Medical Imaging Data Reconciliation, Part 3: Reconciliation of Historical and Current Radiology Report Data

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Correlation of historical imaging and radiology report data with the current imaging data set is a critical step in the radiologic interpretation process and, if incomplete, can adversely affect diagnostic accuracy. In its current form, the extraction and analysis of historical imaging and report data is limited by manual workflow, inefficient data organization, and a lack of imaging and report data integration. The reconciliation of historical and contemporaneous radiology report data provides an opportunity to improve the consistency, completeness, and accuracy of radiology report data, while providing opportunities to automate workflow related to data extraction, interpretation, and peer review. The derived data analytics can in turn be used to facilitate physician consultations, education and training, and proactive intervention in the event of report discrepancies.

Key Words: Data mining, radiology reporting, peer review

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INTRODUCTION

Correlation with historical imaging data is a critical step in the radiologic interpretation process and can often have a profound effect on reporting accuracy and confidence [1-3].

Although the transition to filmless imaging has had a positive impact on the accessibility of historical radiology examinations, review of these historical imaging and report data often remains inefficient and time consuming because of the dissociation of imaging (pixel) and report (textual) data, the organization of historical imaging folders, and the unstructured nature of conventional reports [4,5]. As a result, radiologists and clinicians sometimes bypass important imaging and report data that if viewed could positively affect interpretation and clinical management [6].

The solution would be to create a technology that provides automated tools for historical data extraction and presentation, while encouraging (or even mandating) review of clinically relevant historical imaging data, at the level of individual findings. This could provide valuable clinical insight to both radiologists and clinicians, while providing reconciliation of historical and contemporaneous imaging data, which is critical to ensuring continuity across the radiology continuum [7].

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DEFINING THE PROBLEM

Using conventional technology and workflow, review of historical imaging and report data is largely manual and operator dependent. Historical imaging data, which are stored in a patient's imaging folder, are traditionally categorized on an examination-specific basis. As a result, the individual findings (both normal and abnormal) contained within each radiology report cannot be ascertained without manual review of the radiology report. With increasing radiologist workflow demands and time constraints, comprehensive review of historical imaging data may become adversely affected. This has the potential to negatively affect radiologic diagnosis in several ways: by failing to identify historical imaging and clinical data of clinical relevance; an inability to directly compare prior and current imaging findings; adversely affecting diagnostic sensitivity, specificity, and confidence; and increasing recommendations for imaging follow-up [3,8-10].

Even when radiologists make the effort to review historical imaging data, the challenge is determining which imaging data sets and reports are relevant to the current interpretation task. Although review of the most recent "comparable" imaging data (ie, the same anatomic region or modality) may prove useful, clinically relevant data often remain hidden in earlier or "noncomparable" imaging data (ie, a different anatomic region or modality). When a pertinent finding is recorded on the current radiology report, there is no effective means with which historical imaging data can be automatically queried to determine its presence or absence over time. The corollary is also true, in that historical data recorded on prior

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Table 1. Goals and objectives of report data reconciliation

1. Account for all historical and current report data on a finding-specific basis
2. Automated linkage of image (pixel) and report (textual) data
3. Auto-population feature, which automatically transposes prior report findings (with direct linkage to corresponding images) into current report template
4. Synchronous peer review and report creation to improve workflow and data analysis
5. Automated documentation and feedback of report discrepancies
6. Ability to integrate clinical feedback into data reconciliation
7. Application to sequential analysis of preliminary and final report data
8. Automated finding-specific query and retrieval of the historical report database
9. Ability to integrate finding-specific computerized decision support technologies
10. Creation of a referenceable, finding-specific database for customizable education, training, and creation of best-practice guidelines

reports may be overlooked or understated on the current report. A referring physician who is interested in determining temporal changes in imaging findings may become frustrated at the relative lack of report data consistency.

An often understated deficiency of radiology reporting is the limited oversight and scrutiny of sequential report discrepancies. Although sequential imaging examinations will often prove or disprove historical radiology report findings, these data are often underreported, largely because of concerns over potential medical malpractice [11]. A radiologist interpreting a current imaging examination does not want to undermine or discredit a colleague who has misinterpreted a prior imaging data set. Instead of documenting the discrepancy, the radiologist may elect to understate or ignore the finding, which has the potential to introduce clinical uncertainty on the part of the referring clinician and adversely affect clinical management.

CURRENT PRACTICE

The historical patient imaging folder is typically arranged in chronologic order and sorted according to examination type and anatomic region. Although PACS offer automated hanging protocols to display comparable historical and current imaging studies in tandem, the process of reviewing report data remains manual and dependent on each individual end user. The extraction of historical report data is further compromised by the relative absence of structured reporting in everyday practice, with most radiology providers producing free-text (prose) reports in paragraph format. In an attempt to save time, many radiologists and clinicians elect to limit their searches to the report impression, which has the potential to overlook pertinent data [12]. Although natural language processing has been proposed as an automated means of report data extraction [13,14], this is currently not available in everyday clinical practice and is often limited by inferencing [6].

Although many PACS offer the ability to create a separate "key image" folder consisting of radiologist-selected images of interest, this process remains manual, is left to the discretion of each individual radiologist, and is not inclusive of all report findings. As a result, a radiologist seeking to review historic imaging data would be required to determine which prior imaging examinations are relevant to the current task, read each of these reports, and scroll through the corresponding imaging data sets for direct review. The determination of which prior imaging studies are relevant is especially problematic in light of the fact that pertinent findings cannot be determined without direct review of the report. In addition, the traditional reporting model does not produce an automated link between report and imaging data, requiring time-consuming review of the imaging data set for imaging and report data correlation.

INNOVATION OPPORTUNITY

In an attempt to formalize data reconciliation in historical and current imaging report data, several goals and objectives of the proposed technology should be defined (Table 1). The first premise is that all radiology report data analysis will occur on a finding-specific basis, with direct linkage of imaging (pixel) and report (textual) data associated with each individual finding. This provides a workflow-efficient method for finding-specific data extraction and retrieval, which is independent of imaging examination descriptors. As an example, a right lower lobe lung nodule identified on an abdominal CT report would be recorded in the database in accordance with the finding and anatomic region. In the event a radiologist or clinician were to identify a lung nodule on a current imaging data set (eg, chest radiograph, CT scan, or MRI study), an automated query would be generated that identified historical findings of relevance, regardless of the examination type and date. The direct linkage of image (pixel) and report (textual) data for each individual finding would provide for a direct side-by-side comparison, without time-consuming review of large data sets.

An integral component of the proposed data reconciliation tool for sequential imaging report data is the "auto-population" feature, which automatically transposes anonymized (ie, deidentified) finding-specific historical report data into the current report template. This