European Journal of Radiology 73 (2010) 3–9

Contents lists available at ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

From shared data to sharing workflow: Merging PACS and teleradiology

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ARTICLE INFO

Article history:
Received 4 September 2009
Accepted 7 September 2009

Keywords:
Teleradiology
PACS
SuperPACS
Efficiency in radiology
Radiology Reporting
RIS
Dashboard
Multi-site radiology workflow
Nighthawk
Dayhawk
Commoditization of radiology
Zero Latency Radiology
Global worklist
Virtual Radiology Desktop

ABSTRACT

Due to a host of technological, interface, operational and workflow limitations, teleradiology and PACS/RIS were historically developed as separate systems serving different purposes. PACS/RIS handled local radiology storage and workflow management while teleradiology addressed remote access to images. Today advanced PACS/RIS support complete site radiology workflow for attending physicians, whether on-site or remote. In parallel, teleradiology has emerged into a service of providing remote, off-hours, coverage for emergency radiology and to a lesser extent subspecialty reading to subscribing sites and radiology groups.

When attending radiologists use teleradiology for remote access to a site, they may share all relevant patient data and participate in the site's workflow like their on-site peers. The operation gets cumbersome and time consuming when these radiologists serve multi-sites, each requiring a different remote access, or when the sites do not employ the same PACS/RIS/Reporting Systems and do not share the same ownership. The least efficient operation is of teleradiology companies engaged in reading for multiple facilities. As these services typically employ non-local radiologists, they are allowed to share some of the available patient data necessary to provide an emergency report but, by enlarge, they do not share the workflow of the sites they serve.

Radiology stakeholders usually prefer to have their own radiologists perform all radiology tasks including interpretation of off-hour examinations. It is possible with current technology to create a system that combines the benefits of local radiology services to multiple sites with the advantages offered by adding subspecialty and off-hours emergency services through teleradiology. Such a system increases efficiency for the radiology groups by enabling all users, regardless of location, to work "local" and fully participate in the workflow of every site. We refer to such a system as SuperPACS.

1. Introduction

The business model for radiology practice around the world varies by geography. In general, however, one can identify the following business models: (i) a single facility (hospital or imaging center) employing a number of radiologists, or outsourcing the radiology professional services work to an outside radiology group; (ii) an enterprise with multiple facilities, employing radiologists, or outsourcing the radiology professional services work to a radiology group; and (iii) a radiology group providing professional services to several related or unrelated facilities (in terms of ownership). The facilities may employ IT systems such as Picture Archiving and Communication Systems (PACS), Radiology Information Systems (RIS), and Teleradiology Systems from one or multiple vendors [1].

Regardless of the business model, the outcome of the radiologist work is a final report [2] delivered to the relevant radiology stakeholder (referring physician, patient, administration). The report is expected to be accurate and delivered in a timely manner [1]. In selecting information systems that support the generation and delivery of the final report one parameter governs – how effective they are in increasing radiologist's efficiency [3]. We define efficiency as:

Efficiency = [**Speed** + **Accuracy**] in producing and delivering any **clinical** or **business** result.

Clinical result means delivering a *final report* to the referring physician that contains clinically useful information (narrative and images) *applicable to the patient care*.

Business result means the ability to deliver the *clinical result* FAST under any business scenario (i.e. number of sites, multiple vendors for IT systems, multiple imaging locations, multiple reading locations, result distribution scheme, etc.).

The business model where a radiology group provides professional services to several unrelated facilities (to be referred to as

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doi:10.1016/j.ejrad.2009.10.014

the "***Disparate Model***") is perhaps the most challenging in terms of building an IT infrastructure and system to maximize the efficiency of the group. A typical scenario (Fig. 1) is where a radiology group contracts to deliver complete radiology services, including subspecialty reading, to several sites covering a large geographical area. Each site has multiple information systems from multiple vendors. The sites have different owners and may even compete with each other. Reports and consultations have to be provided to on-site and off-site referring physicians. Each site has its own billing system triggered by its RIS or Hospital Information System (HIS). The radiology group employs subspecialists, but not enough to man each facility with all required subspecialties. Radiology services are required around the clock all year.

It is clear that an information system that maximizes efficiency for radiologists in the Disparate Model would definitely maximize efficiency for the other business models mentioned, as they represent sub-sets of the Disparate Model.

This article will begin with a brief review of the major professional services expected from radiology groups by their stakeholders followed by a discussion of current solutions for the Disparate Model and their limitations. We will then introduce an architecture and system that addresses these limitations and provides unlimited flexibility for solving requirements of single and multi-site radiology service operations. The proposed solution will be named SuperPACS.

2. Stakeholders' expectations for radiology services

Boland [4] and Patti et al. [2] have identified three key stakeholders who look to radiology to expedite the diagnostic process: referring physicians, patients, and hospital administrators. Boland [4] lists four major service expectations and one administrative expectation by these stakeholders:

(i) *Help increase patient access to imaging*. This means facilitating a timely access of patients to the radiologic examinations appropriate to the clinical indications. The implication for a radiology group serving multi-sites is a timely appropriateness check [2], setting the examination protocol, interviewing the patient when needed, guiding the modality technician during examination and assessing the quality of the exam.

(ii) *Customer service*. This includes consultations to walk-in and call-in physicians, allowing "add-on" procedures, providing emergency reading, attending clinical and administrative meetings, teaching radiology and non-radiology residents and providing after hours coverage [5].

(iii) *Expedite report turnaround and image availability*. Provide referring physicians with a final report and relevant images on time so as not to delay continued patient treatment. Provide critical finding notification [6].

(iv) *Accuracy and quality of reading*. Referring physicians are increasingly looking for greater expertise in radiology reports and expect subspecialty reading [5,7]. Peer review and consultation between fellow radiologists are important factors in improving accuracy and quality of reports.

(v) *Understanding the business of radiology*. This is a business/administrative expectation. Radiology is one of the highest revenue sources for medical institutions who in turn expect to increase this revenue through higher patient volumes and throughput at minimum cost. This requires the radiology group serving them to work at maximum *efficiency*, as this term is defined in Section 1.

Considering the above stakeholders' expectation, it is imperative that any radiology group providing service under the Disparate Model must assign appropriate and sufficient ***local*** radiologists to staff the sites it serves as well as provide timely ***subspecialty and off-hours reading and consultation*** to those sites [2,7].

3. Current solutions for the Disparate Model

As detailed in Section 1, the Disparate Model is characterized by multiple sites, each with several information systems of different vendors, with no cooperation between the sites except that each site allows remote access to the members of a radiology group for the purpose of delivering radiology services.

To satisfy the expectations of its stakeholders, radiology groups under the Disparate Model typically use the following solution:

(i) Place radiologists at each site during work hours. Each radiologist reads and reports locally using the locally available information systems: PACS, RIS, Reporting System (dictation, speech recognition, structured report, etc.) [1]. Additional patient information to support the reading may be accessed locally through the site's Electronic Medical Record (EMR), if available. Local worklists that manage the reading amongst the radiology staff are typically driven by the RIS or PACS. Reports are sent to the local RIS that triggers the billing.

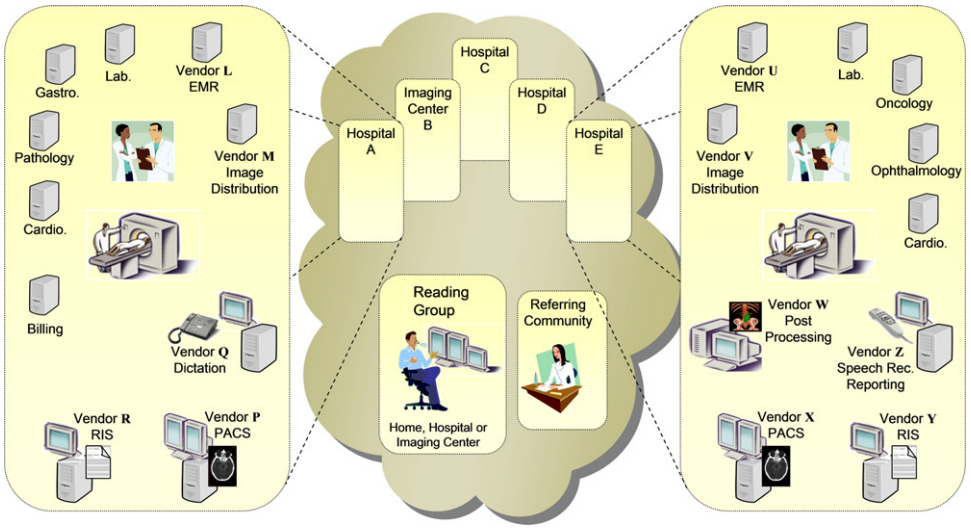

Fig. 1. The Disparate Model. A radiology group provides professional services to several unrelated facilities. Each site has multiple information systems from multiple vendors.