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ORIGINAL ARTICLE

Identifying barriers in telemedicine-supported integrated care research: scoping reviews and qualitative content analysis

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Abstract

Background Integrated care is said to improve the way in which care is delivered. To support integrated care by ensuring close collaboration between involved stakeholders, information and communication technologies, especially telemedicine, are needed. Despite their potential, most telemedicine solutions never make it from pilot project stage to full implementation into usual care. Especially in integrated care scenarios, understanding of the barriers hampering successful telemedicine implementation and application is limited.

Objective and method Four rapid scoping reviews were carried out to cover the following broad sets of barriers in telemedicine implementation: technical, behavioural, economical and organisational barriers. The identified barriers and obstacles were categorised into problem areas with sub-categories and, afterwards, combined in order to identify future research potentials for telemedicine implementation.

Results A total of 118 studies were included for further analysis. The findings suggest that the individuals' characteristics, as well as the surrounding social and health care system, are the most important barriers for telemedicine-supported integrated care. The information system development and application, as well as missing data and evidence for the effectiveness of telemedicine and integrated care, are hampering successful implementation.

Discussion The consolidated problem areas deepen the understanding on how barriers for telemedicine solutions in integrated care settings are interrelated. Conclusively, this helps to successfully develop and implement telemedicine-supported integrated care.

Keywords Integrated care · Telemedicine · Barriers for implementation · Digitisation · Scoping review

Introduction, conceptual background and problem statement

Demographic change and an increasing number of people with multiple chronic diseases are among the main drivers for transition processes in health care (Harper 2010). Integrated care as a promising concept for the handling of this transition process requires close collaboration, networking and alignment of several health or social service providers, patients and other stakeholders (Kodner 2009). The use of

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information and communication technology is seen as one possible way to enable such integrated care across the entire care continuum (Stroetmann et al. 2010). The use of information and communication technology can fulfil the general expectation to improve the way in which care is delivered (Eysenbach 2001; Eng 2002; Sood et al. 2007).

Telemedicine is one phenotype of information and communication technology-supported care delivery (Otto et al. 2018), which is also expected to support integrated care (Melchiorre et al. 2018). Sood et al. (2007) define the term "telemedicine" as information and communication technology used by health care professionals to bridge distances when directly delivering care to a patient. Thereby, the term is clearly delimitated from related terms (Otto et al. 2018), such as eHealth, which is a broader concept [e.g. including electronic health records (European Commission 2017)], and telehealth, which also encompasses lifestyle applications without the involvement of any health care professionals (Abbott and Liu 2013). Despite telemedicine's valid potential, there is a growing concern that most of the telemedicine innovations never make the threshold from pilot project stage to a full implementation and translation into quality care practice (Kuipers et al. 2008; van Dyk 2014). This phenomenon, sometimes called "pilotitis" (Huang et al. 2017), is, among other reasons, rooted in limited evidence on deficits, barriers as well as enablers for information and communication technology-based health care models (Totten et al. 2016). Hence, there is a strong need to explore the barriers hampering successful telemedicine implementation and application, especially in integrated care scenarios.

According to the Oxford Dictionary, "barrier" can be defined as a "circumstance or obstacle that keeps people or things apart or prevents communication or progress" (https://en.oxforddictionaries.com/definition/barrier). The identification of barriers in telemedicine is a first step for further addressing these barriers.

Four categories of barriers for telemedicine implementation in integrated care settings are derived from van Dyk's (2014) review of service implementation frameworks. Based on Rogers' Diffusion of Innovations theory (Rogers 2003) and its application on telehealth by Grigsby et al. (2002), as well as Tanriverdi and Iacono (1998), van Dyk identified the following broad categories of barriers: (1) barriers arising from the non-availability of appropriate technology (technical barriers), (2) barriers revolving around the individual behaviour and willingness to change it, e.g. by adopting a technological innovation for health care (barriers to end-user acceptance), (3) economical barriers (mostly referring to the lack of reimbursement of health care professionals when using innovative technologies) and (4) barriers arising from the organisational structure into which the technology innovation is supposed to be implemented (organisational barriers). As frameworks are said to structure implementation processes and, therefore, increase chances for their success (Maunder et al. 2018), van Dyk's evidence-based framework was deemed useful.

While van Dyk's analysis covers telemedicine evaluation, the current research aims to also focus on telemedicine-supported integrated care scenarios. Therefore, its scope is also broader and similar to that of Auschra (2018), who covers the integration of care in inter-organisational settings. Furthermore, updated evidence on implementation barriers according to the four categories proposed by van Dyk will be systematically researched. Based on these four perspectives, van Dyk's framework will be adapted to also incorporate the implementation of telemedicine-supported integrated care solutions. Through the systematically updated evidence, a broader understanding of barriers to their implementation as well as a refinement of van Dyk's framework towards integrated care will be derived.

Method

In order to update evidence on van Dyk's categories, four independent scoping reviews were conducted. Scoping reviews are particularly useful to combine different research perspectives as they aim to map the literature on a broader field of interest (Peters et al. 2015). Six steps are to be followed when conducting a scoping review:

(I) "clarifying and linking the purpose and research question (identifying the research question)
(II) balancing feasibility with breadth and comprehensiveness of the scoping process
(III) using an iterative team approach to selecting studies, extracting data, incorporating a numerical summary and qualitative thematic analysis
(IV) reporting results
(V) considering implications of study findings to policy, practice, or research
(VI) incorporating consultation (optional) with stakeholders as a knowledge translation component of scoping" (Arksey and O'Malley 2005).

While these steps are done independently for every scoping review, the implications are derived collectively. The research questions and search strategies of each scoping review are documented in Table 1. The applied search strings are detailed in the electronic supplementary material. Studies before 2007

were excluded because the first systematically derived definition and extension of the term "telemedicine" was presented by Sood et al. (2007).

The results of the four single searches within the separate field suggested by van Dyk were categorised in a concept-centric manner (Webster and Watson 2002), leading to individual problem areas and sub-categories. Mayring's method of inductive category formation was used to derive the problem areas (Mayring 2000). After carrying out the individual scoping reviews, the identified problem areas and sub-categories were combined using a Delphi-like procedure, on the basis of Okoli and Pawlowski (2004). The combination led to a consolidated framework of fields of interest for future telemedicine implementation research and processes in integrated care scenarios.

Results

Given the heterogeneity in the designs and scopes of the included studies, a narrative summary of the study findings is presented. Every category of barriers by van Dyk is presented in one sub-section. In the beginning of each subsection, a brief summary of the scoping review is given, followed by a list of the identified problem areas. Each of the problem areas (displayed in *italics*) is subsequently explained in more detail. These findings are taken as a basis to combine the four perspectives into one consolidated framework.

Technical barriers

Technical aspects of integrated care solutions constitute an information and communication technology foundation that enables advanced information processing and exchange. The literature search regarding the technical barriers on the PubMed database yielded 70 results, of which 33 were subsequently selected for an in-depth analysis. This analysis revealed a variety of problem areas scattered along the whole life cycle of integrated care solutions. These include user involvement, domain-specific models, design methodology, interoperability, standardisation, integration, non-functional requirements, as well as equipment and information and communication technology infrastructure.

Especially at the beginning of the life cycle, during the specification of requirements and the early design phase, *user involvement* could be identified as being vital for a successful implementation of eHealth solutions. Inappropriate design choices reduce the quality of the final system, as user involvement is important to detect mismatches between design concepts and reality (Tatara et al. 2013). There should be a thorough understanding of the end user's needs (Sánchez et al. 2017), which leads to improved designs, enhanced functionality, usability and, ultimately, quality (Strisland et al. 2017). As a consequence, lack of user involvement in the specification and design process often leads to insufficient user acceptance (see the section titled "Barriers to end-user acceptance"), which, however, is crucial for a successful implementation (Walker and Clendon 2016). A key challenge is to unify varying expectations from different actors (especially regarding the user interface) (Scholl et al. 2011). In order to successfully introduce a new system, the motivation of some enthusiasts, serving as opinion leaders, is a valuable resource (Lovelock et al. 2017), which needs to be maintained even if the new system initially increases their workload (Sánchez et al. 2017). Although the importance of user involvement is widely known, lacking time and money during the design phase (Strisland et al. 2017), as well as lacking information technology skills of health care staff, are major barriers for user involvement.

As the second problem area, the insufficient usage of *domain-specific models* also hampers the successful diffusion of eHealth solutions. Missing support and compatibility to life cycles (specification, design, implementation and operation)

Table 1 Research questions and search strategies of the conducted scoping reviews according to van Dyk's categorisation of barriers

Scoping review	Research question	Search strategy and field(s) of interest	Database
(1) Technical barriers	Which technical barriers are impeding the design and application of integrated care solutions?	Integrated care, design process and corresponding tasks	PubMed and hand search
(2) Barriers to end-user acceptance	What are the individual and systematic factors influencing end-user acceptance of telemedicine applications?	End-user acceptance, theoretical background, behaviour change for telemedicine, systematic reviews and meta analyses	PubMed and hand search
(3) Economical barriers	What financial and economic barriers exist for telemedicine implementation?	Focus on barriers and synonyms for telemedicine and related concepts in reviews	PubMed, Academic Search Complete (EBSCOhost) and hand search
(4) Organisational barriers: evaluation and quality management	Which deficits and barriers can be identified in the evaluation and quality management of integrated care?	Telemedicine and related technologies, integrated care, quality management and measurement	PubMed, Science Direct and hand search

(Sánchez et al. 2017) and lack of expressiveness of data (Walker and Clendon 2016) have been identified as barriers.

Choice of the correct *design methodology* was also identified as a problem area. According to Scholl et al. (2011), selecting an appropriate design strategy is difficult but very important, as adaptions must be made to incorporate each unique setting. Moreover, the design methodology must be appropriate for a socio-technical development process, ensuring user involvement and coping with the vast amount of technical realisation possibilities (Waterson et al. 2012).

Due to those high degrees of freedom in the system design, *interoperability* plays an important role. On the one hand, the individual components of an eHealth application need to be interoperable with each other to achieve a well-functioning system (Waterson et al. 2012; Lluch 2013; Sánchez et al. 2017). On the other hand, if an eHealth solution should be integrated with other information technology systems in the health context, interoperability between systems is required to prevent errors, inefficiencies and duplications of work (Lovelock et al. 2017). In this context, several studies emphasised the lack of *standardisation* as a significant problem area for the integration and adoption of digital health solutions (Waterson et al. 2012; Walker and Clendon 2016).

Similarly, the lack of *integration* on information and process level was reported to be another problem area for eHealth applications. Lack of integration creates additional work and a fragmented working process (Tatara et al. 2013; Walker and Clendon 2016), rendering integration between isolated components a critical factor for transformative changes (Lovelock et al. 2017). This is all the more important as digitalised care models usually enlarge the amount of collected information, with a high potential to increase workload (Sánchez et al. 2017).

When considering the scaling up of digital health solutions, the problem area of additional *non-functional requirements*, such as scalability, robustness and data integrity, needs to be taken into account. These are both prerequisites for a successful large-scale implementation (Sánchez et al. 2017) and vital for user acceptance of novel digitalised applications (Walker and Clendon 2016). The development of an appropriate infrastructure should be supplemented by supportive coordination actions (Waterson et al. 2012).

Finally, as eHealth solutions heavily rely on information and communication technology, the problem area of inadequate *equipment and information and communication technology infrastructure* impedes the use of information and communication technology and digital health applications. IT infrastructures should be scalable to support a rapid expansion of digital health applications (Pawa et al. 2017), whereas, in reality, problems in availability and reliability occur (Walker and Clendon 2016). Even within a single organisation, common infrastructural barriers exist. Furthermore, Petrakou (2009) reported that, sometimes, IT equipment of the users is inappropriate, if at all existing.

Barriers to end-user acceptance

Barriers to end-user acceptance all focus on the individual who is supposed to take full advantage of the use of telemedicine in his or her care process (Rogers 2003). Barriers are grouped into two main categories, one of which describes *characteristics of the technology*, among them usability, concerns about data security and anonymity, and missing functionalities. The other covers *characteristics of the end user*, be it patient or health care provider, such as cultural beliefs towards technology and the maintenance of individual health.

Of the 136 studies initially found, 103 did not meet the inclusion criteria or were excluded after full-text screening, as they did not inform about end-user acceptance. Thus, 27 systematic reviews and three meta analyses were included in the final analysis, while three applied both methods.

The most commonly identified problem area is the one encompassing *characteristics of the technology* perceived as harmful to his or her health by the patient as the end user. Whether for apps, online platforms, wearables or text message services, usability was a major concern, as use of the application in question was perceived as hard to learn (Molini-Avejonas et al. 2015) due to design flaws (Bonini 2017) or a non-user-centred development of the application (Bashshur et al. 2016). Another aspect of usability focussed on practicability and suitability for everyday conduct, both being hampered by high latencies in data proliferation (Foster and Sethares 2014), obstructiveness of the device in use (Thakkar et al. 2016) or low interoperability with existing devices (Gaebel et al. 2017). The latter is true especially for mHealth solutions (Firth et al. 2016). Apart from usability, adoption was hampered by patients' concerns about data security and anonymity provided by the telemedicine application analysed (Bergmann and McGregor 2011).

Another major barrier subsumed under perceived characteristics of the technology in use were missing functionalities. Among them, personalisation and educational tools were most often mentioned by the included reviews or meta analyses. Personalisation refers to data, like vital parameters or behaviour statistics, being provided, yet not tailored to the individual end user (Gaebel et al. 2017). This problem also arises when no personalised feedback is given on data inserted by the patient (Aguilar-Martínez et al. 2014). Patients reported a lack of educational tools as they have the potential to inform about specific aspects of their disease in a way that is easy to understand without having to attend a physician (Narasimha et al. 2017). As the monitoring of vital data was an essential part of most of the telemedicine solutions discussed in the included articles, major patient concerns were not its availability but limited accuracy (Déglise et al. 2012) and low frequency of feedback on the results of the monitoring (Park et al. 2016).

A lack of psychosocial components also limits patients' willingness to adopt a telemedicine solution. The sub-

category refers to missing elements that allow for forming a supportive community of relatives, peers or patients suffering from the same disease (Bennett et al. 2014). If no community-building option is given (like an uplink to a social network site), at least some interactive components enabling social support (like a chat function) should be included (Pietrzak et al. 2013). This can also be achieved by providing an option for regular contact with a health practitioner, as long as this option is not intended to substitute real-life consultations (Vallury et al. 2015).

While there is evidence on problem areas arising from specific characteristics of the technology in use, the *characteristics of the end user* have gained less attention. Aguilar-Martínez et al. (2014) conclude that every application aiming for self-monitoring of vital parameters or health behaviour requires a pro-active approach towards health from the patient, as opposed to relying on a physician to take care of it. Yet, only two of the included reviews discussed lifestyle-related behaviour or vulnerability as barriers of adoption of such applications (Fjeldsoe et al. 2009; Bashshur et al. 2016). Three studies are concerned with health literacy of the individual (Paré et al. 2007; Déglise et al. 2012; Foster and Sethares 2014).

These findings are in line with a lack of theories being employed by the authors of the included reviews in order to explain the adoption of telemedicine innovations. Of the three reviews mentioning a theoretical basis, one was an intervention to help deal with mental health problems and, therefore, relied on cognitive behavioural therapy (Park et al. 2016). Ahmed et al. (2017) analysed barriers on the basis of Broens' framework for telemedicine implementation (Broens et al. 2007). Even though the above-mentioned results imply behaviour change towards pro-activity being intended by self-monitoring devices, only Fjeldsoe et al. (2009) included studies actually referring to theories of health behaviour change, yet without naming a single one. All in all, the behaviour change which results from applying a telemedicine innovation was found to be seldom rooted in theory, although some variables from behaviour theories (vulnerability, pro-activity) were studied (Fjeldsoe et al. 2009). Similarly, external barriers negatively influencing the individual's adoption decision were mentioned, yet also not rooted in theory. Little evidence was found for barriers arising from cultural beliefs towards technology and maintenance of individual health (Foster and Sethares 2014; Adeloye et al. 2017).

Economical barriers

van Dyk's category "economical barriers" refers mainly to reimbursement and the opening of new patient markets (van Dyk 2014). We broaden this understanding by searching for financial as well as economic barriers in the context of telemedicine and related concepts.

Applying the search string in PubMed (127 results) and Academic Search Complete via EBSCOhost (85 results) lead to 212 results. Thirty articles were published before 2007 and, therefore, excluded. After duplicate removal, 166 articles remained. Four more studies were included via hand search. All in all, 19 studies were included after an analysis of the title, abstract and full text.

It could be found that most of the authors refer directly to financial barriers instead of to economic barriers. Eighteen of the 19 included papers involve different aspects of financial barriers, mainly lack of funding, cost, reimbursement or benefits.

Funding hereby not only refers to lack of funding in general (Saliba et al. 2012; Hage et al. 2013) but also for patients (Kruse et al. 2016), equipment (Jang-Jaccard et al. 2014; Kruse et al. 2016) or on a long-term basis (Saliba et al. 2012; Hunting et al. 2015). Furthermore, a lack of resources that also relates to insufficient funding could be identified (Saliba et al. 2012; Hage et al. 2013).

Another big issue in the field of financial barriers are different *costs* (Skillman et al. 2010), mostly related to the new technology, making the technology less affordable for patients (Alvarado et al. 2017). Firstly, start-up and maintenance cause high costs (Saliba et al. 2012; Ross et al. 2016), due to the purchasing and installation of technology (Frade and Rodrigues 2013; Vimarlund and Le Rouge 2013; Hage et al. 2013; Jang-Jaccard et al. 2014; O'Connor et al. 2016; Alvarado et al. 2017). Secondly, the intervention itself creates high costs that appear in an ongoing manner (Ross et al. 2016; Alvarado et al. 2017). Thirdly, Ross et al. (2016) and Cooper (2015) identified a concern about a successful return on investment.

Reimbursement was mentioned as a financial barrier in almost every second identified paper (Vimarlund and Le Rouge 2013; Fitzner and Moss 2013; Gros et al. 2013; Weinstein et al. 2014; Jang-Jaccard et al. 2014; Rogove and Stetina 2015; Krishna et al. 2017; Alvarado et al. 2017).

Besides a lack of funding and reimbursement, missing *benefits* further hamper the successful implementation of telemedicine projects: financial benefits (Jang-Jaccard et al. 2014) are lacking, as well as incentives for rural practices (Jang-Jaccard et al. 2014).

Moreover, general financial limitations (Govender and Mars 2017) and low insurance coverage, as well as high poverty among the population (Skillman et al. 2010), could be identified as barriers related to finance.

Organisational barriers: evaluation and quality management

Organisation barriers refer to the existing organisational structures and the institutional support to execute telemedical services (van Dyk 2014). In our scoping review section, we focus on aspects of evaluation and quality management referring to telemedicine and integrated care. After applying the search

string, 796 studies were identified. A hand search identified 24 additional studies. Overall, 33 studies were included after a scan of titles and abstracts, as well as full-text analyses. Studies that did not report a method or study design were excluded. The included studies comprised 14 systematic reviews, eight reviews, four observational studies (cross-sectional observational study, propensity score-matched cohort study, case study) and seven studies using qualitative methods, such as web-based survey, Delphi study and interviews. Mapping the literature, two major subject areas were identified. These are: (I) insufficient or fully lacking data for evaluation and quality management purposes and (II) the need for combining evidence-based and practical integrated care solutions.

Within the subject of insufficient or fully lacking data, six problem areas were identified: insufficient evidence, limited understanding of the link between indicators and outcomes, limited patient-centeredness and heterogeneous target populations, lack of measures for quality, missing long-term evaluations and lack of standardisation. The included studies focussed on integrated care as well as on digital innovations in integrated health care settings. The systematic review carried out by Allen et al. (2014) identified and synthesised evidence derived from randomised controlled trials, focussing on the quality of transitional care interventions compared with standard hospital discharge for older people with chronic illnesses. They report *limited evidence* in different quality domains (such as efficiencies for community providers, effectiveness/symptom management and domains of person- and family-centred care) and recommend collaborative research strategies of scientists and family care givers (Allen et al. 2014). Another obstacle for the development of quality indicators in integrated care settings is the *heterogeneous target population*, leading to a complex and even unfeasible development of process and outcome indicators (Kavanagh et al. 2009; Hannon et al. 2012).

Furthermore, the currently prevalent focus on structure and process indicators (e.g. organisational and administrative) led to a *lack of standardised, validated outcome measurement methods and instruments* for systematic integrated care quality assessment (Armitage et al. 2009; Bautista et al. 2016). Although *patient-centeredness* is an organising principle of integrated care (Minkman et al. 2009), patient experience and involvement are currently not routinely applied (Doyle et al. 2013; Wiig et al. 2014; Heyeres et al. 2016). Similarly, performance management is assessed as being highly relevant for integrated care. However, it is currently given little attention in practice (Zonneveld et al. 2017). Data are mostly not gathered for evaluative purposes, e.g. data are collected via ex-post questionnaires, interviews, self-assessment forms, audits or surveys (Strandberg-Larsen and Krasnik 2009). Therefore, evaluation relies on the recollection of partaking individuals instead of happening in real time. Additionally, the follow-up periods of outcome assessments are mostly too short, leading to a *lack of longitudinal measurement methods* and quality indicators covering the whole care pathway (Shaw et al. 2011; Ferrua et al. 2012). Also, the availability of instruments that can simultaneously measure structure, process and outcome quality is limited (Bautista et al. 2016). This is further complicated by the *lack of a shared understanding of quality* across the different stakeholders and groups in integrated care settings (Wiig et al. 2014).

The second subject regarding a need for combining evidence-based and practical integrated care solutions comprises four major problem areas: need for a holistic understanding and acceptance of integrated care by professionals, need for individualised implementation strategies corresponding to regional disparities, need for targeted involvement of professionals and related challenges, and insufficient care pathways for integrated care scenarios. Some studies call for a more *holistic understanding and broader acceptance of integrated care*, e.g. by criticising missing health system perspectives (Tian et al. 2017), a missing focus on multi-faceted, collaborative care chains (Meyer-Delpho et al. 2015), insufficient population-based concepts to measure trans-sectoral quality of care (Schrappe 2015; Geraedts et al. 2017) and no theoretically underpinned outcomes (Allen and Rixson 2008). Several study groups argue that research and implementation need to take the acceptance of quality indicators by ambulatory care physicians into account (Heuvel 2011; de Cruppé et al. 2015). Due to the *regional disparities* in eHealth (De Feo et al. 2012), authors report a need to replicate studies in different settings (Berghöfer et al. 2016) and recommend to use local pilot initiatives as a strategy for step-wise implementation (Heuvel 2011). Looking at process-oriented organisational barriers, the *development and application of care pathways* for integrated care scenarios still lack design principles and standards. There are no common development methods or protocols for such pathways (Sifaki-Pistolla et al. 2017). Care pathways are not integrated with the overall management tasks such as performance and quality management, although they hold great potential, especially for supporting process monitoring or the assessment of process compliance using a computerised pathway system (Vrijhoef et al. 2017).

Mapping of priority areas and research

Using four individual scoping reviews, different problem areas were found, supporting the applicability of van Dyk's categories of barriers to current evidence on telemedicine implementation barriers, as well as those hampering integrated care. These problem areas can be categorised into five broader fields of interest for future telemedicine implementation research (see Table 2). Some problem areas arise from the micro-perspective of adoption units, some from the meso-perspective on environmental influences on the individual and some from the macro-perspective of legal or regulatory

frameworks. These three fields of interest are underlined by a basic category of barriers arising from a lacking knowledge base in information systems development and application, as well as in generating data and evidence.

Discussion

As shown in Table 2, digitisation in health care has many different facets. It not only holds special requirements to the individual as the end user of the technology, but also to his/her direct and indirect structural environment, as well as to implementation research and systems development. Assessment frameworks, like the one presented by van Dyk, are said to improve the quality of already existing applications, as well as planned future ones (Khoja et al. 2007). Our proposed framework, based on van Dyk's combined with barriers to telemedicine, as well as implementation of integrated care scenarios, is intended to do the same.

In order to do so, we present the most up-to-date evidence on van Dyk's four categories of barriers, while, especially, organisational barriers were extended to cover the domain of integrated care.

Barriers to technology acceptance from the individual and technological perspective

The three levels of analysis (micro-, meso- and macro-perspective) derived from the separate scoping reviews focus on the individual as the unit of adoption, as well as the social and organisational structure that influences him/her. Although research is often limited to patients and their needs, the included studies provide evidence on the need for a multi-stakeholder approach, including social and organisational structures of care delivery (Bashshur et al. 2016). All in all, the lack of user-centred development of telemedicine innovations, especially in terms of integrated care, is a key result of this research. Even though it is of vital importance that all technical difficulties are addressed and mitigated as far as possible, focussing solely on technical aspects will not suffice, since telemedicine solutions must also be appropriate for its destined usage and accepted by its prospective users.

Therefore, telemedicine implementation frameworks must contain a behavioural perspective, as telemedicine applications often intend to change health behaviour (Riley et al. 2011). A clear definition of the group of end users is often missing, due to heterogeneous target populations (Alam et al. 2016), as well as a solid theoretical basis for behaviour change (Hastall et al. 2017). Interdisciplinary research involving the users (e.g. patients and health care professionals) and their acceptance and adoption of new technical innovations helps to foster the diffusion of new eHealth applications (Livanos et al. 2018).

The lack of theories informing user choices to adopt a telemedicine innovation is in line with the findings of previous research (Horodyska et al. 2015). In a systematic review on studies evaluating behaviour change interventions (focussed, e.g. on weight loss or smoking cessation), Riley et al. (2011)

Table 2 Consolidated framework of fields of interest for future telemedicine research in integrated care scenarios

Field of interest	Problem area
Levels of analysis	
Micro-perspective (adoption units/individual)	Lack of consideration of individual characteristics
	Financial burden
	Missing financial incentives
Meso-perspective (environment of the individual)	Social and organisational environment of the individual not considered appropriately
	Regional disparities in implementation not addressed
	Unclear involvement of professionals
Macro-perspective (frameworks)	Regulations and structure of the health care system
	Inappropriate strategies for reimbursement and funding
	Information and communication technology infrastructure insufficiently developed
Knowledge base	
Information systems development and application	Lack of technological standardisation
	Characteristics of application and technology insufficiently addressed
	Inappropriate development strategies
	Insufficient integration and interoperability
Data and evidence	Missing research perspectives evaluating telemedicine in integrated care settings
	Inadequate study designs and related measurement tools
	Insufficient and lack of data

reported a paucity of theories being used in the development. Yet, these interventions often use reminder functions as "cues to action", which is an essential part of health behaviour change theories (Riley et al. 2011). Still, behaviour factors such as engagement are often left aside (Saket et al. 2016).

Economical barriers to telemedicine implementation

Our study shows that the economic evaluation of telemedicine-supported integrated care solutions is in need of appropriate methods for evaluation (Tsiachristas et al. 2016). Yet, our research suggests that both providers and patients targeted by telemedicine projects are directly affected by high financial burden and missing financial support. This is also true for lack of funding, inadequate reimbursement or misleading incentives (e.g. disregarding rural settings) hampering integrated care scenarios. Examples for successful reimbursing strategies, as applied in the New Hampshire project, intended to unite telehealth with integrated care, serve as a showcase (Miller 2017). Our results confirm those by Bradford et al. (2016), who mentions economics as one of six success and sustainability factors for telehealth services. They hereby refer to economics as a factor that increases the value of a service by adding benefits and being cost or time saving at the same time (compared to face-to-face services).

Organisational barriers

Regulations and standards need to take regional differences and organisational specifics into account, which, in turn, also influence health professionals (Kiberu et al. 2017). This is in line with the findings of Tanriverdi and Iacono (1998), who state that telehealth services need to be integrated into existing care settings in order to improve care services.

For measuring improvement thorough integrated telemedicine solutions, sufficient data need to be synthesised into evidence for the benefit of telemedicine. As indicated by Bashshur et al. (2005) and Scott et al. (2007), the evaluation approaches for telemedicine projects are too heterogeneous, if evaluation measures are included in the projects' budgets at all (Bashshur et al. 2005). Also, there is no consistent population-based evaluation approach for integrated care (de Bruin et al. 2012). Within health care organisations, data for evaluation and quality management purposes are either insufficient or fully lacking. Combining evidence-based and practical integrated care solutions is, therefore, often not feasible (Strandberg-Larsen and Krasnik 2009).

Concerning integrated care, a similarly strong need for multi-faceted, collaborative transition interventions, spanning settings and different patient profiles to serve as a guidance [e.g. for hospitals (Burke et al. 2013)] was identified. Organisational, compensatory and cultural commitments may be important for the successful implementation of clinical indicator initiatives by health care systems (Ballard 2003). Parallels to the barriers preventing telemedicine solutions from making it into regular care are evident. Therefore, further research in the field of telemedicine usage in integrated care as well as robust evaluation are needed, combining patient-centeredness and legal as well as organisational and technical standards. A need to carry out more rigorous research with longer follow-ups is also common to integrated care settings, as well as telemedicine solutions (Cui et al. 2016; Whitehead and Seaton 2016). In a recent global research agenda for personalised telehealth in the future, Dinesen et al. (2016) summarised 12 priorities to facilitate comparative evaluations of telehealth solutions at multiple levels. The need for multidisciplinary assessment of the effectiveness of new telehealth services and health system design, organisation and practice (e.g. cross-sector integration using telehealth technologies) is directly in line with the identified gaps in this scoping review (Dinesen et al. 2016).

The results concerning the macro layer of the proposed framework are also in accordance with the research opportunities in the realm of digital transformation in health care as identified by Agarwal et al. (2010). They also call for tools assessing eHealth readiness in an area of implementation, which take into account the factors stated in Table 2.

Conclusively, we provide fields of action for multidisciplinary evaluation of telemedicine-supported integrated care, spanning basic fields of interest, such as inadequate technology and terminology, as well as the individual end user and his or her direct and indirect environment. Our identified categories fit those researched by Auschra, yet extend her classification of a barrier for integrated care to make it suitable for information and communication technology-supported integrated care solutions (Auschra 2018). Furthermore, in addition to studying inter-organisational settings, we also focus on intra-organisational processes, such as data collection within a care unit.

Limitations

As scoping reviews cover broad fields of research and, therefore, large amounts of data (Arksey and O'Malley 2005), they are a lengthy process requiring subjective decisions about the breadth of data to include. Applying Delphi-like procedures when planning a scoping review generates some degree of standardisation. Quality assessment of the included literature, as well as a quantification of the strengths of the reported effects (Grant and Booth 2009), does not take place, yet can be a second step towards a more systematic approach. Those problem areas, though each covering different research areas, are not always disjunctive and sometimes highly interrelated. For example, for a further investigation of the technical barriers, they need to be analysed with a more technical focus. Nevertheless, scoping reviews are an adequate first step

towards understanding digital transformation (Anderson et al. 2008).

Summary of findings

Four scoping reviews based on different categories of barriers, including technical barriers, barriers to end-user acceptance, economic as well as organisational barriers, were applied to identify and map current barriers in telemedicine research. It was shown that telemedicine as well as integrated care solutions are hampered by similar sets of barriers that we call "problem areas". Problem areas were classified in three different perspectives (micro: adoption unit; meso: regional disparities; macro: frameworks) on digital transformation, as well as limited knowledge on information systems development and application and data and evidence. As the individual (micro-perspective) cannot be considered in an isolated manner, his/her adoption decision is hugely influenced by the social system around him/her (meso-perspective) and never independent from regulatory and legal standards or the financial background of the health care system studied (macro-perspective).

One major problem area is the inadequate consideration of the individual end user's attitudes towards characteristics of the technology within the design process of a telemedicine solution. Without knowledge about the individual, tailored interventions, also for telemedicine-supported integrated care, are not feasible.

Especially when focussing on integrated care, interoperability of the technology with the existing technological infrastructure is essential. An appropriate design methodology, therefore, secures adequate technological solutions.

Standardised measurement procedures for effectiveness of telemedicine, also when imbedded within integrated care solutions, are often lacking, yet necessary for generating an adequate knowledge base. This is especially important, as proof of effectiveness is a precondition for the funding and reimbursement of telemedicine technology and, therefore, its implementation in health care systems beyond the pilot phase.

Conclusion

The consolidated problem areas provide an in-depth understanding of future research to develop and implement telemedicine solutions in integrated care settings. The importance of such understanding in the wake of demographic change is evident. Future research initiatives can use the identified fields of interest, problem areas and sub-categories to develop a more solid and holistic evidence base.

As frameworks for implementation are said to improve the success of any innovation, the current research further promotes implementation frameworks for telemedicine-supported integrated care scenarios.

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Compliance with ethical standards

Conflict of interest All authors declare no conflict of interest.

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