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## Critical Success Factors for Adopting Telemedicine Applications

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### Cover Page Footnote

We would like to thank the four senior researchers, the practitioners, the owners of the day-care facility and the parents for their contribution to this project.

## INTRODUCTION

Within the healthcare sector the use of Information Technology (IT) is increasing (Kampmeijer et al., 2016; Nictiz, 2016). The use of electronic health records and IT health systems (e-health) has one of the highest priorities in modern healthcare organisations (Kaye et al., 2010). However, the adoption and implementation of healthcare technology seems to be going at a slow rate (Boonstra & Offenbeek, 2010; Nictiz, 2016). E-health is commonly known since 1999 as a broad term for all kinds of healthcare applications (Eysenbach, 2001). M-health is the more specific term for mobile apps in healthcare (Lindeman, 2011).

Telemedicine is a part of both e-health (Della Mea, 2001) and the more narrow m-health, and is defined as "the provision of health care services, through the use of ICT, in situations where the health professional and the patient (or two health professionals) are not in the same location. It involves secure transmission of medical data and information, through text, sound, images or other forms needed for the prevention, diagnosis, treatment and follow-up of patients" (Commission of the European Communities, 2008).

Many studies empirically examined the adoption and usage of IT within organisations (Karahanna et al., 1999). Adoption models for IT applications have been developed, like the Technology Acceptance Model (Davis et al., 1989; Ma & Liu, 2004), and tested within the context of healthcare (Hu et al., 1999). However, studies that focus on critical success factors for the adoption of telemedicine applications are rare (Kampmeijer et al., 2016; Varabyova et al., 2017) and it is still a major challenge for organisations to successfully organise the adoption of e-health applications (Yarbrough & Smith, 2007; Ross et al., 2016).

The m-health project GoAPP (Godivapp Applied in Pediatric Primary Care) started in June 2016. Based on an user-centered approach method (Spinuzzi, 2005) the project aims to develop and implement a telemedicine application (the Godivapp) in Dutch pediatric primary care, specifically in the context of child physiotherapy. The main purpose of the Godivapp is to exchange videos between parents of children whom suffer from lack of motor development and practitioners working in child physiotherapy. Via these videos that are recorded by the parents, the practitioners can more efficiently track the development of the patients. Compared to other primary care organisations within the Netherlands, physiotherapists, who are the largest group of primary care organisations, are early adopters when it concerns IT innovations (Maris et al., 2015). As part of the GoAPP project the following research question needs to be answered: *what are the critical success factors for adopting a telemedicine application for primary child physiotherapists and their patients within the Netherlands?*

The remainder of this paper is structured as follows. In the next section, the key elements of the research question ‘critical success factor’ and ‘adoption’ are defined. The research approach is described in the 3<sup>rd</sup> section. The 4<sup>th</sup> section discusses the findings of the literature review, the expert sessions and the survey results, in order to understand what critical success factors should be taken into consideration in case of adopting a telemedicine application. Subsequently, section 5 provides the conclusions, followed by a discussion and limitations in section 6.

## **THEORETICAL BACKGROUND**

### **Critical Success Factors**

Critical Success Factors (CSFs) are “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation. They are the few key areas where things must go right for the business to flourish. If results in these areas are not adequate, the organisation’s efforts for the period will be less than desired” (Rockart, 1979). Similarly, according to Hietschold et al. (2014) CSFs are best practices, enablers, keys or initial inputs, which affect adoption in a critical way. Alreemy, Chang et al. (2016) define critical success factors in the context of information systems as a factor that eases the implementation of information technology governance or hinders it if not considered. Similarly, Hoerbst and Schweitzer (2015) define CSFs as groups of functional, technical or organisational requirements to foster the integration or evolvement of Clinical Information Systems.

This study is about the adoption of a telemedicine application by physiotherapists and their patients. Based on this context and the above, we employ the following definition of CSFs: *a limited group of functional, technical and/or organisational requirements that ease the adoption of the telemedicine application by physiotherapists and their patients, or hinder it if not considered.*

### **Adoption**

For adoption of IT, technological and managerial challenges need to be organized, including user technology acceptance (Chau & Hu, 2002). Adoption is about embracing or appropriating IT after implementation, in other words, whether ‘it sticks’ (Hage et al., 2013). Implementation, or implementation process, refers to a stream of activities across a period with the aim that the implemented IT application will be used (Boonstra & Offenbeek, 2010). According to May et al. (2003), after implementation and adoption, IT has to be normalized.

Normalization is “the move toward the routinized embedding of telemedicine in everyday clinical practice” (May et al., 2003).

In the context of the GoAPP project the aspects of technology acceptance, implementation, adoption and normalization are studied. More specifically, in this study the focus is on the broad technological and managerial aspects of adoption. Therefore, the definition of adoption is formulated as follows: *organising the technological and managerial challenges in such a way that the telemedicine application is embraced and appropriated by the physiotherapists and their patients.*

## **RESEARCH APPROACH**

The goal of the study described in this paper is to develop a list of critical success factors that can be used to improve the adoption of a telemedicine application. Such an enumeration can be seen as an artefact that requires designing, therefore a design research approach is chosen (Hevner et al., 2004). The design research approach of Hevner et al. (2004) describes an iterative process between three areas; the (scientific) knowledge base, the (business) environment and the IS research project. Using this methodology the following research activities were defined: a literature review, two validation sessions (interviews) and a survey.

### **Literature study**

This research is founded in the scientific knowledge base (Hevner et al., 2004). In order to find possible articles about barriers and/or success factors for adopting e-health applications such as the Godivapp, a systematic literature review is conducted following the guidelines of Brereton et al. (2006). Derived from the research question, a list of keywords is created. From this list, six sentences are formulated that are used in the search process:

1. ‘issues of adoption of e-health’,
2. ‘success factors for e-health applications’,
3. ‘critical success factors for adopting e-health applications’,
4. ‘adoption e-health applications’,
5. ‘best practice e-health apps’,
6. ‘barriers for adopting e-health application’.

‘Google Scholar’, ‘PubMed’ and the search engines of the HU University of Applied Sciences and Avans University of Applied Sciences are used to find relevant articles. The search engines of the universities are both using a combination of databases, including Academic Search Premier, Business Source

Elite, Cochrane Database of Systematic Reviews, Communication & Mass Media Complete, Directory of Open Access Journals, EBSCOhost, ScienceDirect, and Web of Science. A first selection of relevant articles is made by the researchers based on title and abstract. Subsequently, the selected papers are analysed thematically as described by Vaismoradi et al. (2013). For this, all articles are read and possible success factors that were mentioned in the text are derived. During this process, similarities and duplicates among the possible success factors are merged into a newly labelled factor or under one existing factor name.

### **Validation sessions**

As part of the environmental area (Hevner et al., 2004), two semi structured interview sessions are organised, in order to understand which of the possible success factors that are derived from the literature study are considered relevant success factors. Each session is performed with two senior researchers (PhD) from the same research field. For the first interview the two researchers are from the field of innovative business models for e-health applications. For the second interview the two researchers are from the field of e-health applications for child physiotherapy. All four researchers are working at different departments within the HU University of Applied Sciences.

During each session all factors that were mentioned more than once in the articles are ranked using a 5-point Likert scale, where five means the factor is highly relevant and one means completely irrelevant for the adoption of a telemedicine application, such as the Godivapp. Before ranking each factor, a short discussion between the researchers (interviewees) is organised so they would agree about the definition before ranking it together.

After processing the factors mentioned more than once, the researchers were asked to look at the other factors that were found but which were mentioned only once. This is done to determine if essential factors were missing. Subsequently, possible missing factors are also discussed and scored.

### **Questionnaire**

To determine if the scored factors are also relevant within the field of child physiotherapy, and more specifically in the context of the GoAPP project, a survey was conducted among child physiotherapists and parents with children under the age of five. Based on the scored factors a questionnaire was created. For each relevant success factor a statement was formulated based on the definition. For example (translated from Dutch):

The definition of ‘Security’ is: The application is secure, the user can safely use the application without any concerns. Safety aspects are:

- Saved information on (mobile) devices is encrypted so access to this information can be appointed to authorized users only;
- The (encrypted) videos are safely transferable;
- Access to the application can be granted only via an authentication procedure.

The corresponding question/statement in regards to ‘Security’ is: The application has to be secured, this means that the users can use the application without any safety concerns and unauthorized access to the (saved) information is impossible.

For each statement the extent to which the factor will contribute to the adoption of the Godivapp is determined using a 5-point Likert scale. Where five means the factor is contributing very much and one means the factor does not contribute at all to the adoption of the Godivapp. To ensure the validity of the statements, two healthcare experts and three specialists in scientific research and telemedicine, who were not involved in the research till then, reviewed this questionnaire. They confirmed that the statements are related to the selected factors and corresponding definitions and only suggested some minor changes. Consequently, some statements are shortened and some technical terms are explained or replaced by understandable terms within the field of physiotherapy. This resulted into the definitive questionnaire (available in Dutch upon request to the authors).

The survey is send to a total of twelve practitioners that participated in the project GoAPP via the online tool ‘Google forms’. Ten practitioners completed the survey after having been given two weeks to complete it.

Parents with children up to the age of five are given a similar online survey. The only exception was that it included some background information about the project GoAPP as they did not participate in the project before. The survey is distributed among the parents in collaboration with a day-care facility. In total six parents completed the survey. Both surveys were closed after two weeks.

To qualitatively analyse the results of the survey and to calculate the contribution score of a success factor a MS-Excel spreadsheet was created (Appendix 1). The mode, median and mathematical average of the given scores per factor are used to rank the factors and to select the top and lowest success factors. This was done for both groups separately and also together.

After every of the above described research phases, the results are analysed and used to further narrow down the list of factors and improve the ranking of

importance, this is in line with the guidelines for design science research (Hevner et al., 2004).

## **FINDINGS**

In this section the findings are described in order to understand what critical success factors should be taken into consideration in case of adopting a telemedicine application.

### **Literature review**

After conducting the systematic literature study, 22 relevant articles were selected for the thematic analysis (see Table 1).

**Table 1: Articles included in literature study**

Nr	Source	Nr	Source
1	Rodrigues, 2008	12	Elsen, 2016a
2	Savastano et al. 2008	13	Elsen, 2016b
3	Wickramasinghe and Fadlalla, 2005	14	Loghum, 2016
4	Leonard, 2004	15	Dehzad et al., 2014
5	Kaye et al., 2010	16	Lomans, 2015
6	Wickramasinghe and Schaffer, 2009	17	Zorginstellingen.nl, 2016
7	Grood et al., 2016	18	Mobile Doctors Redactie, 2016
8	Cortez et al., 2014	19	Liu et al., 2011
9	Budding, 2016	20	Hage et al., 2013
10	LynneteSh, 2013	21	Ross et al., 2016
11	Mobile Doctors Redactie, 2014	22	Mair et al., 2012

During the thematic analysis (Vaismoradi et al., 2013) the possible success factors are compared and merged based on the context of the article.

For example, the unique factor ‘Security’ consists of the factors, ‘Security’, ‘Protecting security’, ‘Safety’, ‘Safe contact via digital channels between patient and doctor’, ‘Certified ISO27001 & ISAE3402’, ‘Periodic testing the security by specialists’, ‘Untraceable e-mail’ and ‘Safe communication’ (Rodrigues, 2008; Grood et al., 2016; Cortez et al., 2014; Budding, 2016; Elsen, 2016; Dehzad et al., 2014; Zorginstellingen.nl, 2016; Mobile Doctors Redactie, 2016; Mair et al., 2012).



After processing these similarities and duplicates a total of 67 unique success factors remained. These factors are listed, as well as the number of times the factor is mentioned in the 22 articles in Appendix 2.

### **Validation sessions**

The list of factors mentioned more than once consisted of a total of 26 factors (Appendix 2). After processing the 26 factors with the first two senior researchers, three factors ‘awareness’, ‘authentication’ and ‘sales channel’ were selected extra. The researchers explicitly stated that without proper engagement methods and creating awareness among the users a successful outcome of any project is almost impossible.

The other two senior researchers in the field of e-health applications for child physiotherapy acknowledged that the subsequent set of 29 factors could be used to determine critical success factors for the adoption of the telemedicine application. According to these researchers the list was complete and they would not add more factors to the list. Actually, they found that the list with factors should be limited. They tried to narrow down the list of relevant success factors further but after extensive discussion found that they could not do this.

### **Survey**

Based on the mode ( $\geq 5$ ), median ( $\geq 4,5$ ) and mathematical average ( $\geq 4,4$ ) in the given scores per factor, the ten practitioners scored the factors, Security, Cross Platform, User Friendly and Usefulness as the top factors (see Table 2).

**Table 2: Top factors practitioners**

ID	Merged factor	Mode	Median	Mean
1	Security	5,00	5,00	4,60
2	Cross-platform	5,00	5,00	4,60
6	User Friendly	5,00	5,00	4,40
5	Usefulness	5,00	4,50	4,40

These top factors are found nine times or more in the literature (Appendix 2). Cross-platform means that it is important that the application is compatible with the most commonly used operating systems, web browsers and devices. User friendly means that the individual user is able to use and understand the function of the application. Usefulness means that the user is able to recognise the value of the application.

The lowest ranked factors are Standardization, Organisation, Educate & Training, and Adaptability (see Table 3) based on the mode ( $\leq 3,5$ ), median ( $\leq 3,5$ ) and mathematical average ( $\leq 3,3$ ).

**Table 3: Lowest Factors Practitioners**

ID	Merged factor	Mode	Median	Mean
10	Standardization	3,50	3,50	3,30
11	Organisation	3,50	3,00	3,00
8	Educate & Training	3,00	3,00	2,90
22	Adaptability	3,00	3,00	2,80

Except for the factor Educate & Training these factors are mentioned five times or less in the literature. Educate & Training is mentioned eight times and therefore we reason that there should be attention for training end-users before using the application.

The six parents that participated in the research scored the factors, Security, User Friendly, Network, Authentication, Cross-platform and Rules and regulations, as the top factors (mode  $\geq 5$ , median  $\geq 4,5$  and mathematical average  $\geq 4,4$ ) (table 4).

**Table 4: Top Factors Parents**

ID	Merged factor	Mode	Median	Mean
1	Security	5,00	5,00	4,67
6	User Friendly	5,00	5,00	4,67
14	Network	5,00	5,00	4,67
31	Authentication	5,00	5,00	4,67
2	Cross-platform	5,00	5,00	4,50
9	Rules and regulations	5,00	5,00	4,50

Compared with the top factors of the practitioners, the top factor list of the parents also contains the factors Security, User Friendly and Cross-platform. The factors 'Authentication' (access via personal identification) and 'Rules and regulations' (procedures about storage and use of personal data are described and filed) are related to Security. The factor 'Network' means that the application is accessible via Internet using 3G, 4G, WIFI or a Hotspot.

The factors with the lowest scores (mode  $\leq 3,5$ , median  $\leq 3,5$  and mathematical average  $\leq 3,3$ ) are Educate & Training, Leadership, Adaptability, Effects on operational processes, Financing and Investment and Business Case (see Table 5).

**Table 5: Lowest Factors Parents**

ID	Merged factor	Mode	Median	Mean
8	Educate & Training	3,50	3,00	2,83
17	Leadership	3,00	3,50	3,67
22	Adaptability	3,00	3,50	3,67
20	Effects on operational processes	3,00	3,00	3,67
18	Financing (and investment)	3,00	2,50	2,17
3	Business Case	2,50	2,50	2,50

The factors related to financial aspects (Business Case and Financing and investment) of the total list of 29 factors are ranked as lowest rated factors by the parents. Educate & Training and Adaptability got the lowest scores by both parties.

Because the responses of both groups are small and the variation between the scores per factor are small, the results of the practitioners and parents are also combined. The combination scored the factors Security, Cross-platform and User Friendly as the top factors. The factors Business Case, Effects on operational processes, Adaptability, Educate & Training and Financing scored the lowest (see Table 6).

**Table 6: Top and Lowest Scored Factors**

ID	Merged factor	Mode	Median	Mean
1	Security	5,00	5,00	4,63
2	Cross-platform	5,00	5,00	4,56
6	User Friendly	5,00	5,00	4,50

ID	Merged factor	Mode	Median	Mean
3	Business Case	3,50	3,00	3,25
20	Effects on operational processes	3,00	3,00	3,25
22	Adaptability	3,00	3,00	3,13
8	Educate & Training	3,00	3,00	2,88
18	Financing (and investment)	2,50	3,00	3,00

The results related to the top factors are obvious. These factors were scored as top factors by both groups. The overall scores show that Security is the highest rated critical success factor. The individual top factors Network, Authentication, Rules

and regulations and Usefulness are not in the top list. The financially related factors are ranked as lowest rated factors.

## **CONCLUSION**

The adoption of telemedicine applications is not easy, barriers must be overcome (Yarbrough & Smith, 2007; Ross et al., 2016) and therefore critical success factors should be identified for the organisation. In this study, the critical success factors for adopting a telemedicine application for primary physiotherapists and their patients (children younger than the age of five) within the Netherlands were investigated.

The results show that each group (primary physiotherapists and the children's parents) has its own opinion about what is important for adopting a telemedicine application in the context of the GoAPP project. According to this qualitative study based on literature, expert validations, input from practitioner and patient groups and their combined results, three critical success factors are found:

1. Security (including Authentication and Privacy); Personal information (video, audio and text) should be transferred and stored secured. Authentication should be arranged so unauthorised people cannot access and use the private data.
2. Cross-platform; The application is compatible with the most commonly used operating systems, web browsers and devices. It should be possible to add on the application to existing e-health applications.
3. User Friendly; The application should be usable and understandable for everyone, without any education or training beforehand.

However the other factors, although less relevant, still need to be taken into account.

## **DISCUSSION AND LIMITATIONS**

The results of this research are highly relevant, because studies focused on critical success factors for the adoption of telemedicine applications are rare (Kampmeijer, et al., 2016; Varabyova et al., 2017). In the GoAPP project the results from this study are used as input to the effort to form a business model for the telemedicine application (Godivapp). While the findings are already usable in the context of this research there are some limitations that need to be stated.

Although the outcomes of the validation sessions (the experts, practitioners and patients) are similar to the findings from literature, the number of participants is limited. For example, the survey was completed by only ten practitioners and six parents. In the Netherlands there are about 7000 physiotherapy practices (Maris et

al., 2015). Therefore, these results can only be used as an indicator to possible success factors for adopting a telemedicine application. More extensive research needs to be performed to strengthen these results.

It is noteworthy that financial aspects (i.e. having to pay to use the application) seem to not be an issue for adoption. Especially the parents scored this factor very low. In the Netherlands, everybody is insured for basic health care, including physiotherapy. Most of the costs made by the practitioner is paid directly by the insurer and not the patient. Therefore, the parent, or patient, is not aware of the total costs of the treatment. In respect to developing a business model, these results need to be investigated further. We suggest to perform further research specifically focussed on the financial aspects within the context of this research.

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## APPENDIX 1

Practitioners (N = 10)

ID	Merged factor	Mode	Median	Mean
1	Security	5,00	5,00	4,60
2	Cross-platform	5,00	5,00	4,60
6	User Friendly	5,00	5,00	4,40
5	Usefulness	5,00	4,50	4,40
19	Accountability	5,00	4,00	4,00
9	Rules and regulations	5,00	4,00	3,70
13	(IT-)infrastructure	4,50	4,00	4,20
24	Access	4,00	4,00	4,30
37	Sales channel	4,00	4,00	4,20
4	Privacy	4,00	4,00	4,10
21	IT skills	4,00	4,00	4,10
15	Support	4,00	4,00	3,90
7	Collaboration	4,00	4,00	3,80
31	Authentication	4,00	4,00	3,80
3	Business Case	4,00	4,00	3,70
26	Engaging	4,00	4,00	3,70
18	Financing (and investment)	4,00	4,00	3,50
29	Awareness	4,00	4,00	3,40
25	Evaluation	4,00	3,50	3,40
17	Leadership	4,00	3,50	3,10
20	Effects on operational processes	4,00	3,00	3,00
12	Integration	3,50	4,00	3,80
14	Network	3,50	4,00	3,80
16	Implementation	3,50	4,00	3,80
23	(Visionless) Development	3,50	4,00	3,80
10	Standardisation	3,50	3,50	3,30
11	Organisation	3,50	3,00	3,00
8	Educate & Training	3,00	3,00	2,90
22	Adaptability	3,00	3,00	2,80

Parents (N = 6)

ID	Merged factor	Mode	Median	Mean
1	Security	5,00	5,00	4,67
6	User Friendly	5,00	5,00	4,67
14	Network	5,00	5,00	4,67
31	Authentication	5,00	5,00	4,67
2	Cross-platform	5,00	5,00	4,50
9	Rules and regulations	5,00	5,00	4,50
23	Access	5,00	4,50	4,33
7	Collaboration	5,00	4,50	4,17
21	IT skills	5,00	4,50	4,17
5	Usefulness	5,00	4,50	4,00
15	Support	5,00	4,50	3,83
19	Accountability	5,00	4,00	3,67
4	Privacy	4,50	4,50	4,50
26	Engaging	4,50	4,00	3,83
37	Sales channel	4,00	4,00	4,17
25	Evaluation	4,00	4,00	4,00
23	(Visionless) Development	4,00	4,00	3,67
10	Standardisation	4,00	4,00	3,33
11	Organisation	4,00	3,50	3,17
12	Integration	4,00	3,50	3,17
13	(IT-)infrastructure	4,00	3,50	3,17
16	Implementation	3,50	4,00	4,00
29	Awareness	3,50	3,50	3,33
8	Educate & Training	3,50	3,00	2,83
17	Leadership	3,00	3,50	3,67
22	Adaptability	3,00	3,50	3,67
20	Effects on operational processes	3,00	3,00	3,67
18	Financing (and investment)	3,00	2,50	2,17
3	Business Case	2,50	2,50	2,50

## APPENDIX 2

ID	Merged Factor	Count	ID	Merged Factor	Count
1	Security	19	40	Relationship physician and patient	1
2	Cross-platform	15	41	Payment methods	1
3	Business case	15	42	Interactiveness	1
4	Privacy	12	43	Documents centralized	1
5	Usefulness	12	44	customization	1
6	User Friendly	9	45	Technical obstacles	1
7	Collaboration	8	46	Lack of evidence	1
8	Educate/Training	8	47	Cultural aspects	1
9	Rules & regulations	6	48	Secure Login	1
10	Standardisation	5	49	Functionality	1
11	Organisation	5	50	Easy to use	1
12	Integration	5	51	Feeling	1
13	Infrastructure	4	52	Pilot	1
14	Network	4	53	Conflict stakeholders	1
15	Support	4	54	Complexity	1
16	Implementation	4	55	Client needs	1
17	Leadership	3	56	Available resources	1
18	Financing and investment	3	57	Conviction on the intervention	1
19	Accountability	3	58	Planning	1
20	Effects on operational processes	3	59	Harmonization	1
21	IT skills	3	60	Productivity	1
22	Adaptability	2	61	Interaction patient	1
23	Visionless development	2	62	Participation	1
24	Access	2	63	Confidence	1
25	Evaluation	2	64	Riskmanagement	1
26	Engaging	2	65	Benefits	1
27	Distribution	1	66	Continuity	1
28	Investment	1	67	Protecting intellectual property rights	1
29	Awareness	1			
30	Project Group	1			
31	Authentication	1			
32	Identity Management	1			
33	Availability	1			
34	Balance between privacy en quality	1			
35	Change Management	1			
36	Communication during Implementation	1			
37	Sales Channel	1			
38	Current and future requirments	1			
39	Conduct professional organisation	1			