vizient®

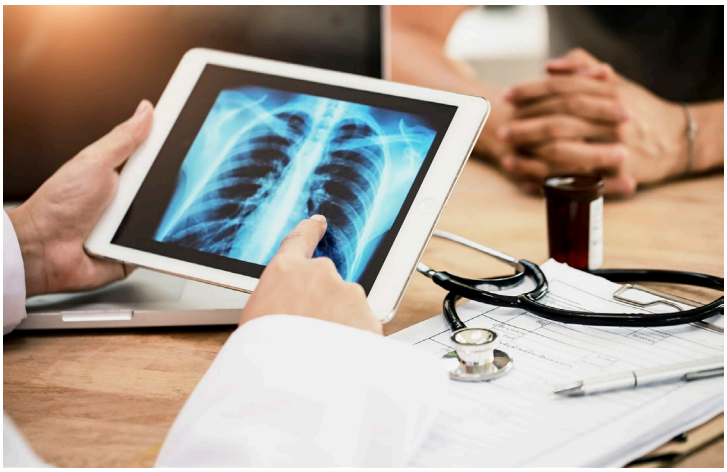
Closing the loop on actionable radiology findings

Vizient Patient Safety Organization (PSO)

Table of contents

Background 3
Assessment 4
Delays in readings or delays caused by discrepancies 5
Failure to communicate, acknowledge or act on radiology findings 6
Recommendations 7
The clinical history and indications for the procedure 7
Structured reporting to improve the consistency and quality of reports 8
Compliance with evidence- and consensus-based guidelines 8
Standardized processes for communicating results to providers and patients 8
Systems for tracking actionable findings and interventions for non-adherence 10
Conduct an organizational assessment and case for change 11
References 12
Appendix A. Expert Advisory Team 15

Background



Failure to communicate and follow-up on actionable imaging test findings can lead to missed or delayed diagnosis and treatment, adverse patient outcomes, and malpractice claims. Inadequate communication of abnormal findings to the referring provider or the patient is the third most common cause of errors in medical malpractice suits against radiologists in the U.S.[1]

In the post-analytic phase, failures in follow-up can occur due to complex processes across different providers, levels of care or healthcare facilities, and lack of integrated information systems and test management systems.[2,3] To close the loop, actionable imaging test findings and follow-up recommendations must be sent, received, acknowledged and understood by the provider. Ideally, test results and recommendations are also clearly communicated in a timely manner to the patient, who shares responsibility for completing the recommendations.[2]

Recommendations by radiologists for additional imaging are increasingly common and are present in approximately 12% of imaging test reports.[4] Actionable radiology findings may require special communication due to the urgency or unexpected nature of the findings.[5] The method of communication should be defined by the severity of the findings and urgency of treatment.[5] To ensure prompt treatment for potentially life-threatening results, The Joint Commission (TJC) requires that organizations define critical results of tests and diagnostic procedures, who should report and receive the results, and an acceptable length of time between the availability of the result and receipt of results by an individual that can act on the results. TJC also requires a review of the timeliness of the reporting process to evaluate the effectiveness of the process.[6]

So-called “incidental” findings are an important subset of actionable findings that require special communication; by definition, these are unexpected abnormalities on imaging that are unrelated to the presenting complaint. Incidental findings may or may not require immediate intervention, but rather delayed follow-up, sometimes months after the initial encounter. As such, there is greater risk of incidental findings being overlooked and going unaddressed, particularly in busy emergency departments (EDs) where urgent needs are addressed.[5,7]

Radiological recommendations are at increased risk for falling through the cracks during transitions in care from the hospital or ED to the outpatient setting, where as many as one-third to three-fourths of recommendations on imaging tests are missed, undocumented or not communicated to the primary care provider (PCP) or patient.[8-13] Challenges in communication occur when results are still pending at discharge or a discrepancy is found between the preliminary and final reading, because responsibility for the management of the findings must be handed off to the outpatient provider by the ordering provider such as the ED physician or hospitalist, who does shift work and may not be working at the time the results are available.[2,5] This situation can be further complicated if patients do not have a PCP.[7]

In comparison, from 1 to 36 percent of recommendations for outpatients are not followed up[3] or do not receive timely follow-up despite the use of alert notification systems.[14] There are a number of factors that

increase the risk of failure in follow-up of actionable findings. Duplicate communication of results to more than one provider can lead to the false assumption by each of the receiving providers that the other recipient will address the findings.[14] Other risk factors include abnormal findings that are only mentioned in the findings section of the report,[12,13] recommendations for further imaging tests that do not include the modality or interval,[15] or failure to notify the patient.[10] Yet, even when informed, patients may not comply with the follow-up recommendations. The patient may misunderstand the potential implications of the findings or their urgency, may have misperceptions about the necessity after receiving treatment in the ED,[10] or there may be language barriers or financial or transportation issues. In Pennsylvania, a new law, Act 112, the Patient Test Result Information Act, requires imaging service providers to notify patients directly of significant abnormalities, in addition to sending the report to the provider who ordered the exam.[16]

Assessment

Vizient® Patient Safety Organization (PSO) members conducted a search of event reports involving delays in communication of post-procedure imaging test results and failures in follow-up of actionable radiology findings to improve our understanding of common issues. This analysis included 243 near-miss and adverse events voluntarily reported in outpatient and hospital settings from January 2017 to August 2018. Using a Vizient proprietary taxonomy, PSO staff reviewed events that were categorized as a radiology/imaging test reporting delay, a discrepancy between the preliminary and final reading, and those found in a text search of key words (e.g., incidental, nodule, mass, or lesion) in relevant event types including radiology/imaging tests, care coordination/communication, and omissions or errors in assessment, diagnosis and monitoring. Reports where an event occurred after completion of the procedure and hand-off to the radiologist for interpretation were included in the analysis. Any reports that identified an error prior to the hand-off to the radiologist or missed radiology findings during interpretation were not included.

Figure 1 displays the issues that occurred post imaging procedure after hand-off to the radiologist or failures in follow up of results. Fifty-one percent of the events involved delays in the reading of imaging tests regardless of the urgency or delays in diagnosis and treatment caused by discrepancies between the preliminary and final readings. The remaining 49% of events involved breakdowns in the communication of results to responsible providers and failures to acknowledge or act on radiology findings. This data likely only represents a portion of reported events due to the need to text search to find these events.

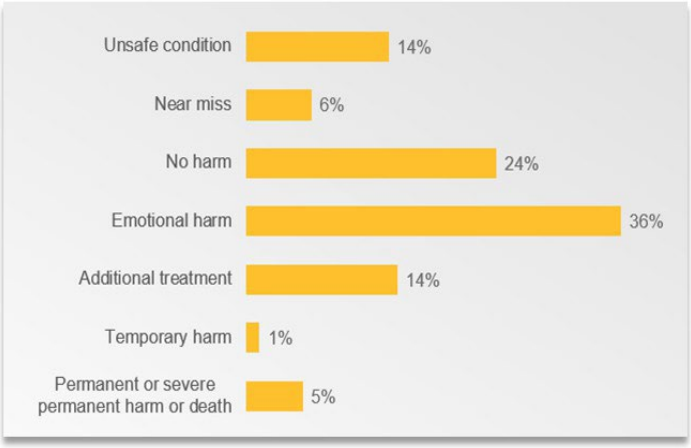
Figure 1. Post-procedure imaging issues or failures in follow-up

Data source: Vizient Patient Safety Organization | Period of data: January 2017-August 2018; Number of events = 243
Percentage total is greater than 100, because more than one issue could be identified in one event.

Of the 243 event reports in this analysis, 44% occurred or were reported in outpatient clinics, 32% in the ED, and 22% in the hospital (2% were unknown).

These reports involved failures in communication of critical, urgent or non-urgent, actionable findings. Event reports were assigned an AHRQ Common Format v.1.1 harm score as follows: 19% were unsafe conditions or near misses, 24% did not cause harm to the patient, 36% caused emotional distress to the patient, 16% required additional treatment or caused temporary harm, and 5% resulted in permanent harm or death (Figure 2).

Figure 2. AHRQ Common Format v.1.1 Harm Scores assigned to post-procedure imaging events



Data source: Vizient Patient Safety Organization
Period of data: January 2017-August 2018; Number of events=243
Abbreviation: AHRQ=Agency for Healthcare Research and Quality

Delays in readings or delays caused by discrepancies

The most common issue identified in event reports (51%, n=123) was that imaging test results including critical and stat tests were not available in an acceptable timeframe due to delays in readings by the radiologist or discrepancies discovered during the final reading. These delays in readings were reported across care settings—39% in the ED, 38% in outpatients, 21% in inpatients, and in 2% the location was unknown. Delays in imaging results in the ED and hospital caused delays in diagnosis and sometimes urgent care in patients with stroke (bypassing the window for treatment), cardiac, pulmonary, and gastrointestinal symptoms (e.g., perforated bowel) and other injuries or traumas. In outpatients, imaging test results were reported to be unavailable for days, weeks, and even up to months.

In some cases, the delays in diagnosis caused emotional distress to the patient; however, in others, the findings were urgent (e.g., ectopic pregnancy and subdural hematoma) or involved a possible malignancy, and led to adverse outcomes. The causes of delays in the reading and availability of imaging test results involved radiologists having an increased workload, not prioritizing based on urgency, or being unavailable or unreachable. Some events involved health information technology-related issues; for example, upgrades prevented images from landing on the radiologist's daily worklist, and corrupted orders prevented images from being available for interpretation because creating a new order created a financial clearance issue.

Other delays in care occurred when there were discrepancies between the preliminary and final reading. By the time the omissions or errors in preliminary readings were caught, the patient had been discharged from the ED or hospital. Consequently, in emergency situations (e.g., stroke or appendicitis), the patient had to be contacted with instructions to return to the ED or hospital for additional treatment or emergency surgery. In non-emergent situations (e.g., fractures), patients were contacted and notified about the change in findings and given instructions to follow-up with their PCP or obtain additional tests. Sometimes, the patient could not be reached by phone and a certified letter had to be sent to the patient. There were additional cases in which discrepancies were not caught until the patient sought care at another facility for their persisting symptoms, and repeat imaging tests showed findings that required urgent or emergency care.

Failure to communicate, acknowledge or act on radiology findings

Verbal communication of critical or urgent test results

In 8% of reports mainly occurring in the ED or hospital, the radiologist did not verbally communicate stat, urgent or critical test results or a change in the preliminary reading directly to the provider such as spinal cord compression, subdural hematoma, pulmonary embolism and pneumothorax. In addition to in-house radiologists, teleradiology services did not verbally communicate critical findings to the ED. In these events, urgent care was delayed until the results were discovered in the electronic health record (EHR) or until another radiologist noted the findings on further review. In some cases, failure in verbal communication led to delays in surgical intervention or the patient had to be readmitted because the patient had been discharged before the results were discovered. Fifteen percent of these events resulted in permanent harm to the patient.

Non-urgent, actionable findings

In 31% of events (n=75), the ordering or PCP did not receive written, electronic or verbal notification of clinically significant or incidental findings or discrepancies in the final interpretation. These communication breakdowns typically occurred or were reported in the outpatient setting and ED. About 40% of these events were near misses or there was no harm to the patient, because the issue was discovered and corrective actions were taken. However, in some cases, the findings went unnoticed for too long and there was an adverse outcome or significant harm to the patient.

There were various factors that contributed to failures in communication. In almost one-third of the cases, the report was sent to the wrong provider; however, the errors were caught in these cases and did not cause harm. Other breakdowns in communication occurred because the radiologist did not dictate or electronically complete, finalize or upload the report electronically or the problem was associated with computer downtime. In other EHR-related issues, the report results dropped from the receiving provider's inbox when responsibility for follow-up was not assigned to them. In other cases, the radiology findings or discrepancies went unaddressed, because they were not available until after the patient was discharged from the ED or the hospital and were not communicated to the PCP or patient. In a few cases, the ordering provider reported treatment planning decisions could not be made when the radiology report did not address their specific request and comparisons were not made.

In 5% of events, the radiology report and findings were available to the responsible provider but were overlooked. There was no documentation of provider acknowledgement of the findings or plan of care in the clinical notes, problem list or discharge summary. The provider did not notify the patient, order the recommended follow-up tests, or make a referral to the appropriate specialist. In some cases, despite subsequent outpatient or ED visits, providers continued to fail to notice the findings in the radiology report. Incidental radiology findings were missed in patients who had other pressing medical problems or were overlooked in care transitions. In another example, the report went unnoticed when the paper report was scanned into the record by clerical staff without prior clinician review.

In another 5% of cases, the radiology report was acknowledged by the provider, but not acted upon. The provider failed to notify the patient of the results, write the orders for referrals or follow-up tests, or the order was cancelled in error. When the findings and/or recommendations in the report were misinterpreted or were unclear, the provider acted in error and misinformed the patient about the results. When more than one provider received the report (e.g., ordering specialist vs. PCP), each may have assumed the other would take responsibility for managing the recommendations, so neither did.

Among these 94 reports involving failures to communicate, acknowledge or act on radiology non-urgent findings, there were 38 cases of incidental findings involving masses, lesions or nodules in the lungs, liver, kidney, spine, ovary, pancreas, etc. Of these, 24% were identified as resulting in permanent harm to the patient or death. Incidental findings and recommendations went unaddressed for months up to more than five years, resulting in significant delays in diagnosis and treatment, enlargement or spread of malignancy and metastases. Failures in

follow-up of imaging test results were discovered during subsequent care visits and on additional imaging tests for worsening of symptoms. In some cases, the patient portal was effective in preventing a delay in care. Although distressed after discovering their abnormal radiology results on the patient portal, the patient or family contacted the provider who had not received, acknowledged or acted on the results. Breakdowns in communication to the patient were reported across care settings. In a couple of cases, the patient was notified of significant findings but did not follow the recommendations.

The findings in the data emphasize the importance of system-wide policies, procedures and processes to ensure that not only critical, but non-urgent findings that could result in patient morbidity and mortality are communicated to the responsible provider and patient for timely treatment and diagnosis. Verbal communication by radiologists and additional surveillance might have prevented serious delays in care.

Recommendations

Vizient PSO, in collaboration with an expert advisory team (Appendix A), identified leading practices for closing the loop on actionable radiology findings that focus on the following phases in the process:

- The clinical history and indications for the procedure
- Structured reporting to improve the consistency and quality of reports
- Compliance with evidence- and consensus-based guidelines when follow-up recommendations are made
- Standardized processes for communicating results to providers and patients
- Systems for tracking actionable findings and interventions including unexpected and non-emergent “incidental” findings, and interventions to facilitate adherence to follow-up recommendations and guidelines

The clinical history and indications for the procedure

Radiologists often do not have adequate clinical information at the time of interpretation.[17,18] As part of standard work, ordering providers should communicate a thorough and specific clinical history including current and past medical history and the indication for the radiological procedure to improve the quality and accuracy of the radiologist’s interpretation.[19] Processes should be developed to measure providers’ compliance with this requirement, and to determine the impact of noncompliance on the quality and accuracy of radiology reports.

Organizations should leverage technology to expedite the flow and accessibility of clinical information to the radiologist during imaging interpretation and possible follow-up.[19-21] Examples are described below.

- Electronic processes with forcing functions that require the ordering provider to enter the reason for the study, the associated ICD-9 code, any pertinent medical history and the patient’s clinical signs and symptoms into the computerized order.[19]
- A picture archiving and communication system (PACS) integrated view of an automatically synthesized clinical history from the patient’s prior radiology reports, the computerized order and electronic health record using natural language processing.[20]
- To facilitate additional recommendations and aid in experiential learning, a PACS accessible EHR integrated program allows radiologists to query desired clinical follow-up information from the EHR after interpretation of imaging results using natural language processing. This integrated program searches the EHR periodically for a relevant answer to a query. When relevant data are found, the radiologist receives a link with information prioritized based on clinical relevance.[21]

Structured reporting to improve the consistency and quality of reports

To prevent findings and recommendations from getting missed or misunderstood in the report, promote consistency in guideline-based care and enable surveillance of text-based reports.

- Use report templates that ensure imaging test findings are mentioned in summary headings and recommendations for additional imaging tests or clinical correlation are clearly spelled out in the recommendations section of the report and include the modality and the interval of time to follow-up.[7,12,15,22-24]
- Create a function that forces radiologists to assign a standardized code (e.g., normal, critical, abnormal/non-urgent or incidental findings) to each report during documentation of findings. An indicator should denote the severity and priority for EHR-based result reporting and tracking.[5,22,25-27]
- Highlight discrepancies between the final and preceding reading in the finding and recommendations section of the report (e.g., bold font, shading and label the heading in the report).[2,5,22]

Compliance with evidence- and consensus-based guidelines

To improve care quality and potential cost-savings, organizations should use resources and tools to improve diagnostic accuracy and compliance with evidence- and consensus-based guidance or guidelines when follow-up recommendations are made.

- Use point-of-care reference materials and clinical decision support, preferably integrated with the PACS at the point of interpretation to improve compliance with guidelines from the American College of Radiology (ACR) or Fleischner Society Guidelines for pulmonary nodules, and promote a common language among providers.[28-34] For instance:
    - ACR Reporting and Data Systems (RADS) provide standard terminology to describe findings and categories for assessing probability of disease by imaging modality (e.g., Lung RADS) and report structure (e.g., TI-RADS reporting template) to decrease the variability in terminology and interpretation of reports.[35]
    - ACR actionable findings white paper provides guidance on standardizing communication based on urgency of findings.[5]
    - ACR white papers provide guidance on the management of incidental findings for pulmonary and liver lesions, adrenal and renal masses, pancreatic cysts, and pituitary, adnexal, mediastinal and cardiovascular, thyroid, gallbladder and biliary, splenic and nodal findings.[36-47]
- Insert evidence-based guidelines into interpretive reports to increase the likelihood of physician adherence to recommended follow-up care for patients.[28]

Standardized processes for communicating results to providers and patients

Organizations should develop standardized processes to ensure that imaging test results are communicated to the provider who is responsible for managing the patient's care and to the patient.

Communication from the radiologist to the responsible provider and between providers

- Define standard work for routine (e.g., normal findings) and non-routine actionable findings such as critical results, discrepancies between the final and a preceding interpretation, and results that may not require immediate action but could lead to an adverse outcome.[2,5,22,48]
- Develop a list of actionable radiology findings, define the appropriate process for communicating

results (e.g., verbal, electronic, fax, phone message) and the required time for the radiologist to communicate the results based on their level of urgency. For example, the ACR Actionable Reporting Workgroup developed recommendations for lists of critical results and actionable findings and timing for communication of results (e.g., within minutes, hours or days of the interpretation) that would apply to most general hospital settings and can be adapted.[5,25,26,48]

- Use natural language processing to prompt the radiologist when a diagnosis meets the criteria for critical results requiring verbal communication and documentation.[5]
- Create a function that forces radiologists to assign a standardized code with urgency to each report when finalizing the documentation of radiology findings. Align these codes to standardized processes for reporting radiology findings to providers.[5,7,22,25-27,30,49,50]
    - Standardize messaging and symbols in the EHR and email notifications that differentiate the priority of results based on assigned codes.[25]
    - Leverage technology to transmit and escalate actionable results via HIPAA compliant messages to providers via pagers, mobile devices or tablets that integrate with the EHR or other information systems to make reports more readily accessible. Functionality should allow the provider to document verification of the day and time the report was reviewed.[25,27,51] Allow providers to customize their preferred methods for transmission of notifications.[25,51]
    - During provider acknowledgement of tests results, make links available to the provider that facilitate follow-up actions and completion of required tasks such as creating a signed order for additional tests or referrals to specialists or other clinicians with the level of urgency, forwarding the information, contacting the radiologist, notifying the patient, and adding follow-up recommendations and the findings to the problem list.[25-27,50,51] Incorporate future reminders and to-do lists to prevent follow-up from falling through the cracks.[25,26,51]
- Create and communicate policies and procedures, agreed upon by stakeholders, that outline expectations, accountability and responsibility for achieving a closed-loop referral process including who is responsible for notifying the responsible provider of actionable findings and for managing the follow-up recommendations depending on the setting where the care occurred (e.g., ordering, primary care provider or specialist).[2,50] Identify surrogate providers and develop algorithms for escalating notification of results when the responsible provider is not available.[2,52] Utilize tools to update provider directories including their availability and back up coverage.[22,25]
- Evaluate vulnerabilities and make process changes to close the loop on referrals between primary care and specialist physicians and expected wait times.[50,53] Use defined key terms in the EHR that communicate the urgency and status of a referral (e.g., closed, open, completed, unresolved, or discontinued) and develop an escalation protocol for high-risk referrals.[55] Monitor referral statuses that remain open or unresolved.[50]
- For patients who received care in the ED or hospital, develop processes for informing outpatient providers about actionable imaging test findings, including pending tests. Incorporate processes for monitoring whether actionable findings were communicated to providers and patients.[7,9,30,49] For example, send coded results on non-urgent, actionable findings to a database[49] or dedicated email inbox[7] and assign non-physician staff responsibility for verifying that the communication of findings was documented or for following-up when this communication was not documented.[30,49]
- If the patient does not have a PCP, develop a plan for follow-up on results before discharge.[2,52] When results come back after discharge, contact the patient by phone or letter and provide referrals.[7,9,49]

Inform and engage the patient in follow-up care

- Define processes for communicating radiology results to the patient. Use standard, multimodal methods to inform and engage the patient in their follow-up care. Educate all patients at the time of examination not to assume their test is normal and how to actively follow-up on pending tests.[52] Address language, health literacy, transportation and financial barriers.[50]
- For hospitalized patients, develop an automated process that populates imaging recommendations into the patient's discharge instructions and review them with the patient at discharge.[49] When test results are not available at the time of discharge from the ED or hospital, provide written instructions on when the results will be available, where to call to obtain pending results and what to do after that.[25,52]
- Encourage patients to use web-based portals and apps to access medical records including radiology reports to improve safety, patient satisfaction and the patient-doctor relationship.[22,25,52,54,55]
- Determine an appropriate timeframe to release abnormal test results to the patient if results were not released by the provider. Provide an alternate method for those patients without electronic access.[25,52]
- Post-procedure, educate patients about the findings from their tests, their significance and the importance of follow-up testing. Give the patient a copy of the report or summary of findings and recommendations, orders for follow-up tests with verbal instructions, and use teach back.[7,52]
- Develop processes for tracking whether patients were notified of actionable findings and follow-up recommendations including when the patient moves across healthcare settings.[7,9,30,49]
- For patients who were not notified of results during an ED or hospital visit, develop standard processes for patient notification such as contacting the patient by phone, leaving a HIPAA compliant voice message requesting a callback or sending a certified letter depending on the urgency of the results.[7,9,49] To ensure patient contact information is current, verify a main and an extra contact number at each visit.[52]
- For cases in which the patient could not be reached about their results, develop an alert in the EHR and tracking system when the patient contacts or is treated at the facility for any reason.[49,52] Integrate patients, families and caregivers as part of the notification process when allowed by state, federal and local laws.[25]
- Promote timely care by multimodal delivery (e.g., letter, email, text message or automated phone call) of patient reminders for scheduled or unscheduled appointments or tests and results follow-up.[25,50]

Systems for tracking actionable findings and interventions for non-adherence

- Develop system-wide processes and natural language processing algorithms to track actionable findings, provider notification and acknowledgement, and patient adherence to additional imaging.[5,10,22,25,30,56]
- Track or monitor documentation to ensure the patient was notified of the findings and recommendations.
- When there is no evidence of adherence to recommendations, implement standardized interventions to determine the reason (e.g., communication failure, test completed outside the

system, or subspecialist referral or biopsy performed) and promote compliance, if applicable.[30]

- To promote compliance, monitor radiologists' rate of trackable recommendations (i.e. those that include the specific modality and due date) and processes that require the coding of actionable findings.

Conduct an organizational assessment and case for change

- Monitor physicians' compliance in relaying the clinical history and indications to the radiologist.
- Monitor radiologists' compliance with evidence-based guidelines, recommendations and organizational procedures for completing reports.
- Review a statistically significant sample of high-risk or problem-prone procedures to ensure communication and follow-up on actionable findings. Identify the frequency of actionable radiology findings, how often there was evidence that follow-up recommendations were completed and the factors contributing to delays and failures in follow-up.
- Conduct a cost-benefit analysis to create a case for organizational process change including technology solutions or additional staff for surveillance and follow-up.
    - Evaluate the costs of a patient navigator who tracks and follows up on recommendations that were not communicated or acted upon (e.g., labor costs).
    - Evaluate the costs associated with developing or purchasing electronic systems to communicate abnormal radiology findings to the provider, and programs that assist in monitoring compliance with recommendations and reminders to follow-up on recommendations.
    - Estimate the potential revenue generated from tests and appointments that are lost to follow-up.
    - Estimate potential cost savings in litigation due to delays in diagnosis and treatment. It is estimated that inadequate communication of imaging results to the referring provider results in 0.71 claim per 1,000 person-years and failed communication with the patient in 0.40 claim per 1,000 person-years.[1]
        - At the University of Rochester, the implementation of a multistage recommendation tracking system generated 4.1 times more revenue than the cost of labor for the program.[30]
- View an example of a recaptured revenue estimator online at radloop.net/calculator.

To learn more about the work organizations are doing to close the loop on actionable findings, listen to the Vizient PSO webinar Closing the loop on incidental radiology findings or review the PowerPoint presentation.

For more information, contact Tammy Williams or Ellen Flynn.

References

1. Whang JS, Baker SR, Patel R, Luk L, Castro A 3rd. The Causes of Medical Malpractice Suits against Radiologists in the United States. Radiology. 2013;266(2):548-554. Available at https://pubs.rsna.org/doi/10.1148/radiol.12111119. Accessed February 4, 2019.
2. Kwan JL, Singh H. Assigning responsibility to close the loop on radiology test results. Diagnosis (Berl). 2017;4(3):173-177. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5673267/.
3. Callen JL, Westbrook JI, Georgiou A, Li J. Failure to Follow-Up Test Results for Ambulatory Patients: A Systematic Review. J Gen Intern Med. 2012 Oct; 27(10): 1334–1348. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3445672/pdf/11606_2011_Article_1949.pdf.
4. Sistrom CL, Dreyer KJ, Dang PP, et al. Recommendations for additional imaging in radiology reports: multifactorial analysis of 5.9 million examinations. Radiology. 2009;253(2):453-461.
5. Larson PA, Berland LL, Griffith B, Kahn Jr CE, Liebscher LA. Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group. Journal of the American College of Radiology. 2014;11(6):552-558. Available at https://www.jacr.org/article/S1546-1440(13)00840-5/pdf. Accessed February 4, 2019.
6. The Joint Commission. National Patient Safety Goals Effective January 2019. Available at https://www.jointcommission.org/assets/1/6/NPSG_Chapter_HAP_Jan2019.pdf. Accessed February 28, 2019.
7. Baccei, Steven J. et al. System-level process change improves communication and follow-up for emergency department patients with incidental radiology findings. Journal of the American College of Radiology, 2017;15(4):639-647.
8. Kadom N, Doherty G, Solomon A, et al. Safety-net academic hospital experience in following up noncritical yet potentially significant radiologist recommendations. AJR American Journal of Roentgenology. 2017;209(5):982-986.
9. Jones J. Failsafe. American College of Radiology. 2017. Available at https://www.acr.org/-/media/ACR/Files/Case-Studies/Patient-Engagement/Failsafe/Imaging3_Failsafe_June2017.pdf. Accessed on November 29, 2018.
10. Dutta, Sayon et al. Automated Detection Using Natural Language Processing of Radiologists Recommendations for Additional Imaging of Incidental Findings. *Annals of Emergency Medicine*. 2013; 62(2):162 – 169.
11. Blagev DP, Lloyd JF, Conner K, et al. Follow-up of incidental pulmonary nodules and the radiology report. *Journal of the American College of Radiology*. 2014;11(4):378-383.
12. Bates R, Plooster C, Croghan I, Schroeder D, McCoy C. Incidental Pulmonary Nodules Reported on CT Abdominal Imaging: Frequency and Factors Affecting Inclusion in the Hospital Discharge Summary. *Journal of Hospital Medicine*. 2017;12(6):454-457.
13. Singh H, Hirani K, Kadiyala H, et al. Characteristics and predictors of missed opportunities in lung cancer diagnosis: an electronic health record-based study. *Journal Of Clinical Oncology: Official Journal Of The American Society Of Clinical Oncology*. 2010;28(20):3307-3315.
14. Singh H, Thomas EJ, Mani S, et al. Timely follow-up of abnormal diagnostic imaging test results in an outpatient setting: are electronic medical records achieving their potential? *Archives of Internal Medicine*. 2009;169(17):1578-1586.
15. Mabotuwana T, Hall CS, Tieder J, Gunn ML. Improving quality of follow-up imaging recommendations in radiology. AMIA Annu Symp Proc. 2018;2017:1196-1204. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5977608/.
16. Carr S. New Pennsylvania Law Requires Patient Notification for Abnormal Imaging Results. *Society to Improve Diagnosis in Medicine*. Available at https://www.improvediagnosis.org/improvedx-march-2019/new-pennsylvania-law-requires-patient-notification-for-abnormal-imaging-results/. Accessed on June 9, 2019.
17. Schneider E, Franz W, Spitznagel R, Bascom DA, Obuchowski NA. Effect of computerized physician order entry on radiologic examination order indication quality. *Archives of Internal Medicine*. 2011;171(11):1036- 1038.
18. Boonn WW, Langlotz CP. Radiologist use of and perceived need for patient data access. *Journal of Digital Imaging*. 2009;22(4):357-362.
19. Obara P, Sevenster M, Travis A, Qian Y, Westin C, Chang PJ. Evaluating the Referring Physician's Clinical History and Indication as a Means for Communicating Chronic Conditions That Are Pertinent at the Point of Radiologic Interpretation. *Journal of Digital Imaging*. 2015;28(3):272-282. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4441688/. Accessed February 28, 2019.
20. Travis A, Chang P, Qian Y, Sevenster M, Mankovich G, Buurman, J. Enhancing Provided Patient Clinical Information by Automated Review of Prior Radiology Reports Using the Clinical Context Indicator (CCI): A NLP Based Data Extraction

and Presentation PACS-integrated Tool. Radiological Society of North America 2013 Scientific Assembly and Annual Meeting, December 1 - December 6, 2013 ,Chicago IL. http://archive.rsna.org/2013/13023785.html. Accessed February 28, 2019.

21. Correlate: A PACS- and EHR-integrated Tool Leveraging Natural Language Processing to Provide Automated Clinical Follow-up. Radiographics: A Review Publication Of *The Radiological Society Of North America, Inc*. 2017;37(5):1451-1460.
22. The Office of the National Coordinator. Safer Guides: Test Results Reporting and Follow-Up. Available at https://www.healthit.gov/sites/default/files/safer_test_results_reporting.pdf. Accessed on October 28, 2018.
23. Ridge CA, Hobbs BD, Bukoye BA, et al. Incidentally detected lung nodules: clinical predictors of adherence to Fleischner Society surveillance guidelines. *Journal of Computer Assisted Tomography*. 2014;38(1):89- 95.
24. Kahn, C. E., Heilbrun, M. E., & Applegate, K. E. (2013). From guidelines to practice: how reporting templates promote the use of radiology practice guidelines. *Journal of the American College of Radiology*, 10(4), 268-273.
25. Partnership for Health IT Patient Safety. Health IT Safe Practices for Closing the Loop: Using Health IT to Mitigating Delayed, Missed, and Incorrect Diagnoses Related to Diagnostic Testing and Medication Changes Using Health IT. 2018. Available at https://www.ecri.org/Resources/HIT/Closing_Loop/Closing_the_Loop_Toolkit.pdf. Accessed on March 4, 2019.
26. Dalal AK, Pesterev BM, Eibensteiner K, Newmark LP, Samal L, Rothschild JM. Linking acknowledgement to action: closing the loop on non-urgent, clinically significant test results in the electronic health record. Journal of The American Medical Informatics Association: JAMIA. 2015;22(4):905-908. Available at https://academic.oup.com/jamia/article/22/4/905/1746218.
27. Lacson R, Prevedello LM, Andriole KP, et al. Four-year impact of an alert notification system on closed- loop communication of critical test results. *AJR American Journal of Roentgenology*. 2014;203(5):933-938. Available at https://www.ajronline.org/doi/pdf/10.2214/AJR.14.13064.
28. McDonald JS, Koo CW, White D, Hartman TE, Bender CE, Sykes A-MG. Addition of the Fleischner Society Guidelines to Chest CT Examination Interpretive Reports Improves Adherence to Recommended Follow-up Care for Incidental Pulmonary Nodules. *Academic Radiology*. 2017;24(3):337-344.
29. Zygmont ME, Shekhani H, Kerchberger JM, Johnson J-O, Hanna TN. Point-of-Care Reference Materials Increase Practice Compliance With Societal Guidelines for Incidental Findings in Emergency Imaging. *Journal of the American College of Radiology*. 2016;13(12):1494-1500.
30. Wandtke B, Gallagher S. Reducing Delay in Diagnosis: Multistage Recommendation Tracking. *AJR American Journal of Roentgenology*. 2017;209(5):970-975.
31. Lu MT, Rosman DA, Wu CC, et al. Radiologist Point-of-Care Clinical Decision Support and Adherence to Guidelines for Incidental Lung Nodules. *Journal Of The American College Of Radiology*. 2016;13(2):156- 162.
32. Berland L. How to Use the ACR Recommendations for Incidental Findings. Available at https://geiselmed.dartmouth.edu/radiology/wp-content/uploads/sites/47/2019/04/Berland_IF.pdf. Accessed on December 6, 2018.
33. Morgan MB, Branstetter BF 4th, Clark C, House J, Baker D, Harnsberger HR. Just-in-Time Radiologist Decision Support: The Importance of PACS-Integrated Workflow. *Journal of the American College of Radiology*. 2011;8(7):497-500.
34. Bueno J, Landeras L, Chung JH. Updated Fleischner Society Guidelines for Managing Incidental Pulmonary Nodules: Common Questions and Challenging Scenarios. *RadioGraphics*. 2018;38(5):1337- 1350.
35. American College of Radiology website. Reporting and Data Systems. Available at https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems. Accessed February 28, 2019.
36. Herts BR, Silverman SG, Hindman NM, et al. Management of the Incidental Renal Mass on CT: A White Paper of the ACR Incidental Findings Committee. *Journal of The American College Of Radiology*. 2018;15(2):264-273.
37. Hoang JK, Hoffman AR, González RG, et al. Management of Incidental Pituitary Findings on CT, MRI, and 18F-Fluorodeoxyglucose PET: A White Paper of the ACR Incidental Findings Committee. *Journal of the American College of Radiology*. 2018;15(7):966-972.
38. Munden RF, Carter BW, Chiles C, et al. Managing Incidental Findings on Thoracic CT: Mediastinal and Cardiovascular Findings. A White Paper of the ACR Incidental Findings Committee. *Journal of the American College of Radiology*. 2018;15(8):1087-1096.
39. Bobbin MD, Ip IK, Sahni VA, Shinagare AB, Khorasani R. Focal Cystic Pancreatic Lesion Follow-up Recommendations

After Publication of ACR White Paper on Managing Incidental Findings. J*ournal of The American College Of Radiology*. 2017;14(6):757-764.

40. Gore RM, Pickhardt PJ, Mortele KJ, et al. Management of Incidental Liver Lesions on CT: A White Paper of the ACR Incidental Findings Committee. *Journal of the American College of Radiology*. 2017;14(11):1429- 1437.
41. Mayo-Smith WW, Song JH, Boland GL, et al. Management of Incidental Adrenal Masses: A White Paper of the ACR Incidental Findings Committee. *Journal of the American College of Radiology*. 2017;14(8):1038- 1044.
42. Megibow AJ, Baker ME, Morgan DE, et al. Management of Incidental Pancreatic Cysts: A White Paper of the ACR Incidental Findings Committee. *Journal of the American College of Radiology*. 2017;14(7):911- 923.
43. Hoang JK, Langer JE, Middleton WD, et al. Managing incidental thyroid nodules detected on imaging: white paper of the ACR Incidental Thyroid Findings Committee. *Journal of the American College of Radiology*. 2015;12(2):143-150.
44. Patel MD, Ascher SM, Paspulati RM, et al. Managing incidental findings on abdominal and pelvic CT and MRI, part 1: white paper of the ACR Incidental Findings Committee II on adnexal findings. *Journal of The American College Of Radiology*. 2013;10(9):675-681.
45. Khosa F, Krinsky G, Macari M, Yucel EK, Berland LL. Managing incidental findings on abdominal and pelvic CT and MRI, Part 2: white paper of the ACR Incidental Findings Committee II on vascular findings. *Journal of The American College Of Radiology*. 2013;10(10):789-794.
46. Heller MT, Harisinghani M, Neitlich JD, Yeghiayan P, Berland LL. Managing incidental findings on abdominal and pelvic CT and MRI, part 3: white paper of the ACR Incidental Findings Committee II on splenic and nodal findings. *Journal of The American College Of Radiology*. 2013;10(11):833-839.
47. Sebastian S, Araujo C, Neitlich JD, Berland LL. Managing incidental findings on abdominal and pelvic CT and MRI, Part 4: white paper of the ACR Incidental Findings Committee II on gallbladder and biliary findings. *Journal of The American College Of Radiology*. 2013;10(12):953-956.
48. American College of Radiology. ACR practice parameter for communication of diagnostic imaging findings. Available at https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en. Accessed February 28, 2019.
49. Dibble E, Swenson D, Cobb C, et al. The RADCAT-3 system for closing the loop on important non-urgent radiology findings: a multidisciplinary system-wide approach. *Emergency Radiology*. 2017;24(2):119-125.
50. Institute for Healthcare Improvement / National Patient Safety Foundation. Closing the Loop: A Guide to Safer Ambulatory Referrals in the EHR Era. Available at http://www.ihi.org/resources/Pages/Publications/Closing-the-Loop-A-Guide-to-Safer-Ambulatory- Referrals.aspx. Accessed on June 9, 2019.
51. Sloan CE, Chadalavada SC, Cook TS, Langlotz CP, Schnall MD, Zafar HM. Assessment of follow-up completeness and notification preferences for imaging findings of possible cancer: what happens after radiologists submit their reports? Academic Radiology. 2014;21(12):1579-1586.
52. Shapiro D. Delay in Treatment: Failure to Contact Patient Leads to Significant Complications. Available at https://psnet.ahrq.gov/web-mm/delay-treatment-failure-contact-patient-leads-significant-complications. Accessed on October 28, 2018.
53. PCPI and the Wright Center for Graduate Medical Education. Closing the Referral Loop: A tool kit to improve the referral management process between primary care and specialist physicians. Available at https://cdn.ymaws.com/www.thepcpi.org/resource/resmgr/Final-CRL-Toolkit-6-19-17.pdf. Accessed on June 9, 2019.
54. Bell SK, Mejilla R, Anselmo M, et al. When doctors share visit notes with patients: a study of patient and doctor perceptions of documentation errors, safety opportunities and the patient-doctor relationship. *BMJ Quality & Safety*. 2017;26(4):262-270.
55. Lee CI, Langlotz CP, Elmore JG. Implications of Direct Patient Online Access to Radiology Reports Through Patient Web Portals. *Journal of the American College of Radiology*. 2016;13(12):1608-1614.
56. Dang PA, Kalra MK, Blake MA, et al. Natural language processing using online analytic processing for assessing recommendations in radiology reports. Journal of the American College of Radiology. 2008;5(3):197-204.

Appendix A. Expert Advisory Team

Vizient PSO developed leading practice recommendations with an expert advisory committee, and is grateful for their contributions to this work.

Mary Allmeyer, MSN, CPPS, RN
Patient Safety/Quality Improvement Manager
Barnes-Jewish Hospital

Philip Amatulle, MD Executive Vice President Hudson Valley Radiologists

Lincoln L. Berland, MD, FACR
Chair, ACR Body Imaging Commission, Professor Emeritus, Department of Radiology
University of Alabama at Birmingham

Howard Blumstein, MD, FAAEM
Professor Emergency Medicine, Hospital Risk Officer
Wake Forest Baptist Medical Center

Lance Borup, MD
Medical Director, Radiology Department
Mercy Health

Michael A. Bruno, MS, MD, FACR
Professor of Radiology & Medicine, Vice Chair for Quality & Patient Safety; Chief, Division of Emergency Radiology, Department of Radiology,
Penn State Milton S. Hershey Medical Center

Lila Camara
Quality and Safety Coordinator
Rhode Island Hospital

Cynthia Cobb
Director of Imaging Operations
Rhode Island Hospital

Jane E. Domingo, MBA, MS, CCC-SLP
Performance Improvement Leader III, Performance Division
Northwestern Memorial HealthCare

Ellen Flynn, MBA, RN, JD, CPPS
Associate Vice President, Patient Safety
Vizient, Inc.

Richard Friedland, MD
President
Hudson Valley Radiologists

Mark Graber, MD, FACP
Founder and President, Society to improve diagnosis in medicine, Professor Emeritus,
SUNY Stony Brook

Andrea Hogsten MSN, RN, CNL
Manager, Patient Safety WellStar
Kennestone Hospital

Dea Hughes, MPH
Program Director, Patient Safety
Northwestern Medicine

Jill E. Jacobs, MD, MS-HQSM, FACR, FAHA
Professor of Radiology
Director of Safety, Department of Radiology Section Chief, Cardiac Imaging
New York University School of Medicine

Nadja Kadom, MD
Director of Pediatric Neuroradiology, Director of Pediatric Neuroimaging Research, Divisions of Neuroradiology and Pediatric Radiology, Associate Professor
Emory Healthcare

Michael Kanter, MD
Executive Vice President, Regional Medical Director, Quality & Clinical Analysis, Quality & Care Delivery Excellence
Kaiser Permanente

Neville Irani, MD
Vice Chair of Quality & Imaging Informatics
Department of Radiology
The University of Kansas Health System

Jason N. Itri, MD, PhD
Vice Chair of Quality and Patient Safety Associate Professor, Department of Radiology
Wake Forest Baptist Medical Center

Andrea Kuthe, RN, BSN, BSPH, CPPS Patient Safety/Quality Improvement Specialist
Barnes Jewish Hospital

Timothy Mosher, MD, MS
Kenneth L. Miller Chair and Distinguished Professor, Department of Radiology; Distinguished Professor, Department of Orthopaedics and Rehabilitation; Distinguished Professor, Department of Pediatrics
Penn State Milton S. Hershey Medical Center

James Nepute, MD
Radiology
Mercy Health

Stacy O'Connor, MD, MPH, MMSc, CIIP
Medical Director of IT Operations, Assistant Professor of Radiology and Surgery, Section of Abdominal Imaging Division of Diagnostic Radiology
Froedtert Hospital & Medical College Physicians

Lee Park, MD
Ambulatory Quality Medical Director
Partners Healthcare System

Rita Pedro, BSN, RN
Quality Improvement Coordinator
Department of Emergency Medicine
Rhode Island Hospital

Kevin Smith, MD
Assistant Professor of Clinical Radiology,
Associate Vice Chair of Clinical Operations,
Department of Radiology and Imaging Sciences
IU Health

Denise Snuttjer, MBA
Radiology Director
UC Denver

Ben Wandtke, MD
President of Medical Staff, FF Thompson Health, Chief of Diagnostic Imaging, FF Thompson Hospital, Associate Professor, Department of Imaging Sciences
University of Rochester Medical Center

Gail Willmann
Patent Safety/Quality Improvement Specialist
Barnes Jewish Hospital

Kimberly Zohner
Quality Manager
Barnes Jewish Hospital

Gianna Zuccotti, MD, MPH
VP Digital Health Transformation
Chief Medical Information Officer
Partners Healthcare

vizient®

Vizient, Inc.
290 E. John Carpenter Freeway
Irving, TX 75062-5146
(800) 842-5146

Vizient, Inc. provides solutions and services that improve the delivery of high-value care by aligning cost, quality and market performance for more than half of the nation's healthcare providers. Vizient provides expertise, analytics, advisory services, and a contract portfolio representing more than $130 billion in annual member purchasing volume, to improve patient outcomes and lower costs. www.vizientinc.com.