SPECIAL SESSION ON ENTERPRISE PACS AND WIDE AREA IMAGE MANAGEMENT

A Grid-Based Implementation of XDS-I as Part of Image-Enabled EHR for Regional Healthcare in Shanghai

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Purpose

Shanghai is large city with about 20 million residents. There are about 500 hospitals and clinics being distributed in 19 districts, which provide healthcare services to the residents and citizens. All of hospitals rank into three grade levels from more than 800 beds (7%), 200 to 800 beds (13.3%), and less than 200 beds (79%). With the city quick developing, the contradiction between the demanding and providing of healthcare resources is becoming serious, since more and more residents live far away from city center, but most large hospitals are still staying in the city center areas. So, the local government wants to solve the problems by encouraging patient going to small hospitals first to have preliminary diagnosis such as having imaging examination and let senior radiologists, working in large hospitals, to make final imaging diagnosis through regional healthcare information exchanging platform. Also the government wants to develop image-enabled EHR (Electronic Healthcare Record) sharing mechanism between some of hospitals to reduce the costs by re-using the prior examination data obtained in other hospitals. So the government funded some projects to solve some of key technical problems and test the work and data flows. In this presentation, we present a design method and implementation solution of image-based EHRs (i-EHRs), fully aligned with the IHE XDS-I integration profile [1] and combined with grid-based image management [2], and give an implementation of i-EHRs in four hospitals and one regional healthcare information center, as well as their preliminary operating results.

Methods

We designed the solution of i-EHRs with SOA architecture and combined the grid-based image management and distribution capability, which are compliant with IHE XDS-I integration profile. There are seven major components and common services in the i-EHRs including: (1) XDS Registry and Repository, which are functioned as Registry and Repository actors; (2) PIX Manager, which is defined as PIX actor defined in IHE XDS/XDS-I profiles; (3) PACS/RISs, which are located in hospitals and functioned as the image/report source actor defined in IHE XDS/XDS-I profiles; (4) PACS/EMR workstations, which are used by end users to access the image/report documents from i-EHRs. They are functioned as consumer actor defined in IHE XDS/XDS-I profiles; (5) XDS-I Gateway (GW) and Grid Agent, which is used to convert the reports to CDA (R2) based documents or create image manifest or DICOM KOS to submit to XDS Repository and to register in Registry, (6) Grid Manager, which functions to manage the data flows of images between the grid agent nodes such as intelligent content delivery, data backup, tracking the image/message data flows; (7) Security Module, which provide the image/report document accessing control, medical data authenticity and integrity, also well as auditing [3]. There are four key use cases services were implemented in i-EHRs: (1) XDS-I.b Submitting and registering of imaging documents from PACS/RIS; (2) XDS-I.b Query and Retrieval; (3) DICOM Submitting, Query and Retrieval from PACS; (4) Grid services of Intelligent Content Delivery for collaborative imaging diagnosis among hospitals. Most services were implemented in XDS-I Gateway (GW). In order to achieve quick responding effect in image retrieving in low bandwidth network environment, we use JPEG2000 progressive display technique to transmit images from a XDS-I GW as Imaging Source Actor to the XDS-I WS as Imaging Consumer Actor.

Results

The first phase of pilot testing of our image-enabled EHR was done in Zhabei district of Shanghai for imaging document sharing and collaborative diagnostic purposes. We built a pilot testing environment in Zhabei district of Shanghai city cross 4 hospitals through VPN with bandwidth around 2-10 MB/s. The Server of i-EHR is consists of XDS Registry, XDS-I Repository, PIX Manager, Grid Manager and a backup server of PACS images shared from hospitals, and located in Healthcare Information Center of Zhabei district of Shanghai city. The XDS-I GW functioning as XDS-I Source and XDS-I Consumer Actors, which were in four hospitals: North City Hospital with 500 beds (Second grade hospital), and three community hospitals (First grade hospital) of Wan Long, Ling Feng and Peng Pu. The piloting testing was started since October of 2009, and there have been more than 50 examinations daily transferred between the North City hospitals and three community hospitals for collaborative diagnosis. The feedback from both users of community hospitals and North City hospital are very positive, as it is easily to use and there was no interfering on their normal radiology diagnostic operation.

Conclusion

With the developed i-EHR system, the seamless sharing of images and reports across the multiple hospitals is achieved, and i-EHR system can provide intelligent image delivery for collaborative imaging diagnosis across multiple hospitals based on work flow requirements, and the feedback from both users of community hospitals and large hospital are very positive. The JPEG2000-based stream data transferring and progressive display technologies overcome limited bandwidth problem and achieve quick responding on image retrieval and display. This project demonstrated that the grid-based implementation of IHE XDS-I for image-enabled EHR can scale effectively to serve a regional healthcare solution with collaboratively imaging services.

References

[1] IHE IT Infrastructure Technical Framework, http://www.ihe.net/Technical_Framework/.

[2] Y. Yang, J. Jin, J. Sun, J. Zhang, "Design and Implementation of Grid-Based PACS in a Hospital with Multiple Imaging departments", Vol.6919, pp69190L1-9, 2008.

[3] IHE ITI_Node_Authentication_Security_Profile_PC_2004_06_15