

BARRIERS IN THE IMPLEMENTATION OF HEALTH INFORMATION SYSTEMS: A SCOPING REVIEW

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Abstract

Context. A well-developed health information system which is implemented according to present standards allows a healthcare quality increase. Our study aims at providing an overview of the barriers which were encountered in the process of implementing the health information systems by reviewing the literature connected to Europe and the United States of America.

Methodology. We searched within five databases (Cochrane Library, Google Scholar, PubMed, ScienceDirect and Scopus) for the exact phrase 'implementation health information system' along with the name of each European country/USA state. Relevance was then tested by scanning titles and abstracts. The third and final step involved assessing all the articles in order to set their relevance and a data extraction tool was created, containing the name of the state/country that the article reports data on, the article citation and the challenges identified.

Results. The barriers identified were classified in four major categories: technical, organizational, behavioral/human and financial. Seemingly, Europe (41 articles) and USA (20 articles) are facing the same issues in the implementation of a health information system. No major difference between EU and non-EU countries was found after our analysis with regards to the identified barriers.

Discussion. Even if recommendations and solutions are continuously being developed in order to solve these barriers, the implementation of a new health information system must be very detailed in order to face all these problems. Additionally, further research is required in order to evaluate their impact on the successful implementation of a health information system.

Keywords: health information system, content analysis, academic articles, EU and non-EU countries, United States of America.

1. Background

1.1. Why is health information relevant?

Health-related information is vital for the field of public health, since it is the foundation for policies, campaigns and programs aimed at maintaining, promoting and improving health (Bryant, 2002, pp. 89-98). Even though information comes through various channels, vital statistics and cause-of-death statistics, to name two of the most rich data sources, serve as solid tools for drafting and implementing public health policies. Country health information systems include a range of population-based and health facility-based data sources (WHO, 2013). However, there are significant disparities between countries, with little improvement in the amount and quality of data especially in low-income countries (Mahapatra *et al.*, 2007, pp. 1653-1663). Up to 2007, only 125 of 193 countries have provided to the World Health Organization data regarding the causes of death at least once after the year of 1950. Moreover, data coming from different backgrounds generally differ with regards to accuracy, relevance, comparability, timeliness and accessibility (Detmer, 2003). To overcome this barrier, various systems have been implemented to support the collection of comparable data from different countries. The European Community Health Indicators Monitoring, for instance, is a European-wide initiative, launched by the European Commission, to collect health indicators from the countries across the continent. In time, its initiators have produced a list of 88 indicators, grouped into five major categories (demographic and socio-economic factors, health status, determinants of health, health interventions: health services, health interventions: health promotion), which provide a realistic picture of the health system they are coming from (European Community Health Indicators Monitoring, 2012).

The financial difficulties which were brought by the generalized financial crisis led to serious effects on the budgets allocated to health worldwide. Although these changes represent both a problem and a challenge, because they can act as important catalysts for structural reforms, they inevitably produced a reduction in the investments in health information systems (Quaglio *et al.*, 2013).

1.2. How did the technology progress impact the collection and use of health information?

The debate over the utility of health information systems in clinical settings is a long one. Some have argued that the arguments *for* their implementation are prevailing over the ones against the implementation of these systems (Maffei, 2006), whereas others have highlighted the increased costs associated with putting health information systems in place (Schmitt and Wofford, 2002; Mildon and Cohen, 2002).

Electronic Health Records are moving from an institutional to an inter-institutional level, which raises concerns about the security and privacy of the shared data (Haas *et al.*, 2011). In order to prevent any threat to become reality, the institutions handling EHRs must pay attention to three security goals, namely confidentiality, integrity and availability (Haas *et al.*, 2011).

Clinical decision support systems are able to improve healthcare quality and safety by enabling health professionals to make better clinical decisions (Johnston *et al.*, 1994; Kuperman *et al.*, 2007; Wright *et al.*, 2009). Recently, their uptake has seen an increase, although it was recognized that more efforts need to be invested towards their evaluation and research, to ensure patients safety (Ammenwerth *et al.*, 2013, pp.1-3).

1.3. How differently are health information systems implemented?

The degree of health information systems implementation is variable, with countries such as Denmark (where 100% of the hospitals and pharmacies are currently using health information systems) leading the ranking (Deutsch, Duftschmid and Dorda, 2010). Other countries, such as the United States of America, the United Kingdom and Australia have also supported the funding of Electronic Health Records, Computerized Provider Order Entry and other consumer health information systems (Waterson, Hoonakker and Carayon, 2013; Stroetmann, 2012).

1.4. Health information systems and safety issues

Despite the benefits that the implementation of health information systems is bringing, attention needs to be paid to the safety of the systems (Menachemi and Colum, 2011). Efforts need to concern the standardization and oversight for the design, implementation and use of health information systems, in order to maintain and promote patient safety (Magrabi *et al.*, 2013). Although health information systems are meant to increase patient safety, by supporting the clinical decision process, concerns have been raised that they can, paradoxically, represent a threat to patient safety (Ash, Berg and Coiera, 2004; Magrabi, 2010). These unwanted events, called ‘e-iatrogenesis’ (Weiner *et al.*, 2007), are in fact part of a bigger category of unintended consequences related to computerized provider order entry (Campbell *et al.*, 2006). It was argued that the identification and understanding of these nine types of consequences (see Table 1) will lead to better managing the computerized provider order entries

Table 1: Unintended consequences related to computerized provider order entry and their frequencies of occurrence

Unintended Consequence	Frequency (%)
	<i>n</i> = 324
More/new work for clinicians	19.8
Workflow issues	17.6
Never ending system demands	14.8
Paper persistence	10.8
Changes in communication patterns and practices	10.1
Emotions	7.7
New kinds of errors	7.1
Changes in the power structure	6.8
Overdependence on technology	5.2
Total	100

Source: Campbell *et al.*, 2006

(Campbell *et al.*, 2006). In a systematic review focused on the use of health information systems in primary care, authors have concluded that the concerns about privacy, patient safety and provider-patient relations can be prevented or solved by strong leadership, effective project management and standard-setting (Ludwick and Doucette, 2008). Based on previous experience, some other critical areas encountered were change management, project management, implementation strategy and basic legal requirements (Deutsch, Duftschmid and Dorda, 2010).

1.5. Purpose of the study

Building on the available literature published so far, our literature review aims at providing an overview of the publications in which barriers encountered in the process of implementing the health information systems were identified. By referring to the implementation process we include the setting up and the running phases and the whole review will be based on this view. We also aim to highlight the most important lessons which were learnt after experiencing the development and implementation of health information systems at various levels in the healthcare system.

2. Methodology

Our literature review focused on the scientific literature dedicated to health information systems and their implementation in Europe and the United States of America (USA). Furthermore, we focused on each European Union (EU) member state and each Non-EU country, as well as each of the fifty states of the United States of America with the purpose of comparing how the HIS implementation processes were undertaken. There is information regarding the implementation of health information systems in both Europe and the United States of America separately, but due to the fact that we have not found any review focused on the comparison between the two settings, we chose to address this issue.

We performed the search by using five databases: PubMed, ScienceDirect, SCOPUS, Google Scholar and the Cochrane Library. Although initially we used all these five databases, only PubMed, Science Direct and Scopus retrieved articles related to our research question, therefore, we excluded Google Scholar and the Cochrane Library from our search databases.

We set our inclusion criteria as being (i) articles in English, published in peer-reviewed journals exclusively, (ii) regardless of their publication date. In the above mentioned databases, we searched for the exact phrase 'implementation health information system' along with the name of each European country/USA state (accounting for each one of the 100 territories).

Following the initial search, results were imported into a reference manager (Mendeley Desktop 1.10.1) and classified by the setting reporting data from (USA state/European country) and by the search engine.

The tables below show the number of results obtained on each database, for Europe (Table 2) and for the USA (Table 3).

Table 2: Number of articles found by searching the exact phrase ‘implementation health information system’ (Selection criteria: European Union states, Non-EU countries, PubMed, Science Direct, Scopus databases)

		DATABASE			
		COUNTRY	PUBMED	SCIENCE DIRECT	SCOPUS
EUROPE	EUROPEAN UNION	Austria	42	76	16
		Belgium	53	2	47
		Bulgaria	5	1	2
		Croatia	20	1	10
		Cyprus	4	0	4
		Czech Republic	9	1	9
		Denmark	71	5	36
		Estonia	5	1	7
		Finland	60	1	39
		France	125	12	46
		Germany	175	9	89
		Greece	73	5	32
		Hungary	7	0	7
		Ireland	27	2	246
		Italy	108	11	59
		Latvia	2	0	2
		Lithuania	6	0	8
		Luxembourg	2	1	2
		Malta	1	0	3
		Netherlands	145	14	122
	Poland	15	2	18	
	Portugal	16	2	9	
	Romania	12	1	12	
	Slovakia	1	0	2	
	Slovenia	15	1	12	
	Spain	70	18	48	
	Sweden	84	3	52	
	United Kingdom	280	6	257	
	NON-EU COUNTRIES	Albania	1	1	2
		Andorra	0	0	0
		Armenia	2	0	2
		Azerbaijan	0	0	0
		Belarus	1	0	1
		Bosnia	7	0	3
Georgia		57	0	29	
Iceland		5	0	0	
Israel		62	5	38	
Kazakhstan		3	0	3	
Kosovo		36	0	3	
Liechtenstein		0	0	0	
Macedonia		6	0	5	
Monaco		1	0	1	
Montenegro		1	0	0	
Norway		75	3	46	
Rep. of Moldova		2	1	1	
Russia		21	0	19	
San Marino		0	0	0	
Serbia		14	1	12	
Switzerland		108	2	50	
Turkey		33	4	24	
Ukraine		5	0	3	
Vatican		0	0	0	

Table 3: Number of articles found by searching the exact phrase ‘implementation health information system’
(Selection criteria: United States of America, PubMed, Science Direct, Scopus databases)

	STATE	DATABASE		
		PUBMED	SCIENCE DIRECT	SCOPUS
UNITED STATES OF AMERICA	Alabama	26	59	14
	Alaska	27	19	12
	Arizona	27	84	23
	Arkansas	14	17	6
	California	169	503	118
	Colorado	32	0	25
	Connecticut	24	2	24
	Delaware	10	0	13
	Florida	42	3	35
	Georgia	41	0	34
	Hawaii	8	1	11
	Idaho	7	0	6
	Illinois	104	1	17
	Indiana	49	2	21
	Iowa	64	2	34
	Kansas	18	0	10
	Kentucky	9	0	15
	Louisiana	19	2	15
	Maine	8	0	9
	Maryland	77	1	32
	Massachusetts	114	1	68
	Michigan	79	2	54
	Minnesota	46	3	40
	Mississippi	6	0	5
	Missouri	27	1	25
	Montana	1	1	2
	Nebraska	15	0	11
	Nevada	5	0	5
	New Hampshire	13	0	5
	New Jersey	30	2	31
	New Mexico	18	1	17
	New York	172	6	129
	North Carolina	83	3	38
	North Dakota	2	2	2
	Ohio	72	0	52
	Oklahoma	22	0	11
	Oregon	66	1	27
	Pennsylvania	79	1	61
	Rhode Island	9	0	7
	South Carolina	25	0	15
	South Dakota	3	1	3
	Tennessee	30	1	24
	Texas	104	5	67
	Utah	56	1	35
	Vermont	6	1	3
	Virginia	64	0	44
	Washington	174	3	68
	West Virginia	5	0	5
	Wisconsin	53	1	30
	Wyoming	1	0	1

Relevance was then tested by scanning titles and abstracts of each paper, as part of our second methodological step. During this second step, we traced a trend in emphasizing the barriers and challenges in implementing a health information system. Therefore, we limited our analysis only to this topic, since the literature we reviewed lacked articles focused on the differences in the HIS implementation process between the US, EU and Non-EU countries, fact that lead us to the third and final step. This involved reading all the articles that were chosen during the previous phases. One criterion for this phase was the availability of the full-text version of the papers. If access to full text was granted, the word 'barrier' and its synonyms ('obstacle', 'issue', 'problem', 'challenge', 'risk') were searched in the manuscripts. Where the search could not be performed, the document was scanned and if the terms were not found, the paper was considered irrelevant. Then, in order to aggregate the findings, a data extraction tool was created, containing the name of the state/country that the article reports data on, the article citation and the challenges identified.

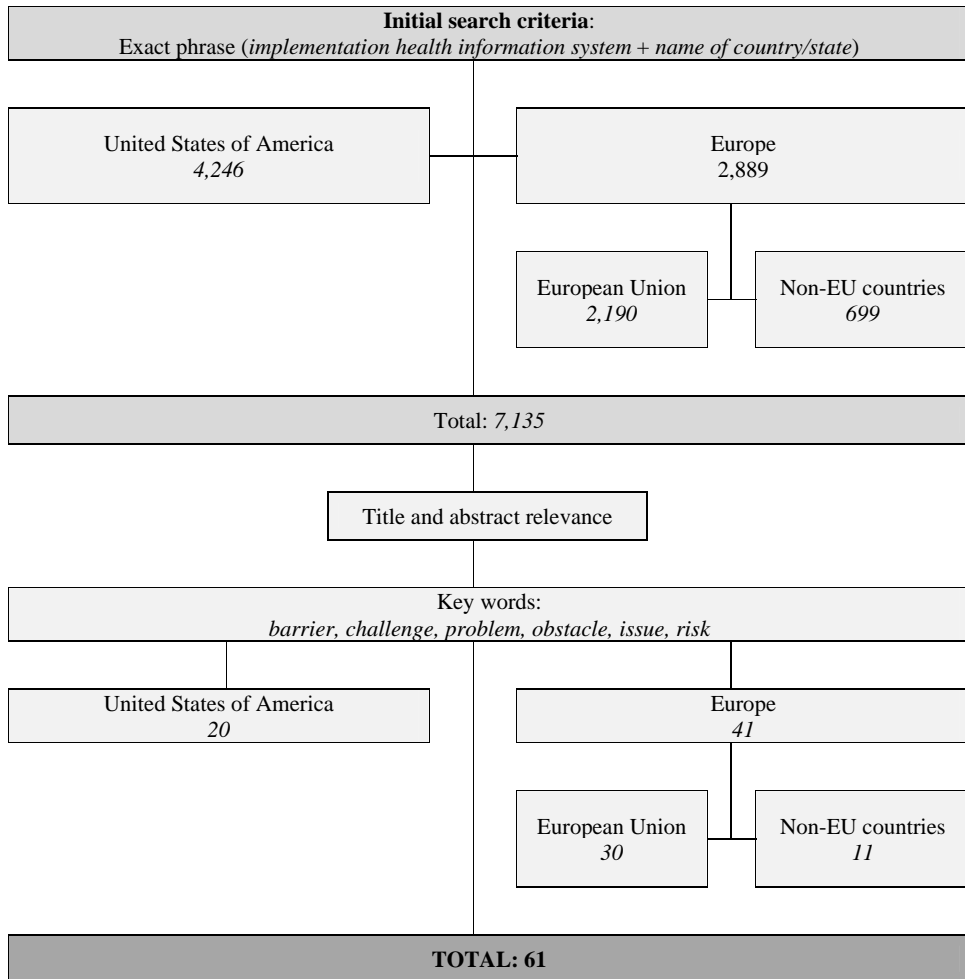


Figure 1: Methodological search strategy

3. Results

Following the literature review, we selected 61 relevant articles for both Europe (European Union – 30, Non-EU – 11) and USA (20). We used exclusively these articles for our further analysis; therefore all our results refer to the total of 61 papers.

To enable a more thoughtful analysis of the barriers identified, we classified them in four major categories: technical, organizational, behavioral/human, and financial. Each of these major categories include a number of subcategories that further on are described in detail. It is important to mention the fact that there were subcategories that may be part of more than one category ('training', for instance, can be included in financial barriers, referring to training-related costs or behavioral/human barriers).

Table 4: Categories and sub-categories of barriers identified in the countries/states analyzed

COUNTRY/STATE	MAIN BARRIERS	SPECIFIC BARRIERS
<i>EUROPEAN UNION</i>		
<i>Austria (7)</i>	Organizational Technological Financial	Data privacy Accidental loss or theft of sensitive clinical data Standardization of records Quality of data Legal foundation Cost-benefit ratio Anxiety and fear due to lack of information
<i>Belgium (3)</i>	Technological Financial Organizational Behavioral	Product/vendor immaturity Server and storage space Computer equipment Communication standard Data safety Funding issues Choice of vendor Training issues End-user equipment availability Physician resistance
<i>Denmark (4)</i>	Organizational Behavioral Technological	Lack of available time or resources Lack of skills Lack of experts Own interpretations and solutions to the problems Insufficient knowledge and uncertainty about procedures Ignorance of sources of error Unclear responsibilities Insufficient communication Clinician autonomy and low acceptance of change Strong professional identity Logistical problems
<i>Finland (2)</i>	Technological Behavioral	Dysfunctional computer systems Nurses' lack of motivation Lack of educational and technical support Lack of interest or fear of the negative effects of computer use Potential harm to doctor-patient relationship Threats to clinician's autonomy and potential extra workload

COUNTRY/STATE	MAIN BARRIERS	SPECIFIC BARRIERS
<i>Germany (3)</i>	Organizational Technological	Data privacy Accidental loss or theft of sensitive clinical data Medical staff training
<i>Greece (1)</i>	Behavioral Technological	Lack of trust in EHR systems Poor computer literacy Systems can be perceived as a distraction which impedes the physician's focus Data quality
<i>Ireland (1)</i>	Technological	Systems did not contain the information needed
<i>Netherlands (2)</i>	Technological	Process of entering and retrieving information Communication and coordination process Reliability.
<i>Romania (2)</i>	Behavioral Organizational Technological Financial	Shortage of skilled personnel Lack of skills to undertake a strategic planning process Relatively little experience in health Cost was considerable as compared to performances.
<i>Spain (2)</i>	Technological Organizational Financial	Rigidity in solving errors Adapting to a new nomenclature Expand coding to all the tests High costs.
<i>United Kingdom (1)</i>	Technological	System heterogeneity Semantic heterogeneity

NON-EU COUNTRIES

<i>Bosnia (1)</i>	Behavioral/Human Organizational	Impact present style of practice Lack of IT education
<i>Georgia (1)</i>	Organizational	Planning, users and maintenance issues
<i>Norway (6)</i>	Technological Organizational Behavioral/Human	Lack of infrastructure Impact present style of practice Lack of data Misunderstanding of the concepts
<i>Switzerland (2)</i>	Behavioral/Human Organizational Technological Financial	Unsatisfactory user interfaces Professional attitudes Frustrating decision-support systems Lack of technology Funding
<i>Turkey (1)</i>	Technological Organizational	Lack of technology Training issues

UNITED STATES OF AMERICA

<i>California (1)</i>	Technological Behavioral/Human	Lack of information and training Lack of trust Insufficient technical equipment
<i>Colorado (1)</i>	Technological Financial Behavioral/Human	Issues in adapting the new platform Lack of money for the equipment Lack of trust
<i>Georgia (1)</i>	Behavioral/Human	Lack of trust Disruption of the work process
<i>Hawaii (1)</i>	Technological Financial Organizational	Lack of information Insufficient workforce Lack of money for the equipment Lack of trust
<i>Massachusetts (1)</i>	Financial Technological	Lack of money for the equipment System design errors

COUNTRY/STATE	MAIN BARRIERS	SPECIFIC BARRIERS
<i>Montana (1)</i>	Organizational Technological Behavioral/Human	Lack of explicit justification of purpose to staff No physician/staff financial incentives Lack of provider performance monitoring
<i>Nebraska (1)</i>	Financial Organizational Technological Behavioral/Human	Information security concerns Resistance from physicians Lack of access to internal information technology support staff Start-up and maintenance costs
<i>New Jersey (1)</i>	Financial Technological Organizational	Lack of time to learn about new systems Increased costs Technical difficulties Interface for the product Effort needed to adapt office systems
<i>New York (1)</i>	Organizational Technological Behavioral/Human Financial	Training issues Change management Process mastering Information technology governance Electronic security Communication and collaboration The amount of capital needed Return on investment Productivity loss during implementation
<i>Oregon (1)</i>	Organizational Behavioral/Human	Shifts in the power Shifts in control with a perceived loss of clinician control Shifts in autonomy
<i>Pennsylvania (1)</i>	Financial Technological Behavioral/Human Organizational	Decline in productivity after implementation Expensive maintenance of the system Inadequate response time of the technical support team increased waiting time for patients Dissatisfaction of the medical personnel
<i>South Dakota (1)</i>	Financial Organizational Technological Behavioral/Human	Information security concerns Resistance from physicians Lack of access to internal information technology support staff Start-up and maintenance costs
<i>Texas (2)</i>	Financial Technological Organizational Behavioral/Human	Lack of capital resources Insufficient time Lack of technical infrastructure Lack of technical support staff Lack of technical knowledge Lack of a well-trained workforce
<i>Utah (2)</i>	Financial Organizational Technological Behavioral/Human	Short time to set up and learn the system Productivity/efficiency concerns Privacy concerns System performance and availability Lack of IT infrastructure Inadequate physician training
<i>Virginia (1)</i>	Financial Organizational Technological Behavioral/Human	Cost of systems Physician and staff time to learn new functions Lost productivity and disorganization during the implementation complexity of functions Time away from patient care
<i>Wyoming (1)</i>	Organizational Technological Behavioral/Human	Implementation without tailored modules Lack of explicit explanation of purpose to staff No physician/staff financial incentives Lack of provider performance monitoring

Although, seemingly, Europe (41 articles) and USA (20 articles) are facing the same issues in the implementation of a health information system, after a thorough analysis we discovered specific aspects on both sides. To a high extent, differences between Europe and USA are related to the availability of data. For example, in Austria (6 articles) and Germany (2 articles) the healthcare professionals have no trust in the way the new health information system will collect and use the data. Furthermore, hospital patients are aware of the potential risk of theft of sensitive clinical data. On the other hand, in Nebraska (1 article) and South Dakota (1 article) data is hardly available; information regarding this issue is missing, so the internal information technology support can be hardly accessed.

However, despite the differences between these two studied areas, the available information could not support the decision whether a new health information system will be more effective in Europe or USA.

According to our analysis, being a European Union member state or a Non-EU member state had no impact on the results, as we found no major difference between the two country categories. We may state that a difference was found only regarding the number of articles related to our topic and research methods. In this respect, for the EU countries we found 31 relevant articles, and only 11 for the Non-EU countries.

However, we cannot conclude that EU countries are necessarily more active in this domain than the Non-EU countries, but rather that articles reporting data from EU countries matched better our search criteria.

3.1. Technological Barriers

Our results revealed that out of 16 European countries and 14 US states, only one country, Bosnia (1 article) is not identifying technological barriers as an obstacle in the implementation of a health information system.

These barriers include obstacles such as the ineffective design (Massachusetts, 1) which may cause extra hours of working (Finland, 2) and data loss (Austria, 7; Belgium, 3) caused by different errors that the system may have (Denmark, 4; Spain, 2; Massachusetts, 1) and the confidentiality and safeguarding of the patient data (Austria, 7; Greece, 1) and the usefulness of the IT, an issue that has a big impact on their willingness on the adoption of a new HIS (Belgium, 3; Denmark, 4; Finland, 2; Georgia (USA), 1; Montana, 1; Nebraska, 1; South Dakota, 1; Wyoming, 1). It has brought up the idea that a huge storage space will be necessary (Belgium, 3), which will imply a severe economic burden for the medical institutions managers. On the other hand, accessibility to a health information system for people in countries that are less developed and cannot implement it can also be a problem. Especially in these countries, this is an issue difficult to tackle, given the fact that financial barriers are also present (Romania, 2; Spain, 2; Nebraska, 1; New Jersey, 1; South Dakota, 1; Virginia, 1).

The issues that this barrier causes may be difficult to combat and if no measures are taken to solve them, they may generate a chain reaction problems phenomenon, which can eventually lead to the failure of HIS implementation.

3.2. Behavioral/Human Barriers

As mentioned in the Technological Barriers section, health professionals' reluctance to change is an obstacle for an effective and efficient implementation program. One of the issues that are related to their reluctance is the shift from paper-based to electronic files (Oregon, 1; Bosnia, 1). They motivate this reluctance with the fact that a shift from paper-based information to electronic files may cause severe data loss and a disruption of their work process (Georgia (USA), 1) (Culler *et al.*, 2009).

According to our analysis, this barrier is a common one, since only one US state (Pennsylvania) and two European countries (Spain and Turkey) have not reported it. Its capacity to block the implementation easily makes it an obstacle that must be avoided or solved immediately.

Lack of communication between the ones that are developing and implementing the system (IT engineers, for instance) and the ones that are using it (medical staff) (Denmark, 4; Switzerland, 2; Montana, 1; Wyoming, 1) is also negatively impacting HIS implementation (Culler *et al.*, 2009). Wright *et al.* (2009) report that medical staff may not find the information system useful if it does not receive academic, social or financial benefits. The lack of literacy regarding IT skills (Bosnia, 1; Greece, 1) is also an issue that stands up in front of the implementers. The most illiterate medical professionals are the ones that are close to their retirement age, which is understandable given the fact that they had a minimal contact with new technology during their career and it is difficult for them to go through the learning process of new information technologies (Agno, Farala and Guo, 2013).

3.3. Financial barriers

Financial barriers represent a major problem for the implementation of a new health information system. They impose strong limitations on the organization and the adaptation of a new system which can improve patient and medication safety making use of new technologies. Specifically, these barriers include funding issues (Belgium, 3; Switzerland, 2), the choice of vendor or producer (Belgium, 1), the time-frame adherence (Denmark, 4; New Jersey, 1; Pennsylvania, 1; Texas, 2; Utah, 2).

First, implementing a new system requires an increased amount of money which will be invested in buying and maintaining the necessary equipment, as reported in Colorado (1 article), or in organizing trainings for the health care professionals and the administrative staff, reported from Hawaii (1 article), in order for them to learn how to use the equipment and/or software and programs. For example, some participants at the trainings declared that they were 'totally computer illiterate', but the training sessions helped them a lot. Similarly, the funds are used to assure the necessary workforce for the new system. Also, in many cases, as New York (3 articles) and Massachusetts (1 article), it is not cost-effective to 'repair' a health information, or to replace it with another one more efficient, because of the amount of capital needed, the return on investment or the productivity loss during the implementation. Moreover, not only the implementation cost is high, but also the maintenance cost, which

follows. In this respect, the literature from Pennsylvania (1 article) stated that a decline in productivity is inevitable because, in some institutions the organizational routines have to be changed and adapted to the new system, and this procedure is time consuming.

Furthermore, the implementation of a new health information system is a difficult and complex task and it requires a long period of time until being completed. Thus, timeframe adherence represents another barrier which has to be exceeded. There are cases confronted with a lack of well-prepared personnel (Denmark, 4; Romania, 2; California, 1; New Jersey, 1; Texas, 2). The existing medical staff usually has no training when referring to the use and knowledge of new functions. As such, organizing workshops for them impacts the system in terms of wasted time. Likewise, Belgian literature (3 articles) on health information system revealed another aspect regarding the economic barriers, namely the choice of vendor. The report from Pennsylvania (1 article), assumed that vendors will shift their focus more on the small practice market, so it will be difficult for them to support the implementation of a health information system in the small practice setting while keeping prices affordable.

3.4. Organizational barriers

Organizational barriers refer to personnel's training issues, organizational resistance, end-user equipment, and availability of data, as reported in articles from Belgium (3 articles), but also refers to the logical storage architecture, the system providers, the participants, the quality of data, as indicated in the Austrian literature (7 articles). Because of the training issues, the implementation phase is difficult due to the large number of professionals who are not educated enough in IT and the impact that the new system will have on the present way of practice, because nowadays more and more healthcare systems from all over the world focus their attention on information systems which can make a qualitative difference in healthcare delivery. Although many health professionals benefit from health information systems, changing the old paper-based structure is difficult. As in the example of Norway (6 articles), physicians perceived the benefits in completely opposite ways. For some of them writing a prescription is much easier and time saving by using the information system, while for others, when it comes to resolve a particular task, it would be easier to be done with the use of the pen and paper.

Also, there are cases like Austria (7 articles) and Germany (3 articles) when the personnel has no trust in how the new system will collect and use the data. Likewise, patients are aware of the potential risk of theft of sensitive clinical data. On the other hand, in Nebraska (1 article) and South Dakota (1 article) the information regarding availability of data is missing, so the internal information technology support can be hardly accessed. Furthermore, another organizational consequence of a health information implementation system, as it is stated in an article from Oregon (1 article), is the shift in the power – forced work redistribution and mandated safety pursuits, control – perceived loss of clinician control, and the autonomy of the institution –

move towards coalitions. When we speak about the shift in the power, we refer to the power held by hospital administrators who can influence and support the change in the system. They can redistribute work and make changes in order to assure the needed safety. Regarding the perceived loss of control and the autonomy of the institution, the health information system will be a threat to the healthcare professionals, especially to the physicians who have traditionally been highly autonomous. While the physicians' autonomy is weakening, coalitions are gaining power because they work together for support in influencing people, so they are considered to be a more effective power tactic.

4. Discussion

The present analysis regarding health information systems in Europe and USA revealed that significant challenges and barriers have been reported over time when implementing these systems. The four categories identified – financial, organizational, technological and behavioral – include sub-categories reported in the mentioned European countries and USA states. Therefore, in most cases, challenges are more complex and difficult to cope with and this situation was reported in other IT domains, too (Deutsch, Duftschmid and Dorda, 2010).

One of the crucial aspects that need to be taken into account is data safety, included in the human/behavioral, technological and organizational barriers, as all analyzed articles mentioned it as being a challenge in implementing health information systems (Hoerbst *et. al.*, 2010, pp. 81-89). Patient safety is currently on the agenda of the ISO and the European Committee for Standardization. Thus, whether referring to USA or Europe, only subsets of software are required to be safe by legislation (Magrabi *et. al.*, 2013). Safety assurance is required not only for all systems, but also for interactions at the system level. As a consequence, safety initiatives need to be launched and enforced in order to ensure standardization of safe designs, implementation and use. Such improvements in security and privacy of data may lead to functional and reliable systems. The use of security standards and an appropriate user interface may, moreover, bring benefits in solving the issue of data safety and privacy. Moreover, although such standards may represent a proper starting point, we still need to take into account specific standards for the evaluation and surveillance of software.

Each level of the implementation process needs to be based on national standards and regulations on the one hand, but also international ones, on the other hand, in order to ensure safety and functionality of health information systems.

Even if that happens, implementation also needs to address the local features and respond to specific and singular needs. However, there are no standard guidelines upon system use so that it responds in the same way to each barrier, which needs to be addressed by further research, to fill this gap.

The mentioned barriers may be solved by registering all manufacturers and making them public, so that beneficiaries have full access to information regarding the use of health information systems. By these means, the medical staff's trust in implement-

ing these systems may increase and lead to positive outcomes. By having a trust model, medical staff may check the data completeness and correctness (Haasa *et. al.*, 2011).

The Austrian case study led to a series of recommendations based on the four major barriers in the implementation of a health information system. Even though they are referring to Austria, they can be easily applied to similar European countries, or even USA states. According to these recommendations (Dorda *et. al.*, 2008), health information systems should not be introduced at once, but specific elements should be focused upon. Therefore, by gathering all the minor aspects and being sure of their functionality, the whole system may be more easily designed and implemented according to the needs. Secondly, when introducing a new health information system, international standards need to be taken into account, but stressing upon local characteristics. This step may refer to semantic standardization, too. The Austrian case also stresses upon the importance of data privacy and safety. As a recommendation, a legal framework needs to be built, in order to handle sensitive health data. In addition to that, data types have to be defined, participants who are allowed to access data and criteria for the participants to be allowed to take part in the system. Apart from these specific recommendations, plans to introduce health information systems need to be in line with similar systems implemented in other countries, by keeping the international background in mind. However, future research is required to be done in order to figure out the necessary proportions when aligning specific requirements to national and international aspects.

As financial barriers are concerned, specific approaches to measure the cost-benefit ratio should be designed. In order to solve this issue, a legal framework including alternatives to the systems may be useful (Deutsch, Dufts Schmid and Dorda, 2010) and currently such a framework for the cost-benefit ratio is under construction. Such a legal framework aims to provide solutions based on country analyses, integrated into the overall concept, still focusing on flexibility so that it can respond to local requirements (Dorda *et. al.*, 2008).

Even if recommendations and solutions are continuously being developed in order to solve these barriers, the implementation of a new health information system must be very detailed in order to face all these problems and the fact that not only the medical staff is confronted by them, but also other users and participants who come in contact with the system (patients, for instance). Additionally, little is known about the effectiveness of such solutions, so consequently further research is required in order to evaluate their impact on the successful implementation of a health information system.

5. Limitations

Given the rapid progress in health information systems, we may assume that all relevant information concerning this topic have not yet been published. Moreover, results can be further limited by restricting this search to articles containing the actual word 'barriers' that may occur in the implementation of health information systems.

Also, the information provided by the articles originates from a broad spectrum of different national backgrounds, making possible comparisons difficult to be established.

Along with the above mentioned limitations, the language may also play a significant role. In order to test our research question, we scanned the scientific literature only for English written journal articles, in order to access a common knowledge base. However, we may have skipped relevant information due to this search criterion, as there may be important articles written in each country's official language.

Another limitation is represented by the lack of access to the full version of each relevant article that we identified within the search phase. By including only those studies that had a full-text version, we may have skipped essential information regarding the barriers of the implementation of the health information systems.

6. Conclusion

A well-developed health information system which is implemented according to present standards allows a healthcare quality increase. However, according to our findings, the implementation of health information systems is confronted with four major types of barriers: organizational, technological, behavioral/human and financial. Each European country and USA state included in the analysis through the use of available literature encountered at some point in time such challenges and, moreover, are still struggling with them. Therefore, implementation of health information systems is not fulfilled and in addition to that, it produces significant drawbacks.

Overcoming these barriers may allow access to health data regardless of time and space. Besides, properly implemented health information systems can enhance effectiveness and generally improve the quality of the health system. It also determines the amount of information to be collected, analyzed and used. Taking into account these benefits, the implementation of these systems may also bring along challenges and problems that request immediate interventions. Not only that barriers may arise, but also these become even more prominent in the context of diversity of health systems, quality and safety policies. Other problems that need to be addressed refer to acceptable standardization for the design and implementation of health information systems, jurisdictional boundaries, safety and privacy of data, semantics, health personnel and patients.

Despite the benefits of health information systems adoption, their implementation will not be achieved unless the identified barriers are reduced or even eliminated.

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