

# HEALTHCARE IS INTEROPERABILITY

## *Challenges and Solutions*

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**Abstract:** Healthcare systems seek to provide services of high quality and profound safety through Healthcare Information Systems (HIS). Despite the potential benefits of HIS and the significant efforts that have been made, it has been reported that healthcare systems have a low success rate. It has been reported that the lack of interoperability still affects the services provided to patients and citizens. In this paper we (a) propose a novel healthcare processes and services classification, (b) present the HIS challenges and (c) suggest a solution based on Service Oriented Architecture (SOA), which can increase the interoperability among systems and hence the quality of provided healthcare services.

## 1 INTRODUCTION

Improving patients' safety implies a complex system-wide effort, which involves all stakeholders and includes a broad range of actions, such as paying attention to medication errors, which are the cause of almost half of all preventable adverse events and optimizing the use of new technologies. Nowadays, the development of Healthcare Information Systems (HIS) that will result in enhanced services and will save and improve human lives is the main priority for the healthcare sector worldwide. In support of this, the economic stimulus bill signed by the USA Congress included about \$19 billion promotes the use of healthcare information technology, including Electronic Prescribing (ePrescribing), which can help prevent medication errors from sloppy hand writing and harmful drug interactions.

Information Technology (IT) applications such as Internet-based telemedicine, personal health records, asynchronous healthcare communication systems, and picture archiving communication systems have been applied in healthcare to improve the capabilities of physicians and clinical staff and provided increased services to patients, caregivers, and citizens in general. It appears that HIS play an increasingly crucial role in the healthcare sector advancement, by providing an infrastructure to integrate people, processes and technologies.

In this paper, the authors analyse and propose a novel classification of healthcare processes and services, present the HIS challenges and finally suggest a solution based on Service Oriented Architecture.

## 2 HEALTHCARE INFORMATION SYSTEMS

HIS have been defined as computerized systems designed to facilitate the management and operation of all technical (biomedical) and administrative data for the entire healthcare system, for a number of its functional units, for a single healthcare institution, or even for an institutional department or unit (Rodrigues et al., 1999). HIS are a key enabler, as they have the potential to improve healthcare services, by providing rapid and widespread access to information at the point of care. A plethora of IS, ranging from order entry and administrative HIS to laboratory and operation theatre HIS, have been implemented in the healthcare sector. In shedding some light on the underlined services that exist in healthcare organizations, we reviewed the normative on HIS classification. Based on the processes that HIS support, Mantzana (Mantzana, 2006) categorized them into: (a) clinical, (b) non-clinical, (c) pharmaceutical and (d) laboratory. The authors

adopt this classification and extend it, by proposing that the patient record category should be added, as it refers to medical records that can be maintained by the citizen or the health professional. This category can be further broken down into services (a) Electronic Patient Records Systems (EPR), which are detailed records of encounters between patients and their healthcare providers and (b) Electronic Personal Health Records (ePHR) that are citizen self-maintained health and healthcare records (Gaunt, 2009). For each service category, we identify and describe related Information Systems, as this is illustrated in Table 1.

Table 1: Healthcare processes and services.

Proc	Service	Ref
Clinical	<b>Clinical</b> Provides electronic charting and documentation to flow sheets, forms, notes, work lists, care plans, etc.	(Manjoney, 2004)
	<b>Telemedicine</b> Delivery of healthcare services and information exchange across distance.	(Wootton, 2006)
Pharmaceutical	<b>Pharmacy</b> Keep records about drugs' ordering, stocking and distribution	(Anderson P., 2009)
	<b>ePrescribing</b> Support medicines orders, administration, use and supply.	(NHS CFH, 2009)
Laboratory	<b>Laboratory</b> Manage laboratory information, flag abnormal values or provide possible explanations for those abnormalities.	(Pantanowitz, 2007)
Non-Clinical	<b>Support</b> HRM services manage information about personnel and management	(Kabene, 2006)
	CPOE services allow physicians to enter and send orders.	(Metzger, 2010)
	e-Learning increases the opportunities to learning and research.	(Land Lesley Pek Wee, 2007)
	<b>Administrative</b> CRM services are built upon the HIS as to integrate information generated from medical acts to sustain the relationship between hospitals and customer.	(Hung, 2010)
	<b>Financial and accounting</b> Financial and accounting transactions with patients, employees etc	(Mantzana, 2006)
Patient Record	<b>Electronic Patient Records (EPR)</b> Detailed healthcare records	(Gaunt, 2009)
	<b>Electronic Personal Health Records</b> Citizen self-maintained records.	(Gaunt, 2009)

The countless amount of hours and money spent on HIS and services advancement aim at the healthcare sector modernization and the enhancement of services provided to citizens and patients. However, these efforts have resulted in HIS that have evolved in a haphazard and fragmented way, and include data in crude formats without any attempt to synthesize or analyze them, as required by proper day-to-day management (Mantzana, 2006). The need to provide an interoperable environment has become imperative, as the non-integrated nature of the healthcare systems is strongly associated among others with the medical errors that occur. For instance: (a) hard copy films are constantly lost/unavailable and (b) information needed for diagnosing is often missing (Cowan, 2004). Thus, as the information needed is not available on time, errors usually occur in prescribing, administering and dispensing drugs services to patients.

### 3 HIS CHALLENGES

Despite the potential benefits of HIS, it has been reported that healthcare systems have a low success rate. In UK, hundreds of millions of pounds and countless hours of peoples' time have been spent on Information Systems implementations. However, the quality of the healthcare systems suffers as a result of medical errors, clinical employees' resistance to change and fragmented care (Leape et al., 1995). Medical errors are the failure of a planned action to be completed as intended (error of execution) or the use of a wrong plan (including failure to use a plan) to achieve an aim (error of planning). Several types of medical errors, such as failure to the administration of treatment, error to employ indicated tests, and avoidable delays in treatment have been reported. The Institute of Medicine (IOM) of USA determined medical errors as a problem of big magnitude reporting that the number of Americans that die each year from medical mistakes to resume to 98,000 approximately (Kohn et al., 2000).

Although the aforementioned findings date back a decade the problem is not eliminated. The medical error rate used to calculate the IOM's national estimate has also been supported by most recent studies in Canada, Australia, and other developed countries. Based on the current state of knowledge of medical harm, it has been estimated that 5% of hospital admissions experience some type of adverse error, 30% of which cause consequential harm (Wachter, 2008). This implies that more than half-a-

million people in the U.S. were affected by preventable medical errors last year. The countless amount of hours and money spent on HIS and services advancement aim at the healthcare sector modernization and the enhancement of services provided to citizens and patients. However, these efforts have resulted in HIS that have evolved in a haphazard and fragmented way, and include data in crude formats without any attempt to synthesize or analyze them, as required by proper day-to-day management (Mantzana, 2006). The need to provide an interoperable environment has become imperative, as the non-integrated nature of the healthcare systems is strongly associated among others with the medical errors that occur. For instance: (a) hard copy films are constantly lost/unavailable and (b) information needed for diagnosing is often missing (Cowan, 2004). Thus, as the information needed is not available on time, errors usually occur in prescribing, administering and dispensing drugs services to patients.

#### 4 HIS SOLUTION

Interoperability is becoming a central issue in the healthcare agenda and researchers and vendors are focusing on ways to address it. According to IEEE, interoperability is the ability of two or more systems that is used to exchange information and to use this information that has been exchanged (IEEE, 1990). In the field of healthcare interoperability means that

the ability to communicate and exchange data accurately, effectively, securely and consistently with different information technology systems, software applications, and networks in various settings and exchange data such that clinical or operational purpose and meaning of the data are preserved and unaltered (Patricia and Noam, 2007). Healthcare interoperability is linked with a variety of both technical and organizational issues such as the diversity of applications and systems across departments and the different attitudes and perceptions between stakeholders. Moreover, even though healthcare organizations invest in integration technologies, in many cases perform point-to-point integration between solutions adding to the lack of interoperability (Jay, 2009). The different aspects of interoperability are addressed by various initiatives. The aim of these initiatives is not only to support data/information exchange, but also to include meaning in them (Lopez, 2009). These peculiarities of HIS make SOA an adequate candidate to solve the problem. Despite the significant benefits that SOA has provided to other sectors, healthcare systems remain laggards, thus, leaving scope for timeliness and novel research.

SOA provides a framework for an infrastructure to facilitate the interactions and communications between services (Papazoglou M. , 2007a). SOAs are more of a paradigm, or a style of design that concludes to architecture. In other words, SOA is a way of thinking about building software than a software development technique (Boersma, 2005).

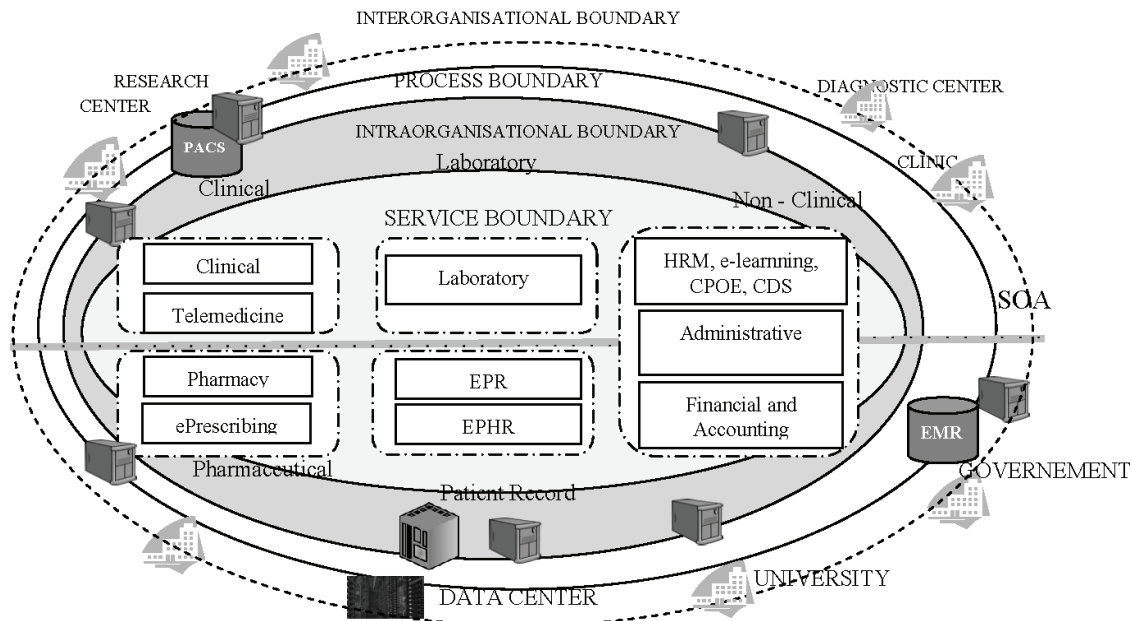


Figure 1: Proposed solution for healthcare systems interoperability.

As SOA is being adopted by the healthcare industry, the collections of processes that each consists of specific services will be available for use, such as pharmaceuticals, labs and patients as seen in Figure 1. In SOA services aid integration of applications that were not written with the intent to be easily integrated, as is the case in most HIS environments. In more detail, service-based applications are developed as independent sets of interacting services offering well-defined interfaces to their potential users (Papazoglou M. ). This is achieved by employing loosely coupled distributed applications between transacting partners and it does not involve fixed agreements before the use of an offered service is permitted. Thus, adding to the flexibility that is required in an interoperable HIS environment. Since the location of a system providing services is transparent, these acquired services may be hosted outside the organization, thus increasing the integration between systems.

## 5 CONCLUSIONS

Despite the amount of hours and money spent on IS implementations and the technological advancement, healthcare systems still face several challenges. Problems, with great magnitude such as medical errors to less substantial as redundant processing and data are still a part of everyday processing. Eliminate medical errors and enhancing the quality of services provided to users in a cost effective way is a challenge that IT developers are facing. The answer can be true interoperability through SOA. SOA can provide true interoperability and enhance the quality of healthcare services provided, as it allows system capabilities to be selected and packaged as services that are better focused and available across the entire organization.

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