Management of Personal Health Information Sharing for Long Term Care Services

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ABSTRACT

Long term care is a service-oriented business process that service providers in the business are loosely-coupled for offering care services at different stages of chronic patients or aged citizens. Sharing Personal Health Information among those providers need to integrate perspectives not only from business process management perspective but also from technical implementation. This study takes a service-oriented approach to implement a Personal Health Information sharing mechanism that aims to support a follow-up care plan creation operation in a community health service center. The implementation integrates distributed Personal Health Information toward a common business goal that can advance our knowledge for managing service-oriented business process and accumulate experiences for healthcare service innovations.

Keywords: Service-Oriented Business Process Management, Long Term Care, Personal Health Information, Web Service

1. INTRODUCTION

Personal Health Information (PHI) is the individual’s health related data existed at various places and managed by individual or different healthcare providers [21]. For instance hospitals maintain patients’ medical records and social welfare organizations keep individuals’ social benefit packages especially for those aging citizens and chronic patients. PHI is essential for healthcare providers in that physicians can have prompt response to patient’s acute conditions without running the same laboratory testing again [31]. Case managers in Long Term Care (LTC) center can have adequate assessment on individual’s PHI when designing his/her follow-on care plan [33]. However, in current healthcare systems, PHI is still scattering in various places without having an effective framework to share the valuable information [17].

Sharing PHI among different healthcare providers is challenging under current fragmented healthcare delivery systems [3]. Taking Taiwan as an example, two major systems provide different LTC services in parallel for needed individuals. One from medical system provides services such as nursing home and day care center. The other from public health system offers care such as home care and social benefit. Both of the systems maintain patients’ PHI for their own business purposes on different location and in various formats. National Health Insurance Program [6] in Taiwan in somehow can manage PHI for evaluating healthcare providers’ performance and patients’ medical expenditure. However, the limited accessibility of individuals’ PHI throughout different providers does incur unnecessary waste. Furthermore, with some many available healthcare providers now, individuals have to back-and-forth many places to collect their PHI in order to get proper treatments or to have an acceptable follow-on care plan.

Modern Information and Communication Technology (ICT) can have substantial impact on the operations of PHI sharing. Healthcare providers are now one of the major users of advanced ICT. Most of their business processes have been computerized and the information created during the process is kept in electronic formats [11]. To radical restructure the whole healthcare delivery system for the purpose of sharing PHI seems challenge in many fronts [12,17,34]. However, the emerging Service-Oriented Computing (SOC) has the potential to create a business process coordination mechanism [20] for PHI sharing. It enables service providers to be loosely-coupled together on exchanging information for their own purposes [13]. Many technologies on SOC have been standardized and accepted by major technical vendors [8] and will have the chances to inspire healthcare providers on service innovations.

This study takes a service-oriented approach to develop a framework on sharing PHI among different healthcare organizations. A service scenario, based on a business process in one LTC center, is created to explain the coordination process in terms of business process management and technical implementation. A brief literature review is followed including the nature of PHI, standards related to PHI sharing under patient care coordination process, and implementation technologies of SOC. Section 3 proposes the PHI sharing framework to integrate perspectives from business process management and technical details. Section 4 presents the results of PHI sharing implementation with a care plan creation application at LTC center. Section 5 discusses the finding and implications of this study with a conclusion remark.
2. LITERATURE REVIEW

Personal Health Information is attracting more attention on both public and private sectors as the increasing of aging population and chronic patients [24, 31]. PHI can be created not only in hospital setting by health professional but also at individuals’ daily activities created by them. The PHI created should be integrated and used to individuals’ health promotion [7]. Effective sharing PHI from various sources can have substantial impact on the quality of care [34]. For instance, a PHI sharing mechanism can support diabetic patients on collecting their daily blood glucose data in a daily or weekly basis. Their physicians can have the long term blood glucose variation information and adjust patients’ care plan accordingly [18]. Or, hospitals can share patients’ medical summary and lab testing data with other providers to further reduce resource waste.

Currently, two major approaches support electronic format PHI management. One is Electronic Health Record (EHR) that aims to support continuing, efficient and quality health care [11]. International Organization for Standardization [4] defines it as a repository of patient data in digital format, stored and exchanged securely, and accessible by multiple authorized users. EHR grows up from the paper based patient health record that also inherent the proprietary traditions of different organizations. EHR has been adopted by many healthcare organizations at different levels to streamline their service operations. The other is Personal Health Record (PHR) that is a tool to help individuals in maintaining health and wellness as well as a tool to help with illness [31]. Markle Foundation defines it as an electronic application through which individuals can access, manage and share their health information, and that of others for whom they are authorized, in a private, secure, and confidential environment [9]. PHR has just drawn much intention recently by public and private sectors in responding to the potential service models incurred from the demographic developments. PHI is individual’s health information regardless EHR or PHR that should be shared and used by related care providers to promote individuals’ health status. Many standard organizations have defined the formats and content on exchanging PHI. However, sharing PHI in certain situations need not only standardized format but also business process coordination and supportive technologies [31].

Integrating the Healthcare Enterprise (IHE) is an industrial initiative formed by Radiological Society of North America (RSNA) and Health Information and Management Systems Society (HIMSS) in 1999. It aims to stimulate the integration of the information systems that support healthcare organizations [28]. IHE does not define standards of informatics but integrate existing standards such as Health level Seven (HL7) and Digital Imaging and Communications in Medicine (DICOM) to construct a set of service scenarios that support specific healthcare service domains. The architecture of the scenario includes Technical Framework (TF) for various domains such as cardiology, radiology, or patient care coordination (PCC). Under each TF, Integration Profiles (IP) are defined as information sharing mechanisms within and among organizations and now over 60 IP are defined in different healthcare domains. Each IP includes the descriptions in term of its actors, information content, and transaction workflow that organizations can it as a basis to design their own information sharing operations. For instance, Cross-Enterprise Sharing of Medical Summaries (XDS-MS) is an IP from PCC-TF that defines medical summary sharing operations between requestor and provider and the IP also provide a structure for service-oriented approach implementation [4].

Service-Oriented approach is a multidisciplinary paradigm that aims to integrate knowledge from different areas to improve service industry’s performance [22]. It takes complex managerial situations as an evolutionary system that components in the system operate autonomously and will adjust their behavior as they interact with each other [5, 29]. The approach uses SOC technologies to coordinate interactions among components in the service system. Service system consists with people, technologies, and information in which system designers can configure available resources to build capabilities for each component to be functioning internal and externally [30]. Service systems share some common attributes such as people-centered perspective that people are the main focus on service design [19]; interactive-based process that each component may have different situation and they will interact with each other toward a common goal [27]; and loosely-coupled feature that each component only interacts with others through message exchange as needed [32]. To facilitate this message exchange process between different types of organizations, two sets of developments should be in place for the participants to follow. One is a set of service scenario that is created from the business domain and accepted by the participants such as healthcare industries. The other is a set of SOC technologies that is developed to implement the service scenario and accepted by standard bodies and major ICT vendors [8, 21].

One of SOC implementation is to package a service-oriented business processes from provider into a Web Service [13]. SOC allows service requesters to reorganize Web Services from different provider to construct a new Web Service [16]. W3C defines Web service as a software system designed to support interoperable machine-to-machine interaction over a network [1]. A typical Web service operational architecture consists of three participants: service providers who create Web services and publish them to outside world, service brokers who maintain a registry of published Web services; and service requesters who discover required Web service and bind the service operations within their applications [10]. Based on Extensible Markup Language (XML), three SOC technologies facilitate the interaction among the service system components. They are Simple Object Access
Protocol (SOAP): communication protocol among entities, Universal Description, Discovery and Integration (UDDI): registration and searching of web services, and Web Services Description Language (WSDL): the service description language. In deploying Web service as operational business process, extension standards are needed in coordination and composition of Web services from different providers. The technologies used for this deployment could be Web Service Business Process Execution Language (BPEL) and Web Service Conversation Language (WSCL) [23].

PHI sharing is a service-oriented business process including participants from different healthcare providers and requesters. The information sharing operations among various participants require vast amount of human-to-human and human-to-machine interactions. These interactions are labor-intensive and time-consuming operations and may have the chance to introduce operational errors during the process. With SOC technologies, many of these interactions can be done through predefined or dynamic machine-to-machine conversations [2] and can save unnecessary resource wastes for improving the quality of human-to-human interactions.

3. SERVICE DESIGN AND IMPLEMENTATION

3.1 Business Process Management
PHI sharing framework consist with business process coordination and technical implementation levels that provide a holistic view of the service process in focus. In this study, two major LTC service delivery systems operate concurrently and generate numerous LTC service providers with sophisticate service items. The framework needs to integrate information and coordinate business processes from the systems. Currently, authority of LTC in Taiwan initiates a service provider, Health Service Center (HSC), as community-based healthcare service coordinator to streamline the LTC operations. This study proposes a PHI sharing framework with SOC technologies for one HSC to coordinate different service providers on care plan creation operation. Figure 1 depicts the care plan creation process with needed PHI from other providers.

From business process coordination perspective, PHI sharing framework takes XDS-MS IP from PCC TF as the basis for designing care plan creation operation. XDS-MS IP describes a basic process flow to mirror current medical summary exchange process. It defines actors and transactions involved in the exchange process. Based on the XDS-MS IP, a follow-on care plan creation scenario in HSC is developed as follow.

When senior citizen discharged from hospital and requiring follow on care services, an application of care plan creation (APP_CP) is activated in HSC. APP_CP was designed to interact with Manager in HSC (Mgr_HSC) to collect patient’s initial information, coordinate with intra- or inter-organization for PHI sharing, and evaluate patient’s care requirement to Mgr_HSC for decision making. After Mgr_HSC input patient’s identification, APP_CP organizes a coordination process and then send the PHI request to those organizations’ PHI service applications. The requests ask information from the hospital to estimate health status, from Family Affair Section (FAS) to understand available family supports, and from Social Welfare Organization (SWO) to evaluate suitable benefit package. When the required PHI is fulfilled, APP_CP will notify Mgr_HSC to decide details of the care plan and arrange care activities among various providers. Table 1 is the USE CASE that describes the interactions among service requester and providers.

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<th>Table 1 Use Case of APP_CP</th>
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3.2 Technical Detail Implementation
SOC technologies are introduced to implement this service-oriented application. APP_CP aims to assist Mgr_HSC to coordinate different PHI providers and create care plan for individuals. Traditionally, APP_CP needs to contain many user interfaces to receive individuals’ information from Mgr_HSC in order to calculate the details of the care plan. In this study, those human-to-machine interfaces have been reduced and replaced with machine-to-machine interactions by taking SOC technologies. Three PHI sharing service have been packaged as Web Services for different PHI providers in our business scenario. Figure 2 illustrates the interactions among different service providers in the care plan creation scenario.

WS_MS is for hospital to share medical summary,
WS_FS is for FAS to share family status regarding care supports, and WS_SB is for SWO to evaluate social benefit package. The shared information from each organization can be part of their ordinary business process, or can be extracted from their operational database. WS_MS follows the definition of XDS-MS IP that includes the content and encoding methods of medical summary and the binding operations between service provider and requester. This study defines the content for WS_FS and WS_SB according to the information requirements from APP_CP.

WSDL is used to describe and define the Web Services in PHI sharing scenarios. SOAP is used to wrap and exchange PHI. BPEL is used to coordinate the Web Services and create an integrated process to streamline APP_CP operation. In this study, computer language C# from Microsoft Visual Studio 2005 is used for application development. SQL server 2005 is the supportive database and BizTalk 2006 is the process engine for Web Services coordination. Figure 3 depicts the coordination of Web Services in APP_CP.
4. DISCUSSION

From business process management view, Figure 2 is the sequence diagram of APP_CP that describes the interactions among actors in the care plan creation scenario. On the right hand side of the diagram are the service providers who prepare the PHI sharing Web Services available for requesters. They may have different implementations on how the PHIIs are rendered. However, the WSDL tags of <portType>, <input>, and <output> abstracts what are the services and how to interact with them. The BPEL tags coordinate Web Services according to the design of APP_CP and arrange the Web Services of PHI sharing in correct sequence. It can also combine two or more Web Services into one flow as shown in middle part of the diagram.

From technical implementation perspective, Figure 3 is the screenshot of APP_CP Web Service coordination from BizTalk 2006 process engine that describe the interactions between APP_CP and different Web Services. The business managers can organize and coordinate the interactions with service providers in advance or dynamically according to the condition of each care plan creation event [25]. The service providers run their own business processes autonomously and will only be coupled together to support a PHI sharing process when the event is activated [13]. The PHI sharing operations are conducted behind the user interfaces of the application that Mgr_HSC needs not to know the details of how the PHIIs have been requested and received. The collection of required information will be done through the machine-to-machine communications organized by the process engine. This implies that service industries can take advantage of machine-to-machine business process cooperation by applying SOC technologies to accommodate the dynamic and distributed service environment [15].

The implementation explicitly links the business process scenario with the technical implementation [21]. In this study, it specifies how the PHIIs are provided with the binding operations between providers and requester. The flexibility of BPEL can facilitate business process engineers to combine various Web Services from providers to create a new Web Service for their innovative business purposes. Moreover, the two layers structure of WSDL description allows service providers to adjust detail implementation of the services without having to change the service description [26]. In other words, no change has to be made on the description of Web Service for requesters when service providers adjust or introduce new technologies in their internal business processes.

5. CONCLUSION

This study presents a PHI sharing framework that describes how a loosely-coupled business process can be cooperated with a Service-Oriented approach. Although the business case of HSC in this study is a pseudo service scenario, a community HSC has been consulted for the care plan creation process. This study is limited with its field deployment. However, the framework presents the structure of implementing a business process with SOC technologies and explains the conversations between business and technical levels. This can advance our knowledge on distributed healthcare service developments.

PHI has gained more attention as the increasing of health and computer literacy in public. Individuals are willing to allocate resources on their health promotion and like to have more control on their health status. Sharing PHI can have substantial influence on the development of innovative healthcare service models. Many initiatives such as IHE and HL7 are focusing on the definition of medical documents for exchanging among healthcare providers. This study implements the standards with field service scenario. More practical developments should be in place to test the limitation of SOC technologies and accumulate filed experience on managing service-oriented business process. Future research of this study will extend the PHI sharing development to patient self-care context and discuss the interactions related to daily care activities.

REFERENCES

