Automated Radiology-Pathology Module Correlation Using a Novel Report Matching Algorithm by Organ System

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Objectives and Rationale: Radiology-pathology correlation is time-consuming and is not feasible in most clinical settings, with the notable exception of breast imaging. The purpose of this study was to determine if an automated radiology-pathology report pairing system could accurately match radiology and pathology reports, thus creating a feedback loop allowing for more frequent and timely radiology-pathology correlation.

Methods: An experienced radiologist created a matching matrix of radiology and pathology reports. These matching rules were then exported to a novel comprehensive radiology-pathology module. All distinct radiology-pathology pairings at our institution from January 1, 2016 to July 1, 2016 were included ($n = 8999$). The appropriateness of each radiology-pathology report pairing was scored as either "correlative" or "non-correlative." Pathology reports relating to anatomy imaged in the specific imaging study were deemed correlative, whereas pathology reports describing anatomy not imaged with the particular study were denoted non-correlative.

Results: Overall, there was 88.3% correlation (accuracy) of the radiology and pathology reports ($n = 8999$). Subset analysis demonstrated that computed tomography (CT) abdomen/pelvis, CT head/neck/face, CT chest, musculoskeletal CT (excluding spine), mammography, magnetic resonance imaging (MRI) abdomen/pelvis, MRI brain, musculoskeletal MRI (excluding spine), breast MRI, positron emission tomography (PET), breast ultrasound, and head/neck ultrasound all demonstrated greater than 91% correlation. When further stratified by imaging modality, CT, MRI, mammography, and PET demonstrated excellent correlation (greater than 96.3%). Ultrasound and non-PET nuclear medicine studies demonstrated poorer correlation (80%).

Conclusion: There is excellent correlation of radiology imaging reports and appropriate pathology reports when matched by organ system. Rapid, appropriate radiology-pathology report pairings provide an excellent opportunity to close feedback loop to the interpreting radiologist.

Key Words: Radiology pathology correlation; radiology education; concordance.

INTRODUCTION

Radiology-pathology correlation is an essential component of learning radiology (1–5). Accurate and timely feedback, such as that provided by radiology-pathology correlation, is a crucial element in developing expertise and accuracy in diagnosis (6). However, aside from breast imaging, rigorous radiology-pathology correlation is haphazardly performed, with the majority of the correlation requiring the radiologist to actively seek pathologic results via the medical record or discussion with clinicians (7–9). Unfortunately, this process results in inadequate radiology-pathology correlation, missed opportunities for valuable feedback to radiologists, and may also cause the propagation of inaccurate information.

We created an automated radiology-pathology module to convey radiology and pathology reports to the interpreting radiologist and trainee, allowing the radiologists to receive appropriate feedback for all pathology results available following the interpretation of imaging studies. The module alerts the reporting radiologist to matching pathologic pairings via both a computerized radiology-pathology module integrated with Picture Archiving and Communication System (PACS) and via a secured e-mail. The radiologist then has the opportunity to review the imaging study through the radiology-pathology module in our PACS while simultaneously making a decision about concordance of the radiology interpretation with the pathologic diagnosis. Prior studies have

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acknowledged the value of radiology-pathology correlations by testing modules that use natural language processing, with one study reporting moderate accuracy (71%) in pairing appropriate reports (10,11). However, despite the potential benefits of these systems, they have not yet been routinely utilized by the radiology community as high accuracy in matching reports is necessary to allow for seamless integration into a radiologist's daily workflow.

Our radiology-pathology module improves on previously described systems by utilizing an alternative algorithm using matching rules that were initially defined in a manual fashion. Our hypothesis was that manually defined matching rules for radiology and pathology reports by organ system could allow our automated algorithm to produce highly accurate correlation of radiology and pathology reports. The purpose of this study was to assess radiology-pathology report correlation obtained via a novel manual matching system.

METHODS

Radiology-Pathology Report Matching

Institutional Review Board approval was obtained for this retrospective study. One year of prior pathology specimen names were initially retrieved from institutional databases to define matching rules, yielding 24,924 unique entries. A radiologist with 7 years of experience individually mapped each specimen name to a relevant interpreting radiology subspecialty. For example, a pathology specimen named "Endometrial curettings" was mapped to abdominal radiology because this subspecialty interprets pelvic ultrasounds, abdominopelvic computed tomography (CT) and magnetic resonance imaging (MRI), which image the endometrium. Some specimen names were mapped to multiple subspecialties if appropriate, such as thyroid nodule aspirations, which were relevant to the following subspecialties: abdominal, thoracic, neuroradiology, pediatric radiology, nuclear medicine, and interventional radiology. Pairings were then exported to a commercially available comprehensive radiology-pathology module (Primordial Design LLC, San Mateo, CA), which also receives data feeds of all radiology and pathology reports, allowing the matching rules to be applied. The module analyzes incoming pathology reports based on the words in the structure of the pathology report. At this institution, the structure uses the word "specimens" to signify the name of the specimen. The structure of the pathology report has a next field of Diagnosis. This field marks the end of the name of the specimen. The name of the specimen is one of the 24,924 unique entries that were categorized as described. A crosswalk was then created for each specimen name to a specific body part section as above.

Matches then generated two forms of communication with the radiologist: (1) an e-mail containing the radiology report impression and full pathology report that is automatically sent through the hospital-wide, secure e-mail server to the last interpreting radiologist and trainee (resident or fellow); (2) a radiology-pathology module propagated with "'n' New Pathology Follow-ups" where "n" is the total number of pathology follow-ups in the radiologist's queue (Fig 1). A new case will come into the cue with each new radiology-pathology correlation. After the radiologist reviews the case either via e-mail or via the module, the case will fall off the site. This system was made available to all radiologists at all sites within our system. The radiology-pathology module created a table of patients with the full radiology report and the full pathology report. This system is integrated with the PACS system, allowing the radiologist to view studies with one click for re-evaluation (Fig 2).

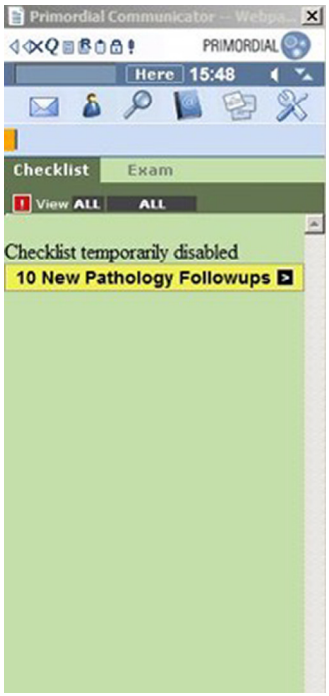

Figure 1. Primordial communicator demonstrating 10 New Pathology Follow-ups in the radiologist's queue displays conveniently on the radiologist's dashboard. Clicking on ">" launches the radiology-pathology module.

The system was designed to accept data feeds in a prospective manner. This system was first installed in December 2015.

Subjects

All anonymized radiology-pathology report correlations performed at our institution from January 1, 2016 through July 1, 2016 were retrospectively identified ($n = 26,665$). Duplicate entries of the same pathology report secondary to radiology resident interpretations or addenda to the original pathology report were excluded (17,666 excluded). Ultimately, 8999 distinct radiology-pathology correlations were included for analysis.

Radiology-Pathology Correlation Assessment

A radiologist with 4 years of experience evaluated the appropriateness of each radiology-pathology report pairing as