The Journal of Emergency Medicine, Vol. 65, No. 6, pp. e568–e579, 2023

0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2023.08.001

Administration of Emergency Medicine

The Value of Using a Quality Assurance Follow-Up Team to Address Incidental Findings After Emergency Department or Urgent Care Discharge: A Cost Analysis

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□ **Abstract—Background: Incidental finding (IF) follow-up is of critical importance for patient safety and is a source of malpractice risk. Laboratory, imaging, or other types of IFs are often uncovered incidentally and are missed, not addressed, or only result after hospital discharge. Despite a growing IF notification literature, a need remains to study cost-effective non–electronic health record (EHR)–specific solutions that can be used across different types of IFs and EHRs. Objective: The objective of this study was to evaluate the utility and cost-effectiveness of an EHR-independent emergency medicine–based quality assurance (QA) follow-up program in which an experienced nurse reviewed laboratory and imaging studies and ensured appropriate follow-up of results. Methods: A QA nurse reviewed preceding-day abnormal studies from a tertiary care hospital, a community hospital, and an urgent care center. Laboratory values outside preset parameters or radiology over-reads resulting in clinically actionable changes triggered contact with an on-call emergency physician to determine an appropriate intervention and its implementation. Results: Of 104,125 visits with 1,351,212 laboratory studies and 95,000 imaging studies, 6530 visits had IFs, including 2659 laboratory and 4004 imaging results. The most common intervention was contacting a primary care physician (5783 cases [88.6%]). Twenty-one cases resulted in a patient returning to the ED, at an average cost of $28,000 per potential life-/limb-saving intervention. Conclusions: Although abnormalities in laboratory results and imaging are often incidental to patient care, a dedicated emergency department QA follow-up program resulted in the identification and communication of numerous laboratory and imaging abnormalities and may result in changes to patients' subsequent clinical course, potentially increasing patient safety. © 2023 Elsevier Inc. All rights reserved.**

□ **Keywords—patient safety; risk management; malpractice claims; incidental findings; abnormalities; cost-effectiveness; imaging results; laboratory results**

Introduction

Communication with primary care providers (PCPs) after an acute care visit and lack of clear physician ownership are common sources of error and litigation (1–4). Laboratory tests and radiographic studies are often ordered in acute care settings, such as the emergency department (ED) or urgent care centers (UCC), and results may not return until after a patient has been discharged. Urine and wound cultures and sexually transmitted infection (STI) testing, for example, commonly take 24–48 h to result.

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Received: 18 January 2023; Final submission received: 6 July 2023;
Accepted: 10 August 2023

Even if results could be available on the day of discharge, it may be impractical to wait for all of the studies to return when the patient is deemed safe for discharge. In these cases, there is neither an opportunity to discuss results with the patient nor to include them in a discharge summary shared with them and their PCP. In other cases, results may be available predischarge but they do not relate to the patient's presenting symptom. However, these results may contain important incidental findings (IFs) and recommendations for follow-up care, with varying acuity and urgency (e.g., a pulmonary nodule on a chest x-ray study, an aneurysm on computed tomography [CT], or an asymptomatic anemia).

Compounding the need for follow-up, emergency radiology is faced with rapidly growing imaging volumes, with advanced imaging dramatically increasing the likelihood of finding abnormalities from 7.4% to as high as 53% (2,5–16). Although these findings vary in clinical significance, there is potential for IFs to represent life-threatening disease, such as malignancy (2,17). Nevertheless, these incidental radiologic abnormalities are frequently not addressed when in the ED or after discharge (6,7,14,18).

A variety of systems have been suggested to improve follow-up, yet we are unaware of studies describing how many hospitals or hospital systems have a formal system to ensure ED follow-up.

Many institutions rely on physicians or registered nurses when working clinical shifts to follow-up on results of late-returning studies (1,19–21). This includes follow-up of cultures and final reads of radiographs; follow-up of electrocardiograms (ECGs), radiology over-reads, culture results; and follow-up of incidental radiology findings (21–23). Others have used nurse practitioners and physician assistants to follow up culture results and IFs (3,9,18,20,24,25). Finally, others have leveraged radiology administrative staff to contact patients directly and schedule post-discharge follow-up imaging appointments (26).

Technological solutions include an electronic log system and e-mail notifications for tests pending at discharge or IFs on CT (8,19,27,28). Attempts at improving compliance by means of standardization include a discharge summary template for tests pending at discharge, radiology report template for IFs, and mailing a notification of IFs to patient and PCP (12,23,28,29). Notably, electronic health records (EHRs) are a promising approach to facilitate follow-up of abnormal results, but research has shown that EHRs alone are insufficient to improve care quality and may even be counterproductive due to a high volume of alerts and notifications to physicians (30–36).

Despite prior interventions, previous studies have found the percentage of abnormal tests not followed up on at discharge ranged from 1% to 75% (19,37).

In the early 2000s, aware of these inherent limitations of our fragmented health system and how it struggles to tackle the emergence of ED IFs, we instituted an emergency medicine (EM) quality assurance (QA) follow-up program. This program is nursing-led in conjunction with an on-call senior emergency physician and is tasked with reviewing all laboratory and radiology reports for any abnormalities requiring follow-up within or beyond our institution, an urban tertiary care teaching hospital.

We set out to follow up on all laboratory and imaging tests of any ED and UCC patient registered on the previous day who was discharged or still in the ED. Our QA team would not only address abnormalities among patients with in-network PCPs, but also among patients with out-of-network PCPs or without a PCP. Faced with constrained information technology budgets and a plethora of different EHRs within our own health network, we purposefully decided that our QA team would remain EHR-independent. This allowed for our QA team's purview to grow over time and to include a suburban community hospital, as well as a UCC. Communication to patients and PCPs is performed independent of the EHR. Finally, our HER-independence and clinical model enables us to support sustained continuity of care in partnership with PCPs, which has been found to decrease hospitalizations, ED use, and unnecessary IF downstream testing, and to improve receipt of preventative services (38–40).

The objective of this study was to evaluate the utility and cost-effectiveness of an EHR-independent EM-based QA program in which a dedicated, experienced nurse reviews laboratory and imaging studies to ensure appropriate follow-up for abnormal results.

Materials and Methods

Study Design

This was an observational study of a QA follow-up program from August 1, 2018, through September 30, 2019. Three clinical sites were included in the study, with approximately 90,000 visits. The primary clinical site was an urban tertiary care teaching hospital with an annual ED volume of 55,000 visits, where all laboratory and imaging results were reviewed by the QA team. A more limited subset of data comprising radiology over-reads and IFs and late-returning laboratory results, such as culture data, was processed for two affiliated clinical sites, a suburban community hospital with annual ED volume of 16,750 visits and a UCC with an annual volume of 17,500 visits. This study was part of an Institutional Review Board–exempted quality improvement project.

The QA follow-up team comprises two full-time nurses who each work 3 days per week, with per-diem

coverage for the seventh day, for between 8 and 12 h of staffing per day. All follow-up nurses are experienced current or former ED clinical nurses. In addition, the QA nurses are supported by an administrator who works 32 h/week. Funds for the QA follow-up staff are paid by the hospital system and the administration and oversight of the QA follow-up system are supported by the ED. The QA team includes an on-call physician who is a rotating senior EM attending physician who acts as administrator on call for a variety of departmental functions, including any time-sensitive function outside of clinical care in the ED. These physicians include the department chair, vice chairs, and other senior-level departmental leadership.

Data Review Protocol

Each day the QA nurse reviews all laboratory values for abnormalities and all updates to radiology imaging from the preceding day for patients who have been discharged from the ED to home or a medical rehabilitation facility. Pending culture data are reviewed daily as well. Preset parameters are used to determine necessary follow-up for laboratory abnormalities (Table 1).

Radiology studies are reviewed for all findings for which a follow-up study is recommended by the radiologist (e.g., a repeat radiograph recommended to ensure resolution of a pulmonary consolidation). In addition, when a clinically significant finding is noted on the final radiology report that was not noted on the wet read (i.e., preliminary read to evaluate for acute pathology), the attending radiologist contacts the QA nurses and recommends the appropriate intervention, whether that is contacting the patient, calling the patient back to the ED, or communicating the finding to the PCP.

Prior records are reviewed to determine whether an abnormality is a new finding. The ED and UCC visit notes are reviewed to see whether the abnormality was addressed and what arrangements were made to address it. If intervention is required, the default action is to contact the patient's PCP by e-mailing or faxing them the identified abnormality. Importantly, the QA team aggregates IFs pertaining to the same patient, rather than notifying the PCP piecemeal, thereby reducing alert fatigue. Finally, patients are contacted directly if the PCP is unknown or indicates the patient is not part of their panel or the finding requires the patient to take an immediate or critical action.

Clinical judgment is often used to guide notification for other IFs and, when presented with ambiguous situations, the on-call emergency physician is queried, thereby offering another opportunity to reduce unnecessary PCP notifications. Conversely, they may press for communication with PCPs or patients due to the high acuity of an IF or final-read finding. If the patient is contacted, further history may be gathered (e.g., to elicit whether the patient has symptoms consistent with a radiographic suggestion of pneumonia). The patient may be called back to the ED for further evaluation or prescribed medication; at times no further action will need to be taken.

For QA team documentation, a note is placed in the EHR where the visit took place documenting the action taken by the QA nurse or the recommendation from the radiologist or on-call emergency physician. In addition, the QA nurse keeps an electronic log of all patient care communications made. Finally, the state department of health is notified of any reportable conditions.

Data Collection and Processing

Data were drawn from the QA follow-up team logs, which recorded the date, test abnormality, and intervention taken. Focused chart reviews were performed on patients who were called back to the ED. Follow-up actions were summarized for all visits. Author consensus was used to determine potentially life- or limb-saving interventions among patients called back to the ED. Lastly, we looked at cost of this follow-up initiative compared with alternatives commonly used in other health care systems. The total program cost was divided among potentially life- or limb-saving interventions to determine the cost per critical intervention.

Results

During the study period, the ED QA follow-up team reviewed 1,351,212 laboratory studies at the primary clinical site and approximately 95,000 imaging studies across all three clinical sites, which resulted in 6530 patient visits with IFs. A total of 6588 patient or PCP contacts were undertaken during the study period. The most common action taken was contacting a patient's PCP (5783 cases). An on-call emergency physician was consulted 741 times and a medication was prescribed 613 times. In select situations, an action other than contacting a patient or a PCP was undertaken. These include contacting a facility or rehabilitation center, sending a certified letter when unable to reach the patient, and contacting the department of public health for reportable conditions (typically STIs). These actions were indicated as "other" (Table 2).

Although the QA follow-up system exists primarily for patients discharged from the ED, in instances when the QA team was made aware of a critical result in an inpatient this was communicated to the inpatient team. This occurred based on the results of urine cultures, blood cultures, peritoneal culture, varicella zoster virus serology, and radiologic findings, including fracture, dislocation, pleural effusions, hardware malalignment, and pulmonary consolidation (2,5,7).

Table 1. List of Follow-Up Protocol Reporting Parameters

Variable	Parameters Warranting Follow-Up
Laboratory tests	
White blood cell count	< 3 or $> 25 \times 10^9$/L
Hematocrit	10% decrease from prior value
Platelet count	< 50 or $> 600 \times 10^9$/L
International normalized ratio	Outside of therapeutic range (per chart review)
Glucose, mg/dL	< 50 or > 150
Lipase, IU/L	> 180 or greater than prior value
Total bilirubin, mg/dL	> 1.5 or greater than prior value
Lactate dehydrogenase, alkaline phosphatase, and raised aspartate aminotransferase, alanine aminotransferase	50% higher than upper limit of normal or 50% increase from prior value
N-terminal prohormone of brain natriuretic peptide, pg/mL	> 750
Thyroid-stimulating hormone, $\mu IU/mL$	$< .27$ or > 4.42
Potassium, mEq/L	< 3.4 or > 5.4
d-Dimer	If greater than age adjusted cutoff (> 500 ng/mL **fibrinogen-equivalent units** if aged ≤ 50 years or age multiplied by 10 in patients aged >50 years), only if no computed tomography angiography is ordered
Erythrocyte sedimentation rate, mm/h	> 50
Alkaline phosphatase	No follow-up
Urine/serum toxicology	No follow-up
Urine microscopy	No follow-up
Troponin	Elevated from prior values
Creatinine	Elevated from prior values
All other laboratory results	Value outside of reference range
Cultures	
Wound, cerebrospinal fluid, blood, urine, throat, genitourinary, stool	Any positive culture
Imaging	
Examples of communicated findings: urolithiasis, pneumonia, fractures, sinusitis, pulmonary vascular congestion, foreign body, small bowel obstruction, diverticulosis, diverticulitis, cholecystitis, appendicitis, epididymitis, osteomyelitis, granulomas, hemangiomas, pulmonary opacities or nodules, new or large pleural effusions, elbow effusions, spondylolisthesis, adenomas, mesenteric adenitis, fibroids, ovarian cysts, ovarian or testicular torsion	—

Of the 6530 visits with IFs, 2659 (40.7%) involved laboratory test results and 4004 (61.3%) were related to imaging study results (Table 3). Categorization of laboratory testing is detailed in the Appendix. Medications were prescribed most commonly on the basis of culture data (432 cases) and imaging findings (122 cases).

Table 2. Interventions Taken by Quality Assurance Nurses

Action Taken	No. of Visits	%
Primary care physician contacted	5783	88.6
Medical doctor consult	741	11.3
Called patient	805	12.3
Called pharmacy	613	9.4
Contacted inpatient team	21	0.3
Patient return to emergency department	21	0.3
Other	10	0.2

Table 3. Interventions Taken for Laboratory Tests and Imaging Studies

Test	Visits With a Follow-Up Action, n (%)	Visits Where PCP Was Contacted, n (%)	Visits Where MD Was Consulted, n (%)	Visits Where Patient Was Called, n (%)	Visits Where Medication Was Prescribed, n (%)
Any laboratory test	2659 (40.7)	2116 (79.6)	562 (21.1)	593 (22.3)	496 (18.7)
Chemistries	918 (14.1)	867 (94.4)	55 (6.0)	54 (5.9)	35 (3.8)
Culture	614 (9.4)	172 (28.0)	467 (76.1)	477 (77.7)	432 (70.4)
Complete blood count	614 (9.4)	608 (99.0)	8 (1.3)	8 (1.3)	3 (0.5)
Hemoglobin A1c	183 (2.8)	177 (96.7)	4 (2.2)	6 (3.3)	3 (1.6)
Liver function tests	157 (2.4)	155 (98.7)	4 (2.5)	3 (1.9)	7 (1.9)
Other laboratory	99 (1.5)	86 (86.9)	10 (10.1)	15 (15.2)	3 (7.1)
Coagulation studies	69 (1.1)	61 (88.4)	2 (2.9)	10 (14.5)	0 (0.0)
NT-proBNP	46 (0.7)	46 (100.0)	0 (0.0)	1 (2.2)	0 (0.0)
Thyroid-stimulating hormone	44 (0.7)	44 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Inflammatory markers	37 (0.6)	36 (97.3)	1 (2.7)	1 (2.7)	1 (2.7)
Sexually transmitted infection	34 (0.5)	14 (41.2)	18 (52.9)	24 (70.6)	16 (47.1)
Any radiology study	4004 (61.3)	3801 (94.9)	190 (4.7)	217 (5.4)	122 (3.0)
Computed tomography	2226 (34.1)	2153 (96.7)	61 (2.7)	69 (3.1)	43 (1.9)
X-ray study	1085 (16.6)	979 (90.2)	115 (10.6)	122 (11.2)	70 (6.5)
Ultrasound	603 (9.2)	586 (97.2)	8 (1.3)	18 (3.0)	5 (0.8)
Magnetic resonance	100 (1.5)	93 (93.0)	7 (7.0)	8 (8.0)	4 (4.0)

MD = medical doctor; NT-proBNP = N-terminal prohormone of brain natriuretic peptide; PCP = primary care provider.

For laboratory tests, follow-up was most common for chemistry panels (n = 918), blood counts (n = 614), and cultures (n = 614). Follow-up for imaging studies was most often related to CT (n = 2226), followed by x-ray study (n = 1,085) and, less commonly, ultrasound (n = 603) and magnetic resonance imaging (n = 100).

Senior emergency physician consultations were used most frequently for culture data (n = 467), abnormal x-ray studies (n = 115), and abnormal CTs (n = 61), followed by chemistry panel abnormalities (n = 54) and STI testing (n = 18). Although the most common action taken overall was contacting the PCP, the action taken for culture results was more commonly a call to the patient (78%), then physician consult (76%) and prescription of medication (70%).

Table 4 outlines the 21 cases that resulted in a patient being called back to the ED. Eight of these instances were due to an imaging study, 12 were due to laboratory study abnormalities, and 1 was based on an ECG. Among these patients, 7 were ultimately discharged, 10 were admitted, and 4 declined to re-present to the ED.

Notable findings included over-reads of CT angiography of the head and neck, which showed an arteriovenous fistula, a basilar thrombus, an middle cerebral artery aneurysm, and a carotid dissection. Additional imaging over-reads included an ankle x-ray over-read showing

Table 4. Outcomes for Patients Called Back to the Emergency Department

Case No.	Test	Narrative	Outcome	Hospital/Outpatient Course
1	Laboratory	*Clostridioides difficile* resulted positive, called back to ED, declined, prescribed PO antibiotics and told to follow-up with PCP.	Declined	—
2	Laboratory	Elevated d-dimer not addressed during ED visit, called back to ED. CTA negative for pulmonary embolism.	Discharged	—
3	Laboratory	Contacted after positive blood cultures that were drawn prior to lithotripsy. Called back to ED.	Admitted	Started on IV antibiotics. Hospitalized for 4 days and discharged with 14-d treatment for bacteremia.
4	Laboratory	Urine culture resulted resistant to antibiotics. Not tolerating PO. Called back to ED.	Admitted	Treated for resistant urinary tract infection with IV antibiotics for 1 wk.
5	Laboratory	Elevated hemolyzed potassium was not re-checked. Called back to ED, potassium was normal on recheck.	Discharged	—
6	Imaging	CTA head and neck initially read as normal and patient discharged. Over-read with possible dural AV fistula. Neurosurgery consulted with plan for outpatient angiography.	Discharged	—
7	Laboratory	Urine culture resulted with antibiotic-resistant organism. Called back for IV antibiotics, urinary catheter exchange, admitted to urology.	Admitted	Admitted for 4 d and discharged with midline and outpatient IV antibiotics.
8	Imaging	CTA head and neck initially read as normal and patient discharged. Called back with over-read showing basilar artery thrombus. However, this over-read was then found to be posted in error. No new symptoms uncovered and was discharged.	Discharged	—
9	Imaging	CTA head and neck initially read as normal and patient discharged. CTA over-read with middle cerebral artery aneurysm, called back, plan for outpatient CTA.	Discharged	Outpatient CTA most consistent with artifact.
10	Imaging	Ankle x-ray study initially read as negative. Over-read demonstrated calcaneus fracture. CT showed calcaneus fracture with articular extension. Orthopedics consulted, advised outpatient follow-up.	Discharged	Followed up outpatient, healed well with casting and nonoperative management.

(*continued on next page*)

Table 4. (*continued*)

Case No.	Test	Narrative	Outcome	Hospital/Outpatient Course
11	Laboratory	Blood cultures resulted with GPC and patient was called back to the ED. Patient did not re-present for evaluation.	Declined	—
12	Imaging	CT chest initially read with rib fractures, over-read demonstrated pneumothorax. Referred to tertiary care center for trauma evaluation.	Admitted	Pneumothorax larger on re-presentation and tube thoracostomy performed. Admitted for 2 d with improvement in pneumothorax and removal of catheter.
13	Laboratory	Arthrocentesis performed for knee effusion. Joint cultures were sent and returned positive for GPC.	Discharged	On re-evaluation knee pain was significantly improved. Orthopedics consulted; felt to be a contaminant. Discharged with PO antibiotics and outpatient orthopedics follow-up.
14	Laboratory	Presented with weakness and chills. Found to have urinary tract infection. Discharged with PO antibiotics. Called back with blood cultures that grew Gram-negative rods.	Admitted	Admitted to ED observation unit for antibiotics for pyelonephritis. Symptomatically improved and discharged the next day.
15	Imaging	Over-read of chest x-ray study with concern for loculated effusion.	Admitted	Admitted for 6 d. CT chest suggestive of malignancy. CT abdomen pelvis with widespread blastic skeletal disease. Thoracentesis performed. Lymph node biopsy performed.
16	Laboratory	Called back for GPCs in blood culture. MRI obtained, which showed discitis/osteomyelitis. Transferred to tertiary care center.	Admitted	Spine surgery consulted, advised conservative management. Admitted to ICU. Improvement in symptoms on IV antibiotics. Discharged with PICC and IV antibiotics.
17	Laboratory	Patient who presented with flank pain was signed over to oncoming attending awaiting a CT, laboratory testing, and urinalysis. CT showed kidney stones. Discharged by oncoming team without a urinalysis. Primary attending had patient called back for urinalysis. Patient declined, as he was feeling better.	Declined	—

(*continued on next page*)

Table 4. (*continued*)

Case No.	Test	Narrative	Outcome	Hospital/Outpatient Course
18	Imaging	MRI spine initially read as paracentral disc protrusion but with no cord signal abnormality. Over-read with cord signal abnormality.	Admitted	Spine surgery re-consulted, and taken to OR for microdiscectomy. Admitted for 3 d. Lower extremity weakness improved.
19	Laboratory	Stool cultures returned growing *Salmonella*. Patient discharged on appropriate antibiotics and was improving and declined re-evaluation.	Declined	—
20	Imaging	CTA head and neck showed a stable aneurysm. Over-read demonstrated carotid dissection. Neurology consulted; admitted to neurology service.	Admitted	Review of imaging showed carotid web vs. post-surgical change. Discharged the next day.
21	ECG	ECG obtained, not remarked on by ED attending. Over-read by cardiology as high-degree atrioventricular block.	Admitted	Admitted to cardiology, pacemaker placed, no complications, discharged next the day.

AV = arteriovenous; CT = computed tomography; CTA = computed tomography angiography; ECG = electrocardiogram; ED = emergency department; GPC = Gram-positive cocci; ICU = intensive care unit; MRI = magnetic resonance imaging; OR = operating room; PCP = primary care physician; PICC = peripherally inserted central catheter; PO = per os.

a calcaneus fracture, a CT chest over-read showing a pneumothorax, a chest x-ray over-read showing a loculated pleural effusion, and magnetic resonance spine over-read showing canal narrowing and associated cord signal abnormality. Laboratory abnormalities included positive stool, urine, and blood cultures. Another patient was called back when a cardiologist over-read an ECG as showing a high-degree atrioventricular block. In this instance, the on-call physician was contacted by the cardiologist regarding the ECG finding and the QA nurse intervened to facilitate calling the patient back to the ED.

Since institution of this follow-up program, our QA department has become aware of a miss rate of abnormalities among follow-up studies that were not appropriately addressed by the QA follow-up program that averages less than 1 per year. These missed cases were due to either data reporting malfunction, such as the institution of new laboratory results reporting system without including the follow-up team in the process, or human error. These missed cases were uncovered on QA reviews of ED returns or outside physician and patient complaints.

We found the average pay rate for the QA nurses to be $55.65 per hour with a total of 80 hours of staffing coverage weekly, totaling $231,504 per year. The cost of the QA follow-up administrator, at a rate of $27.60 per hour and a 32-hour work week, totaled $45,926 per year. No additional funding is allocated for the on-call physician; their QA duties are included in their pre-existing function as on-call administrator, for which the ED affords them a stipend. With a total annual staffing cost of $277,430, the ED QA system identified 6530 abnormalities at a cost of $42.48 per visit with an abnormality or abnormalities. For the 21 patients called back to the ED, there was an average cost of $13,211 per patient. Of the 21 patients called back, 9 were admitted for a potentially life- or limb-saving intervention (cases 3, 4, 7, 12, 14, 15, 16, 18, and 21). One additional patient had a life-threatening etiology identified, for which the patient declined to re-present to the ED (case 11). This resulted in an annual program cost of $27,743 per potentially life- or limb-saving intervention. Table 5 compares the cost of this system with commonly used alternative follow-up systems.

Discussion

In this study, we described what we believe to be a unique comprehensive EHR-independent QA system that addresses late-returning laboratory results, incidental radiologic findings, and radiology over-reads. Thousands of patient contacts were made and multiple high-risk

Table 5. Savings of Dedicated Quality Assurance Nurse Model vs. Common Alternatives

Variable	Dedicated QA Nurses (Current Scenario)	Charge Nurses Scenario*	ED Attending Scenario
Nurse wage, $/h	55.65	65	210
No. of h/wk	80	80	80
No. of wk/year	52	52	52
Annual wages, $	231,504.00	270,400.00	873,600.00
QA oversight ED attending wage	Covered as on-call administrator wages	Covered as on-call administrator wages	No need
QA administrator wage, $/h	27.60	27.60	27.60
No. of h/wk	32	32	32
No. of wk/year	52	52	52
Annual wages, $	45,926.40	45,926.40	45,926.40
Total annual wages, $	277,430.40	316,326.40	919,526.40
Abnormalities, n	6530	6530	6530
Call-back patients, n	21	21	21
Admitted patients, n	10	10	10
Cost per abnormality, $	42.49	48.44	140.82
Cost per call back, $	13,210.97	15,063.16	43,786.97
Cost per potentially lifesaving intervention, $	27,743.04	31,632.64	91,952.64

ED = emergency department; QA = quality assurance.

* Human Resources, personal communication, September 22, 2021.

conditions were identified and appropriately triaged. We believe this system improves outpatient follow-up and coordination of care regarding abnormalities identified during a patient's ED stay. Furthermore, our data offer an understanding of the likelihood of requiring emergency physician consultation, as well as the appropriate staffing level and cost to establish a QA team capable of covering multiple sites.

This QA follow-up system has several compelling features. Although other follow-up systems have been characterized, the combination of follow-up of radiology over-reads, incidental radiologic findings, and incidental laboratory abnormalities across a variety of clinical sites in one centralized communication system has not been described in the literature. Given the importance of appropriate follow-up of all of the above abnormalities, it is logical and efficient to have a unified means of communicating these findings to patients and PCPs and leaving documentation in the electronic medical record. We find it sensible to have a senior emergency physician who is not clinically working at the time to be available for oversight, and we made use of the established department administrator on call to satisfy this function. We also rely on fixed follow-up protocols, as well as the judgment of experienced clinical nurses, to interpret abnormal laboratory values in context. We believe there are many institutions that may benefit from instituting a similar program. Such a program should be generalizable across a variety of clinical environments, including academic and community hospitals, as well as UCCs and other clinical care locations. Support on the institutional level for a QA follow-up system is necessary, recognizing the large proportion of health care that is delivered or initiated in the ED that warrants ongoing outpatient care.

Furthermore, we found that a nurse-led QA system has the potential for substantial cost savings compared with the standard practice of having working clinicians identify discrepancies, review results, and contact patients, or that of assigning ED charge nurses to that effect (Table 5). The current annual staffing cost for the QA nurses and administrator totaled $277,430. Assuming that the entire suite of tasks performed by the QA follow-up program were performed by a charge nurse, at an average local rate of $65 per hour, the annual costs would total $316,326. Likewise, if follow-up was done by an emergency attending physician, another common scenario throughout the United States, given an average local emergency physician rate of $210 per hour, the yearly costs would total $919,526

(41). Notably, costs might be considerably higher if administrative support does not exist and the ED QA process relies solely on charge nurses or an emergency physician, or a combination of both. In addition to lowering hourly rates, a dedicated QA nursing team brings with it gains in efficiency and communication compared with working clinicians who must task-switch between QA follow-up and clinical work. Future studies may address whether this gain effectively decreases liability and malpractice risk.

This system is not meant to supplant the disclosure of IFs to the patient directly. Findings are expected to be conveyed to patients at the time of discovery or at the time of hospital discharge. Rather, this system provides an additional layer of communication and involvement of the patient's PCP in order to assure appropriate follow-up. Thus, instances in which the QA nurse contacts the patient directly only occur when a finding was not identified during the patient's ED stay and needs an immediate or critical action.

Limitations

Limitations to this study include that it takes place within one health care system and aspects of its implementation may not be applicable to differently structured systems, although we did remove the EHR-dependence, which is often referred to in the literature as a deterrent to reproducibility.

Our dataset may not include all radiology over-reads that are communicated directly to the ED team while a patient is still in the ED, as these data are outside the purview of our ED QA follow-up system. This limits the conclusions that can be drawn regarding the frequency and clinical implications of all radiology overreads. In addition, the QA follow-up system by design does not address findings among patients who are admitted to the hospital or transferred to other medical facilities.

This study may be further limited by a lack of formal study of our own follow-up miss rate. Our miss rate data are based on QA reviews of ED returns and outside physician and patient complaints and does not account for patients who sought follow-up outside of our hospital network or when a missed case was not reported to us. Thus, the number of studies missed by this follow-up system may be higher than reported. Financial limitations may preclude the implementation of a similar program in other hospital systems. However, up-front costs of meticulous follow-up should result in downstream benefits through improved health care, reimbursement for follow-up interventions, and limits to malpractice liability. Finally, although our QA team addresses PCP alert fatigue, this study does not assess whether downstream communication confirmation or recommended follow-up care occurred for all visits. Future studies will need to address these issues.

Conclusions

Although abnormalities in laboratory and imaging studies are often incidental to a patient's care, this is not always the case, and a dedicated ED QA follow-up program can result in the identification, communication, and treatment coordination of numerous laboratory and imaging abnormalities. This may lead to changes in patients' subsequent clinical course, and potentially lower costs.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jemermed.2023.08.001.

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Article Summary

1. Why is this topic important?

Laboratory and imaging abnormalities are often uncovered incidentally and are missed, not addressed, or only result post discharge. Incidental finding follow-up is of critical importance for patient safety and a source of malpractice risk.

2. What does this study attempt to show?

This article describes our institution's implementation of a unique and cost-effective system for identifying and communicating abnormalities in laboratory and imaging studies among discharged emergency department (ED) and urgent care center patients as a means of improving outpatient follow-up and coordination of care.

3. What are the key findings?

More than 6000 incidental laboratory and imaging findings were identified over a total of 104,125 patient visits. Twenty-one patients were called back to the ED with potentially life-threatening findings and 9 were admitted for interventions, at an average cost per potential life-/limb-saving intervention of $27,743.

4. How is patient care impacted?

An EHR-independent means of communicating incidental findings to patients and primary care provides promotes appropriate follow-up of uncovered potential malignancies or newly identified acute or chronic medical conditions, with the intent of improving patient health and safety in a cost-conscious manner.