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SYSTEMS-LEVEL QUALITY IMPROVEMENT

Innovative Power of Health Care Organisations Affects IT Adoption: A bi-National Health IT Benchmark Comparing Austria and Germany

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Abstract Multinational health IT benchmarks foster cross-country learning and have been employed at various levels, e.g. OECD and Nordic countries. A bi-national benchmark study conducted in 2007 revealed a significantly higher adoption of health IT in Austria compared to Germany, two countries with comparable healthcare systems. We now investigated whether these differences still persisted. We further studied whether these differences were associated with hospital intrinsic factors, i.e. the innovative power of the organisation and hospital demographics. We thus performed a survey to measure the "perceived IT availability" and the "innovative power of the hospital" of 464 German and 70 Austrian hospitals. The survey was based on a questionnaire with 52 items and was given to the directors of nursing in 2013/2014. Our findings confirmed a significantly greater IT availability in Austria than in Germany. This was visible in the aggregated IT adoption composite score "IT function" as well as in the IT adoption for the individual functions "nursing documentation" (OR = 5.98), "intensive care unit (ICU) documentation" (OR = 2.49), "medication administration documentation" (OR = 2.48), "electronic archive" (OR = 2.27) and "medication" (OR = 2.16). "Innovative power" was the strongest factor to explain the variance of the composite score "IT function". It was effective in hospitals of both countries but significantly more effective in Austria than in Germany. "Hospital size" and "hospital system affiliation" were also significantly associated with the composite score "IT function", but they did not differ between the countries. These findings can be partly associated with the national characteristics. Indicators point to a more favourable financial situation in Austrian hospitals; we thus argue that Austrian hospitals may possess a larger degree of financial freedom to be innovative and to act accordingly. This study is the first to empirically demonstrate the effect of "innovative power" in hospitals on health IT adoption in a bi-national health IT benchmark. We recommend directly including the financial situation into future regression models. On a political level, measures to stimulate the "innovative power" of hospitals should be considered to increase the digitalisation of healthcare.

Keywords IT adoption · IT benchmarking · Health IT · eHealth · Austria · Germany

Introduction

International health IT benchmarking initiatives

Multinational health IT benchmarks have become a common instrument to measure IT indicators that give an account of the readiness for health IT in a country and to stimulate cross-country learning [1]. The OECD eHealth model survey is a methodological approach to define relevant indicators in terms of availability and use of a broad range of systems and functionalities in different health care settings from the perspective of different stakeholders [2]. Parts of the OECD model survey formed the foundation of the Survey of the European Commission where hospitals from 30 countries responded to

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questions of the availability and use of systems, health information exchange, IT infrastructure, context and governance variables [3].

Cross-country learning that draws on benchmark facts allows politicians to find out whether the eHealth strategy in their country meets the initial expectations, to learn from best practice examples and to align the eHealth strategy accordingly [4]. With the many differences in healthcare systems around the globe that potentially affect the adoption of eHealth, benchmarking among countries with a similar healthcare context seems promising to identify eHealth specific facilitators and inhibitors [5]. In 2012, the Nordic countries therefore launched an initiative to benchmark the availability, use and usability of eHealth systems across their countries [6]. Another example of health IT benchmarks in similar healthcare system environments was the comparison between Germany and Austria [7], which was conducted in 2007 and published in 2010.

Against this background we decided to repeat the Austrian German health IT benchmark using relevant OECD indicators. Knowing that both healthcare systems are shaped to a large degree by national regulations [8, 9], laws have the potential to exert a strong influence on the general health IT climate and on the monetary conditions of the health care organisation [10, 11]. In addition, other factors with a potential impact on health IT adoption, in particular the perceived innovative power of the organisation could make the difference between adopting and non-adopting organisations. Some case studies hint at the importance of organisational innovativeness [12, 13]. Finally, there are other facilitators and inhibitors on the level of the hospital demographics known from the literature, which need to be taken care of for adjustment, first and foremost "size" of the organisation [14, 15], ownership [16], teaching status [14, 17] and system affiliation [18].

Healthcare systems in Germany and Austria

Germany and Austria both have an insurance-based healthcare system with the majority of the population insured in the statutory health insurance (Table 1). Whereas Germany has higher expenditures per capita, life expectancy at birth is marginally lower. Austria furthermore shows a higher physician- and nurse-to-bed ratio with regard to acute care facilities, which hints at a better staffed acute care system. Austria also shows a shorter average length of stay.

Research framework

In order to benchmark Austria and Germany with regard to health IT, we propose a research framework, which describes the environment and potential forces in this field (Fig. 1). The benchmark object in our study was the availability of IT functions in the hospital information systems. The availability was judged by the clinical stakeholders as the experts, who are familiar with the IT functions and IT systems that shape the clinical processes. We thus speak of "perceived technical availability", which can differ from the "technical availability" as seen through the eyes of a chief information officer [21] and from the actual "use" of these functions.

In our framework, we assume that IT adoption of hospitals is exposed to two major potential forces: The top-down force "country specific forces, in particular the legal-financial environment" and the bottom-up force "innovative power of the organisation". This research framework also integrates existing knowledge about hospital demographics exerting a potential influence on IT adoption as discussed above. The framework draws on existing models, particularly on the socio-technical-material framework [22], in which the material environment, e.g. laws, financing schemes and other forces, that cannot be changed easily, was integrated.

This framework allows the following research questions to be derived:

1. Do German and Austrian hospitals differ with regard to their "perceived technical availability" of IT functions?
2. Do demographic factors of the organisation play any role to explain possible differences?
3. Does perceived "innovative power" of an organisation contribute to the understanding of potential differences between the two countries?

Country specific context forces will be used to discuss the results rather than to phrase research questions.

Methods

Study design and measurement instrument

We conducted an observational cross-sectional study in acute hospitals in Austria and Germany. We hereby chose directors of nursing as representatives of clinical stakeholders to answer the questions. Due to their dual role as experts in the clinical field and as board members or as high-ranking executives they oversee the area of interest. Furthermore, they represent the largest group of healthcare professionals in a hospital, who are exposed to IT systems in their daily work.

IT adoption was operationalised by measuring the "perceived technical availability" of 27 IT functions that were taken from the OECD eHealth model survey and previous surveys within the framework of IT Report Healthcare [23, 24]. These functions covered the six clusters: "documentation", "order entry and results reporting", "decision support", "patient safety", and "supply chain functions" and "interface functions". The implementation status of each of these IT functions had to be rated on a 4-point Likert scale (1 = "no implementation planned", 2 = "implementation started/

Table 1 Selected indicators describing the healthcare systems in Austria (AUT) and Germany (GER)

Indicator	AUT	GER
Total population in Mio.	8.5	80.6
Public and private health expenditure per capita in US $	4,553.1	4,818.9
Life expectancy at birth in years	81.2	80.9
Hospital beds per 1000 population	7.7	8.3
Percentage of population in statutory or primary private health insurance in %	99.9	99.8
Average length of stay in days	6.5	7.7
Physicians-to-bed ratio (Full Time Equivalent)	0.33	0.23
Nurse-to-bed ratio (Full Time Equivalent)	0.90	0.61
Spending of the statutory health insurance per hospital bed in Euro	161,482	127,482

All indicators show data from the year 2013. Figures for "Total Population" are derived from the OECD Population Statistics [19]. All other indicators are taken from statistics in the OECD publication "Health at a Glance" [20]

resources provided", 3 = "implemented in at least one unit but not in all", 4 = "implemented in all units").

In addition, the hospital demographics "country", "location", "size", "ownership", "system affiliation", "teaching status" and "surgery available" were included into the questionnaire. "Innovative power" of the organization was rated on a 10-point scale with 1 denoting no power and 10 the highest possible power. The entire questionnaire[1] is shown in Appendix Table 4.

Data management and statistical analysis

One thousand seven hundred fifty four email addresses of German and 169 of Austrian directors of nursing in hospitals could be identified by Internet research. They represented 96.1% percent of the German acute hospitals[2] and 95.5% of the Austrian ones. The questionnaire was made available to them between November 2013 and February 2014 [23] utilising the online survey tool Unipark (http://www.unipark.com).

All data were analysed using R (Version 3.2.1). Statistical significance was set at alpha = 0.05. To account for multiple testing, p-values were Bonferroni adjusted. In order to describe the two samples, we tested for differences with regard to the demographic variables using logistic regression analyses with the criterion country (Austria as reference). The samples were also contrasted with the population in each country regarding the "size" of the hospital (see Appendix Table 5).

In order to compare both countries, we used a sub-score within the Workflow Composite Score (WCS) [26], an aggregated score, which measures the IT potential of hospitals to support clinical workflows. WCS provides four *descriptors* which are represented by sub-scores: (1) data and information, (2) IT function,[3] (3) integration of IT functions and (4)

distribution of data and information. These sub-scores, which are reflective of points given to IT features that relate to the particular descriptor, are expressed as normalised sum values [26]. In this study these values could range from 0 to 100 points.

To evaluate the IT adoption of both countries we utilised the sub-score "IT function". It is a highly reliable score (split half reliability r = 0.89) that integrates the 27 IT functions addressed in this survey [26]. The sub-score "IT function" served as criterion in a stepwise forward multiple linear regression analysis, into which "country", the demographics variables and the variable "innovative power" were entered as predictors. The final model was tested for non-multi-collinearity, homoscedasticity and normal distribution of the residuals. The significant predictors of this model were used in subsequent logistic regressions to test the country differences on the level of the 27 individual IT functions. To this end, the implementation status of the 27 IT functions was dichotomised, which were then analysed as criterion in univariate logistic regressions with "country" as predictor and adjusting for demographic variables.

Results

Sample

A total of 464 German and 70 Austrian directors of nursing took part in the survey, which corresponded with a response rate of 26.5% in Germany and 41.4% in Austria. Hospitals of all "size" categories and federal states participated in both countries. We compared the sample data to all population measures that were made available by the responsible federal offices (portion of for-profit hospitals, bed-size and teaching status in Germany and portion of for-profit hospitals as well as the bed-size in Austria). Significance testing revealed no significant differences between the sample and the population in both countries (see Appendix Table 5). Additionally, we

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[1] The entire questionnaire comprised 52 questions. Only results related to the research questions are presented in this paper.

[2] The German population of hospitals was constituted by those hospitals that had to deliver a quality report.

[3] This descriptor was originally called "function"[26]. For the sake of clarity we changed it to "IT function".

compared the sample data of both countries: There were no country specific differences with regard to "size", "system affiliation", "teaching status" and availability of a "surgery theatre" (Table 2). Only "ownership" turned out to be significantly different with an odds ratio of 2.24 (95% CI 1.31–3.78), i.e. a 2.24 greater chance to find a for-profit hospital participating in the survey in Austria compared to Germany (Table 2).

IT adoption: "Perceived technical availability"

Figure 2 shows the frequency distribution of the adoption[4] of the 27 IT functions in the two countries. This descriptive approach revealed nine IT functions with nearly equally distributed adoption rates (difference less than five percentage points). Eleven IT functions had higher adoption rates (> five percentage points) in Austria whereas seven functions showed higher adoption rates in Germany. The highest difference in favour of Austria was found for "nursing documentation" ($\Delta = 35.8$ percentage points), the highest difference in favour of Germany for "identification of samples" ($\Delta = 23.0$ percentage points).

The aggregated WCS sub-score "IT function", which provided an integrated view on all IT functions, yielded an arithmetic mean of 57.9 (SD = 18.8, $n = 70$) for Austrian hospitals and of 52.3 (SD = 12.6, $n = 464$) for German hospitals. The two countries differed significantly with regard to this score ($p = 0.027$). This indicated a higher adoption level of IT functions in Austrian hospitals compared to German ones.

In order to explain the variance of this score a stepwise forward multiple linear regression analysis was performed. "Innovative power" had the strongest effect with the highest beta coefficient ($p = 0.000$) on the aggregated score. Furthermore, the variance of the "IT function" sub-score could be also explained by the demographic variables "hospital size" ($p = 0.000$) and "hospital system affiliation" ($p = 0.015$). These results indicated that larger hospitals and those hospitals belonging to a multihospital system had higher "IT function" values. The final model with the four significant predictors could account for 42.8% of the total variance in "IT function" (Table 3).

The effect of "innovative power" on the aggregated WCS sub-score "IT function" was similar for both countries: more innovative hospitals had higher scores than less innovative ones as shown in the two univariate linear regression analyses (Fig. 3). However, Austrian hospitals had significantly higher

innovation values ($\bar{x} = 6.9$, SD= 2.1; $n = 60$) than German hospitals ($\bar{x} = 5.9$, SD = 2.1; $n = 409$). A univariate logistic regression analysis with country as criterion resulted in a significant OR value of 1.25 (95% CI 1.09–1.44).

IT adoption: Adjusted "perceived technical availability" for individual IT functions

Based on the knowledge that "innovative power", "hospital size" and "hospital system affiliation" could significantly explain the variance of the aggregated "IT function" sub-score (WCS), the computation of the OR values of the 27 individual functions were adjusted for the influence of these two demographic variables. Knowing that the two samples differed significantly with regard to hospital "ownership" this variable was included as third demographic factor for the adjustments (Fig. 4).

The adjustment for demographic variables (all values of the adjustment see Appendix Table 7) led to significant differences between the countries. Only for "identification of samples" (OR = 0.39) Germany showed a higher IT adoption. Whereas the adjustment resulted in five IT functions with significantly higher perceived availability for Austria, i.e.

- "nursing documentation" (OR = 5.98).
- "intensive care unit (ICU) documentation" (OR = 2.49) and
- "medication administration documentation" (OR = 2.48),
- "electronic archive" (OR = 2.27),
- "medication" (OR = 2.16),

Discussion

Sample and research questions

This study is based on a large sample of hospitals in Austria and Germany with a good response rate. A wide coverage of different hospitals from different regions in both countries and of different size classes participated.

There is a higher "perceived technical availability" of IT in Austrian hospitals compared to German hospitals. "Nursing documentation", "ICU documentation", "medication administration documentation", "electronic archive" and "medication" show a significantly greater availability in Austrian hospitals. In comparison, only one IT function, i.e. "identification of samples", was more often available in Germany.

These results partly resemble the findings of the 2007 study, which was published in 2010 [7]. At that time "nursing documentation", "electronic archive" and "picture archiving and communication system" showed a significantly higher

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[4] These frequency distributions relate to the data without "no response" answers, which had been coded as missing values. These frequencies therefore differ from the ones published in the IT Report Healthcare [23], where the distributions of all responses are shown.

Fig. 1 Research framework of the eHealth benchmark between Germany (GER) and Austria (AUT): variables in black font were observed in this study, *black arrows* mark the integration of the variables into the regression analysis, *light grey arrows* mark environmental forces that could affect the results but were not included into the regression analysis
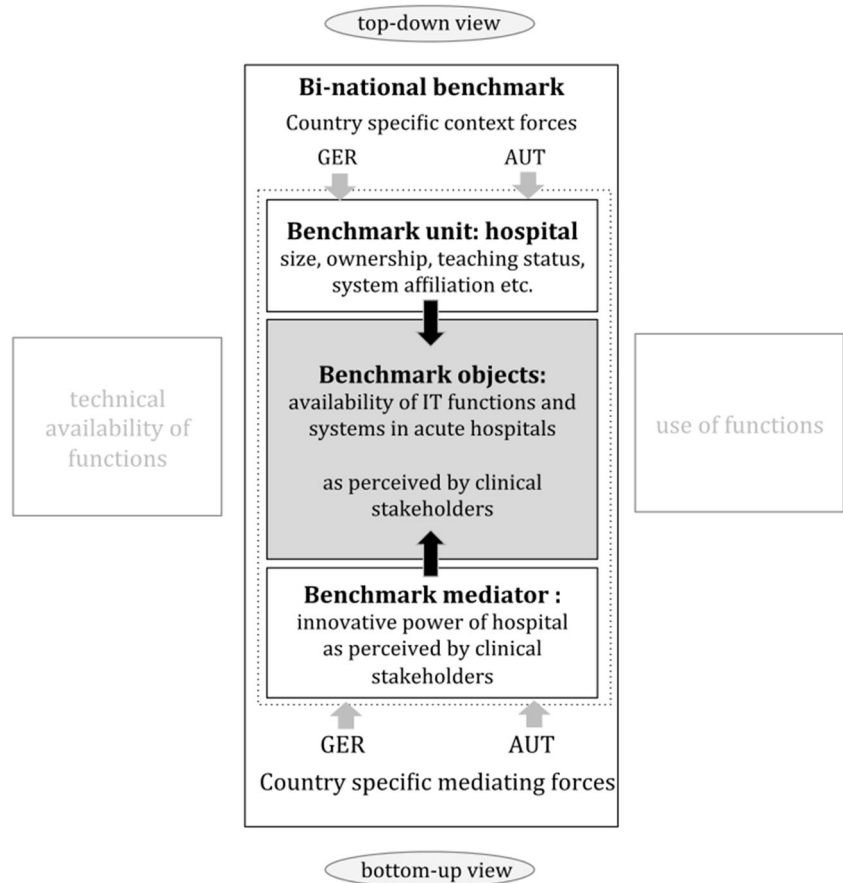
availability in Austria than in Germany. This indicates that the differences between both countries still persist with regard to the first two applications and now include more functions than in 2007. The significantly higher composite sub-score "IT function" in Austria than in Germany matches with a comparable sub-score (AUT = 0.653 versus GER = 0.502), which was developed in the context of the European Hospital Survey [25].

"Hospital size", i.e. the number of beds, and "system affiliation", i.e. whether the hospital is working on its own or in a multihospital system, were found to significantly influence the variation of the sub-score "IT function" but could not explain the difference between the two countries. The association between hospital demographics and IT adoption matches other findings with regard to "size" and "system affiliation" [14, 15, 18] but contradicts the literature with regard to the effect of "ownership" and "teaching status". The correlation between the latter two variables and "hospital size" may explain this result [14]. In both countries, teaching hospitals and not-for-profit hospitals tend to belong to the group of larger hospitals.

"Innovative power" of the organisation as perceived by the directors of nursing exerted a forceful effect on the variation of the WCS sub-score "IT function", which was not only

significant but yielded the highest beta coefficient in the model. "Innovative power" worked uniformly in both countries with regard to fostering IT adoption, but was significantly higher in Austria than in Germany. Thus the overall potential impact of "innovation power" was stronger in Austria than in Germany.

Research framework

The research framework, which underlays this study, assumed two main forces: the bottom-up force "innovative power" of the organisation and top-down forces, in particular the legal-financial environment. At first glance, the influence of "innovative power" seems trivial or tautological. However, we contend that the strength of this factor was not predictable, even though we expected some positive correlation with IT adoption. Our findings affirm studies which emphasize the important role of "innovative power" and "organisational culture" [12, 26] but did not demonstrate it empirically. Innovation always entails some sort of risk to be associated with the implementation of the innovation [27]. Organisations with strong innovative power often venture forth on unchartered territory also at the costs of failure.

Fig. 2 Adoption rates (implemented in at least one unit) for 27 IT functions sorted by size of difference with the largest positive difference between Austria and Germany at the top
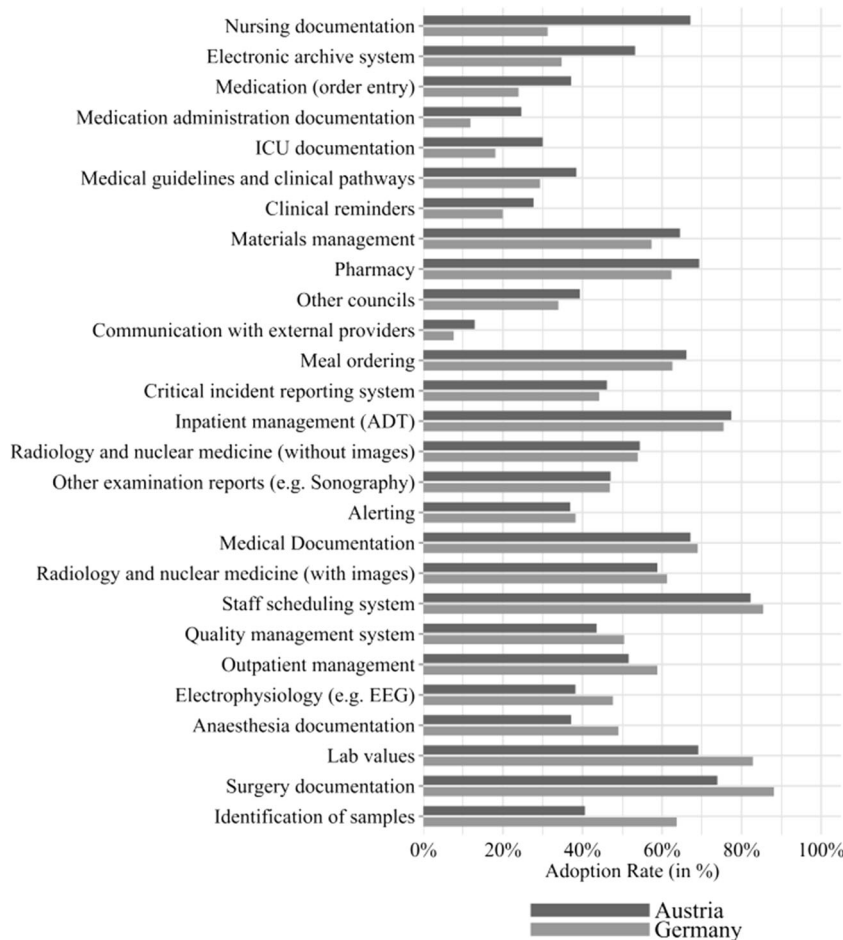
"Innovative power" could therefore be also associated with the top-down acting context factor legal-financial environment. In Germany, shortcomings in the reimbursement of investment costs within the G-DRG system are discussed as a strong inhibitor of innovative changes with mid- or long-term return of investment [28] such as health IT. IT often needs time to unfold its potential and contribute to a positive cost-benefit ratio because of a

Table 2   Summary of hospitals demographics (95% CI in brackets) and the results of univariate logistic regression analyses for hospital demographics (predictor) and country (criterion) of the sample

Sample	Overall	GER	AUT	Odds ratio (95% CI Range)	p-value
Hospital size (number of beds)	299.32 (±25.74) [n = 515]	299.52 (±27.93) [n = 445]	298.04 (±67.68) [n = 70]	1.000 (0.999–1.001)	0.969
Percentage of hospitals affiliated to a multi-hospital system	49.90% (±4.40) [n = 487]	48.47% (±4.75) [n = 425]	59.68% (±6.23) [n = 62]	1.378 (0.943–2.035)	0.101
Percentage of hospitals with surgery	69.66% (±3.90) [n = 534]	70.47% (±4.15) [n = 464]	64.29% (±11.22) [n = 70]	0.754 (0.448–1.294)	0.295
Percentage of for-profit hospitals	27.31% (±3.82) [n = 509]	24.94% (±4.04) [n = 441]	42.65% (±11.32) [n = 68]	2.238 (1.313–3.781)	0.003**
Percentage of teaching hospitals	46,93% (±4.35) [n = 505]	45.90% (±4.59) [n = 464]	58.54% (±4.53) [n = 41]	1.66 (0.750–2.078)	0.123

*p < 0.05, **p < 0.01, ***p < 0.001*

Table 3 Final multiple linear regression model resulting from stepwise forward selection with, IT function sub-score" as criterion (all models see Appendix Table 6)

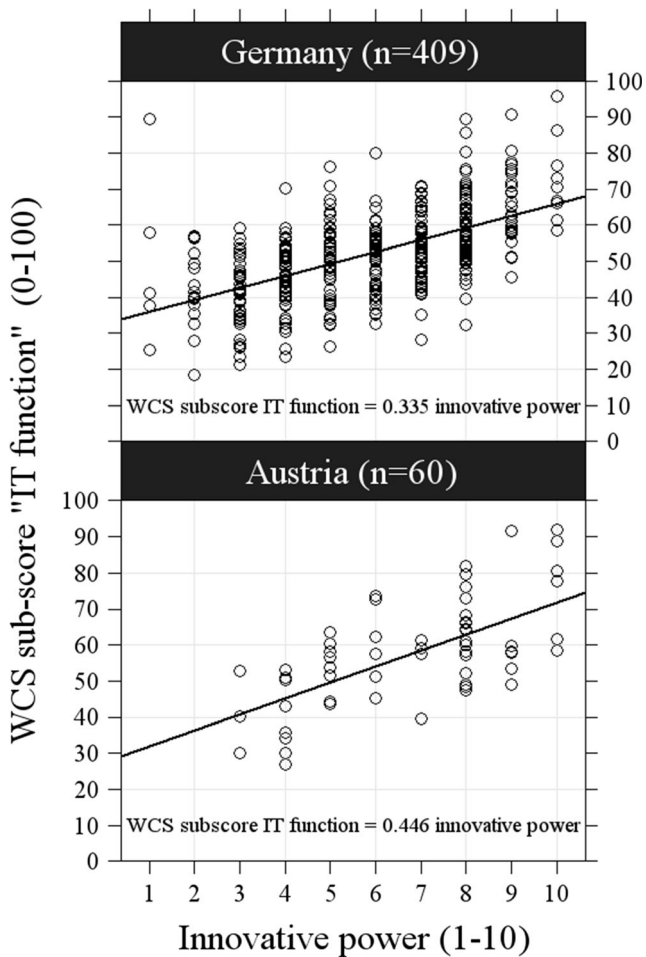| Independent variables	Beta-Weight (p-Value)
Intercept	0.000 (0.000)***
Innovative power	0.572 (0.000)***
Hospital size	0.288 (0.000)***
Country (Austria as reference)	0.151 (0.001)***
System affiliation (hospital in a multihospital affiliation as reference)	0.099 (0.025)*
R^2	0.433
Adj. R^2	0.428
F-statistic:	77.61
Degrees of freedom (df)	4 and 406
p-value:	0.000
n	411

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Fig. 3 Scatterplot "innovative power" of the organisation perceived by the directors of nursing versus WCS sub-score "IT function" for both countries

complex implementation and integration process [29, 30]. Unlike Austria, Germany shows an ongoing trend to shorten the length of stay (LOS). This difference may explain a higher pressure to act in Germany [31] and to curb costs, e.g. cutting nursing staff (see lower nurse-to-bed ratio in Germany in Table 1) instead of investing in new technology. Comparing the spending of the statutory health insurance per hospital bed in both countries also reveals a more favourable situation in Austria than in Germany (161,482 Euro in Austria versus 127,482 Euro in Germany in Table 1). Assuming similar cost structures, these figures point to the fact that there is more money in the health care system in Austria than in Germany.

The top-down force legislation had been discussed in the 2007 study to account for the higher adoption rates of "nursing documentation" in Austrian hospitals. Austria had passed a law, the Austrian Healthcare and Nursing Act [32], already in 1997 that stipulates the documentation of the full nursing process including the nursing diagnoses [7]. It was argued that it took some time before this law got manifested in corresponding IT adoption rates of "nursing documentation" systems. The effects of this law can still be seen. In Germany, the Nursing Complex Intervention Score (German: Pflegekomplexmaßnahmen Score PKMS) of the Hospital Financing Reform Law of 2009 [33] could potentially stimulate the uptake of "nursing documentation" but became effective in 2012 only. This circumstance may have made it difficult to measure its effect in particular given a slow acceptance of the PKMS.

Legislation seems to be most effective if it stipulates health IT and at the same time helps building enough free space to let health IT emerge or to give direct incentives for health IT adoption such as the Meaningful Use Program in the United States of America [34].

Limitations

The limitations of this study are related to the research design as an observational cross-sectional study that does not allow any causal relations to be derived. We assume that "innovative power" comes prior to IT adoption and thus may influence adoption behaviour. However, it could also be the other way round. Because organisations had implemented novel IT functions they felt they were innovative. Even more complex, feeling innovative and behaving innovative may be intertwined in a self-reinforcing process [35], i.e. because an organisation judges its "innovative power" as high, it adopts innovative technology and because it

Fig. 4 Adjusted OR values and 95% CI for demographic variables. Austria served as reference category in the logistic regression: OR > 1 indicates a greater chance that an IT function is implemented in Austrian hospitals than in German ones. For example, having implemented a nursing documentation system was 5.98 times more likely in Austria than in Germany
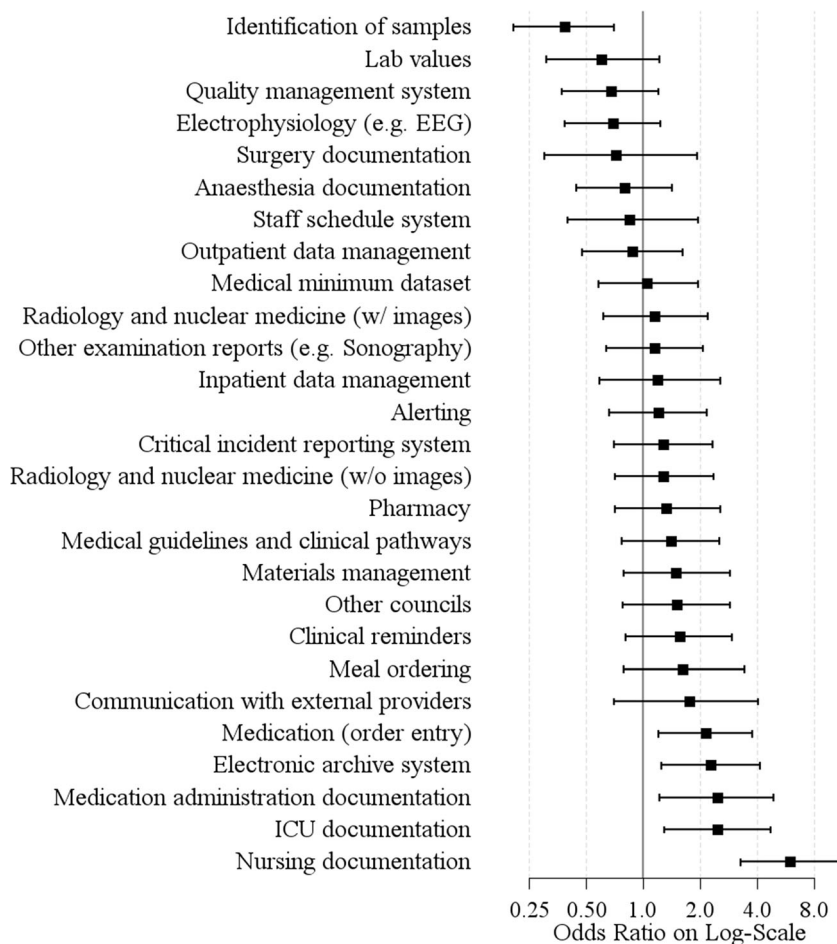
has adopted innovative technology it judges its "innovative power" as high.

Apart from "innovative power", other factors may have a potential influence on health IT adoption, e.g. "management of the IT implementation process" and "user support" [36], "commitment of the top management team" [13, 27] and "participation of clinical end users" [37]. They should be considered in future studies. In addition, "innovative power" itself needs further clarification in particular facilitators and inhibitors, e.g. factors acting behind the scenes such as IT governance and centralisation [38].

Cross-sectional studies are prone to the self-selection bias. There are statistical techniques such as the propensity score that aim to remediate this bias [39]. We did not employ any of these methods because we did not find significant differences between the samples and the corresponding populations with regard to a selected number of variables. Equally, we did not have access to specific variables that might differentiate between

responders and non-responders and thus could be entered into propensity analyses.

Another limitation arises from making the questionnaire only available to directors of nursing. Even though they represent the largest user group of health IT in hospitals, this study lacks the perspective of other medical professions such as physicians or therapists that would complement the user's viewpoint in hospitals.

Conclusions

This study is the first to empirically demonstrate the effect of "innovative power" in hospitals pursuing a regression approach in a bi-national health IT benchmark. We recommend including the financial situation of healthcare organisations into future regression models. On a political level, measures to stimulate the "innovative power" of hospitals should be considered to increase the digitalisation of healthcare.

Appendix

Table 4   Questionnaire

Items	Feature	Measure	Scale
In which state is your organisation located?		states	nominal
Postal code		free text	nominal
In which town is your organisation located?		free text	nominal
Please indicate the ownership status of your organisation		ownership	public private non-profit
Please indicate the teaching status of your organisation		teaching status	university hospital general teaching hospital no teaching hospital
How many beds does your organisation have?		number	metric
Is your organisation affiliated with a system of other hospitals?		system affiliation	single hospital hospital in a system with … members
Does your hospital have a surgery theatre?		existence	yes/no
Please evaluate the innovative power of your organisation with regard to IT		perceived innovative power	1 … 10
clinical documentation			
clinical documentation: electronic medical summaries and observation reporting		implementation status	likert scale
clinical documentation: medical minimum dataset		implementation status	likert scale
clinical documentation: nursing documentation		implementation status	likert scale
clinical documentation: medication (order entry)		implementation status	likert scale
clinical documentation: surgery documentation		implementation status	likert scale
clinical documentation: anaesthesia documentation		implementation status	likert scale
clinical documentation: ICU documentation		implementation status	likert scale
order entry and observation reporting			
oder entry and observation reporting: lab values		implementation status	likert scale
oder entry and observation reporting: radiology and nuclear medicine (without images)		implementation status	likert scale
oder entry and observation reporting: radiology and nuclear medicine (images)		implementation status	likert scale
oder entry and observation reporting: electrophysiology (e.g. EEG)		implementation status	likert scale
clinical decision support			
clinical decision support: medical guidelines and clinical pathways		implementation status	likert scale
clinical decision support: clinical reminders		implementation status	likert scale
clinical decision support: alerting		implementation status	likert scale
clinical decision support: medication therapy		implementation status	likert scale
patient safety			
patient safety: electronic identification of lab samples		implementation status	likert scale

Table 4 (continued)

Items	Feature	Measure	Scale
patient safety: electronic tracking of medication loop (from ordering to administration)		implementation status	likert scale
patient safety: electronic medication administration documentation		implementation status	likert scale
patient safety: electronic identification of medical supplies and drugs		implementation status	likert scale
patient safety: electronic identification of warehouses and other locations		implementation status	likert scale
patient safety: electronic identification of patients		implementation status	likert scale
patient safety: critical incident reporting system		implementation status	likert scale
supply chain			
supply chain: materials management		implementation status	likert scale
supply chain: pharmacy		implementation status	likert scale
supply chain: meal ordering		implementation status	likert scale
interface function			
interface function: inpatient data management		implementation status	likert scale
interface function: outpatient data management		implementation status	likert scale
interface function: quality management system		implementation status	likert scale
interface function: electronic archive system		implementation status	likert scale
interface function: staff schedule system		implementation status	likert scale
interface function: communication with external providers		implementation status	likert scale
What is the degree of Wi-Fi implementation in your institution?		implementation status	likert scale
Which electronic devices do clinicians use for processing patient data? (multiple responses possible)			
	PC	existence	yes / no
	Notebook (Computer on Wheels)	existence	yes / no
	PDA	existence	yes / no
	Bedside Terminal	existence	yes / no
	Tablet-PC	existence	yes / no
	Smartphone	existence	yes / no
	Thin-Client	existence	yes / no
Are clinical routine data in your organisation used for secondary data analysis (e.g. quality management, clinical research, administration)?			yes/no
For what type of tasks are these clinical routine data used?			
	Improvement of patient safety	type of tasks (nominal)	yes/no
	Monitoring health outcomes	type of tasks (nominal)	yes/no
	Disease or case management	type of tasks (nominal)	yes/no
	Billing	type of tasks (nominal)	yes/no
	Governance (Data Warehouse)	type of tasks (nominal)	yes/no
	Quality management	type of tasks (nominal)	yes/no
	Clinical research	type of tasks (nominal)	yes/no
	Training and education	type of tasks (nominal)	yes/no
	Identification of evidence based "best practice"	type of tasks (nominal)	yes/no
Please describe the availability of the electronic patient record system in your organisation.			

Table 4 (continued)

Items	Feature	Measure	Scale
		implementation status	likert scale
Which parts of the nursing process are supported by the nursing software used in your organisation?			
	Documentation of nursing measures	existence	yes / no
	Documentation of problems	existence	yes / no
	Scores	existence	yes / no
	Nursing assessment	existence	yes / no
	Documentation of nursing goals	existence	yes / no
	Documentation of ressources	existence	yes / no
	Documentation of goal evaluation	existence	yes / no
Which special documentation features does the software have?			
	PKMS	existence	yes / no
	DRG-relevant nursing diagnosis	existence	yes / no
	Wound documentation	existence	yes / no
	MRSA documentation	existence	yes / no
	Hygiene documentation	existence	yes / no
Nursing problems are documented using …. Nursing problems are documented using …. Nursing problems are documented using ….			
	Catalogue based on ICNP	existence	use (currently or planned)
	Free text	existence	use (currently or planned)
	NANDA-I catalogue in German	existence	use (currently or planned)
	Proprietory catalogue	existence	use (currently or planned)
	EPA-AC	existence	use (currently or planned)
	ENP	existence	use (currently or planned)
	apenio	existence	use (currently or planned)
	ICF	existence	use (currently or planned)
	Other	existence	use (currently or planned)
Nursing measures are documented using …. Nursing measures are documented using ….			
	Catalogue based on ICNP	existence	use (currently or planned)
	Free text	existence	use (currently or planned)
	Proprietory catalogue	existence	use (currently or planned)
	LEP 2.x	existence	use (currently or planned)
	LEP 3.x	existence	use (currently or planned)
	ENP	existence	use (currently or planned)
	apenio	existence	use (currently or planned)
	NIC	existence	use (currently or planned)
	Other	existence	use (currently or planned)
Which patient data are available on PC workstations for ward rounds? (multiple responses possible)			
	patient demographics	existence	yes / no
	results (text)	existence	yes / no
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	warnings	existence	yes / no
	orders	existence	yes / no
Which patient data are available on mobile devices (e.g. over smartphone)? (multiple responses possible)			
	patient demographics	existence	yes / no

Table 4 (continued)

Items	Feature	Measure	Scale
	results (text)	existence	yes / no
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	warnings	existence	yes / no
	orders	existence	yes / no
How many clinical units have an in-patient access to patient data?			
		relative number of units	percent
How many clinical units in your institution do have mobile access to the patient data?			
		relative number of units	percent
Please evaluate the overall use of electronic patient data during ward rounds			
	The completness of data is …	quality	good / acceptable / bad
	The up-to-dateness of data is …	quality	good / acceptable / bad
	The time it takes to compile data is …	quality	good / acceptable / bad
Is the surgery date scheduled electronically in your institution?			
		existence	yes / no
Which electronic data is accessable for the anesthetist and surgeon before surgery? (multiple responses possible)			
	patient demographics	existence	yes / no
	results (text)	existence	yes / no
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	warnings	existence	yes / no
	orders	existence	yes / no
Please evaluate the overall use of electronic patient data during pre-surgery			
	The completness of data is …	quality	good / acceptable / bad
	The up-to-dateness of data is …	quality	good / acceptable / bad
	The time it takes to compile data is …	quality	good / acceptable / bad
In which format are patient data transmitted to the normal ward and the intensive care unit?			
normal ward	electronic format for all data (structured data)	type of format	
	electronic format for specific data (structured data)		
	via an electronic document management system (e.g. PDF)		
	paper based		
intensive care unit	electronic format for all data (structured data)	type of format	
	electronic format for specific data (structured data)		
	via an electronic document management system (e.g. PDF)		
	paper based		
Which electronic data from the surgery are available on the normal ward? (multiple responses possible)			
	patient demographics	existence	yes / no
	results (text)	existence	yes / no
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	warnings	existence	yes / no
	orders	existence	yes / no
Which electronic data from the surgery are available on the intensive care unit? (multiple responses possible)			
	patient demographics	existence	yes / no
	results (text)	existence	yes / no

Table 4 (continued)

Items	Feature	Measure	Scale
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	warnings	existence	yes / no
	orders	existence	yes / no
Please evaluate the overall use of electronic patient data during post-surgery			
	The completness of data is …	quality	good / acceptable / bad
	The up-to-dateness of data is …	quality	good / acceptable / bad
	The time it takes to compile data is …	quality	good / acceptable / bad
Are there electronic reminder functions for physicians and nurses concerning pending actions (e.g. orders) for patients before discharge?			
		existence	yes / no
How many clinical units have access to an electronic system that supports medical guidelines or clinical pathways?			
		relative number of units	percent
Which data is automatically provided in electronic form for the medical summary? (multiple responses possible)			
	patient demographics	existence	yes / no
	results (text)	existence	yes / no
	results (images)	existence	yes / no
	results (electrophysiology)	existence	yes / no
	kardex with medication and vital signs	existence	yes / no
	surgery data	existence	yes / no
Is the medical summary made available electronically to the general practitioners?			
	yes, via a portal	existence	yes / no
	yes, via eMail	existence	yes / no
	yes, via other IT systems	existence	yes / no
	not	existence	yes / no
Please evaluate the overall use of electronic patient data during discharge			
	The completness of data is …	quality	good / acceptable / bad
	The up-to-dateness of data is …	quality	good / acceptable / bad
	The time it takes to compile data is …	quality	good / acceptable / bad
Are nursing reports created electronically?			
			yes / no
Which parts of the nursing process can be incorporated into the electronic nursing report?			
	Documentation of nursing measures	existence	yes / no
	Documentation of problems	existence	yes / no
	Scores	existence	yes / no
	Nursing assessment	existence	yes / no
	Documentation of nursing goals	existence	yes / no
	Documentation of ressources	existence	yes / no
	Documentation of goal evaluation	existence	yes / no
Which special documentation features can be incorporated into the electronic nursing report?			
	PKMS	existence	yes / no
	DRG-relevant nursing diagnosis	existence	yes / no
	Wound documentation	existence	yes / no
	MRSA documentation	existence	yes / no
	Hygiene documentation	existence	yes / no
Please evaluate the overall use of electronic patient data for the electronic nursing report			
	The completness of data is …	quality	good / acceptable / bad
	The up-to-dateness of data is …	quality	good / acceptable / bad
	The time it takes to compile data is …	quality	

Table 4 (continued)

Items	Feature	Measure	Scale
			good / acceptable / bad
How satisfied are you with the software used to support the clinical workflows			
	Ward round	satisfaction	likert scale
	Pre-surgery	satisfaction	likert scale
	Post-surgery	satisfaction	likert scale
	Discharge	satisfaction	likert scale
How satisfied are you with the cooperation with the IT department regarding the support of clinical workflows			
		satisfaction	likert scale
Is your organisation a reference customer of an IT vendor?			
		existence	yes / no
Is there a central IT department in your organisation?			
		existence	yes / no
Who takes the project lead when implementing IT projects in the clinical practice?			
		profession	Employee of the IT department
			Physicians / nurses (Key-User)
			Employee of the IT department together with a physician / nurse
Is there a physician or nurse responsible for IT matters in your organisation?			
	A physician is responsible for IT matters	responsibility	yes / no
	A nurse is responsible for IT matters	responsibility	yes / no
What role do physicians / nurses (Key-User) play in your organisation with regard to IT matters?			
	They contribute to the IT strategy development		yes / no
	They contribute to evaluating and selecting new IT systems		yes / no
	They act as project manager at the clinical end for IT implementation and training		yes / no
	They contribute to the development and conduct of clinical training		yes / no
	They support clinical IT functions on behalf of the IT department		yes / no
	They work on innovative means to integrate IT into clinical practice		yes / no

Questionnaire attached in Excel file Appendix table 4

Table 5 Comparison of samples and populations

Indicator	Population	Sample	Statistic	p-value
Germany				
Teaching hospitals	43.23% [n = 1765]	45.91% [n = 464]	0.963	0.326
For-profit hospitals	29.19% [n = 1737]	24.94% [n = 441]	2.916	0.088
Hospital size (Bed Count)	290.84 [n = 1765]	299.52 [n = 464]	-0.538	0.591
Austria				
For-profit hospitals	44.16% [n = 274]	42.65% [n = 68]	0.007	0.929
Hospital size (bed count)	232.00 [n = 274]	298.04 [n = 70]	−1.757	0.082

We used Pearson's Chi-Square tests as null hypothesis significance tests for the proportion of teaching hospitals and for-profit hospitals. To compare the hospital size, measured by bed count, we used the Welch Two Sample t-test

Table 6   Multiple linear regression model on "IT function" sub-score

Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
(Intercept)	31.750 (1.441)***	28.948 (1.437)***	28.949 (1.433)***	28.713 (1.525)***	28.725 (1.702)***	29.081 (1.860)***	30.578 (1.981)***
Innovative power	3.532 (0.226)***	3.509 (0.221)***	3.447 (0.223)***	3.523 (0.235)***	3.523 (0.235)***	3.437 (0.243)***	3.314 (0.256)***
Hospital size		0.010 (0.002)***	0.010 (0.002)***	0.009 (0.002)***	0.009 (0.002)***	0.010 (0.002)***	0.009 (0.002)***
Country ("Austria" as reference)			2.510 (1.392)	3.266 (1.470)*	3.265 (1.473)*	3.826 (1.524)*	4.584 (1.850)*
Hospital system affiliation ("hospital in a system" as reference)				1.687 (0.690)*	1.688 (0.694)*	1.576 (0.708)*	1.384 (0.758)
Availability of surgery ("surgery available" as reference)					−0.019 (1.124)	−0.070 (1.159)	−0.595 (1.290)
Ownership ("for-profit hospital" as reference)						−0.072 (1.231)	0.713 (1.425)
Teaching status ("teaching hospitals" as reference)							−0.037 (1.202)
R^2	0.344	0.417	0.421	0.433	0.433	0.425	0.415
Adj. R^2	0.343	0.414	0.417	0.428	0.426	0.416	0.403
Num. obs.	469	450	450	411	411	396	351
RMSE	10.432	9.941	9.916	9.852	9.865	9.867	9.874

Results of the Forward Selection Models. In each iteration, one variable is added that contributes most to the explained variance. Within the brackets we show the standard error of the regression coefficients

Table 7   Adjusted odds ratios for all IT functions

IT-Function	Germany	Austria	Adjusted odds ratios	p-value
Identification of samples	63.68% [$n = 424$]	40.62% [$n = 64$]	0.385 [0.208–0.702]**	0.002
Lab values	82.85% [$n = 449$]	69.12% [$n = 68$]	0.604 [0.308–1.225]	0.150
Quality management system	50.48% [$n = 420$]	43.55% [$n = 62$]	0.678 [0.373–1.214]	0.194
Electrophysiology (e.g. EEG)	47.66% [$n = 449$]	38.24% [$n = 68$]	0.697 [0.386–1.235]	0.221
Surgery documentation	88.15% [$n = 329$]	73.91% [$n = 46$]	0.720 [0.300–1.937]	0.484
Anaesthesia documentation	49.03% [$n = 463$]	37.14% [$n = 70$]	0.798 [0.443–1.423]	0.447
Staff scheduling system	85.44% [$n = 419$]	82.26% [$n = 62$]	0.853 [0.400–1.964]	0.692
Outpatient accounting	58.81% [$n = 420$]	51.61% [$n = 62$]	0.876 [0.478–1.625]	0.671
Medical minimum dataset	68.97% [$n = 464$]	67.14% [$n = 70$]	1.054 [0.586–1.955]	0.864
Radiology and nuclear medicine (with images)	61.25% [$n = 449$]	58.82% [$n = 68$]	1.153 [0.615–2.200]	0.659
Other examination reports (e.g. sonography)	46.88% [$n = 448$]	47.06% [$n = 68$]	1.155 [0.642–2.076]	0.628
Inpatient accounting	75.48% [$n = 420$]	77.42% [$n = 62$]	1.188 [0.589–2.574]	0.645
Alerting	38.26% [$n = 426$]	36.92% [$n = 65$]	1.210 [0.666–2.173]	0.527
Critical incident reporting system	44.21% [$n = 423$]	46.15% [$n = 65$]	1.280 [0.700–2.347]	0.422
Radiology and nuclear medicine (without images)	53.90% [$n = 449$]	54.41% [$n = 68$]	1.286 [0.709–2.364]	0.411
Pharmacy	62.38% [$n = 420$]	69.35% [$n = 62$]	1.329 [0.713–2.568]	0.381
Medical guidelines and clinical pathways	29.34% [$n = 426$]	38.46% [$n = 65$]	1.412 [0.772–2.541]	0.254
Materials management	57.38% [$n = 420$]	64.52% [$n = 62$]	1.489 [0.793–2.874]	0.223
Other councils	33.94% [$n = 436$]	39.34% [$n = 61$]	1.511 [0.784–2.877]	0.211
Clinical reminders	19.95% [$n = 426$]	27.69% [$n = 65$]	1.571 [0.807–2.967]	0.172
Meal ordering	62.62% [$n = 420$]	66.13% [$n = 62$]	1.622 [0.791–3.448]	0.196
Communication with external providers	7.62% [$n = 420$]	12.90% [$n = 62$]	1.766 [0.700–4.053]	0.199
Medication (order entry)	23.92% [$n = 464$]	37.14% [$n = 70$]	2.156 [1.214–3.797]*	0.008
Electronic archive system	34.76% [$n = 420$]	53.23% [$n = 62$]	2.268 [1.247–4.165]*	0.008
Medication administration documentation	11.82% [$n = 423$]	24.62% [$n = 65$]	2.484 [1.223–4.874]*	0.009
ICU documentation	18.10% [$n = 464$]	30.00% [$n = 70$]	2.489 [1.291–4.722]*	0.006
Electronic nursing documentation	31.25% [$n = 464$]	67.14% [$n = 70$]	5.981 [3.276–11.372]***	0.000

Implementation Rates per Country and corresponding Odds Ratios (and 95% CI) derived from a logistic regression analysis where country served as criterion ("Austria" as reference)

References

1. Ludwick, D. A., and Doucette, J., Adopting electronic medical records in primary care: lessons learned from health information systems implementation experience in seven countries: lessons learned from health information systems implementation experience in seven countries. *Int. J. Med. Inform. [Internet]* 78(1):22–31, 2009. doi:10.1016/j.ijmedinf.2008.06.005.

2. OECD. OECD Guide to Measuring ICTs in the Health Sector [cited 2016 Apr 7]. Available from: http://www.oecd.org/health/health-systems/Draft-oecd-guide-to-measuring-icts-in-the-health-sector.pdf.

3. European Comission. European hospital survey: Benchmarking deployment of e-health services (2012-2013) : final report. EUR, Scientific and technical research series, Vol 26359. Luxembourg: Publications Office; 2014. 1 online resource [292].

4. Adler-Milstein, J., Ronchi, E., Cohen, G. R., Winn, L. A. P., and Jha, A. K., Benchmarking health IT among OECD countries: better data for better policy. *J. Am. Med. Inform. Assoc. [Internet]* 21(1):111–6, 2014. doi:10.1136/amiajnl-2013-001710.

5. Lapão, L. V., The challenge of benchmarking health systems: is ICT innovation capacity more systemic than organizational dependent? *Isr. J. Health Policy Res. [Internet]* 4(1):41, 2015. doi:10.1186/s13584-015-0036-5.

6. Hyppönen, H., Kangas, M., Surname, N., Reponen, J., Koch, S., and Surname, A. et al. Nordic eHealth benchmarking: *Nordisk. Ministerråd.*, 2015.

7. Hübner, U., Ammenwerth, E., Flemming, D., Schaubmayr, C., and Sellemann, B., IT adoption of clinical information systems in Austrian and German hospitals: results of a comparative survey with a focus on nursing. *BMC Med. Inform. Decis. Mak. [Internet]* 10(1):8, 2010. doi:10.1186/1472-6947-10-8.

8. Wörz, M., and Busse, R., Analysing the impact of health-care system change in the EU member states–Germany. *Health Econ. [Internet]* 14(Suppl 1):S133–49, 2005. doi:10.1002/hec.1032.

9. Sommersguter-Reichmann, M., and Stepan, A., The interplay between regulation and efficiency: evidence from the Austrian hospital inpatient sector. *Socio-Econ. Plan. Sci. [Internet]* 52:10–21, 2015. doi:10.1016/j.seps.2015.09.001.

10. Wittie, M., Ngo-Metzger, Q., Lebrun-Harris, L., Shi, L., and Nair, S., Enabling quality: electronic health record adoption and meaningful use readiness in federally funded health centers. *J Healthc. Qual. [Internet]* 38(1):42–51, 2016. doi:10.1111/jhq.12067.

11. Adler-Milstein, J., DesRoches, C. M., Furukawa, M. F., Worzala, C., Charles, D., Kralovec, P., et al., More than half of US hospitals have at least a basic EHR, but stage 2 criteria remain challenging for most. *Health Aff. (Millwood) [Internet]* 33(9):1664–71, 2014. doi:10.1377/hlthaff.2014.0453.

12. Tsiknakis, M., and Kouroubali, A., Organizational factors affecting successful adoption of innovative eHealth services: a case study employing the FITT framework. *Int. J. Med. Inform. [Internet]* 78(1):39–52, 2009. doi:10.1016/j.ijmedinf.2008.07.001.

13. Lewis, W., Agarwal, R., and Sambamurthy, V., Sources of influence on beliefs about information technology use: an empirical study of knowledge workers. *MIS Quart. [Internet]* 27(4):657–78, 2003.

14. DesRoches, C. M., Charles, D., Furukawa, M. F., Joshi, M. S., Kralovec, P., Mostashari, F., et al., Adoption of electronic health records grows rapidly, but fewer than half of US hospitals had at least a basic system in 2012. *Health Aff. (Millwood) [Internet]* 32(8):1478–85, 2013. doi:10.1377/hlthaff.2013.0308.

15. Liebe, J., Egbert, N., Frey, A., and Hübner, U., Characteristics of German hospitals adopting health IT systems - results from an empirical study. *Stud. Health. Technol. Inform. [Internet]* 169:335–8, 2011.

16. Hikmet, N., Bhattacherjee, A., Menachemi, N., Kayhan, V. O., and Brooks, R. G., The role of organizational factors in the adoption of healthcare information technology in Florida hospitals. *Health Care Manag. Sci. [Internet]* 11(1):1–9, 2008.

17. Amarasingham, R., Diener-West, M., Plantinga, L., Cunningham, A. C., Gaskin, D. J., and Powe, N. R., Hospital characteristics associated with highly automated and usable clinical information systems in Texas, United States. *BMC Med. Inform. Decis. Mak. [Internet]* 8:39, 2008. doi:10.1186/1472-6947-8-39.

18. McCullough, J. S., The adoption of hospital information systems. *Health Econ. [Internet]* 17(5):649–64, 2008. doi:10.1002/hec.1283.

19. OECD. Demography: OECD Publishing; 2014.

20. OECD. Health at a Glance 2015: OECD Publishing; 2015.

21. Liebe, J., Hüsers, J., and Hübner, U., Investigating the roots of successful IT adoption processes - an empirical study exploring the shared awareness-knowledge of Directors of Nursing and Chief Information Officers. *BMC Med. Inform. Decis. Mak. [Internet]* 16(1):10, 2016. doi:10.1186/s12911-016-0244-0.

22. Fernando, J., and Dawson, L., The natural hospital environment: a socio-technical-material perspective. *Int. J. Med. Inform. [Internet]* 83(2):140–58, 2014. doi:10.1016/j.ijmedinf.2013.10.008.

23. Hübner, U., Liebe, J.D., Hüsers, J., Thye, J., Egbert, N., and Ammenwerth, E. et al., IT-Report Gesundheitswesen: *Pflege im Informationszeitalter*, 2015.

24. Liebe, J. D., Hübner, U., Straede, M. C., and Thye, J., Developing a workflow composite score to measure clinical information logistics. a top-down approach. *Meth. Inf. Med. [Internet]* 54(5):424–33, 2015. doi:10.3414/ME14-02-0025.

25. Sabes-Figuera, R., Maghiros, I., and Abadie, F., European hospital survey. JRC scientific and policy reports, Vol 26358. Luxembourg: *Publ. Off. Europ. Union*, 2013. Online-Ressource (.

26. Zailani, S., Gilani, M.S., Nikbin, D., and Iranmanesh, M., Determinants of telemedicine acceptance in selected public hospitals in Malaysia: clinical perspective. *J. Med. Syst. [Internet]*, 38(9), 2014. doi: 10.1007/s10916-014-0111-4.

27. Song, D., Li, D., and Qiu, L., The relationship between CIO's presence in the top management team and IT's contribution to corporate innovation: an empirical study. *Front. Bus. Res. Chin. [Internet]* 4(4):685–701, 2010. doi:10.1007/s11782-010-0116-x.

28. Neubauer, G., The economic future of german hospitals. *Gesundh ökon Qual manag. [Internet]* 19(01):26–35, 2014. doi:10.1055/s-0033-1356449.

29. Mair, F. S., May, C., O'Donnell, C., Finch, T., Sullivan, F., and Murray, E., Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review. *Bull. World Health Organ. [Internet]* 90(5):357–64, 2012. doi:10.2471/BLT.11.099424.

30. Cresswell, K., and Sheikh, A., Organizational issues in the implementation and adoption of health information technology innovations: an interpretative review. *Int J. Med. Inform. [Internet]* 82(5):e73–e86, 2013. doi:10.1016/j.ijmedinf.2012.10.007.

31. OECD. Health at a glance 2015 [Internet]. doi: 10.1787/health_glance-2015-en.

32. Gesundheits- und Krankenpflegegesetz: GuKG, 1997.

33. Bundesministerium für Gesundheit. Krankenhausfinanzierungsreformgesetz: KHRG, 2009.

34. Jones, S. S., Rudin, R. S., Perry, T., and Shekelle, P. G., Health information technology: an updated systematic review with a focus on meaningful use. *Ann. Intern. Med. [Internet]* 160(1):48–54, 2014. doi:10.7326/M13-1531.

35. Sydow, J., and Schreyögg, G., Self-reinforcing processes in and among organizations. New York: Palgrave Macmillan; 2013. 1 online resource.

36. Hoerbst, A., Hackl, W. O., Blomer, R., and Ammenwerth, E., The status of IT service management in health care - ITIL® in selected European countries. *BMC Med. Inform. Decis. Mak. [Internet]* 11(1):76, 2011. doi:10.1186/1472-6947-11-76.

37. Bush, M., Lederer, A. L., Li, X., Palmisano, J., and Rao, S., The alignment of information systems with organizational objectives and strategies in health care. *Int. J. Med. Inform. [Internet]* 78(7):446–56, 2009. doi:10.1016/j.ijmedinf.2009.02.004.

38. Hübner, U., What are complex ehealth innovations and how do you measure them? position paper. *Meth. Inf. Med. [Internet]* 54(4):319–27, 2015. doi:10.3414/ME14-05-0001.

39. Höfler, M., Pfister, H., Lieb, R., and Wittchen, H. U., The use of weights to account for non-response and drop-out. *Soc. Psychiatr. Psychiatr. Epidemiol.* 40(4):291–9, 2005.