Physiotherapists' Acceptability Towards a Monitoring Tool for Muscle Fatigability in Hip Fracture Clients

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Abstract

Background: The aging demographic change leads to an increase of hip fracture clients for physiotherapists in Germany. However, a device called Eforto® that allows for measuring grip work and fatigue resistance as indicator of muscle fatigability could potentially help physiotherapists to monitor their clients' level of recovery. This study focuses on two aims: (1) *to explore what the treatment context of physiotherapists regarding working with community-dwelling older adult hip fracture clients is*. The other aim is formulated as (2) *to explore what the underlying factors of physiotherapists' acceptability towards monitoring muscle fatigability of community-dwelling older adult hip fracture clients by using the Eforto® device are.*

Methods: The current study is a qualitative interview study and is based on the Theory of Acceptance and Technology (UTAUT). Seven German physiotherapists who have worked or who are currently working with community-dwelling older adult hip fracture clients took part in the study ($M_{Age} = 46.8;\ SD_{Age} = 14.6; M_{years\ of\ Experience} = 22.7;\ SD_{years\ of\ Experience} = 14.5$). The transcribed interviews were analysed first via inductive thematic analysis and then via a context analysis based on an integrative approach including deductive and inductive methods. A code structure was developed based on the determinants of the UTAUT model, being *Performance Expectancy (PE)*, *Effort Expectancy (EE)*, *Social Influence (SI)* and *Facilitating Conditions (FC)*. Three additional codes were based on the dependent variable of the UTAUT model *Behavioural Intention (BI)*, one of the model's moderators *Gender*, and a rest category codes named *Other*. In total 13 codes were created and analysed.

Results: The results of the study gave insights into the context of the physiotherapy treatment of community-dwelling older adult hip fracture clients and showed that physiotherapists show interest in the Eforto® device. However, it also became clear that the physiotherapists had some conditions under which they might want to integrate the device in their treatment of community-dwelling older adult hip fracture clients, such as scientific evidence for its contribution in improving.

Conclusion: The insights provided by this study suggest that the Eforto® device might be useful in the context of physiotherapy treatment of hip fracture clients. However, further studies need to be completed to understand what other factors that have not been caught in this study might be of relevance in this regard.

Introduction

Demographic Change Demands for Novel Approaches in Physiotherapy Treatments

In Germany, the demographic change leads to a rising number of older adults, and it is estimated that by 2060, 33% of the German population will be older than 65 years compared to 20% in 2013 (Statistisches Bundesamt [Destatis], 2015). As a result, also the number of hip fractures increases as older aged people are more vulnerable to fall and more often suffer from osteoporosis which are both risk factors for hip fractures (Guerado et al., 2016; Kanis et al., 2000; Parkkari et al., 1999). This is in line with a significant increase in hip fractures in Germany between 2009 and 2019 (Rupp et al., 2021). Community-dwelling geriatric adults suffering from hip fractures regularly engage in outpatient physiotherapy after undergoing surgery and visiting a rehabilitation centre to recover which supports clients in regaining the capacity to perform relevant daily life activities and build muscle mass (Stadler, 2020).

However, the increasing number of hip fracture clients poses a greater burden on physiotherapists. This is the case as the number of physiotherapists reduces due to the skilled worker shortage in the physiotherapy sector. In 2022, on average, eight out of 10 physiotherapy vacancies remained open as there are no unemployed physiotherapists for these (Tiedemann & Malin, 2023). Consequently, greater pressure is put on physiotherapists to successfully treat these clients so that they quickly recover, to be able to treat waiting clients. However, hip fracture clients encounter a long-lasting endeavour of recovery, taking between four months and a year, or for some clients even longer (Koot et al., 2000; Zidén et al., 2010). Hence, as physiotherapists regularly work for longer periods with hip fracture clients, it is of interest to them to find out which exercises might be useful for the individual client's recovery.

The Importance of Physiotherapy for Hip Fracture Clients' Recovery

The traditional and most widely used approach of hip fracture recovery states that patients are fully recovered when they reach a pre-existing physical capacity level (Alarcón et al., 2011; Ariza-Vega et al., 2014; Auais et al., 2018; Bellelli et al., 2007). In this regard, the objective of physiotherapy treatment for community-dwelling hip fracture clients, who before their fracture were able to independently live in their own household, also includes that these will be able to live independently again (Belzl et al., 2019). Nevertheless, according to a study by Dyer et al. (2016) of those suffering a hip fracture and living in Western countries, 10-20% are institutionalised within six months to one year after the fracture. To prevent this, physiotherapists provide information and training on specific exercises that help their hip fracture clients to gradually get back to carrying out daily life activities (Gorman et al., 2013).

Moreover, increased frailty predicts the need for residential care but is also considered to heighten the risk of future falls in community-dwelling older adults (Kojima, 2015, 2018). Frailty comprises decreased endurance and strength, as well as diminished physiological function leading to a risen susceptibility of the individual for establishing death and/or heightened dependability (Morley et al., 2013). Hip fracture clients who underwent surgery are generally frail. Combatting their frailty is rather critical as they are vulnerable and, therefore physiotherapy also focuses on preventing future falls of hip fracture clients that could lead to repeated fractures (De Dobbeleer et al., 2023; Gilliespie et al., 2001, as cited in Swanenburg et al., 2003). In this regard, it might be beneficial to create a tool that can measure a client's susceptibility for dependability to adapt physiotherapy treatment accordingly.

Fatigue Resistance and Intrinsic Capacity

Muscle strength and muscle volume diminish when getting older (Morley, 2003). As a result, the muscle activities needed when being an older adult for sustained daily activities need to be closer to the person's personal maximum. Due to its importance for geriatric clients, skeletal muscle fatigue resistance needs to be included in clinical decision-making (Bautmans & Mets, 2005). Fatigue resistance is "the ability to produce sustained skeletal muscle force" and is crucial for older adults in terms of properly functioning on the daily basis (Bautmans & Mets, 2005, p. 217). However, due to their frailty it is difficult or even impossible to measure skeletal muscle fatigue resistance with common assessment tools, such as treadmill tests or isokinetic evaluations (Bautmans & Mets, 2005).

As a result, Bautmans and Mets (2005), developed a fatigue resistance (FR) test that can also be performed by frail or ill older adults if these are bedridden or have difficulties moving larger muscle groups. In this test which measures muscle fatigue resistance, a Martin Vigorimeter (MV) device, consisting of a rubber bulb being compressible that is connected to an aneroid manometer is used and clients had to squeeze the MV bulb as hard and long as they can. The one testing can either verify that the strength utilised at the start is the maximal grip strength or if they consider it as too low they can encourage harder squeezing from the one being tested (Bautmans & Mets, 2005). For each hand, the time measured in seconds it took until the pressure reduced to 50% of the maximal grip strength was recorded. Whenever the pressure reduces, standardised verbal encouragement is given.

However, the MV is an analogous device and therefore measurements may not be precise (e.g., for the FR test time is measured via a handheld stopwatch) and it requires that a trained professional is present to conduct the testing.

Muscle function is considered to be a marker of intrinsic capacity which when being lost indicates ageing and of which consequence a person can lose independence (De Dobbeleer et al., 2023). It is defined as all capacities of physical and mental kind that a person can draw on (Beard et al., 2016). When it is lost, the person becomes dependent and one of the factors that influence intrinsic capacity is injury, such as a hip fracture (Noppen et al., 1993). As there are no devices for early-onset prevention and detection of diminished intrinsic capacity yet that would help with improved health management and prevention of intrinsic capacity loss, a device called Eforto® was developed (De Dobbeleer et al., 2023). In this regard, MV has been transformed from an analogous device into a system consisting of the Eforto® device and a corresponding smartphone application (APP).

The Eforto® Device and Monitoring of Muscle Fatigability

The Eforto® device was created on behalf of a European initiative that aims to integrate it in a broader context to improve physical capacity and resilience as well as recovery monitoring. In the context of physiotherapy, the device is supposed to be used by the hip fracture client during treatment sessions while the physiotherapist guides them through the tests while providing verbal encouragement and monitoring the client's results.

Eforto® and its APP are constructed as illustrated in Figure 1. The APP guides the client through the four different tests that are conducted with the device, three tests to measure the maximal grip strength and one test to measure muscle fatigability and beforehand provides a test that contains questions about the client's current self-perceived fatigue. Moreover, the APP is connected with the device via a Bluetooth®. The ergonomic bulb is directly attached to a plastic handpiece where the batteries and the sensor are placed (*Eforto - Welcome!*, n.d.). With the Eforto® device, FR tests can be utilised, and thereby, grip work (GW) is measured. In addition, Eforto® monitors muscle fatigability, composed of FR and GW, which is regarded as a dynamic and ecological indicator of resilience and physical reserve capacity of a human. Furthermore, it has been proven that Eforto® is a reliable and valid instrument for measuring muscle fatigability (De Dobbeleer et al., 2023). In the context of physiotherapy of community-dwelling older adults recovering from a hip fracture, Eforto® may be beneficial for monitoring the client's recovery and adjusting treatment accordingly.

Also, the Eforto® APP is an eHealth technology which can be described as a technological instrument that can be used to support well-being, health and healthcare (Gemert-Pijnen et al., 2018). The Eforto® APP as an eHealth technology can have various benefits. For example, since Eforto® provides the clients with data about their muscle fatigability, the clients could be empowered due to the access to their private health data which leads to a heightened

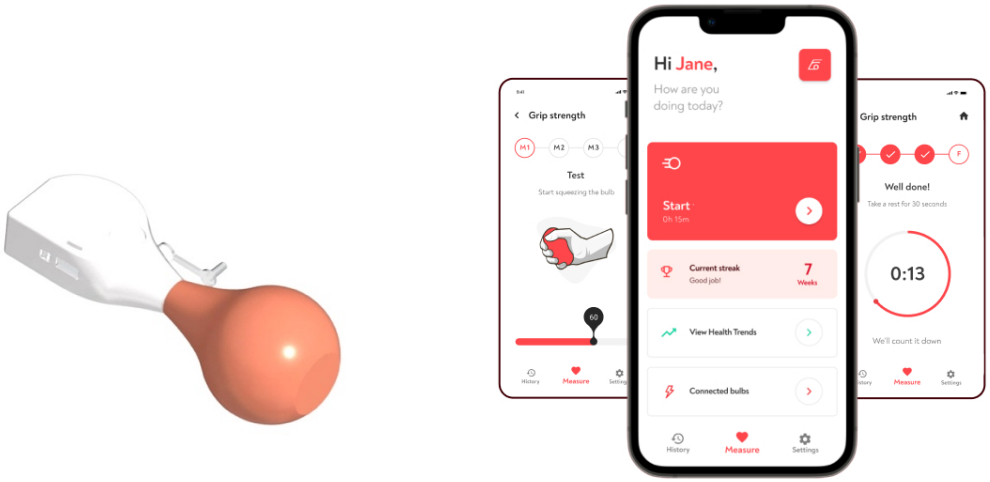
knowledge about their individual health (Gemert-Pijnen et al., 2018). Moreover, also the physiotherapists can be empowered as the APP allows them to make informed decisions about their client treatment. Another benefit of eHealth is that treatments' effectiveness can be enhanced, such as by allowing the physiotherapist due to the monitoring of the client's muscle fatigability to select certain exercises to improve their recovery.

However, there are also barriers of eHealth. One of these, an implementation barrier, is when users lack eSkills. If people do not have literacy in digital health, the uptake of an eHealth technology might be hindered (Gemert-Pijnen et al., 2018). Another barrier is that of privacy and security, which is an ethical barrier. This may apply for example with Eforto® if it is unclear for the user where the client's data is stored and whether it is sold so that it can be misused to the disadvantage of the user.

To implement the device in a specific context such as that of physiotherapists, it is essential to understand the context it would be used in and the acceptance of the target group, the physiotherapists, towards integrating Eforto® in their treatment. Therefore, the current study focuses on exploring physiotherapists' acceptability of using the physical resilience monitoring device Eforto® for treatment of community-dwelling older adult clients that are in the recovery process from a hip fracture. To study the acceptability, the Unified Theory of Acceptance and Use of Technology (UTAUT) will be applied.

Figure 1

The Eforto® Device and the Eforto® Smartphone Application



Note. On the left side is the Eforto® device depicted and on the right side the Eforto®

smartphone application is illustrated. From *eforto—Welcome!* (n.d.). Retrieved 12 March 2023, from https://eforto.com/

The Unified Theory of Acceptance and Use of Technology Model

To analyse the acceptability of physiotherapists towards Eforto®, the Unified Theory of Acceptance and Use of Technology (UTAUT) Model will be utilised (see Figure 2). According to Proctor et al. (2011, p. 67) acceptability can be defined as "the perception among implementation stakeholders that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory". Analysing the acceptability of physiotherapists towards monitoring muscle fatigability via the Eforto® device in community-dwelling older adult hip fracture clients is of important as if the physiotherapists are not satisfied with the device, it will not be successfully implemented in the context of physiotherapy.

The UTAUT model was created by (Venkatesh et al., 2003) to explain users' adoption of information systems. This model was shown to be able to disclose up to 70% of usage intention variance which in terms of behavioural research is an extraordinarily high prediction for ability (Anderson & Schwager, 2004; Davis et al., 1989; Oshlyansky et al., 2007; Venkatesh et al., 2003). Moreover, the UTAUT model is composed of four determinants. The first three, namely *Performance Expectancy (PE), Effort Expectancy (EE),* and *Social Influence (SI)* all have an influence on *Behavioural Intention (BI)* which in turn together with the fourth determinant *Facilitating Conditions (FC)* directly influence the *Use Behaviour*.

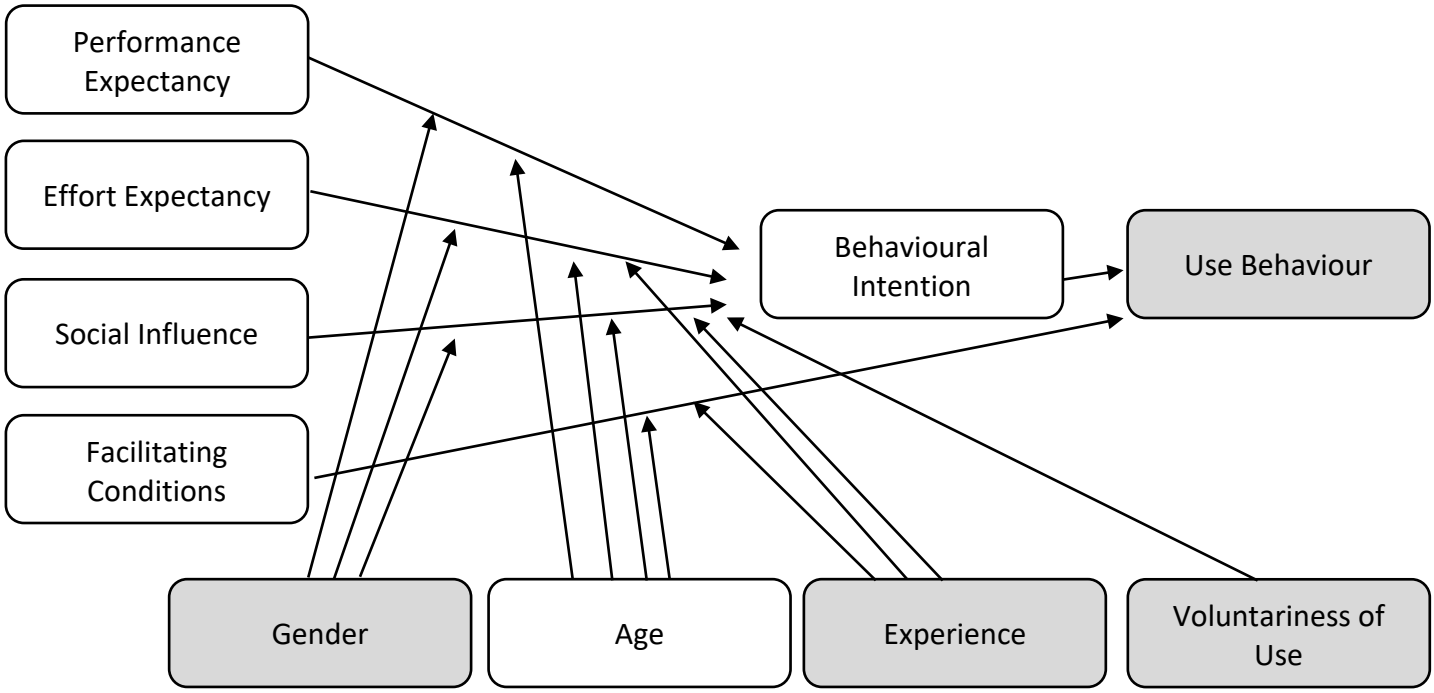
PE "is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance" and is also considered as the predicting intention to the greatest extent (Venkatesh et al., 2003, p. 447). The Eforto® device might be able to improve client treatment as it allows for monitoring of muscle fatigability. According to Takeuchi et al. (2008), physiotherapists view patient outcomes partially as success in their job. Thus, PE of physiotherapists towards eEorto® in hip fracture client treatment might favourable. EE is regarded as the extent to which a user associates ease with the system's use. In terms of physiotherapists acceptability towards integrating a novel device for client treatment, EE could play an important role. This might be the case as physiotherapists are often under time pressure due to the short duration of their treatment sessions with their clients (Brattig et al., 2014). As a result, it can be assumed that physiotherapists value devices that can be easily and quickly used. Furthermore, SI is described "as the degree to which an individual perceives that other important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451). And the fourth determinant FC is thought to be the extent to which a human thinks that a technical and organisational infrastructure exists to aid system use.

Moreover, four moderators are included in the UTAUT model. The first moderator *Gender* has an influence on the effect of the three determinants that influence *BI.* The moderator *Age* affects the relationship of all four determinants. *Experience,* the third moderator, influences the effect of *EE* and *SI* on *BI* as well as the effect of *FC* on *Use Behaviour.* The fourth moderator *Voluntariness of Use* solely influences the effect of *SI* on *Use Behaviour.*

A study conducted by Estel et al. (2022) with German physiotherapists showed that a significant higher number of younger physiotherapists compared to older physiotherapists were found to agree with the statement that they see a great potential of digitalisation in their domain. Therefore, it is critical to analyse in what way the age of physiotherapists plays a role in their acceptance towards the usage of Eforto® with frail, community-dwelling older adults. The current study focuses only on one of the four moderators of the UTAUT model due to the study's scope but also because the field of physiotherapy is still dominated by women which could make male participant recruitment more difficult. Moreover, voluntariness of use was not included in the current study as physiotherapists that work with outpatient hip fracture clients usually are employed at a physiotherapy practice. Therefore, whether a device for client treatment would be purchased and therefore used depends highly on the decision of their employer.

Figure 2

The UTAUT Model



Note. The focus of this study lies on the UTAUT model variables that are coloured white.

Research Questions

It is of interest to explore whether Eforto® is perceived as useful by physiotherapists when working with community-dwelling older adult hip fracture clients. This study will have two aims to examine the different factors that contribute to this.

This study's first aim is *to explore what the treatment context of physiotherapists regarding working with community-dwelling older adult hip fracture clients is*. This aim focuses on an contextual inquiry which is critical to prevent a mismatch between contexts, technology, and users (Kip et al., 2018).

Furthermore, the second aim of this study is *to explore what the underlying factors of physiotherapists' acceptability towards monitoring muscle fatigability of community-dwelling older adult hip fracture clients by using the Eforto® device are.* To thoroughly investigate this, several sub-questions based on the UTAUT determinants and the moderator gender need to be explored:

SQ1: What are physiotherapists thoughts towards the capability of Eforto® usage to assist them in attaining advantages from their performance in their job?

SQ2: What are physiotherapists' motivations behind their perceptions of the ease of use of the Eforto® device?

SQ3: What do physiotherapists think about what their geriatric hip fracture clients and the general practitioners of these clients might think about them using Eforto® in their hip fracture client treatment?

SQ4: What do physiotherapists think in terms of the existence of a supporting technical and organisational infrastructure for the use of the Eforto® device?

SQ5: How does physiotherapists' acceptability towards the Eforto® device differ according to their age?

Method

Research Design

This research contains a qualitative study with semi-structured interviews. The goal of the current study is to investigate physiotherapists' acceptance towards monitoring muscle fatigability with the Eforto® device in their community-dwelling older adult hip fracture clients. For this purpose, semi-structured interviews were found most suitable since while the researcher can direct the discussion towards the significant subtopics, there is still flexibility through which certain topics can be focused on in more detail. The study period in which data collection took place and that participants were thoroughly informed about their rights and the aim of the study, and subsequently provided written statements of informed consent. The study

was approved by the BMS faculty Ethics committee of the University of Twente (reference number: 230562).

Study Participants and Procedure

This qualitative interview study encompassed a convenience sample of practicing physiotherapists in Germany who were participating on a voluntary basis. The inclusion criteria were: Physiotherapists, who are practicing, and currently treat or in the past have treated community-dwelling older adult hip fracture clients. All participants gave their written consent.

As a first step, the participants received an email from the researcher in which they were asked if they would like to participate in this study. Also, the participant information letter was attached to it. This letter contained information about the purpose and background of the study as well as about who conducts and organises it. Moreover, information was given regarding expectations of what participants will be asked to do in the research, and the duration of data storage. Besides, the letter briefed the potential recruits that participation is voluntary and that withdrawal from it is possible any time up to the 31.05.2023. Also, in the information letter, confirmation of ethical approval for the study by the BMS ethics committee of the University of Twente (reference number: 230562), and what risks and benefits are prevalent and additional sources for further support were included. Furthermore, participants were informed about what would happen to their data, who has access to it and how they can get more information about the findings of the study. In the end, the researchers' contact details were listed, and the participant was asked to contact the researcher if they consider participating. If this was the case, the researcher asked the participant for a suitable time to conduct the interview and proposed a place where it could take place.

Before the interview has started, the participants were welcomed by the researcher who also introduced herself and thanked them for participating. Next, the participants were briefed about the aim of the study, approximate interview length, their rights to withdraw and to refuse to answer questions if they would like to and finally were asked to read and sign the consent form if they would like to participate. Then, they are asked twice for permission to be recorded, before and directly after the Dictaphone was turned on. In between the researcher asked the participant if there were any remaining question and answered them. Thereafter, the interviewer started the interview.

During the interview, a minimum of 18 questions were asked. In the first part of the interview, the participants were asked a maximum of 12 questions and eventually probes if the participants showed to have difficulties answering a question. Next, the participants were

provided with a short introduction to and explanation of the Eforto® device and were given the opportunity to perform a muscle fatigability measurement with the device on themselves.

The second part of the interview focused on physiotherapists' acceptance towards using Eforto® in hip fracture client treatment and contained of a maximum of 24 questions as well as probes. After the interview, the participant was immediately debriefed by the interviewer about their rights during this research.

Measures

An interview scheme was created to provide the interviewer with some guidance during the semi-structured interviews (see Appendix D). It first detailed eight steps that were undertaken for the preparation and rightful conduction of the interviews. In the second part of the interview scheme, a total of 39 questions were listed, comprised of 20 main, and 19 sub-questions.

The first part contained ten main questions and two sub-questions. It focused on demographics and an overview of the physiotherapy treatment procedure of community-dwelling older adult hip fracture clients to understand the treatment context of the participants. The context is important to understand physiotherapists' acceptance towards Eforto®. The second part of the interview focused on exploring physiotherapists' acceptance towards using the Eforto® device in community-dwelling older adult hip fracture client treatment by investigating their answers to questions about the four determinants and the dependent variable of the UTAUT model.

Materials

The interviews were recorded with the Dictaphone Olympus WS-853 to ensure that the data is not prone to be abused, e.g., via data hacking through the internet. Also, the recorded interview MP3 files were transcribed via the software Amber Script and coded via the software ATLAS.ti 23. Moreover, the Eforto® device and the respective application Eforto® BLE installed on the Nokia 5.3 smartphone were shown to the participants and they had the chance to try out the measurement with the device.

Data Analysis

As a first step to prepare for the data analysis, the interview recordings were transcribed verbatim by the program Amber Script. Then, after the transcripts have been anonymised by providing certain numbers to certain audio-recordings and transcripts, the audio-recordings were deleted eight days after the interviews have been conducted. Next, the program ATLAS.ti 23 was used to code the transcripts to prepare them for the content analysis. The coding scheme was developed via a cyclic, iterative process that included deductive and inductive components.

First, the transcripts have been read freely to comprehend the data's overall meaning which is considered as a vital first step for analysing data (Crabtree & Miller, 2022; Pope et al., 2000). What followed was corresponding with the approach of Strauss and Corbin (1990) the inductive thematic analysis of the data to identify certain themes that have been mentioned more than once. This was especially useful for the detection of codes concerning the exploration of the treatment context of physiotherapists' regarding working with community-dwelling older adult hip fracture clients.

Next, for the context analysis of the data, an integrated approach was selected (Bradley et al., 2007). In this approach, deductive and inductive analysis is utilised. Deductive analysis was applied by creating codes according to the variables of the UTAUT model and identifying and ascribing data similar to these codes. The main codes are *PE, EE, SI, FC, BI, Age, Gender, and Experience*. Another code that was integrated is called *Other*. It stored certain chunks of information that were not fitting into one of the other codes but appeared relevant due to the quantity of it being mentioned. Then, inductive analysis was utilised in which data was allocated via open coding to subcodes and codes. In this regard, also new codes were created connected to the physiotherapy treatment context of community-dwelling older adult hip fracture clients. Furthermore, to refine the code structure, coded parts of the interview transcripts were constantly compared to each other and with newly arising codes and adapted accordingly.

Intercoder reliability was granted since, the researcher and another person independently coded first a part of one interview and compared it with each other and later coded an interview separately. The level of agreement can be regarded as being strong ($\kappa = 0.86$), because of which the intercoder-reliability could be claimed to be sufficient (McHugh, 2012).

Results

Study Demographics

The iterative analysis of the interview transcripts led to a greater picture of the acceptance of physiotherapists towards monitoring muscle fatigability in their hip fracture clients via the use of Eforto®. The sample consisted of seven participants who are all working in the region of Osnabrueck ($M_{Age} = 46.8$; $SD_{Age} = 14.6$; $M_{years\ of\ Experience} = 22.7$; $SD_{years\ of\ Experience} = 14.5$) and of whom one identified as male and the other six as female. Two of the participants are considered younger and have less working experience as physiotherapists when compared to the respective means of age and working experience, while the other participants are above these means. All seven participants that were approached, decided to take part in the study, and none decided to withdraw. Therefore, all seven participants

were included in the study. In the following, the different UTAUT model categories and their characteristics based on the interview analysis will be discussed (see Table 1).

Context of Hip Fracture Client Treatment for Physiotherapists

The proportion of community-dwelling older adult clients that the participants work with is relative high while in comparison the proportion of community-dwelling older adult hip fracture clients is relatively low ($M_{community-dwelling\ older\ adult\ clients} = 55\%;\ SD_{community-dwelling\ older\ adult\ clients} = 26.4;\ \mathrm{M}_{\mathrm{community-dwelling\ older\ adult\ hip\ fracture\ clients}=12.6\%;SD}{}_{\mathrm{community-dwelling\ older\ adult\ hip\ fracture\ clients}=13.4}$) The treatment procedures described by the participants varied to a great extent with the most stated exercises being walking exercises, muscle training, especially of the muscles of the hip and mobilisation of the hip. Also, the place where treatment takes place differs greatly. Some prefer to treat the client at their home, some prefer to work with them in the practice's gym and others like to treat their clients in a treatment room.

Regarding the indicators of a client's physical functioning level physiotherapists focus on, the most frequently mentioned were the gait pattern, walking distance, muscular strength, and mobility of the client. In terms of how important the monitoring of muscle fatigability is for physiotherapists when treating community-dwelling older adult hip fracture clients, the majority thought of it as being very important and mentioned to monitor it by letting their clients repeat certain exercises that require strength duration or letting them repeatedly walk distances or stairs. One participant thinks it becomes only important after the client's bodily restrictions are reduced and another participant claimed the role of muscle fatigability has been neglected.

In terms of the physiotherapists opinions towards using technological devices for the treatment of their community-dwelling hip fracture clients, two claimed they would be open towards it if the device would be handy and not difficult to use and five participants showed great interest and a positive attitude in this regard, as the following quote demonstrates:

> Well, I love quantification and qualification. I also love taking reports and retesting, because it's totally motivating for the patient when they hear that I've gotten better. As for us therapists, it is super important to see whether we are right with our therapy methods, which we select individually, whether they are really effective, and that's why I think measuring methods are very important. For example, through digital devices.

UTAUT Model Variables and Other Code Results

To enable simple and clear understanding of the results of the interview transcripts' data analysis, the code structure has been illustrated in Table 1.

UTAUT Categories	Subcategories (Codes)	Example Quotes	Interviews Mentioning Code	Frequency of Subcategories
Effort Expectancy				
	Frequency of use *It describes how often physiotherapists would use the Eforto® device during client treatment.*	"Um, three times during a prescription". "I would use it, I think, once a month, because they also need time to build up strength. So, I wouldn't do it during every treatment.".	7	9
	Effort of use *Level of ease to use the Eforto® device in client treatment.*	"Two, so little effort". "Eight, eight or nine in patient treatment, because it just eats up too much time". **"**We really have to look closely how we spend our 20 minutes of therapy sessions. That's why I find it pretty nice that it can be done easily and quickly".	7	16
	Ease of examining recovery *The extent to which the device could make it easier for physiotherapists to examine the level of recovery of their clients.*	"Eh, easier, because that's another indication of what I then have, one more parameter that I just have for my assessment"	6	14
Performance Expectancy				
	Treatment improvement *The use of the device improves the treatment of the clients.*	**"**That's completely new to me, and I find it uncomplicated, and it has a motivational and fun factor, and it's easy. I think it's easy and useful". "Well, as it is now, I just think it's cool to have quantified values. […] I can see whether we're on the right track"	5	10
	Supporting evaluation parameter *Device helps physiotherapist to monitor recovery of client by giving clear data. Can be used to show older adults that they need support.*	"That it has clear parameters, i.e., clear numbers and good comparability". "Eh, easier, because that's another indication of what I then have, one more parameter that I just have for my assessment".	6	14
	Novel device *No other devices are used to measure muscle fatigability.*	"I don't use instruments.". "I don't use any measuring instruments there, just a goniometer to measure the joints".	4	4
Facilitating Conditions				
	Internal support *The physiotherapist needs support from within the practice and client setting.*	„Support from the employer, who needs to buy and pay it". "Support from the client, who needs to take part in it".	4	6
	External Support *Physiotherapist needs support from external organisations to*	"Someone would need to instruct me how this would work on the smartphone, those technological things" "Support for instruction from the company".	5	9

UTAUT Categories	Subcategories (Codes)	Example Quotes	Interviews Mentioning Code	Frequency of Subcategories
	properly conduct the testing.			
	Barriers *Physiotherapist thinks of several barriers when integrating the Eforto® testing in their work.*	”[…] we are not digitalised yet. I would have to use my own smartphone“. “There are of course some patients who have problems with their arms or with their hands”.	6	20
Social Influence				
	Open minded *Physiotherapist believes that clients are open to try the device.*	“I think they are open-minded and would go along with it”. “So, I think the patients would be open to that”.	6	13
	Inhibitions of older adults with technology *Convinced older adults will have problems with or refuse to work with this technological device.*	“When it would come to the point when they would need to set up something on a smartphone by themselves. I believe, that would be a barrier for many older adults”.	3	3
	Relevance unclear *Physiotherapist thinks clients will not understand the relevance of the assessment for their treatment.*	“So yes, most of them will ask themselves, why am I doing this? Because, because the connection is not so clear at first”.	2	5
Behavioural Intention				
	Conditional intentions *The physiotherapists think that the device could be integrated in their work but only if certain conditions are met.*	“What consequences do I draw from this if I now notice that the patient is weakening?” “Um, if there are studies that prove that it is a success, so to speak, that would be sufficient for me. […] that you can prove that you have achieved success with key figures”	6	13
	Serious intentions *Physiotherapists would integrate Eforto® in their treatment.*	“Yes, definitely, because it’s fun and incredibly motivating”	3	5

Performance Expectancy.

In terms of the improvement of treatment, especially the *motivational factor* that Eforto® conveys was emphasised by the participants as being helpful in their client treatment as it may increase the client's ambition to improve during a next testing. Also, it was mentioned that the quantified data provided by the device can be of benefit to know whether the physiotherapist is *using the right exercises* with the client and also in case of *change of client*, to let the physiotherapist who takes the treatment over, know on what level the client is.

Regarding the supporting evaluation parameter, participants expressed a positive attitude as they saw the device as helpful for comparing data and to base their professional judgment and decisions on objective parameters. However, Eforto® was rather viewed as a supportive element in client treatment. In addition, the device is a novum for the measurement of muscle fatigability as there is no technological device that is used yet by the physiotherapists to objectively assess this concept.

Effort Expectancy.

Regarding frequency of use of Eforto® for a client, participants stated *varying lengths of pause between the usage of the device*. However, there is a consensus among their statements that the device should not be used more often than every few weeks. One of the interviewees gave the following explanation for this: *"You don't get success that quickly. That's depressing for the patient when he's worse. Well, it has to be psychological too, it's valuable when he sees, oh, I've improved, and you can't do that that quickly" (Participant X).* Moreover, in respect to the effort of use, only one participant stated that it is more effortful to use Eforto® due to it being *time consuming* as they only have 20 minutes per treatment session with a client and as these clients are older they take more time to get prepared for the treatment, such as undressing their shirt. Also, the physiotherapist claimed that they still have to do a clinical report at the beginning of such a session and then only little time is left for the actual treatment. The other participants agreed that it takes *little effort* to apply the device. Furthermore, the ease of examining recovery was found to be present with the device for all but one participant. The participants found this to be the case as Eforto® can be used as a supporting, additional parameter for client examination.

Social Influence.

According to all but one physiotherapist, the clients would be open-minded towards using the Eforto® device in their treatments and that they might be more motivated also due to the significant data that is produced. Three physiotherapists, of whom two are younger aged, are also concerned that there might be some inhibitions of older adults when it comes to working

with technical devices. In their view, older adults often do not own a smartphone, do not know what an App is and therefore would need some help to be able to operate one properly without making mistakes. Moreover, it has been stated that the connection between hip fracture and measuring muscle fatigability via grip work might be unclear for clients and would need to be explained first. Besides, the *client compliance* may be disturbed as like one participant mentioned it, she believes that their clients often ask themselves why they are doing assessments first if they could already work on the impacted body part.

Facilitating Conditions.

The physiotherapists mentioned that the main facilitating condition needed is both internal and external support. Considering the internal support, the participants stated that it is important that their *employers are willing to buy the Eforto*® device for the practices they are working at. Also, the *client's willingness and motivation* to work with the device is critical. One participant also mentioned that they value the exchange of experience with the device with their colleagues. Moreover, external support such as from the company that develops the device in form of *a training on how to operate it*, seemed to be a relevant factor to implement the device. Another aspect that was referred to as important, was that normal values are needed to be able to correctly *classify the condition of the client*.

However, there are also barriers that have been claimed, such as the testing being too *time consuming* when it takes about five to ten minutes of the twenty minutes one treatment session takes. Besides, *it takes time to learn to operate Eforto*® and there could be potential *technological problems*, e.g., no availability of WIFI at houses of geriatric clients or the App could break down. Also, two participants claimed that the practices they are working at are *not digitalised*, which means that they would need standard sheets to document the results. Another participant stressed the importance of normal values to be able to classify the client's progress. Furthermore, it might be that client compliance is missing and that the employer refuses to buy Eforto®. Also, a *client's comorbidity*, such as dementia and rheumatism, could make it impossible to use the device with these clients.

Behavioural Intention.

The behavioural intention of physiotherapists to use the Eforto® device for measuring muscle fatigability in their treatment of older adult hip fracture clients has been analysed, and conditional and serious intentions have been discovered. Only one participant appeared to be completely satisfied with Eforto® and would be interested to utilise it in their treatment of older adult hip fracture clients as they perceived Eforto® as *motivating and fun*. All other participants expressed that some conditions would need to be met to use the device in their client treatment.

The most important conditions that should be met are *scientific evidence that the usage of the device is successful for hip fracture client treatment*, that there is scientific evidence that the *muscle fatigability measured via grip work is related to the recovery level of the hip* and that the device is *purchased by their employer for the practice they are working at*.

Other suggestions for the usage of Eforto® include that the device would only be used with clients with upper limb injuries, for diagnosis, or assessment in the beginning of a treatment, and to shorten the testing duration, e.g., by transforming Eforto® into an analogous measurement device. Another condition set was that the App should be user-friendly and that instructions are given on how physiotherapists should proceed when their client gets weaker.

The younger aged participants claimed more concerns towards the device in comparison to the older participants. They also claimed more often that due to the length of the testing duration it would not be feasible to implement it and since they believed that the older generation could have difficulties handling the technological device and a smartphone. In this regard, they suggested to wait with the implementation about 15 years until the adult generation which has more knowledge of technology, becomes the older generation.

Other.

One more subcategory that became apparent during the analysis was the incomprehension of hand-hip connection. Four physiotherapists expressed concerns in terms of not understanding how measurements of muscle fatigability via grip strength can be used to draw conclusion about the hip and its recovery. They stated that they do not see how the two muscle groups correlate with each other regarding muscle fatigability and that it is possible to train grip strength without improving in hip strength.

Discussion

To sum up, this research gave insight into underlying factors of acceptability of physiotherapists towards trying the Eforto® device for monitoring muscle fatigability in the treatment of their community-dwelling older adult hip fracture clients and the treatment context of these clients. In the contextual inquiry, it became clear that community-dwelling older adults are the majority of clients physiotherapists treat, but those that suffer from a hip fracture still remain only a small proportion. In addition, there do not seem to be any consistent guidelines regarding the treatment of these hip fracture clients and for the indicators of physical functioning, physiotherapists are focusing on although for some emphasis is put on muscle training and strength, improve walking distance and monitor gait, and increasing mobility.

The UTAUT model determinants PE, EE, and SI show that there is a positive mindset and acceptance of physiotherapists towards trying Eforto®. The only determinant that would need to be worked on is FC which's analysis provides feasible recommendations for adjustment, such as being provided with instructions of how to use the Eforto® device.

Physiotherapists' PE in this study was overall positive due to the objective measurement data that Eforto® provides. It was also mentioned that the also the clients could view their progress and that this would also motivate the clients and treatment can be adapted according to the quantified data that can be monitored. This is in accordance with what Takeuchi et al. (2008) said. They claimed that patient outcomes are also part of a physiotherapists' success and due to the quantified data provided by Eforto® physiotherapist would have evidence for their success.Regarding, EE as it was also mentioned by Brattig et al. (2014), some physiotherapists mentioned that they are often times under great time pressure and therefore cannot apply the Eforto® device in their client treatments. In terms of SI, the physiotherapists expect that their clients are open-minded towards using the Eforto® device.

The fact that age, especially young age, was found to be more reluctant towards the implementation of Eforto® was surprising as according to Estel et al.'s (2022) study rather younger than older physiotherapists agreed that they see that there is a great potential regarding digitalisation within physiotherapy. Also, the fact that cognitive capabilities reduce with age and that this may make it more difficult for older people to adopt new technologies seems to contradict the findings (Venkatesh et al., 2012). However, it makes sense since the reason why the younger physiotherapists are more reluctant to adopt the device is also based on their disbelief that older adults may face problems with such technological devices.

Moreover, the physiotherapists of this current study may be characterised as major adopters according to the Diffusion of Innovation (DoI) theory by Roger's (1962). Innovativeness is defined as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system" (Rogers, 1983, p. 245). Rogers differentiates the different groups of adopters and laggards and according to this differentiation, the physiotherapists of this study fit best into the category of the early majority who are described as being deliberate in their decision to adopt something and therefore also need longer times to do so but who adopt earlier than the average human (Rogers, 1983). Related to this, the physiotherapists showed a positive mindset towards using Eforto® with their community-dwelling hip fracture clients but at the same time are reluctant to use it until several conditions are met, such as that scientific evidence is provided that the muscle fatigability of the hip and that of the hand and underarm are related.

Strength & Limitations

This study has one greater limitations. All participants work in the same region. Therefore, the sample may have provided relatively homogeneous answers, thus lacking some diversity. Also, younger and older physiotherapists' statements cannot be compared as only two of the seven physiotherapists are of younger age. Moreover, some participants might have answered questions in a socially desirable way since the interviewer was acquainted with some of the participants. Also, the sample size may be considered being located on the lower bound of being sufficient. When conducting the analyses, it seemed that full saturation of answers was not reached yet as with every interview new information was accumulated. As a result, content validity is hampered and thus the findings do not represent a generalisable picture of the topic of research (Bowen, 2008). In addition, the intercoder-reliability has been conducted with a second coder who does not belong to the research field. Although the first coder gave elaborate instructions in how one codes, what the definitions of the different codes are and also conducted a coding trial with the second coder, there is the possibility that due to differences in expertise the intercoder-reliability might be questioned.

Future Research

Future research may consider focusing also on whether it is useful to implement Eforto® in the context of fatigue and bedridden people as it was suggested by the physiotherapists. It would also be possible to investigate how well older adults can work with the device on themselves and whether it is possible to link their accounts with their physiotherapy practices so that the clients could do their Eforto® measurements at home to save some time. Moreover, in this study, only the UTAUT model moderator Age was analysed. Therefore, it might be of interest for future research to also focus on the other moderators of the UTAUT model. Also, as the sample of the current research was considerably small and the saturation has not been reached, it could be considered to conduct a similar study with a greater sample of physiotherapists.

Conclusion

This study contributed to the scientific world by giving insights on the potential acceptability of Eforto® in the physiotherapy setting for the treatment of community-dwelling older adult hip-fracture clients. The most important condition is to further investigate the usefulness of Eforto® in the context of physiotherapy and to examine in what way Eforto® might need to be adapted to the treatment context of physiotherapists.

References

Alarcón, T., González-Montalvo, J. I., Gotor, P., Madero, R., & Otero, A. (2011). Activities of daily living after hip fracture: Profile and rate of recovery during 2 years of follow-up. *Osteoporosis International*, *22*(5), 1609–1613. https://doi.org/10.1007/s00198-010-1314-2

Anderson, J., & Schwager, P. (2004). SME adoption of wireless LAN technology: Applying the UTAUT model. *Proceedings of the 7th Annual Conference of the Southern Association for Information Systems*.

Ariza-Vega, P., Jiménez-Moleón, J. J., & Kristensen, M. T. (2014). Change of residence and functional status within three months and one year following hip fracture surgery. *Disability and Rehabilitation*, *36*(8), 685–690. https://doi.org/10.3109/09638288.2013.813081

Auais, M., Morin, S. N., Finch, L., Ahmed, S., & Mayo, N. (2018). Toward a Meaningful Definition of Recovery After Hip Fracture: Comparing Two Definitions for Community-Dwelling Older Adults. *Archives of Physical Medicine and Rehabilitation*, *99*(6), 1108–1115. https://doi.org/10.1016/j.apmr.2018.01.022

Baumgart, S. (2012). *Die Heilmittelverordnung als Ausgangspunkt der Kommunikation zwischen Arztpraxis und physio-/massagetherapeutischen Praxen im ambulanten Versorgungsbereich. Eine deutschlandweite Fragebogenerhebung. 33*(8), 338–377.

Bautmans, I., & Mets, T. (2005). A fatigue resistance test for elderly persons based on grip strength: Reliability and comparison with healthy young subjects. *Aging Clinical and Experimental Research*, *17*(3), 217–222. https://doi.org/10.1007/BF03324600

Beard, J. R., Officer, A., de Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J.-P., Lloyd-Sherlock, P., Epping-Jordan, J. E., Peeters, G. M. E. E. (Geeske), Mahanani, W. R., Thiyagarajan, J. A., & Chatterji, S. (2016). The World report on ageing and health: A policy framework for healthy ageing. *The Lancet*, *387*(10033), 2145–2154. https://doi.org/10.1016/S0140-6736(15)00516-4

Bellelli, G., Frisoni, G. B., Pagani, M., Magnifico, F., & Trabucchi, M. (2007). Does cognitive performance affect physical therapy regimen after hip fracture surgery? *Aging Clinical and Experimental Research*, *19*(2), 119–124. https://doi.org/10.1007/BF03324677

Belzl, H., Ernst, U., Heining, S., Hirsch, U., Riedel, T., Schmidt, J., Settner, M., & Simmel, S. (2019). *Nachbehandlungsempfehlungen* (Annual Report No. 5; pp. 1–146). Deutsche Gesellschaft für Orthopädie und Unfallchirurgie e.V. https://dgou.de/fileadmin/user_upload/Dokumente/Qualitaet_und_Sicherheit/2019_Nachbehandlungsempfehlungen.pdf

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: A research note. *Qualitative Research*, *8*(1), 137–152. https://doi.org/10.1177/1468794107085301

Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative Data Analysis for Health Services Research: Developing Taxonomy, Themes, and Theory. *Health Services Research*, *42*(4), 1758–1772. https://doi.org/10.1111/j.1475-6773.2006.00684.x

Brattig, B., Schablon, A., Nienhaus, A., & Peters, C. (2014). Occupational accident and disease claims, work-related stress and job satisfaction of physiotherapists. *Journal of Occupational Medicine and Toxicology*, *9*(1), 36. https://doi.org/10.1186/s12995-014-0036-3

Crabtree, B. F., & Miller, W. L. (2022). *Doing Qualitative Research*. SAGE Publications.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003.

De Dobbeleer, L., Swart, M. M., Geerds, M. A. J., Baggen, R. J., Jansen, A.-J. S., Tielemans, R., Silva, H., Lieten, S., Barbé, K., Peeters, G., Vollenbroek-Hutten, M. M. R., Melis, R. J. F., & Bautmans, I. (2023). Validity and reliability of Eforto®, a system to (self-)monitor grip strength and muscle fatigability in older persons. *Aging Clinical and Experimental Research*. https://doi.org/10.1007/s40520-023-02365-3

Dyer, S. M., Crotty, M., Fairhall, N., Magaziner, J., Beaupre, L. A., Cameron, I. D., & Sherrington, C. (2016). A critical review of the long-term disability outcomes following hip fracture. *BMC Geriatrics*, *16*(1), 158. https://doi.org/10.1186/s12877-016-0332-0

eforto—Welcome! (n.d.). Retrieved 12 March 2023, from https://eforto.com/

Estel, K., Scherer, J., Dahl, H., Wolber, E., Forsat, N. D., & Back, D. A. (2022). Potential of digitalization within physiotherapy: A comparative survey. *BMC Health Services Research*, *22*(1), 496. https://doi.org/10.1186/s12913-022-07931-5

Gemert-Pijnen, L. van, Kelders, S. M., Kip, H., & Sanderman, R. (Eds.). (2018). Introducing eHealth. In *EHealth research, theory and development: A multidisciplinary approach* (pp. 3–26). Routledge. https://doi.org/10.4324/9781315385907

Gesar, B., Hommel, A., Hedin, H., & Bååth, C. (2017). Older patients' perception of their own capacity to regain pre-fracture function after hip fracture surgery – an explorative qualitative study. *International Journal of Orthopaedic and Trauma Nursing*, *24*, 50–58. https://doi.org/10.1016/j.ijotn.2016.04.005

Gorman, E., Chudyk, A. M., Hoppmann, C. A., Hanson, H. M., Guy, P., Sims-Gould, J., & Ashe, M. C. (2013). Exploring Older Adults' Patterns and Perceptions of Exercise after Hip Fracture. *Physiotherapy Canada*, *65*(1), 86–93. https://doi.org/10.3138/ptc.2012-01BH

Guerado, E., Sandalio, R. M., Caracuel, Z., & Caso, E. (2016). Understanding the pathogenesis of hip fracture in the elderly, osteoporotic theory is not reflected in the outcome of prevention programmes. *World Journal of Orthopedics*, *7*(4), 218–228.

https://doi.org/10.5312/wjo.v7.i4.218

Kanis, J. A., Johnell, O., Oden, A., Jonsson, B., De Laet, C., & Dawson, A. (2000). Risk of hip fracture according to the World Health Organization criteria for osteopenia and osteoporosis. *Bone*, *27*(5), 585–590. https://doi.org/10.1016/S8756-3282(00)00381-1

Kip, H., Beerlage-de Jong, N., & Wentzel, J. (2018). *The contextual inquiry* (pp. 167–186). https://doi.org/10.4324/9781315385907-8

Kojima, G. (2015). Frailty as a Predictor of Future Falls Among Community-Dwelling Older People: A Systematic Review and Meta-Analysis. *Journal of the American Medical Directors Association*, *16*(12), 1027–1033. https://doi.org/10.1016/j.jamda.2015.06.018

Kojima, G. (2018). Frailty as a Predictor of Nursing Home Placement Among Community-Dwelling Older Adults: A Systematic Review and Meta-analysis. *Journal of Geriatric Physical Therapy*, *41*(1), 42–48. https://doi.org/10.1519/JPT.0000000000000097

Koot, V. C. M., Peeters, P. H. M., de Jong, J. R., Clevers, G. J., & van der Werken, C. (2000). Functional Results after Treatment of Hip Fracture: A Multicentre, Prospective Study in 215 Patients. *The European Journal of Surgery*, *166*(6), 480–485. https://doi.org/10.1080/110241500750008808

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282.

Morley, J. E. (2003). Editorial: Sarcopenia Revisited. *The Journals of Gerontology: Series A*, *58*(10), M909–M910. https://doi.org/10.1093/gerona/58.10.M909

Morley, J. E., Vellas, B., van Kan, G. A., Anker, S. D., Bauer, J. M., Bernabei, R., Cesari, M., Chumlea, W. C., Doehner, W., Evans, J., Fried, L. P., Guralnik, J. M., Katz, P. R., Malmstrom, T. K., McCarter, R. J., Gutierrez Robledo, L. M., Rockwood, K., von Haehling, S., Vandewoude, M. F., & Walston, J. (2013). Frailty Consensus: A Call to Action. *Journal of the American Medical Directors Association*, *14*(6), 392–397. https://doi.org/10.1016/j.jamda.2013.03.022

Noppen, M., Vincken, W., Meysman, M., Segers, E., Dewaele, M., & Mets, T. (1993). Clinical usefulness and safety of bronchoalveolar lavage (BAL) in elderly patients. *Archives of Gerontology and Geriatrics*, *16*(1), 33–38. https://doi.org/10.1016/0167-4943(93)90024-C

Oshlyansky, L., Cairns, P., & Thimbleby, H. (2007, September 1). *Validating the Unified Theory of Acceptance and Use of Technology (UTAUT) tool cross-culturally*. Proceedings of HCI 2007 The 21st British HCI Group Annual Conference University of Lancaster, UK. https://doi.org/10.14236/ewic/HCI2007.67

Parkkari, J., Kannus, P., Palvanen, M., Natri, A., Vainio, J., Aho, H., Vuori, I., & Järvinen, M. (1999). Majority of Hip Fractures Occur as a Result of a Fall and Impact on the Greater

Trochanter of the Femur: A Prospective Controlled Hip Fracture Study with 206 Consecutive Patients. *Calcified Tissue International*, *65*(3), 183–187. https://doi.org/10.1007/s002239900679

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *BMJ : British Medical Journal*, *320*(7227), 114–116.

Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Administration and Policy in Mental Health and Mental Health Services Research*, *38*(2), 65–76. https://doi.org/10.1007/s10488-010-0319-7

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed). Free Press ; Collier Macmillan.

Rupp, M., Walter, N., Pfeifer, C., Lang, S., Kerschbaum, M., Krutsch, W., Baumann, F., & Alt, V. (2021). The Incidence of Fractures Among the Adult Population of Germany. *Deutsches Ärzteblatt International*, *118*(40), 665–669. https://doi.org/10.3238/arztebl.m2021.0238

Stadler, C. (2020). *Einfluss einer akutgeriatrischen Behandlung auf die Selbstständigkeit von Hüftfrakturpatienten im Alltag* [Ludwig-Maximilians-Universität München; Application/pdf]. Elektronische Hochschulschriften der LMU München. https://doi.org/10.5282/EDOC.25547

Statistisches Bundesamt (Destatis). (2015). *Bevölkerung Deutschlands bis 2060—13. Koordinierte Bevölkerungsvorausberechnung* [Brochure]. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsvorausberechnung/Publikationen/Downloads-Vorausberechnung/bevoelkerung-deutschland-2060-presse-5124204159004.pdf?__blob=publicationFile

Strauss, A., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques* (p. 270). Sage Publications, Inc.

Swanenburg, J., Mulder, T., De Bruin, E. D., & Uebelhart, D. (2003). Physiotherapeutische Interventionen bei Osteoporose. *Zeitschrift für Rheumatologie*, *62*(6), 522–526. https://doi.org/10.1007/s00393-003-0562-3

Takeuchi, R., O'Brien, M. M., Ormond, K. B., Brown, S. D. J., & Maly, M. R. (2008). "Moving Forward": Success from a Physiotherapist's Point of View. *Physiotherapy Canada*, *60*(1), 19–29. https://doi.org/10.3138/physio/60/1/19

Tiedemann, J., & Malin, L. (2023). *Jahresrückblick 2022 – Fachkräftesituation angespannter denn je* (pp. 1–6) [Annual report]. Kompetenzzentrum Fachkräftesuicherung (KOFA). https://www.kofa.de/media/Publikationen/KOFA_Kompakt/Jahresrueckblick_2022.pdf

Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a

Unified View. *MIS Quarterly*, *27*(3), 425. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, *36*(1), 157–178. https://doi.org/10.2307/41410412

Zidén, L., Scherman, M. H., & Wenestam, C. (2010). The break remains – Elderly people's experiences of a hip fracture 1 year after discharge. *Disability and Rehabilitation*, *32*(2), 103–113. https://doi.org/10.3109/09638280903009263

Appendices

Appendix A

Dear Ms/Mr X,

I am looking for physiotherapists who would like to participate as interview partners for my bachelor thesis project. My research aims to understand physiotherapists' acceptance of using the Eforto® device in the treatment of community-dwelling older adult clients with hip fractures.

Eforto® is a newly developed device that reliably measures muscle fatigue susceptibility. It is also being investigated whether it is useful for measuring exercise capacity. It is of great interest to find out if this device can be useful in the physiotherapy treatment of older adult hip fracture patients living in their own homes. I am therefore looking for physiotherapists who:
practice your profession and
with older adult patients with hip fractures who live, work or have worked in their own households.

If you meet these criteria and are interested in participating in the study, please read the attached participant information letter carefully for more information about this study. If anything is unclear or you have any questions about the study, please contact me at the email below.

If you decide to participate, please let me know by email as soon as possible. The interviews can be conducted until May 31, 2023.

Contact details:
- Student and researcher: first name and surname
- Course code: XXXXXXX
- Email: XXXXXXX

Best regards
Researcher's first name and surname

German Translation of the Participant Invitation Email

Sehr geehrte/r Frau/Herr X,

für das Projekt meiner Bachelorarbeit suche ich Physiotherapeuten und Physiotherapeutinnen, die als Interviewpartner:innen teilnehmen möchten. Meine Forschung zielt darauf ab, die Akzeptanz von Physiotherapeuten und Physiotherapeutinnen gegenüber der Verwendung des Eforto®-Geräts bei der Behandlung von in ihrem eigenen Haushalt lebenden älteren erwachsenen Patienten mit Hüftfrakturen zu verstehen.

Eforto® ist ein neu entwickeltes Gerät, das die Muskelermüdungsanfälligkeit zuverlässig misst. Außerdem wird untersucht, ob es für die Messung der körperlichen Belastbarkeit von Nutzen ist. Es ist von großem Interesse herauszufinden, ob dieses Gerät in der physiotherapeutischen Behandlung von älteren erwachsenen Patienten mit einer Hüftfraktur, die in ihrem eigenen Haushalt leben, sinnvoll eingesetzt werden kann. Daher suche ich Physiotherapeuten und Physiotherapeutinnen, die:
Ihren Beruf ausüben und
mit älteren erwachsenen Patienten mit Hüftfrakturen, die in ihrem eigenen Haushalt leben, arbeiten oder in der Vergangenheit gearbeitet haben.

Wenn diese Kriterien auf Sie zutreffen und Sie an der Studienteilnahme interessiert sind, lesen Sie bitte das beigefügte Informationsschreiben für Teilnehmer sorgfältig durch, um weitere Informationen zu dieser Studie zu erhalten. Falls Unklarheiten bestehen oder Sie Fragen zu der Studie haben, kontaktieren Sie mich bitte unter der unten angegebenen E-Mail.

Wenn Sie sich für eine Teilnahme entscheiden, teilen Sie mir dies bitte so schnell wie möglich per E-Mail mit. Die Interviews können bis zum 31.05.2023 durchgeführt werden.

Kontaktdetails:
- Studentin und Forscherin: Vorname Nachname
- Kurscode: XXXXXXX
- E-Mail: XXXXXXXXXX

Mit freundlichen Grüßen
Vorname und Nachname der Forscherin

Appendix B

UNIVERSITY OF TWENTE.

Information Letter and Consent Form for The Participation in Medical-Scientific Research

The Eforto® Device

Dear Sir/Madam,

With this information letter, I would like to ask if you would like to participate in a short interview study for my graduation project. The aim of this interview is to hear your opinion about a new device called Eforto®. Participation is voluntary. In this letter, the study will be further explained, potential (dis-)advantages are listed, and I will explain what it entails to participate.

Do you want to read through the information and decide if you want to participate? If you would like to participate, please fill out the consent form found in Appendix B.

Ask your questions:
You can make your decision with the information found in this information letter. In addition, we encourage you to:
- Ask questions to the researcher who gives you this information

1. General information
The University of Twente, in collaboration with Ziekenhuisgroep Twente (ZGT), has set up this graduation project to research the intention of physiotherapists to use Eforto® to monitor muscle fatigability and grip strength in community-dwelling older adult hip fracture clients. We would like several physiotherapists to participate in this study. Moreover, we have received approval for this study from the ethical review board of the BMS University of Twente.

2. What is the purpose of the study?
The purpose of this study is to find out whether physiotherapists would like to use the Eforto® device to monitor muscle fatigability in community-dwelling older adult hip fracture clients. To achieve this, we want to interview several physiotherapists regarding the factors that are important when assessing a client's physical health and whether they think Eforto® can support them in this regard. We may be able by measuring grip strength to monitor muscle fatigability and thereby to measure the client's ability to recover. The relevance of monitoring physical resilience to monitor the client's recovery process for physiotherapists is also explored during the interview.

3. What is the background of the study?
The development of the Eforto® device is based on a European initiative. It was built to measure muscle fatigability and thus to potentially offer the possibility to monitor physical resilience, which is the "ability to resist functional decline or recover physical health following a stressor" (Whitson et al., 2016, p. 4650). This might be the case, as muscle fatigability is a dynamic and ecological marker of a human's physical resilience and physical reserve capacity. The Eforto® device is composed of an ergonomic rubber bulb attached to a plastic handpiece (see Figure 1). Eforto® measures muscle fatigability by measuring the maximum grip strength and the time it takes until it reduces to 50%. Therefore, first, the user is instructed to squeeze the rubber bulb as hard as they can to identify their maximum grip strength. Then, in the next round of squeezing, the user is requested to squeeze the rubber bulb as hard and as long as they can until the grip strength reduces to 50%. The

results of different users can be viewed and saved on a smartphone application (see Figure 2). Thereby, monitoring of muscle fatigability is made possible.

4. How will the study proceed?

If you participate, you will be invited for an interview that takes about 45 minutes. During the interview, several questions will be asked regarding:

- The various factors that are important to you in assessing the physical health of your client.
- Whether it is relevant for you to gain insight into the physical resilience of your client.
- Whether it is relevant for you to understand grip strength and muscle fatigability of your client, specifically clients recovering from a hip fracture operation.
- Whether you would like to use the Eforto® device (see Figure 1) to monitor your clients.

Figure 1: The Eforto® device

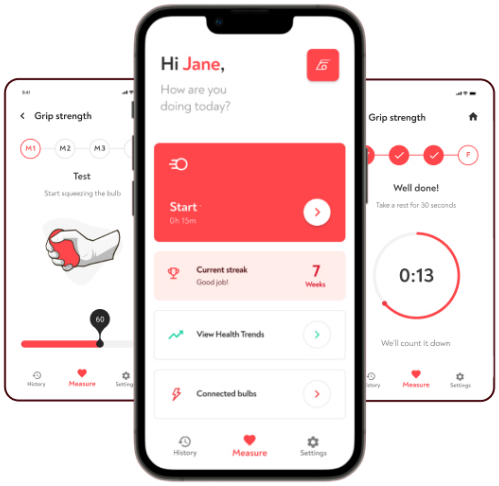


Figure 2: The Eforto® device application for the smartphone

5. What is expected of you?

We want the study to go well. Therefore, we will make the following arrangements with you:

- You will answer the questions asked by the interviewer in as much detail as possible.
- You will inform us if at any time you wish to stop your participation.
- You will inform us during or up to seven days after the interview if you no longer wish your data to be used for research.

6. What are the advantages and disadvantages of participating in the study?
During the interview you will be provided with a piece of cake and a cup of tea or coffee. However, otherwise there is no benefit to you personally from participating in this study. If you participate in this study, you will be helping the researchers understand more about the opinion of physiotherapists about the Eforto® device and monitoring muscle fatiguability. Participating in the study will take about 45 minutes of your time. Participation is voluntary.

7. When does the study stop?
Your participation in the study ends when:

- All the main questions and sub-questions of the interview have been sufficiently answered.
- You want to stop the study yourself. You may do so at any time. Please report this immediately to the researcher. You do not have to tell why you are stopping.
    - What happens if you withdraw from the study?
      If you request it within seven days after your interview the researchers will delete all data collected from you.

8. What happens after the study?
If you are interested in the results of the study, you can contact the researcher in July 2023. The main outcomes of the study will then be sent to you via email.

9. What will we do with your data?
Are you participating in the study? Then you also give us permission to collect, use and store your data as described below for a period of ten years. Note that identifiable details (your name) will be removed, as I transcribe the interview within seven days, and only the written text will be saved without identifiable details.

What data do we keep?
We keep this data:
- Your gender
- Your age
- Your years of experience as a practising physiotherapist
- the region the practice you are working at is located in

How do we collect the above data?
The interview is recorded with your permission and later converted into readable text. This way we can properly analyse your answers.

Why do we collect, use and retain your data?

We collect, use and store your data to answer the questions in this study and to publish the overarching results. Since this interview study is part of a larger FORTO project, its results belong to this project and therefore the results can be part of a publication in the overarching project. The Forto consortium may also need this data to potentially market the Eforto® grip work system.

How do we protect your privacy?
To protect your privacy, only your age, gender, your years of experience as a practicing physiotherapist, and the region of the practice you are working at remain visible. Any data that can directly identify you, such as your name, is omitted and not stored. This ensures that no one can find out your identity in reports and publications about the study.

Access to your non-reducible data from persons outside the research team.
Data such as your answers during the interview, your age, your gender, your years of experience as a practicing physiotherapist, and the region of the practice you are working at may be shared with other members of the project team at the University of Twente and the ZGT Almelo. In this way, the information from my graduate project can be used for future advancements of the Eforto® device project.

How long do we keep your data?
We keep your data for a maximum of 10 years at the University of Twente.

May we use your data for other research?
Your data may also be important for other scientific research in the field of recovery or of the further development of the Eforto® device after the end of this study. For this purpose, your data will be kept for ten years at the University of Twente. In the consent form you indicate whether you approve of this. Do you not give permission for this? Then you can still participate in this study.

Can you withdraw your consent to the use of your data?
You can withdraw your consent to the use of your personal data up to seven days after your interview This applies to the use of your data in this study for use in other research. But please note: if you withdraw your consent, and researchers have already collected data for a study, then they may still use this data.
Want to know more about your privacy?

- Would you like to know more about your rights in processing personal data? Then visit
  https://www.bmi.bund.de/SharedDocs/downloads/EN/gesetztestexte/datenschutzanpassungsumsetzungsgesetz.html.
  OR
  https://www.autoriteitpersoonsgegevens.nl/en

Do you have questions about your rights? Or do you have a complaint about the processing of your personal data? If so, please contact the person responsible for processing your personal data. See Appendix A for contact information.

If you have complaints about the processing of your personal data, we recommend that you first discuss them with the research team.

10. Will you receive compensation if you participate in the study?
Participation in the study does not cost you anything. You will not be paid for participating in this study.

11. Are you insured during the study?
You are not additionally insured for this study because participating in the study has no additional risks.

12. Do you have any questions?
For questions about the study, please ask the investigator or contact one of the investigators using the contact information in Appendix A.

13. Do you have a complaint?
If so, discuss it with the investigator or contact one of the investigators using the contact information in Appendix A.

14. How do you provide consent to the study?
You can take your time to think about this research. Then tell the researcher if you understand the information and whether or not you want to participate. Do you want to participate? Then fill out the consent form that you will find enclosed with this information letter. You and the researcher will both receive a signed version of this consent form.
Thank you for your attention.

Appendix A; Contact information
Researcher contact information:
- Name: first name surname
- XXXX student at the University of Twente
- Email: XXXXXXXXXXXXX

Supervisor contact information:
- Name: first name surname
- Assistant Professor at the University of Twente
- Email: XXXXXXXXX
- Telephone: XXXXXXXXX

Appendix C; Consent form

It is important for us to ensure that you are understanding the aims and nature of this study which have been described in the participant information letter. In order to indicate that you agree to and understand the conditions described, please tick the boxes:

I confirm that I have read the participant information letter of this research. I was also able to ask questions and consider the given information. My questions were sufficiently answered. I had enough time to decide whether to participate.	☐
I know that participating is entirely voluntary. I also know that I can decide at any time not to participate or to withdraw from the study without giving a reason and without facing any consequences until the 30.05.2023.	☐
I consent to the collection and use of my data (age, gender, my years of experience as a practising physiotherapist, and the region the practice I am working at is located in), and for the data collected during the interview for answering the interview questions in this study.	☐
I understand that participating in this study involves an audio-recorded interview and that the audio-recording will be transcribed and afterwards destroyed.	☐
I understand that this study is part of a larger project, and the results can be published.	☐

I want to participate in this study.
My name is (participant):..... Signature:
Date: ____/ ____/ ____

I certify that I have fully informed this participant about the interview study about the acceptability of eforto®. If any information becomes known during the study that could affect the participant's consent, I will inform him/her in a timely manner. Researcher's name (or representative):
Name: Signature:
Date: ____/ ____ / ____

Appendix D

Interview Scheme

Permission and Instruction

1. Check if the recording device is working.
2. Read the questions in a calm manner.
3. To encourage the interviewee throughout the interview, ask the following open-ended questions:
   - Can you explain that?
   - What exactly do you mean by that?
   - Can you tell me more about that?
   - Can you give examples?
4. Thanking the physiotherapist for their agreement to participate in the interview.

- Introduce yourself. Briefly describe the interview's duration, purpose, and content.
- The study's aim is to examine the physiotherapists' acceptance towards the use of the eforto® device in community-dwelling older adult hip fracture clients' treatment; This would allow the eforto® researchers and developers to improve the device and to gain insights into the contexts in which the device could be implemented in.
- Questions asked will be covering topics such as your age, gender, working experience as a physiotherapist experience with and opinion on use of technology and specifically the Eforto® device for the treatment of community-dwelling older adult hip fracture clients.
- The interview lasts about 45 minutes.
- The physiotherapist has always the option to refuse to answer a question.

5. Request permission to record the conversation.
6. Does the physiotherapist have any questions? If not, the interview starts.
7. After the recording has started, ask again for permission to do the audio recording.
8. During the interview, make sure that all critical questions in bold are asked. Keep the conversation naturally flowing as much as possible and ask questions that are not bold if feasible.

Abbreviations, based on UTAUT:

BI: behavioural intention

EE: expected effort

FC: facilitating conditions

PE: performance expectancy
SI: social influence

Interview with Physiotherapists

Hello Mr./Ms. [insert name of respective participant],
First of all, I would like to thank you very much for agreeing to participate in my graduation research. My name is Rebecca Kruschka and I am the researcher who is working on this project and the one who will conduct the interview with you today.
The qualitative research for which you agreed to participate has the aim to understand the acceptability of physiotherapists towards using the Eforto® device for the treatment of community-dwelling older adult hip fracture clients. As a result, a better understanding can be generated in regard to how the device could be implemented and what could still be improved. The interview will take about 45 minutes and you have the right to refuse to answer any questions and to withdraw from the study at any time until the 31.05.2023 without giving a reason and without facing any consequences. It is possible to have your data deleted from the study if you withdraw from this study within seven days after the interview was conducted. Now that I provided you with all necessary information via the participant information letter and again in person, I would like to ask you to read and sign the consent form if you would like to participate in this study. [if they read and sign the consent form proceed, if they do not want to read and sign the consent form stop the interview] Do you give consent for me to audio-record the interview? [wait for participant's answer: if answers 'yes' proceed; if answers 'no' stop the interview] Do you have any question [wait for participant's question and answer it]? Then I will start recording the interview now. [start audio-recording] I have to ask again to confirm your consent for this audio recording: Do you consent to me audio-recording this interview with a Dictaphone? [wait for participant's answer: if answers 'yes' proceed, if answers 'no' stop the interview]. Ok let us start with the interview then:

1. **Demographic information: How old are you?**

2. **Demographic information: What is your gender?**

3. **In what region is the practice you are working at located in?**

4. **How much work experience in years do you have in practicing physiotherapy?**

5. **What do you estimate is the percentage of community-dwelling older adult clients you treat?**

6. **What do you estimate is the percentage of community-dwelling older adult hip fracture clients you are treating?**

7. **What is the treatment procedure when working with a community-dwelling older adult client that suffered from a hip fracture and has undergone surgery and physical rehabilitation?**

8. **What indicators are you looking at for examining the physical functioning level of your community-dwelling older adult clients who suffer from a hip fracture?**

9. **How important is it for you to monitor the muscle fatigability of your community-dwelling older adult clients who suffered from a hip fracture?**

- If they do not monitor muscle fatigability in community-dwelling older adult clients who suffer from a hip fracture: What do you monitor during the treatment of community-dwelling older adult hip fracture patients?
- If they monitor muscle fatigability in community-dwelling older adult clients who suffer from a hip fracture: how did you learn that monitoring muscle fatigability is important when treating community-dwelling older adult hip fracture clients?

10. **We are currently studying if grip work, which indicates the work the forearm muscles deliver when executing the fatigue resistance test, is an indicator of physical resilience. Grip work is a measurable factor of frailty and physical resilience is defined as the "ability to resist functional decline or recover physical health following a stressor". How important is it for you to monitor the physical resilience of your community-dwelling older adult clients who suffer from a hip fracture?**

11. **What is your opinion towards using technological devices for the treatment of your community-dwelling older adult hip fracture clients?**

Next, I would like to ask some questions about using the eforto® device. I already informed you about the eforto® device in the information letter. However, I will quickly reiterate its main functions and how it is supposed to work:
The development of the eforto® device is based on a European initiative. It was built to measure muscle fatigability and thus to offer the possibility to monitor physical resilience which is the "ability to resist functional decline or recover physical health following a stressor" (Whitson et al., 2016, p. 4650). This is the case, as muscle fatigability is a dynamic and ecological marker of a human's physical resilience and physical reserve capacity. The eforto® device looks like this (***** *showing the Eforto® device to the participant)*. It is composed of an ergonomic rubber bulb attached to a plastic handpiece. Eforto® measures muscle fatigability by measuring the maximun grip strength and the time it takes until it reduces to 50%. Therefore, first, the user is instructed to squeeze the rubber bulb as hard as they can. Then, in the next round, the user is requested to squeeze the rubber bulb as hard and as long as they can until the grip strength reduces to 50%. The results of different users can be viewed and saved on a smartphone application. Thereby, monitoring of muscle fatigability is made possible.

Would you like to try out the device?

- If yes: show them the Eforto BLE application and translate what is written there. Then, give the device to the participant and ask them to press the rubber bulb as hard as they can until their maximum grip strength has been successfully measured. Next as them again to press the rubber bulb as hard and as long as they can until they reached 50% of their maximum grip strength and show them the results]
- If no: procede with the interview

Do you have any questions regarding the eforto® device? If there are no further questions, I will proceed with the next question that I have for you.

12. **BI: Would you consider using eforto® in your work with community-dwelling older adult hip fracture clients?**
    a. If yes/no: Why?

13. **PE: What do you think about carrying out the eforto® measurements with community-dwelling older hip fracture clients in physiotherapy treatment?**
- Do you think it is easy or difficult to use eforto®, and can you explain that?
- EE: On a scale of 1-10, how effortful do you think is the use of the eforto® measurement in client treatment? 0 means not effortful at all, and 10 means very effortful.
- EE: What do you think about how often the device should be used in hip fracture clients' treatment?

14. **What do you think about using the Eforto® device to measure muscle fatigability?**
- EE: Do you think it will make it easier or harder for you to detect the level of recovery?
- PE: How is it compared to other measurement instruments you use to measure muscle fatigability?

15. **SI: What do you think your hip fracture clients/general practitioners think about using eforto® during their physiotherapy?**

16. **PE: What is your opinion on the entire eforto® system?**
- PE: Do you think eforto® will help you to improve the recovery of your community-dwelling older adult hip fracture clients?
- PE: What are the advantages of eforto® for you?
- PE: What are the disadvantages of eforto® for you?
- Would you recommend it to others?

17. **If the eforto® device would be applied as standard to physiotherapy treatment of all hip fracture clients, what would you think?**
- In your opinion, what are the disadvantages and advantages of using eforto® as standard in physiotherapy?

Would you be interested in using eforto in your treatment? Yes (Q17)/no (Q18)

18. **FC: What support would you need to use the eforto® device in the treatment of community-dwelling older adult hip fracture clients?**

- [If the participant has difficulties to answer the question, give as a starting point the advice that they can think of other devices they are already using]

19. What are the reasons why you would <u>not</u> use the eforto® device in the treatment of community-dwelling older adult hip fracture clients?

- FC/Barriers?: If skills are the reason, what skills do you believe you need?
- If the physiotherapy practice facilities are the reason, what facilities do you think you need?
- FC: If the physiotherapist reports to need help:
    - What kind of help do you think you need?
    - Who could provide this help?

We reached the end of this interview. Thank you very much for participating in this study. If you have any questions, you can ask them now or write an email to the email-address provided in the information letter. I would like to emphasise again that you are allowed to withdraw from the study at any time from this study until the 31.05.2023 and that your data will be destroyed and not be used for the study if you request it within seven days after the interview has been conducted.