Development of an Implementation Framework for Telerehabilitation following Hip / Knee Total Joint Replacement in Austria

Master Thesis

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Declaration

I declare that I have developed and written the enclosed Master Thesis completely by myself, and have not used sources or means without declaration in the text. Any thoughts from others or literal quotations are clearly marked. This work was not used in the same or in a similar version to achieve an academic grading or is being published elsewhere.

Wien, 19.09.2019

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Signature

Preface

When I was working as a nurse, mainly in traumatology and mobile care, patients with total joint replacements were part of everyday life. There was always the question, how their recovery could be supported, especially the weeks between hospital and inpatient rehabilitation. Now as a process manager, I am even more interested in integrated health care and convinced of the great opportunities digitalization might offer. But this is not just because of devices. Digitalization goes beyond hardware and software. From my point of view as a health professional and a process manager, usefulness, support in adaption of processes and increasing of "digital awareness" are key factors for digitalization. This brought up die idea of the development of an implementation framework within a telemedical context, which addresses organizational and technical aspects.

I would like to thank my advisor – Dipl. Sporting. Dr. Mario Heller, for his support, patience and especially the specific feedback. Also, many thanks to all the interviewed experts for providing their knowledge and experience.

There are lots of "thank yous". My greatest goes to Michael – for always and ever calming me down and helping me focusing what's important in life.

Many thanks to all my funny and loud families for keeping my feet on the ground, especially to my Mum & Augustin – who have always supported me in all my diverse "projects" in my life so far.

For the last two years – very special thanks to all my fellow students of #mdh17.

Last but not least – so much thank you to all my extraordinary and awesome friends, especially the "stprockcitlyladies & boys" for being there, everywhere and everywhen.

Abstract

Hip and knee total joint replacements are the most common surgical procedures performed in Austria. The number of these interventions is increasing steadily, as well as the demand for rehabilitation places. Telerehabilitation has the potential, especially concerning the mentioned orthopedic interventions, to replace or supplement conventional rehabilitation, which has already been proven by studies.

For successful implementation of telemedicine projects, such as telerehabilitation, a framework is essential, in which organizational and technical aspects are discussed.

In order to develop such a framework, experts in the field of telerehabilitation and / or potential users like orthopedists and physiotherapists were interviewed. Questions refer to essential organizational, technical and legal aspects as well as process steps, potential success factors and challenges.

As a central result of this framework, a checklist has been developed, which illustrates the essential steps of the implementation. It also considers approaches of project management or system requirements.

Key aspects are for example, timing and type of integration of telerehabilitation. The use of devices that are already familiar to patients (and health care professionals) is essential for a high level of acceptance and thus for a successful implementation. Financing, technical maturity and the willingness to implement as well as readiness to digitize and realize telerehabilitation are seen as challenges.

However, according to the experts, some measures are still missing in Austria. For instance, a development of an organizational manual or funding of telerehabilitation. Involvement of universities for increasing the therapist´s acceptance of telerehabilitation or certifications of telerehabilitation applications might also be helpful. Development of a culture toward digitalization is also seen as essential for driving telerehabilitation forward.

Kurzfassung

Implantationen von Hüft- bzw. Knietotalendoprothesen zählen zu den häufigsten chirurgischen Eingriffen, die in Österreich durchgeführt werden. Die Zahl dieser Operationen steigt stetig, sowie auch die damit verbundene Nachfrage an Rehabilitationsplätzen. Telerehabilitation hat das Potential, vor allem in Zusammenhang mit den erwähnten orthopädischen Eingriffen, konventionelle Rehabilitation zu ersetzen bzw. zu ergänzen, wie bereits durch Studien gezeigt wurde.

Für eine erfolgreiche Implementierung von telemedizinischen Vorhaben, wie Telerehabilitation, ist ein Vorgehensmodell essenziell, in dem organisatorische sowie technische Aspekte berücksichtigt werden. Als Grundlage zur Entwicklung dieses Modells wurden im Rahmen dieser Arbeit ExpertInnen auf dem Gebiet der Telerehabilitation und / oder potenzielle AnwenderInnen wie OrthopädInnen und PhysiotherapeutInnen befragt. Im Fokus der Interviews stand die Diskussion von wesentlichen organisatorischen und technischen Themen sowie zu Prozessschritten, Erfolgsfaktoren und Herausforderungen im Rahmen der Einführung von Telerehabilitation.

Als zentrales Ergebnis dieses Vorgehensmodells wurde eine Checkliste entwickelt, die die wesentlichen Schritte der Implementierung abbildet. Dabei werden auch Ansätze des Projektmanagements und Systemanforderungen berücksichtigt.

Wesentliche Aspekte bei der Implementierung sind beispielsweise Zeitpunkt und Art der Integration von Telerehabilitation. Der Einsatz von Geräten, die den Anwendern bereits vertraut sind, ist vor allem wesentlich für eine hohe Benutzerakzeptanz und somit für die erfolgreiche Implementierung. Finanzierung, technische Reife und die Bereitschaft zur Digitalisierung und Realisierung der Telerehabilitation werden als Herausforderungen gesehen.

Um Telerehabilitation in Österreich erfolgreich implementieren zu können, fehlen nach Ansicht der ExpertInnen beispielsweise noch die Entwicklung und Bereitstellung eines Organisationshandbuches oder Methoden zur Finanzierung von Telerehabilitation. Die Einbeziehung von Universitäten und angehenden TherapeutInnen, zur Erhöhung der Akzeptanz könnte ebenso hilfreich sein. Eine Sensibilisierung der Bevölkerung für das Thema Digitalisierung wird als erforderlich gesehen, um die Entwicklungen rund um Telerehabilitation voranzutreiben.

Table of Content

1 Introduction

"The government gets telerehabilitation off the ground"[1] – an Austrian newspaper announced 2018, as telerehabilitation was embodied in the Austrian law.

Studies have already proven that telerehabilitation - "the provision of rehabilitation remotely using modern information and communication technologies (ICT)" – after total joint replacement has the potential to substitute or complement conventional rehabilitation. [1], [2], [3], [4]

Raising rates of both, total hip replacement (THR) and total knee replacement (TKR), [5, p. 180] as well as increasing demand of rehabilitation or moreover the shift from inpatient to outpatient rehabilitation [6, p. 143] might be a purpose for telerehabilitation in Austria. Although some effort is seen in implementing telemedical services, no framework, model or guide for implementing telerehabilitation, especially not for total joint replacement was found.

In the context of this thesis, a framework is seen as an approach which provides support for a defined project. It consists of process steps, recommendations and / or relevant aspects of the (project) environment. Synonyms for framework can be model or guideline.

The framework might also be used for implementation of telerehabilitation following total joint replacement in other countries. According to the Organization for Economic Cooperation and Development (OECD), in Germany and Switzerland rates of knee and hip replacement are similar to Austria. [5, p. 178] Also, the process of rehabilitation might be regulated like in Austria. But for this thesis, respectively developing the framework, only experts from Austria were involved.

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[1] Der Standard, *„Regierung bringt Telerehabilitation auf den Weg,",* November 6, 2018. [Online], Available: https://www.derstandard.at/story/2000090724771/regierung-bringt-telerehabilitation-auf-den-weg [Accessed Aug. 02. 2019]

1.1 Problem

As already mentioned, according to the OECD, Austria (beside, Germany, Switzerland and Belgium) has the highest rates in both, hip and knee replacement. [5, p. 180] With around 19.000 (each) surgical procedures they are in the Top 10 of all surgical procedures in Austria (per year). [7]

In OECD countries the rate of total hip replacement has increased by 30% between 2000 and 2015 and the rate of knee replacement has nearly doubled. [5, p. 178]

Usually patients who follow a total joint replacement get an inpatient or outpatient rehabilitation treatment after the hospital stay (acute care). [8, p. 18], [8, Sec. Appendix, table 5] According to Gesundheit Österreich (GÖG) it is assumed, that there is, also due to the demographic trend, an increasing demand of rehabilitation. [8, p. 148] Compared to 2016, 2020 will be a total bed deficit of only 9 beds (inpatient) for diseases of the locomotor system, [8, Sec. Appendix, table 9a] but 546 outpatient rehabilitation places are missing. [8, Sec. Appendix, table 9b] Telerehabilitation might contribute to close the gap of these missing resources.

Telemedicine services are usually implemented in a complex setting with different interactions and stakeholder. A structured framework – considering Austrian conditions and particular diseases / patients could provide support for the implementation. [9]

1.2 Research questions

- Which organizational, technical and legal aspects are required for the implementation of a telehealth service?
- Which steps are essential for successful implementing of telerehabilitation after total joint replacement in health care organizations (hospital, rehabilitation center etc.) in Austria?
- What are the key factors for successful implementation?

1.3 Method / Research strategy

This thesis consists of the following two main parts:

First, based on a literature search, background and related work was depicted. Therefore, a literature search was made for providing knowledge for this theoretical part. This was done in relevant databases like Pubmed, IEEE xplore, journals or

on the internet. State of the art and key factors in organizational, technical and legal aspects were identified.

In the second part, based on the first, a qualitative content analysis was done. An interview guideline was developed, and expert knowledge was gathered in form of interviews. In the chapter 3 (Methodology), the process of the qualitative study is explicated in detail. Results are described afterwards.

2 Background and Related Work

2.1 Rehabilitation in Austria

Rehabilitation is to remove, improve or prevent damage / functional disorder, limitation of abilities or impairment of participation through interdisciplinary teams. [8, p. 21]

According to the Austrian law of social insurance ("Allgemeines Sozialversicherungsgesetz" (ASVG)) the aim of rehabilitation is to "recover the state of health of the insured and their relatives, that they are able to occupy a appropriate place in the community as long as possible and without care or assistance (= prevention of need for care)". [10, Ch. § 302]

Rehabilitation is a coordinated process of activities, which should limit the progress of the disease or turn it back. Basically, the process is divided into four phases, which are usually chronologically. [6], [8, p. 9]

Phases of Rehabilitation in Austria [8, pp. 12–13]

- Phase I: early mobilization in hospitals ("Frührehabilitation" or "Akutrehabilitation")
- Phase II: rehabilitation in the meaning of social security law – directly after the hospital stay.
  - o Inpatient rehabilitation takes place directly after or within 12 weeks after the hospital stay. Precondition is the sufficient stability of patients, which means that they need to be able to do 2-3 hours (a day) of therapeutically activities.
  - o Outpatient: in this phase outpatient rehabilitation is possible under determined preconditions, but the extent of rehabilitation measures needs to be the same as inpatient (between 2,5 and 3,5 units per day) [8, pp. 24–25]
- Phase III: can be done only by outpatient treatment. The aim is the stabilization of achieved effects of phase II and sustainable positive change. Phase II is a precondition for phase III.
- Phase IV: long term follow-up care; can be done without medical supervision. Individual responsibility of patients is required.

Following surgery and postoperative care in an acute hospital, patients are admitted to an inpatient rehabilitation institution. Normally takes this place directly or within 12 weeks after the acute hospital care [8, pp. 18–19], which is usually the case. In Austria, average waiting time is 83 days from approval until admission. [8, Ch. Apendix, table 6]

Outpatient rehabilitation requires adequate mobility and securing of support at home. It is important, that outpatient rehabilitation is more flexible and allows the consideration of the patient's individual situation. Sufficient high quality rehabilitation activities and institutions are required. [8, pp. 18–19] An overview of the process and phases is depicted in *Figure 1*.
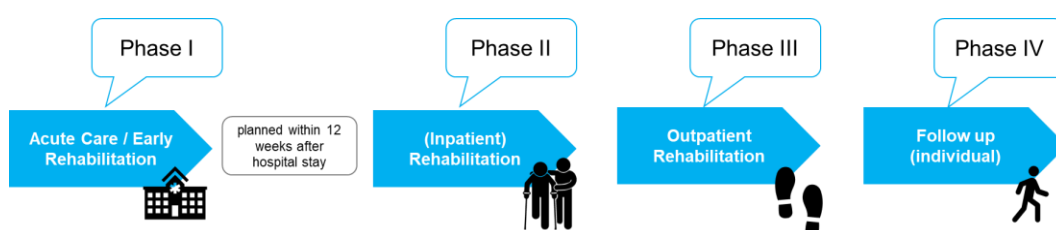

Figure 1 Phases of rehabilitation [8, pp. 12–13]

According to the Austrian rehabilitation plan, a shift from inpatient to outpatient treatment is planned. Therefore, an exchange of 487 inpatient to outpatient places concerning therapy of the locomotor system is needed until 2020. [8, p. 151]

Legal foundations of rehabilitation in Austria

The Austrian law for social insurance regulates the scope of medical rehabilitation, responsibilities for granting of activities and eligibility. Since 2018, as already mentioned, telerehabilitation has been equivalent to outpatient rehabilitation according to the Austrian law for social insurance § 302. Although it is not described in which way or extent telerehabilitation can be done. [10]

All three parts of the social health insurance, accident insurance, pension insurance and health insurance are responsible for granting medical rehabilitation. [8, p. 17]

2.2 Total joint replacement

"Total joint replacement is a surgical procedure in which parts of an arthritic or damaged joint are removed and replaced with a metal, plastic or ceramic device called a prosthesis. The prosthesis is designed to replicate the movement of a normal, healthy joint." [11]

More than one million total hip replacement procedures are done worldwide every year, what makes it one of the most frequently executed operations. In most cases, the indication for total hip and knee replacement is osteoarthritis (around 90%). [12] Others are inflammatory arthritis, dysplasia or fracture. The major aim of the surgery is to reduce pain, improve function and therefore life quality of patients. [13], [14]

Several different methods of surgical procedures are performed concerning total hip and knee replacement. Normal anatomy of the pelvis, arthritic changes and an overview of the surgical process of a total hip replacement is shown in *Figure 2*. Outcomes of the treatment are usually very good. According to Shan et al., benchmarked by health-related quality of life (HRQOL), which is a key outcome measurement of surgery, significant benefits are proven. [12]

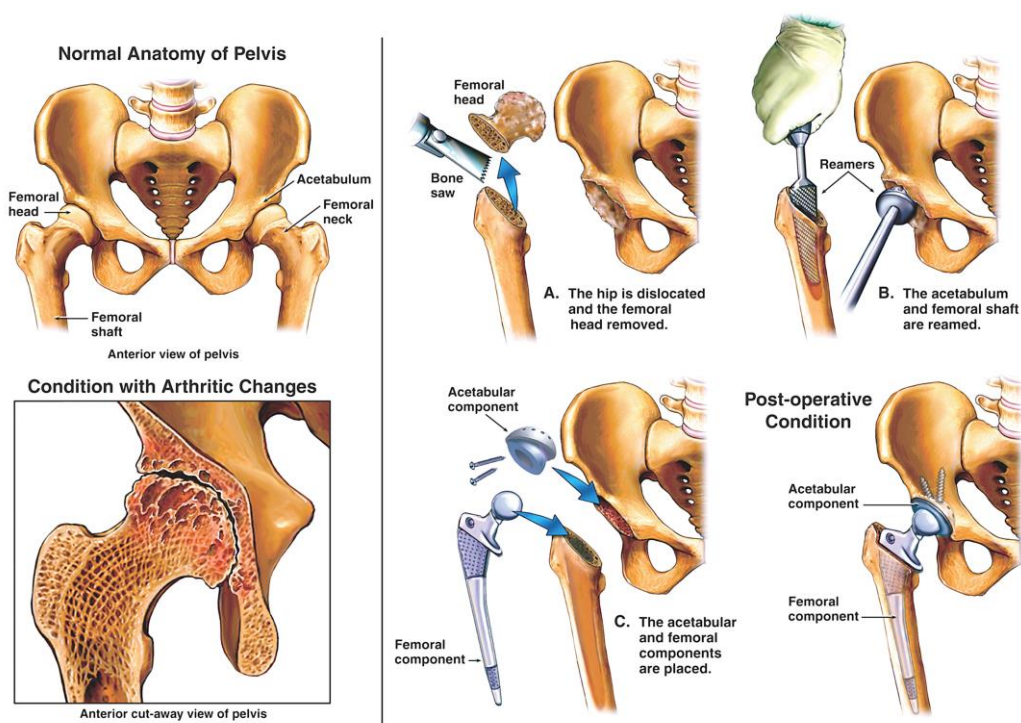*Figure 2. Surgical procedure of total hip replacement ©Nucleus Medical Media Inc / Alamy Stock Photo*

2.2.1 Total joint replacement in Austria

According to the OECD, Austria has one of the highest rates in both, hip and knee replacement. [5, p. 180] With around 19.000 (each) surgical procedures they are in the Top 10 of all surgeries in Austria per year (2017), as depicted in *Figure 3* [15]

MEL-Code	Anzahl Leistungen
operative med. Leistungen gesamt	1.096.040
1 BF020 Extrakapsuläre Kataraktoperation mit Linsenimplantation (LE=je Seite)	115.523
2 JN020 Entbindung (LE=je Sitzung)	54.291
3 NF020 Arthroskopische Operation des Kniegelenks (LE=je Seite)	37.364
4 JK030 Curettage (LE=je Sitzung)	34.447
5 JN040 Entbindung durch Sectio Cäsarea (LE=je Sitzung)	25.628
6 NE120 Implantation einer Totalendoprothese des Hüftgelenks (LE=je Seite)	19.153
7 BA010 Korrektur des Augenlids (LE=je Seite)	19.027
8 NF230 Implantation einer Totalendoprothese des Kniegelenks (LE=je Seite)	18.940
9 HM110 Cholezystektomie – laparoskopisch (LE=je Sitzung)	16.503
10 AJ070 Dekompression des Nervus medianus – offen (LE=je Seite)	15.139

Figure 3 Top 10 surgical procedures in Austria 2017. Total hip and knee replacements are highlighted [15]

In OECD countries, the rate of hip replacement has increased by 30% between 2000 and 2015 and the rate of knee replacement has nearly doubled. [5, p. 180]

The average age of Austrian patients receiving a total joint replacement remains relatively stable. Patients, who received a total hip replacement between 2009 and 2015 were 67.1 respectively 67.4 years old. For total knee replacement the average age was 69.7 respectively 69.5 years. In the mentioned period there were more female (57%) patients than male. [16] According to the Austrian Ministry of Health, the average stay (for both, THR and TKR) in the hospital is currently 9 days. [17]

2.3 Telerehabilitation and its context

Telerehabilitation is embedded in a broader context and terms. As a subarea of telemedicine, it uses information and communication technology to guide and evaluate rehabilitation at a distance. [18], [19]

According to the American Telemedicine Association, "telerehabilitation refers to the delivery of rehabilitation and habilitation services via information and communication technologies, also commonly referred to, as " telehealth" technologies. Telerehabilitation services can include evaluation, assessment, monitoring, prevention, intervention, supervision, education, consultation, and coaching. Telerehabilitation services can be deployed across all patient populations and multiple healthcare settings including clinics, homes, schools, or community-based worksites." [7]

Physio Austria say that telerehabilitation is "a term that describes the provision of "rehabilitation remotely", using modern information and communication technology as a means of delivery." [20]

As mentioned, telerehabilitation is seen as a form of telemedicine, which is a multidimensional and multidisciplinary concept. [21], [22] Sood et al. found 104 peer reviewed perspectives of telemedicine. According to them, telemedicine is a subset of telehealth, uses communications networks for delivery of healthcare services and medical education from one geographical location to another, primarily to address challenges like uneven distribution and shortage of infrastructural and human resources. [22] In addition, also the World Health Organization (WHO) is considering their definition: [23, pp. 8–9]

> The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. [23, pp. 8–9]

Beside telerehabilitation other examples of telemedicine are: [24, p. 14]

- Teleradiology: transfer or exchanging of medical images, like x-rays
- Telepathology: clinical laboratory and management of
- Teledermatological: video or image assisted dermatology
- Telecardiology: handling of cardiovascular diseases
- Telesurgery: supporting or performing of surgical procedures, together with tools resulting from artificial intelligence, robotics or virtual reality
- Telemonitoring: remotely monitoring of the health condition of patients

Telehealth is also a term, which comes along in this context. It is seen as not only curative, like telemedicine, rather it also includes a broader range including health promotion and prevention. [25, p. 31]

The WHO definition says, "Telehealth involves health services delivered from a distance. It encompasses remote clinical diagnosis and monitoring (such as with telemedicine) and includes a wide range of non-clinical functions encompassing prevention, promotion and curative elements of health. It often involves the use of electronic means or methods for health care, public health, administration and support, research and health education." [25, p. 31]

A report of the WHO refers, that teleradiology is the most prevalent initiative of telehealth in the European Region. 83 % (38 countries) of the member states use teleradiology. 72% (33 countries) uses telemonitoring and only one country uses telehealth in the field of orthopedics. [25, pp. 31–32]

In the broadest concept of all these definitions, eHealth – "can be understood as the application of the internet and other related technologies in the health sector for improving access, efficiency, efficacy, and quality of clinical and corporate processes used by health organizations, physicians, patients and consumers in an effort to improve the health status of patients." [24, p. 11]

The European Union (EU) even has a more meticulous definition and stresses the interaction and communication between patients and/or health professionals in the "eHealth Action Plan 2012-2020". In this paper the EU states a roadmap, challenges, barriers and several aspects, like research and education, which need to be considered towards an innovative health care in the EU. [26]

In Austria eHealth is seen as "[…] the use of information and communication technologies in health-related products, services and processes. Combined with structural changes in the health system, eHealth contributes to improving citizens' health and efficiency in providing health services." [27] Activities concerning eHealth and telemedicine in Austria are depicted in chapter 2.3.3

Additionally, mHealth constitutes a cross-section of all telehealth applications. It stands for more or less all health related topics and activities by using mobile devices, such as mobile phones, tablets and patient monitoring devices." [28, p. 6] The permanent availability of (personal) mobile devices has the potential to improve health outcomes. In the last years, there has been an increasing number of mHealth projects, such as the development of mobile apps. [29, p. 6] 2017 were more than 300.000 mobile health apps (with health, fitness and medical content) available worldwide. [30, p. 10], [31, p. 10]

All these definitions highlight that telehealth is a wide-open concept and constantly developing field. Figure 4 sums up the different terms in context of telerehabilitation.
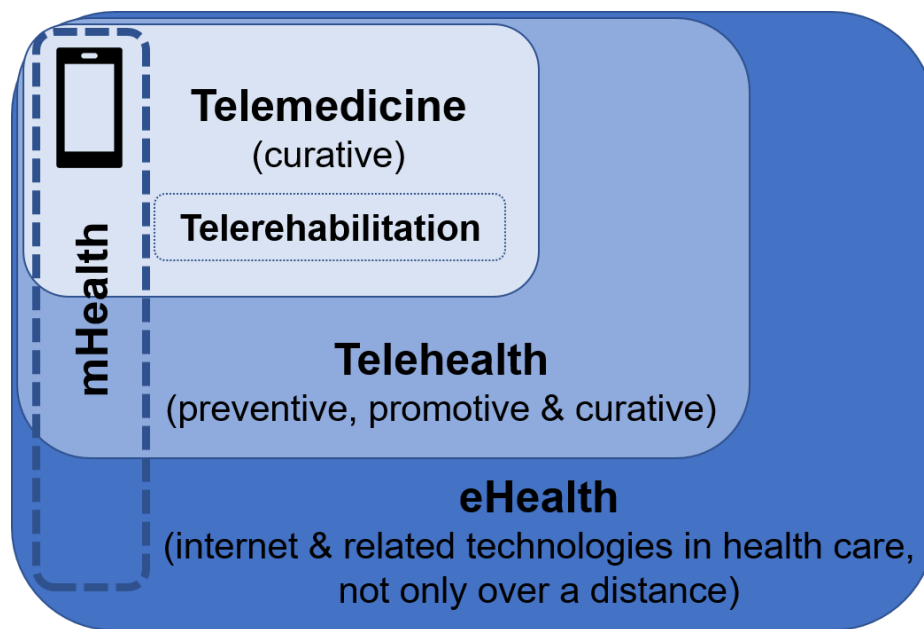
Figure 4 context of telerehabilitation (modified) [32]

2.3.1 Benefits of telerehabilitation and telemedicine

No matter where patients are located, access to medical or therapeutic services, as well as reduced or eliminated waiting times are major benefits of telemedicine and also telerehabilitation. [24, p. 15] Telemedicine supports the idea of integrated and patient centered health care, applying or forcing approaches of (technical and organizational) interoperability and development of new organizational models, which leads to increased quality of health care processes. [24, p. 15] The possibility of integration of evidence medicine, which assures the availability of relevant data within the telerehabilitation settings, is another contribution to qualitative care. [33, p. 12]

According to Pastora-Bernal et al., strong evidence on efficiency was found, especially using telerehabilitation after total hip and knee arthroplasty. [34] They describe that it is a useful and effective alternative to face-to-face rehabilitation, no matter which technical method is used (videoconferencing, phone calls, etc.).

Concerning effectiveness of telerehabilitation various studies have shown, that telerehabilitation after total joint replacement might be as effective as conventional rehabilitation or results are even better. [35], [36], [37] Although study groups of these studies are mostly very small, or the evaluation relates to pilot studies instead to fully implemented telerehabilitation. [33, pp. 12–13]

Furthermore, some bias is identified: according to Pastora-Bernal et al. it is found that telerehabilitation groups have more contact to health professionals (video conferencing and phone calls) and so they maybe receive additional services. [34]

Patient satisfaction, motivation and compliance must be high for changing the health care process, which is happening when new methods like telerehabilitation are implemented. Also, satisfaction of healthcare professionals is relevant. [38] Becevic et al. found that users, like patients and health professionals are highly satisfied with telehealth in general, not only telerehabilitation. Additionally, users are confident in providing health care via distance. [39]

Empowerment of patients - which means that people increase contribution to their treatment success [40] is seen as another benefit. With telerehabilitation it is possible to adapt the treatment on individual requirements of patients and active involvement through regularly feedback. [41, p. 297]

Another aspect in implementing telerehabilitation is cost effectiveness, mainly due to avoidance of travel times. [33, p. 12] If patients live more than 30 km from the provider, savings were identified, when home visits of health care professionals were replaced by telerehabilitation. [2] An analysis of the costs of telerehabilitation after total knee replacement compared to usual rehabilitation shows that telerehabilitation is cost-effective, but no longer more effective and less expensive if transportation costs are excluded. [42]

Another study shows that "e-exercise" (online physiotherapy session) is cheaper compared to usual physiotherapy, but total costs (societal and total healthcare costs) did not significant vary between both groups. [43]

Reducing or eliminating of waiting and travel times, empowerment of patients, cost effectiveness, increasing quality of health care, as well as effectiveness can be summarized as benefits of telerehabilitation.

2.3.2   Barriers of telemedicine and telerehabilitation

There are some reasons why telemedicine is not implemented broadly. The four main areas of barriers of telemedicine are: [24, p. 15]

- Technological: the lack of infrastructure, skills and interoperability of ICT-systems in healthcare or data and confidential issues

- Organizational: the (re) design of processes, organization and roles in health care or the lack of strategic alignment between involved stakeholders

- Human: the resistance to change, lack of skills or skepticism

- Economic: costs and initial funding

The change in health care service / process models and their difference to the traditional health care approach is seen as a major obstacle. [23, p. 11]

In their report on the eHealth status (based on a survey of member states) the WHO (European region) identified the lack of funding of telehealth programs as main barrier, although it is also said, that public funding for eHealth programs is available. [25, p. 34]

2.3.3 eHealth and telemedicine in Austria

Austria did some fundamental implementations in the field of eHealh within the last 15 years, like the realization of the eCard or launching ELGA, the Austrian nationwide electronic health record. [27] They were initiated in line with a concept of an Austrian eHealth initiative, where marginally telemonitoring is mentioned as a central element of eHealth, which is still a draft. In Vienna and Styria regional eHealth strategies, respectively a platform[2] which provides an overview of projects exist. Telemonitoring is part of it, but not telerehabilitation. [44], [45]

Furthermore, telemedicine is mentioned in the target-based governance agreement ("Zielsteuerungsvertrag Gesundheit"). In the context of the installment of information and communication technology for patient care and innovation in healthcare, telemedicine is seen as activity for achieving this goal. [46, p. 19]

As another initiative on federal level, 2013 the Austrian commission for telehealth services was set up with the aim to identify telemedical applications for chronical diseases. [47, p. 36] The commission proposed telemonitoring activities in the field of diabetes and cardiac insufficiency. According to this, some (pilot) projects were implemented, respectively exist, as "Gesundheitsdialog Diabetes Melllitus" and "HerzMobil". They were mainly initiated and coordinated by social health insurances with the focus on telemonitoring. [48], [49]

Also seen as telemedical application, the "1450 – Die telefonische Gesundheitsberatung" was launched in 2017. It is an initiative of the federal ministry of health, which provides 24/7 help and advice by phone for several questions concerning health. In 2019, the nationwide rollout will be completed. [41]

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[2] Gesundheitsfonds Steiermark, *„eHealth Steiermark Informationssystem" [Online]. Available: https://www.ehealth-steiermark.at/eHealthSIS/faces/sis/home.xhtml [Accessed: Aug. 03, 2019]*

The commission for telehealth also listed some recommendations for telemonitoring services, but not for telerehabilitation. [50] No existing framework for implementing telerehabilitation services in Austrian health care facilities / organizations was found. One of the commission's recommendations was establishing an ICT (technical) framework for telehealth. [50] For the part of telemonitoring, a technical guideline (to ensure technical standardization in Austrian health services) for the ICT infrastructure was developed. Therefore, the infrastructure of ELGA is addressed to use for activities in the field of telemedicine. [51]

Little published data was found concerning measures in the field of telerehabilitation. One rehabilitation center in Tirol (Münster) did a pilot project with patients, who suffered from multiple sclerosis. The aim was providing sustainable long-term support for patient. Instructions for exercises via video and reminders were the main function. According to the center´s medical director, the positive feedback of the pilot project is intended to prove through a comprehensive study in several rehabilitation centers. [52], [53] A second pilot project was initiated by the Austrian insurance institution for railway and mining. 67 people did the telephysiotherapy program "Evocare" following an inpatient telerehabilitation. Participants were significant more satisfied than patients of the comparison group. Also, the health-related quality of life (according to the SF 36[3]) was evaluated better. [54]

Since November 2018 legal requirements for outpatient telerehabilitation in Austria are fulfilled. According to the Austrian law for social insurance § 302 – the outpatient rehabilitation - including telerehabilitation are part of the medical rehabilitation in Austria. In which way or extent, required preconditions or other relevant aspect is not explained or even mentioned. [10]

To sum up, Austria has done several fundamental initiatives in eHealth, some implemented telemonitoring measures and few telerehabilitation projects. Some recommendations are established, but no criteria for approving telemedical services, as the German pension insurance did, for instance. Criteria which must be met to be accepted for telerehabilitation by the mentioned German insurance, are amongst some others, a detailed concept of telerehabilitation, evidence of qualification of therapists, a data protection and ICT security plan.

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[3] Rand Corporation, "36-item Short Form-Survey (SF-36)" *Rand Cooperation*, [Online]. Availiable: https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form.html [Accessed: Aug. 31, 2019]

Telerehabilitation measures are accepted only, when providers and tools are fulfilling these criteria and are permitted by the insurance. [55, pp. 8–9]

2.4 Existing implementation frameworks and models in telerehabilitation

For effective implementation of telehealth services, guidelines like frameworks or models are essential. They provide information about benefits, limitations, efficient and effective ways to implement and operate that services. [56] According to van Dyk, a comprehensive and holistic framework is needed, which includes technology as well as organizational aspects and approaches of change management. [32]

Several of them are existent in the field of telemedicine. While they mainly address telehealth in general, there are few which address telerehabilitation in specific. No guideline or framework was found for telerehabilitation after total joint replacement.

2.4.1 Framework in the field of telerehabilitation

American Telemedicine´s Associations´(ATA) principles for delivering telerehabilitation services

The principles for delivering telerehabilitation services are developed by members of the ATA Telerehabilitation "Special Interest Group" and is an enhancement of "A Blueprint for Telerehabilitation Guidelines" from 2010. [7] It provides information for all involved stakeholders and is seen as an assistive tool for implementing telerehabilitation. The principles address 4 dimensions which should be taken into consideration when implementing telerehabilitation. [7]

- **Administrative principles** include considering actual laws, contractual requirements and professional regulations, as well as informed consent for patients concerning the scope of telerehabilitation. Furthermore, also complying with (non)medical documentation and considering billing and reimbursement arrangements are addressed in the administrative principles.
- **Clinical principles** cover integration of guidelines and standards, training of professionals in equipment and software operation and assuring of ICT support. Any modifications should go along with standards in health care and the security of patients during the telerehabilitation should also be taken into account.

- **Technical principles** address safe equipment, which supports diagnostic and treatment and also complies with organizational regulations, especially concerning cleaning. Strategies for modification of hardware or software is also mentioned.
- **Ethical principles** mean that values and ethics should be integrated in procedures concerning telerehabilitation. Adherence of laws and other regulations as well as informing patients about their rights and responsibilities within the scope of telerehabilitation.

The use of the ATA principles was evaluated by Krupinski and Bernard. In the survey 97% of the responders believe "that telemedicine / telehealth should have standards and guidelines, primarily because they add credibility, standardize approaches and decrease liability." Many of the users adopt guidelines to fit in their organizations and to their specific indication where they use telemedicine. [56]

2.4.2 Frameworks in the field of telemedicine

As mentioned, telerehabilitation is a subarea of telemedicine, following frameworks / models in the field of telemedicine are depicted exemplarily:

Pan American Health Organization Framework for the Implementation of a Telemedicine Service [24]

The Pan American Health Organization (PAHO) developed an implementation framework for a telemedicine service. When technology innovation is introduced, a range of factors should be considered. In their model the multidisciplinary approach and the change management, which is essential for implementing a telemedicine service is addressed. Innovative ICT means not just putting devices in an organization; it requires several changes in the organization, like processes and team culture. Therefore, the needed steps are described at different levels: [24]

- Basic levels:
  - o Strategic level: determining priorities and needs in a broader context (social, health, resources)
  - o Organizational level: organizational aspects, like teams and their relationships, structure, processes and change management are focused on this level
  - o Public policy level: planning, management and communication in context to the public health system
- Service development: 4 key dimensions are focused:

- o Legal, regulatory and security issues like data protection, privacy and responsibility of data
- o Technology and infrastructure issues, like technological infrastructure and interoperability
- o Human resource issues, like clarifying tasks for all persons involved in the telemedicine service (including the organizations changes) training, information and communicating
- o Financial issues like cost effective analyses and preparing a budget
- Follow up, evaluation and optimization like the measurement of medical effectiveness, process and cost effectiveness. Among others, also the "Model for Assessment of Telemedicine applications" (MAST) is described, which is an evaluation model developed for a project for the European commission. It focuses the multidisciplinary approach (with different domains of evaluation like clinical effectiveness and patient´s perspective) in telemedical projects. [24], [57]

Transfer model for digital health applications in everyday healthcare [58]

The German "Bertelsmann Stiftung" described a model, which addresses the framework and process of implementation of digital healthcare applications. [58, pp. 10–11] It includes steps from the first brainstorming to operating, including the description of success factors and barriers.

The model provides a generic project plan. Therefore, it describes 6 phases and 7 work packages, which correlate, as is shown in *Figure 5*. The 7 Work packages are divided in sub-work packages, which allow a more detailed picture of the transfer process.
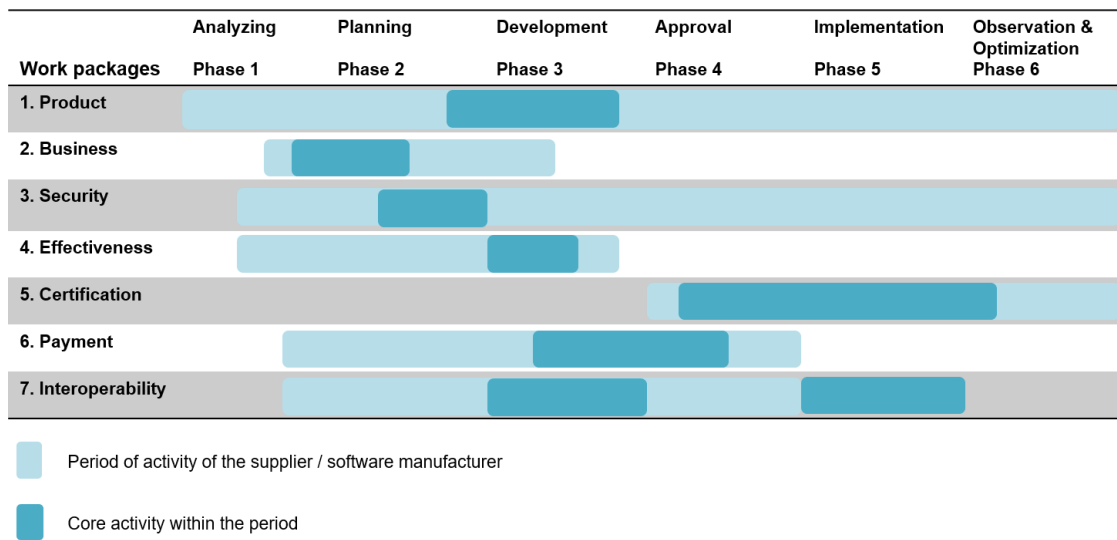
Work packages	Analyzing Phase 1	Planning Phase 2	Development Phase 3	Approval Phase 4	Implementation Phase 5	Observation & Optimization Phase 6

Legend:

- Period of activity of the supplier / software manufacturer
- Core activity within the period

Figure 5 Transfer model of digital-health-applications (modified). [58, p. 7]

The international Code of Practice of Telehealth services [59]

The Code, developed by the "Telehealth Quality Group" (TQG), an European Economic Interest Group (EEIG) provides a quality benchmark for telehealth services. [59, p. 2] Moreover, services can be certified to the Code. It also incorporates or references to some standards of the International Organization for Standardization (ISO). The code focuses on how services and their processes are organized. Additional competencies, knowledge of staff and service requirements are addressed. [59, p. 5]

2.5 Technology and telerehabilitation

From a technical perspective there exist two different methods (referring time) in telerehabilitation respectively in telemedicine. This means, the possibility of a live interaction or a delayed exchange or communication between the patient and the health professional. Both could be sender or receiver of data. The modalities are describes below and outlined in *Figure 6*. [60, p. 93]

- Asynchrony / store-and-forward: data is transferred from one (sender) to another one (receiver) and is stored
- Synchrony / real-time: simultaneous interactions of persons (via phone, videoconferencing, etc.)
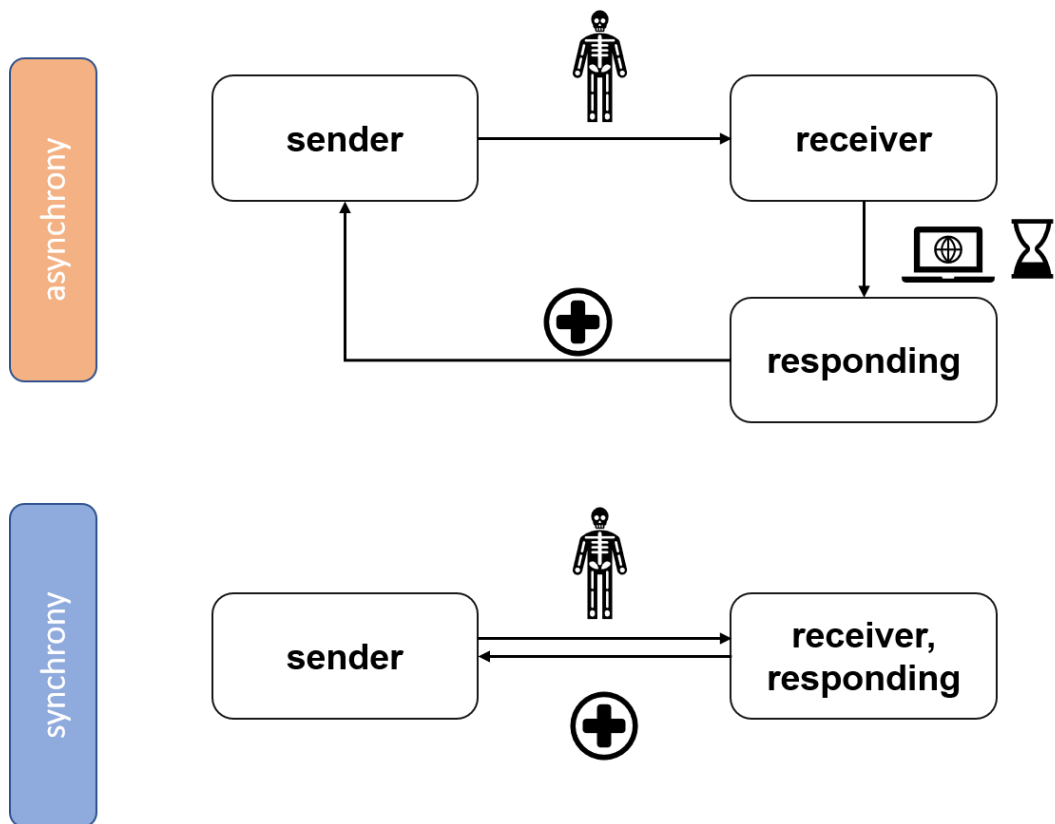
Figure 6. Methods of telerehabilitation [60, p. 93]

All modalities require interoperability – the ability to share data among several units or persons. While syntactic interoperability, the way of communication and required data formats defines, the content aspects are considered at semantic interoperability. [61]

Beside time referral methods, used technologies can be classified as: [62]

- Image-based: usage of audio/video-based communication, like phone calls or video conferring [62]
- Sensor-based (e.g. motion tracking): motion capture systems record movement (kinematic) data. Due to high accuracy, the interpretation of measured data could lead to better therapeutic assessment and therefore outcomes. [63] Sensor technology can be classified in vision based and non-vision based. Vison based can be used marker-based (cameras capture identifier points on the human body) or marker-less (cameras track the body-movement via the body silhouette). The latter are characterized through high accuracy and low cost. Non-vision sensors track motions via internal, magnetic or electric sensor. They usually are attached to the human body for a longer period of time. [64]

- Virtual reality (VR) based: VR is defined as "a set of images and sounds, produced by a computer, that seem to represent a place or a situation that a person can take part in." [65] Studies show, that VR is able to contribute to patient motivation. [66], [67] Moreover it appears to be effective in telerehabilitation after total joint replacement, which means reducing pain and improvement of functional recovery. [67], [68]

Research shows that mixed methods (synchrony / asynchrony) and mixed technologies (image / sensor / VR) might bring optimal outcomes concerning effectivity in rehabilitation patient satisfaction and relief healthcare professionals. [69]

Technical structure of a telerehabilitation system

From a technical point of view, not only time referral methods or technologies concerning interaction between health professionals and patients can be described. Systemically seen, it can be depicted as a layered model. Figure 7 shows the technical structure with the different levels of a telerehabilitation system and their specification or examples.

The application level indicates the kind of medical intervention, like telerehabilitation, while the interaction level is providing the communication between the system and the user, like information and visualization of motion data or feedback. The functions, which enable this, are found on the service level, which consist of technical components from the lower levels. Below, the communication level includes modules for authorization, encryption, network management and data transfer like movement data. Furthermore, different communication channels (SMS, phone calls, video conferencing, etc.) are provided. Different data types, like master data or medical data were captured and processed at the data level, where they also be prepared for users. Sensors and devices are relevant for measuring motion data which is transferred directly or in the form of therapy results. [41, pp. 292–294]
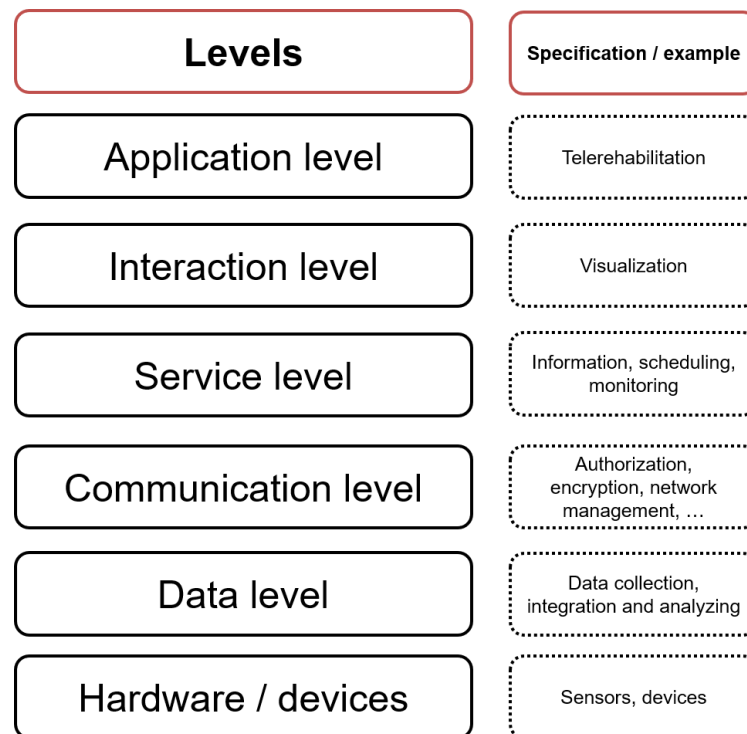
Figure 7 Technical structure of a telerehabilitation system (modified). [41, p. 293]

Gaming Consoles in Telerehabilitation

Research hast shown, that gamification / game-based telerehabilitation has the potential to increase the intensity of rehabilitation. Assumed reasons are the improvement of user engagement and that gamification is perceived as enjoyable. [70], [71]

"Microsoft Kinect", which is originally an add-on sensor (marker-less) for a Microsoft Gaming Console ("Xbox 360"), is obviously one of the most known sensors, related to telemedicine.

Several studies investigate the "Kinect" and its use in therapy and telerehabilitation. [72], [73], [74], [75] Originally designed for gaming, it consists mainly of a video camera, an infrared depth camera and a multiarray microphone and allows the user to control the system via gesture or voice commands. [73], [63] Essential advantages compared to other motion capture systems (mainly marker based) are the low costs, safeness and the portability. [76], [75] Hondori et al. found, that Kinect is a suitable tool for rehabilitation, especially if full body-motion is needed. [63] A major reason is the providing of a Software Development Kit (SDK), which enables access to skeletal tracking data and can be used in the development of telerehabilitation systems. [63]

According to Microsoft, the Kinect production was stopped, but the technology is used in several other products of them, like the "HoloLens, a mixed reality headset." [77]

The field of gaming technologies in telerehabilitation, especially home-based applications, might be interesting for further research. [78]

Technology acceptance

Besides financing or organization, acceptance of technology is mentioned as one key determinant when implementing telemedical services. [79] For addressing this issue, it is essential to understand user acceptance and factors which contribute or adversely affect user acceptance and why. [80] As an example, the "Technology acceptance model" (TAM) is mentioned. It explains user acceptance by the key factors perceived usefulness and ease of use. [81] The TAM is seen as one of the most known models, [81] although it has some limitations, such as a lack of intrinsic motivation factors. [80]

For implementing telerehabilitation, many different approaches need to be considered as well as technical structures. To sum up, technological methods, which are deployed in telerehabilitation are divers. Moreover, it is assumed, that during (pilot) studies, technology becomes outdated and patients may be less motivated and low compliant, which might lead to lower effectiveness of the intervention. Therefore, new approaches to overcome long lasting studies must be considered. [33, p. 66]

3 Methodology

Used methodology for this thesis is described in this chapter. After a literature research for gathering knowledge about background information, already existing initiatives and projects concerning telerehabilitation following total joint replacement, the framework was developed by using a qualitative content analysis. Therefore, following steps were done:

- Background and material selection
- Development of the category system
- Extraction
- Conditioning
- Analyzing

Details for carrying out these steps are explained later in this chapter.

3.1 Qualitative content analyzes

A qualitative approach aims purposely answering open research questions with the aim of describing processes or situations. It is characterized by a less structured procedure, to enable unexpected information and uses often text for interpreting. [82, p. 185] Because of the intention of gaining knowledge in order to answer unsolved issues of practical problems, the qualitative approach was chosen. For developing the implementation framework, knowledge from experts is essential. Therefore, systematic expert interviews were conducted. The aim of this is raising as well technical as process knowledge and information. According to Bogner et al. experts are "persons - based on specific practical knowledge or experience, which refers on a limited, defined problem – who have the possibility to structure their interpretations in a meaningful and managed way for others." [83, p. 13] Furthermore, this knowledge is significant and relevant in the field and therefore orientation for other players. [83, pp. 13–14]

Beside the qualitative approach, other marks can characterize a study design. No standardized classification system for research methods is existing. [82, p. 182] Nevertheless some are established, like a guideline according to Montero & León. [82, p. 182], [84] According to them, Table 1 shows the study design of this thesis according to the respective criteria: [84]

Table 1 Study design

Criteria	Thesis – study design
Theory of science	Qualitative study
Aim of scientific findings	Applied research study
Subject of the study	Original study
Data base	Primary analysis
Interest of knowledge	Explorative study
Location of the study	Field study
Number of research objects	Sample study

Qualitative content analysis is strongly associated with Philipp Mayring, who developed several methods for analyzing qualitative content. In this thesis, his approach is used in a modified way by Jochen Gläser & Grit Laudel. [85, p. 46] According to Gläser et al., Mayrings approach is very much oriented on the quantitative content analyzes. [85, p. 198] Categories were developed within an open approach, but it is intended, not to complement them, so categories are mainly "closed". Additionally, frequencies of text passages were analyzed. In context to that, Gläser et al. say, that it is needed to develop new categories during the whole analyzing process, otherwise information might be lost. Therefore a procedure was developed, which is open for new information during the overall analyzing process. [85, pp. 198–199]

The aim of this procedure is to prepare the (interview) material, that it can be used to answer the research questions. Building a category system, based on theoretical background is the focus of qualitative content analysis. [83, p. 73] Categories are used as kind of a "search grid" to which the substance was allotted. If necessary, new categories were added. [85, pp. 199–201]

According to Gläser et al. a five-steps-analyzing concept was used. It is shown in Figure 8 Figure 8 Five-steps-analyzing concept (modified) [85, p. 203] as well as the key elements of each step. [85, pp. 200–204], [83, pp. 73–75] Details of the procedure are presented in the following subchapters.
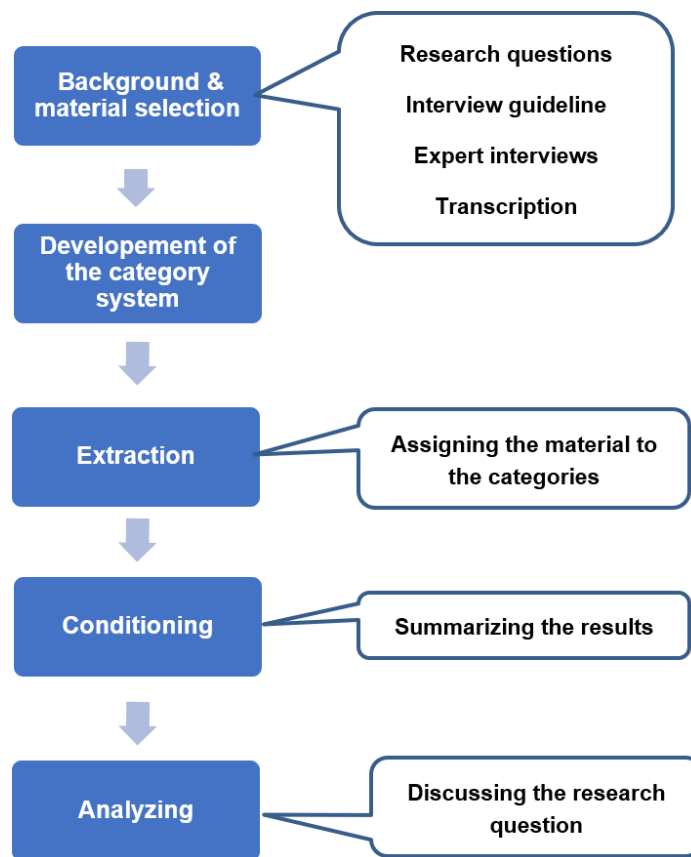
Figure 8 Five-steps-analyzing concept (modified) [85, p. 203]

3.1.1 Background and material selection

Research question

As already depicted in chapter 1.2, research questions are:

- Which organizational, technical and legal aspects are required for the implementation of a telehealth service?
- Which steps are essential for successful implementing of telerehabilitation after total joint replacement in health care organizations (hospital, rehabilitation center etc.) in Austria?
- What are the key factors for successful implementation?

Interview guideline

Expert interviews were done by using an interview guideline. This is recommended, if several different topics need to be considered, which are defined by the aim of the research. Topics like usefulness, process or success factors were asked within this research. Based on the mentioned literature review and the aim of the thesis, the interview guideline was developed. It includes 8 topics and 13 questions. First, introduction questions were asked, in order to talk about the expert´s experiences in telerehabilitation. Table 2 shows the questions which were discussed with the experts. The checklist is seen as a frame and allows, if necessary, to ask additional questions. [83, pp. 27–28]

Table 2 Expert interview checklist

	Topics	Questions
1	Intro	What's your **experience** with telerehabilitation / In which **role** (responsibility) did you experience telerehabilitation?
2	indication	The WHO developed a model / framework for telerehabilitation - a central topic is or are indications where telerehabilitation makes sense. Studies show that telerehabilitation is often applied in the field of neurology and orthopedics. **Why or why not could telerehabilitation making sense in total joint replacement in Austria?**
3	Integration telerehabilitation / moment in time	Austria has the highest rate on total knee replacements and the second highest in total hip replacements within the EU. [5, p. 180] Studies show that telerehabilitation is as effective as conventional Rehabilitation. Moreover, it has the potential to relieve therapists and, in many cases, to reduce costs. [1], [3], [2], [4] Meanwhile telerehabilitation is considered in the ASVG – it is equal to outpatient rehabilitation. [10, Ch. § 302] **In which rehabilitation phase could telerehabilitation make sense and why?**

		How could the ideal integration of telerehabilitation be respectively the transition from inpatient or outpatient rehabilitation to telerehabilitation?
		How could patient be recruited? What are the requirements / preconditions for patients?
4	Roles and Implementation	Studies often stress the necessary interdisciplinary approach of telerehabilitation. However, one stakeholder has to be in the "lead" when it comes to implementation of telerehabilitation. **Who or which institution should be in this role (companies, hospitals, social insurance, therapists…)?**
5	Success factors and challenges	In the "Journal of Telemedicine and Telecare a review was published, where 45 studies were analyzed with the aim of finding success factors for the implementation of telemedical applications. The result was, that user acceptance was the most important (37 %), followed by the technical factor (29%). [79]
		What is your experience – how can the highest possible user (patients, doctors, therapists) acceptance **be achieved** (without ignoring other factors)?
		What are the **challenges in Austria, which step needs special consideration when realization telerehabilitation?** (organizational, technical, cultural) – Which challenges do you meet / met; how did you cope with them?
6	Technical implementation	Basically, there are three methods of telerehabilitation: - Synchrony – e.g. videoconferencing or chat - Asynchrony – e.g. with virtual reality - Use of biomechanical measurement systems

		In your opinion - which of these methods is most effective and efficient one? Which differences does they make in implementation of telerehabilitation?
7	Evaluation	A known model for evaluation of telemedicine applications is the so called "MAST model" – which allows an interdisciplinary assessment. [57] **When will telerehabilitation be successful?**
8	Process	Taking account of relevant studies / models could following process be taken into consideration for the implementation of telerehabilitation: [24], [86], [87] - Clarification of legal and financial aspects - Definition of team and roles - Selection of the system: technical, organizational requirements (including data protection, interoperability, budget and so on) under consideration of different methods (synchrony / asynchrony) - Definition of the process – from patient recruiting to evaluation - Selection of the patients (defining of criteria roles and selection of the patients) - Training of the therapists - Creation of the therapy plan (only telerehabilitation or both – conventional and telerehabilitation activities) - Training and education of the patients - Run a pilot operation - Evaluation of the pilot operation (considering of already available models, like MAST, etc.) **Is this approach conceivable for you (in Austria)?** If yes, why – if not, which steps must be adapted?

Expert interviews

Getting knowledge directly form the experts is done through systematic and analytical information acquisition. Information can be technical, but also process know-how, which both are essential for this thesis. More or less, this knowledge is always present and reproduceable by experts. [83, pp. 24–25] Qualitative content analyzes is used for retrieval of this information. [83, p. 72]

Based on the definition and the aim of the study, experts were selected. For this thesis, as experts were persons designated, who are working in orthopedic rehabilitation (physicians and therapists) and / or have experience with the implementation of telerehabilitation (physicians, CIO´s). No experience with (the implementation of) telerehabilitation or telemedical services at all is not an exclusion criterion. Focus of the development of the implementation framework is the perspective of users (health professionals).

The interviewees came from three different federal states of Austria (Vienna, Lower Austria, and Upper Austria,).

Therefore, seven experts were chosen, with following background:

- Physicians: specialists in orthopedic and rehabilitation (most of them with a focus on total joint replacement)
- Therapists: specialists in orthopedic and rehabilitation (working in hospitals, rehabilitation institutes or self-employed)
- Specialists in information and telecommunications technologies in health care and experience with innovation and telemedical projects (one of them is also a physician)

The first contact was made by phone, E-Mail or in person. Following a description of the research question and confirmation of the interview, appointments were arranged via phone or E-mail directly with the experts.

All experts were asked, if they require the interview checklist in advance. Just three of them affirm. It was sent via E-Mail, at least three days before the interview took place.

All interviewees signed a letter of agreement. The template is found in appendix A. As the mother tongue of all asked persons has been German, the interviews were done in German. Therefore, the German interview checklist is included in appendix B.

The interviews took place in the offices of the experts respectively one of them via phone and were all recorded via iPhone X and iPhone 8. The duration of the

interviews was in average 23 minutes. The shortest took 12 and the longest 39 minutes.

Transcription

According to Kuckartz et al, transcription is the textualization of recorded information (the expert interview). How and in which details depends on the purpose of the research. [88, p. 38] In order to get all needed information of the text material, interviews were fully transcript. This approach is also recommended by Gläser et al. [85, p. 193]

As there are no established transcriptions rules or standards [85, p. 193], transcription rules were defined based on Kuckartz et al.: [88, p. 44]

- It was transcribed literally, not phonetically or comprehensively.
- It was transcribed in standard German, dialects were not transcribed, and language and punctuation were slightly modified.
- Passages of the interviewer were marked by an "I" and the ones by the expert with an "E".
- Possible conclusions on persons (experts) were removed.
- Significant longer breaks were marked with points in brackets (…).
- Approving comments of the interviewer (like "aha") were not transcribed.
- Interjections of the interviewer or the expert were marked in brackets.
- Paralinguistic utterances were not noted.
- Each turn-taking is marked by a blank line.

For transcription and extraction, a Qualitative-Data-Analyses (QDA) Tool was used. According to Bogner et al. this kind of software is useful to support structuring and coding the interview material. One of the most commonly used QDA tool in German speaking countries is MaxQDA [4], which was chosen for this thesis (Version 2018.2, student license). [83, pp. 83–86] It was initial developed for reductive summarizing methods, and is therefore related to qualitative content analyzes. [83, p. 85]

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[4] VERBI GmbH: „MaxQDA The Art of Data Analysis." MaxQDA.de. https://www.maxqda.de/

3.1.2 Development of the category system

Category systems are a key element of qualitative approaches. Categories are labels or terms, which text passages with the same meaning or content were assigned (Extraction). This could be single words or phrases. [88, p. 57]

Initially based on the interview guide, following categories were build:

- Experience of the experts
- Usefulness & indication
- Integration of telerehabilitation
- Lead
- Technology
- Challenges
- User acceptance
- Preconditions
- Process
- Successful implementation

3.1.3 Extraction

In this step, text material was assigned (extracted) to the defined categories, which directly was done in the software (MaxQDA) by using the so called "cut and paste technique". Therefore, text passages were marked and appointed to the category. It is important, that text segments still are understandable and not quoted out of context. [88, pp. 64–66] According to Gläser et al., extraction means taking information out of the text material in contradiction to coding, which is indicating the text. [85, p. 199] Within extraction a basis of information is created, for answering the research questions.

The material was read four times to prove and assure the correct assignment of text and categories. Due to traceability, experts (anonymous), categories, text passages, date, time and section were documented in MaxQDA. Additionally, mentioned data was also exported and stored in a Microsoft Excel file.

Initially categories as mentioned in subchapter 3.1.2 were complemented by

- "Required measures"
- "Role of physiotherapists and physicians"
- In the category "usefulness", two subcategories were built:
  - "Advantages"
  - "Disadvantages"

The final categories, their definitions and the linkage between research questions and category system is shown in Table 3.

Table 3 Categories, definitions and referring research questions

Category	Definition	Referring research question (short form)
Experience	Experience of the expert / role in Telerehabilitation projects	(introduction)
Usefulness & Indication	The usefulness of telerehabilitation after THR / TKR in Austria Is this indication appropriate for telerehabilitation? Advantages (e.g. for patients, health professionals or the health system) Disadvantages (e.g. for patients, health professionals, or the health systems)	Organizational, technical and legal aspects
Integration of Telerehabilitation	The ideal integration of telerehabilitation– when or in which stage of rehabilitation How telerehabilitation could be integrated	Essential process steps
Lead	Who or which institution may have the lead in implementing telerehabilitation	Organizational, technical and legal aspects
Role of physicians and (physio) therapists	Responsibilities and tasks of physicians and therapist in telerehabilitation	Organizational, technical and legal aspects
Technology	Different types of technology, used in telerehabilitation	Organizational, technical and legal aspects

	Advantages and disadvantages of the different methods, effectivity and efficiency Differences in implementation	
Challenges	Organizational, technical, cultural challenges within an implementation project	Organizational, technical and legal aspects
Required measures for implementing TR	Measures, which are necessary or questions, which are still not answered in the field of implementing telerehabilitation in Austria	Organizational, technical and legal aspects
User acceptance	Factors, which contribute to user acceptance and satisfaction	Success factors
Preconditions	Requirements for implementing a telerehabilitation service, organizational, technical, personal,	Organizational, technical and legal aspects
Process	Steps, which must be considered	Essential process steps
Successful implementation	Indicators or situations for successful implementation Factors, which contribute to successful implementation	Success factors

3.1.4   Conditioning

In chapter 4 results are described per categories and essential statements of the experts are quoted as examples. Summarized results are found in Table 4.

3.1.5   Analyzing

Results are discussed in chapter 5 (Implementation Framework). Additionally, they were summarized per category and linked to the research questions, providing an

overview of the results of the study. Research questions are answered in chapter 6 (Conclusion).

4 Results

This chapter describes the results of the expert interviews. Based on the mentioned categories, results are presented and illustrated by quotes (examples) by the experts. Additionally, a summary is presented in Table 4.

4.1 Expert interviews

Experience of experts with telerehabilitation

As introductory question, the experts were asked about their experience with telerehabilitation.

Two of the experts already realized concrete (pilot) projects in the field of telemedicine and telerehabilitation. Positive experiences were reported, especially facilitations concerning patients like elimination of travel times and simplifying of coordination times. One usually imagines how telerehabilitation could be used by himself as a patient.

Projects were done with camera systems for motion capturing, such as "Microsoft Kinect" and also with motion tracking body sensors.

One expert who realized already projects, also gave lectures on telerehabilitation.

„Erfahrungen habe ich positive gemacht mit der Telereha, die sich vor allem auswirken auf den Patienten, ja, weil er sich sehr viele Wegzeiten erspart, Koordinationszeiten und weil er auch eine freie Zeiteinteilung hat" – E1

„Also erstens mal in der Rolle eines CDO (Chief Digitalization Officer)." – E1

„Und im Endeffekt kann ich drei konkrete Projekte sagen, die wir auch durchgeführt haben." – E2

„Der erste Ansatz und da haben wir auch Pilotprojekte gemacht, das waren welche, sagen wir mal, Kamerasysteme, dass der Patient seine Übungen (I: wie die Kinect, oder sowas?) im Prinzip, so eine Art Feedbackschleife, quasi, dass er halt irgendwie ob er die Übungen richtig hat und dann aufzeichnen. Die zweite Variante war durchaus auch sozusagen mit Körpersensoren diese zu Übungen machen." – E2

"Ahja, ich habe das auch gelehrt auf der […], also ich habe da wirklich eine Vorlesung über Telereha gehalten." – E2

A large part of experts had no practical experience with telerehabilitation. One expert already read about it and another one was thinking about associating phone calls with telerehabilitation, where he usually informing therapists about patients.

"Wir haben noch nichts, und haben dadurch auch noch keine Erfahrung." - E5

"keine, ich habe zwar darüber gelesen, aber persönlich noch nicht" - E6

"[…] weil ich ja Patienten aus ganz Österreich habe, die machen halt die Physiotherapie vor Ort […] und ich telefoniere dann relativ oft mit den Physiotherapeuten, frage wie es geht, die geben mir dann Feedback." – E3

Usefulness & indication

Basically, experts think that it would be valuable and makes sense in both indications.

A mixed model, like conventional rehabilitation, as in a hospital or outpatient clinic in combination with telerehabilitation is identified as useful. One expert also mentions the "Bricks and Clicks" approach, *"a business model in which a company operates both an online store (the clicks) and an offline store (the bricks) and integrates the two into a single retail strategy"* [89] and means, that such services could be provided decentral.

One expert considers, that telerehabilitation could be done as a single method, without conventional rehabilitation or face-to-face contact with therapists (within an institution). On the other hand, it is also mentioned, that patients always need direct instructions and supervision by therapists and that they are met in different conditions, which is difficult to evaluate via telerehabilitation. Only in the further course of the rehabilitation, when they know the terms and exercises, they are ready to do telerehabilitation.

"Aber wenn du Telereha machst, hast du zumindest etwas in der Hand, dass du es ohne die Bricks machen kannst." – E1

"Und ich glaube, dass generell, generell in Zukunft, wenn es irgendwie geht dezentral geleistet werden, also in den Clicks, nicht mehr in den Mauern." – E1

"Der [sic] Patient kann nicht Übungen durchführen nur aufgrund von telephysiotherapeutischen Anleitungen […] Im weiteren Verlauf, wenn der Patient die Bezeichnungen und die Begriffe kennt, glaub ich kann man einiges sicher auch

mit Telephysiotherapie machen, aber den [sic] direkten Kontakt vollständig zu ersetzen ist glaub ich nicht sinnvoll." – E3

The tools of telerehabilitation for behavioral measures or as an information guide is seen as an operational purpose. Referring to the experts, patients get a lot of information during their hospital stay, about the process of recovery and the resultant behavioral guidelines, which are sometimes difficult to remember for them, even when they were provided as a booklet or brochure. Therefore, telerehabilitation could provide this information, complemented by videos or the like and provide support for the patients in a more effective way.

„Was sicher gut ist, dass du einen ungefähren Leitfaden hast, was kann ich tun, was darf ich tun, was wäre mit dem Gelenk, egal ob Hüfte oder Knie, was wäre mit dem alles möglich. Das ist sicher gut, weil das wissen die Leute nicht, und das merk ich auch oft, wenn die raus gehen, weil zu wenig Zeit ist, und auch nicht aufgeklärt werden oder ganz wenig und das ist sicher nicht schlecht." – E7

The raising possibilities in digitalization might lead to lots of opportunities in telerehabilitation, one expert notions, that it is easier to transport data than people and therefore telerehabilitation after both, total hip replacement and total knee replacement is applicable.

"[…] glaube ich, dass man in der Telerehabilitation mit der Digitalisierung sehr viel machen kann." – E1

„Weil wir einfach besser Daten transportieren können als Menschen. Deshalb wären diese zwei Bereiche prädestiniert." – E1

Primarily the total hip replacement is seen as an ideal indication for telerehabilitation by one expert, because of the high medical standards in Austria. However, it is crucial to distinguish between elective surgeries or non-elective. Elective surgeries are scheduled in advance. In contrast, non-elective is done because of an urgent health condition like a fractured hip [90] (e.g. because of an accident). Usefulness is especially given at the elective procedure.

"Die Hüftoperationen sind auf einem, also in Österreich auf einem sehr hohen Niveau, wobei man unterscheiden muss, ob das elektive Operationen waren oder nach Unfällen, weil da ist auch die Luxationsrate eine andere. Und auch ob das eine Zweit- oder Erstoperation war. Aber für die elektive Hüfte bei Koxarthrose Erstoperation […] das stell ich mir sehr sinnvoll vor." – E5

As advantages are seen, avoidance of travel times, the painstakingly journey with crutches and waiting times at the physiotherapist's practice or rehabilitation center.

Greater flexibility in time management, independence of patients concerning therapists or localization of rehabilitation centers. Patients could even do some exercises in the office. Furthermore, it is seen as more cost-effective.

According to therapists it would not matter, if patients may be too late or do not appear for an appointment.

"[…] weil er sich sehr viele Wegzeiten erspart, Koordinationszeiten und weil er auch eine freie Zeiteinteilung hat, und vor allem für Patienten, die noch im vollen Berufsleben sind. Ja. ist es eine Möglichkeit, dass sie ihre Bedürfnisse, die sie haben, sie möchten was tun, ja, haben halt keine Zeit, dass sie das so einteilen können, dass sie doch was tun können, wenn sie nicht irgendwo ortsgebunden sind." – E1

„[…] keine Wartezeiten hat. Meistens auch keine Ausfälle von wegen ich bin zu spät oder sonstiges. – E6

„Ich könnte mir schon vorstellen, dass das in manchen Bereichen ganz gut wirken könnte, vor allem ist es vermutlich kostengünstiger." E4

The lack of interpersonal relationships and communication as well as the missing possibility to perform manual therapy, like lymph drainages is considered as a disadvantage of telerehabilitation. Patients might move more stable through physical support, which is not possible with telerehabilitation and therefore seen as a downside.

„[…] wenn du jemanden die Hand am Rücken legst, beim Gehen, geht der auf einmal tausend Mal stabiler. Genau das mein ich, genau das holst du mit der Telereha nicht ab." – E7

„Manche Patienten kommen auch in die Therapie, weil sie das zwischenmenschliche brauchen. Und ich glaube, das fällt halt da schon ein bisl weg." – E4

„Lymphdrainage oder manuelle Therapiemöglichkeiten kann man halt alle nicht wirklich machen." – E4

One expert thinks, discussions about costs and funding are miserable. He also adds, that technology cannot take fears away, like humans could.

„ich finde es im Grund erbärmlich, […] Du kannst niemanden, ein Tonband oder was auch immer, kann niemand die Angst nehmen, oder die Ängste, die er hat."

Integration of telerehabilitation / point in time in the rehabilitation process

According to most of the experts, the optimal integration of telerehabilitation takes place in a later phase of rehabilitation, because the patient needs to feel comfortable with the exercises and maybe just needs some motivation or feedback, which could be done by telerehabilitation.

„ich glaube im weiteren Verlauf, nicht in der Akutphase" – E3

„direkt postoperativ glaube ich nicht, dass es so gescheit ist" – E4

Experts suggest, it should be integrated during the hospital stay. It is considered by all as a combination of face-to-face units and exercises or information via telerehabilitation. It is also be thought about the need of the inpatient rehabilitation, which is not seen as necessarily, as long as personal contact is given.

"Ideal wäre auf dem stationären Aufenthalt, dass man ihnen das zeigt" – E1

„[…] regelmäßige Face-to-face Betreuung glaub ich kann es nicht ersetzen, es kann nur das Intervall größer werden." - E3

„Die Frage ob es überhaupt grundsätzlich einen stationären Aufenthalt braucht sag ich mal, meine Überzeugung ist, es braucht nicht unbedingt einen stationären, es braucht aber einen persönlichen Kontakt sozusagen" – E2

One expert recommends telerehabilitation directly after the acute care process (hospital stay), but just for the total hip replacement. For patients with total knee replacement, telerehabilitation is suggested after the inpatient rehabilitation (phase II), assuming the surgical outcome is very good.

"In der Phase, bei der Hüfte wurde ich sagen, bei gutem Verlauf, direkt an das Akutkrankenhaus, im Anschluss an den Akutaufenthalt möglich. Bei Knieprothesen aufgrund der größeren Streuung möchte ich da nicht so eine allgemeine Aussage treffen. Bei sehr guten Ergebnissen auch da, bei den üblichen derzeit, nach einer stationären Rehabilitation zum Erhalt des Erlernten und zum Verfestigen." – E5

Furthermore, it is considered as potential temporary rehabilitation between the acute phase (hospital stay) and the phase II rehabilitation (inpatient or outpatient).

„Nach einem stationären Aufenthalt, vor einer stationären Reha, als Übergangsmöglichkeit" – E4

One of the experts considers an integration of telerehabilitation in early rehabilitation and due to the increasing age of patients with total joint replacement, also an involvement of relatives.

„Wenn die Telereha schon eingebunden wird in das Akutprogramm. Also das ist ganz wesentlich. Dadurch, dass unsere Patienten immer älter werden, ist es immer eine Frage ob man nicht auch die Angehörigen in die Frührehab, d.h. im Akutkrankenhaus miteinbindet." – E5

Education and training are emphasized as important by most experts and are ideally done during the hospitalization, because patients, therapists and other instructors are available, and questions could be answered easily. Some of the interviewees think, that it is not possible to just hand a device to the patients or tell them to download an application without training and education.

"durch entsprechende Schulung […]". – E2

„[…] dass man ihnen das zeigt, wie sie mit so einer App, weil da brauchts Unterstützung, wie man mit dem umgeht und dass man vielleicht die eine oder andere Übung vielleicht mit ihnen gemeinsam ausübt. Was ich nicht möchte ist, dass man sagt, nimm dir die App und mach. – E1

When telerehabilitation is just used as an information guide for behavioral measures it is considered to implement telerehabilitation in all phases of the rehabilitation process.

„Als Leitfaden find ich es in allen Phasen gut denkbar." – E7

Lead & roles of physicians and therapists

Basically, experts think that health professionals should have the lead in telerehabilitation, like (attending) physicians, who need to decide and initiate it. Doctors will prescribe telerehabilitation and they will be responsible for providing medical information for patients. It is considered that (physio)therapists take a key role, especially in the training and education of patients. One interviewee also sees nurses, respectively the whole health care team as essential part.

„Medizinisch muss es natürlich der Arzt, die ärztliche Community pushen, operativ sollte es aus meiner Sicht die Therapeuten einschulen und administrieren." – E2

One expert assumes, that the role of health professionals as knowledge carries will decrease, because therefore databases will be used, but physicians and therapists will be still important concerning interpersonal tasks as taking fears or providing safety and security or for interpreting medical data.

„Arzt als Wissensträger und der Therapeut als Wissensträger wird abnehmen, sag ich mal (...) diese Wissensträgerfunktion wird die Maschine können. […] Heute kann ein Mediziner ja nur ganz spezielles, was ganz verständlich ist, gewisse Spezialdisziplinen, eine Hüfte, ein Knie, da wissen sie alles, aber holistisch, gesamt, warum das Knie kaputt ist, vielleicht gar nicht so, das wird eine Maschine besser können und an dem wird es natürlich auch enden, aber die Berührung wird bleiben für die Therapeuten." – E1

According to some experts, the lead in the field, respectively the key role for the realization of telerehabilitation is intended to be at insurances, moreover at those who pay for the rehabilitation, no matter if public or private.

„Der der das zahlt und das ist in diesem Fall die Versicherung." – E1

„Naja, wahrscheinlich der Krankenversicherungsträger, der die Endoprothese bezahlt." – E7

„Aber natürlich die Krankenkasse hat halt diese, also die öffentlichen Zahler, von mir aus auch die Privatversicherung sollten das natürlich schon pushen." – E2

One expert considers, that also a physiotherapist practice can lead telerehabilitation measures.

„Aber ich hätte da nichts dagegen, wenn man da eine kleine Praxis, die sich auch auf Telerehabilitation einschießen will, den Physiotherapeuten diese Kompetenzen zu geben." – E6

If telerehabilitation is implemented, the organization must be able to continue this undertaking independently and should not be reliant on defined persons, one of the interviewed persons points out. It is crucial, that the top management identifies themselves with this initiative.

„Also der Ownership, also ich glaube wenn eine Organisation was macht, sollte eine Organisation aufgestellt werden, die auch unabhängig von einzelnen Personen, so schwierig es ist, aber es sollte von einem Team getragen werden, und nicht von einzelnen Personen und das oberste Management sollte sich damit identifizieren." – E2

One person thinks, the lead can be done by hospitals and telerehabilitation could be prescribed like an orthopedic tool.

„Es gibt jemanden von uns bei der Entlassung, wenn die letzte Therapieeinheit aus ist der sagt, da ist ein Tool, um da weiter zu machen, oder, ich weiß bei uns machen die Abteilungssekretärinnen auf den Stationen, die organisieren ja auch

Krücken für zuhause, oder Motorschienen, dass man das so wie ein orthopädisches Tool empfiehlt. – E4

Technology

According to the experts, technology must be clear understandable, easy to use and robust. Ideally patients can use well known and accepted devices like their mobile phones or smart-TVs, which can be used without great effort, instead of any additional equipment. Some interviewees say it is even conceivable that common messaging platforms like "WhatsApp" or "Telegram" could be applied, because patients are familiar with it.

"Technik muss einfach sein und gut funktionieren ohne dass man da jetzt großen Aufwand hat." -E3

"Soweit ich mir das vorstellen kann, geht das auch über „WhatsApp"." – E4

Another aspect concerning technology, is that it supports or assists everyone. But therefore, is has to be easy in usage and secure. It is important, that patients want do use it by their own and are not forced to use technology.

„Und sozusagen ich glaube grundsätzlich, dass Technologie, wenn sie die entsprechende Niederschwelligkeit in der Anwendbarkeit, Sicherheit oder was immer hat, dass das eigentlich allen was hilft, aber der Patient muss es freiwillig wollen." – E2

Asynchrony methods are seen as most effective and efficient by various interviewed experts. A mix of asynchrony and motion sensors seems to be ideal, although the implementation would be the most complex. Regardless of their benefits, implementing sensors might be a big effort in both, costs and handling. Probably they are not appropriate for all patient groups. One expert means that all three addressed methods, synchrony, asynchrony and in combination with motion sensors will be needed, dependently on the user groups and requirements.

According to one asked person, sensors could also be used to monitor not only the quality of the rehabilitation but also the quantity. He says, that sometimes patients just pretend to do their exercises.

„[…] nur die Sensorik per se ist keine Rehabilitation. Das ist eigentlich nur eine, sozusagen, diese Sensoren müssen in die Variante 2 eingebunden werden. Ich glaube, dass die asynchrone Übungsform mit quasi asynchroner Überwachung das effizienteste ist." – E2

„Also ich glaube eh, dass es die technisch aufwändigste ist, die asynchrone, aber die effektivste." – E2

„[…] die asynchrone. Weil die Sensoren aus eigener Erfahrung, Umgang mit Sensoren ist heikel. Da braucht man ein KnowHow um das entsprechend umzusetzen." – E5

„Ich glaube man muss es sehen, zur Überprüfung ob der Patient wirklich das macht, was man ihm vorgibt (...) sind sicherlich Sensoren am besten. […] Aber der Patient gibt ja oft vor, dass er diese Übungen macht und es gibt z.B. für Bewegungsschienen Zeitmesser und andere Sensoren und da ist die Diskrepanz schon sehr groß." – E3

„[…] alle drei Sachen sind super. Für den einen passt das andere nicht und umgekehrt. […] alle drei Sachen haben ihre Berechtigungen." – E7

One expert believes that the most effective way to implement telerehabilitation is the usage of synchronous methods, because it is possible to give feedback immediately (assuming the operation of quality equipment). Otherwise the patient gets response hours later and is possibly not able to perform exercises correctly. On the other hand, one expert means that synchrony is effective, but not efficient and therefore telerehabilitation would not make sense.

" […] Videokonferenz, ja, das wird am effektivsten sein, aber kommt auf die Qualität der Kamera drauf an, wenn man das gut sieht, wird man sofort Rückmeldung geben können." – E4

„Also ich glaube die 1:1 hat keine Effizienz, hat durchaus eine Wirksamkeit, aber da brauche ich keine Telereha machen." – E2

Virtual Reality applications are also imaginable, especially for motivational reasons, is seen by one person.

„Die Virtual Reality, weiß nicht, ist natürlich auch cool, wenn man sagt, ich tu Tennis spielen, virtuell, oder ich geh laufen. […] Also, das ist auch eine Motivation." – E1

Technical inconveniences, like low battery runtime (and relating frequently charging) or a weak connectivity were experienced as a challenge, by one expert.

" […] das ist eine der Hürden, dass diese Aufladerei von diesen Dingen, ja und die Connectivity gegeben ist." – E2

The necessity of establishing a design studio to fulfill all the different requirements of the usability in telerehabilitation is suggested by one interviewed person.

„Es ist immer wichtig, dass es die Leute verstehen, aber trotzdem professionell wirken. Ich sehe, das wird eine eigene Sparte, da wirst du ein Designstudio brauchen." – E7

One expert thinks it would be interesting, to neglect technology, but just to identify the patient's needs, because in his opinion telerehabilitation should not be technology driven.

„Das spannende wäre, nicht auf die Technologie zu schauen, sondern zu schauen, was braucht der Patient in dem Fall und dann stoppel ich das zusammen. Weil das kann ja nie technologiegetrieben sein." – E1

Challenges

Financing of the services is the most mentioned challenge by the experts. Additional technical readiness and availability, like a broad and stable internet / network, the willingness to realize telerehabilitation as well as sustainability were also brought up by several interviewees.

„Das ist glaub ich das erste, dass mal wer sagt, ja wir zahlen das." – E1

„Die Finanzierung." – E5

„Eine Verfügbarkeit von entsprechender Technologie." – E2

Required measures for implementing telerehabilitation

Development of the society concerning digitalization, like taking fears away (not only concerning digitalization, also related to recovery) is seen as required for implementation by one expert. Telerehabilitation has to be equal to conventional (face-to-face) rehabilitation.

"Dass man die Gesellschaft weiter entwickeln muss, dass man sagt, das gibts auch […] dass sie keine Angst haben vor dem. Angstfrei. Dass das das gleiche ist. Dass sie nicht zweite Klasse werden, wenn sie das tun, wenn sie nicht mehr rein fahren in das Spital." – E1

The possibility of storing medical reports or progress documentation of the telerehabilitation, maybe in the national electronic health record is considered as necessary measure by one expert. Furthermore, if reports are transferred regularly, the telerehabilitation will be funded by the social insurance, is the idea of this interviewee.

„Wir glauben schon, dass wenn wir das […] in der Zukunft als gemeinsame Plattform anbieten, wo alle Telerehasysteme oder Telesysteme einspeichern oder

es einen zentralen Punkt gibt, wo alle Gesundheitseinrichtungen darauf zugreifen können, dass das auch durchaus die Akzeptanz, so auf die Art, ein Service wird dann bezahlt, wenn die Zwischenbefunde in der […] landen." – E2

Additional to a technical guideline, which already exists, an organizational manual is needed for supporting the implementation of telerehabilitation. Further a kind of certification for applications to prove quality and effectiveness in the field of telerehabilitation should be established, according to some experts.

„Aber zusätzlich zum Implementierungsleitfaden und einem technischen Framework, brauche ich einen Organisationsleitfaden. D.h. was heißt es für mich als Arzt, Telereha zu integrieren." – E2

„Wie schaut die Organisation aus, macht man sich da Termine aus, wie bei einer Therapie und es sitz wer davor oder weiß man es gibt einen Slot." – E4

"Also, dass man so eine Art Qualitätskriterium hat, was ist eigentlich ein gutes System, was ist kein gutes System. Und dann auch diese, vielleicht bräuchten wir so eine Art Zertifizierungsstelle, wo man sagt, das ist ein gutes." – E2

Involvement of universities and introducing the field of telerehabilitation to students is necessary to increase the acceptance of therapists for this topic. They are significant influencer of patients, one interviewed person says.

„Die Akzeptanz der Therapeuten ist ein ganz wesentlicher Faktor. Wenn die nicht dahinterstehen, werden es die Patienten auch nicht. Das sind die entscheidenden Influenzer. Das wird auch eine Hürde sein, bei einer Implementierung. Bei technischen Hilfsmitteln sind die therapeutischen Berufsgruppen zum Teil sehr ablehnend gegenüber. Also das ist schon wichtig, dass man die Ausbildungsstätten, die Fachhochschulen und Masterlehrgänge entsprechend schon hineinholt, frühzeitig ins Boot holt." – E5

User acceptance

According to experts, high user acceptance can be achieved, by high usability and simple handling of devices and software. It needs to be robust and video service delivery for example must be fast without interruptions. Clear understanding and easy to read instructions of what to do is also mentioned as a factor for high user acceptance. Also, familiar devices are important. Moreover, patients should not want to put the device / application down, the interviewees said.

"Es muss einfach sein und verständlich, was zu tun ist. Das Ding muss extrem robust sein." – E2

„Dass es schnell funktioniert, dass es nicht hakt, dass die Technik dahinter läuft, weil wenn das immer stockt und ständig Werbung kommt, dann könnte das schon mühsam werden, aber wenn das gut rennt." – E4

An incentive system, like achieving points or benefits for the time the patient uses the telerehabilitation system is also mentioned by the experts. Also, the usage of scales or measured values that patients have the possibility to see and compare what they have achieved, seems to be important. If they are successful, they get a motivational message or a reward. Comparing to others and gamification was also mentioned as potential method for increasing user acceptance. Also, options to interchange and communicate with others via the system might be useful.

„Gamification, dass wäre für mich noch wichtig. Und so Marker, so Wochenmarker, was müssen die dort erreicht haben." – E1

„Das Anreizsysteme, d.h. das er Punkte erreichen muss, dass er Benefits hat, dass er sich vergleichen kann, mit einer Vergleichsgruppe, eventuell dass es auch einen Gruppenmodus gibt, ähnlich wie bei Videospielen, wo man im Sinne einer Selbsthilfegruppe auch kommunizieren kann." – E5

One interviewed person means, that the bonding of the patients and the telerehabilitation institutions must be high, because this is a precondition for a higher patient adherence and user acceptation.

"Weil die Bindung an die Institution ist glaub ich ganz wichtig, für die Adherenz und dann für sich das drauf einlassen." – E5

Financing of the system is for one expert a factor that would raise user acceptance, also as perpetuate the knowledge of the health professionals.

„Indem man es ihnen zahlt. […] und dass man ihr Wissen verewigt, aber das ist schwierig, weil die müssen was hergeben." – E1

Just one expert thinks that younger patients are more digital-affine than older ones. Young people do not have much fear of contact with telerehabilitation and it might not work with older patients.

"Und je jünger die Patienten sind, umso affiner, da denke ich mir, dass die da jetzt wenig Berührungsängste hätten mit irgendwelchen Übertragungen oder Konferenzen. Bei den älteren, die das jetzt nicht so gewohnt sind, wird es wahrscheinlich nicht funktionieren." – E3

Oblige patients who get a total hip or knee endoprosthesis to telerehabilitation, especially if it is in form of a behavioral guide, which they have to use, is also an option, one expert thinks.

In dem Fall wäre es ja noch einfacher, weil ich mein, da gehts ja um Hüft- und Kniepatienten, die definitiv eine kriegen und wenns das gibt, müssen sie das als Empfehlung mitbekommen oder Verpflichtung fast." – E7

For one interviewed health professional, it is not conceivable implementing telerehabilitation as only option, it is just possible as a part of the rehabilitation process. Also, from the point of view of a patient, the expert would not like it, because of rehabilitation or training at home.

" […] eigentlich als Büroarbeiter ende. Das taugt mir eigentlich überhaupt nicht, das würde mich nicht glücklich machen. Von daher gibts Teile, ein paar Stunden am Tag, aber den ganzen Tag nur Telerehabilitation wäre für mich undenkbar. Absolut nicht vorstellbar." – E6

„Wenn ich mich als Patient sehen würde, der Telerehabilitation in Anspruch nehmen würde, also ich glaube mir würde es nicht so taugen, weil ich bin nicht so gerne zuhause in meinen 4 Wänden und mache da meinen Sport." – E6

Preconditions

Patients who are open minded and interested towards digitalization, self-motivated and have an age appropriate cognitive performance, bring the ideal preconditions for telerehabilitation, experts say. It is important, that users understand the exercises, which they have to perform and think that telerehabilitation could help them. Furthermore, enjoying movement and a good awareness of their body are also mentioned. Body awareness is essential to guide people in executing movements, especially if it is only instructed verbal and remotely. Also, a good surgery outcome was mentioned.

„Also kognitiv völlig intakt, aufgeschlossen elektronischen Hilfsmitteln, interessiert, und die entsprechende Adhärenz, und sonst (...) ein gutes OP-Ergebnis." – E5

„Er braucht im Prinzip ein sehr gutes Körpergefühl, weil du kannst keine Patienten eine Übung anleiten, nehm ich jetzt mal an, ich hab mit dem wie gesagt keine Erfahrung, die sich nicht selber gscheid spüren […] Aber wenns alles nur auf verbaler Ebene ist, nehm ich an, ist es recht schwierig für manche Klienten das umzusetzen." – E6

According to some of the interviewees, patients need to be well informed about computers. One expert means, that also some equipment and space at their homes is needed.

"Die sich auch mit der EDV auskennen." – E4

Process

Following process steps were discussed with the experts:

1. Clarification of legal and financial aspects
2. Definition of team and roles
3. Selection of the system: technical, organizational requirements (including data protection, interoperability, budget and so on) under consideration of different methods (synchrony / asynchrony)
4. Definition of the process – from patient recruiting to evaluation
5. Selection of the patients (defining of criteria roles and selection of the patients)
6. Training of the therapists
7. Creation of the therapy plan (only telerehabilitation or both – conventional and TR, activities)
8. Training and education of the patients
9. Run a pilot operation
10. Evaluation of the pilot operation (considering of already available models, like MAST, etc.)

According to the experts, the process of implementation is, on principle, conceivable and one interviewee already did some pilot projects in implementing a telerehabilitation service, following the same process steps.

One expert added the development of personas as supplementary step, also the prototyping and testing of a click dummy, if the telerehabilitation system is not, or still in development.

„Das ist genau unser Ablauf, entspricht unserem Vorgehensmodell, was wir eigentlich für unsre Pilotstudien gemacht haben." – E2

„Ich würde es ganz umdrehen und am Anfang Personas definieren, weil dort sieht man ob die das wollen oder nicht." – E1

Other experts opine, that a pilot project is an essential implementation step. Furthermore, the involvement of the therapists in the whole process and the part of the training is crucial for the implementation.

"Wichtig ist, einen Piloten durchzuführen." – E3

„Ganz wichtig, das Training der Therapeuten. Die müssen eingebunden sein." – E5

One thinks that the process is practicable and that there is just a lack of money. Another interviewee added a launch campaign to the discussed process model.

"Meines Erachtens, wenn sie das haben, brauchen sie eine Launch Kampagne für das digitale, für den digitalen Markt, also das ist ja ganz, weil wie wird das publik." – E1

Successful implementation

According to most experts, successful implementation means, that patients are satisfied, as well as telerehabilitation is useful and patients making progress, respectively they have good or better clinical outcomes compared to conventional rehabilitation. Also, physicians and therapists need to experience, that telerehabilitation is effective. More organizational efficiency due to ceasing of travel times, appointment management etc. and sustainability are mentioned.

Success means, that telerehabilitation is provided as standard treatment in the health care system (across several health care institutions), reproducible, evaluable and of course funded (no matter if public or private) is also mentioned by the interviewed persons.

„Ja, erfolgreich ist es immer, wenn der Patient zufrieden ist und wenn er sagt, das war sinnvoll und hat ihm weitergeholfen, egal wo er steht." – E7

„Na in dem der Patient sagt, es ist sinnvoll. Und wir, also sowohl der Therapeut als auch ich sehen, dass die Therapie effektiv ist." – E3

„Wenn ich bessere Ergebnisse erreiche, wie im stationären. Gesamthaft gesehen, wo ich auch bewerte die Zeit, die einer fährt. also wo ich wirklich gesamthaft bewerte […] medizinische Verbesserung, das hoffe ich, das soll halt gleich sein, zumindest. Das müsste mindestens gleich sein. Dann habe ich einen organisatorischen Outcome, das ist das ganze fahren, das anmelden. Dann habe ich eine Nachhaltigkeit." – E1

„Also erfolgreich, also ist es in der Regelversorgung. das heißt erfolgreich ist es implementiert, wenn es in der Regelversorgung ist, wenn es dafür Geld gibt, entweder von öffentlicher oder privater Hand oder der Patient selber bezahlt. Das ist ja wurscht, aber dass es halt finanziert wird und dass es auch wirklich auch einfach reproduzierbar ist, also ich sag mal, dass es auch auswertbar ist." – E2

One expert means, that success would be an integrated (rehabilitation) system or process, because recovery is not a consistent process in Austria.

„Wenn wir überhaupt ein durchgängiges System hätten in Österreich, […] das ist ein zerpflückter Schrebergarten, die Durchgängigkeit, die Durchlässigkeit des Prozesses des Gesund werden ist nicht durchgängig gegeben." – E5

Patient empowerment, specifically in the meaning of continuing the training, even the rehabilitation is completed, was also noted by interviewees.

"Empowerment von den Patienten und gelingt es mir den in die Bewegung zu holen oder in seine Übungen zu holen." – E1

„Für den Patienten, wenn er halt wirklich danach, mit diesem Übungsprogramm seine Übungen macht und seine Erfolge hat und dann das gute Outcome hat, mit er hat keine rezidiven Verletzungen mehr, wieder normalen Alltag, normale Aktivität, Sport." – E6

4.2 Summary of the interviews

Table 4 illustrates the reduced interview results per defined category and linked to the research questions. Statements which were mentioned by more than one expert, were highlighted in bold.

Table 4 Summary of interview results

Which organizational, technical and legal aspects are required for the implementation of a telehealth service?	
Category	**Result**
Lead	• **Health professionals, like physicians, physiotherapists** • Whole care team as essential part • A physiotherapist practices • Insurances, moreover, financiers • Organizations, not defined persons • Identification of the top management • Prescribed by an orthopedic tool (in coordination with physicians and therapists)

Roles physiotherapists and physicians:	• Physiotherapists take a key role, especially in training and education • Health professionals as knowledge carriers will decrease, but still important concerning interpersonal tasks
Usefulness	• **Useful** • **Makes sense in both indications** • **Mixed model – conventional rehabilitation and telerehabilitation** • **Patients need direct instructions and supervision, therefore usefulness in a further course** • **Useful as information guide** • Telerehabilitation as a single method • Digitalization offers lots of opportunities • Easier to transport data than people • Ideal indication because of high medical standards in Austria, but distinguish between elective and non-elective; usefulness is especially given at elective • Discussion about costs and funding is miserable Advantages: • **Avoiding of travel times and journey with crutches** • **Elimination of waiting times** • **More flexibility in time management** • **Independently** • **Cost effective** Disadvantages: • **Lack of interpersonal relationships and communication** • **Missing possibility for manual therapy** • No physical support (which might lead to a more stable movement)
Preconditions	• **Open minded** • **Interested towards digitalization** • **Self-motivated**

	• **Able to understand the exercises** • **Positive attitude toward telerehabilitation** • **Enjoying movement and good body awareness** • **Good surgery outcome**
Integration / point of time in the rehabilitation process	• **In a later phase of rehabilitation** • **Combination of face-to-face and telerehabilitation** • **Potential temporary rehabilitation between the acute phase (hospital stay) and the phase II rehabilitation** • **As information guide for behavioral measures in all phases** • Telerehabilitation with not necessarily need of an inpatient rehabilitation, as long a personal contact is given • After acute are, but just for total hip replacement • After inpatient rehabilitation for total knee replacement
Technology	• **Clear understandable, easy to use and robust** • **Possibility to use well known devices and / or common messaging platforms** • **But patients need to want to do it by their own** • **Asynchrony methods as most effective and efficient** • **A mix of asynchrony and sensor based seems ideal, but complex** • **Sensor might be a big effort in costs and handling and are probably not appropriated for all user groups** • Suitable technology depends on user groups and requirements • Sensors for monitoring quality and quantity of the rehabilitation • Most effective are synchronous methods, because of immediately feedback • Synchrony is effective, but not efficient • Virtual reality for motivation • Technical inconveniences as a challenge

	• Establishing a design studio for usability requirements • Neglect technology, just identify patient needs, telerehabilitation cannot be technology driven
Challenges	• **Financing / funding** • **Technical readiness and availability** • **Willingness to realize telerehabilitation** • **Sustainability**
Required measurement	• **Development of an organizational manual for implementing telerehabilitation** • Storing medical reports of telerehabilitation in the national electronic health record and funding telerehabilitation when reports are transferred regularly • Certification for applications to prove quality and effectiveness • Involvement of universities and increasing the acceptance of therapists • Development of society concerning digitalization

Which steps are essential for successful implementing of telerehabilitation following total joint replacement in an organization (hospital, rehabilitation center, etc.) in Austria?

category	Result
Process	• **Discussed process is conceivable** • Already done like this • Adding development of personas • Adding prototyping and testing of a click dummy, if the system is not or still in development • Pilot project is essential • Involvement of therapists, especially in training • Launch campaign as additional step

What are the key factors for successful implementation?

Category	Result
Successful implemented	• **Patient satisfaction**

	• **Physicians and therapists need to experience that telerehabilitation is effective**
	• **Organizational efficiency**
	• Telerehabilitation is provided as standard in health care
	• When it is reproducible, evaluable and funded
	• If telerehabilitation leads to an integrated (rehabilitation) system or process
User acceptance	• **High usability and simple handling of devices and software**
	• **Clear understanding and easy to read instructions**
	• **Usage of familiar devices**
	• **Incentive system**
	• **Usage of scales or measured values and comparing to others,**
	• **Gamification**
	• **Interchange and communication with others, group dynamics**
	• Bonding of patient and telerehabilitation institutions
	• Financing
	• Perpetuate the knowledge of the health professionals
	• Younger patients do not have much fear, but would not work with the older ones
	• Obliging patient
	• Telerehabilitation should not be the only option, patients won't like training at home

5 Implementation Framework

In this chapter the approach of an implementation framework for telerehabilitation after total joint replacement is discussed.

Studies have already shown how an implementation framework of telerehabilitation could look like. Results of the present thesis describe, how implementation of telerehabilitation after total joint replacement in Austria is conceivable. Furthermore, it summarizes success factors, possible challenges and required measurements. At the end of this chapter a checklist for implementation is provided.

5.1 Organizational, technical and legal aspects

In advance of every project, as an implementation of telerehabilitation, several aspects need to be considered. Necessity, usefulness, preconditions and technology are among them. The usefulness of telerehabilitation after total hip and knee replacement is not only proven by several studies [1], [91], [36], [92]. This is also confirmed by interviewed experts. According to them it makes sense in both cases, total hip and knee replacement. Total hip replacement is seen as ideal indication, because of the high medical standards in Austria, one expert mentioned. But it is also stressed to distinguish between elective (procedures are scheduled in advance) and non-elective (done because of an urgent medical condition) surgery. The latter may lead to more complications.

It is considered to mix conventional rehabilitation, which means face-to-face appointments and telerehabilitation. The issue that patients usually need direct instructions and supervision from their therapists, could be addressed. Telerehabilitation measures are seen in a further course of treatment. No studies were found, for the ideal integration or point in time of rehabilitation. The reason could be, because little data concerning telerehabilitation in Austria was found and other countries might not have such structured rehabilitation programs. As an informational guide for patients, telerehabilitation is thinkable in all phases of rehabilitation.

Only one expert believes, that telerehabilitation makes sense as single method, replacing conventional rehabilitation at all.

Raising opportunities of digitalization in the field of telerehabilitation were also addressed by one expert and understood as useful.

Avoidance or reduction of travel times, more flexibility in time management, elimination of waiting time and cost effectiveness are assumed as advantages of telemedicine by the experts as well as in literature. [93], [24, pp. 14–15]

According to the interviewees, disadvantages are the lack of interpersonal relationship, which also was found by Peretti et al. [19] The missing possibility for manual therapy is another downside. According to Kary et al., who did a study on patients' perspective on telerehabilitation following total knee replacement, patients felt, that telerehabilitation should supplemented by manual therapy or manual assessment of their affected joint. This meets the consideration of experts, that a mixed method (conventional and telerehabilitation) is seen as useful, like mentioned above.

Health professionals, like physicians and physiotherapists are proposed in the lead of telerehabilitation following a total joint replacement. The whole care team is seen as essential part. Also, insurances, moreover financiers are suggested to be in the lead. Furthermore, it is important, that an organization and its top management identifies itself with telerehabilitation, not only (some) persons or a project group.

Physiotherapists take a key role, especially in training and education. One expert mentioned they are substantial influencer, since they stay in touch with the patient.

Using telemedical services, like telerehabilitation requires open minded, in digitalization interested users (patients and health professionals) with a positive attitude towards digital services. Moreover, patients need to be self-motivated, having good cognitive abilities to understand exercises and enjoying movement. A good surgery outcome is also helpful for effective telerehabilitation.

Also, preconditions concerning usability are essential, such as clear understandable, easy to use and robust devices, respectively applications. From the patient´s view it is ideal to use well known devices like their smartphones, tablets or smart-TV´s. It is also taken into consideration, to use common messaging platforms, like "WhatsApp" or "Telegram" for telerehabilitation measures. According to John et al. a telerehabilitation program also includes parts of E-learning, telecoaching or Social Networking and is becoming a holistic concept. [94]

A mix of asynchrony and sensor-based technologies is ideal, but complex and probably not appropriated for all user groups, especially not for older ones. Reasons might be the big effort in costs, as well as in handling, according to the

experts. Therefore, technology needs to be chosen depending on user groups and requirements.

As challenge, technological inconvenience is seen, like low runtime of battery or weak network connectivity.

Technological aspects have a high dependence to user acceptance and therefore successful implementation, which is specified in section 5.3. One experts sees virtual reality as a motivator for patients, which was also found in some research related to telerehabilitation after total knee replacement. [67], [95], [66]

Considering challenges at the beginning of implementation might have the potential to meet them earlier and probably overcome them. Financing or funding of telerehabilitation is seen as the biggest challenge. A start-up-financing, as it was, respectively is done for establishing ELGA applications in Austrian health organizations, could be a possible way. [96] Storing medical reports of telerehabilitation in the national electronic health record and funding telerehabilitation when reports are transferred regularly, is an idea of one expert.

Technical readiness and availability, willingness to realize telerehabilitation as well as sustainability are also mentioned as notable challenges. Development of an organizational manual for implementing telerehabilitation is focused by the experts as required measurement. Although a technical framework already exists, at least for telemonitoring [51], no guidance for organizational questions is provided, like this is done for ELGA. [97] Furthermore involvement of universities for increasing the acceptance of physiotherapists, which was already mentioned as a key factor for telerehabilitation, is necessary.

Due to the large variety of health applications, which is increasing steadily, [19] certifications of telerehabilitation applications to prove quality and effectiveness is another requirement. As mentioned, the German pension insurance only accepts telerehabilitation, if providers and their tools are permitted by the insurance, [55, pp. 8–10] which also might be imaginable for Austria.

Technology is changing quickly [1] and according to Jansen-Kosternik it is assumed that during projects used technology is already outdated. This leads to less motivated patients [25] and should be taken into consideration, when implementing telerehabilitation.

Development of our society towards digitalization is also mentioned as requirement in context with the implementation of telehealth services. According to Meskó et al. the transition in the field of digital healthcare is slowing down, because of ignoring the priority of cultural change. [98]

5.2 Implementation steps

As part of expert interviews, process-steps of an implementation of telerehabilitation were discussed and based on the result adopted:

- Legal and financial aspects
- Definition of the team and roles
- If applicable creating of personas for prototyping and development of a click dummy
- Selection of the system
- Definition of the process
- Selection of the patients
- Training of the therapists
- Creation of the therapy plan
- Training and education of the patients
- Running a pilot operation
- Evaluation of the pilot operation
- Launch campaign

Basically, the suggested process of the implementation is conceivable by the experts. In addition, the development of personas was suggested, which seems not relevant in the context of the thesis. Due to the given indication the user group is already very restricted. Prototyping and testing of a click dummy were supplemented, if the ICT system for telerehabilitation is not yet or still in development. A launch campaign for the introduction of the provided service is also suggested.

Within the process-steps of implementation, early involvement and training of physiotherapists is essential. According to several studies, early participation and considering of requirements of all users is necessary. [41, p. 289], [79]

5.3 Key factors for successful implementation

Telerehabilitation is successfully implemented, when patient satisfaction is fulfilled, and organizational efficiency is given. In addition, telerehabilitation as standard care, which is reproducible, valuable and funded as well as the contribution to an integrated health care system, is seen as success.

As mentioned in several studies, user acceptance is a key factor for successful implementation of telemedical services. [79] High usability and simple handling of devices and software, as well as a clear understanding, easy to read instructions and the use of familiar devices contribute toward high user acceptance, was found within the work of this thesis. As mentioned, the average age of patients who receive a total joint replacement in Austria is between 67 and 70 years. It is assumed, that this user group is not as digital affine as younger people. [99, p. 19], [91] Therefore, usability and easy handling is even more important.

To motivate patients and raise acceptance and therefore success, an incentive system and gamification is suggested. According to Pesare et al., gamification has the potential to improve user engagement in a medical context. [70]

The usage of scales or measured values and comparing them to others, combined with interchange and communication among users, in line with group-dynamics, also might lead to increasing user acceptance. Linking of patients and rehabilitation institutions would also contribute to higher user acceptance.

5.4 Implementation framework checklist

Table 5 shows a checklist for implementing telerehabilitation after total joint replacement, considering both, literature and results of the expert interviews. Moreover, tools of project management in the field of information technology are also part of the checklist. These are depicted following M. Dugas. [100, pp. 218–221] An idea how to create work packages can also be found at the "transfer model", which is described in chapter 2.4.2. Moreover aspects of requirement specification are included, which means the describing of product or system requirements. [100, p. 219]

This sums up organizational and technical aspects, as well as requisite process steps, success factors and possible challenges.

The checklist is supplemented by – according to interviewed experts – still required measures for sustainable implementing of telerehabilitation.

Table 5 Implementation framework checklist

STRATEGIC CONSIDERATONS (PRE-PROJECT)
Strategic considerations should be addressed before planning and executing the project. Topics in this section are seen on a strategic and policy level.

Topic	Measures, comments and examples
Corporate Goals	Is telerehabilitation a contribution to fulfilling corporate goals, like digitalization or process consolidation?
Usefulness of indication	In case of total hip and knee replacement usefulness is proven through several mentioned international studies and interviewed experts in Austria within this thesis. Usefulness may differ between elective and non-elective (may lead to more complications) surgical procedures
Advantages	Avoidance or reduction of travel and waiting times More flexibility in time management Cost effectiveness
Disadvantages	Lack of interpersonal relationship Missing possibility of manual therapy
Change management	As accompanying measures within the whole project With the aim to support cultural change towards digitalization Ensures clearly and timely information of all stake holder
Stakeholder Management	Identifying of all stakeholders, like involved health professionals, insurances, hospital / rehabilitation institution owners, patient representatives Identifying their expectations
Legal and financial aspects	Legally embedded in the ASVG (outpatient rehabilitation) Financing is not regulated; suggestions by experts are funding by insurances (private or public)

	A regularly medical report of progress of the rehabilitation as prerequisite of funding might be a possible approach

PROJECT MANAGEMENT

This section is about project management, setting up a team and planning the implementation of telerehabilitation

Topic	*Measures, comments and examples*

Project Goals	What are the goals when implementing telerehabilitation following total joint replacement?
	
	• Reducing of waiting times and / or process throughput times
	• Patient satisfaction, through:
	   o Avoiding of travel times
	   o Location-independent training
	   o Reducing of waiting times
	   o Empowerment
	   o Incentive and gamification
	• Patient loyalty, linking of rehabilitation organizations (health care workers) and patients
	• Contribution to digitalization
	• Marketing

Project Team	Setting up a project team: • Health professionals as physicians and therapists are seen in the lead • Especially physiotherapists are key stakeholder and key user • Involving the whole organization, including the top management • Early involvement is essential • Define responsibilities within the project team (for the whole project)

Project Planning	Project planning is usually supported by a software or done in a handbook, like Project Management Austria (PMA) is providing[5]
	Defining project period (start and end dates)
	Definition of work packages and Milestones (basically chronological, but also parallel); work packages are described in detail in the section "Project execution".
	• Kick Off the project • Present situation and process • Target situation and process • Business case • System requirements • Selection of the system • Configuration and testing of the system • Implementation • Evaluation

PROJECT EXECUTION	
Planned Work packages are described	
Topic	*Measures, comments and examples*
Kick Off Meeting	Introducing of the project idea, goals and project team
Present situation and process	Depicting the actual rehabilitation process and responsibilities
Target situation and process	Depiction of the process under consideration of telerehabilitation as basic concept.
Business case	Considering: • acquisition costs

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[5] Projekt Management Austria: *"PMA Standard Projekthandbuch"* [Online] Available: https://www.pma.at/de/service/downloads [accessed: Sep. 01, 2019]

	• system life cycle • maintenance costs

Defining of users (user classes)	Users and their characteristics (probably in the form of personas)
	
	• Health professionals
	   o Physiotherapists
	   o physicians
	• Patients following a total hip / knee replacement, usually around 70 years

System requirements	System or technology is essential for user acceptance – consideration the characteristics of the age group of potential users is important Clear understandable, robust, easy to use, well known devices (e.g. own smartphone or smart TV) as advantage in usability and acceptance Considering responsiveness (PC and mobile use) of the software for using the system on mentioned well-known devices If the system still has to be developed, prototyping, creating and testing of a click dummy Mix of asynchrony and sensor based is seen as ideal Avoiding technological inconvenience like weak connectivity Considering social networking platforms respectively components of them, like chats and virtual reality as a motivational factor Quick changing of technology must be taken into account Functional requirements: depicting use cases (functionalities) like: • Register (for all user groups) • Sign on (for all user groups)

	• Defining exercises
	
	• Assigning exercises to patients
	
	• Defining health professionals to patients
	
	• Communication
	    o Synchrony / asynchrony
	    o Video / audio / text
	    o Communication between user groups (health professionals, patients, user support)
	    o Communication with support
	
	• Giving Feedback
	    o When achieving a goal
	    o Automatically by the system
	    o Individual by the health professional
	
	• Consideration of gamification, incentives and social networking for keeping users motivated
	
	• User administration
	
	• Etc.
	
	Consideration of software quality attributes like FURPS [101, p. 6]
	
	• Functionality
	
	• Usability
	
	• Reliability
	
	• Performance
	
	• Supportability
	
	For detailed requirement specification, the IEEE standards association provides a standard for software requirement specification [6]

Selection of the system	Using an evaluation matrix with selection criteria
Configuration and testing of the system	Defining test protocols; an example is provided by P. Wolfinger [101, p. 67]

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[6] IEEE Recommended Practice for Software Requirements Specifications, IEEE 830-1998, August 2019. [Online]. Available: https://standards.ieee.org/standard/830-1998.html

	Involving of health professionals and ideally patients

Implementation	Deftermining a time-period for the pilot project
	
	Defining the process of telerehabilitation in detail (consideration of the system)
	
	• Ideal integration of telerehabilitation in a further course of treatment as mixed method (face-to-face and digital)
	• As informational guide in all phases of treatment
	
	Education and training of (physio)therapists
	
	• Is seen as essential in implementation of telerehabilitation
	• Providing a user documentation
	
	Preparing terms of use
	
	Selection of patients:
	
	• Defining of criteria roles and selection of the patients
	• Providing information and informed consent
	• Preconditions concerning patients:
	  o open minded toward digitalization
	  o self-motivated
	  o good cognitive abilities
	  o good surgery outcome
	• Increasing user acceptance through:
	  o Easy and clear instructions and handling of devices
	  o Early involvement
	  o Incentives
	  o Gamification as a motivator
	  o Measured values and comparing to others
	
	Creation of a therapy plan under consideration of
	
	• point in time (phase of rehabilitation)

	• and mixed methods approach (face-to-face and telerehabilitation) Patient education and training • Ideally within the inpatient rehabilitation • Providing an easy to understand user documentation Defining the process for user support (technical, functional and organizational user support) Running a pilot project

Evaluation	Defining of evaluation criteria, depending on the goals of the implementation, like
	
	• Reducing of waiting times and / or process throughput times (measuring process times before and after implementing telerehabilitation)
	• Patient satisfaction, through:
	   o Avoiding of travel times
	   o Location-independent training
	   o Reducing of waiting times
	   o Empowerment
	   o Incentive and gamification
	• Patient loyalty, linking of rehabilitation organizations (health care workers) and patients
	• Contribution to company goals, like digitalization or process consolidation
	
	Considering already available models like MAST – model of assessment in telemedicine

Suggestions of improvement	Defining and if appropriate realization of these measures

POST PROJECT	
Post processing of the project and decision of further strategy	
Topics	*Measures, comments and examples*
Evaluation of the project management tools	Where project management tools appropriate?
Decision how the project / implementation will continue and next steps	

REQUIRED MEASURES IN AUSTRIA
Development of an organizational manual for implementing telerehabilitation (technical framework already exists, at least for telemonitoring)
Involvement of universities for increasing the acceptance of physiotherapists, which was already mentioned as a key factor for telerehabilitation
Certifications of telerehabilitation applications to prove quality and effectiveness
Medical reports on progress of the rehabilitation as prerequisite of funding (maybe within the ELGA infrastructure) might thinkable
A start-up financing (like it was done in context with ELGA) is thinkable

5.5 Limitations

Although telerehabilitation is embedded in the Austrian law and measures concerning eHealth are implemented, little data and experience in implementing telerehabilitation is existent in Austria. Especially the assumed key player, physiotherapists have few experience or imagination, what telerehabilitation in their professional environment could be and how it contributes to the health care process, they are involved to. Therefore, some of the statements and knowledge gained through this thesis are based on estimates, not experience and mainly from a user´s (health professionals) perspective. Long term success factors as well as sustainably implemented telerehabilitation measures are not existent. Therefore, experts are not necessarily tangible. An interesting and important question would be, why there are just a few telerehabilitation pilot projects, although it is widely seen as useful and effective. What are the reasons for the non-existing integration

of telerehabilitation in routine health care processes, except the known factors, like a lack of financing or limitation concerning digital affinity in the targeted user group?

6 Conclusion

In the context of this thesis, the framework provides support for implementing telerehabilitation following total joint replacement and considers several issues.

<u>Organizational, technical and legal aspects</u>

Although embedded in the Austrian law, little data and experience is evident in Austria. Nevertheless, several subjects for implementing telerehabilitation were found.

The definition of an implementation team, especially the involvement of health care workers has to be done early. Due their usually close connection to patients, therapists should have a key role in implementing telerehabilitation.

From a technological point of view, high usability is an important issue. Considering a middle age of around 68 years of patients, who receive a total knee or hip replacement, easy handling of devices (ideally well-known, like smartphones) and applications is crucial as well as clear understandable instructions.

Funding, technical readiness and the willingness to realize telerehabilitation are seen as main challenges.

<u>Implementation steps</u>

Several steps were discussed with the interviewed experts. Concerning the implementation process, the way how and when integration of telerehabilitation is done, is seen as important. A combination of face-to-face and telerehabilitation as well as the integration in an inpatient setting seems to be a proper approach for this patient group. Amongst many other measures, running a pilot project is also essential, experts stressed.

Several implementation steps are depicted in the framework checklist in chapter 5.4. Also, aspects of project management were added.

<u>Success factors</u>

High usability and clear understandable instructions are essential for user acceptance and therefore success factors.

Telerehabilitation would be successful implemented, when patient satisfaction is high and treatment results are as good as with conventional rehabilitation.

Additionally, secured funding as well as telerehabilitation as part of the treatment process and contribution to an integrated health care system, demonstrating sustainable achievement, is also seen as success.

<u>What else?</u>

Some requirements were identified, which are assumed to promote the integration of telerehabilitation in Austria. Funding, linked to proven progress of the treatment, providing of an organizational manual for implementing and early involvement in the education of therapists are some of the missing essentials. A start-up financing, like it was provided for the implementation of the Austrian health record is also conceivable. Further research in case of funding needs to be done, like a development of business cases or financing regulations.

Furthermore, creating awareness of digitalization among health professionals is an important initiative in digital healthcare. Generally, long-term projects would be necessary to gain more experience in telerehabilitation in Austria.

Literature

[1] M. Tousignant, H. Moffet, P. Boissy, H. Corriveau, F. Cabana, and F. Marquis, "A randomized controlled trial of home telerehabilitation for post-knee arthroplasty," *J Telemed Telecare*, vol. 17, no. 4, pp. 195–198, Jun. 2011.

[2] M. Tousignant *et al.*, "Cost Analysis of In-Home Telerehabilitation for Post-Knee Arthroplasty," *J Med Internet Res*, vol. 17, no. 3, Mar. 2015 [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4397389/. [Accessed: 19-Oct-2018]

[3] H. Moffet *et al.*, "In-Home Telerehabilitation Compared with Face-to-Face Rehabilitation After Total Knee Arthroplasty: A Noninferiority Randomized Controlled Trial," *The Journal of Bone and Joint Surgery-American Volume*, vol. 97, no. 14, pp. 1129–1141, Jul. 2015.

[4] M. Tousignant, P. Boissy, H. Corriveau, H. Moffet, and F. Cabana, "In-Home Telerehabilitation for Post-Knee Arthroplasty: A Pilot Study," *International Journal of Telerehabilitation*, vol. 1, no. 1, pp. 9–16, Sep. 2009.

[5] OECD, Ed., *Health at a glance 2017: OECD indicators.* Paris: OECD, 2017.

[6] Gesundheit Österreich GmbH, "Allgemeine Infos | Österreichischer Rehabilitationskompass," *Österreichischer Rehabilitationskompass.* [Online]. Available: https://rehakompass.goeg.at/#/allgemein. [Accessed: 19-Feb-2019]

[7] T. Richmond *et al.*, "American Telemedicine Association's Principles for Delivering Telerehabilitation Services," *International Journal of Telerehabilitation*, vol. 9, no. 2, pp. 63–68, Nov. 2017.

[8] M. Gyimesi *et al.*, "Rehabilitationsplan 2016," Gesundheit Österreich Forschungs- und Planungs GmbH, Wien, Jun. 2016.

[9] S. Türk, "Hüft- und Knie-Endoprothetik in Österreich," Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, Wien, Jul. 2018.

[10] *Bundesgesetz vom 9. September 1955 über die Allgemeine Sozialversicherung (Allgemeines Sozialversicherungsgesetz – ASVG.* [Online]. Available: https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10008147. [Accessed: 03-Jul-2019]

[11] American Academy of Orthopedic Surgeons, "Total Joint Replacement," *OrthoInfos - AAOS.* [Online]. Available: https://www.orthoinfo.org/en/treatment/total-joint-replacement/. [Accessed: 04-Jul-2019]

[12] L. Shan, B. Shan, D. Graham, and A. Saxena, "Total hip replacement: a systematic review and meta-analysis on mid-term quality of life," *Osteoarthritis and Cartilage*, vol. 22, no. 3, pp. 389–406, Mar. 2014.

[13] J. A. Singh, "Epidemiology of Knee and Hip Arthroplasty: A Systematic Review§," *The Open Orthopaedics Journal*, vol. 5, no. 1, pp. 80–85, Mar. 2011.

[14] R. Pivec, A. J. Johnson, S. C. Mears, and M. A. Mont, "Hip arthroplasty," *Lancet*, vol. 380, no. 9855, pp. 1768–1777, Nov. 2012.

[15] Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, "Krankenanstalten in Zahlen: Leistungen," *Medizinische Leistungen bei stationären Krankenhausaufenthalten.* [Online]. Available: http://www.kaz.bmgf.gv.at/medizinische-dokumentation/leistungen.html. [Accessed: 29-Oct-2018]

[16] L. Leitner *et al.*, "Trends and Economic Impact of Hip and Knee Arthroplasty in Central Europe: Findings from the Austrian National Database," *Scientific*

Reports, vol. 8, no. 1, Dec. 2018 [Online]. Available: http://www.nature.com/articles/s41598-018-23266-w. [Accessed: 28-Jun-2019]

[17] Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, "Leistungen & Diagnosen," *Kliniksuche.at.* [Online]. Available: https://kliniksuche.at/suche/behandlungen?koerperbereich=2&behandlung=5. [Accessed: 15-Jul-2019]

[18] M. Zampolini *et al.*, "Tele-rehabilitation: present and future," *Ann Ist Super Sanitá*, no. 44, p. 10, 2008.

[19] A. Peretti, F. Amenta, S. K. Tayebati, G. Nittari, and S. S. Mahdi, "Telerehabilitation: Review of the State-of-the-Art and Areas of Application," *JMIR Rehabilitation and Assistive Technologies*, vol. 4, no. 2, p. e7, Jul. 2017.

[20] Physio Austria, "Telerehabilitation | physioaustria.at," *physioaustria.at*, 03-Jul-2019. [Online]. Available: https://www.physioaustria.at/news/telerehabilitation. [Accessed: 03-Jul-2019]

[21] R. Bashshur, G. Shannon, E. Krupinski, and J. Grigsby, "The Taxonomy of Telemedicine," *Telemedicine and e-Health*, vol. 17, no. 6, pp. 484–494, Jul. 2011.

[22] S. Sood *et al.*, "What Is Telemedicine? A Collection of 104 Peer-Reviewed Perspectives and Theoretical Underpinnings," *Telemedicine and e-Health*, vol. 13, no. 5, pp. 573–590, Oct. 2007.

[23] World Health Organization, Ed., *Telemedicine: opportunities and developments in member states: report on the second Global survey on eHealth*. Geneva, Switzerland: World Health Organization, 2010.

[24] Pan American Health Organization, "PAHO Framework for the Implementation of a Telemedicine Service," Pan American Health Organization, Washington D.C., 2016.

[25] C. B. Peterson, C. Hamilton, and P. Hasvold, *From innovation to implementation: eHealth in the WHO European region*. Copenhagen, Denmark: WHO Regional Office for Europe, 2016.

[26] European Commission, "eHealth Action Plan 2012 - 2020," European Commission, Brussels, Dec. 2012 [Online]. Available: https://ec.europa.eu/health/sites/health/files/ehealth/docs/com_2012_736_en.pdf. [Accessed: 01-Jul-2019]

[27] Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, "eHealth in Österreich." [Online]. Available: https://www.sozialministerium.at/cms/site/gesundheit/liste.html?channel=CH3978. [Accessed: 16-Jul-2019]

[28] WHO Global Observatory for eHealth, *MHealth: new horizons for health through mobile technologies*. Geneva: World Health Organization, 2011.

[29] K. Knöppler, T. Neisecke, and L. Nölke, "Digital Health Anwendungen für Bürger," Bertelsmann Stiftung, Feb. 2016 [Online]. Available: https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/Studie_VV_Digital-Health-Anwendungen_2016.pdf. [Accessed: 14-Jul-2019]

[30] Research2Guidance, "mHealth App Economics," Berlin, Nov. 2017.

[31] H. Kraus-Füreder, "Gesundheits-Apps (Grundlagenpapier unter besonderer Berücksichtigung des aspekts Gesundheitskompetenz)," Institut für Gesundheitsförderung und Prävention, Graz, Mar. 2018.

[32] L. Van Dyk, "A Review of Telehealth Service Implementation Frameworks," *International Journal of Environmental Research and Public Health*, vol. 11, no. 2, pp. 1279–1298, Jan. 2014.

[33] S. Jansen-Kosterik, "The added value of telemedicine services for physical rehabilitation," Universiteit Twente, Twente, 2014.

[34] J. M. Pastora-Bernal, R. Martín-Valero, F. J. Barón-López, and M. J. Estebanez-Pérez, "Evidence of Benefit of Telerehabitation After Orthopedic Surgery: A Systematic Review," *Journal of Medical Internet Research*, vol. 19, no. 4, p. e142, Apr. 2017.

[35] S. Bini and J. Mahajan, "Clinical outcomes of remote asynchronous telerehabilitation are equivalent to traditional therapy following total knee arthroplasty: A randomized control study," *Journal of Telemedicine and Telecare*, vol. 23, no. 2, pp. 239–247, Feb. 2017.

[36] A. Kalron, H. Tawil, S. Peleg-Shani, and J.-J. Vatine, "Effect of telerehabilitation on mobility in people after hip surgery: A pilot feasibility study," *International Journal of Rehabilitation Research*, no. 41, pp. 244–250, May 2018.

[37] N. Artz, K. T. Elvers, C. M. Lowe, C. Sackley, P. Jepson, and A. D. Beswick, "Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis," *BMC Musculoskeletal Disorders*, vol. 16, no. 1, Dec. 2015 [Online]. Available: https://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-015-0469-6. [Accessed: 30-Jan-2019]

[38] M. Tousignant *et al.*, "Patients' Satisfaction of Healthcare Services and Perception with In-Home Telerehabilitation and Physiotherapists' Satisfaction Toward Technology for Post-Knee Arthroplasty: An Embedded Study in a Randomized Trial," *https://home.liebertpub.com/tmj*, 13-Jun-2011. [Online]. Available: https://www.liebertpub.com/doi/abs/10.1089/tmj.2010.0198. [Accessed: 08-Jul-2019]

[39] M. Becevic, S. Boren, R. Mutrux, Z. Shah, and S. Banerjee, "User Satisfaction With Telehealth: Study of Patients, Providers, and Coordinators," *The Health Care Manager*, vol. 34, no. 4, pp. 337–349, Oct. 2015.

[40] WHO, "Health Promotion Glossary," p. 36, 1998.

[41] M. A. Pfannstiel, P. Da-Cruz, and H. Mehlich, Eds., *Digitale Transformation von Dienstleistungen im Gesundheitswesen I*. Wiesbaden: Springer Fachmedien Wiesbaden, 2017 [Online]. Available: http://link.springer.com/10.1007/978-3-658-12258-4. [Accessed: 16-Aug-2019]

[42] F. Fusco and G. Turchetti, "Telerehabilitation after total knee replacement in Italy: cost-effectiveness and cost-utility analysis of a mixed telerehabilitation-standard rehabilitation programme compared with usual care," *BMJ Open*, May 2016 [Online]. Available: https://bmjopen.bmj.com/content/6/5/e009964.full. [Accessed: 15-Jul-2019]

[43] C. J. J. Kloek, J. M. van Dongen, D. H. de Bakker, D. Bossen, J. Dekker, and C. Veenhof, "Cost-effectiveness of a blended physiotherapy intervention compared to usual physiotherapy in patients with hip and/or knee osteoarthritis: a cluster randomized controlled trial," *BMC Public Health*, vol. 18, no. 1, Dec. 2018 [Online]. Available: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-018-5975-7. [Accessed: 15-Jul-2019]

[44] G. Kainz, O. Rafetseder, E.-E. Schlemmer, and S. Heissenberger, "eHealth Portfolio 'Wiener eHealth Projekte,'" Stadt Wien, Gesundheits- und Sozialplanung, Wien, May 2018.

[45] Gesundheitsfonds Steiermark, "eHealth Steiermark Informationssystem." [Online]. Available: https://www.ehealth-steiermark.at/eHealthSIS/faces/sis/home.xhtml. [Accessed: 15-Aug-2019]

[46] Bund, Hauptverband der österreichischen Sozialversicherungsträger, and Bundesländer, "Zielsteuerungsvertrag auf Bundesebene, Zielsteuerung Gesundheit 2017-2021." 2017.

[47] I. Weik and S. Sauermann, "Telemonitoring in Österreich," *Zeitschrift für Gesundheitspolitik*, no. 03/2016, pp. 36–43, Mar. 2016.

[48] Landesinstitut für integrierte Versorgung Tirol, "Herzmobil Tirol," *Herzmobil Tirol*. [Online]. Available: https://www.herzmobil-tirol.at/page.cfm?vpath=index. [Accessed: 16-Jul-2019]

[49] Versicherungsanstalt für Eisenbahn und Bergbau, "Gesundheitsdialog Diabetes Mellitus," *Versicherungsanstalt für Eisenbahn und Bergbau*. [Online]. Available: https://www.vaeb.at/cdscontent/?contentid=10007.747216. [Accessed: 16-Jul-2019]

[50] Telegesundheitsdienste-Kommission, "Empfehlungen und Bericht der Telegesundheitsdienste-Kommission gemäß § 8 BMG an die Frau Bundesministerin für Gesundheit," Wien, Oct. 2014 [Online]. Available: https://www.bmgf.gv.at/cms/home/attachments/4/5/9/CH1417/CMS14234790 59781/empfehlungen_und_bericht_der_tgdk_gem.___8_bmg_an_die_fbm_f uer_gesundheit_endg._23.10.2014.pdf. [Accessed: 19-Oct-2018]

[51] Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz, "Rahmenrichtlinie für die IT-Infrastruktur bei der Anwendung von Telemonitoring." 2018.

[52] C. Brenneis, "VPKA-Kongress 2017," Schladming, Oct-2017.

[53] "VPKA-Kongress: Christian Brenneis über die Entwicklung einer Nachsorge-App für MS-PatientInnen," *Verband der Privatkrankenanstalten Österreichs*. 18-Sep-2017 [Online]. Available: https://privatkrankenanstalten.at/vpka-kongress-christian-brenneis-ueber-die-entwicklung-einer-nachsorge-app-fuer-ms-patientinnen/. [Accessed: 15-Aug-2019]

[54] V. Sadil, H. Füreder, S. Haas, J. Roitner, O. Zörner, and E. Pickl, "Tele-Physiotherapie: nachhaltig oder kurzlebiger Hype?," in *Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin*, 2018, vol. 28, p. V34 [Online]. Available: http://ezproxy.fhstp.ac.at:2328/DOI/DOI?10.1055/s-0038-1625794. [Accessed: 19-Oct-2018]

[55] Deutsche Rentenversicherung, "Anforderungen an Telereha Nachsorge." Feb-2017.

[56] E. Krupinski and J. Bernard, "Standards and Guidelines in Telemedicine and Telehealth," *Healthcare*, vol. 2, no. 1, pp. 74–93, Feb. 2014.

[57] K. Kidholm *et al.*, "A MODEL FOR ASSESSMENT OF TELEMEDICINE APPLICATIONS: MAST," *International Journal of Technology Assessment in Health Care*, vol. 28, no. 01, pp. 44–51, Jan. 2012.

[58] K. Knöppler, L. Oschmann, J. Neumann, and T. Neisecke, "Transfer von Digital-Health-Anwendungen in den Versorgungsalltag (Teil 1: Transfermodell, Varianten und Hürden)." Aug-2016.

[59] Telehealth Quality Group, "International Code of Practice for Telehealth Services 2018/19 v2." 2018.

[60] S. Kumar and E. R. Cohn, *Telerehabilitation*. London: Springer, 2013 [Online]. Available: https://rentals.springer.com/pdfreader/telerehabilitation. [Accessed: 13-Jul-2019]

[61] B. Bergh *et al.*, "Die Rolle von Integrating the Healtcare Enterprise (IHE) in der Telemedizin," *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz*, vol. 58, no. 10, pp. 1086–1093, Oct. 2015.

[62] T. G. Russell, "Physical rehabilitation using telemedicine," *J Telemed Telecare*, vol. 13, no. 5, pp. 217–220, Jul. 2007.

[63] H. Mousavi Hondori and M. Khademi, "A Review on Technical and Clinical Impact of Microsoft Kinect on Physical Therapy and Rehabilitation," *Journal of Medical Engineering*, vol. 2014, pp. 1–16, 2014.

[64] A. Ali, K. Sundaraj, B. Ahmad, N. Ahamed, and A. Islam, "Gait disorder rehabilitation using vision and non-vision based sensors: A systematic review," *Bosnian Journal of Basic Medical Sciences*, vol. 12, no. 3, p. 193, Aug. 2012.

[65] Cambridge English Dictionary, "Virtual Reality," *Cambridge English Dictionary*. Cambridge [Online]. Available: https://dictionary.cambridge.org/dictionary/english/virtual-reality. [Accessed: 16-Aug-2019]

[66] M. K. Holden, T. A. Dyar, and L. Dayan-Cimadoro, "Design and Testing of a Telerehabilitation System for Motor Re-Training using a Virtual Environment," in *2006 International Workshop on Virtual Rehabilitation*, New York, NY, USA, 2006, pp. 134–139 [Online]. Available: http://ieeexplore.ieee.org/document/1707541/. [Accessed: 30-Jan-2019]

[67] C. Jin, Y. Feng, Y. Ni, and Z. Shan, "Virtual reality intervention in postoperative rehabilitation after total knee arthroplasty: a prospective and randomized controlled clinical trial," p. 6.

[68] M. Chughtai, J. M. Newman, A. A. Sultan, C. Clinic, S. M. Navarro, and A. Bhave, "The Role of Virtual Rehabilitation in Total Knee and Hip Arthroplasty," *Orthopaedic Surgery*, vol. 32, p. 7.

[69] Mr. Naeemabadi, B. Dinesen, O. K. Andersen, N. K. Madsen, O. H. Simonsen, and J. Hansen, "Developing a telerehabilitation programme for postoperative recovery from knee surgery: specifications and requirements," *BMJ Health & Care Informatics*, vol. 26, no. 1, p. e000022, Apr. 2019.

[70] E. Pesare, T. Roselli, N. Corriero, and V. Rossano, "Game-based learning and Gamification to promote engagement and motivation in medical learning contexts," *Smart Learning Environments*, vol. 3, no. 1, Dec. 2016 [Online]. Available: http://slejournal.springeropen.com/articles/10.1186/s40561-016-0028-0. [Accessed: 14-Jul-2019]

[71] D. Anton, I. Berges, J. Bermúdez, A. Goñi, and A. Illarramendi, "A Telerehabilitation System for the Selection, Evaluation and Remote Management of Therapies," *Sensors*, vol. 18, no. 5, p. 1459, May 2018.

[72] D. Anton, A. Goni, A. Illarramendi, J. J. Torres-Unda, and J. Seco, "KiReS: A Kinect-based telerehabilitation system," in *2013 IEEE 15th International Conference on e-Health Networking, Applications and Services (Healthcom 2013)*, Lisbon, Portugal, 2013, pp. 444–448 [Online]. Available: http://ieeexplore.ieee.org/document/6720717/. [Accessed: 26-Oct-2018]

[73] D. Antón, G. Kurillo, A. Goñi, A. Illarramendi, and R. Bajcsy, "Real-time communication for Kinect-based telerehabilitation," *Future Generation Computer Systems*, vol. 75, pp. 72–81, Oct. 2017.

[74] M. Naeemabadi, B. Dinesen, O. K. Andersen, and J. Hansen, "Influence of a Marker-Based Motion Capture System on the Performance of Microsoft Kinect v2 Skeleton Algorithm," *IEEE Sensors Journal*, vol. 19, no. 1, pp. 171–179, Jan. 2019.

[75] S. T. L. Pöhlmann, E. F. Harkness, C. J. Taylor, and S. M. Astley, "Evaluation of Kinect 3D Sensor for Healthcare Imaging," *Journal of Medical and Biological Engineering*, vol. 36, no. 6, pp. 857–870, Dec. 2016.

[76] Mr. Naeemabadi, B. Dinesen, O. K. Andersen, S. Najafi, and J. Hansen, "Evaluating Accuracy and Usability of Microsoft Kinect Sensors and Wearable Sensor for Tele Knee Rehabilitation after Knee Operation:," in *Proceedings of the 11th International Joint Conference on Biomedical Engineering Systems and Technologies*, Funchal, Madeira, Portugal, 2018, pp. 128–135 [Online]. Available: http://www.scitepress.org/DigitalLibrary/Link.aspx?doi=10.5220/0006578201280135. [Accessed: 26-Oct-2018]

[77] Microsoft Corporation, "Kinect - Windows app development." [Online]. Available: https://developer.microsoft.com/en-us/windows/kinect. [Accessed: 16-Aug-2019]

[78] R. Altilio, L. Liparulo, M. Panella, A. Proietti, and M. Paoloni, "Multimedia and Gaming Technologies for Telerehabilitation of Motor Disabilities [Leading Edge]," *IEEE Technology and Society Magazine*, vol. 34, no. 4, pp. 23–30, Dec. 2015.

[79] T. H. F. Broens, R. M. H. A. Huis in't Veld, M. M. R. Vollenbroek-Hutten, H. J. Hermens, A. T. van Halteren, and L. J. M. Nieuwenhuis, "Determinants of successful telemedicine implementations: a literature study," *J Telemed Telecare*, vol. 13, no. 6, pp. 303–309, 2007.

[80] H. Taherdoost, "A review of technology acceptance and adoption models and theories," *Procedia Manufacturing*, vol. 22, pp. 960–967, 2018.

[81] Y. Lee, K. A. Kozar, and K. R. T. Larsen, "The Technology Acceptance Model: Past, Present, and Future," *Communications of the Association for Information Systems*, vol. 12, 2003 [Online]. Available: https://aisel.aisnet.org/cais/vol12/iss1/50. [Accessed: 16-Aug-2019]

[82] N. Döring and J. Bortz, *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften*, 5. vollständig überarbeitete, aktualisierte und erweiterte Auflage. Berlin Heidelberg: Springer, 2016.

[83] A. Bogner, B. Littig, and W. Menz, *Interviews mit Experten: eine praxisorientierte Einführung*. Wiesbaden: Springer VS, 2014.

[84] I. Montero and O. G. León, "A guide for naming research studies in Psychology," vol. 7, p. 17.

[85] J. Gläser and G. Laudel, *Experteninterviews und qualitative Inhaltsanalyse*, 4th ed. VS Verlag für Sozialwissenschaften | Springer Fachmedien Wiesbaden GmbH 2010.

[86] M. John, "Telemedizinische Assistenzsysteme in der Rehabilitation und Nachsorge – Projekte, Technologien und Funktionen," *B&G Bewegungstherapie und Gesundheitssport*, vol. 33, no. 05, pp. 197–207, Oct. 2017.

[87] D. Kairy *et al.*, "Telerehabilitation implementation and routine clinical use: Preliminary findings from a case study across three rehabilitation centers," in *2017 International Conference on Virtual Rehabilitation (ICVR)*, Montreal, QC, Canada, 2017, pp. 1–2 [Online]. Available: http://ieeexplore.ieee.org/document/8007529/. [Accessed: 30-Jan-2019]

[88] "Udo Kuckartz: Einführung in die computergestützte Analyse qualitativer Daten: Wiesbaden: VS Verlag für Sozialwissenschaften 2005. 255 Seiten. ISBN 3-531-14247-X. Preis: € 19,90," *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, vol. 58, no. 4, pp. 740–741, Dec. 2006.

[89] Big Commerce Essentials, "Why Brick-and-Click Retailers are Finding Success," *BigCommerce*. [Online]. Available: https://www.bigcommerce.com/ecommerce-answers/why-brick-click-retailers-are-finding-success/. [Accessed: 12-Aug-2019]

[90] Johns Hopkins Medicine, "Types of Surgery," *hopkinsmedicine.org*. [Online]. Available: https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/types-of-surgery. [Accessed: 02-Sep-2019]

[91] M. J. Nelson, K. M. Crossley, M. G. Bourke, and T. G. Russell, "Telerehabilitation Feasibility in Total Joint Replacement," *Int J Telerehabil*, vol. 9, no. 2, pp. 31–38, Nov. 2017.

[92] H. Shukla, S. Nair, and D. Thakker, "Role of telerehabilitation in patients following total knee arthroplasty: Evidence from a systematic literature review and meta-analysis," *J Telemed Telecare*, vol. 23, no. 2, pp. 339–346, Feb. 2017.

[93] M. Pramuka and L. Van Roosmalen, "Telerehabilitation Technologies: Accessibility and Usability," *International Journal of Telerehabilitation*, pp. 25–36, Mar. 2015.

[94] M. John, "Telemedizinische Assistenzsysteme in der Rehabilitation und Nachsorge – Projekte, Technologien und Funktionen," *B&G Bewegungstherapie und Gesundheitssport*, vol. 33, no. 05, pp. 197–207, Oct. 2017.

[95] M. Lee, D. Suh, J. Son, J. Kim, S.-D. Eun, and B. Yoon, "Patient perspectives on virtual reality-based rehabilitation after knee surgery: Importance of level of difficulty," *Journal of Rehabilitation Research and Development*, vol. 53, no. 2, pp. 239–252, 2016.

[96] ELGA GmbH, "ELGA: Förderrichtlinie," *ELGA*. [Online]. Available: https://www.elga.gv.at/gda/foerderrichtlinie/index.html. [Accessed: 02-Sep-2019]

[97] ELGA GmbH, "Organisationshandbuch für ELGA-Bereiche." 24-May-2019.

[98] B. Meskó, Z. Drobni, É. Bényei, B. Gergely, and Z. Győrffy, "Digital health is a cultural transformation of traditional healthcare," *mHealth*, vol. 3, pp. 38–38, Sep. 2017.

[99] Techniker Krankenkasse, "Homo Digivitalis TK-Studie zur Digitalen Gesundheitskompetenz 2018," Hamburg, Apr. 2018.

[100] M. Dugas, *Medizininformatik: ein Kompendium für Studium und Praxis*. Berlin: Springer Vieweg, 2017.

[101] P. Wolfinger, *IT-Projektmanagement Essentials*. Oettingen, 2018.

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Appendix

A. Declaration of consent

Sehr geehrte/r

Im Rahmen meiner Masterthesis „Implementation Framework for telerehabilitation after total joint replacement (exemplified by hip/knee) in Austria" / Studiengang "Digital Healthcare" | Fachhochschule St. Pölten) werden Experteninterviews durchgeführt. Mit diesem Schreiben ersuche ich, um Ihr Einverständnis das Interview aufzuzeichnen und die Ergebnisse für meine Arbeit zu verenden (in anonymisierter Form). Die Tonaufzeichnung wird nicht veröffentlicht.

Herzlichen Dank,

Doris Kraushofer

Hiermit erkläre ich mich mit der Durchführung des Interviews einverstanden, stimme der Aufzeichnung des Interviews sowie der Verwendung der Ergebnisse im Rahmen oben genannter Masterthesis zu.

_____ _____am _____

Experte

B. Interview Checklist (German)

	Kategorie	Fragen/Theman
1	Intro	Welche **Erfahrungen** haben Sie mit Telerehabilitation gemacht / in welcher **Rolle** haben Sie Telerehabilitation erlebt?
2	Indikation	Die WHO hat ein Model/ein Framework entwickelt, in dem Fragen zur Telereha adressiert werden – eine zentrale Frage ist dabei die Entscheidung, wo bzw. bei welcher Indikation Telerehabilitation angewendet wird. In der Literatur findet man beim Thema Telereha häufig im Bereich Neurologie und Orthopädie – **warum oder warum nicht kann Telerehabilitation bei HTEP /KTEP in Österreich sinnvoll sein?**
3	Integration Telereha/Zeitpunkt	Österreich hat in der EU die höchste Rate an Knietotalendoprothesen und die zweithöchste Rate an Hüfttotalendoprothesen. [5, p. 180] Studien zeigen, dass Telerehabilitation genau so effektiv ist wie konventionelle Rehabilitation. Darüber hinaus das Potential hat, Therapeuten zu entlasten und in vielen Fällen Kosten zu reduzieren. [1], [2], [3], [4] Im ASVG findet Telerehabilitation mittlerweile Berücksichtigung und wird der amb. Rehabilitation gleichgestellt. [10, Ch. § 302] **In welcher Phase der Reha sehen sie Telerehabilitation sinnvoll und warum?**

		Wie sieht **die ideale Integration der Telereha** bzw. wie kann der Übergang von stationärer bzw. amb. Reha zu Telerhabilitation erfolgen? Wie kann eine **Patientenrekrutierung** aussehen – welche Voraussetzungen müssen Patienten erfüllen?
4	Rollen Implementierung	In der Literatur wird oft der (notwendige) Interdisziplinärer Ansatz von Telerehabilitation betont und dass dennoch ein Akteur den „lead" haben sollte – **Wer oder welche Institution sollte diese Rolle übernehmen und warum?** (Industrie, Krankenhaus, niedergelassener Bereich, Physio, Sozialversicherung, etc.) In welcher Rolle sehen Sie Ärzte/Therapeuten?
5	Erfolgsfaktoren und Herausforderungen	Im „Journal of Telemedicine and Telecare wurde ein Review veröffentlicht, in dem 45 Arbeiten analysiert wurden mit dem Ziel Erfolgsfaktoren für die Implementierung von telemedizinischen Anwendungen herauszufinden. Dabei hat sich Userakzeptanz mit 37% vor Technologie (29%) als wichtigster Faktor herausgestellt. [79] **Was ist Ihre Erfahrung, wie kann man eine möglichst hohe Userakzeptanz** (Patienten, Therapeuten, Ärzte) erreichen (ohne jedoch andere Faktoren zu vernachlässigen)? Was hingegen sind die **Herausforderungen in Österreich, welcher Schritt muss bei der Umsetzung von Telerehabilitation besonders berücksichtigt** werden? (organisatorisch/technisch/kulturell) – was sind/waren für Sie Herausforderungen, wie sind Sie diesen begegnet?
6	Technische Umsetzung	Derzeit existieren verschiedenen Methoden der Telerehabilitation • Synchron – mit z.b. Videokonferenz oder Chatfunktion • Asynchron – z.B. mit Virtual Reality

		• Einsatz von biomechanischen Messsystemen Welche dieser **Methoden** sind Ihrer Meinung nach **am effektivsten und effizientesten?** Welchen **Unterschied** macht die technische Umsetzung in der Implementierung?
7	Evaluierung	Ein bekanntes Modell zur Evaluierung von telemedizinischen Anwendungen ist das sgn. MAST Modell [57] – welches eine multidisziplinäre Bewertung ermöglicht. Wann ist für **Sie Telerehabilitation erfolgreich implementiert**?
8	Ablauf	Unter Berücksichtigung der aktuellen Studien / Modelle kann folgender Ablauf der Implementierung in Erwägung gezogen werden: [24], [86], [87] ▪ Klärung rechtlicher und finanzieller Aspekte ▪ Definition Team und Rollen ▪ Auswahl des Systems: technische, organisatorische Anforderungen, (inkl. Datenschutz, Interoperabilität, Budget) unter Berücksichtigung der verschiedenen Modelle (synchron, asynchron) ▪ Prozessmodellierung - Ablauf der Reha von Patientenrekrutierung bis Evaluierung ▪ Auswahl der Patienten (Festlegen von Kriterien, Rollen und Auswahl selbst) ▪ Training der Therapeuten ▪ Erstellung Trainingsplan (nur Telerehabilitation oder gemischt, welche Übungen, etc.) ▪ Training/Schulung der Patienten ▪ Durchführung eines Pilotbetriebes ▪ Evaluierung (unter Berücksichtigung der bereits vorhandenen Modelle, wie z.B. MAST, etc.) Ist dieses **Vorgehen für Sie (in Österreich) vorstellbar**? Warum ja, warum nicht, welche Schritte müssten adaptiert werden?