Recommendations for Additional Imaging: A Novel Characterization Scheme for Ensuring Appropriate Follow-up

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Background – Recommended Additional Imaging

- Radiologists recommend additional imaging (RAI) studies in 1.3 – 20.9% of cases [1,2,3]
- Studies have shown that recommended follow-up imaging is not performed 36 - 69% of the time [4,5,6]
- We developed a novel characterization scheme, which mimics the American College of Radiology's Breast Imaging Reporting and Database System (BI-RADS), only the characterization scheme is applied to *all* imaging
  - Certain report modalities are excluded (e.g. mammogram), as their follow-up is assured via other processes
- We have applied this coding scheme to all reports at a moderate/large sized private practice group in the Midwest.

Methods – Applying a novel characterization scheme

- The characterization scheme (figure 1) was applied to all reports at a private practice radiology group in the Midwest
  - This program applied to 9 community hospitals ranging in size from 18 – 175 beds
- A backend database (SQL SERVER – Microsoft; Redmond, WA) was constructed to interpret, log, and track these follow-up recommendations
- Case Example
  - For example, if a radiologist wants a follow-up of a chest CT nodule in 6 months, they would annotate the report as "I.3.[modality].[time interval]"
  - Here the modality and time interval for the follow-up exam are provided for tracking by the developed tracking algorithm (Java - Sun Microsystems; Menlo Park, CA)

Code	Code Meaning	Categorization Code
0	Incomplete, further imaging (or comparison with priors) is required	Follow-up necessary. Further immediate imaging or information is recommended. Format: "I.0.[modality]".
1	Negative	No follow-up. No cause of patient's symptoms identified.
2	Benign findings	No follow-up. Potential/actual explanation of patient's symptoms identified.
3	Probably benign, short interval follow-up suggested	Follow-up necessary. Further, time delayed imaging is recommended. Format: "I.3.[modality].[time in months]".
4	Suspicious abnormality	Follow-up necessary. Recommend non-imaging action (e.g. biopsy, referral).
5	Highly suggestive of malignancy, action should be taken	Critical results.
Int		Interventional procedure

Figure 1: The categorization code adopted by the private practice radiology group to help define and track recommended follow-up examinations.

Methods – Notification of Ordering Provider

- All follow-ups are tracked and assessed for fulfillment daily
- A follow-up is considered delinquent if:
  - It has been 2 weeks since the request of an immediate follow-up (e.g. “I.CT.0”)
  - It has 4 weeks since the request of a timed follow-up (e.g. “I.3.CT.6”)
  - Additional time is allowed to PET/CT follow-up for scheduling reasons
- If a follow-up is found to be delinquent, a follow-up notification (figure 2) is sent to the ordering provider of the original exam
- This follow-up notification is accomplished via a HIPAA compliant eFax transmission, along with a copy of the original report

Dear Dr. XXXX:

Patients demonstrating abnormal findings on radiology studies which require subsequent monitoring are sometimes lost to follow up. This results in poor patient care and significant legal liability for you and our local healthcare systems. In an effort to address this, our medical practice tracks recommendations for radiology follow up made by our physicians. This is intended to augment, but not replace, your clinical follow up of these patients.

On [*Date of Original Exam*], you ordered a [*exam modality]* on patient: [*Patient Name]* (DOB: [*Patient DoB]*; MRN: [*Patient MRN]*). This exam demonstrated a finding that required further imaging evaluation.

The relevant radiology report is included in this communication. To date, we do not have record indicating that this follow-up imaging has been performed.

We are aware there are numerous reasons why we may have no record of the imaging being performed, but we wish to ensure your patients are never lost to follow up. If you feel that this letter should be forwarded to another medical provider please do so, or inform us that we may do so.

In the event that this matter has already been clinically addressed, please disregard this notification. If you wish to stop receiving these notifications, please send an email to *[contact information]* with the subject header "STOP".

Thank You,

The Radiology Associates of the Fox Valley

Contact information

[The original text of the report, including the recommendation for follow-up, is displayed here.]

Figure 2: An example of the follow-up notification sent to the ordering provider if the follow-up was not performed within out system. Note that a copy of the original report is included for the ordering provider’s reference.

Results – Overall RAI trends

	CR	CT	MR	US	NM	Other	Total
Total	131,181	47,888	19,030	23,868	2.385	6,565	237,917
RAI*	701	1,915	183	583	53	9	3,444
% RAI (95% CI)	0.51 (0.47 - 0.54)	4.09 (3.91 - 4.27)	0.98 (0.84 - 1.12)	2.73 (2.52 - 2.93)	2.22 (1.63 - 2.81)	0.14 (0.05 - 0.23)	1.44 (1.42 - 1.52)
CRAI†	329	696	67	256	33	7	1,388
% CRAI	46.9 (43.2 - 50.6)	36.4 (34.2 - 38.5)	36.6 (29.6 - 43.6)	43.9 (39.9 - 47.9)	62.2 (49.2 - 75.3)	77.8 (50.6 - 100)	40.3 (38.7 - 41.9)
Post-letter§	53	383	35	85	14	0	570
% ↑CRAI	+7.56%	+20.0%	+19.1%	+14.5%	+26.4%	0	**+16.5%**

Table 1. Summary of all codes supplied by the radiologists for 2019.
* - Recommended Additional Imaging
† - Compliance with recommended additional imaging
§ - The number of additional follow-ups performed after the HIPAA compliant communication was sent to the ordering provider.

This analysis consists of a total of 237,917 reports coded during the 2019 Calendar year

Results – Clinical Impact

- Following the HIPAA compliant notification, there was a noticeable increase in follow-up adherence
- A total of 570 additional follow-up exams were performed secondary to the follow-up notification letter
- This equates to an additional 13% of RAI being completed
- In addition, a number of additional biopsies and follow-up exams (Table 3) were performed thanks to our notification letter
  - The pathology was not always available, with path result assumed in some cases based on history of subsequent radiology exams
  - Several cases were marked as clinically determinate based on the follow-up exam (e.g. recurrent lymphoma)

	CR	CT	MR	US	NM	Total
Additional Exams Performed post-notification	53	383	35	85	14	570

Table 2: The number of additional follow-up exams after the notification letter was sent

	# of exams	% of all RAI
Bx performed – path positive	15	2.64%
Bx performed – path unavailable	30	5.27%
Presumed Malignant case on follow-up	14	2.46%
Suspicious finding – additional follow-up recommended	26	4.57%

Table 3: A table summarizing the clinical impact of the follow-up assurance scheme.

Discussion

- We describe a categorization system which allows identification of reports when further imaging is recommended, identify when this recommended imaging is not performed, and contact the ordering physician to help ensure appropriate follow-up.

- We trained a group of 35 board certified radiologists providing coverage to 9 community practice hospitals in the use of this system and coded a total of 237,917 reports over a one-year period.

- We developed a computerized system to track whether the recommended imaging was performed, and a HIPAA compliant method to alert ordering physicians when such imaging was not performed.

- We sent 2,056 notifications when further imaging was not performed, resulting in obtaining 570 further studies and improving overall compliance with recommendations by 13.1%.

- All such requests for additional follow-up imaging were made on the basis of imaging findings alone, no clinically conditional follow-up recommendations were tracked

Discussion

- As our group reads over 250,000 cases a year, we wanted a system that was at least partially automated.

- The system implemented was on a small enough scale that each follow-up recommendation was evaluated by a Board certified radiologist to evaluate for alternative follow-up completion criteria before a letter was sent to the ordering provider

- The scheme is intended as an adjunct to the various other "-RADS" schemes in the literature.
  - For example, while Lung-rads may help determine the correct interval for follow-up imaging, the categorization scheme detailed in this report ensures the follow-up occurs

- The overall completed recommended additional imaging (CRAI) was similar to the literature (~40%)
  - There are many reasons why CRAI is perhaps lower than expected: patients decline the follow-up exam, the patient has since been given a subspecialist referral (obviating the need for imaging), the patient has transitioned to hospice, the patient has a contraindication to the requested exam, etc.

- The additional imaging performed has a definitive, measurable impact on clinical care as evidenced by the increased # of clinically appropriate biopsies and surveillance imaging

Discussion – Future work

- The code used by our group also supplies a “positive or negative” designation
  - The radiologist codes the exam as “positive” if there is a radiological finding for the provided indication, and “negative” if it does not

- As radiology transitions from a fee-for-service industry, this data could be used to help further evaluate ordering provider imaging habits and identify outliers
  - Providers with a high proportion of ‘negative’ studies, compared to their peers, may benefit from altering their ordering habits

- Additional notification methods would likely be of benefit
  - Notifying the patient’s PCP or, even, the patient themselves, could have an additional benefit on follow-up adherence.

- Implementation of Natural Language Processing (NLP) would help to scale this application to a higher volume setting

- More complete access to the Electronic Medical Record (EMR) at the participating facilities would help us better delineate the clinical improvements realized by this characterization scheme

References

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