Abstract

Physicians’ acceptance of Electronic Health Record (EHR) systems is a critical factor for a successful implementation. In an attempt to understand the factors influencing physicians’ acceptance of EHR systems, the presented research examines the effects of social influence, health IT (HIT) experience, and privacy concerns using a modified Technology Acceptance Model (TAM). The empirical study presents results from a survey of Austrian physicians in private practices. Structural Equation Modeling (SEM) and mediation analyses were used to analyze the data. The results indicate that the presented model is suitable to explain physicians’ intention to use EHR systems. In line with expectations, privacy concerns, social influence, and HIT experience had a significant impact on the perceived usefulness of HIT, which in turn was related to positive attitudes towards EHRs as well as the intention to use them.

1. Introduction

Most industrialized countries face the challenge of rapidly rising healthcare costs whereas the quality and efficiency of care can still be improved [28,31,38]. Health information technology (HIT) is commonly regarded as an important tool to improve the quality and safety of care while reducing healthcare costs, and electronic health records (EHR) are among its most promising components [9].

Various countries (e.g., Denmark, New Zealand, Australia, Canada, USA, UK) have started remarkable initiatives and pilot projects for designing and engineering nationwide EHR systems that enable data storage, usage, and exchange. Although the purpose of all EHR systems is similar in different countries, there are notable differences within the specific implementations [39,41].

Austria, also among these countries, is currently experiencing a series of major reforms and innovations in the health sector. The aims of these reforms are to increase quality and safety of diagnoses and treatments, to improve data security, and finally to cut healthcare costs by avoiding redundant examinations and reducing administrative efforts. One of the major initiatives in Austria is the implementation of a nationwide EHR system, called ELGA (ELeKtronische GesundheitsAkte; German for “electronic health record”). The EHR system allows universal access to medical data for all public healthcare providers across the country. Austria’s broader HIT initiatives started in 2005, when every Austrian citizen was provided with a smart card (“eCard”) that has been used since then for patient identification and can be upgraded for e-government applications.

In the same year, the Austrian health reformation law was passed, which contained the explicit goal to establish a nationwide EHR system. A feasibility study presented in 2006 provided recommendations for the legal, technical, and architectural framework of ELGA [26] and was used for a more detailed planning on the functions and components starting in 2007. At that time, different stakeholders (e.g., physicians, health associations, patients’ organizations) became involved and started a very emotional and heated debate. Many health professionals had serious concerns regarding certain aspects of the ELGA implementation [19]. However, the Austrian National Council passed the law to implement ELGA in late 2012, deciding on a decentralized EHR system based on centralized indices for patients, providers, and medical documents [4].

Health professionals’ acceptance is known to be a crucial factor for successful EHR implementations [19]. After a call for action by the Austrian Resident Doctors’ Association, several private physicians responded with strikes and protests to the Austrian EHR plans. Doctors generally feared the loss of privacy, additional workload and costs, increased medical liability, and bad usability of the ELGA system [19]. This might be the reason why Austria is now facing major challenges when it comes to physicians’ intentions to adopt the new ELGA system. In 2008, a regional qualitative study investigating the opinions, needs, and acceptance of ELGA among a small sample of physicians in one Austrian state was conducted [19] and identified ELGA related topics that had caused uncertainty and concern among doctors.
In an attempt to further identify aspects and mechanisms that may lead to a higher acceptance of ELGA among Austrian physicians, a quantitative survey was conducted. A nationwide quantitative research approach that addresses the problem on a broader level can help gain a more holistic view on factors influencing physicians’ intention to use the new EHR system. Thus, the goals of the presented study was a) to identify and analyze factors that influence the ELGA acceptance among doctors and b) to examine the mechanisms that lead to a higher intention to use the ELGA system after its implementation. Knowing which factors are relevant to the physicians’ intention to use ELGA can allow policymakers to control these factors in order to increase acceptance. As a result, it is more likely that the expected improvements of the EHR system will occur.

2. Theoretical considerations and hypotheses

2.1. TAM and health IT

The application of the Technology Acceptance Model (TAM) [14] is a suitable approach to predict and explain physicians’ reactions to health IT (HIT), in particular EHR [23,25]. Therefore, in order to pursue a cumulative research agenda, TAM instead of any other IT acceptance model was chosen as an underlying model. Additional aspects that reflect characteristics of the Austrian HIT implementation were identified from other acceptance theories like the Unified Theory of Acceptance and Use of Technology (UTAUT) [47].

Derived from the Theory of Reasoned Action (TRA), a general model for the prediction of behavioral intention in any social psychological setting [2], TAM discovered several constructs that explain and predict (the intention of) IT use.

The most proximal antecedent of actual IT use is intention to use IT, which is commonly conceptualized as IT acceptance and considered as a reliable predictor of actual IT usage [13,23,37]. The intention to use is determined by a person’s attitude towards IT, which constitutes the sort and intensity of feelings one has for or against an object or behavior; in the presented case it is the attitude towards the usage of the ELGA system. Moreover, according to TAM attitude towards IT as well as intention to use IT is influenced by perceived usefulness and perceived ease of use [13,14]

Thus, there are three key constructs that are expected to determine physicians’ intention to use ELGA: perceived usefulness and perceived ease of use, as well as attitude towards the usage of ELGA.

Within the presented study, we investigated perceived usefulness and attitude as potential antecedents of intention to use ELGA. Since the research object (ELGA) had not yet been implemented and there had not been any user interaction with the planned EHR system or any prototypes at the time of the study, the construct perceived usefulness was operationalized as expected rather than experienced usefulness, and perceived ease of use was not investigated. Though there are several physicians who already use electronic medical records locally within their practices, the functions and usability of these IT solutions cannot be regarded as comparable to the nationwide ELGA system in general. Therefore, doctors’ experiences with several HIT solutions within their practices are not a reliable source to derive information for the construct perceived ease of use of ELGA, though it is an important aspect when it comes to HIT experience in general. Besides, prior studies have shown that there is a lack of significant relationship between ease of use and usage intention among physicians, which might be because physicians are willing to adopt beneficial applications of information technology even if the technology may not be easy to use [10,25].

Recent studies on health professionals’ acceptance of HIT indicate, that in addition to the constructs already considered in the generic version of the TAM approach, the intention to use computerized health care solutions can be determined by the following factors: (i) social influence, (ii) HIT experience, and (iii) privacy concerns [12,16,23]. Thus, in the present study these factors were included as external variables. Figure 1 summarizes the research model. The constructs and assumed relationships are described below.

2.2. Attitude towards ELGA

Attitude is the most proximal antecedent of intention to use. It is commonly described as a mental state involving beliefs, feelings, and values that influence a person’s intention towards a certain behavior [1,2,15].
In particular, attitudes towards a behavior correlate with the beliefs about certain consequences arising from the intended behavior. Therefore, attitude constitutes the sort and intensity of feelings one has for or against an intended behavior [40]. Within TRA, attitude has been introduced to explain the intention to engage in a certain behavior [2,15]. Within TAM, attitude is proven to be an important predictor of intention to use an IT system [13,14]. In the areas of HIT, attitude towards an EHR has been defined as the feelings and beliefs regarding the utility, quality, and efforts related to the usage of an EHR [21]. Therefore, attitude towards ELGA can be measured by the physician feeling comfortable with the idea of providing or gathering health information via ELGA or by recommending patients not to opt-out.

Based on these theoretical considerations the following hypothesis was derived:

**H1: There is a positive relationship between the attitude towards ELGA and the intention to use it.**

### 2.3. Perceived usefulness

Perceived usefulness is defined as the extent to which a person believes that using a particular technology will enhance job performance [14]. Therefore, perceived usefulness is closely linked to outcome expectations, instrumentality, and extrinsic motivation [48]. In recent HIT studies applying the TAM approach, perceived usefulness was generally defined as enhanced job performance; though a broader definition of usefulness is highly suggested [23]. Therefore, additional aspects like making performance easier, increasing efficiency, lowering costs, improving quality and safety of care, or empowering patients should be included to gain a more holistic picture of perceived usefulness [1,5,7].

In the presented study, perceived usefulness was defined in such a broad sense and three major aspects were included. First, usefulness can be experienced through any expected particular benefit resulting from the individual ELGA functions (e.g., discharge summary, electronic referrals, immunization record, medication list, or maternity card) for the physician or other stakeholders. Second, expected cost reduction, either within the doctor’s practice or for the Austrian healthcare system as a whole, may be an expression of perceived usefulness. Finally, any sort of expected general improvement, for example, in quality of care, administration, cooperation among health professionals, or doctor-patient relationships can be regarded as perceived usefulness. As predicted by TAM, the suggested hypotheses are:

**H2a: There is a positive relationship between perceived usefulness and the intention to use ELGA.**

**H2b: There is a positive relationship between perceived usefulness and the attitude towards ELGA.**

**H2c: As a consequence of H2b and H1, there is an indirect effect of perceived usefulness on intention to use ELGA (H2a) via attitude towards ELGA. Thus, the direct effect of perceived usefulness on intention to use ELGA (H2a) can at least partially be explained by the mediation through attitude.**

### 2.4. Social influence

Social influence, part of the theoretical construct social norms, is considered to be a person’s perception on whether or not a technology should be used based on the opinion of people who are regarded as important [10]. Research in psychology proves social norm to be an important determinant of intention to use a system and its perceived usefulness [10,46,48]. Social influence can originate from colleagues or friends [34] as well as from top management [32,35,36].

Since Austrian physicians in private practices usually work independently from other doctors and are not subordinated to any kind of management, social influence is likely to originate from public opinion related to medical and practice administration.

National efforts in HIT projects are of high interest in the Austrian media. A press review on ELGA presented by the “Initiative ELGA” – an independent private initiative providing information and media reports on HIT related topics for Austrian health professionals on a public website – listed more than 190 reports in newspapers on EHR in general or ELGA, in particular in the years 2007 to 2009 [27]. Many of the reports contain interviews with policy makers or Austrian Resident Doctors’ Association representatives discussing benefits and risks of the ELGA implementation. Therefore, the reports on ELGA and EHRs are an important source of information and, since often representing other physicians’ and policy makers’ opinion, also an important source of influence for Austrian doctors.

Scientific medical journals, regularly reporting about studies on successes and failures of EHR systems, can also be considered as an important source of social influence on physicians with regard to expected characteristics and intended usage of EHR systems in Austria. Therefore, in line with relevant literature, the following hypotheses were derived:

**H3a: There is a positive relationship between social influence and the intention to use ELGA.**

**H3b: There is a positive relationship between the social influence and the perceived usefulness of ELGA.**

**H3c: As a consequence of H3b and H2a, the expected direct effect of social influence on intention to use ELGA (H3b) can at least partially be explained by the mediation through attitude.**
use ELGA (H3a) is at least partially mediated by perceived usefulness.

2.5. HIT experience

ELGA is a computerized health care solution. That is why experiences with HIT are deemed as an important factor influencing ELGA acceptance. Since ELGA or any related prototypes have not been implemented at the time of the study, HIT experience was not defined as experiences with the particular ELGA system, but with comparable HIT solutions like practice information systems or electronic medical records within a practice. Physicians who have used a practice information system or an electronic medical record before are likely to have worked with functions that will be provided by ELGA on a national level.

Prior studies revealed a positive relationship between the level of experiences and the IT satisfaction or acceptance [12,35]. Computer experience is also proven to have a significant influence on attitudes towards usage [17]. Moreover, HIT experience may lead to the development of a perception of which characteristics of HIT makes it useful [29,42]. Physicians with various levels of HIT experience are therefore likely to expect potential benefits of ELGA in a different way. These differences can influence their recognition regarding ELGA usefulness, which may also affect their post adoption usage of ELGA [42].

Based on the considerations above, the following hypotheses were derived:

H4a: There is a positive relationship between HIT experience and the intention to use ELGA.
H4b: There is a positive relationship between HIT experience and the attitude towards ELGA.
H4c: There is a positive relationship between HIT experience and perceived usefulness of ELGA.
H4d: Consequently, there is an indirect effect of HIT experience on intention to use via intention to use and attitude towards ELGA.

2.6. Privacy concerns

The goal of inter-institutional EHRs is to accumulate and store information of patients regardless of the place of origin of the data. Thus, the EHR becomes a lifelong medical record, containing a huge dataset of highly sensitive information that needs to be protected from any unauthorized access. However, when data is transferred to another medical institution, it automatically loses the protection of the implied trusted domain of the medical institution creating it. It is a fact that enabling access to an increased number of users also increases threats to security and privacy of health information [18]. Losses of health information privacy can be the result of inadequate legal regulations or careless technical system design and implementation [20].

Data protection regulations and legislations have been established in industrialized nations to ensure confidential and secure data processing of personal and even more so of highly sensitive data like health information. However, despite these legal frameworks prior studies have shown a relationship between privacy concerns and attitudes towards the disclosure of personal information in a business setting [44,45]. Therefore, it is not surprising that privacy and data protection are among the major concerns in EHR implementation.

Privacy concerns have a significant influence on a person’s attitude towards the usage of EHRs [3,22]. People’s negative expectations associated with privacy in EHR reach from financial anxiety, embarrassment, and job security to loss of information autonomy [3]. However, not only patients but also doctors have serious concerns about privacy and data protection in EHRs, which can affect their attitude as well as their intention to use EHRs [16,19].

Cultural values can influence a person’s privacy concerns [6]. Austria is known as a nation with very strict data protection laws and a very powerful data protection lobby. Therefore, it is no surprise that among the eighteen most dominant negative emotions of physicians versus ELGA, data privacy and data protection concerns are on rank two [19].

This leads to the following hypotheses:

H5a: There is a negative relationship between privacy concerns and the intention to use ELGA.
H5b: There is a negative relationship between privacy concerns and the attitude towards ELGA.
H5c: Due to expectations in H5b and H1, the relationship between privacy concerns and intention to use ELGA (H5a) can be explained by the mediation through attitude.

3. Research method

3.1. Participants and procedure

The survey was conducted between June and August 2010. The research instrument was developed with experts from the eHealth Management Austria and the Austrian Resident Doctors’ Association. A pretest was conducted and feedback from 15 Austrian physicians was incorporated into the final instrument.

Two thousand randomly chosen physicians in private practices in Austria were invited via mail to fill out a paper-based questionnaire. Out of the 307 respondents, 204 participants (24% female) provided a sufficient amount of questionnaire data (less than 5%
of missing values [33]) and were therefore included in the analyses.

### 3.2. Measures

As to the external variables, privacy concerns were measured with four items (e.g., “The intended health IT functions ensure a sufficient level of data protection”; reverse coded, responses ranged from 0 = *do not agree at all* to 3 = *agree completely*), social influence was measured with six items (e.g., When have you last read about health IT in the newspaper?”; responses from 0 = *never* to 3 = *in the last month*), and health IT (HIT) experience is indicated by the percentage of 14 health IT functions that a participant has already been using. Perceived usefulness was treated as latent construct with three indicators: the perceived benefit of the 14 HIT functions for various stakeholders (e.g., physicians, patients, other healthcare professionals) in percentage term, cost reductions (two items; e.g., “Health IT will reduce costs within the healthcare system”; responses from 0 = *do not agree at all* to 3 = *agree completely*), and potential for improvement (five items; e.g., “I am expecting administrative improvements”; responses from 0 = *do not agree at all* to 3 = *agree completely*). Attitude towards ELGA was measured with four items (e.g., “I would recommend my patients to use eHealth functions”), and intention to use ELGA with seven items (e.g., “I am willing to participate in pilot-projects of ELGA functions”). Responses were scored on four-point scales (0 = *do not agree at all* to 3 = *agree completely*).

Results of exploratory and confirmatory factor analyses provided good support for the validity of the measures. Likewise, the high Cronbach’s α coefficients indicate that the measures are reliable. The means, standard deviations, Cronbach’s α reliability coefficients, and zero-order correlations of the variables are shown in Table 1.

| Table 1. Means, standard deviations, and inter-correlations for the studied variables |
|----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|                                | M   | SD  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Socio-demographics              |     |     |     |     |     |     |     |     |     |     |     |      |
| (1) Gender                      | 0.24| 0.43|     |     |     |     |     |     |     |     |     |      |
| (2) Age                         | 3.75| 0.77| -0.24*|     |     |     |     |     |     |     |     |      |
| (3) General practitioner vs. specialist | 0.52| 0.50| 0.03| -0.11|     |     |     |     |     |     |     |      |
| (4) Size of town                | 3.13| 1.64| -0.12| -0.26*| -0.02|     |     |     |     |     |     |      |
| External variables              |     |     |     |     |     |     |     |     |     |     |     |      |
| (5) Privacy concerns            | 2.22| 0.66| -0.08| -0.04| -0.07| -0.16*|     |     |     |     |     | (0.76) |
| (6) Social influence            | 1.64| 0.85| -0.07| -0.09| -0.12| -0.04| 0.04|     |     |     |     | (0.90) |
| (7) Experience                  | 0.10| 0.12| -0.07| -0.15*| -0.11| -0.12| -0.25*| 0.06|     |     |     |      |
| Perceived usefulness            |     |     |     |     |     |     |     |     |     |     |     |      |
| (8) Cost reduction              | 1.00| 0.91| -0.07| -0.06| 0.04| -0.08| -0.54*| -0.16*| 0.12|     |     | (0.87) |
| (9) Stakeholder benefit         | 0.79| 0.22| -0.02| -0.04| 0.10| 0.01| -0.08| -0.48*| -0.14*| 0.10*| 0.49*|      |
| (10) Improvement                | 1.59| 0.81| -0.07| -0.02| -0.04| -0.16*| -0.57*| -0.13| 0.25*| 0.70*| 0.64*| (0.91) |
| Outcomes                        |     |     |     |     |     |     |     |     |     |     |     |      |
| (11) Attitude                   | 1.24| 0.94| -0.12| 0.16*| 0.00| -0.23| -0.66*| -0.04| 0.30*| 0.58*| 0.57*| 0.70*| (0.90) |
| (12) Intention to use           | 1.27| 0.82| -0.07| 0.08| -0.05| -0.23| -0.57*| 0.04| 0.37*| 0.49*| 0.56*| 0.74*| 0.75*| (0.92) |

*Note. N = 204. Cronbach’s alphas reliability coefficients are in the diagonal. Coefficients > .80 and > .90 are indicative of a good and excellent internal consistency of the measure [30]. * p < .05.

### 3.3. Data analysis

The hypothesized model was tested by means of structural equation modeling (SEM). First, a Null Model (M0) was specified without any direct or indirect effects. The Null Model then was compared to a model including direct effects from the external variables to intention to use HIT (M1), a model that also included indirect effects via attitude towards HIT (M2; i.e., additional paths from the external variables to attitude towards HIT, as well as from attitude to intention to use), and a model that additionally
included indirect effects via perceived usefulness (M3; i.e., additional paths from the external variables to perceived usefulness, as well as from perceived usefulness to attitude and intention to use).

The final model only included significant effects (M4). Socio-demographic variables were not included in the SEM, because they were not systematically related to the studied variable (see Table 1).

The goodness-of-fit of the models was evaluated using the $\chi^2$ goodness-of-fit statistic and a combination of the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). CFI > .95, TLI > .90, and RMSEA < .08 were considered as indicating good model fit [24,43]. Different models were compared using $\chi^2$ difference tests; moreover, Akaike’s Information Criterion (AIC) was used as a descriptive measure, where models with a smaller AIC are considered superior.

4. Results

Table 2 shows the goodness-of-fit statistics of the five models (M0-M4). Model fit improved significantly when adding direct effects (M0 vs. M1), as well as indirect effects via acceptance (M0/M1 vs. M2) and perceived usefulness (M0/M1/M2 vs. M3): All the $\chi^2$ difference tests were significant ($p < .001$), and the fit indices improved (e.g., CFI and TLI were low for Models 0 and 1, but high for Models 3 and 4).

The external variables explained 38% of variance in intention to use ELGA (M1): Privacy concerns had a negative, $B = -0.64, SE = 0.72, p < .001, \beta = -0.51$, and HIT experience a positive effect on intention to use ELGA, $B = 1.65, SE = 0.40, p < .001, \beta = 0.23$, whereas no significant effect was found for social influence, $B = 0.05, SE = 0.05, p = .405, \beta = 0.05$.

Similarly (M2), privacy concerns, $B = -0.89, SE = 0.08, p < .001, \beta = -0.62$, and HIT experience, $B = 1.15, SE = 0.43, p = .008, \beta = 0.14$, but not social influence, $B = -0.03, SE = 0.06, p = .660, \beta = -0.02$, were significantly related to attitude towards ELGA ($R^2 = .46$). Attitude in turn was a significant predictor of intention to use ELGA, $B = 0.56, SE = 0.05, p < .001, \beta = 0.64$ ($\Delta R^2 = .22$). Furthermore, all external variables showed (marginally) significant effects on perceived usefulness (M3; $R^2 = .41$): Privacy concerns, $B = -0.68, SE = 0.07, p < .001, \beta = -0.59$, and social influence, $B = -0.12, SE = 0.05, p = .027, \beta = -0.13$, were negatively related to perceived usefulness, whereas HIT experience revealed a positive effect, $B = 0.73, SE = 0.39, p = .060, \beta = 0.11$. Perceived usefulness in turn was positively related to attitude towards ELGA, $B = 0.73, SE = 0.08, p < .001, \beta = 0.59$ ($\Delta R^2 = .20$), as well as to intention to use ELGA, $B = 0.55, SE = 0.09, p < .001, \beta = 0.50$ ($\Delta R^2 = .09$).

Several direct effects were partially or fully mediated by the intervening variables attitude towards ELGA and perceived usefulness: First, the direct effect of perceived usefulness on intention to use became smaller in size but remained significant when attitude towards use was included as a mediator. This already indicates partial mediation. The mediation is further confirmed by the significant indirect effect from perceived usefulness on intention to use via attitude, $B = 0.12, SE = 0.05, p < .001$ (in line with H2c).

Second, interesting results were obtained for social influence: Considering perceived usefulness as intervening variable revealed a marginally significant negative indirect effect of social influence on intention to use ELGA (H3c), $B = -0.06, SE = 0.03, p = .051$, as well as a significant positive direct effect (H3a; see Figure 2). Thus, social influence in general had a positive effect on intention to use, but only if its negative effect on perceived usefulness was controlled for.

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>AIC</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA</th>
<th>Model comparison</th>
<th>$\Delta \chi^2$</th>
<th>$\Delta df$</th>
<th>p</th>
</tr>
</thead>
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<tr>
<td>M0 Null model</td>
<td>552.06</td>
<td>22</td>
<td>596.06</td>
<td>.35</td>
<td>.07</td>
<td>.35</td>
<td>M0-M1</td>
<td>96.10</td>
<td>3</td>
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<tr>
<td>M1 Direct effects</td>
<td>455.96</td>
<td>19</td>
<td>505.93</td>
<td>.46</td>
<td>.02</td>
<td>.34</td>
<td>M0-M1</td>
<td>96.10</td>
<td>3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>M2 Direct effects</td>
<td>244.56</td>
<td>15</td>
<td>302.36</td>
<td>.72</td>
<td>.32</td>
<td>.28</td>
<td>M0-M1</td>
<td>96.10</td>
<td>3</td>
<td>&lt;.001</td>
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<td>via attitude</td>
<td>33.91</td>
<td>10</td>
<td>101.91</td>
<td>.97</td>
<td>.89</td>
<td>.11</td>
<td>M0-M3</td>
<td>518.15</td>
<td>12</td>
<td>&lt;.001</td>
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<tr>
<td>M3 Direct effects</td>
<td>38.76</td>
<td>13</td>
<td>100.76</td>
<td>.97</td>
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<td>via attitude and perceived usefulness</td>
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<td>.10</td>
<td>M3-M4</td>
<td>518.15</td>
<td>12</td>
<td>&lt;.001</td>
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</tbody>
</table>

Note. N = 204. AIC = Akaike’s Information Criterion, CFI = Comparative Fit Index, TLI = Tucker Lewis Index, RMSEA = Root Mean Square Error of Approximation.
Third, perceived usefulness fully explained the effect of HIT experience on attitude (H4d), $B = 0.59$, $SE = 0.29$, $p = .043$, and partially explained the effect on intention to use ELGA (H4e), $B = 0.44$, $SE = 0.23$, $p = .049$. Finally, the direct effect of privacy concerns on intention to use was fully mediated by attitude, $B = -0.12$, $SE = 0.04$, $p < .001$, and perceived usefulness, $B = -0.37$, $SE = 0.047$, $p < .001$. Additionally, perceived usefulness partially mediated the effect of privacy concerns on attitude, $B = -0.49$, $SE = 0.07$, $p < .001$.

Removing non-significant direct effects did not result in a loss of model fit (M3 vs. M4: non-significant effect in the $\chi^2$ difference test; see Table 2). Thus, Model 4, which is illustrated in Figure 2, was chosen as the final model. As can be seen in Figure 2, the results were in line with the hypotheses, except for Hypothesis 3b. One additional unexpected direct effect was obtained: from privacy concerns to perceived usefulness.

![Figure 2. Final Model (Standardized Coefficients) Note. Dashed lines represent fully mediated effects. *** $p < .001$, ** $p < .01$, * $p < .05$.](image)

Interpretation of the standardized coefficients [11]:

$\beta = |.10| = small; |.30| = medium; |.50| = large.

### 5. Discussion and implications

The results of the present study were in line with expectations derived from TAM: Attitude towards ELGA was a significant predictor of intention to use ELGA (H1). Similarly, perceived usefulness had a significant positive impact on intention to use ELGA (H2a), as well as on the attitude towards ELGA (H2b), which partially explained (mediated) the direct effect of perceived usefulness on intention to use ELGA (H2c).

The external variables, social influence (H3a), HIT experience (H4a), and privacy concerns (H5a) had significant effects on intentions to use ELGA in the expected directions. These direct effects could (partially) be explained by the intervening variables attitude towards ELGA and perceived usefulness (H3bc, H4bcd, H5bc).

As recent research showed, the effect of the perceived usefulness on actual IT usage is stronger for users with generally higher levels of IT experience [29]. Therefore, relevant IT experience is considered to have an impact on the perceived usefulness of a similar IT product. The results of our investigation confirm these findings; doctors who are more familiar with ELGA relevant HIT features from their practice information systems tend to have a better attitude towards ELGA. They feel more comfortable with the idea of providing or gathering health information via ELGA or recommending patients not to opt out. One major reason for their positive attitude is the fact that due to their higher level of HIT experience they consider ELGA as more useful in terms of cost savings, benefits for several stakeholders, and improvements for their practices. Consequently, doctors with a higher level of HIT experience are significantly more likely to use the ELGA system as soon as it is implemented.

Contrary to expectations, ELGA was considered less (rather than more) useful, if social influence was high (H3b). This might be explained by the fact that during and after the rising public debate on the ELGA implementation in Austria, there was a tremendous amount of mostly negatively biased information about EHR systems in the public media. The Austrian Resident Doctors’ Association initiated most of the public campaign against ELGA using newspapers, television, and radio to communicate their concerns. This legally established chamber is responsible for public relations, political and economic representation towards policy maker, and organizational services for their members. The representing institution is well recognized among physicians, doctors widely rely on the chamber’s statements related to political and strategic issues. Therefore, their media campaigns can be considered as an important influence on physicians’ ELGA acceptance. Since the news coverage of ELGA, especially in relation to its asserted additional costs and administrative workload for physicians, has been rather negative in Austria, physicians who consumed ELGA related reports very likely developed negative expectations on the usefulness of the EHR system.

Besides HIT experience and social influence, also privacy concerns had a significant impact on the perceived usefulness of ELGA, which was an unexpected finding. Recent research identified several causes for physicians’ fears that data privacy and data protection could not be guaranteed within EHR implementations [19]. Doctors feel that confidentially stored health data will attract hackers and that no EHR system can be entirely secured against hacker attacks. Furthermore, they fear that health professionals tend to handle medical information carelessly, which causes insecure privacy circumstances. Even corruption could lead to leaks in the EHR security measurements.
Finally, due to the fact that health data is considered invaluable for many companies (e.g., private life and health insurance companies, pharmaceutical companies, employers) they fear that unauthorized third parties will use EHR data. In addition to the illegal scenarios mentioned above, doctors fear that third parties might find legal ways to gain access to certain EHR data some day. Physicians even worry that public authorities like national health insurance agencies could use EHR data to derive information for potential savings or structural changes, for example, by identifying doctors or patients who cause above-average health expenses [19]. These privacy concerns have been found to lead to a negative perception of the usefulness of ELGA as well as a negative attitude towards a nationwide EHR system and also influence the physicians’ intention to use it in a negative way.

One important finding in technology acceptance research arising from the presented study is the fact that social influence in the form of public media campaigns as well as educational and informative material broadcasted to the target audience has a significant impact on the perceived usefulness of an IT system, which is about to be implemented. Policy representatives and advocates in favor of the implementation of HIT systems should be aware of the potential of public announcements and information campaigns using public media channels in order to influence physicians’ perception of usefulness. Especially, beneficial aspects of EHR systems should be highlighted, like long-term workload and cost reductions that justify a potential loss of productivity within the early development stages.

Furthermore, the findings show that privacy concerns have a negative effect not only on the intention to use an HIT system, but also on its perceived usefulness. The identified effect should be considered in future HIT acceptance research. Also, the results imply that policymakers have to define robust and clear privacy regulations. Specifically in Austria but presumably also in other countries, the regulation of privacy principles alone does not seem to be enough. The presented research indicates that in order to decrease privacy concerns not only clear privacy laws, but also an adequate enforcement of regulations in terms of penalties as well as raising public awareness to breaches and infringements are extraordinarily important. Therefore, in the area of health information exchange, educating and informing healthcare providers as well as patients to better understand and apply privacy regulations is essential for higher acceptance levels.

Finally, three broad approaches to national EHR implementation can be distinguished: top-down, bottom-up, and middle-out. As an example, the UK initially pursued a top-down approach and intended to deliver standardized EHR applications centrally organized through the National Health Service Connecting for Health [39]. In contrast, the US implemented a bottom-up strategy and decided to use federal and state incentives to increase adoption levels among providers and ensure some basic standards of interoperability [8]. Australia’s incremental approach can be defined as middle-out approach, since government investment in national infrastructure, standard development, and governance are combined with local responsibility for choosing compatible clinical IT systems. Estimations presume that the middle-out approach may be best for local acceptance and national connectivity [39]. Since the national government establishes a nationwide EHR-system to realize a longitudinal health record for each citizen and promote health information exchange among healthcare providers, Austria’s approach can be considered as top-down strategy. Notable participation of practitioners’ representatives in planning or early implementation phases was not pursued in Austria and is not likely to be considerably increased in the future. Therefore, in order to realize the full potential of EHR systems by raising doctors’ acceptance levels, it is important to educate physicians and raise their awareness in terms of the potential value proposition arising from the new ELGA system. The benefits are not only improving patient safety and quality of care, e.g., through allergy or drug interaction alerts. Having a patient’s longitudinal health information available in a standardized view reduces the basic interview time and leaves more time to discuss problems in detail, to educate patients in their conditions and treatments, to engage them in their care process, and to improve the doctor-patient relationship.

6. Limitations

Possible limitations of the presented study relate to the sample size and the non-experimental cross-sectional research design. As with many empirical studies, the sample size was not very large and the respondents in the final sample were not representative to the Austrian population of physicians. A broader sample, including physicians in an inpatient setting would have increased confidence in the result. Therefore, it could be of interest to investigate the model using a broader sample or including different EHR stakeholder groups.

Furthermore, the data were collected at one point in time, which is why the results cannot be interpreted causally. The hypothesized direction of effects (from the external variables to perceived usefulness to attitude to intention to use) is in line with theories and
prior research. Nevertheless, influences in the reversed direction (e.g., from intention to use to the external variables) might be plausible as well. Future studies using an experimental design or more waves of data over a longer time period are needed to resolve the issue of causality.

Despite these possible shortcomings, it should be noted that the model presented explained 69% of variance in intention to use ELGA. The results confirm that TAM is a valuable tool for explaining the intention to use HIT from attitudes, perceived usefulness, and the analyzed external variables. Therefore, the presented model is suitable to examine mechanisms that can lead to a higher EHR acceptance among physicians.

7. References


