Assessing Documentation of Critical Imaging Result Follow-up Recommendations in Emergency Department Discharge Instructions

Anurag Gupta^{1,2,3} · Ronilda Lacson^{1,3} · Patricia C. Balthazar¹ · Shan Haq¹ · Adam B. Landman^{2,3} · Ramin Khorasani^{1,3}

Published online: 12 December 2017
© Society for Imaging Informatics in Medicine 2017

Abstract

To facilitate follow-up of critical test results across transitions in patient care settings, we implemented an electronic discharge module that enabled care providers to include follow-up recommendations in the discharge instructions. We assessed the impact of this module on documentation of follow-up recommendations for critical imaging findings in Emergency Department (ED) discharge instructions. We studied 240 patients with critical imaging findings discharged from the ED before ($n = 80$) and after ($n = 160$) implementation of the module. We manually reviewed hand-written forms and electronic discharge instructions to determine if follow-up recommendations were documented. Follow-up recommendations in ED discharge instructions increased from 60.0% (48/80) to 73.8% (118/160) post-module implementation ($p = 0.03$), a relative increase of 23%. There was no significant change in the rate of documented critical imaging findings in the discharge instructions (77.5% [62/80] before the intervention and 76.9% [123/160] after the intervention; $p = 0.91$). Implementation of a discharge module was associated with increased documentation of critical imaging finding follow-up recommendations in ED discharge instructions. However, one in four patients still did not receive adequate follow-up recommendations, suggesting further opportunities for performance improvement exist.

Keywords Radiology information system · Emergency care information systems · Care continuity · Care transitions, health · Discharge summaries, patient

Introduction

The emergency department (ED) is often a high-stress environment with transient episodes of care, both of which pose significant challenges to communication between patients and healthcare providers. In addition to the chaotic ED environment, communication challenges with patients include language barriers along with literacy and comprehension issues. Previous studies have attempted to overcome these concerns with printed electronic discharge instructions [1], email reminders [2], phone call reminders [3], text message reminders

[4], and scheduling of outpatient appointments prior to ED discharge [5]. The impact of such interventions has been modest and requires further innovation and study.

In the USA, there were over 136 million patient visits to the ED in 2011, of which nearly half (64 million) received at least one diagnostic imaging study [6]. ED clinicians rapidly assess a myriad of patient symptom presentations, develop a hypothesis-driven diagnostic and therapeutic plan, and ultimately decide to either admit (15% in 2011) a patient to the hospital for further intervention or discharge (85% in 2011) the patient to a home care setting [6, 7]. While the ED clinician does not have a longitudinal relationship with the patient, as a primary care physician or specialist often does, the ED clinician is responsible to formulate an outpatient care plan for patients being discharged home after workup and treatment in the ED. Patients are given verbal and written discharge instructions summarizing these plans. For a written ED discharge instruction to be a meaningful means of information exchange, it must include pertinent details of diagnosis, relevant test results, and referral for outpatient follow-up. These basic requirements can often be missing, leading to

✉ Ronilda Lacson
rlacson@partners.org

¹ Center for Evidence-Based Imaging, Brigham and Women's Hospital, 20 Kent Street, #260A, Brookline, MA 02445, USA

² Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA, USA

³ Harvard Medical School, Boston, MA, USA

uncoordinated care, missed follow-up, delayed diagnosis with poor clinical outcomes, and increased cost [8–10].

Identification and communication of critical imaging results is integral to clinical practice and patient safety. We launched a quality improvement effort in 2009 that resulted in the development of a critical result communication policy, which enables automatic graded notification of referring providers for critical radiology results [11]. The Joint Commission further requires discharge summaries to include significant findings [12]. Studies show that 72% of physicians do not routinely notify patients of normal test results and 36% fail to communicate abnormal test results (e.g., fail to communicate an incidental lung nodule) [13]. Moreover, there are few mechanisms to monitor and ensure follow-up of patients who have critical test results that need to be followed across transitions in patient care settings [14]. In May 2012, we transitioned from a hand-written ED discharge instruction form with a single line to report test results to an electronic ED discharge instruction module that enabled care providers to easily include radiology studies performed, comment on study findings, and attach the formal radiology report in the patient discharge instructions [15].

The goal of this study is to assess the impact of implementing an electronic discharge instruction module on documentation of follow-up recommendations for critical imaging findings in comparison to previous hand-written discharge instructions form in the ED. We hypothesize that an electronic discharge instruction module integrated into the electronic medical record and with imaging test result reporting feature would increase documentation of follow-up recommendations in patient discharge instructions.

Materials and Methods

Setting and Population

This before and after study was performed in a single ED, located in a 793-bed, urban academic Level-1 trauma center. The requirement to obtain informed consent was waived by the institutional review board for this Health Insurance Portability and Accountability Act (HIPAA)-compliant study.

From the radiology administrative data repository, we identified all patients who underwent any diagnostic imaging study (e.g., chest x-ray, computed tomography scan, magnetic resonance imaging) associated with an imaging alert notification while in the ED from 7/1/2011 to 12/31/2013 [16]. We focused on “yellow” imaging alert notifications of critical results, which are the lowest category of alerts, covering findings that are not urgent or immediately life-threatening [11]. Most frequent “yellow” alerts included pulmonary nodules and pulmonary infiltrates and effusions. We excluded “orange” and “red” alerts (higher categories of alerts requiring urgent or emergent therapy) since it would be acted upon

within that particular ED visit, while yellow alerts would require outpatient follow-up [11].

All adult patients discharged home from the ED with a yellow alert during the study period were eligible. From eligible patients, we randomly selected 80 patients whose discharge data was before implementation of the electronic discharge instruction module (7/1/11–12/31/11), and an additional 160 patients in similar 6-month periods after implementation in two consecutive years (7/1/12–12/31/12 and 7/1/13–12/31/13). Although full implementation of the module began in May 2012, pre-implementation orientation and testing began three months prior.

Intervention

Before the intervention, ED discharge instructions were hand-written forms with a single line to report test results (Fig. 1). The form did not include dedicated space for follow-up recommendations. The quality improvement intervention consisted of implementation of a custom-developed electronic ED discharge instruction module integrated into our electronic medical record. The module automatically presents the discharging clinician with all imaging studies performed in the past 24 h; they can be selected and included in the discharge instructions with a single click. Further, if an attending radiologist has finalized the report for an imaging study, then its text can also be included in the patient discharge instruction document (Fig. 2). Finally, the module has a dedicated slot for the discharging clinician to specify follow-up instructions, as illustrated in Fig. 3. Details of the implementation have been described previously [15].

Data Collection

From the radiology administrative data repository, we obtained a report of all “yellow” alerts for sample patients in the baseline and intervention periods. For the baseline period, the discharge instructions were scanned as Portable Document Format (PDF) files into the electronic medical record (EMR); the intervention period included the electronic patient discharge instruction document along with other care provider notes in the document section of the EMR. Using a chart review tool, two physicians [XXX, XXX] conducted a structured review of records belonging to all the sample patients associated with “yellow” imaging alerts to determine if the alerts were mentioned in the discharge instructions and if specific follow-up instructions were provided for each alert. After initial training wherein differences were reconciled via discussion, subsequent analysis of 10% of cases resulted in 100% agreement.

Fig. 1 Hand-written ED discharge instruction form

ABOUT YOUR EMERGENCY DEPARTMENT VISIT:
 Note to provider: Please remember to use plain language, not medical terms

Patient: Please bring this with you when you go to any doctor or clinic or return to the emergency department

The name of the doctor or physician's assistant who cared for you _____ MD/PA
 (please print)

What we think the problem is: _____

Test results: _____

Some of your tests will be looked at by another doctor. Please tell your primary care doctor or clinic to check on these tests. Tests to check on: _____

What to do: _____

We are giving you more information on _____
 Please read this information now. If you need help or have questions, please ask before you leave the emergency department.

Medications:

☐ You should keep taking all of your medications

☐ You need to start taking new medication(s). Follow the directions on the medication label: _____

☐ Stop taking _____

After you leave the emergency department:

☐ Please call your doctor or clinic and tell them that you were seen in the emergency department and you need to be seen in _____ days.

☐ Please call this specialty doctor or clinic: _____
 Make sure you tell them you were seen in the emergency department and need to be seen in _____ days.

☐ If you don't have a doctor or clinic, call the Brigham Physician Referral line at 1-800-294-9999. They will help you find a doctor.

If you have questions or concerns, call your doctor or clinic or return to the emergency department.

Patient Signature: _____

These instructions were given to you by: _____
 Date _____ Time _____ Signature _____ MD/RN/PA CID _____

MEDICAL RECORDS

EMERGENCY DEPARTMENT

Outcome Measures and Statistical Analyses

Our primary outcome measure was the documentation of specific follow-up instructions for critical imaging findings. The sample size was powered to detect a 15% effect size with a power of 0.8 ($\alpha = 0.05$) with an estimated

baseline proportion of 40%. All statistical analyses were performed using commercially available software (JMP Pro 10; SAS Institute, Cary, NC). Chi-square test was used to assess pre- and post-intervention differences. A two-tailed p value of < 0.05 was considered to be significant.

Imaging Tests Performed

Imaging tests performed during the visit must display on the patient's discharge instructions.
 Please select relevant tests to be included.

[Refresh Imaging Results](#)

Select Results for Discharge Instructions

Include in Discharge Instructions	Name of Test	DateTime	Status	Attach Report to Discharge Instructions	Comments/Instructions
☒	ED OUTSIDE STUDY	03/03/2015 16:15	Completed	☐	

Fig. 2 Section within the discharge module to attach radiology reports

Fig. 3 Emergency Department electronic discharge instruction module

The screenshot displays the 'Tests Performed' section of the Emergency Department electronic discharge instruction module. The interface is divided into a sidebar and a main content area. The sidebar contains a list of navigation options: Discharge Instructions, Diagnoses, Procedures, Treatment, Tests Performed, Follow-up, Notifications, Medications, Patient Instructions, and Work/School Note. The main content area is titled 'Tests Performed' and includes a 'NONE' button. Below this, there are four main sections: 'Laboratory Tests Performed', 'Pending Laboratory Tests', 'Imaging Tests Performed', and 'Other Tests Performed'. Each section has a 'Retrieve' or 'Refresh' button and a text box for comments. The 'Laboratory Tests Performed' section includes a list of tests with checkboxes: Complete Blood Count, Chemistry Studies, Liver Function Tests, Cardiac Tests, Coagulation Studies, Urinalysis, Thyroid Studies, CSF Studies, Toxicology Tests, Rapid (Point of Care) Tests, Pregnancy Test, Microbiology Tests, and Other. The 'Pending Laboratory Tests' section includes a 'Pull In/Refresh Pending Tests' button and a note: 'NOTE: Clicking Pull In/Refresh Pending Tests will overwrite the data in this text box.' The 'Imaging Tests Performed' section includes a 'Refresh Imaging Results' button and a message: 'No Imaging Lab results are found as of 5/26/2013 12:09:00 PM'. The 'Other Tests Performed' section includes buttons for ECG, Stress Test, and Vascular Testing.

Results

During the study period, 42,315 ED patients underwent a diagnostic imaging study, of which 7243 (17%) were associated with an imaging finding generating a “yellow” alert notification. The mean age of patients during the baseline period was 55.8 (standard deviation = 20.4) and 55.5 during the intervention period (standard deviation = 19.6), not significantly different (t test p value = 0.20). The majority of patients were female, 52.5% at baseline and 52.2% at intervention (chi-square p value = 0.93).

Common imaging findings generating a “yellow” alert with corresponding follow-up recommendations are included in Table 1. After the intervention, the rate of documented follow-up recommendations for specific imaging findings increased from 60.0% (48/80) to 73.8% (118/160) ($p = 0.03$), a relative increase of 23%.

There was no significant change in the rate of documented critical imaging findings in the discharge instructions (77.5%

[62/80] before the intervention and 76.9% [123/160] after the intervention; $p = 0.91$).

Discussion

In a previous study, we demonstrated that an automated alert notification system for communicating critical imaging results was successfully adopted and associated with increased

Table 1 Imaging findings and follow-up recommendations

Imaging findings	Follow-up recommendations
Pulmonary nodules	Chest CT
Pulmonary infiltrates	Follow-up imaging
Renal mass or cyst	Follow-up imaging
Compression fracture	Lumbar spine MRI
Lytic lesions in the bone	Follow-up imaging

adherence to institutional policy for communicating critical imaging results [17]. Further, this system combined with a patient safety initiative reduced the proportion of critical results among reports lacking documented communication between care providers [18]. Although most critical imaging results require communication with the ED physician who is the current provider (while the patient is admitted in the ED), decisions for follow-up testing, specifically for less critical findings, reside with the ambulatory primary care physician (PCP) who cares for the patient when he/she is discharged. These ED results with recommended follow-up must be communicated to the ambulatory provider as he/she ultimately decides on whether follow-up testing is indicated. With implementation of an electronic discharge instruction module integrated into the electronic medical record and with imaging test result reporting features, we demonstrated a significant increase in documentation of follow-up recommendations for critical findings in ED discharge instructions. The baseline documentation rate was 60% because the study focused on “yellow” imaging alert notifications of critical test results, which are defined as primarily new or unexpected radiologic findings that could result in mortality or significant morbidity without appropriate follow-up [11]. It increased significantly to 73.8%.

Including imaging result follow-up recommendations in the patient discharge summaries also provides patient and caregiver support. Patients are given copies of discharge instructions upon discharge from the ED. Follow-up of an imaging test is included in the care transition plan, and will therefore be accessible to the patient and caregiver for discussion and follow-up with their PCP.

The discharge module provides an effective way to retrieve results that need further management until follow-up tests are implemented [19]. Future studies will evaluate the impact of electronic discharge modules that include follow-up recommendations on timely performance of recommended follow-up management. These will include considering whether patients have a PCP, and assessing whether this impacts follow-up completion.

Our study had limitations. It was performed in a single academic setting with an established history of computerized physician order entry and EMR adaptability using a homegrown information system, making its generalizability uncertain. Chart abstractors were not blinded to the paper based or electronic format of the discharge instructions. As a retrospective analysis, this study did not evaluate patient comprehension of ED discharge instructions and we did not measure the impact on patient outcomes. In addition, we did not measure whether follow-up recommendations or alternative tests were actually performed.

Conclusion

Implementation of an electronic discharge instruction module integrated into the electronic medical record and with imaging

test result reporting features was associated with a 23% relative increase in the documentation of critical imaging finding follow-up recommendations. Despite these improvements, one in four patients did not receive adequate imaging follow-up recommendations in ED discharge instructions, suggesting further opportunities for performance improvement exist.

Acknowledgements The authors would like to thank Ms. Laura Peterson for reviewing the manuscript.

Funding Information The study is supported by grant R21HS22586 from the Agency for Healthcare Research and Quality (AHRQ).

References

1. Vukmir RB, Kremen R, Ellis GL, DeHart DA, Plewa MC, Menegazzi J: Compliance with emergency department referral: The effect of computerized discharge instructions. *Ann Emerg Med.* 22(5):819–823, 1993
2. Sharp B, Singal B, Pulia M, Fowler J, Simmons S: You’ve got mail ... and need follow-up: The effect and patient perception of e-mail follow-up reminders after emergency department discharge. *Acad Emerg Med.* 22(1):47–53, 2015
3. Fletcher SW, Appel FA, Bourgois M: Improving emergency-room patient follow-up in a metropolitan teaching hospital. Effect of a follow-up check. *N Engl J Med.* 291(8):385–388, 1974
4. Scott KR, Milne WK, Arora S, Carpenter CR: Hot off the press: Post-emergency department automated messaging to improve follow-up compliance—what is the number needed to text? *Acad Emerg Med.* 22(5):639–641, 2015
5. Murray MJ, LeBlanc CH: Clinic follow-up from the emergency department: Do patients show up? *Ann Emerg Med.* 27(1):56–58, 1996
6. Rahman M, Dixit A, Donley V, Gupta S, Hanslik T, Lacson E, Ogundipe A, Weigel K, Smith MC: Factors associated with inadequate blood pressure control in hypertensive hemodialysis patients. *Am J Kidney Dis.* 33(3):498–506, 1999
7. Weiss AJ, Wier LM, Stocks C, Blanchard J: Overview of Emergency Department Visits in the United States, 2011: Statistical Brief #174. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Rockville, 2006
8. You JJ, Laupacis A, Newman A, Bell CM: Non-adherence to recommendations for further testing after outpatient CT and MRI. *Am J Med.* 123(6):557–558, 2010
9. Caines LC, Brockmeyer DM, Tess AV, Kim H, Krieger G, Bates CK: The revolving door of resident continuity practice: Identifying gaps in transitions of care. *J Gen Intern Med.* 26(9):995–998, 2011
10. van Walraven C, Taljaard M, Etchells E, Bell CM, Stiell IG, Zarnke K, Forster AJ: The independent association of provider and information continuity on outcomes after hospital discharge: Implications for hospitalists. *J Hosp Med.* 5(7):398–405, 2010
11. Anthony SG, Prevedello LM, Damiano MM, Gandhi TK, Doubilet PM, Seltzer SE, Khorasani R: Impact of a 4-year quality improvement initiative to improve communication of critical imaging test results. *Radiology.* 259(3):802–807, 2011
12. The Joint Commission. National Patient Safety Goals 2013.
13. Boohaker EA, Ward RE, Uman JE, McCarthy BD: Patient notification and follow-up of abnormal test results. A physician survey. *Arch Intern Med.* 156(3):327–331, 1996
14. Dutta S, Long WJ, Brown DF, Reisner AT: Automated detection using natural language processing of radiologists recommendations

- for additional imaging of incidental findings. *Ann Emerg Med.* 62(2):162–169, 2013
15. Bell EJ, Takhar SS, Beloff JR, Schuur JD, Landman AB: Information technology improves Emergency Department patient discharge instructions completeness and performance on a national quality measure: A quasi-experimental study. *Appl Clin Inform.* 4(4):499–514, 2013
 16. Lacson R, O'Connor SD, Andriole KP, Prevedello LM, Khorasani R: An automated critical test result notification system: Architecture, design and assessment of provider satisfaction. *AJR Am J Roentgenol*, 2014
 17. Lacson R, Prevedello LM, Andriole KP, O'Connor SD, Roy C, Gandhi T, Dalal AK, Sato L, Khorasani R: Four-year impact of an alert notification system on closed-loop communication of critical test results. *AJR American journal of roentgenology.* 203(5): 933–938, 2014
 18. Lacson R, O'Connor SD, Sahni VA, Roy C, Dalal A, Desai S, Khorasani R: Impact of an electronic alert notification system embedded in radiologists' workflow on closed-loop communication of critical results: A time series analysis. *BMJ Qual Saf.* 2015
 19. Poon EG, Gandhi TK, Sequist TD, Murff HJ, Karson AS, Bates DW: "I wish I had seen this test result earlier!": Dissatisfaction with test result management systems in primary care. *ArchInternMed.* 164(20):2223–2228, 2004