

The Economic and Social Value of an Image Exchange Network: A Case for the Cloud

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Abstract

As the health care environment continually changes, radiologists look to the ACR's Imaging 3.0[®] initiative to guide the search for value. By leveraging new technology, a cloud-based image exchange network could provide secure universal access to prior images, which were previously siloed, to facilitate accurate interpretation, improved outcomes, and reduced costs. The breast imaging department represents a viable starting point given the robust data supporting the benefit of access to prior imaging studies, existing infrastructure for image sharing, and the current workflow reliance on prior images. This concept is scalable not only to the remainder of the radiology department but also to the broader medical record.

Key Words: Cloud, image exchange, Imaging 3.0, patient-centric, value

J Am Coll Radiol 2016;■:■-■. Copyright © 2016 American College of Radiology

INTRODUCTION

Imaging 3.0[®] is the ACR's current initiative to position radiology at the forefront of the changing health care landscape. This program emphasizes the importance of adding value on behalf of the patient, hospital system providers, and payers. Imaging 3.0 specifically identifies patient-centered care as a core principle. We believe the concept of universal accessibility of diagnostic images promotes that goal, and we propose the creation of a nationwide database repository for prior imaging examinations. This would be useful for practices that cover multiple locations and for patients who switch facilities. Currently evolving technology presents a new opportunity for image sharing: leveraging “the cloud.” This

undertaking represents a tangible endeavor to measurably improve patient care outcomes, reduce cost, and add value for multiple stakeholders. We make a case that breast imaging should initiate this process given its current infrastructure, workflow, and high likelihood of success.

INTERPRETATION PERFORMANCE

Breast tissue composition is unique to each individual, and prior images provide a reference for evaluating subtle changes to assist in the early detection of malignancy. When an abnormality is identified, the patient is “recalled” for additional imaging. The average recall rate in the United States is approximately 10% [1]. Approximately 95% of these patients recalled from screening will not have cancer, and these cases are counted as false positives.

The value added by reviewing all prior mammograms cannot be overstated. The improved performance of mammographic interpretation when prior examinations are available is well documented, with the following results: reducing false positives in screening mammography by 40% to 60% [2-11], reducing false positives in diagnostic mammography by 80% [9-11], improving earlier detection of breast cancer by 25% [12], and reducing lymph node-positive breast cancer by 3.6% [12]. Dr. Sickles previously demonstrated that the

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Dr Pearson has received grants from Mammosphere (a nonprofit 501(c)(3) now part of lifeIMAGE) and personal fees from lifeIMAGE. In addition, Dr Pearson has a patent (“Apparatus and Method for Utilizing Mammogram Images for Verification Issues”). Dr Avrin has received grants from National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering, and RSNA Image Share Network. The other authors have no conflicts of interest related to the material discussed in this article.

performance of unnecessary additional examinations was increased by 260% when prior mammograms are not available for comparison [5,6]. These high recall rates account for the majority of preventable imaging costs related to breast cancer screening [13].

PATIENT OUTCOMES

Mammography has been shown to reduce cancer mortality by up to approximately 40% [14-18]. Comparison with previous examinations is associated with a significant decrease in the frequency of axillary node metastasis and the cancer stage for screening mammography [12]. With diagnostic mammography, comparison with prior examinations improves true-positive findings, resulting in improved sensitivity for detection of malignancy. These improvements are attributable to the ability to accurately detect subtle incremental mammographic changes that may otherwise be overlooked.

Additional radiation exposure, estimated at 1 mSv per diagnostic mammographic examination [19], is also an undesirable result of additional imaging [20-22]. When practicing the principle of “as low as reasonably achievable,” available prior examinations should be sought before repeating additional images. However, in practice, prior examinations are often unavailable because of misplacement of films, patients’ not remembering the locations of their last mammographic examinations 10% of the time [23], and failure of prior facilities to quickly forward available images. Approximately 50% of requested prior examinations are not received within 2 weeks despite diligent efforts [23].

PATIENT EXPERIENCE

Many women understand the value of screening mammography, with approximately 60 million women undergoing the examination yearly in the United States. The majority of screening-detected breast cancers are diagnosed at an early stage (stage 0 or I). This results in an overall 96% to 99% survival rates of low-grade disease with less extensive surgery, chemotherapy, and radiation therapy [15,24]. Cancers detected with the aid of available comparison mammograms have more favorable characteristics than when prior examinations are not available [25].

Despite the indisputable evidence that annual screening mammography beginning at 40 years of age saves lives, a substantial percentage of women are not following these recommendations. Confusion regarding the benefits of screening mammography has been

exacerbated by the recent US Preventive Services Task Force recommendations that reduce the frequency of screening mammography [26]. Additionally, there is increasing awareness of the anxiety some women face from false-positive results on screening mammography [27,28]. By reducing recall rates, ready access to prior examinations for comparison should minimize these perceived “harms” of screening mammography. Fewer callbacks also result in lower out-of-pocket costs and a decrease in biopsies. Patients themselves are becoming increasingly aware of radiation exposure, and this publicity pressures radiologists to become judicious stewards of radiation exposure. We expect that improved mammographic accuracy provided by prior comparisons would result in greater certainty regarding the benefits of screening mammography and therefore decrease the controversy surrounding screening guidelines.

VALUE CREATION

Currently, tremendous effort is expended to obtain prior images. Patients’ examinations often are located at multiple facilities in various geographic locations. Hospitals and outpatient imaging centers spend significant time and money tracking and compiling prior patient records, creating and mailing CD-ROMs, and importing images from discs into PACS, resulting in an estimated cost to facilities of \$12 to \$30 per patient [9,23,29]. Some facilities require patients to procure their own prior images, which predictably results in delayed appointments or skipped examinations altogether. The federally mandated Mammography Quality Standards Act requires that referring physicians and self-referred patients receive reports within 30 days of examinations [30]. However constant pressure to reduce report turnaround times results in the inability to wait for outside prior images, resulting in suboptimal reports with increased radiologist frustration and diminished performance [31]. Approximately 30% unnecessary additional work per case is created when report addenda are issues as prior outside examinations become available and must be reread.

At the National Consortium of Breast Centers conference in March 2013, an application analyst reported that cloud-based image sharing improves care at breast centers while reducing costs [32]. Image sharing via CD-ROMs suffers from unpredictable reliability, and virtual private networks are limited by network security, disparate manufacturers, network traffic, and IT resources. A study at the University of Utah demonstrated that

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