PROVIDING INTEGRATED E-HEALTH SERVICES FOR PERSONALIZED MEDICINE UTILIZING CLOUD INFRASTRUCTURE

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Abstract

The purpose of this paper is to introduce a multidisciplinary project that combines state of the art technologies like cloud computing, Service-Oriented-Architecture (SOA), homecare telemedicine technologies, e-PHR, e-Prescribing, e-referral and e-learning. The combination of these technologies will lead to an innovative integrated e-health platform that delivers many benefits to the society, the economy the industry and the research community. Therefore, a consortium from experts both from industry (two companies, one hospital and one healthcare organization) and academia (three universities) were set to investigate, analyse, design, build and test the innovative ehealth platform. This paper presents an analysis of the integrated ehealth services concept and the early stages of the project. In doing so, we aim at increasing the awareness of this important endeavour and provide insights of the knowledge gained so far throughout our work.

Keywords: Integrated e-health services, cloud computing, SOA, e-PHR, e-prescribing, e-referral

1 INTRODUCTION

Most developed countries are facing important overall problems regarding health care services, such as: (a) aging population with increased demand on specialized health care services (e.g. Chronic diseases), (b) need for increased efficiency with limited financial resources (e.g. Staff/bed reduction), (c) requirements for increased accessibility of care outside hospitals (e.g. Home care) to name a few. To these problems, advances in information and communication technologies have provided considerable assistance (Li, 2012). For example, utilizing sensor technologies, a patient’s vital data can be collected in a smart home setting. The bio-information can then be transferred via the Internet to medical databases and the healthcare professionals. Using the appropriate sensing equipment at a smart home setting, patients, elderslies and people with disabilities can have their health signals and information examined on a real-time and/or in an archival basis.

Nevertheless, the aforementioned scenario of home care healthcare services augments one of healthcare longstanding challenges, the e-health integration. E-health integration has been associated with various aspects, amongst others: strategic, social, and/or organisational (Finnegan and Hamid, 2009). In this respect, there is a common tendency to address e-health integration by an overall approach, seen as integrated patient centred care (Leventhal et al., 2012). Integrated patient centred care reflects on integrated e-health services requiring coordination across professionals, facilities,
support systems that is continuous over time and between patient visits (Singer et al., 2011). This approach is observed on national healthcare strategies that encourage patient involvement in their healthcare treatment. Moreover, in the USA and Europe, online personal health records that allow patients to manage their health data have emerged (Pagliari, 2011). For example in Finland, this integration trend can be observed in a legislation that allows citizens to access and interact with their own Electronic Healthcare Records (EHRs), e-Prescriptions and audit-logs via the Internet (Ruotsalainen et al., 2008). Following similar legislative opportunities worldwide, patients increase their involvement with HIS. This is a growing involvement, seen in parallel with the availability of mobile health applications through mobile phones and other portable devices (e.g. tablets).

Mobile technologies and especially smart phones support patients and professionals to interact with integrated EHR and other e-health applications. This is an emerging area of e-health, given the term m-health (Chatterjee et al., 2009). According to Sarasohn-Kan (2010), a major mobile application vendor provides 5,805 health, medical and fitness applications with 73% of them used by patients and 27% by healthcare professionals (Sarasohn-Kahn, 2010).

Another promising area that allows people to be constantly monitored regarding their physical condition, is the integration of sensing and consumer electronics. Market experts forecast that monitoring services will correspond to about US$ 15 billion market pool in 2017 (Chowdhury et al., 2012). These services either as m-health and/or via the internet in-home networks, can aid residents and their caregivers by providing continuous medical monitoring, memory enhancement, control of home appliances, medical data access, and emergency communication (Alemdar and Ersoy, 2010).

The aforementioned approaches empower the patients and allows them to take their own measurements, and provide verbal and written inputs (Clemensen et al., 2011). In a technological respect the empowerment happens through information-sharing, offering the patients a visual overview of their course of treatment, letting the patients take their own measurements, and letting them provide verbal and written inputs (Clemensen et al., 2011).

Many of these applications are based on SOA as e-health services can be easily delivered to both desktop and mobile computer devices using for instance Java and Visual Studio development environments. Based on the SOA paradigm e-health services can be exposed and run over cloud (in the form of SaaS) (Poulymenopoulou et al., 2012).

Therefore, it is evident that state of the art technologies like cloud computing and SOA can be used to provide efficient, scalable, portable, interoperable and integrated IT infrastructures that are cost effective and maintainable. Yet, despite the significant importance of these technologies, the healthcare sector has not paid much attention on these technologies. As a result, many stand alone applications exist in the area of healthcare providing services and supporting the activities of all actors involved such as patients, healthcare professionals, laboratories, hospitals. Emphasis should be placed on past failures of e-health endeavours that have caused the death of patients (e.g. London Ambulance Service Computer-Aided Dispatch) (Avison and Young, 2007). Literature indicates that the non integrated nature of health applications and numerous medical errors that occur, can affect the life of
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Thousands of patients per year (Khoumbati et al., 2006). For that reason, it is of high importance to integrate healthcare services. In addition to this, there is a need to deliver better services and reduce the cost of health expenses. The latter can be achieved through patient monitoring applications that will allow patients to continue their treatment at home and will free up space and staff at hospitals. All these can be achieved through an innovative integrated e-health services platform that utilises advanced technologies like cloud computing and SOA.

The PINCLOUD project, seeks to integrate different application components, leading to the provision of an end-to-end personalized disease monitoring and medical data service “anytime, anywhere”, which ensures an independent living regardless of age. Constant monitoring can enhance early detection of emergency conditions and diseases for at risk patients and also provide a wide range of healthcare services for people in need. The remaining of the paper is structured as follows Section 2 presents the Literature Review, Section 3 analyses the PINCLOUD, Section 4 the expected benefits of the project and Section 5 includes the Conclusions and Future Research Agenda.

2 Literature Review

In order to proceed to the literature review, we reviewed representative studies gathered from various databases, such as: (a) Google scholar, (b) IEEE Xplore, (c) AISeL and (d) Science Direct. In these databases we used a keywords search “Home care and telemedicine healthcare services”, “Cloud computing in healthcare”, “SOA and ehealth services”, “HIS integration” against categories, such as: (a) keywords, (b) title and (c) abstract. Additional steps included a backward references search, were we reviewed the references of the studies yielded from the keyword search, thus extending our knowledge of the theory and methodology used (Levy and Ellis, 2006). We then integrated these studies with the results from a wider research, using the same databases, but with keywords referring to “SOA and Cloud implementation”. Additionally, in an attempt to provide valuable insights for the Information Systems (IS) community we structured the review in a conceptual arrangement as seen in the following sections (Vom Brocke et al., 2009).

2.1 Integrated Healthcare Services

Integration in health care is a multi facet issue due to the nature of the healthcare. Healthcare is a complex system, with many different stakeholders, and unique parameters as each disease entity occurs in a unique individual who experiences it in his/her unique personal way in his/her unique social context (Miles, 2009). Healthcare services are part of this system. Healthcare services are distributed between several actors (physicians, nurses, residents, and other clinical support staff) and artefacts (information technology, machines, paper notes) and thus difficult to govern (Kannampallil et al., 2011). These particularities (e.g. Complexity, unique nature) push healthcare organizations, professionals and academics, to focus and address this important issue, as healthcare services integration can reduce cost, enhance the quality of services and affect the well being of patients.
On the integration issue, literature indicates that healthcare organizations often proceed to redesign, automate their Information Systems (IS) to integrate their business processes (Firat et al., 2008). To achieve this, sophisticated practices are applied to aid this redesign. In this respect, Business Process Management (BPM) techniques and tools in parallel with SOA are employed to align business processes (based on patient needs) to end-to-end integration (Koufi et al., 2010b; Strnadl, 2007). Additionally, cloud computing (an issue analysed in the next section) is seen as a new way of delivering computing resources and services, with many managers and experts believing that it can improve health care services, benefit health care research, and change the face of health information technology (Kuo, 2011). This issue is further analysed in the next section.

2.2 Cloud Computing in Healthcare

Despite the fact that the concept of cloud computing is not new, it is only recently that cloud technologies and applications are widespread (Jennings, 2009; Vaquero et al., 2008; Velte et al., 2010). Cloud computing offers the potential to dramatically reduce the cost of software services through the commoditization of IT assets and on-demand usage patterns. According to the Gartner senior analyst Ben Pring (2011) "it's become the phrase du jour". Virtualization of hardware, rapid service provisioning, scalability, elasticity, accounting granularity and cost allocation models allow clouds to promise the ability to efficiently integrate and adapt resource provisioning to the dynamic demands of end users and applications (Chorafas, 2011; Dillon et al., 2010; Doukas et al., 2010; Marks, 2008; Rittinghouse and Ransome, 2009). Following this stream of motivation, more and more vendors are offering healthcare solutions and services such as telemedicine, electronic medical records, medical imaging, and patient management that can be consumed or integrated by healthcare providers, payers and customers over a cloud. An example of such an application in health care is the well known Microsoft HealthVault, a web-based platform from Microsoft used to store and maintain health and fitness information. Whereas, other cloud platforms that undertake the storage of personal health information online include the Oracle’s Exalogic Elastic Cloud (an integrated platform for running business applications) and Amazon Web Services (a set of infrastructure and application services that enable you to run virtually everything in the cloud).

Except well known technology vendors (e.g. Microsoft, Amazon etc.) many previous studies reported the potential benefits of cloud computing and proposed different models or frameworks in an attempt to improve health care service. Some examples of the research and propositions of the field are presented in the following paragraphs.

Koufi et al., (2010a) report on a cloud-based prototype emergency medical system for the Greek National Health Service integrating the emergency system with personal health record systems. The proposed system grants physicians with access to patient data from anywhere and with any computing device while containing costs.

Rolim et al., (2010) present a system to automate the process of collecting patients’ vital data via a network of sensors connected to legacy medical devices. This cloud-based system aims to transport the data to medical centres so as to be stored, processed, and distributed accordingly to the needs at the
time. The authors claim that their system may be beneficial as it can provide clients with 7-days-a-week, automated, real-time data collection, in an error prone easy deployment process.

Hoang and Lingfeng (2010) propose a Mobile Cloud for Assistive Healthcare (MoCAsH) as an infrastructure for assistive healthcare. The authors report on the advantages of Cloud computing, alongside the concepts of mobile sensing, active sensor records. They also addresses various quality-of-service issues concerning critical responses and energy consumption.

Nkosi et al., (2011) propose a bio-sensor based framework that can advance distant diagnostics and healthcare information gathering. The authors report that Bio-sensor based systems can be used to gather relevant multimedia health information and improve the quality of remote diagnostic both for ambulatory and continuous monitoring of chronic diseases. In more detail, they address bio-sensor signal processing and secure communication of sensor signals based on next generation mobile technology and bio sensors, with the aim to facilitate the development of secure and innovative m-health services.

Doukas et al.,(2012) propose a distributed platform based on Cloud Computing for management of pervasive healthcare data. The authors report that pervasive applications through continuous monitoring of patients and their context generate a vast amount of data that need to be managed and stored for processing and future usage. Thus they emphasise that cloud computing and service-oriented applications are the new trends for efficient managing and processing data online. To this end, their work presents an integrated system for managing sensor data related to the detection of disabled or elderly citizens falls. Wearable sensors collect the fall related data, which are then handled by the Cloud Platform.

Hussain et al., (2013) designed and developed the Smart Clinical Decision Support System (Smart CDSS) that takes input from diverse modalities, such as sensors, user profile information, social media, clinical knowledge bases, and medical experts to generate standards-based personalized recommendations. The authors include Smartphone-based, accelerometer-based, environment-based activity-recognition algorithms in order their system to recognizes users’ daily life activities. For example, social media data are captured for a diabetic patient from his/her social interactions on Twitter, e-mail, and Trajectory and then combined with clinical observations from real encounters in health-care facilities. The input is converted into standard interface following HL7 vMR standards and submitted to the Smart CDSS for it to generate recommendations. The authors tested the system for 100 patients and utilised the Azure cloud infrastructure for their research.

Considering the aforementioned examples it is timeliness to incorporate state-of-the-art technologies and architectural paradigms such as: (a) SOA and cloud computing, and (b) sensor devices for home care, to improve healthcare services. The same need was the trigger that initiated the project presented in this paper and brought together a consortium of experts both from industry and academia (two companies, one hospital, one healthcare organization and academia three universities). The consortium is set to investigate, analyse, design, build and test an innovative e-health platform. This project
entitled “Providing Integrated e-health services for personalized medicine utilizing CLOUD infrastructure (PINCLOUD)” is analysed and presented in the next section.

3 PINCLOUD

This section presents the innovative integrated e-health platform, starting with the conceptualization and main ideas of this solution.

3.1 Concept and Main Ideas

State of the art technologies like cloud computing and SOA are used to provide efficient, scalable, portable, interoperable and integrated IT infrastructures that are cost effective and maintainable. As explained despite the significant importance of these technologies, the healthcare sector is just starting to realize their potential. As a result, many stand alone applications exist in the area of healthcare providing services and supporting the activities of all actors involved such as patients, healthcare professionals, laboratories, hospitals etc. Due the non integrated nature of e-health applications and services numerous medical errors occur that cause the life of thousands of patients per year. For that reason, it is of high importance to integrate healthcare services. In addition to this, there is a need to deliver better services and reduce the cost of health expenses. The latter can be achieved through patient monitoring applications that will allow patients to continue their treatment at home and will free up space and staff at hospitals. All these can be realized through an innovative integrated e-health services platform that utilises advanced technologies like cloud computing and SOA.

PINCLOUD, as presented in Figure 1, seeks to integrate different application components, leading to the provision of an end-to-end personalized disease monitoring and medical data service “anytime, anywhere”, which ensures an independent living regardless of age.

As illustrated in Figure 1, a patient can be remotely monitored by a physician located either at a hospital or at an individual medical office. The doctor monitors the patient using a home care platform that receives and analyses patient’s medical data. The PINCLOUD home care platform will include among others the following services: (a) Asthma or COPD disease management; (b) Hyper-tension disease management; (c) Diabetes monitoring; (d) ECG monitoring; (e) Video/ Audio Access to physicians for remote consultation; (e) Remote picture and text archiving and communication service (back-up/long term archiving complementary to infrastructure operated by hospitals) and (f) Fall Prevention and Detection Services.

The doctor can also access the patient’s electronic health care record that is provided on-line through a cloud computing service. The latter can support the doctor in decision making and results in better quality of health service. The doctor retrieves and updates the patient’s medical data and can also use the PINCLOUD on-line system to: (a) prescribe a new medicine; (b) fill in an e-referral for specific exams (e.g. A blood test); (c) inform and advise his/her patient or (d) ask the patient to visit the
hospital. Following the doctor’s advice, the patient visits a pharmacy, or a diagnostic centre or a hospital. At the final stage, the healthcare service providers (doctors, hospitals, diagnostic centres) and pharmacies interact with the health insurance organisation to compensate all outstanding orders and medical actions.

3.2 Progress beyond the state-of-the-art

PINCLOUD is a multidisciplinary project that combines state of the art technologies like cloud computing, SOA, homecare telemedicine technologies, e-PHR, e-Prescribing, e-referral and e-learning. The combination of these technologies will lead to an innovative integrated e-health platform that delivers many benefits to the society, the economy the industry and the research community. We propose to use the power and the capabilities offered by cloud computing (e.g. dynamic scaling) to overcome specific limitations of the current application’s deployment in the area of healthcare. Also we propose to develop and run e-health applications on different clouds to test the interoperability and the integration of both the applications and the clouds. The PINCLOUD applications will be developed using SOA and web services (Josuttis, 2007; Rosen, 2009; Themistocleous and Mantzana, 2010). Systems integration is always a challenge as multiple users and organisations with different views, requirements, policies, interests and demands interact. For that reason, issues related to SOA governance, security, quality of service, architectural design and resuability are considered as important and there is a need for further research to address these issues (Clemons and Yuanyuan, 2011; Koumaditis and Themistocleous, 2012).
From a different point of view, Europe and North America have to overcome problems caused by the financial crisis and their aging population. It is estimated that in 2050 the 50% of the Europeans will be pensioners and the healthcare expenses will rise (Coughlin and Pope, 2008). This indicates that there is a need for solutions that will serve a bigger amount of patients, deliver better quality of services and cost less (Erl, 2005; Josuttis, 2007). The combination of the aging population, the prevalence of chronic diseases, and the emergence of telemedicine technologies have been instrumental in ushering homecare as a viable alternative to the traditional in-patient model of care (Davis, 2010). Homecare has long been recognized as a less expensive mode of provision of care. Some estimates suggest that the savings are in the range of 50-70% of in-patient costs for certain diseases such as chronic diabetes, cardio-pulmonary, and arthritis (Detmer et al., 2008; Gibbons, 2006). The applications of telemedicine in homecare deal with monitoring and administration of clinical service. Monitoring includes routine collection of vital signs and specific tests for certain chronic diseases, such as levels of blood glucose for patients with diabetes. Administration of clinical services includes remote instructions for medications at prescribed intervals and remote examinations in such specialties as teledermatology, teleradiology and telepsychiatry (Nesbit, 2006). This shift from acute, inpatient treatment to chronic, community based, guided selfcare and health risk management will demand unique advances from the information technologies (Vouyioukas et al., 2007). An increasing need of solutions that limits the economical burden of the classic centralized public and private healthcare model within the current scenario is observed, featured by the aging of population, the growth of chronic pathologies and neurological disorders, the increasing risk of pandemics, the higher demand of healthcare and quality of life, and the change of familiar models in industrial countries (Coughlin and Pope, 2008; Davis, 2010; Doukas et al., 2007; Maglogiannis and Hadjiefthymiades, 2007). Despite the proved reliability of ICT to provide efficient solutions to homecare and ehealth, their diffusion is still very scarce. Therefore, improving patients’ well being, in acute and chronic care is the goal that homecare should achieve.

Other categories of state of the art applications that improve the quality of health service include Personal Health Records (PHR), e-referral and e-prescribing. PHR can be described as “computer-based tools that allow people to capture, access and coordinate their lifelong health information and make appropriate parts of it available to those who need it” (Kaelber et al., 2008). Three general PHR models have been proposed (Detmer et al., 2008): a) the stand-alone model, b) Electronic Health Record (EHR) system, and c) the integrated one, which is an interoperable system providing linkage with a variety of patient information sources such as EHRs, home diagnostics, insurance claims etc. The main types of health information supported by PHRs are problem lists, procedures, major illnesses, provider lists, allergy data, home-monitored data, family history, social history and lifestyle, immunizations, medications and laboratory tests (Halamka et al., 2008; Tang et al., 2006). Widely known PHR platforms in terms of centralized web-based portals include Dossia (www.dossia.org) and Microsoft Health Vault (www.healthvault.com/) platforms. Many systems presented in literature offer integration with already established PHRs platforms (Reti et al., 2009; Zhou et al., 2010). Early experiences from the adoption of PHR-based systems have been found to be positive, showing that such systems can be feasible, secure, and well accepted by patients (Jennett and Watanabe, 2006). Still
many problems have been outlined in the literature such as insufficient data accuracy, weak integration with third-party services and interoperability issues, concerns on information privacy, increased cost and others (Detmer et al., 2008; Kaelber et al., 2008). Willingness of people to share data has been found to be critical in advancing the model in which people record and share care-related information.

The adoption of e-Prescribing and e-referral applications has been increased during the last decade. These applications (a) improve the collaboration and communication among the involved actors and organizations, (b) speed up the process, (c) support decision making, (d) advance the quality of services, (e) reduce medical errors and (e) decrease cost. The Greek government, estimated that, the adoption of an e-prescribing application, an e-procurement system, and a solution that monitors fuel prices – would result in 8 billion euro savings per year. This alone represents 70% of the austerity measures announced in 2010 by the Greek government (Fonda et al., 2010; Themistocleous and Mantzana, 2010). For that reason the Greek ministry of health pushes towards the implementation e-prescribing systems. Although, the implementation of these systems contribute towards the delivery of better services and reduce the cost, experts report that the biggest advantage from the application of these solutions comes when they are integrated with e-PHR (Deutsch et al., 2010; Gilbertson, 2008; Lee et al., 2006; Wang et al., 2004). We extend this view and we suggest the biggest benefit will come from the integration of e-Prescribing, e-referral, e-PHR and homecare telemedicine applications.

Literature and practice indicate that such applications are not available yet and only propositions and prototypes exist (e.g. as explained in the literature review section). In addition to this, the integration of the aforementioned technologies can be useful and efficient only in case cloud computing is used, due to the heavy load and the amount of data exchanged. Today, there is a lack of such an integrated environments based on SOA and cloud computing and this demonstrates how innovative and important PINCLOUD is.

The implementation of telemedicine and remote care requires specialized training of clinical and administrative personnel (Davies et al., 2009; Geisler and Wickramasinghe, 2009; Gibbons, 2006) Thus, another interesting issue is related to the e-learning system that will be developed as part of the PINCLOUD. The literature reports that the required resources and computer power increase as the number of users goes up. This is more obvious when multimedia material is used by an e-learning system. To avoid problems of this nature it is recommended that the e-learning is delivered as a service that runs over a cloud infrastructure.

For the development of PINCLOUD, action research methodology will be employed and the integration will be based on a process driven technique which is considered as the most appropriate in the case web services, SOA and cloud computing (Themistocleous and Mantzana, 2010). To sum up, in the context of this research we will attempt to investigate issues that require further research like: (a) dynamic scaling, scalability, elasticity, security, fault tolerance, accounting granularity, cost allocation, and interoperability in clouds, (b) SOA governance, SOA architectural design, QoS and security, (c) resource allocation and management in e-learning systems that run over clouds, (d) the development of remote homecare telemedicine applications, (e) the implementation of ePHR, e-
referral and e-Prescribing applications, (f) the integration and management of all the aforementioned applications and (g) management and governance and security issues related to the integrated eHealth environment. In doing so, this will result in an innovative, comprehensive and robust platform that will address the problems reported earlier on. The advances proposed in PINCLOUD involve the integration of PHR systems with pervasive health monitoring systems and enabling user-friendly access to the foreseen e-referral and e-prescription services provided via the cloud-computing platform. PINCLOUD will deliver significant benefits to the users, the society, economy, and academia and it will extend the body of knowledge. The expected benefits from our approach are presented in the following section.

4 Expected Benefits

The project shall build a reliable, secure and extensible platform warranting stakeholder collaboration and enjoying public trust. The expected benefits for all participant organizations include: (a) the development of integrated healthcare services that improve quality of service and reduce costs; (b) business process reengineering, improvement, simplification and integration; (c) enhanced decision making for health organizations and significant reductions to medical errors; (d) standardization, automation, synchronization, better control and communication; (e) improved coordination, management and scheduling of specific health supply chains and services; (f) development of monitoring systems that improve quality of care of patients at home; (g) establishment of an infrastructure that provides up-to-date information; (h) development of an innovative organizational environment for the participating hospital using horizontal processes instead of the traditional hierarchical organization; (i) implementation of an extensible and maintainable infrastructure that can be enriched with other medical services; (j) development of an appropriate, sustainable technological framework that can be deployed and applied in other relevant situations and environments; (k) investigation of state-of-the-art technologies and novel research that extends the body of knowledge; (l) significant research outcomes and publications of excellent quality; (m) production of new platforms, infrastructures and solution that can be further exploited, (n) knowledge and expertise gained can lead to competitive advantage and (o) production and export of technical know-how for all the participants.

The expected results of PINCLOUD are of great importance for the businesses that deal with the medical/health sector as they will gain the potential to gain competitive advantages through the project. The area of healthcare is significant and the need for advanced and innovative IT solutions in this area is apparent too. Thus, the participant enterprises will have the opportunity to: (a) develop an integrated platform that can be used by other organizations in the future; (b) better understand and analyze the complexities of the Greek healthcare environment; (c) experiment and implement innovative integrated solutions that can be turned into products; (d) gain expertise and know-how on a complex area; (d) sell these products and know-how at national and international level since PINCLOUD seeks to develop an innovative solution; (e) obtain and reinforce experiences that can be used for the development of other network-oriented systems and (f) extend their business activities.
The benefits for both healthcare organizations include among others: (a) specifications of processes for the management of healthcare processes; (b) simplification and acceleration of business processes; (c) better management of healthcare tasks; (d) personalized disease monitoring and cost calculation; (e) more efficient operation and (f) economies of scale.

The benefits that delivered to the academic institutions participating in the project are equally important and include: (a) knowledge exchange and transfer; (b) engagement in innovative research; (c) investigation of state of the art technologies; (d) opportunity to publish research articles of high quality; (e) prospect to conduct applied research and combine theory and practice.

PINCLOUD will deliver the following benefits to the national economy and society: (a) enhancement of occupation and working activities for the participating partners; (b) the reinforcement of scientific research; (c) improved delivery of healthcare services at reduced cost; (d) patients’ and next of keen satisfaction; (e) the development of innovative and state of the art healthcare systems; (f) more efficient allocation and management of computing resources; (g) the development of new products and jobs; (h) reduction of medical errors and consequently the amount of people that are affected or die due to them; (i) the reduction of the cost as a immediate effect of the reduction of medical errors; (j) technical, scientific and research benefits; (k) reduction of the amount of prescriptions and referrals and the associated cost; (l) improvement of the quality of life of people who live in islands or rural areas.

5 CONCLUSIONS

This paper introduces a multidisciplinary project that combines state of the art technologies like cloud computing, SOA, homecare telemedicine technologies, e-PHR, e-Prescribing, e-referral and e-learning in healthcare environment. The aim of the project is to create an integrated e-health platform that delivers many benefits to the society, the economy the industry and the research community. To this end, various technologies (e-health, cloud etc.) and healthcare issues (e.g. integration, prescribing etc.) were presented. Additionally, our intentions on the way we propose to address and combine these issues were explained and depicted.

Our immediate steps include a thorough analysis of the requirements on issues such as: (a) stakeholders (e.g. Focus on home care, medication prescription, referral for diagnostic tests and reimbursement for the target patient groups), (b) Medical Services (e.g. Focus groups and interviews to clinicians in order to define scenarios, requirements and constraints) and (c) Business Scenarios (e.g. identify business scenarios addressing hospital administration, reimbursement as well as regulatory issues, patient identification and liability issues).
References


Chorafas, D. 2011. 'Cloud Computing Strategies', Taylor and Francis Group, LLC.

Chowdhury, M., Krishnan, K. and Vishwanath, S. 2012. 'Touching lives through mobile health: Assessment of the global market opportunity', PricewaterhouseCoopers, India.


Davis, J. 2010. 'Using Service Aware Standards to Secure the Exchange of the Electronic Health Record', In (Eds), Proceedings of SOA in Healthcare: Improving Health through Technology: The role of SOA on the path to meaningful use, Westin Arlington Gateway, in Arlington, VA USA., OMG, July 12-14


Firat, K., Moser, L. and Melliar-Smith, M. 2008 In IT Pro (Ed,.^ (Eds, I E E E C o m p u t e r S o c i e t y


Gilbertson, D. 2008 In SOA in Healthcare realizing quality-of-care, (Ed,.^ (Eds, OMG) April 15-17, 2008 - Chicago, IL USA.


Koufi, V., Malamateniou, F. and Vassilacopoulos, G. 2010a. 'Ubiquitous access to cloud emergency medical services', In (Eds), Proceedings of Information Technology and Applications in Biomedicine (ITAB), 2010 10th IEEE International Conference on, 1-4. 3-5 Nov. 2010


Koumiditis, K. and Themistocleous, M. 2012. 'CRITICAL SUCCESS FACTORS FOR IMPLEMENTING SOA IN HEALTHCARE', International Journal of Healthcare Technology and Management (IJHTM).


Li, K. 2012. 'Smart home technology for telemedicine and emergency management', Journal of Ambient Intelligence and Humanized Computing, 1-12.


Rosen, M. 2009 In SOA in Healthcare(Ed,^ OMG, Chicago, IL USA, pp. 26.

Ruotsalainen, P., Livari, A. and Doupi, P. 2008. 'Finland's strategy and implementation of citizens' access to health information.', Stud Health Technol Inform., 137(379-385.)


