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An International Comparison of Factors Inhibiting Physicians' use of Hospital Information Systems

Heiko Gewald
Neu-Ulm University of Applied Sciences, heiko.gewald@hs-neu-ulm.de

Alicia Núñez
Universidad de Chile, anunez@fen.uchile.cl

Corinna Gewald
Neu-Ulm University, corinna.gewald@hs-neu-ulm.de

Leah J. Vriesman
University of California at Los Angeles, vriesman@ucla.edu

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Heiko Gewald
Neu-Ulm University of Applied Sciences
heiko.gewald@hs-neu-ulm.de

Alicia Núñez
Universidad de Chile
anunez@fen.uchile.cl

Corinna Gewald
Neu-Ulm University of Applied Sciences
corinna.gewald@hs-neu-ulm.de

Leah J. Vriesman
UCLA
vriesman@ucla.edu

Abstract

Finding ways to strengthen health care systems is a matter of great concern all around the world. Health care operations struggle with limited resources and diminishing workforce capabilities, making it imperative for effective and efficient operations. Hospital information systems (HIS) can help achieve this mission, providing reliable, timely, and relevant information about patient characteristics, reimbursement, and status of tests and quality metrics. However, there are still barriers toward the adoption of HIS by health care professionals. This study explores the inhibitors perceived by physicians for adopting HIS. The main motivation for this research is to answer the question: "**What are the factors inhibiting physicians' use of Hospital Information Systems?"** This research question is of great interest as physicians are considered to be the key to successful HIS deployment, adoption and use. This study takes a qualitative research approach, employing ninety-eight (98) interviews at nine different hospitals, complemented by more than 40 hours of workplace shadowing. We conducted our research in the United States, Chile and Germany, as the three countries have developed healthcare systems but take different approaches to fostering the use of IT in hospitals and have implemented at different organizational levels.

Our findings show that the alignment of user, system and process is important as expected. However, the results point out that leadership and organizational setting play vital roles, although they were often neglected in previous studies.

Keywords

eHealth, Health IT, physicians, hospitals, hospital information systems, international comparison

1. Introduction

The use of information technology (IT) in healthcare has been an area of academic interest for some time now, and strengthening hospital information systems (HIS) is a priority demonstrated in developed and developing nations. Methods of deployment and adoption in international comparison vary by organizational policies, government mandates and tax-incentives, and even generational differences among clinicians and their familiarity with options. However, motivations for using HIS are largely similar: improvements in quality of care (Sharma, Chandrasekaran, Boyer, & McDermott, 2016), decreasing healthcare delivery costs (Bardhan & Thouin, 2013) and avoidance of non-necessary procedures (Yaraghi, 2015) are among the most often quoted benefits. Also, the increasing aggregated use of electronic health records is starting to discover meta-trends such as detecting previously unnoticed

diseases and epidemiological patterns (Anderson et al., 2016). Therefore, the continuous growth of these systems is expected (Wiggins, Peterson, & Moss, 2015).

Several researchers conducted reviews of the literature on the use of IT in healthcare in different contexts (e.g. Boonstra, Versluis, and Vos (2014), Buntin, Burke, Hoaglin, and Blumenthal (2011), Chaudhry et al. (2006), or Lluch (2011)). The reported findings vary from positive to negative to inconclusive (McCullough, Parente, & Town, 2016). An undisputable picture has not yet emerged. Taking the expected benefits of HIS and the investments into IT (Wakefield et al., 2007) into account one wonders why healthcare IT-systems everywhere in the world have difficulties to deliver on expectations (Davino, 2011). Naturally this question has multiple influential factors and is extremely complex to answer. Driven by personal experience and anecdotal evidence, we will take a step towards answering this question by assessing the role of the user (i.e. clinical staff, nurses and specifically physicians). A physician's acceptance of HIS is an important prerequisite for successful healthcare delivery (Tulu, Burkhard, & Horan, 2006; Walter & Lopez, 2008). Only if users use the IT as expected the anticipated benefits can be realized (Engelbert & Graeml, 2015). Due to their important role, physicians are often considered a main obstacle to successful IT deployment in hospitals (Boonstra et al., 2014; Kaplan, 1987; Paré, Sicotte, & Jacques, 2006). This leads to our research question: "**What are the factors inhibiting physicians' use of Hospital Information Systems?"**

Although numerous studies have been conducted on this issue, there is still no comprehensive understanding, and literally all relevant papers advocate that further research is needed. Therefore, the chosen approach was not to perform a quantitative study, but instead - informed by the available knowledge - to conduct qualitative research. Based on previously identified inhibitors of physicians' use of HIS we interviewed 98 users of HIS from nine different hospitals in three different countries from two different continents, and, wherever possible, we shadowed the users at their workplace. This allowed us to analyze the ways that three different healthcare systems have implemented HIS and gave us the opportunity to compare findings and derive international insights. All together we conducted more than 112 hours of interviews and more than 40 hours of workplace shadowing. The findings were coded, sorted and compiled into a reference framework. The framework shows that the alignment of user, process and system together with leadership and organization comprise the key factors to explain non-use of HIS.
The paper starts with a literature review, followed by the research method. Then, we discussed our findings and derived the proposed framework. The last section includes the limitations, guidance for further research as well as the implications and conclusion.

2. Literature Review

Numerous studies have been conducted over the years trying to explain physicians (non-) adoption of HIS. In this section, we provide some brief definitions and discuss major issues regarding the relationship between physicians and HIS in hospitals.

2.1 Definitions

As IT in hospitals can be very broad and complex, we define HIS as the *administrative IT system(s) used in hospitals for managing patient related information*. This includes cross-functional systems like the hospital information system (general administration, billing etc.) or the electronic medical record (patient data relating to a specific case) etc. The definition excludes function-specific medical IT systems like x-ray machines, heart catheters etc. which are used by specialists only (although the data may feed into other administrative systems). It

also needs to be pointed out that the definition focuses on systems within a hospital and does not include inter-organizational systems like health information exchanges or electronic health records across sites.

2.2 Adoption, Resistance and Mandatory Use

Numerous studies conducted research about the interaction of users and systems in healthcare (for reviews of the literature see Boonstra and Broekhuis (2010); Holden and Karsh (2010); Shaikh and Karjaluoto (2015)). The most popular study objects are the electronic medical record (EMR) and HIS in general. Several popular IS adoption models have been utilized (TAM, TAM2, UTAUT, SCT etc.), adapted to the healthcare context (Hadji, Martin, Dupuis, Campoy, & Degoulet, 2016) and sometimes extended by specific constructs. However, no model has yet emerged to sufficiently explain hospital physician's adoption behavior.

Due to laws, policies, and regulations etc., the process to deliver care includes an enormous part of documentation (Tulu et al., 2006). If a hospital switches from a paper-based system to an electronic medical record, the physician does not have a choice whether to use the system. It is mandatory for the physician to use it, whether the individual likes it or not. As such adoption is not the question, neither is acceptance or intention. Reflecting these arguments, there is certainly the case of resistance defined as "*opposition of a user to change, associated with a new IS implementation*" (Kim & Kankanhalli, 2009, p.567). Under these circumstances, users try several ways to avoid the system. These can be active, passive, overt, or covert negative behavioral responses (Laumer & Eckhardt, 2012). Some studies in the field of IS resistance have been conducted (Hirschheim & Newman, 1988; Kim & Kankanhalli, 2009; Lapointe & Rivard, 2005; Laumer & Eckhardt, 2012). There has also been specific attention dedicated to hospitals (Bhattacherjee & Hikmet, 2007; Doolin, 2004). All these studies highlight the importance of including the user into the implementation process as they will need to change their customary working patterns, which has an impact on their work (Liu & Cheng, 2015). However, resistance is typically a problem that arises when the change happens, i.e. before or during the implementation of a new system. Although this is an important issue to address, the vast majority of physicians in hospitals work on systems which are already implemented, and therefore, the case for resistance is restricted to rather specific circumstances rather than general implementation.

Following this line of thought, we argue that neither studies on adoption nor on resistance help explain the behavior of hospital physicians when using an existing system in a way which is compliant with the rules and regulations of the healthcare industry. If a medical staff conducts its daily business in a hospital, use of HIS is not voluntary but mandatory. The end-user has no choice whether to use the system, or not (Melone, 1990). This decision has been made by the management when they decided to acquire this system (Vehring, Riemer, & Stefan, 2011). Previous research shows that user behavior differs in settings where system use is voluntary or mandatory (Gallivan, 2001). When it comes to mandatory use of systems, the number of studies in IS decreases rapidly (Chan et al., 2010). Of course there is always a discussion whether system use can be really mandatory or if there is always a degree of voluntarism involved (DeLone & McLean, 2002; Vehring et al., 2011). However, it seems to be widely accepted that "*even when use is required, variability in the quality and intensity of this use is likely to have a significant impact on the realization of the system benefits*" (DeLone & McLean, 2002, p.5). This is due to the fact that even in mandatory settings, the extent of system use varies by user (Burton-Jones & Grange, 2012; Melone, 1990).
Bearing that in mind, the question remains: Which factors influence the users' behavior (the degree of usage) towards the system? Which factors form positive or negative attitudes?

2.3 Inhibitors to HIS Use

A lot of research has been devoted to identify the factors which encourage or hinder physicians to use HIS (Cocosila & Archer, 2016). Especially helpful are the reviews of the literature of Boonstra et al. (2014), Boonstra and Broekhuis (2010), Buntin et al. (2011), Holden and Karsh (2010), and (Lluch, 2011).
The following list provides an overview of previously identified inhibitors:

- lack of interoperability
- insufficient ease-of-use
- insufficient efficiency within the system
- professionals need to adapt their working customs
- insufficient integration with other clinical processes overly complex system
- technology does not fit to professionals' needs/work procedures
- threat to physician's professional autonomy
- negative impacts on physician–patient relationship
- patient privacy and information security concerns
- network effect, leaders are not using the system
- lack of IT-infrastructure
- insufficient speed/response times
- lack of IT support/technical assistance
- lack of integration with existing systems
- lack of user's IT skills
- lack of knowledge and training on the system
- lack of system reliability
- patient data in the HIS may not be complete

This comprehensive list of inhibitors to hospital physicians' use of HIS served as the main inputs for the interview guideline as described in the research method section.

3. Research Method

Our research design consisted of a qualitative approach to address the overall aim of this explorative study. Based on previous work and the previously identified inhibitors to physician's use of HIS, a semi-structured interview guideline was developed. This semi-structured interview was combined with workplace shadowing in nine hospitals: three in Chile, two in Germany and four in the United States, to allow international comparison. Hospitals were chosen using a convenience sampling. The findings were coded, sorted and compiled into a reference framework.

3.1 Research Subjects

This study is concerned with the factors that inhibit physicians' use of HIS. To get a broad overview we tried to engage physicians form several disciplines and hierarchical ranks. As appropriate, non-physician staff (nurses and administrative staff) were included in the study if they had specific insights in physicians' interaction with the HIS (often the staff members used the HIS on behalf of the physician).
Data collection took place from June 2015 to November 2016. All together 98 informants provided their thoughts. Their respective demographics are given in Table 1.

Data was collected at nine hospitals in Chile (Ch), Germany (D), and the United States (USA).

Department	Physicians	Staff
Surgery	10	2
Intensive care/ ICU	9	4
Neurology	8	
Internal medicine	9	7
Orthopedics	7	7
Anesthesia	1	2
Pediatrics	5	8
Dental Medicine	1	2
Family Medicine	3	6
Radiology	1	5
Pain Management	1	
Sum	**55**	**43**

Age	
20-29	26%
30-39	29%
40-49	24%
50-59	15%
60+	4%

Sex	
Female	51%
Male	49%

Table 1. Informants' demographics

Hospital Ch1 is a large high complexity public hospital in Chile that belongs to a nationwide health service. It has multiple HIS, which are not integrated into a single system. The hospital still relies to a large extend on paper-based medical records.

Hospital Ch2 is a large hospital built under a concession model in Chile. It is implementing a unique HIS, which seeks to have a singular electronic health record for the patient. This system also aims to be integrated with an ERP (SAP) to cover the administrative tasks of the hospital. However, the integration of the systems is still in progress. As such, paper records are still used today.

Hospital Ch3 is a small size clinic that belongs to a state company, and provides medical attention exclusively to their employees. It has multiple HIS, however one of them covers approximately 70% of all medical records. The clinic still relies on paper records, however there are plans to improve the situation.

Hospital D1 is a large university medical center, ranking amongst the 10 largest hospitals in Germany. The hospital is comprised of several different clinics which often have their own IT departments. It has a unified administrative back office system complemented with several different HIS systems in different clinics. Several clinics use paper-based medical records or a mixture between electronic and paper records. Also, there is a variety of different electronic medical records software in use and different stages of implementation. In summary, hospital A has a very complex and heterogeneous IT-landscape.

Hospital D2 is a specialized clinic of medium size in Germany. This clinic is part of a larger hospital group and two departments are run by a university medical center. It provides one uniform HIS system for all physicians and administrative departments. However, the hand-over of data between organizations proves to be a challenge due to data privacy requirements. The hospital still relies to a large extend on paper-based medical records as addition to the electronic systems.

Hospital USA1 is a large university medical center, ranking amongst the 10 largest hospitals in the United States. The hospital comprises of several different specialized clinics. Hospital USA1 has a unified HIS which all physicians have to use. This system has been implemented more recently.

Hospital USA2 is a large hospital which is part of a nationwide organization. It employs a singular HIS across all its locations and does not use paper-based records of any form. The system has been developed specifically for this organization.

Hospital USA3 is a medium-sized, commercially-oriented hospital which is part of a state-wide medical group. It has as singular HIS which is mandatory to use for all physicians

working at USA3. The fully-integrated system uses a standard HIS software package customized to this specific medical group.
Hospital USA4 is a large non-profit hospital which is part of a nationwide group and has a heavy focus on research. It has as singular HIS based on a standard software solution which is mandatory to use for all physicians. Since implementation of the HIS, the hospital ceased to use paper-based records of any form.

Key characteristics of the hospitals is provided in are given in Table 2.

	Ch1	Ch2	Ch3	D1	D2	USA1	USA2	USA3	USA4
Beds	550	400	12	1,600	230	400	750	200	900
Staff	2,500	1,400	170	9,000	500	1,400	5,300	600	4,900
Cases[1]	1,150	1,400	75	415	7	97	1,345	15	163

Table 2: Characteristics of Interview Sites (all figures *approximated)*

3.2 Semi-structured interviews and workplace shadowing

The interviews identified inhibitors and enablers associated with the implementation of HIS, and were based on a semi-structured interview guideline. This guideline consisted of three sections: (a) "Know your Interviewee": Demographic data of the interviewee and specification of her/his workplace and/or specific tasks/role(s); (b) "How do you use the HIS?": Description of the way the interviewee uses the system as part of her/his daily working routines; (c) "How do you like working with the HIS?": Inhibitors identified in previous research were tested with the interviewee and optimization potential identified.

Interviews were arranged ahead of time so that informants were prepared for the discussion. The questionnaire was not sent in advance. Talks lasted between 45 minutes and two hours. All together more than 112 hours of interviews were conducted between June 2015 and November 2016. Due to the sensitivity of the matters, the majority of interviewees in Germany and the United States did not agree to have the interviews recorded or full minutes been taken by a second interviewer. Therefore, the team needed to rely on multiple ways to record information Apart from recordings (where allowed), the team used handwritten notes taken during the conversation, on-site visualization of medical work, and memorization.
A common problem in social sciences is the disparity between self-reported behavior and the actual observable actions. To mitigate this effect, we tried wherever possible to not only rely on interviews but to conduct workplace shadowing. The team spent more than 40 hours accompanying physicians on their ward rounds, during team meetings and observing their general work. Our main goal was to “see” how the physician interacts with the system. Unfortunately, not all hospital policies allowed workplace shadowing.

4. Data Analysis

The interpretation of the data collected was done as suggested by Miles, Huberman, and Saldana (2013): All notes taken and recorded interviews were reviewed, clarified as necessary and coded. Open coding was guided by association to either previously reported inhibitors or by associating a new concept. Following open coding, axial coding was performed to ensure all important aspects have been identified. Coding was done by three researchers independently. All disputes were discussed until a unanimous agreement was reached.
The results of the coding were organized in a table listing the major categories and associated concepts. These were put into perspective to form a framework to structure the findings as

[1] All cases are reported in thousands per year and reflect the latest available figures

presented below. Quotes with 'P', 'N' and 'S' were attributed to German physicians, 'D' to American informants and 'E' to Chilean participants.

5. Discussion of Findings

Our findings underline that physicians in Germany and the US are generally not technophobic. *"Everything in our daily life is on the computer. I can't see why this should be different when it comes to medicine."* [D12]. However, there is also resistance to technology adoption. Not because physicians do not see the benefits of IT, but mainly because entering data is time consuming, system crashes and lack of standardization leads to duplication of data entry. In summary, technology is considered to be good when it is useful to complete a process in a more efficient or effective way, compared to a given alternative. We found evidence which supports (semi)rational and emotional arguments for the way physicians interact with the provided HIS. The interpretation of statements and observations indicate a clear relationship between user, process and system, with their respective interactions among them. Leadership and organizational settings also have a strong impact in the adoption of HIS. The individual categories and their relationship are depicted in Figure 1 and are discussed thereafter.

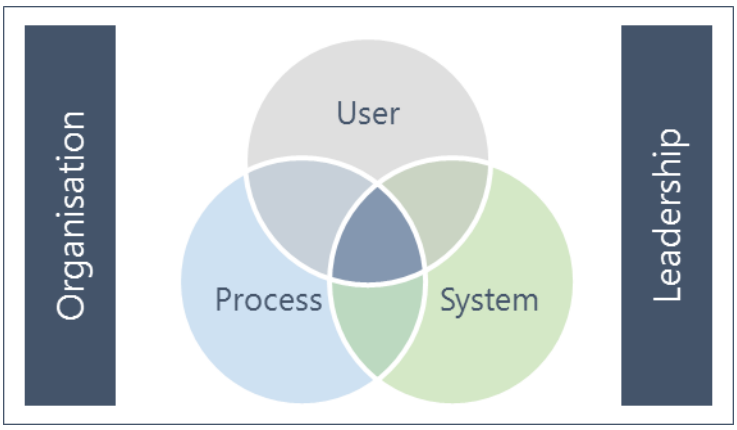

Figure 1. Framework of Findings

5.1 User - Process – System

Our sample represents users that are satisfied with the HIS and those who openly dislike it. In line with the findings of Chau and Hu (2002), we observed that physicians usually showed a positive attitude towards the HIS when it closely matches their established work behavior, i.e. a good 'fit' (Goodhue & Thompson, 1995) between user, system and process. As the Chilean physicians and non-physicians put it: "[we] *like systems which are easier and friendlier with the users, so* [we] *can save time in* [our] *work"* [E1, E3, E10, E23, E28 E32, E33].

We saw that the **users** (physicians) were satisfied with the HIS when they had the feeling that they could get their work done more efficiently and/or effectively. The better exchange of information or access to it, being able to read all entries (compared to bad handwriting on paper files) and decision support were named as major enablers. In this context, 97% of Chilean informants agreed that increasing efficient collaboration within the department and increasing personnel effectiveness are enablers of HIS. In addition, 79% of them found electronic data exchange with other providers to be a major enabler. Although the all three countries' informants had different attitudes towards IT in general, no one refused to work with the system. Some felt that their work is increasingly becoming too IT-focused ("*At some*

point in time, we all will have to study computer sciences to do our job" [N04]), however, this was more within the German and "older" informant base.

We were surprised by the difference in attitude towards technology amongst younger physicians in the US versus Germany and Chile. Although generally younger personnel were more tech savvy than older physicians, the American doctors had a significantly better attitude towards HIS than Germans and Chileans. The interviews revealed interesting findings: (1) Pupils get in touch with IT earlier during school in the US. Apparently, the integration of IT into general teaching is advanced compared to Germany. In Chile, the first efforts to incorporate information and communication technologies in education started in 1992 (Fondef, 2008), and even though there are advances with respect to equipment, there is still a gap with other OECD countries such as Germany and the US. Chile has the specific challenge to broaden access to technologies for the general public in order to close the gap to the US and Germany. This results in a more ambivalent approach towards IT for Chilean and German physicians who show an attitude toward the HIS as being "[...] a standard tool to work with just as a stethoscope" [D04]. (2) All younger interviewees in the US were able to touch-type, making their physical interaction with the HIS much more efficient; (3) Health IT is an integral part of the academic education of medicine students in the US… "We were taught about HIS at medical school." [D08, D09, D11-D14], whereas these topics were not taught to the German and Chilean interviewees.

The effect of training on hospital-specific HIT use was considerable. Physicians from all locations who attended training sessions on the system were more comfortable using it and (from observation) faster and more knowledgeable (i.e. were able to use more functionality). Physicians acknowledge that training is helpful ("*It was very hard to use the system in the beginning but the training helped a lot to make the most out of it*" [P07]). The US informants reported often getting computer-based training even before starting their jobs or on their first day at work, which was generally perceived as sufficient. *"Training on the system was on the first day. That is enough to get you started. Everything else you learn on the job."* [D11]. Chilean informants mentioned that one of the main inhibitors of HIS use was the lack of training and identified a need to improve training in three dimensions: a prior training, a better training and a continuous training [E6, E9, E11, E12, E20, E21, E30, E32]. When asked specifically about this topic 100% of them agreed that there is lack of current knowledge and training on the system amongst "*all hospital staff*".

The impact on the relationship between patient and physician was valued differently, depending on the specialization of the interviewee. When a lot of physical interaction with the patient was necessary, the use of HIS was sometimes perceived as more hindering. On the other hand, it was also noted that some physicians believe patients may regard it positively to see hospital staff working with advanced technology ("I like working with the system. Patients see that we are up to date" [N05]). Several German informants complained about the HIS lagging behind modern hard-/software concepts like smartphones, tablets and apps. A general perception was "Why do I have access to all media on my iPhone but not on my medical system?"[P5]. In the US, on the contrary, the interviewees generally felt the HIS was "a very expensive system [sometimes even "the best system available"], which shows how much [we] physicians are valued" [D01; D04]. However, 67% of Chilean interviewees mentioned that they believe there is a negative impact on physician-patient relationship.

The HIS can strongly support the working process if it is used as designed. When information is entered timely, accurately, and meaningfully, the major tasks (like writing the doctor's

letter) are very quickly done: "*We continuously update our doctor´s letters as part of our documentation and so in the end they are done very quickly."* [P13]. However, this also requires all necessary systems to be integrated: "*Writing doctor's letters is the task we like to postpone most because it takes so much time to retrieve all information needed from the system."* [P04]. However, some informants mentioned information overload ("*I don't want all the information automatically thrown onto me. As a doctor, I want to think and make my own decisions.*" [P10] Others have a general mistrust in the information provided by the system ("*With all that copying and pasting one cannot trust the information in the system all the time.*" [P14]). System integration and data integrity show to be a key requirement for successful working processes. *"The system gives a holistic view of the patient so I can make better decisions"* [D04]. In fact, this was one of the issues repeatedly mentioned by Chilean interviewees including the lack of interoperability, the insufficient integration with other clinical procedures, and the lack of integration with existent systems [E5, E9, E12, E18, E23, E26, E27, E29, E33].

Another interesting finding was the attitude of some younger physicians who actually valued the possibility the system provides them when handling standardized procedures in order to enhance decision making. This empowers the individual, as it makes a single person much more independent from others when it comes to decision making. *"The system allows me to act more independently because it gives a lot of guidance based on best practices."* [D13]. Also, the ability of some HIS to provide recommendations such as display warnings in case of errors was perceived positively.

In Germany and Chile, a major recurring critique regarding the system was the graphical user interface (GUI). This was frequently regarded as either being too complex or "*not made for doctors*" [P05], and "*small font, too many spaces*" [E5]. This coincides with the findings in the process-category on the established working habits. Additionally, the physicians complained about multiple logons to different systems (as opposed to a single sign on) and/or the need to press too many buttons before being able to retrieve information. Chilean interviewees also complained about inadequate functionalities of the interface "*the system has many functions that we do not use and lack many others that we need*" [E8, E20], as well as the poor intuitiveness of the system "*it is complex to understand*" [E1, E5, E8, E11, E12, E30, E31].

Whereas the Chilean and German physicians complained about long response times and system outages (it needs to be noted that the latter was not observed during workplace shadowing), none of these matters were raised with the US informants. This is of special interest, as response times are largely perceptions. The latter are enforced by word-of-mouth and general attitude within the department. However, objective measures of response times have not been conducted in this research. It needs to be pointed out that the general hardware situation in the US was significantly better compared to Germany and Chile apparently due to major investments into IT over the last 3-4 years. *"There is a lot of money in the system."* [D01]. The good (and expensive) hardware situation in the US was noted positively by the interviewees as making their life much easier and feeling valued by their management. *"What we use is probably the best system available. It shows how much our work is valued*." [D04]. Chileans on the other hand do perceive an opportunity implementing infrastructure and hardware according to need.
Additional issues mentioned by Chilean users included recurring internet connectivity problems, potential vulnerability of the systems, lack of information backup, excess of visual information or functions which do not fit the current needs of the users, and the importance

that the system is in the local language. One interviewee mentioned *"the phone is connected to the same network as the internet, so if we have problems with the internet connection, the phone does not work either"* [E1]. Participants all agreed upon three important inhibitors: the insufficient ease-of-use because the system is too complex, the lack of IT support or technical assistance, and the lack of system/infrastructure reliability.

In summary, the three categories (user, process, system) are tightly coupled. Task-Technology-Fit (Goodhue & Thompson, 1995) implies a system is used when the technology provided fits the task to be performed. We saw that physicians generally are not opposing the HIS provided. Germans are struggling with the GUI and (perceived) long response times. This makes it difficult for them to get to a good fit with the system. Incomplete, redundant or difficult to get-to information was another inhibitor which was shared in Germany and Chile. However, the better the individual department adapted to the HIS (i.e. adjusted the processes accordingly), the better the overall fit was perceived to be. These three factors are so closely connected to each other that there seems to be no way forward by addressing only one of them.

5.2 Leadership

Leadership apparently plays a strong role in the way physicians interact with the HIS. Leadership is asserted by the direct (usually clinical) supervisor/superior and by hospital management.

Our findings clearly underline the important role the superior plays in forming attitudes and behavior towards HIS in her/his department. Whenever the clinical head was skeptical of HIS e.g. "*Technology is necessary these days but paper is faster and more efficient* [P01]" this attitude was mostly seen in the overall department, and vice versa. The department head strongly influences the working procedures and leads by example. In wards where the head was a supporter of the HIS, we saw the same attitude with all physicians. In departments with skeptical heads support was usually much lower. Especially in the US, we saw a strong attitude of the leadership toward a broad education of the residents, including working efficiently. Interestingly, the superiors in Germany who are in favor of the HIS typically spent several years of their professional life in the US. Also, anecdotal evidence emphasizes that the US interviewees made better use of the information the HIS consolidates in terms of management information. *"The system enables us to manage population health rather than just treating individual patients."* [D06]. The German informants mainly regarded the system as "an IT-System" whereas the US colleagues saw it as source of information to manage their departments. *"I can report on anything which helps me manage my department better."* [D03].

When it comes to implementation approaches of the HIS we saw significant differences in leadership styles between the US, Chile and Germany. In a nutshell, the American approach seems to be more highly regimented. Driven by the financial incentives of the U.S.'s HITECH act of 2009, hospital management provided sufficient funds for implementing HIS systems and also demanded timely implementation. This had several implications: (1) Strong stakeholder engagement of the hospital administration in order to claim results and benefits; (2) The elimination of paper files and full conversion to electronic records; and, (3) Physicians who did not want to work fully digital were "managed out", i.e. left the hospital into retirement or private practice. *"The only place where you can avoid working with HIT is in private practice."* [D15].

In summary, the findings show that leadership plays an important role in attitudes and use of HIS. When the head is a strong supporter of the HIS, the fit between task and system seems much better. This implies that processes are adopted to the system or the system was customized to support the process. When management puts strong emphasis on implementing the HIS and asserts the corresponding managerial actions, the overall situation resulted in higher acceptance (due to non-conformist physicians leaving) and lower fraction (due to abolishing paper records and non-integrated systems). *"Successful EMR implementation needs strong leadership"* [D06].

5.3 Organization

The main hindrance raised by Chilean and German physicians was the inferior organizational integration with other departments within the system. Due to the leadership issues described above, no coherent system and process integration structure was found around the hospital. This has resulted in a complex IT landscape which comprises several different HIS systems and heterogeneous working procedures: "*I have put the request for a consultation into the system, faxed the request to the other department and yet I have to call them every time to make sure they get the information.*" [P28], "*if the system were integrated with other units such as pharmacy, it would facilitate our work"* [E12], *"I think that the system should be installed in the whole hospital, so all units would communicate easily"* [E6] The US interviewees did not face these problems as the systems implementation approach was different and resulted in a coherent landscape within the hospitals we visited.

An additional observation was that many German physicians felt the IT department too distant from the medical professions. Chileans physicians also perceived the lack of support staff. They found it difficult to communicate and interact with IT personnel. Interestingly, this point was not brought up on interviews with American physicians. Here it seems that the general approach towards the HIS seems to be a more concerted action resulting in better interaction between IT and users.

We saw that when the organization is well aligned and the implementation mandated with incentives, the overall performance in terms of satisfaction with the HIS increases. This has strong implications for the inner model of user, process and system.

5.4 Summary

In summary, the information gathered in interviews and workplace shadowing showed that physicians are willing to work with the health information system when it helps them to do their job more effectively or efficiently. The latter derives from good coordination between user, process and system. Our general observation was that the better this construct works, the better the physicians interact with their system, and better results are achieved.

Key challenges identified mainly for Chile and Germany are the lack of interoperability across the systems and requirements for new hardware such as computer and other devices. In fact, most of the HIS in Chile have been implemented only on an individual level. Training is essential to encourage adoption and implementation of HIS. Lack of proper training in the complex nature of the health system hinders the effectiveness of health personnel.
For all countries, we perceived an increasing need for real-time data to more efficiently track patient status and outcomes. Real-time and reliable data collection will help to monitor work and a better decision-making process.

We also saw the influence of leadership (strong and coordinated leadership enables good use of IT), the impact organizational alignment has on system use, and the general formation of positive attitude towards IT based on educational curricula. As such, our framework consists of an inner model (user-process-system) where all factors influence each other and an outer model (leadership, organization and educational background) which impacts the inner model.

6. Limitations and Further Research

This research is an exploratory qualitative study to provide deeper insights into the way physicians in three countries use the HIS systems provided by the hospital or clinic. Due to the limited number of informants it lacks generalizability. Also, regretfully, we were not allowed to record the conversations in Germany and the US, therefore we needed to rely on many responses taken from memory. Future research could benefit from our findings through a basis for comparing more sites, a variety of healthcare settings and users of the hospital information systems.

7. Implications and Conclusion

Our findings show that different IS research strands are required to explain use of HIS by hospital physicians. We found not only a basis to agree with Task-Technology-Fit, but also detected the influence of business/IT-alignment and even long-term impact from educational background. We found evidence that the overall topic is not yet understood well enough to conduct large scale quantitative research. In order to assess the specifics of HIS use in hospitals, more qualitative research is necessary and we hope that our framework is able to guide some thoughts. So far, the framework has been able to provide information from three different countries with interesting results. Our findings provide evidence that the previously identified inhibitors are not yet complete and the root cause originates even deeper all the way back to the educational curriculum of physicians.

From a practical perspective, we were able to provide some topics which are too often overlooked when implementing HIS systems. There is a serious need for Business Process Reengineering found in other industries that could also apply for hospitals. A (new) system does not solve a problem. Only a combined effort of system customization together with adapting working habits seems to lead to success. This will also require serious and ongoing change management effort.

In conclusion, we compiled an exploratory study into the question how physicians in hospitals use the HIS systems the hospital provides. In a setting of mandatory use, we were interested in the enablers and inhibitors of system use. We found that the relationship between user, process and system and the influence of leadership and organization plays the biggest role. Our findings show that it requires work from all sides in order to shape the IT landscape in a way that HIS really supports the physician and finds broad acceptance.

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