


Motivation of Physicians to Use and Recommend Apps for the Treatment of Haemophilia

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Abstract

Digitalization of health care and the availability of suitable end devices lead to an increase in the use of telehealth applications. Most research on telehealth focuses on patients or organizations (like hospitals), while the role of physicians in this context is often neglected. In case of serious and chronic diseases, they play two major roles in the use of telehealth. Firstly, they may influence the patient's decision whether to use it at all (if more than one option is available, they may also influence the patient's choice of software). Secondly, if there is a need for a physicians' participation (eg, in telecare), an adoption decision by the physician to use the system is necessary. We develop a model to understand a physician's motivations to recommend the use of telehealth software to patients and to adopt it himself. The results demonstrate that physicians recommend telehealth based on their own use intention and the perceived performance improvements in patient treatment. Further, their own use intention is dependent on the usefulness of the system for their work. Potential disadvantages like decreased patient autonomy or cost of the system use do not influence the physician's decisions.

Keywords

telehealth, chronic disease management, physicians, treatment recommendation, haemophilia

Introduction

The effectiveness of telehealth apps has been shown in the treatment of numerous chronic diseases,^{1–4} including haemophilia.^{5–7} Compared to paper-based alternatives, apps improve therapy adherence, they are more comfortable to use, they improve the communication between physicians and patients, and they reduce costs in the healthcare system.^{7–12} Despite these advantages, telehealth is still not as widely used when comparing the reported user numbers with the number of haemophiliacs. In Germany, for example, only around a third of haemophiliacs use telehealth and only about half of the care centres offer it^{13,14} (most of the physicians treating haemophilia are associated with a care centre), although available solutions exist since 2009.¹⁵ This study is carried out to investigate this discrepancy. The use of telehealth in chronic disease management (CDM) usually includes two parties, the physician and his patients. While several studies already investigated what prompts patients to use telehealth,¹⁶ the physician-side is under-researched.¹⁷

The lack of research regarding physicians is problematic, since they play a key role in telehealth propagation: Not only are they users themselves, but their recommendations also impact patient behaviour.¹⁸ Furthermore, their acceptance of telehealth explains much of its uptake and outweighs other factors like technology problems or lack of resources.¹⁷ Use of telehealth by patients does not necessarily mean that physicians will use and work with the collected data electronically. Sometimes, physicians just let their staff prepare the collected data, but they continue to work based on papers themselves. Hence, physicians play a dual role as potential

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recommenders and adopters of telehealth. Understanding and influencing physicians' behaviour is vital for its effective use. However, telehealth research so far has mainly focused on patient behaviour, physician–patient interaction and the general impact of telehealth.¹⁶ Studies in healthcare information technology (HIT) research have analysed physician motivation to adopt HIT or the impact of their recommendation behaviour, but not both. On one hand, recommendation behaviour was only observed as a predictor. For example, the effect of physician recommendations on patients' privacy decisions when using electronic health record (EHR) systems was examined and identified as a positive influence.¹⁸ On the other hand, studies analysing physician HIT adoption behaviour^{19,20} do not relate their findings to the resulting recommendation behaviour. Other studies researched the effect of recommendations, but not what triggers recommendations.²¹

To summarize, physicians are central to the adoption and recommendation process of HIT, but the variables driving the recommendation as well as the connection between recommendation and adoption in this context are insufficiently researched. Knowledge of these variables would allow to explain why telehealth apps, although beneficial in chronic disease treatment, are sometimes not used. This study focuses on the physicians' motivation to recommend and adopt telehealth technology and is carried out to identify the driving factors behind recommendations and close this gap.

Next, we discuss previous research. Then, we describe the exact context of our study. This is followed by modelling and hypotheses development. After that, we discuss the design and present results of our survey. Finally, we discuss the results and give some conclusions.

Firstly, we consider research regarding physician recommendations independently of HIT.

There are studies, for example, that show physician recommendations as a positive predictor of vaccination²² or participation in cancer screening.²³ O'Malley et al.²⁴ analysed the circumstances and occurrence of physician recommendations for cancer screening. They show that certain patient groups are more likely to receive recommendation than others, which was not based (only) on their medical condition. In their study, patients with easier access to the healthcare system and better socioeconomic status are more likely to receive mammography recommendations. In other words, physician recommendations are influenced by predictors different from a pure healthcare context. The referenced studies show the importance of physician recommendations and that physicians seem to be influenced by non-health variables, but they do not explain the physicians' motivation to recommend a behaviour.

Telehealth can be viewed as a treatment intervention like medication. Therefore, a recommendation for telehealth use can also be compared with a regular drug prescription. In prescription research, it has been analysed which factors determine the prescription of drugs.²⁵ The somewhat

surprising result of the study is that physicians purely rely on their preference for a drug instead of considering patient's characteristics. This finding has been replicated in various treatment scenarios. The studies usually conclude that a physicians' preference for a treatment is the determining factor in the choice of a treatment. This was shown in early studies²⁶ and confirmed again in recent replication research.²⁷ These studies only use a few variables relating to prescribing physicians (like the size of the practice where the prescribing physician works or his association with a medical society). The studies show the impact of the physician's preferences, but they lack the ability to provide insight into how these preferences are formed.

In summary, there is evidence for the importance and value of physicians' recommendation, but the internal drivers of physician recommendation remain unclear. The findings from drug prescription behaviour show that physicians prescribe based on their preferences, but the internal drivers of these preferences remain unclear. To better understand these drivers, we develop below a model for the recommendation behaviour of physicians that also includes their potential willingness to get involved with telehealth apps beyond simply recommending them to patients. Bearing this in mind, our main research question can be stated as:

What motivates physicians to recommend and adopt a telehealth software for treatment of a chronic disease?

We will now lay out the setting of our study, in which we intend to measure these drivers: Central concerns of patients with chronic diseases are self-management and easy access to physicians, if needed. Both can be facilitated by telehealth technology.²⁸ The implementations of telehealth vary among treatment contexts: Telehealth seems to be most useful in monitoring chronic diseases or other long-duration health threats, for example, high-risk pregnancies.²⁹ Defining factors are as follows: (Relatively) long distances between physician and patient, permanent possibility of critical incidents and individualised treatment.^{28,30} In order to conduct a study in such a treatment scenario, we need to concentrate on a chronic disease, which includes patient self-management in addition to the patient–physician interaction. These requirements are met by the treatment of haemophilia, a bleeding disorder. It is characterized by the life-long need for medication (frequency depends on the severity) and the permanent possibility of bleeding incidents, which may create additional negative effects like joint arthropathy. The patients are cared for by a system of treatment centres, by which the physicians are organized. In Germany, the centres also distribute the medicine (replacement factors). The physicians need to report replacement factor consumption to a central registry. The context is adequate for our research question, since physicians can either just recommend the telehealth software to the patient or use additional functions themselves, as further explained below.

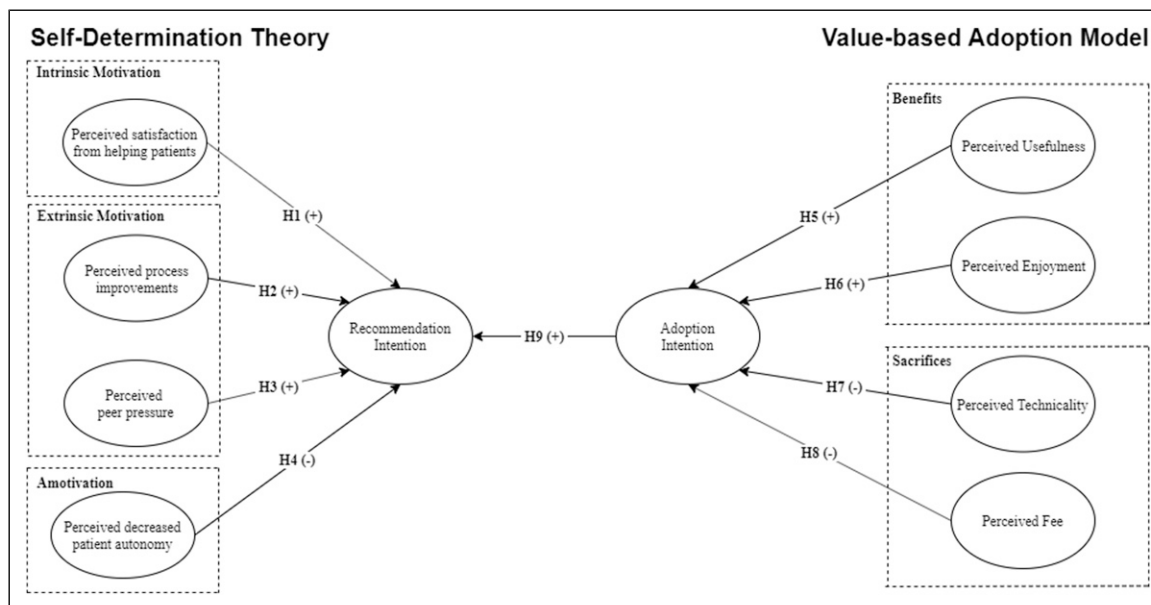


Figure 1. Main research model.

Hypotheses and Research Model

As shown above, research on physicians' recommendation of telehealth technology and their adoption behaviour has several gaps, specifically when describing what variables influence these behaviours. Currently, no standardized model exists to measure recommendation behaviour. Therefore, we develop a new model, where we use Self-Determination-Theory (SDT)³¹ and Value-based Adoption Model (VAM)³² as frameworks. We identify relevant variables based on the literature.

Self-Determination-Theory is used to model the different motivational factors because we want to describe the physicians' motivation to recommend telehealth technology. SDT views any motivation as part of three fundamental psychological needs: Autonomy, competence and relatedness.³¹ These needs are satisfied by relating self-perceptions: Autonomy by perceiving oneself as independent, competence by perceiving one's own actions as effective and relatedness by feeling affiliated to a social group. The satisfaction of those needs results into a level of motivational engagement. Three motivational types are distinguished: Intrinsic motivation, extrinsic motivation and amotivation.³³ Motivation is intrinsic when an activity provides satisfaction by itself. If an activity can lead to measurable benefits (here, for example, less documentation errors), then it is extrinsically motivated. If an activity does not lead to satisfaction, the motivation can turn into an amotivation, leading to a rejection of the activity. Our model is organized according to these three motivation types (see Figure 1).

A possible intrinsic motivation for physicians is the satisfaction a physician receives when helping patients who would use the app. Helping patients by recommending a useful app is likely to improve the relationship with the patient which is an important component of a physician's job

satisfaction.³⁴ Early studies on physicians' intrinsic motivation are rare,³⁵ but research of physicians' job satisfaction determined that serving people is a frequent positive intrinsic influence on satisfaction.³⁶ We therefore hypothesize the following:

H1: Perceived satisfaction from helping patients positively influences the recommendation intention.

A physician's decision about the best treatment can also be influenced by external, extrinsic factors. These external factors differ from an intrinsic satisfaction, as a physician indifferent to his patients still wants to provide an effective treatment. A physician might even feel responsible to use new technology as part of his professional self-perception.³⁷ Good professional experience is a component of a physician's job satisfaction,³⁶ which reflects the need to experience oneself as competent.³³ Therefore, we assume here that physicians perceive new telehealth technology as beneficial to the treatment process. The available apps improve patient behaviour in key concerns like therapy adherence, since documenting is easier and the documentation is readily available to the physician. Apps also enable close monitoring in case of high-risk treatments and improve the physician's reaction time. Better monitoring also leads to less emergency admissions overall, thus reducing the physicians' workload and increasing the patients' quality of life.³⁸ More reliable data and their better further processing help the physician to improve the treatment of patients. The physician may perceive the new technology as helpful to improve his professional results.

H2: Perceived process improvements positively influence the physician's recommendation intention.

Another extrinsic factor is peer pressure from the physician's professional community. Physician behaviour, when implementing new research results, is influenced by whether

these results are already part of established peer practice.³⁹ Gagnon et al³⁷ used the theory of interpersonal behaviour to describe telemedicine adoption by physicians and concluded that social norms and responsibility within the physician community positively influence the intention to adopt a telemedicine technology. The impact of the physician's peer group on his perceived relatedness and job satisfaction was also shown by McMurray et al,³⁴ further establishing the importance of the physician's peer group. A systematic review by Godin et al.⁴⁰ compared models describing healthcare professionals' behaviour and found that a component of social influence is beneficial to accurate predictions. Similar results were given by Malik et al,³⁶ who found respect by peers to be a frequent socio-cultural determinant of physicians' job satisfaction. In the context of our study, peer pressure arises when other physicians recommend the app to their patients or report on resulting treatment improvements. Therefore, we assume the following hypothesis.

H3: Perceived peer pressure positively influences recommendation intention.

If any of the three SDT dimensions, relatedness, autonomy, or competence, are negatively perceived, motivation turns into amotivation. Amotivation factors decrease the likelihood of performing a behaviour, in our case recommending an app. In case of telehealth technology, physicians may fear the perceived loss of patient autonomy. In chronic disease management, patient autonomy is a necessity, since patients often need to take their medication by themselves and, if possible, keep track of their own health status. This is beneficial to physicians since it reduces their workload. However, a new telehealth technology (like documentation apps) that introduces better monitoring may have also adverse effects. The patients could feel to be in a state of permanent surveillance. This could have a negative impact on the patient–physician relationship, since the patient might feel that the physician does not trust him and his self-management abilities anymore. Low levels of trust between patient and physician are associated with further negative effects, like lower perceived physician empathy and reduced treatment compliance.⁴¹ Hence, physicians may refrain from recommending such apps, since they worry about negative effects from a decrease in perceived patient autonomy.

H4: Perceived decrease in patient autonomy negatively influences recommendation intention.

As outlined above, besides simply recommending the app, the physician also has the option to use the telehealth system himself. If patients use the app and transfer the data to the treatment centre where their physician is treating them, the physician can use the telehealth system for following functions:

1. He can have the data automatically reformatted as required by the central register and transmit them as required by law.

2. He can create charts that show the patient's 'experience' with haemophilia over time as documented since the use of the app.
3. He can make comparisons of the patient with other patients with respect to haemophilia and other patient characteristics (eg a comparison of patients with same severity of the disease and similar age but different consumption of clotting factors).

The option to use additional features of the telehealth system constitutes an adoption decision by the physician. We use the VAM³² to model the physicians' adoption decision. Among multiple models available for adoption behaviour, VAM has been used, for example, in studies of adoption of mobile and IoT devices.⁴² The model is an implementation of the cost-benefit paradigm from decision theory,⁴³ measuring a product's utility by matching what it provides (benefits) and what it demands (sacrifices). Benefits are separated into *enjoyment* and *usefulness* based on Cognitive Evaluation Theory (CET)⁴⁴ while sacrifices include the sub-dimensions *technicality* (cost in time and effort) and *fees* (monetary cost). *Usefulness* and *enjoyment* to the physician have been shown to influence adoption decisions in healthcare-specific contexts.^{20,45,46} Considering *technicality* and *cost*, especially, the lack of reimbursement⁴⁷ can be considered a sacrifice. In contrast to SDT, where context-dependent variables have to be derived from the literature for each motivational type, the VAM variables are already set and summarized in the following four hypotheses:

H5: Perceived usefulness positively influences the adoption intention.

While perceived usefulness is the extrinsic component of the benefit construct, perceived enjoyment reflects the intrinsic component.

H6: Perceived enjoyment positively influences the adoption intention.

Technicality reflects the non-monetary cost component of sacrifice. To use telehealth software efficiently, the physician needs to invest his own time. The time investments are not reimbursed so far.

H7: Perceived technicality negatively influences the adoption intention.

Besides the physicians, the staff of treatment centres also requires training in the use of telehealth software and time to maintain it, creating financial burden that they receive as salary or overtime costs. These costs are usually directly or indirectly borne by the physicians.

H8: Perceived costs negatively influence the adoption intention.

Hypotheses 5–8 consider different factors influencing the physicians' own adoption decision. Once a physician intends to adopt a telehealth system, each additional patient using the system will increase the overall usefulness of the telehealth system. Therefore, the physician will recommend the app to additional patients, making his adoption intention a positive influence on recommendation behaviour:

H9: Adoption intention positively influences recommendation intention.

Figure 1 shows the combined hypotheses. It further shows that the model consists of two parts, the SDT-part to the left and the VAM-part to the right.

Methods

Selection and Description of Participants

To test the proposed hypotheses, a survey is conducted among all physicians who specialise in haemophilia treatment in Germany. These physicians work in or with designated haemophilia treatment centres. Therefore, their number can be relatively reliably estimated at around 150 which represents the whole population (no prior sampling). Almost all of them are also members of the Deutsche Hämophiliegesellschaft e. V. (DHG), the largest German association of haemophilia patients. We sent the survey to them via the DHG (ie we did not receive their addresses) by regular mail accompanied by a supporting letter from the scientific advisory board of the DHG. A response could be given via mail or via a website that contained the online version of the survey (where physicians did not have to reveal their identity). Reminders to fill out the survey were also sent to treatment centres and expressed personally at a haemostasis conference.

Physicians tend to have the lowest response rate in studies across healthcare personnel.¹⁹ We received 47 responses in total, sample characteristics are shown in Table 1. On one hand, this is a small number of responses. On the other hand, the respondents represent almost one-third (31.3%) of the whole population. We received 1677 data points from the 47 surveys and 138 missings; this corresponds to a missing rate of 8.2 %. We utilized multiple imputation to replace missing values to prevent row-wise observation dropout due to missings. All missings were replaced using the Stata 14.1 mi imputation functionality. This helps to reduce potential bias from a small sample size.

Data Analysis

Our data and model were analysed using Stata 14.1. Additionally, SmartPLS 3 was used to test the structural equation modeling (SEM). Several methods were used to evaluate the results of the questionnaire. Cronbach α to test internal consistency, average variance extracted (AVE) and construct reliability (CR) to determine convergent validity and a Varimax-rotated EFA result to assess factor loadings and structure. Then, three multiple regressions were performed to test the different parts of the model. To test the complete model, we utilized SmartPLS 3 to perform a PLS-SEM. To estimate model fit, we used Standardized Root Mean Square Residual (SRMR) ($<.08$)⁴⁸ and Normed Fit Index (NFI) ($>.9$).⁴⁹ We further checked for common method bias (CMB) by testing if factor-level VIFs are lower than 3.3.⁵⁰

Table 1. Characteristics of Surveyed Physicians.

Variable	Characteristic	N	%
Physicians interviewed		47	
Age group	Below 30	0	0
	30–39	2	4
	40–49	13	27
	50–59	28	59
	Above 60	4	8
Gender	Male	25	54
	Female	22	46
Physician works in a centre offering telehealth	Yes	36	77
	No	11	23
Performed treatments per month		\bar{X} 17.12	SD: 12.76

Variables and Questionnaire Development

We adopted the variables from Ryan and Deci³³ as a starting point for the STD part since no specific scale for physician recommendation behaviour was available. They were adapted to our context as follows. The intrinsic motivation is measured as the satisfaction from helping patients, which is adopted from Ryan and Deci's 'satisfaction from helping others'.³³ Extrinsic motivation is based on Hatz et al,²⁰ who developed the PMA scale to measure factors influencing physicians to adopt medical innovations. We adopted two of their constructs, 'functional' as *perceived process improvements* and 'conformity' as *perceived peer pressure*. However, we specify the medical innovation as apps for chronic disease treatment. Amotivation is operationalized, as discussed above, as a concern that patients may feel that they lose their *autonomy* and feel permanently observed when using an app. We created a self-designed construct to measure this potential argument against recommending an app. All items of the SDT part of the model were covered by 15 questions. All items were translated to German. All scales are 5-point-Likert scales. A physician's agreement with each item was indicated from 'Does apply' to 'Does not apply'. As shown in Table 2, all constructs are measured by three items. This was done to shorten the answering time and reduce the response burden⁵¹ as much as possible, while retaining acceptable construct measures.

The constructs for the VAM part of the model are based on Kim et al.³² They provide scales to measure *perceived usefulness*, *expected enjoyment*, *perceived technicality* and *perceived cost* as well as *adoption intention* in the context of mobile internet in general. We adapted the scales to the more specific case of telehealth. As above, all items were translated to German. All scales are 5-point-Likert scales. All items of the VAM part of the model were covered by 15 questions. Only the recommendation intention was measured by one item since it acts as dependent variable in this study.

Table 2. Reliability and Validity.

Variable	Item	Factor Loading	Cronbach's α	Mean (SD)	AVE	CR
Perceived satisfaction from helping others	INT1	0.6675	0.96	3.93 (1.26)	0.84	0.94
	INT2	0.7268				
	INT3	0.6292				
Perceived process improvements	IMPI	0.6802	0.88	3.75 (1.23)	0.69	0.87
	IMP2	0.6308				
	IMP3	0.7296				
Perceived social pressure	SOC1	0.6912	0.87	3.13 (1.27)	0.71	0.88
	SOC2	0.7365				
	SOC3	0.7921				
Perceived decreased patient autonomy	AUT1	0.8467	0.84	2.11 (0.95)	0.69	0.87
	AUT2	0.8805				
	AUT3	0.6499				
Perceived usefulness	USE1	0.7658	0.86	3.82 (1.15)	0.85	0.94
	USE2	0.7758				
	USE3	0.8004				
Perceived enjoyment	ENJOY1	0.8356	0.96	3.30 (1.23)	0.85	0.94
	ENJOY2	0.9217				
	ENJOY3	0.8083				
Perceived technicality	TECH1	0.7833	0.91	3.90 (1.07)	0.74	0.89
	TECH2	0.8287				
	TECH3	0.9245				
Perceived fee	COST1	0.7684	0.79	2.04 (0.95)	0.63	0.83
	COST2	0.7614				
	COST3	0.8112				
Adoption intention	INTENT1	0.8935	0.96	3.82 (1.39)	0.86	0.95
	INTENT2	0.7749				
	INTENT3	0.8880				

The study was presented to the advisory board of the DHG, which approved it and provided an additional cover letter. The cover letter informed about the purpose and anonymity of the study. All procedures performed were in accordance with the ethical standards of conducting a questionnaire study. Two members of the advisory board also assessed the translation and wording of the items.

We added five variables to measure sociodemographic properties and control for the physicians' working conditions. The added variables include the physician's age and gender, his treatment frequency of haemophiliacs (in terms of number of patients per month), distribution of documentation method and his centre's app support (ie if a telehealth system is available in the treatment centre). The responding physician must estimate the variables *treatment frequency* and *distribution of documentation method* because they are usually not exactly documented anywhere. If a treatment centre does not

support an app use, the patient cannot transmit the data electronically to the centre and the treating physician. While age and gender are rarely a determining factor for change in physician behaviour,⁴⁰ this might differ in the case of new technologies. Asking about treatment frequency is necessary, since physicians treat a strongly varying number of haemophilia patients. Physicians with a high treatment frequency might be more likely to use telehealth as a tool to reduce their work load. The physicians' age was measured in age brackets to maintain anonymity in the small sample.

Results

Respondent Data

More than three quarters of the participants work in centres supporting the use of telehealth apps. Note that about half of

Table 3. Results of the Multiple Regression Models.

Variables	SDT Model 1	SDT Model 2	VAM Model
Sample size (n)	47	38	38
Age	−0.05	−0.03	−0.19
Gender	−0.26	−0.22	−0.21
Frequency	0.00	0.00	−0.01
Centre supports telehealth	0.44		
Adoption intention	0.45	0.45**	
Perceived satisfaction from helping others	0.41***	0.25	
Perceived process improvements	0.40***	0.24***	
Perceived peer pressure	0.12	0.08	
Perceived decreased patient autonomy	−0.04	−0.05	
Perceived usefulness			0.52***
Perceived enjoyment			0.21
Perceived technicality			0.22
Perceived fee			−0.19
Constant	0.26	0.52	2.10
Dependent variable	Recommendation intention	Recommendation intention	Adoption intention
Mean VIF	2.64	2.29	2.20
Max VIF	4.54	4.31	3.48
Adj. R ²	0.865	0.841	0.643

*** = P<.01, ** = P<.05, * = P<.1

the treatment centres in Germany offer telehealth for haemophilia.⁵² This means that centres that offer telehealth are overrepresented in our sample (via physicians who work there). However, not all patients treated in a centre use telehealth. According to the surveyed physicians, about 63% of patients use paper-based documentation and only 33% an app. The resulting 4% use some electronic support that they or someone built for them (eg a spreadsheet). Most physicians in the sample are between 40–59 years old with a nearly equal gender distribution. No physician is younger than 30. The treatment frequency ranged from 3 to 55 patients per month. On average, a physician treats 17.12 patients per month, but as assumed, the differences in treatment frequency are big (SD = 12.76).

Reliability and Validity.

As Table 2 shows, all constructs meet the criterion of a minimal Cronbach α of .7 for the overall reliability.⁴⁸ Since we use several adopted or self-designed measures, a confirmatory factor analysis was conducted to ensure the quality of the measures. The global criteria are below the usual thresholds (RMSEA: .204; CFI: .708; TLI: .64), which is likely due to the small sample size. Construct-wise, the results satisfy the statistical requirements: as Table 2 shows, the AVE is above .5 (Fornell–Larcker-Criterion) for each construct. The CR is also above the recommended threshold of .7⁵³ for each construct. Factor loadings are also above the required threshold of .6.⁵³ Therefore, all of our constructs can be used in the upcoming analyses.

Regression Analysis

The regression analysis is split into three parts: Firstly, we analyse the variables influencing recommendation intention considering the full sample (SDT Model 1, n = 47) but without the formative parts of VAM. We only consider intrinsic and extrinsic motivation, amotivation and the physicians' adoption intention as antecedents of recommendation intention (see Figure 1). The regression shows acceptable overall results (Adj. R² and VIF), but only two factors are significant (see Table 3, column 2). A closer look at the data reveals that nine physicians work in centres that do not support telehealth. Obviously, they cannot use the functions of the software that are provided for physicians and have the data transferred automatically to the central registry. Therefore, they cannot adopt telehealth, and the (lack of) adoption intention has no influence on recommendation intention in the whole sample (see Table 3, column 2). In the next calculation, we reduce the sample to include only physicians in centres that already offer telehealth (n = 38), that is, we exclude the relating variable *centre supports telehealth*. Now the variable adoption intention is also significant in the expected way (see Table 3, column 3). In the last regression, we analyse the VAM Model (see Figure 1), that is, the variables influencing adoption intention (see Table 3, column 4). Note that for ease of reading, we define constructs as 'perceived' by the physicians, yet in the case of physicians in centres not supporting telehealth, 'expected' would be probably the correct term (in principle they could have gathered some experience in the past if they previously worked in a centre that supported telehealth).

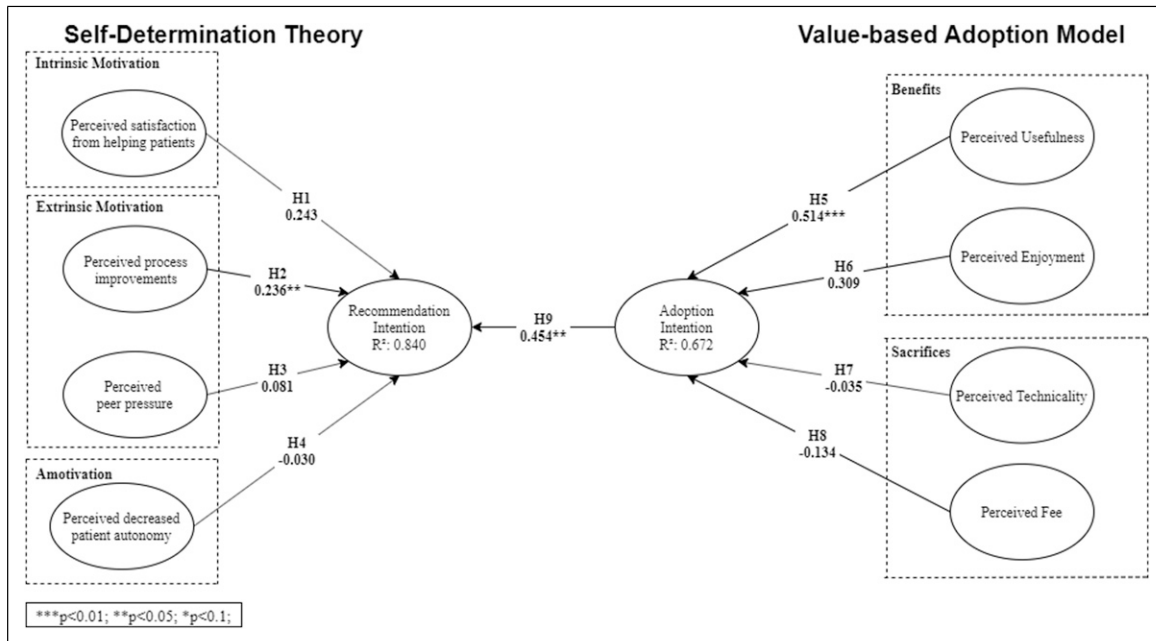


Figure 2. Result of the partial least squares structural equation modeling model.

Table 3 presents the results of the regression analyses.

The maximum variance inflation factor (VIF) is far below the critical threshold of 10 in all models, indicating no confounding from multicollinearity.⁵⁴ The adjusted R^2 shows that the models explain a relevant part of the change in the dependent variable. Due to the high significance and adj. R^2 all three regressions achieve a statistical power level of 90 %.⁵⁵ The intrinsic motivation perceived satisfaction from helping others and the extrinsic motivation perceived process improvements show a significant influence on recommendation intention, while perceived usefulness exerts a significant influence on adoption intention. The three control variables age, gender and frequency show no change or influence in any model. Adoption intention is only significant if centre using telehealth is not included in the regression, that is, if we only observe physicians whose centre is supporting telehealth.

SEM Analysis

In a second step, partial least squares regression (PLS) with SmartPLS 3 was used to analyse the whole research model at once. In contrast to the multiple regression analysis, this allows us to consider the effect of the complete VAM part on recommendation intention. Figure 2 shows the main results. Three connections are identified as significant influence: perceived process improvements ($\beta = .236$, $P = .048$), perceived usefulness ($\beta = .514$, $P = .006$) and adoption intention ($\beta = .454$, $P = .016$), both the SDT and VAM part of the model are relevant to explaining recommendation. These results are consistent with the previous regression analyses, indicating the robustness of the results. The results also show that the

constructs, including the ones that are not significant, have the expected signs.

With the adjusted R^2 of .840 for recommendation intention and .672 for adoption intention (see Figure 2), the chosen antecedents are well-suited for predicting both constructs. The statistical power for both constructs is above .99; therefore, the possibility of type-II-errors is very low.⁵⁶ The model fit requirements are satisfied with an SRMR of .035 and an NFI of .937^{48,49}. Factor-level VIFs also stay below 3.3, indicating no CMB.⁵⁰

Discussion

The key findings are that physicians would recommend a haemophilia app to their patients especially if the physicians themselves use the functions afforded by the software, that is, they perceive the software as useful and adopt it. In addition, perceived process improvements positively influence the physician's recommendation willingness. These relationships are shown in the PLS-SEM and supported by the regression analyses, which we will discuss in more detail in the following sections.

The PLS-SEM showed three significant relationships regarding recommendation intention. As expected, the physician's adoption intention influences whether he will recommend the app to a patient. It offers the strongest explanatory value for recommendation in the model. Physicians recommend telehealth software if they use its features themselves. The physician's decision to use the software is influenced by his perceptions of the usefulness of its functions, which confirms previous findings on the importance of

perceived usefulness in physician HIT adoption.^{21,45,46,57} As described above in the section on hypotheses development, the functions include here automated reporting to the national central registry, easy visualization of patients' haemophilia-relevant blood values and comparison of patients by different criteria. Perceived process improvements influence the recommendation intention as well. These improvements are also provided by the functions of the app and include patient monitoring, easier reporting processes and making patient data more easily available for further processing. The relevance of improved efficiency concurs with a longitudinal telehealth study, where physician requirements for adoption were researched.⁵⁸ The other extrinsic motivation, peer pressure, does not influence the recommendation intention. This may be explained by an earlier study by Zheng et al.⁵⁹: They found that the adoption decision by physicians is influenced by healthcare professionals only if they are also part of the physician's friend network. The items in our study did not focus on befriended physicians only. Venkatesh et al.⁴⁵ offer another explanation. They found a significant, but adverse effect of social influence: Physicians who were better connected in their professional networks were less likely to introduce new EHR technology, if the new technology was perceived as reducing their autonomy and power. While the peer pressure shows no negative influence in our case, the effects may cancel each other out. The remaining STD part showed no other influence on recommendation intention. Physicians do not recommend telehealth software out of an intrinsic desire to help patients, but rather due to the influences listed above. Physicians fear that patients feel a decrease in autonomy when they are monitored by their physician through the app. However, this amotivation variable is not influential. This may be explained by the positive effects of telehealth software on patient autonomy identified in several recent studies showing that self-governing of treatments increases patient autonomy.⁶⁰⁻⁶² The positive effect may offset the expected decrease in autonomy.

Apart from perceived usefulness, the VAM variables were non-significant. Concerning perceived enjoyment, the topic of chronic disease management may simply be too serious to allow for much joy when using the system. Perceived technicality may be more system-than physician dependent, and the two existing systems could be easy enough to use. A recent study researched, for example, the physician satisfaction in places where telehealth was rapidly established due to COVID. They found that technical difficulties and tedious handling impeded physician satisfaction.⁶³ Perceived fee is also likely not significant since the two systems are supported either by a pharmaceutical company or an independent association supporting research in haemostaseology (VFTH e.V.). In this context, both act as third parties that supply/finance the server infrastructure as well as technical support and free training courses.^{14,64}

The findings of the three multiple regression models support the results of the PLS-SEM and offer additional

insight: As the first regression analysis showed, satisfaction from helping others can be a significant influence under specific conditions. If recommendation intention does not consider the physicians' own system use, they seem to be influenced by the (perceived) satisfaction from helping patients. However, under daily work pressure, their altruism is overshadowed by the usefulness of technology for their daily work. It can be expected that if they can work with the technology in a useful way, they will become more effective which will benefit their patients too. The regression analysis therefore validates the main findings of the PLS-SEM model, with perceived usefulness and process improvements as the most influential variables. The treatment frequency had no influence on either recommendation or adoption intention, perhaps due to a relatively small absolute number of haemophiliacs a physician is treating. Neither did age, but more than half of the physicians in this sample were in the group between 50 and 59 (which is also true for the whole population).

Our study contributes knowledge to the research about physicians as central decision-makers in health environments. This follows the remark of Sykes et al.¹⁹ that the increasing deployment of EHRs makes understanding the drivers of its use an issue of practical and scientific significance. While previous research suggested that physicians' treatment decisions were usually determined by personal preferences, our study finds usefulness for work to be the determining factor as the most important lesson.

The practical implication for the development of telehealth apps for illnesses like haemophilia is that it is not enough to develop software that benefits patients. Physicians treating the illness must be involved to include processes they deal with, partly in the background. The benefits for physicians will then lead to their recommendation to patients, especially, if both sides are made aware of the possibilities afforded by the software. Insurance companies and other supporters of telehealth software (eg patient associations) may also learn from our findings since apps reduce treatment costs.

Limitations

Limitations of our study mainly concern the sample size as well as the specific setting and the indirect measurement. The sample size was addressed by using a mix of methods well-suited to handle small sample sizes. Regression analysis as well as PLS-SEM has been utilized to ensure our results are not biased by a single methodological confounding factor. While haemophilia treatment as the setting of the study only relates to a small number of patients and physicians (compared to diabetes, for example), there is no reason to expect that the results do not hold on a bigger scale, that is, in the treatment of more prevalent chronic diseases, since the impact of a physician's recommendation is likely similar. Lastly, we only measured the intention to use and recommend the telehealth system. Since our main results only include physicians of centres where the telehealth systems are already

available, the barriers from intention to actual use are low. Nonetheless, a future follow-up study would ideally have a longitudinal design and track the relation between intention and use.

Declaration of Conflicting Interests


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