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ORIGINAL PAPER

Primary Care Physician's Attitude Towards the GERMAN e-Health Card Project—Determinants and Implications

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Abstract In Germany e-health cards will be distributed nationwide to over 80 million patients. Given the impending mandatory introduction of the e-health technology, the objective of this study was to examine the determinants of primary care physicians' acceptance of the technological innovation. The study was conducted prior to the introduction of the e-health cards. A questionnaire survey was carried out addressing primary care physicians from different fields. The reduction of medication error rates and the improvement of communication between medical caregivers are central aspects of the perceived usefulness. Primary care physicians rate their involvement in the process of the development of the technology and their own IT expertise concerning the technological innovation as rather low. User involvement and IT expertise can explain 46 % of the variance of perceived usefulness of the e-health card. User involvement plays a crucial role in the adoption of the German e-health card. Primary care physician's perspective should be represented in the process of developing and designing the technology.

Keywords E-health card · Perceived usefulness · Physician attitudes · Technology-acceptance model

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Introduction

The use of Information and Communication Technology (ICT) in healthcare is increasing. ICT has the potential to improve the effectiveness and efficiency of care [1]. The success of these technologies depends on the acceptance of its users [2]. In research technology acceptance has been defined in various ways. Corresponding to an overview by Whitten and Richardson [3] definitions fall into one of four categories: effectiveness or efficiency (a), adoption/utilization (b), perception (c), or satisfaction (d). Effectiveness or efficiency can be understood to be of diagnostic or therapeutic value. The acceptance or utilization can be measured by the rate of adoption. Perceptions can be measured by questionnaires and include subjective factors such as perceived usefulness and perceived ease of use. Satisfaction is regarded as a central determinant of technology acceptance [4], but may be a vague concept with high satisfaction-scores and low discriminant validity. Acceptance is regarded as an ambiguous multidimensional construct which is subject to contextual influences. Predictors of technology acceptance are separated into four main categories: Organisational factors (e), technology factors (f), job factors (g), and individual factors (h) [5].

Organisational factors include the degree to which the new technology can be integrated with existing technologies, the management commitment, training, end user participation, and organisational justice. The technology factors studied most often are response time, flexibility, breakdowns, ease of use, and usability. Job factors are the degree of job change caused by the new technology. Individual factors include computer self-efficacy, expert knowledge, age, and gender.

The most prominent model for examining technology acceptance is the technology-acceptance model (TAM) by Davis [6]. TAM is an adaptation of the theory of reasoned action by Fishbein and Ajzen [7] specifically tailored for modelling technology acceptance. The goal is to provide an explanation of the determinants of technology acceptance that is both concise and theoretically justified [8]. TAM posits that perceived usefulness and perceived ease of use are the two relevant beliefs for the acceptance of computer technology. Perceived usefulness is defined as the user's subjective probability that using the technology will increase his or her job performance. Perceived ease of use is the extent to which the user expects the technology to be free of effort. Both perceived usefulness and perceived ease of use determine the attitude towards the target system. The attitude determines the behavioural intention. In addition, perceived ease of use influences perceived usefulness. The easier a system is to interact with, the greater will be the benefit for the organisation. Perceived usefulness and perceived ease of use are determined by external factors such as system features, contextual factors, or personal attributes (see Fig. 1).

A variety of external factors as determinants of central beliefs have been studied [9–13]. Regarding external factors influencing individual's expectations on the outcomes of using a technological innovation prior to introducing the technology, computer self efficacy is a central belief. It is defined as the belief that one has the capability to perform a particular operation with the computer. The construct derives from Banduras widely accepted research on the role of self efficacy within the framework of Social Cognitive Theory [14]. Paré, Sicotte and Jaques examine the role of psychological ownership on physicians' acceptance of clinical information systems [15]. Psychological ownership is shown to be positively associated with physicians' perceptions of system utility and user friendliness.

The findings about the effects of psychological ownership are related to the research on positive effects of user involvement on the success of implementing new technology. User involvement refers to participation in the system development process by representatives of the target user group [16]. Ives and Olson describe five factors by which user participation may lead to increased user acceptance: by developing realistic expectations about system capabilities, by providing an arena for bargaining and conflict resolution about design issues, by leading to system ownership, by decreasing user resistance to change, and by committing users to the system. Beyond system acceptance, outcomes of user involvement refer to system quality. Participation is predicted to improve system quality by providing a more accurate and complete assessment of user information requirements, by providing expertise about the organization the system is to support, by avoiding development of unacceptable or unimportant features, and by improving user understanding of the system [16]. In their review Hyclak and Kolchin come to the conclusion that user involvement is critical in implementing new technology as such involvement results in greater support and commitment for technological change [17]. Research shows that user involvement in design and implementation of a new technology positively affects users perceptions of system usefulness, system appreciation and system satisfaction [18–20]. Additionally, involvement in the implementation process can reduce the employees level of strain, which is found to increase during the implementation process of new technologies [21].

Study context and objective

In Germany e-health cards will be distributed nationwide to over 80 million patients [22]. The objective of the nationwide implementation of the e-health card system is to facilitate and standardize the communication between the institutions of the German healthcare system, i.e. physicians, hospitals, pharmacies, and health insurance organ-

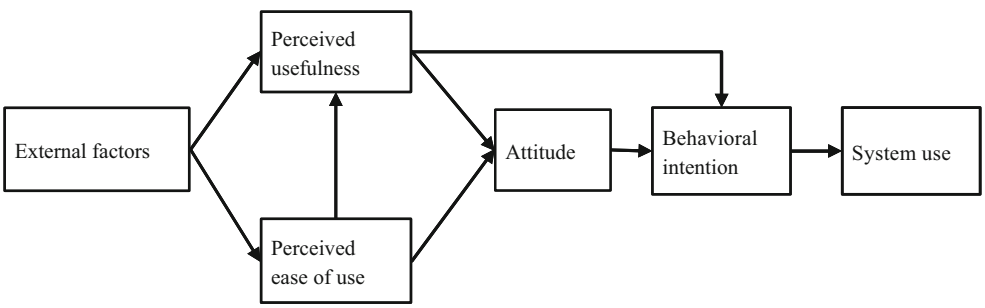

Fig. 1 Original Technology Acceptance Model [6]

izations. Obligatory applications of the e-health card will be the storage of administrative data either on the card or a background system (insurance data, information on co-payment status, entitlement to treatment in other European countries) and electronic prescriptions. Optional applications imply the storage of medication records, emergency data, additional health information, electronic discharge letters, and personal data supplied by the patients (e.g. diabetes flow charts). At present the technology is being tested in several model regions, ahead of the forthcoming nationwide launch of the e-health card.

The use of the e-health card technology is linked with an electronic health professional card (HPC) for the authentification of physicians and pharmacists. For the electronic prescription as a first mandatory application of the e-health card, the physician generates the prescription on his computer. He signs the prescription with a six figure digital signature. The e-prescription is either saved on the card or on a central server. The physician has the option to print out medication, which is for information only and does not replace the electronic prescription. The pharmacy can access the prescription directly on the card or, through the card, on the server with his health professional card. The pharmacist checks the digital signature and hands out the medication. The prescription is then deleted.

Although the use of the e-health card is mandatory for healthcare professionals and patients, the new system is a complex network that depends upon the acceptance of its users [23]. Thus, the acceptance of all potential users is required to facilitate the success of this technology. The purpose of our work was to analyze factors influencing the primary care physicians' acceptance of the new technology. Prior to implementing the e-health-card in Germany, the study examined in particular the impact of personal beliefs (user involvement and IT expertise), job-related factors (IT use in medical practice, size of medical practice, and years of professional experience) and sociodemographic factors (age and sex) on primary care physicians' anticipated usefulness of the e-health-card-system. The objective was to detect barriers to a successful implementation of the new technology that could be overcome with systematic measures prior to the introduction of the technological innovation. The research model is based on TAM [6]. According to the literature, the external variable user involvement is hypothesized to positively affect perceived usefulness [15, 18, 20, 24]. The user involvement measured is a perceived representative user involvement, i.e. the feeling of being represented as a group involved in the process of developing and introducing a technological innovation. The IT expertise is related to IT control and computer self-efficacy and therefore hypothesized to positively influence perceived usefulness [25]. User involvement and IT expertise as personal beliefs are supposed to have a stronger impact on the perceived usefulness of the e-health card than socio-demographic and job related factors.

Methods and materials

To examine the present research question a questionnaire addressing primary care physicians from different fields had to be developed. The process of questionnaire development and design followed an iterative process to maximise the utility of the methods applied. In the first step a prototype of the questionnaire was developed. Some items regarding the acceptance of the e-health card system were adapted from Davis [26] and Taylor and Todd [27]. In the second step a group of experts involved in the design, development, and specification of the German e-health card evaluated the items. Then two focus groups with primary care physicians were conducted to test the items and scales and add new aspects of constructs when necessary. The method of focus groups can be applied in the questionnaire development cycle to learn how potential respondents structure their thoughts about a topic, to gather information about their opinions concerning the sensitivity or difficulty of the questions, to specify terminology, or to generate new items [28, 29]. In the next step the revised survey instrument was tested by conducting cognitive think aloud-interviews. Cognitive interviewing addresses the mental processes of respondents. It provides a way to address difficulties in designing questionnaires, such as minimising response error due to the wording of questions, format of the questionnaire and the order of the questions. In the think-aloud interview the respondent puts his or her thoughts into words while completing the questionnaire [30]. With respect to readability, comprehensibility, directness, concreteness, unambiguousness, and relevance for the construct of each item the final questionnaire was completed.

The survey was carried out in the setting of a medical congress in November 2004 addressing primary care physicians from all fields of medicine. Respondents were recruited among visitors of the event. Prior to the data collection the interviewers were trained by the researchers in terms of inclusion and exclusion criteria, standardization of the screening, and standardization of the interview situation. Further training included frequently asked questions regarding the e-health card technology. The recruitment locations were balanced across the congress events with special respect to events comprising IT and health care technology. These events did not serve as recruitment locations in order to avoid selection bias in terms of IT interest and expertise. Inclusion criteria required that participants had to be primary care physicians working in Germany. Seven hundred contacts met the inclusion criteria; 243 of those agreed to participate (response rate

of 35%); 188 (77%) were primary care physicians, 55 (23%) were physicians working in hospitals. The present analysis includes only primary care physicians.

Beside the items for sociodemographic and job related factors, the scales being developed for the personal beliefs user involvement, IT expertise, and perceived usefulness were chosen to examine the present research question. The hypotheses were tested with a stepwise linear regression analysis.

Results

First descriptive sociodemographic and job related characteristics of the respondents are reported, followed by the results of factor analysis, reliability testing and descriptive measures for the personal beliefs. Finally the results of the regression analysis are presented.

Of the 188 questionnaires, 63.7% were received from men and 36.3% from women, 22.9% were aged ≤40, 39.1% were aged 41–50, 31.9% were aged 51–60, and 6.1% of the respondents were aged >60. The majority (52.3%) of the respondents indicated that they practiced in the field of general medicine, 11.6% were physicians practicing in internal medicine. Other fields, e.g. gynaecology, neurology, and surgery, were marginally represented (see Table 1). The sample is representative for the population of German physicians working in medical practice regarding age and gender, as reported elsewhere [31]. Many of the respondents used information technology for various applications: 91% for their accounting system and prescriptions, 81.9% for the patient management, 76.9% to access drug information, 75% for writing letters, and 46.3% to access the internet.

Table 2 presents the items of each personal belief. The factor loadings and reliability of the scales are satisfying. When comparing the scale scores perceived usefulness was rated higher than user involvement and IT expertise (higher scores stand for better ratings). The reduction of medication error rates and the enhancement of communication between medical caregivers are expected to be consequences of the technological innovation by the majority of the respondents. Nevertheless the mean ratings of perceived usefulness are rather low (in the range from 1–4) and the average rating of user involvement shows very low values. The primary care physicians assess their own IT expertise on average as adequate, however the IT expertise of their assistants is considered as rather poor.

The regression model can explain 46% of the observed variance of the primary care physicians' perceived usefulness of the e-health-card (see Fig. 2 and Table 3). The factors age, sex, size of medical practice, years of professional experience, and IT use were removed in the stepwise procedure (see Table 3). The hypothesized positive effects of user involvement and IT expertise on the anticipated usefulness of the e-health-card could be confirmed. Figure 3 illustrates the standardized partial regression plots of the independent variables user involvement and IT expertise. When comparing the effects of the independent variables by means of the standardized beta-coefficients, user involvement plays a larger role in explaining the differences in perceived usefulness.

Discussion

As there are limitations to all research, it is essential to state those which affect the conclusions of this study. The data was collected at one point in time, therefore causal inferences cannot be drawn from this data [32]. Correlation and regression analyses are not substitutes for controlled experiments. Further limitations stem from the use of self-report-measures for all variables. The study was undertaken prior to introducing the e-health-card technology; therefore objective outcome data such as system use could not be collected. Thus, social desirability might have influenced the answers [33, 34]. However, it is to be expected that the sample is not representative in terms of interest in

Table 1 Profile of the respondents (N=188)

Profile of the respondents	
Factor	%
Sex	
Male	63.7
Female	36.3
Age	
≤40	22.9
41–50	39.1
51–60	31.9
>60	6.1
Field	
General medicine	52.3
Internal medicine	11.6
Gynaecology	5.8
Ophthalmology, Otorhinolaryngology	5.8
Dentistry	5.8
Neurology, Psychiatry	5.2
Surgery	2.9
Others	10.5
IT use	
Accounting system	91.0
Prescriptions	91.0
Patient management	81.9
Drug information system	76.9
Letters	75.0
Internet	46.3
Others	4.6

Table 2 Item factor loadings, descriptive measures, and reliability of the scales

Items and scales	Factor loading	*M*	SD	Min	Max
Perceived usefulness (Cronbach's alpha 0.74)					
The e-health card will reduce medication error rates	0.81	2.73	1.052	1	4
The e-health card will facilitate the communication between medical care institutions	0.82	2.66	0.961	1	4
The e-health card will reduce time for medical office administration	0.81	1.84	0.907	1	4
User Involvement (Cronbach's alpha 0.68)					
Physician's interests are being considered during politician's decision making about the implementation of the e-health card	0.84	1.63	0.697	1	4
Physicians' needs are not being met during the specification of the e-health card[a]	0.73	1.54	0.667	1	4
Physicians' interests are being sufficiently represented by medical associations in the development process of the e-health card	0.79	1.88	0.754	1	4
IT Expertise (Cronbach's alpha 0.64)					
It will take a lot of time to get familiar with the new e-health card software[a]	0.75	1.69	0.804	1	4
Expensive training will be required to introduce assistants to the e-health card system[a]	0.80	1.69	0.796	1	4
My computer skills will allow me to manage the new e-health card system without expensive training	0.74	2.55	0.969	1	4

[a] Note: negatively worded items were reversed-scored.
M mean, *SD* standard deviation, *Min* minimum, *Max* maximum

information technology and IT expertise. Since efforts have been made in varying recruitment locations and in avoiding the recruitment of participants in the context of IT tutorials and courses, the selection bias might be marginal.

Nevertheless, the study results suggest that personal beliefs, in particular user involvement, play a crucial role in the adoption process of a new technology since they positively affect the perceived usefulness as a central determinant of the IT use according to TAM [6]. Presumably the perceived usefulness of a technology is multifaceted. However, our findings indicate the importance of user involvement in the appreciation of new technology. The results indicate that the user's perspective needs to be incorporated even in mandatory IT implementation processes to facilitate the success of the technology. The fact that IT use in medical practice has no significant effect on the perceived usefulness of the technology can be interpreted in different ways. Since the findings suggest that IT is widely used in medical practice for various applications, the additional benefit of an e-health card is perhaps not evident to the physicians. On the other hand, the ratings of perceived usefulness are rather low, i.e. physicians are not aware of useful aspects of the new technology or do not judge the established aspects as useful in their practice. This unawareness might cause the phenomenon that IT use does not affect the perceived usefulness of the technological innovation. In both cases, the high potential of the e-health card to improve the efficacy, effectiveness, and efficiency of health care delivery needs to be communicated as a direct way to maximise the perceived usefulness. It is

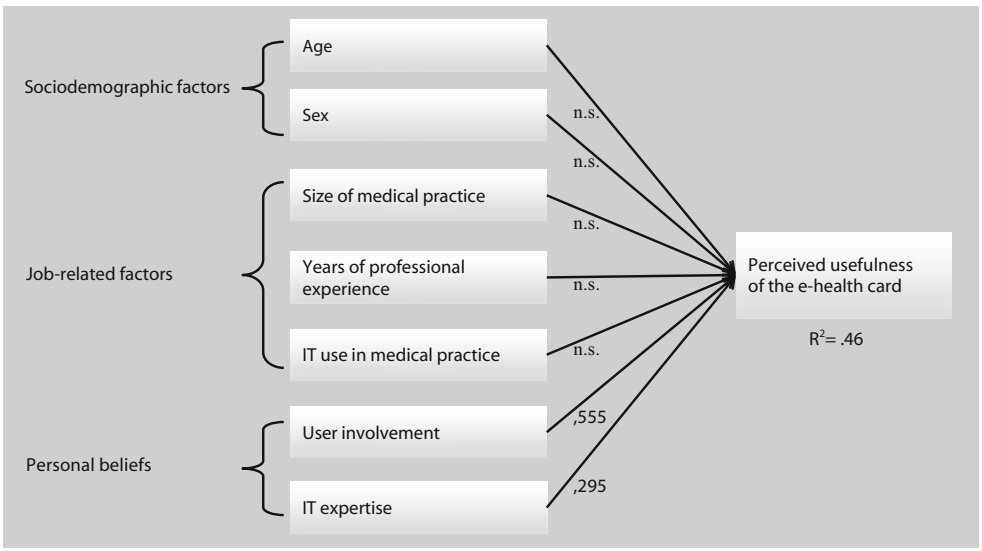

Fig. 2 Research model and regression results

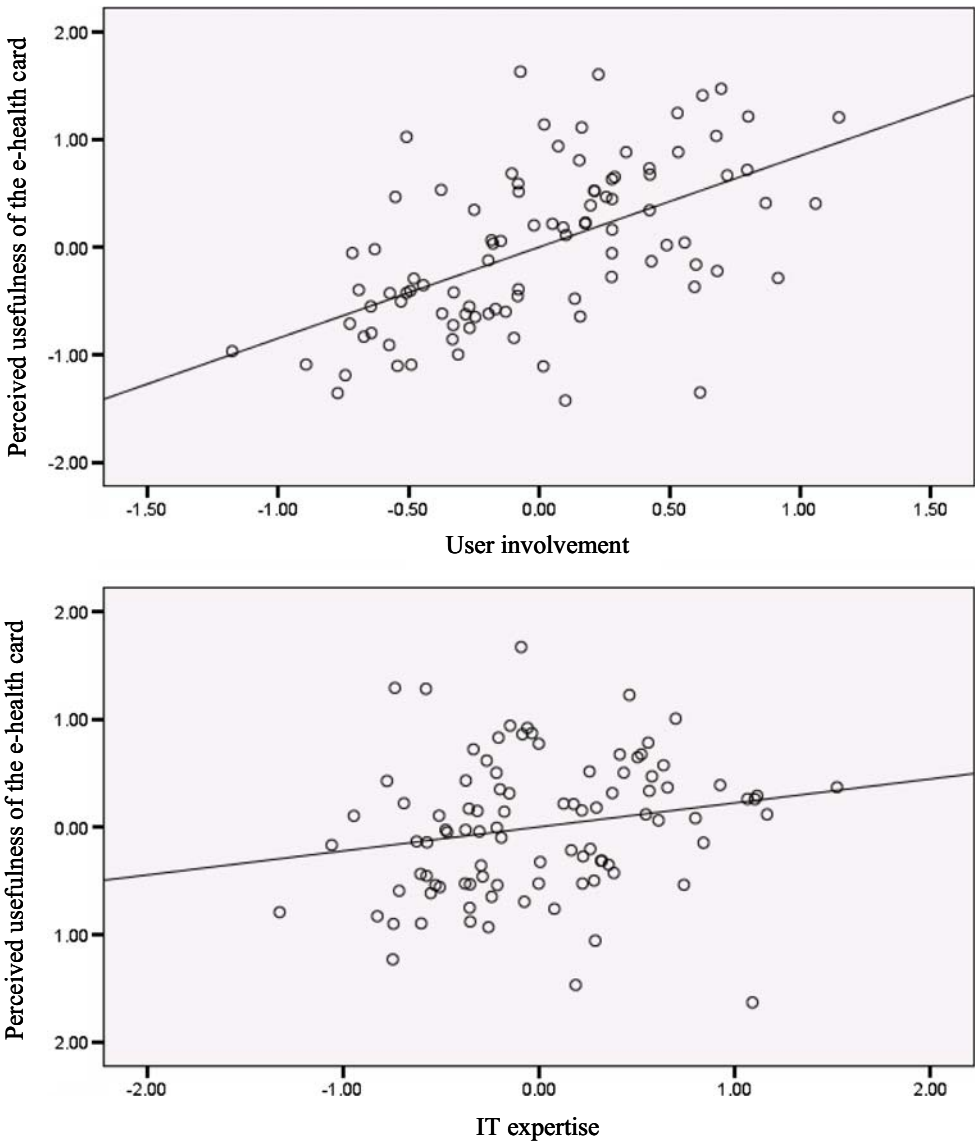

Fig. 3 Standardized partial regression plots

important that technologists and scientists working with ICT learn to educate health care professionals about the possible applications and their usefulness in the proper circumstances [35]. The statements concerning user involvement show low values, hence there is a wide scope for measures addressing physicians' requests and needs as an indirect way to improve the perceived usefulness by integrating the user's perspective. It has to be stressed that the user involvement measured in this study is the perceived, i.e. subjective, representative user involvement. This implicates that the measures to be undertaken have to deal with the physicians' subjective perspective and their feelings of being involved as a group of German physicians. The subjective impression of being a stakeholder and of having the opportunity to participate in the development process is vital. The physician's perspective needs to be measured in empirical studies and has to be integrated into the design and implementation process of the e-health card.

Table 3 Stepwise linear regression analysis (dependent variable: perceived usefulness of the e-health card)

	Beta coefficients	*t* value	*p*
Independent variable			
User involvement	0.555	7.767	0.000
IT expertise	0.295	4.126	0.000
Adjusted coefficient of determination (adjusted R^2)	0.46		
Removed variables			
Age	−0.032	−0.455	0.650
Sex	0.049	0.6941	0.491
Size of medical practice	−0.072	−0.978	0.330
Years of professional experience	−0.023	−0.323	0.747
IT use in medical practice	−0.022	−0.291	0.771

Designing the technology according to the cognitive needs of physicians is central [36]. Since German physicians are organized into scientific organisations as well as federal German Medical Associations, these organisations should foster the involvement of the physicians' perspective in the company responsible for the introduction, maintenance, and enhancement of the e-health card system owned by all contract partners of the German healthcare system on the federal level. To use the full potential of such measures the efforts and their results need to be communicated by public-awareness programs [37] and target group specific information campaigns.

The next step in examining the determinants of a successful implementation of the e-health card is to conduct prospective studies in representative settings. This research should evaluate the effect of user involvement while testing and implementing the technology and use objective measures of user acceptance. Beyond the physicians' concerns, research should focus on the patient's perspective on the new technology. Patient's requirements need to be met as it is to be expected that the involvement of the patients perspective and the communication of such efforts also results in a higher acceptance of the new technology.

Conclusion

The implementation of computer technology is often obstructed by user's unwillingness to adopt the new technology. Perceived usefulness and perceived ease of use are two central beliefs for the acceptance of computer technology. External factors influencing the central beliefs such as control, motivation, emotion, cognitive absorption, self efficacy and psychological ownership have been studied in diverse settings. As to the acceptance of the German e-health card system, the reduction of medication error rates and the improvement of communication between medical caregivers are central aspects of the perceived usefulness. The study results suggest that primary care physician's involvement in the process of developing and testing the new technology and their own IT expertise influence their perception of the usefulness. Therefore primary care physician's needs should be measured while testing the new technology. Those efforts should result on the one hand in training and information campaigns for primary care physicians and on the other hand in designing and adjusting the new technology according to the future user's special needs.

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