DO GERMAN PHYSICIANS WANT ELECTRONIC HEALTH SERVICES?

A Characterization of Potential Adopters and Rejecters in German Ambulatory Care

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Abstract: Germany is introducing a nation-wide health telematics infrastructure that enables various electronic health services (EHS). Little is known about the burdens and drivers for potential adoption of these innovations. Based on a quantitative study among German physicians participating in pilot test regions for health telematics, this paper clusters potential adopters and rejecters of EHS, based on their usage intention as determined with the UTAUT model. The study furthermore depicts opinions, attitudes, as well as equipment of physicians in ambulatory care to find similarities in terms of IT diffusion, process and security standardization, patient involvement, communication, documentation and general working patterns. The clustering shows that "Supporters" and "Rejecters" of EHS differ significantly in many aspects investigated. Based on these empirical findings, implications for design and introduction of e-health services can be derived, ranging from a different way of approaching physicians in ambulatory care to incentive structures for EHS usage.

1 INTRODUCTION

As health information systems have the potential to improve Healthcare quality (Shekelle et al., 2006), German health authorities are currently building a nationwide telematics infrastructure (TI) in order to harmonize transactions and data storage of e-health applications in the German public health system. Universal accessibility of data without institutional boundaries, via web services or common portable data carriers, aims at reducing healthcare costs by avoiding redundant examination of patients and administration (Bundesministerium für Gesundheit, 2005). Unified telematics specifications can ensure high data security standards, a standardized access process and common data formats throughout the national health system (Sunyaev et al., 2008). Misuse can be avoided by mandatory encryption of health data and role based access rules for health care providers (gematik, 2008b, German Federal Office for Information Security, 2008).

A major goal of the efforts is the enforcement of patient centered treatment (Marschollek and Demirbilek, 2006), standardization and transparency of medical treatment. In Germany the telematics infrastructure is used as the backbone for the mandatory electronic health card (eHC) system. The infrastructure is specified by a government controlled institution, and connects existing information systems of care providers via a common

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network with shared data storage locations (Fraunhofer Institut, 2005). This service oriented architecture (SOA) provides services: the primary systems (e.g., clinical information systems or practice information system) of medical institutions can invoke them to communicate with other care providers and maintain, review or share medical data objects. A local component, called "Connector," encapsulates all local services, as encryption or card access and establishes a secure virtual private network (VPN) connection to the central services if needed (gematik, 2008a).

So far a number of different basic offline health services, such as electronic prescription, emergency data, and insurance basic data service, have been tested in seven regions to verify the functions of the technical infrastructure deployed. In the long term, further services like electronic health records, electronic physician letters, and electronic drug documentation should be offered online via the infrastructure. The infrastructure will be kept open for the development of commercial value-added services (Bernnat, 2006). Evaluation of the online functionality of electronic health services will be started with around 200 care providers in the test region, involving about 100,000 citizens with health insurance.

2 DISPUTE OVER THE EHC

Previous surveys have shown that a vast majority of physicians rejects electronic services offered by the National TI (Techniker Krankenkasse, 2009, Oliver Kalthoff et al., 2008). Numerous campaigns have been started by medical associations and politicians, calling for a moratorium of the eHC project (Tuffs, 2008). The main reasons for rejection, as indicated by the objectors, are safety concerns about central storage of patients' medical data as well as the unsatisfactory performance during the offline testing of services and infrastructure (Oliver Kalthoff et al., 2008). Moreover, testing and introduction of the eHC have been delayed many times: although the initial introduction date was set for 2006, the testing has still not been completed in 2009. The date of the final introduction is not yet clear.

In order to get a clear picture of the characteristics of physicians in the ambulant sectors, we analyzed the characteristics in depth of physicians who, in contrast to care providers in hospitals, decide independent of management on the adoption of the TI and its services. Important fields of medical work, intended to be improved by the telematics, were the focus of the research. The goal was to conclude whether rejection and support of the telematics correlate with other aspects that are important in daily work in ambulatory practices. Therefore, the usage intention was measured directly to get a clear picture of the general adoption preferences. To scrutinize the publicly dispersed criteria leading to rejection, we grouped physicians according to their behavioral intention. The resulting clusters were then analyzed in terms of the remaining criteria to find out which characteristics were common for the different adopter groups.

Consolidated findings, of the survey thus enabled predictions about general attitude, working characteristics, and equipment of physicians, derivable from the usage intentions.

3 METHODOLOGY

3.1 Survey Design

The survey was developed based on the Unified Theory of Acceptance and Use of Technology (UTAUT) to determine the usage intention for electronic health services deployed via the national TI for the support of ambulatory care (Venkatesh et al., 2003). Based on medical goals documented by leading institutions of the healthcare system and the German government (Bundesrepublik Deutschland, 1988), we further asked for certain important healthcare aspects, such as security concerns (Sunyaev et al., 2009), treatment and administration standards, patient involvement, and inter-institutional communication (Hoppe and Richter-Reichhelm, 2000, Haux, 2005), before posing the questions about telematics and EHS. The question sequence was designed to ensure minimum influence of the public opinion on the answer patterns not directly related to the telematics.

The questionnaire was named "Survey on IT diffusion in ambulatory health care." We investigated the state of conventional Information Technology in ambulatory practices and its usage by physicians as well. The goal was to gain information on the status quo of the testing region concerning the aspects mentioned. Further, we were keen to find the medical domain-related characteristics of medical personnel and practices to be predictable when measuring usage intention based on the UTAUT model.

3.2 Sample Description

We distributed 500 questionnaires to all physicians in ambulatory care of the Bavarian testing region for healthcare telematics by mail, but also provided the questionnaire on the Internet. The test region has 452,000 inhabitants on 2,847 square kilometers. The region is geographically well definable because of its heterogeneous structure, which makes the region suitable for field testing since it represents the structure of Germany very well (ZTG Zentrum für Telematik im Gesundheitswesen GmbH, 2009). We received 117 responses, representing a response rate of 23.2%.

Only 4 physicians used the online option to submit their results, the remaining 113 returned it by mail.

3.3 Clustering of the Respondents

The respondents were cluster analyzed according to their usage intention. For this purpose a hierarchical cluster analysis was performed, using ward's clustering algorithm and the squared Euclidean distance as distance metric (Backhaus et al., 2006). Usage intention was measured by the behavioral intention scale as used in UTAUT by Venkatesh et al. (Venkatesh et al., 2003). The rating scales were

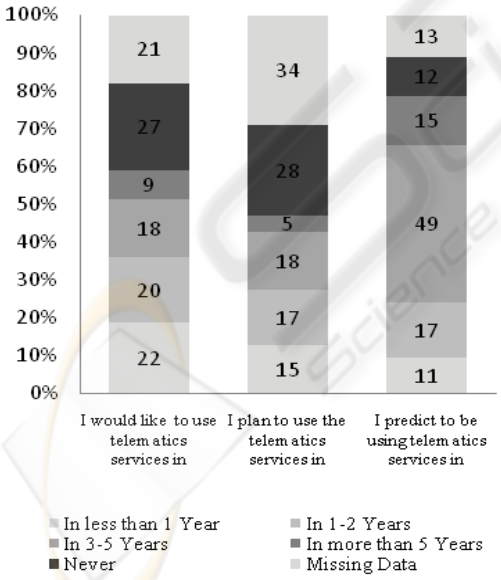


Figure 1: Detailed Usage Intention.

slightly adapted to the given context (Table 1). They ranged from 1 (intended adoption in less than 1 year) to five (no intended adoption at all). As all variables were measured on the same rating scales, there was no need for normalization of the cluster variables. Respondents that did not completely answer all three items were excluded from the analysis. The total mean reflects the combined opinion of all 117 respondents.

4 RESULTS

4.1 Description of Clusters

The cluster analysis revealed two different clusters that can unambiguously be interpreted as "Supporters" (Cluster 1) (also referred to as adopters/potential adopters) and "Rejecters" (Cluster 2) of telematics services. 49 physicians were grouped into the supporters cluster and 29 into the rejecters cluster. The remaining respondents were excluded. This categorization is surprising; we expected the group of supporters to be smaller, as their opinion is merely perceived in the public discussion of telematics services. The supporters embrace the new technology and show a significantly ($p<0.001$) higher intention, plan and prediction of usage than the rejecters (table 1).

Table 1: Usage Intention from electronic healthcare services deployed by via the TI.

Description	Supporters	Rejecters
Behavioral Intention: From 1 (In less than 1 year) to 5 (Never)	Do see the benefits the TI and are willing to use the services in the short term	Do not see the benefits of the TI and are not willing to use the services
I intend to use the system ***	1.94	4.83
I plan to use the system. ***	2.17	4.90
I predict I would use the system ***	2.55	3.86

***p < .05; **p < .01; ***p < .001**

No significant distinction could be observed in terms of age, experience, or size of the practice (number of physicians, number of patients). However, significantly ($p<0.05$) more medical specialists are grouped into the supporters' cluster than general practitioners.

Table 2: Characteristics of physicians and practices.

	Total Mean	Mean Adopter	Mean Rejecter
Age	**49.7**	**48.9**	**50.9**
Gender (1=Female, 2=Male)	**1.70**	**1.67**	**1.73**
Specialization * (1=Family Doctor, 2=Medical Specialist)	**1.59**	**1.62**	**1.44**
Number of physicians working in the practice	**2.1**	**1.7**	**2.3**
Patient consultations per day ***	**46.5**	**40.3**	**61.7**
Average time spent on patient contact per day	**7.4**	**6.3**	**7.0**
Patients visiting the practice per day	**86.1**	**79.9**	**99.5**
Number of employees in the practice	**4.5**	**4.8**	**4.0**

***p < .05; **p < .01; ***p < .001**

Moreover, physicians with a significantly lower frequency of patient consultations are more often ($p<0.001$) supporters of the new TI services, as they are likely to have more time to treat every single patient, thus using the services. When interpreting this data, it has to be taken into account that the field of medical specialists is very diverse in Germany, and can only be compared with caution. Dermatologists and orthopedists declared to medicate regularly more than 80 patients per working day, whereas specialists, such as anesthetists or pediatricians, covered only a range of 20 to 40 patients.

4.2 Current use of Information Technology in Ambulatory Healthcare

The results seen in Figure 2 show widespread use of conventional IT Technology in ambulatory care. For more than 84% of all physicians, the Internet is currently a source for medical information. While Internet consultations for medical content is a commodity for both groups, the practice of Internet access is only a commodity for adopters, significantly less ($p<0.001$) so for the cluster of the rejecters, where only about half are connected to the Internet. Internet access is apparently used significantly more ($p<0.05$) by the supporters for email communication within the health system with colleagues, other institutions and patients.

Further, medical data are already distributed among medical institutions, mainly by the adopter cluster, even though a common and secure electronic communication platform is not yet in place. Hence, the inter-institutional communication differs significantly, while very few differences can be seen concerning the electronic documentation within the practices. Physician-patient contacts are documented electronically by 78% of the physicians, and for 73%, even with electronic medical records (EMR). All respondents reported having an information system in their practice. Most supporters already use electronic utilities to represent their practice on the Internet, to exchange patients' medical data and to communicate within the public health system. We conclude thus that the supporters see the telematics as complementary offers for extending the electronic functionalities, which most of them are already using.

The rejecter cluster is using IT within their practices but lags behind significantly in terms of Internet based communication matters in every criterion measured. The rejecter cluster cannot be characterized as opponents of IT, as they are using it in their practices and have similar usage patterns for the Internet concerning their personal skill enhancement. The question why the internal usage is common but the joint usage a matter of strong resistance will be discussed in the following sections.

4.3 Process Standardization

As one of the goals of the TI is the overcoming of institutional boundaries within the public health system, we asked for the current status of inter-institutional communication during the treatment processes. A majority of 56% of all respondents reported having regular contact during treatments and 33% at least partly. Only 7% stated being isolated in inter-institutional treatments of patients. A significant difference between the adopter cluster and the laggards cluster could not be observed. As the potential adopters often transmit information electronically, it is likely that the rejecters still use traditional communication matters for the coordination of their treatments.

Both clusters do not significantly differ concerning process documentation either. Practices seem to document their treatment processes extensively , as the experienced level of process

Question	Total Yes	Total No	Total Mean	Mean Adopter	Mean Rejecter	Yes = 1, No = 2
			◆	■	▶	Yes / No
Practice with Internet access ***	76%	20%	1.21	1,09	1,43	
Physician consults Internet for medical Information	84%	11%	1.12	1,07	1,14	
Practice with web presence *	50%	45%	1.47	1,37	1,64	
Physician uses email to consult patients*	25%	70%	1.74	1,63	1,89	
Physician uses email to consult colleagues and health organizations *	59%	37%	1.38	1,30	1,54	
Practice documents patient contacts electronically	78%	17%	1.18	1,18	1,25	
Practice uses Electronic Medical Records	73%	22%	1.23	1,18	1,29	
Practice exchanges medical information electronically with other institutions ***	44%	51%	1.54	1,39	1,79	

*p < .05; **p < .01; ***p < .001

Figure 2: Adoption and Usage of conventional IT by Physicians in Ambulatory Care.

documentation standard is very high. 82% claim that the processes are for the most part documented. For the adopter cluster, significantly more processes are derived from their IT systems, whereas the laggards cluster has a lower level of IT orientation. Whether these processes are based on best practice or evidence-based-medicine cannot be determined in this context. The potential adopters also show significantly ($p<0.001$) higher interests in cost-benefit analysis for their practices, while cluster 2 mostly does not regard this as being useful.

4.4 Processes and Infrastructure of the EHC

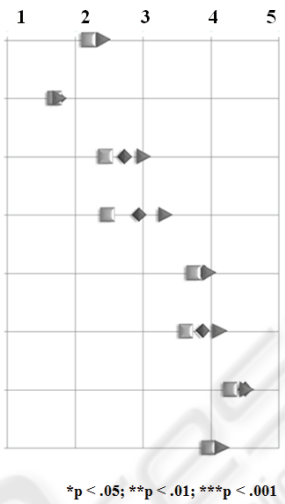
Regarding the German telematics and processes, infrastructures, applications and security standards of the EHC, both clusters show a very low knowledge level. Very few physicians have dealt with the characteristics of the infrastructure as the security standards and necessary hardware infrastructure affecting their practices. Also, the workflows which affect the practices when already specified electronic health services such as electronic prescriptions are introduced are hardly known by both groups. Personal experience with the particular EHC systems can therewith not be the driver of the broad rejection among the physicians. Just a small fraction has visited the sample installation which is available in the testing region in order to study a sample of the systems to be deployed in all medical facilities in Germany. The adopter cluster shows slightly more involvement in the telematics; however, significant differences cannot be seen, which excludes the system knowledge as a criterion behind the adoption decision.

4.5 Perceived Value of IT, Documentation, Communication and Patient Involvement

Ambulatory care needs IT in order to efficiently run a practice today; this can be almost be regarded as common sense within both groups. More than 80% agree or strongly agree that they cannot productively run their businesses without IT support. More than 70% do not see IT simply as a supportive instrument, but believe that the technology provides an added value to their practice. The adopter group experiences a significantly higher value of IT ($p<0.01$), even though the majority of both groups see the necessity of using IT-Systems. As our results have shown, electronic communication is already very common among the group of potential adopters.

The belief that electronic communication will be common in the public health domain within 5 years seems to follow from the daily experience of this group. Documentation, communication, and treatment standards all show significantly higher support ($p<0.001$) among the potential adopters. A comprehensive medical documentation maintained by all involved care providers is seen as being essential by the adopter cluster, while the opposing cluster is undecided. Patient involvement in medical documentation shows similar tendencies and significant differences between the two groups

Question	Total Mean	Mean Adopter	Mean Rejecter
Our practice maintains contact with other medical institutions during inter-institutional treatments	2,29	2,19	2,41
Treatment processes of our practice are documented	1,75	1,69	1,76
Practice processes are aligned to the IT Systems we are using *	2,72	2,44	3,00
A cost-benefit analysis for the practice would be helpful **	2,93	2,47	3,32
I am familiar with the processes affecting my practice after the introduction of the eHC	3,89	3,73	3,96
I am familiar with the infrastructural requirements to use the eHC infrastructure in my practice	3,86	3,63	4,12
I have visited a sample implementation of the eHC infrastructure to get familiar with the technology	4,49	4,28	4,52
I am familiar with the security standards used by the TI and the eHC (e.g. encryption)	4,01	3,96	4,15



*p < .05; **p < .01; ***p < .001

Figure 3: Process standardization and eHC related knowledge.

observed. The rejecters by trend doubt the benefits of process standardization for their practices, and fear an administrative overhead. They tend towards the opinion that the daily work in practice is too diverse to adopt standards for most workflows.

Standardized documentation for medical treatments generally has lower support than does standardized administrative documentation. While the adopter cluster is rather supportive, the laggards are undecided or dismissive. Expectedly, the potential adopters regard e-health as a significant development in medical treatment. Both groups seem to have similar information providers concerning e-health offers. As the total mean is lower than the mean of both clusters, physicians with missing contacts for information seeking have not specified any preference concerning potential adoption of electronic health services. Both groups are rather undecided concerning the information duty for patients about e-health risks and chances of e-health services. As the adopter cluster has a higher level of IT usage, the trend to see physicians as information providers is well understandable since the understanding of the services is likely to be higher in this group.

4.6 Data Security

Ambulatory physicians generally show a very high need for data security. National standards for the handling of patients' data are equally supported as committing guidelines for the individual practices. For most care providers, it is important to inform their patients about the usage of medical data. The adopters generally see a higher need for security standards for their own practice and for the public health system in general. Both groups are sceptical about the central storage of medical data, and have a tendency towards decentralized storage in patients' hands to ensure their data sovereignty in the long term. While the adopting cluster fears delays in treatment processes when abandoning centralized storage concepts, the laggards are significantly less concerned ($p<0.001$). The group of potential adopters certify themselves as having significantly higher ability to inform their patients about the usage of their medical data compared to the opposing group.

5 SUMMARY AND CONCLUSIONS

The results show that the group of physicians ready to adopt EHS offered via the TI significantly differs from the more dismissive group in many aspects. Tendencies of the data security topic, dominating the public opinion concerning telematics adoption in Germany, do not differ when comparing the potential adopters and rejecters telematics services. Both groups strongly support nationwide unified security standards for their own practices also.

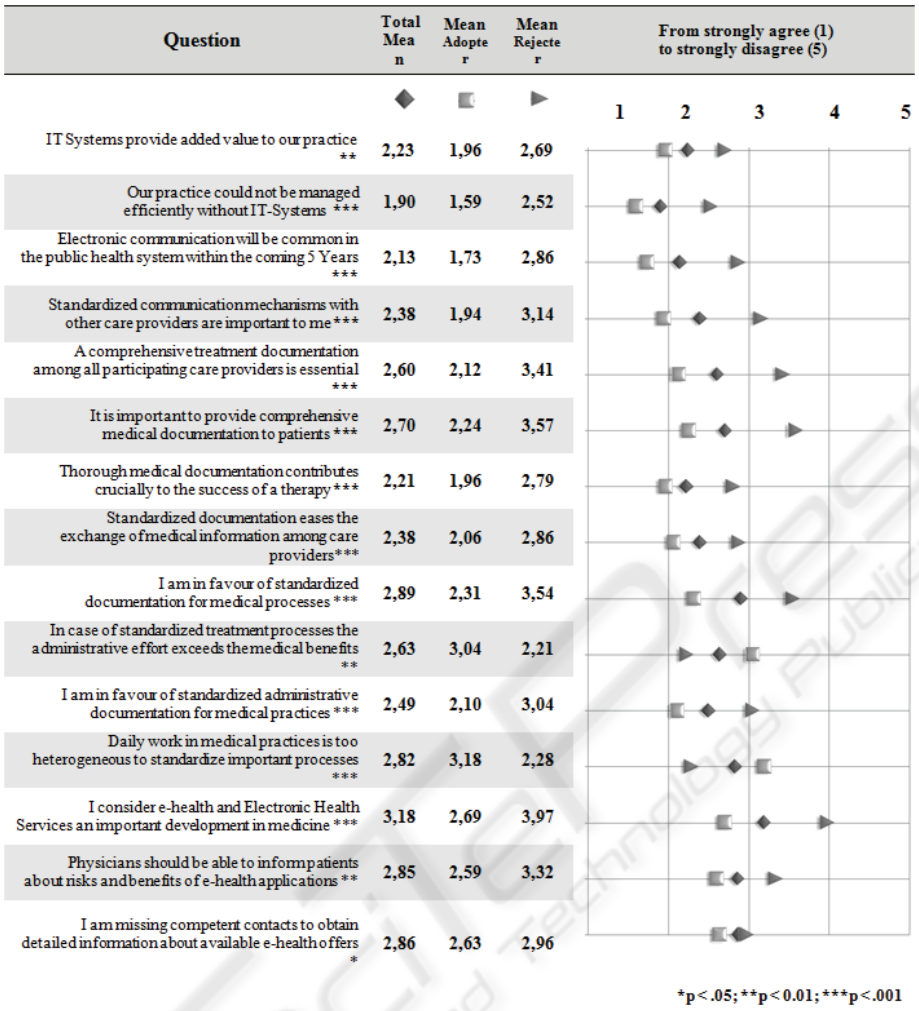


Figure 4: Standards, patients' involvement, communication standards, e-health, and IT-diffusion.

Adopters favor even higher security standards than do the rejecters, independent of EHS offers. As the eHC system tries to ensure exactly the demanded security standards, other factors are more likely to be responsible for the adoption decision. The two identified clusters differ significantly in terms of General IT adoption, process and documentation standardization, patient involvement, cost-benefit aspects, their medical specialization and their patient throughput. The rejecters are not just lagging behind in terms of IT adoption, but also in many aspects of standardization, cost awareness and transparency. It is likely that they regard the EHS as a mean to enforce the aspects mentioned and therefore are less supportive. The higher patient throughput of the rejecters and their low interest in cost analysis for their practices indicates that they are benefiting above average from the status quo. EHS can be further seen as a utility for patient involvement and shared medical documentation, which show similar answer patterns.

The German healthcare system has a group of very progressive care providers. Conventional IT can be considered to be a commodity for this group of physicians. They are open for standards and patient involvement, and therefore are keen to utilize telematics services for this purpose. As both clusters claim to maintain contact during treatments with other medical institutions, but only the supporters utilize IT for this purpose, the difference in IT usage should not result in treatment quality, but in efficiency increase. To investigate this, further studies should be done to measure the impact of IT in ambulatory care on both efficiency and medical effectiveness.

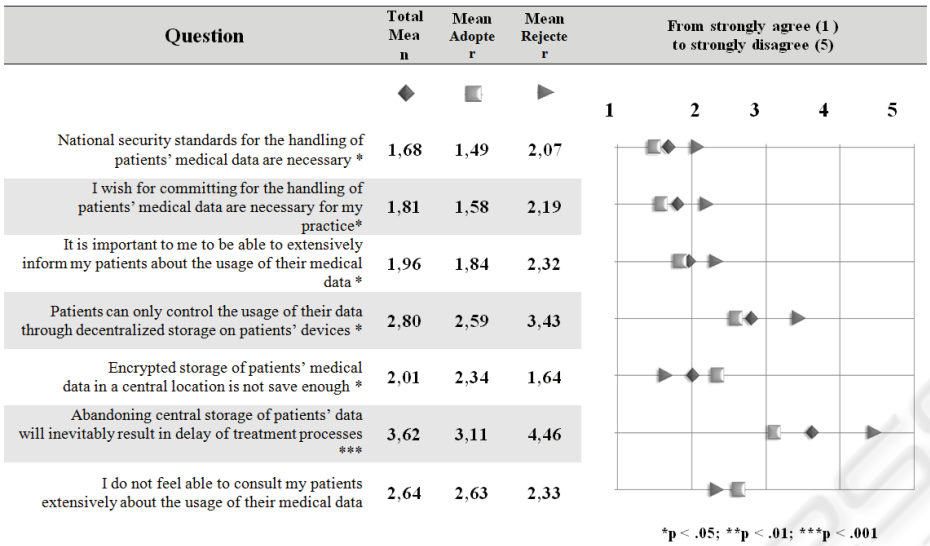


Figure 5: Security Standards for Medical Data.

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