Using Computerized Provider Order Entry to Enforce Documentation of Tests with Pending Results at Hospital Discharge

J. Cadwallader[1,2]; C. Asirwa[1,2]; X. Li[2]; J. Kesterson[2]; W.M. Tierney[1,2]; M.C. Were[1,2]

[1]Indiana University School of Medicine, Indianapolis, IN; [2]Regenstrief Institute Inc, Indianapolis, IN

Keywords

Patient Discharge, Routine Diagnostic Tests, Medical Order Entry Systems, Documentation, Medical Errors

Summary

Background: Small numbers of tests with pending results are documented in hospital discharge summaries leading to breakdown in communication and medical errors due to inadequate follo-wup.

Objective: Evaluate effect of using a computerized provider order entry (CPOE) system to enforce documentation of tests with pending results into hospital discharge summaries.

Methods: We assessed the percent of all tests with pending results and those with actionable results that were documented before (n = 182 discharges) and after (n = 203 discharges) implementing the CPOE-enforcement tool. We also surveyed providers (n = 52) about the enforcement functionality.

Results: Documentation of all tests with pending results improved from 12% (87/701 tests) before to 22% (178/812 tests) (p = 0.02) after implementation. Documentation of tests with eventual actionable results increased from 0% (0/24) to 50% (14/28)(p<0.001). Survey respondents felt the intervention improved quality of summaries, provider communication, and was not time-consuming.

Conclusions: A CPOE tool enforcing documentation of tests with pending results into discharge summaries significantly increased documentation rates, especially of actionable tests. However, gaps in documentation still exist.

Correspondence to:

Jason Cadwallader, MD
Regenstrief Institute
410 W. 10th Street, Suite 2000
Indianapolis, IN 46202–3012
Email: jascadwa@iupui.edu

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1. Introduction

Breakdowns in communication across healthcare transitions are major risks to patient safety. Lack of appropriate follow up of tests which have results pending at hospital discharge adversely affects patient safety. Up to 41% of hospital patients are discharged with pending test results [1], and almost half of these patients experience medical errors related to inadequate follow up of these tests [2]. Poor management of tests can lead to duplication of services, necessary care that is delayed or neglected altogether, patient dissatisfaction, adverse events, and litigation [3, 5–8].

It is increasingly evident that many of the errors related to tests with pending results are due to breakdown in communication in transitioning care from inpatient-to-outpatient settings [9]. Discharge summaries are the primary medium of communication between inpatient and outpatient providers but are woefully inadequate at documenting tests with pending results. This is reflected by our previously reported findings that discharge summaries mentioned only 16% of tests with pending results at discharge [10]. Our work, and that by others, highlights the gap between everyday practice and current policy recommendations, which emphasize the need for discharge summaries to 'include all pending labs or tests' [11, 12].

Approaches are urgently needed to improve discharge summaries' documentation of tests with pending results. Discharging providers do not know, a priori, which of the pending tests will require further action. So they must accurately document all tests with pending results to facilitate proper patient follow-up. We are starting to see efforts to improve this documentation, but unfortunately, optimal approaches have not been elucidated.

As an example, a recent publication described an outpatient Electronic Health Record (EHR) based results management application, which was used to track laboratory and radiology results, for the inpatient setting [13]. However, use of the tool by physicians was poor and barriers to integration such as relevancy of results, time constraints, and integration into workflow limited its observed impact.

The increasing adoption of EHRs within hospitals still offers a unique opportunity to improve this documentation. This is because Computerized Provider Order Entry (CPOE) systems, used to create EHR-based discharge summaries, can be leveraged to enhance the documentation of tests with results pending at discharge. In fact, such use of EHRs would support the 'meaningful use' requirement for these systems to improve coordination of care [14].

We created a tool, as part of an existing CPOE system, which enforces documentation of tests with pending results into discharge summaries. In this paper we describe the development and implementation of this tool. We also report results of a pre-post analysis of the effect of this tool on documentation rates of pending tests into discharge summaries, and findings of a satisfaction survey of inpatient providers who used the tool during preparation of discharge summaries. We hypothesized that requiring the listing of tests with pending results in discharge summaries would improve the documentation rate of such tests and be valued by clinicians.

2. Methods

2.1 Study Setting and Electronic Health Record

We performed this study at a Midwest urban public teaching hospital on the campus of an academic medical center. This hospital is served by a comprehensive EHR [15] that contains a locally grown CPOE system, The Medical Gopher, into which all orders and discharge summaries must be entered.

2.2 Intervention

To complete a discharge summary, providers at this institution use the CPOE's discharge template into which providers enter select details about the patient, e.g. hospital course and discharge diagnoses, into pre-defined fields. However, most other discharge summary information, including information about tests with pending results, is entered as free text within the discharge summary narrative. This CPOE discharge template combines the tasks of order entry and summary narrative into one global template.

Because our recent study showed that only 16% of tests with pending results were documented in this hospital's discharge summaries [10], we programmed two modifications into the CPOE discharge summary template. We created a dedicated free-text field for documenting tests with pending results (▶ Fig. 1: Item #20) and made this a required field where the provider filled in tests with pending results or selected the option of '_No pending test results_' (▶ Fig. 1). Once the summary was finalized, data from the new 'tests with pending results' field were incorporated into the discharge summary and was also stored into the EHR repository (▶ Fig. 2). Discharge summaries could be printed and mailed to follow-up providers or viewed from any workstation.

2.3 Study Design

Our evaluation was conducted with the General Internal Medicine Hospitalist Service (GIMHS) at the study institution. This service is made up of nine teams: eight containing an attending physician working with resident housestaff and one made up of a faculty physician without housestaff. For the GIMHS teams, discharge summaries can be completed by any team member. All GIMHS team members received instructions about the new tool that required documentation of tests with pending results and were encouraged to practice with the new tool before using it for a real patient. Before introducing the requirement to document pending test results, GIMHS providers could enter tests with pending results as free-text anywhere within the discharge summary. After the intervention, discharging providers could still document tests with pending results in the discharge narrative but were now also required to complete the field for 'Tests with Pending Results'. Round the clock support for the tool was available as part of standard CPOE support, but no users had specific technical problems with this tool during the study period.

2.4 Study patients

The tool enforcing documentation of tests with pending results was implemented in February 2009. We evaluated the number of tests with pending results that were listed in discharge summaries by comparing patients discharged in the month before implementation with patients discharged in the month after implementation. Given the large number of patients admitted to this institution during the study months, the study was still adequately powered for statistical analysis (detailed in Section 2.8 Statistical Analysis). Through queries of the EHR, we identified all adult patients discharged from the GIMHS during the study months who had pending test results at the time of discharge. Discharge summaries for study patients were manually reviewed by three physician investigators (JC, MCW, & CA). Patients who died during the hospitalization, left against medical advice, were discharged to hospice, or were transferred to another hospital were excluded.

2.5 Determining Which Pending Tests Were Documented in the Discharge Summary

Two physician reviewers read through the entire textual discharge summary and independently abstracted all tests mentioned within each discharge summary as having pending results. (JC & MCW) The reviewing physicians discussed and adjudicated any disagreements.

2.6 Identifying Actionable Results Returning After Discharge

To identify whether results returning after discharge required clinical action, we used an algorithm modified from Roy et al. [1] which we had employed in a previous study [10]. Two physician-reviewers (JC & CA) independently analyzed results for pending tests that returned within two months after discharge date and used their clinical judgment, the discharge summary, and data contained in the patient's record to determine whether the test result was actionable. An actionable result required providers to take one or more of the following actions: start, discontinue, or change a treatment; order a new diagnostic test or change an existing test order; or schedule an earlier primary care or specialist appointment (▶ Fig. 3). In contrast to Roy's study, all tests with pending results at dis-

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charge, not just the abnormal results, were reviewed in our study. Unlike in Roy et al., in our study no survey was sent to query the discharging or follow-up primary care physician to determine if they were aware of the results.

2.7 Outcomes

The primary outcome was the frequency of tests with pending results that were documented in the discharge summaries. Secondary outcome measures included (a) proportion of actionable tests that were documented, (b) proportion of discharge summaries that documented any tests with pending results.

2.8 Survey

We assessed study providers' attitudes towards the new tool (which enforced documentation of tests with pending results) using an anonymous web-based survey. Given that there were no validated instruments to assess provider attitudes on documentation tools for pending tests, we developed an original survey with input from a group of faculty General Internists. The survey was emailed to all 54 of the providers who wrote discharge summaries during the intervention period but we were unable to obtain a valid email address for two providers, thus limiting us to a convenience sample of 52 providers. The surveys asked whether requiring documenting such tests via CPOE improved the quality of the summary, overall documentation of tests with pending results, and communication with outpatient follow-up providers. We also asked providers whether requiring documenting such tests made writing discharge summaries more difficult or time-consuming, and whether the new tool should remain part of the CPOE. Responses were on a 5-point Likert Scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

2.9 Statistical Analyses

Patient characteristics and survey results were tabulated using simple summary statistics. Comparisons were made using t-test (or Wilcoxon test if variables were highly skewed) for continuous variables and Fishers Exact test for categorical variables. To detect 10% difference in the rates of pending tests documented in the summaries (primary outcome), Fisher's exact test has 99% power for two-sided alpha 0.05 for 812 tests of intervention vs. 701 tests of control. Inter-rater reliability for identifying actionable tests was estimated with the kappa statistic. We compared documentation rates of all tests with pending results and tests with actionable results between the intervention and control period using generalized estimating equations (GEE) to account for correlation among multiple tests nested within each discharge summary.

3. Results

3.1 Study Patients and Providers

Of 2715 patients discharged during the study months, 742 (27%) were identified as having one or more pending test results at the time of hospital discharge. Of this group, we reviewed 419 (56%) randomly-selected summaries for 378 unique patients. From the 419 reviewed, 34 summaries (8%) were excluded: 15 for patients who died during hospitalization, 8 who were transferred to another hospital, 7 who left against medical advice, 3 discharged to hospice, and 1 because the new tool malfunctioned. The remaining 385 summaries were analyzed: 182 pre-intervention and 203 post-intervention. Neither age, gender, race, nor mean number of tests pending at hospital discharge differed between pre- and post-intervention summaries (▶Table 1). Length of stay was shorter post-intervention, but GEE with exchangeable correlation structure did not indicate any significant correlation between the mention of the pending test in the discharge summary with either length of hospitalization, days before discharge that a test was ordered, or with patient's age and race. Of 69 unique providers creating discharge summaries during the study months, there were no differences

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between the groups by type of provider: 12 faculty physicians and 1 medical student created summaries in both the pre- and post-intervention months while 32 residents in the pre-intervention and 30 residents in the post-intervention months created summaries (p = 1.0).

3.2 Documentation of Pending Tests Into Summaries

The reviewers' agreement on the number tests with pending results was high (kappa = 0.8). As depicted in ▶ Table 2, intervention summaries listed 22% of tests with pending results (178/812) compared to 12% of control summaries (87/701, p = 0.02). None of the 24 tests (0%) with actionable results in the control summaries were documented as pending compared to 14 of 28 (50%) tests with actionable results in intervention summaries (p<0.001).

We examined the correlation between documenting whether a test was pending and the type of provider who prepared the discharge summary. Three hundred fifty-two (53%) of the discharge summaries were prepared by 56 residents, 227 (34%) by 24 attending physicians, 81 (12%) by 7 nurse practitioners, and 5 (0.8%) by 2 medical students. Results from the GEE with exchangeable correlation structure did not indicate any significant correlation between documentation of pending tests and the type of provider. Although it seemed that medical students tended to include the fewest pending tests (8%, 95% CI: 2–25%) compared to attending physicians (14%, 95% CI: 7–24%), nurse practitioners (19%, 95% CI: 10–32%), and residents (17%, 95% CI: 11–25%), this difference was not significant.

Though not statistically significant, more discharge summaries in the intervention group had at least one test with pending results documented – 29% vs. 22.5% (p = 0.2) (▶ Table 2). In the post-intervention period, 101 of 178 (57%) pending tests were documented specifically within the 'Tests with Pending Results' field, 77 of 178 (43%) were documented in the discharge narrative, and 46 of 178 (26%) were documented in both places.

3.3 Survey Results

Twenty-six (50%) of 52 providers responded and felt that the tool for documenting tests with pending results was useful (3.7 ± 0.37 on a 5-point scale), improved quality of the discharge summary (3.8 ± 0.36), improved communication with follow-up providers (3.6 ± 0.31) and improved their documentation of tests that had pending results at discharge (3.7 ±0.32). Respondents disagreed that it took them much longer to complete the discharge summary (2.7 ± 0.46) or that enforcement made documentation more difficult (2.2 ± 0.35). Nineteen of the 26 (73%) responding providers wanted to continue using the tool while 6 (23%) were neutral and only 1 (4%) wanted the CPOE tool removed.

4. Discussion

Enforcement of documentation of pending tests though a CPOE-based tool significantly improved documentation of these pending tests into discharge summaries, especially where results eventually required a change in patient management. Baseline documentation rate of all tests with pending results was low at 12% prior to the intervention. We would expect this rate to be similar for EHR systems where the summary narrative is generated independently of orders. After our intervention, the overall documentation rate for pending tests increased to 22% (an 83% increase), and documentation of tests whose results required a change in patient management increased from 0% to 50%. This demonstrated increase provides support for the assertion that the integration of order entry and summary narrative processes, which allows for enforcement of documentation, is worthwhile. Discharging providers also indicated a strong preference toward using this tool. Given the key role of discharge summaries in transition of care [9], this tool should improve communication between in- and outpatient providers and help reduce errors related to ignored tests after discharge [2].

Even though our intervention significantly increased the listing of tests with pending results in discharge summaries, these summaries still fell far short of the recommendation that summaries should 'include all pending labs or tests' [11]. Our findings highlight that simply requiring providers

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to document what is pending is not sufficient to meet the recommendation for complete documentation. Other barriers might still make it difficult for providers to document this information. For example, providers may truly be unaware of all the tests ordered and more importantly whether the results are finalized – this is especially true in today's complex environment where a multidisciplinary team of providers share in patient care. The need to interact with multiple data systems further inhibits a provider's ability to compile a complete list of pending tests as they may lack the time or capability to do so. Ideally, institutions with comprehensive EHRs should proactively display tests with results pending at discharge as the summary is being prepared. This is not trivial, as it involves interfacing multiple data systems: Admission-Discharge-Transfer, CPOE, Lab, Pathology, Radiology, etc. It is this complexity that makes our simple intervention worth implementing in the interim while the more sophisticated systems are being developed.

There are multiple limitations to our study. First, the study was conducted on one service at a single teaching hospital, and the findings may not translate to other services or institutions. Second, although the study period allowed for an adequate sample size, its overall duration was short. This study could have been improved by including a post intervention wash out period or by collecting data over a longer period of time. Third, the intervention involved use of a CPOE system, and might have limited utility in institutions that do not use CPOE. Even for institutions that use CPOE our system combines the discharge tasks of order entry and summary narrative which may not be applicable. Fourth, the unexpected difference in length of stay between the control and intervention groups could indicate a difference in case mix and as a result skewed the type and frequency of tests that were still pending at discharge. Finally, there are several limitations associated with the survey. Our original survey was not validated, and given the 50% response rate to the survey, the survey results many not have been representative of the entire group. We also could not correlate survey responses by a provider with the provider's documentation of pending results because the survey data were collected anonymously.

Nevertheless, we demonstrated that it is possible to proactively improve documentation of pending tests via CPOE. To further improve documentation rates, we are currently in the process of improving this system to automatically display tests with pending results to the provider who is preparing the discharge summary and are designing a randomized trial that will allow us to evaluate the effects of our intervention on errors due to missed tests with pending results.

5. Conclusion & Implication of Results for Practitioners

A simple CPOE-based tool to require documentation of tests with pending results into hospital discharge summaries significantly improves documentation rates (especially of actionable tests) and was well liked by physicians preparing discharge summaries. Systems that automate the process of identifying tests with pending results at the time of hospital discharge are needed, but are technically complex to implement. In the interim, physicians and hospital systems will significantly benefit from adoption of tools to enforce documentation of tests with pending results into the discharge summary.

Human Subjects Protections
The study was conducted in accordance with ethical principles for medical research and was approved by Indiana University Institutional Review Board.

Conflicts of Interest
The authors have no conflicts of interest in the research to declare.

Fig. 1 Modified CPOE-based discharge template. Field #20 enforces documentation of tests with pending results

Fig. 2 Discharge summary with information about 'Test Results Pending At Discharge' incorporated.

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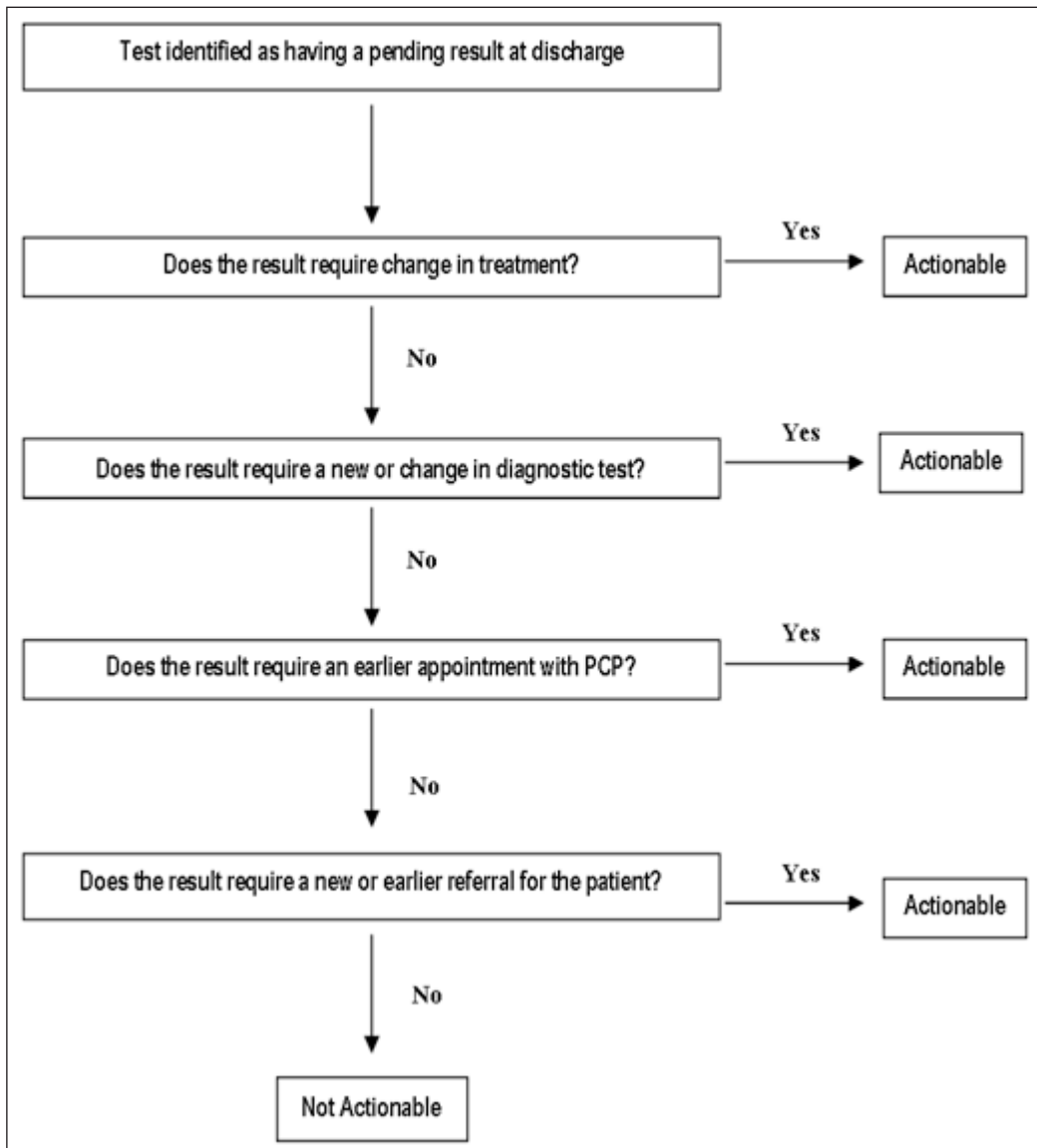Documentation of Tests with Pending Results at Hospital Discharge

Fig. 3 Algorithm to determine whether results pending at discharge are actionable.

Table 1 Patient characteristics

Characteristics	Control n=182	Intervention N=203	p-Value
Mean age, y (range)	56.7 (18.9,99.4)	54.0 (17.6,92.0)	0.09
Female gender, %	47.8	47.3	1.00
Ethnicity, %			
Black	50.0	47.8	
Hispanic	2.7	6.4	0.20
White	43.4	44.3	
Other	3.8	1.5	
Length of Stay, days (range)	6.4 (1,44)	4.4 (1,18)	0.003
Mean tests pending at discharge, n (range)	4.1 (1,23)	4.2 (1,23)	0.53

Table 2 Study outcomes

Tests documented in discharge summary	265/1513 (17.5%)		
Tests with actionable results	52/1513 (3.4%)		

Characteristics	Control	Intervention	p-Value
Tests with pending results listed in summary	87/701 (12%)	178/812 (22%)	0.02
Tests with pending results listed in required field		101/178 (57%)	
Tests with pending results listed in the discharge narrative		77/178 (43%)	
Tests with pending results listed in both the required field and the discharge narrative		46/178 (26%)	
Tests with actionable results	0/24 (0%)	14/28 (50%)	<0.001
Summaries with at least one test with pending result documented	29%	22%	0.2

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