Consequently, when planning telemedicine interventions, relatives of the patients as well as the professional network of healthcare professionals have to be part of the user-centered design process. A recent review by Adu and colleagues (2018) suggests a lack of such measures. Yet, as the direct social environment can serve as technological support when struggling with the use of the application (Jang-Jaccard et al. 2014), this is especially important. Apart from that, being part of a community is of vital importance for people living in a rural area. Telemedicine solutions allowing for social support in the case of illness can help fulfilling this need (Peeters et al. 2012). Therefore, acceptance research also has to focus on community and cultural influences (Kelly et al. 2003).

Process-related barriers: Paying respect to existing regional structures and the people involved in them is a key aspect in overcoming barriers to telemedicine implementation (Hage et al. 2013) and proves that neither people nor processes can be viewed separately. Especially for healthcare providers, a seamless integration of telemedicine technologies into their work processes is important (Monthuy-Blanc et al. 2013). Guidelines for diagnosis and treatment therefore need to incorporate telemedicine measures (Govender and Mars 2016). Since evidence on the applicability of digital interventions, especially for the treatment of chronic diseases, is still scarce (Kruse et al. 2017), this is difficult to achieve.

For telemedicine solutions to be integrated non-obstructively into everyday life conduct of patients and providers alike (Wu et al. 2017), easy to handle applications are of vital importance for both user-groups (Asua et al. 2012; Cajita et al. 2017). Think-aloud methods (Bolle et al. 2016) and standardized assessment tools for usability (Stoyanov et al. 2015; Wildenbos et al. 2018) should therefore be employed as part of the design process. Training to improve eHealth literacy for both healthcare providers and patients (Cartmill et al. 2016) could also be a necessary and helpful step in successfully addressing some of the barriers.

Within organizations as well as whole regions, a structured implementation plan for telemedicine is imperative (van Dyk 2014). Governments need to provide a regulatory system of laws and standards which allows for financing of a telemedicine infrastructure, reimbursement of telemedicine use and liability in case of malpractice (Jang-Jaccard et al. 2014; Kruse et al. 2017). Especially financing schemes are of high importance in rural areas (Saliba et al. 2012). Another aspect of a region-centered implementation strategy is a clear communication of telemedicine benefits to all stakeholders (Kayyali et al. 2017).

Object-related barriers: The telemedicine technology in question furthermore has to be developed by considering people involved and existing processes. It has to be fitting for the regional and local infrastructure and acceptable by patients and healthcare providers. Only then can a holistic telemedicine approach for rural and underserved areas be effective.

By following the recommendations provided – which are independent from a special country or social system -, we are optimistic that the barriers identified can truly be overcome, leading to more successful implementation of telemedicine initiatives.

Conclusion

This paper provides a clear itemization of barriers existing for the successful implementation of telemedicine initiatives. The 98 barriers identified are triggered by eleven factors, including patient, healthcare provider, culture and disease (people-related); health sector, standards/guidelines, legal framework, finance, organization and methodology (process-related); and technology (object-related). The high interrelation between these factors calls for holistically addressing factors influencing the implementation process. Only if the users are seen as embedded in their direct (community) and influenced by their indirect environment (e.g. legal or financial framework), an improvement of the status quo can be accomplished.

Recommendations to address the barriers identified in the given complexity are provided. In addition, our findings provide aspects for future research to focus on the barriers identified. Only with a broad understanding of what prevents the implementation of telemedicine initiatives from reaching regular care can this implementation process be improved.

Conclusively, our findings suggest that telemedicine applications do not need to remain stuck in the pilot stage but can be supported, especially by addressing the individual and his/her environment.

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REFERENCES

Adu, M. D., Malabu, U. H., Callander, E. J., Malau-Aduli, A. E., and Malau-Aduli, B. S. 2018. "Considerations for the Development of Mobile Phone Apps to Support Diabetes Self-Management: Systematic Review," *JMIR MHealth and UHealth* (6:6), p. e10115.

Aromataris, E., Fernandez, R., Godfrey, C. M., Holly, C., Khalil, H., and Tungpunkom, P. 2015. "Summarizing Systematic Reviews: Methodological Development, Conduct and Reporting of an Umbrella Review Approach," *International Journal of Evidence-Based Healthcare* (13:3), pp. 132–140.

Asua, J., Orruno, E., Reviriego, E., and Gagnon, M. P. 2012. "Healthcare Professional Acceptance of Telemonitoring for Chronic Care Patients in Primary Care.," *BMC Medical Informatics and Decision Making* (12), p. 139.

Bashshur, R. L., Howell, J. D., Krupinski, E. A., Harms, K. M., Bashshur, N., and Doarn, C. R. 2016. "The Empirical Foundations of Telemedicine Interventions in Primary Care.," *Telemedicine Journal and E-Health* (22:5), pp. 342–375.

Bashshur, R. L., Reardon, T. G., and Shannon, G. W. 2000. "Telemedicine: A New Health Care Delivery System," *Annual Review of Public Health* (21:1), pp. 613–637.

Bashshur, R. L., Shannon, G., and Sapci, H. 2005. "Telemedicine Evaluation," *Telemedicine and E-Health* (11:3), pp. 296–316.

Bergmann, J. H. M., and McGregor, A. H. 2011. "Body-Worn Sensor Design: What Do Patients and Clinicians Want?," *Annals of Biomedical Engineering* (39:9), pp. 2299–2312.

Bolle, S., Romijn, G., Smets, E. M. A., Loos, E. F., Kunneman, M., and van Weert, J. C. M. 2016. "Older Cancer Patients' User Experiences With Web-Based Health Information Tools: A Think-Aloud Study," *Journal of Medical Internet Research* (18:7), p. e208.

Boonstra, A., and van Offenbeek, M. 2010. "Towards Consistent Modes of E-Health Implementation: Structurational Analysis of a Telecare Programme's Limited Success.," *Information Systems Journal* (20:6), pp. 537–561.

Brauns, H.-J., and Loos, W. 2015. "Telemedizin in Deutschland," *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz* (58:10), pp. 1068–1073.

Cajita, M. I., Hodgson, N. A., Budhathoki, C., and Han, H.-R. 2017. "Intention to Use MHealth in Older Adults with Heart Failure," *Journal of Cardiovascular Nursing* (32:6), pp. E1–E7.

Cartmill, B., Wall, L. R., Ward, E. C., Hill, A. J., and Porceddu, S. V. 2016. "Computer Literacy and Health Locus of Control as Determinants for Readiness and Acceptability of Telepractice in a Head and Neck Cancer Population," *International Journal Telerehabilitation* (8:2), pp. 49–60.

Dantu, R., and Mahapatra, R. 2013. "Adoption of Telemedicine - Challenges and Opportunities," in *Proceedings of the Nineteenth Americas Conference on Information Systems*, Chicago, Illinois, August 15.

van Dyk, L. 2014. "A Review of Telehealth Service Implementation Frameworks," *International Journal of Environmental Research and Public Health* (11:2), pp. 1279–1298.

Fitzner, K., and Moss, G. 2013. "Telehealth-An Effective Delivery Method for Diabetes Self-Management Education?," *Population Health Management* (16:3), pp. 169–177.

Govender, S. M., and Mars, M. 2016. "The Use of Telehealth Services to Facilitate Audiological Management for Children: A Scoping Review and Content Analysis.," *Journal of Telemedicine & Telecare* (23:3), pp. 392–401.

Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., Schwarz, P., and IMAGE Study Group. 2011. "Systematic Review of Reviews of Intervention Components Associated with Increased Effectiveness in Dietary and Physical Activity Interventions," *BMC Public Health* (11:119).

Gros, D. F., Morland, L. A., Greene, C. J., Acierno, R., Strachan, M., Egede, L. E., Tuerk, P. W., Myrick, H., and Frueh, B. C. 2013. "Delivery of Evidence-Based Psychotherapy via Video Telehealth.," *Journal of Psychopathology & Behavioral Assessment* (35:4), pp. 506–521.

Hage, E., Roo, J. P., van Offenbeek, M. A. G., and Boonstra, A. 2013. "Implementation Factors and Their Effect on E-Health Service Adoption in Rural Communities: A Systematic Literature Review.," *BMC Health Services Research* (13:1), pp. 1–16.

Hastall, M., Dockweiler, C., and Mühlhaus, J. 2017. "Achieving End User Acceptance: Building Blocks for an Evidence-Based User-Centered Framework for Health Technology Development and Assessment," *Universal Access in Human–Computer Interaction. Human and Technological Environments,* pp. 13-25.

Helitzer, D., Heath, D., Maltrud, K., Sullivan, E., and Alverson, D. 2003. "Assessing or Predicting Adoption of Telehealth Using the Diffusion of Innovations Theory: A Practical Example from a Rural Program in New Mexico," *Telemedicine Journal and E-Health* (9:2), pp. 179–187.

IHS Markit. 2014. "Global Telehealth Market Set to Expand Tenfold by 2018 | IHS Online Newsroom," *News Releases*. (http://news.ihsmarkit.com/press-release/design-supply-chain-media/global-telehealth-market-set-expand-tenfold-2018, accessed May 7, 2018).

Jang-Jaccard, J., Nepal, S., Alem, L., and Li, J. 2014. "Barriers for Delivering Telehealth in Rural Australia: A Review Based on Australian Trials and Studies," *Telemedicine & E-Health* (20:5), pp. 496–504.

Kayyali, R., Peletidi, A., Ismail, M., Hashim, Z., Bandeira, P., and Bonnah, J. 2017. "Awareness and Use of MHealth Apps: A Study from England," *Pharmacy (Basel)* (5:2), pp. 33-47.

Kelly, K. J., Edwards, R. W., Comello, M. L. G., Plested, B. A., Thurman, P. J., and Slater, M. D. 2003. "The Community Readiness Model: A Complementary Approach to Social Marketing," *Marketing Theory* (3:4), pp. 411–426.

Kruse, C. S., Bouffard, S., Dougherty, M., and Parro, J. 2016. "Telemedicine Use in Rural Native American Communities in the Era of the ACA: A Systematic Literature Review.," *Journal of Medical Systems* (40:6), pp. 1–9.

Kruse, C. S., Soma, M., Pulluri, D., Nemali, N. T., and Brooks, M. 2017. "The Effectiveness of Telemedicine in the Management of Chronic Heart Disease - a Systematic Review," *JRSM Open* (8:3), pp. 1-7.

Ly, B. A., Labonté, R., Bourgeault, I. L., and Niang, M. N. 2017. "The Individual and Contextual Determinants of the Use of Telemedicine: A Descriptive Study of the Perceptions of Senegal's Physicians and Telemedicine Projects Managers," *PLOS ONE* (12:7), p. e0181070.

Mayring, P. 2000. "Qualitative Content Analysis," *Forum: Qualitative Social Research* (2:1), pp. 1–10.

Mettler, T., Rohner, P., and Winter, R. 2010. "Towards a Classification of Maturity Models in Information Systems," in *Management of the Interconnected World*, A. D'Atri, M. De Marco, A. M. Braccini, and F. Cabiddu (eds.), Physica-Verlag HD, pp. 333–340.

Moher, D., Liberati, A., Tetzlaff, J., and Altman, D. G. 2009. "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement," *BMJ* (339).

Monthuy-Blanc, J., Bouchard, S., Maiano, C., and Seguin, M. 2013. "Factors Influencing Mental Health Providers' Intention to Use Telepsychotherapy in First Nations Communities," *Transcult Psychiatry* (50:2), pp. 323–43.

Otto, L., Harst, L., Schlieter, H., Wollschlaeger, B., Richter, P., and Timpel, P. 2018. *Towards a Unified Understanding of EHealth and Related Terms – Proposal of a Consolidated Terminological Basis*, presented at the 11th International Conference on Health Informatics, Funchal, Madeira, February 2, pp. 533–539.

Oxford Dictionaries. (n.d.). "Barrier | Definition of Barrier in English by Oxford Dictionaries," *Oxford Dictionaries | English*. (https://en.oxforddictionaries.com/definition/barrier, accessed May 3, 2018).

Oxman, A. D., and Guyatt, G. H. 1991. "Validation of an Index of the Quality of Review Articles," *Journal of Clinical Epidemiology* (44:11), pp. 1271–1278.

Peeters, J. M., de Veer, A. J. E., van der Hoek, L., and Francke, A. L. 2012. "Factors Influencing the Adoption of Home Telecare by Elderly or Chronically Ill People: A National Survey," *Journal of Clinical Nursing* (21:21–22), pp. 3183–3193.

Rogers, H., Madathil, K. C., Agnisarman, S., Narasimha, S., Ashok, A., Nair, A., Welch, B. M., and McElligott, J. T. 2017. "A Systematic Review of the Implementation Challenges of Telemedicine Systems in Ambulances," *Telemedicine and E-Health* (23:9), pp. 707–717.

Saliba, V., Legido-Quigley, H., Hallik, R., Aaviksoo, A., Car, J., and McKee, M. 2012. "Telemedicine across Borders: A Systematic Review of Factors That Hinder or Support Implementation," *International Journal of Medical Informatics* (81:12), pp. 793–809.

Simpson, S. G., and Reid, C. L. 2014. "Therapeutic Alliance in Videoconferencing Psychotherapy: A Review.," *Australian Journal of Rural Health* (22:6), pp. 280–299.

Singh, G., O'Donoghue, J., and Soon, C. K. 2002. "Telemedicine: Issues and Implications," *Technology and Health Care* (10:1), pp. 1–10.

Sood, S., Mbarika, V., Jugoo, S., Dookhy, R., Doarn, C. R., Prakash, N., and Merrell, R. C. 2007. "What Is Telemedicine? A Collection of 104 Peer-Reviewed Perspectives and Theoretical Underpinnings," *Telemedicine and E-Health* (13:5), pp. 573–590.

Stoyanov, S. R., Hides, L., Kavanagh, D. J., Zelenko, O., Tjondronegoro, D., and Mani, M. 2015. "Mobile App Rating Scale: A New Tool for Assessing the Quality of Health Mobile Apps," *JMIR MHealth and UHealth* (3:1), p. e27.

Tanriverdi, H., and Iacono, C. S. 1998. "Knowledge Barriers to Diffusion of Telemedicine," in *Proceedings of the International Conference on Information Systems 1998* (Vol. 5), Atlanta, GA, USA, pp. 39–50.

Watson, A. R. 2016. "Impact of the Digital Age on Transforming Healthcare," in *Healthcare Information Management Systems: Cases, Strategies, and Solutions*, C. A. Weaver, M. J. Ball, G. R. Kim, and J. M. Kiel (eds.), Cham: Springer International Publishing, pp. 219–233.

Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), xiii–xxiii.

Wildenbos, G. A., Peute, L., and Jaspers, M. 2018. "Aging Barriers Influencing Mobile Health Usability for Older Adults: A Literature Based Framework (MOLD-US)," *International Journal of Medical Informatics* (114), pp. 66–75.

Wu, Y., Yao, X., Vespasiani, G., Nicolucci, A., Dong, Y., Kwong, J., Li, L., Sun, X., Tian, H., and Li, S. 2017. "Mobile App-Based Interventions to Support Diabetes Self-Management: A Systematic Review of Randomized Controlled Trials to Identify Functions Associated with Glycemic Efficacy," *JMIR MHealth and UHealth* (5:3), p. e35.