BOOMERANG: *New Software*

1. **Highlights Changes** between Preliminary vs. Final versions of Radiology Reports to Improve Feedback to Residents and Fellows.
2. **Search Past Reports** for Interesting Cases or Follow-up.

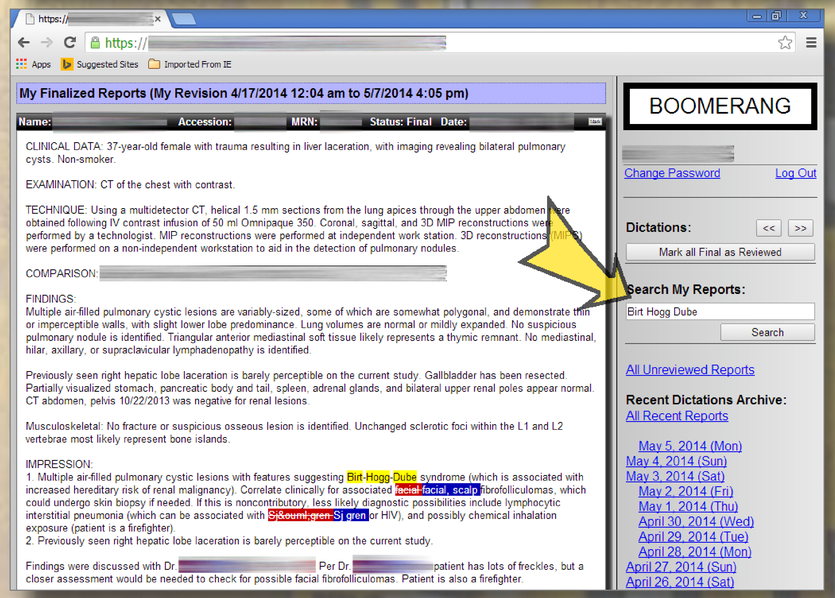
Michal Kulon MD | Christopher Gaskin MD | Dan O'Malley
University of Virginia, Department of Radiology

SCREEN SHOTS:

Impression:

Vascular:
1. Scattered calcific atherosclerotic disease of the aorta, predominately confined to the aortic arch.
2. Tubular ascending aorta measures 39 mm.
3. Pulmonary artery enlargement, suggestive of pulmonary arterial hypertension.
4. Global cardiomegaly with significant right left atrial and left ventricular enlargement.

Chest:
1. An 11 mm pleural based right lower lobe pulmonary nodule. This may be further evaluation with CT guided biopsy in the Department of Radiology versus PET/CT are recommended.
2. Innumerable centrilobular perilymphatic micronodules with an upper lobe predominance, scattered cysts, and scattered ground glass opacification. These findings are nonspecific but are suggestive pulmonary sarcoidosis without lymphadenopathy. Given patient's history of respiratory bronchiolitis with hypersensitivity pneumonitis and lymphocytic interstitial pneumonia favored diastolic heart failure, a cardiac MRI is suggested to be less likely, evaluate for cardiac sarcoidosis.
3. Acute to subacute sternal fracture and subacute left-sided rib fractures.
4. Colonic diverticulosis without evidence of diverticulitis.



Background:
Traditionally, feedback provided to radiology trainees on their reports is sporadic and limited. Thorough feedback requires significant time and effort, and is also logistically difficult. Radiologists in training (residents and fellows) generate preliminary reports containing their interpretation of the images. These reports are sent electronically to the attending radiologist to edit/sign to become final reports. The attending may edit the preliminary report to change the findings, interpretation of findings, recommendations, or style/clarity of language. Due to the typically high volume of reports, it is impractical for the attending radiologist to provide feedback to the residents on every report and less critical changes are only very rarely communicated. Feedback on major changes, such as incorrect interpretation or missing a major finding, is more common, but unfortunately this critical feedback is also variable and does not always occur. Positive feedback on reports is quite limited; a trainee drafting an excellent report or having the correct conclusion on a difficult case that is not directly staffed out in person will likely not lead to any reinforcement.

Evaluation:
"Boomerang," a web-based program was developed to periodically fetch all new radiology electronic reports and their revisions, highlight the changes, and present these to trainees and attendings. Radiology trainees can securely log in with a username and password using any web browser on either a computer or portable device. They are then presented with a scrollable page containing all of their recent reports, with all changes clearly marked. Deletions are marked by red highlight and strike-through, while additions are highlighted blue. Reports without changes are easily identified by light-green backgrounds and absence of text highlights. Preliminary reports that have not yet been edited/signed by the attending are displayed separately with gray backgrounds.

This program allows the trainees to easily see edited text in their reports, and thus provides valuable educational feedback without requiring any additional time or effort from the attendings. Attendings also benefit: time spent on feedback is reduced, and trainees are made aware of common minor stylistic changes, resulting in the trainee adopting these in their reports sooner. Trainees can dismiss the viewed reports so that these are no longer displayed. All recent reports, including dismissed reports can be accessed from an archive feature and are organized by date.

Technical implementation of Boomerang utilizes the PHP programming language and a database that stores multiple revisions of the reports and authorized users (configurable for MySQL, Microsoft SQL Server, or other). The reports are obtained by polling the underlying database of the dictation software. This has been tested with Apache and IIS web servers, with tested installations on servers running either Linux (Ubuntu 12.04, CentOS 5.9), or Microsoft Windows Server. Other server operating systems were not tested, but most are likely compatible due to the portability of PHP and MySQL. End-users can use any computer with a web browser (such as Windows, Apple, or portable devices), and can log-in using either their password specific to Boomerang, or institution-wide password authenticated against institutional LDAP server(s). The LDAP (Lightweight Directory Access Protocol) authentication facilitates user management, especially if institutional policy mandates periodic changes to the passwords, allowing such changes to be automatically propagated to Boomerang, and users can have the same passwords as for other applications such as PACS or electronic health record. Granularity of highlighted changes can be configured to either whole words (default), sentences, or characters. Due to the necessity to protect patients' health information, deployment on firewall-protected hospital network utilizing HTTPS / SSL is suggested.

Discussion:
Automated improvement in feedback to radiology trainees would be expected to facilitate their education as they would be exposed to all report changes. This in turn can result in improvement in the quality of subsequent preliminary reports. The tool is particularly helpful for overnight reports, since the authoring resident may not have the opportunity to discuss all the cases with all of the morning subspecialty attendings. If used judiciously, this tool also has the potential to improve the efficiency of workflow during busy days, by enabling trainees to the send reports on the straight-forward cases directly to the attending for review and signature, without the traditional time-consuming side-by-side discussion with the attending which require the resident to view the case again and wait while the attending makes their assessment. Although reports on straight-forward cases have less frequent attending edits, feedback would be highlighted and shared automatically when this occurs.

Conclusion:
Boomerang software has been deployed at our institution leading to improvement in feedback to trainees on their preliminary reports. The feedback is asynchronous, complete, and non-judgmental.

References:

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3. Teunissen PW, Stapel DA, van der Vleuten C, Scherpbier A, Boor K, Scheele F. Who wants feedback? An investigation of the variables influencing residents' feedback-seeking behavior in relation to night shifts. Acad Med. 2009 Jul;84(7):910-7
4. Ivers N, Jamtvedt G, Flottorp S, Young JM, Odgaard-Jensen J, French SD, O'Brien MA, Johansen M, Grimshaw J, Oxman AD. Audit and feedback: effects on professional practice and healthcare outcomes. Cochrane Database Syst Rev. 2012 Jun 13

Demo Version available on radiology-universe.org