

Hospital Post-Discharge Laboratory Results Management System

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Abstract: The transition of clinical care from the hospital setting to outpatient follow-up creates patient safety risk due to the changes in clinical management and inefficiencies of information exchange. Diagnostic findings from the hospital setting are often important for patient care in the transition to the outpatient setting and are particularly important for test results that return after the patient has been discharged from the hospital. Prompt examination of test results and clear channels for communicating the information to patients and providers are key mechanisms for reducing medical errors during care transitions, especially in hospitalist care models. Mayo Clinic Hospital in Phoenix, AZ, created a quality improvement solution utilizing an existing electronic laboratory reporting system, a Microsoft Access database solution, patient admission and discharge time-stamp data, and a single multi-user email account to ensure the review of all laboratory results generated after hospital discharge. Results of laboratory tests originating in the hospital and finalized after patient discharge are routed through a Microsoft Access programmed database to report findings to a multi-user Microsoft Outlook email account. Filters on laboratory data direct pertinent data to the multi-user account for clinical review. The account is reviewed each day by a designated hospitalist provider and action is taken on the results to facilitate care as needed to manage post-discharge laboratory data results. The automated laboratory result tracking solution is a cost efficient quality improvement initiative, utilizing basic data exchange from the hospital's laboratory information system and inpatient stay data which is routed through common desktop office productivity software to create an organizationally driven patient safety solution to manage post-discharge laboratory data results.

Introduction

The transition from inpatient to outpatient care is a potentially dangerous period since major health issues can develop and may not be adequately addressed¹. A key risk area comes from a failure to maintain the continuity in care once the patient has left the hospital. This may be attributed to the non-affiliation of medical providers in hospital and outpatient settings, difficulties in data exchange of disparate clinical information systems and lack of timely transfer of pertinent clinical information. Medical errors, such as failure to follow up on laboratory and radiological results, at this juncture have been shown to be closely related to discontinuity in care². Therefore, clarity in follow-up communication between the hospital, patient, and outpatient provider is crucial during the transition of care.

Physicians are often unaware of potentially actionable results that are pending after patients are discharged from the hospital due to the volumes of testing, delays in order completion and limited systematic tracking of diagnostics tests in progress with a clear need to improve result follow-up systems to address this problem³. A survey of seventy-four interns and residents at a large urban teaching hospital conducted by Lin, et al, demonstrated that 46% of those surveyed had seen a patient's condition worsen at least several times in the past year due to inadequate follow-up on clinical results. The study identified several barriers to timely follow-up including the lack of reminder systems, difficulty accessing results, competing care demands, and miscommunication about follow-up responsibilities. These previously identified factors may be compounded with transitions in clinical data

management as with changes in electronic medical record vendors or with changes within other hospital information management systems.

Techniques used by providers to manage post-discharge test results include reminder systems to queue results for subsequent evaluations at a later time, management of finalized results when they arrive in the physician's clinical mailbox, or automatically scheduling follow-up outpatient visits to assess results and other techniques. For teaching hospital based clinicians, follow-up on outpatient test results is important for learning and reinforcement of quality patient care practices⁴. However, the organizational dynamics of hospital physician teams makes it likely that patients diagnosed by one physician in the hospital may not see that same physician again. Information technology can be used to ameliorate or even solve this multi-system problem by bringing potentially actionable results to the attention of care teams and patients.

Estimated likelihoods for clinically significant results come from a previous evaluation completed in 2004 by Roy, et al, who reviewed the lab results of 2644 consecutive patients that were discharged from the hospital. Of the discharged patients, 41% of patients had pending results with a total of 2033 tests pending at discharge, and 191 (9.4%) of those tests were later determined to be actionable³. Given the potential for important results to be overlooked during the transition of care, the need for process quality assurance is apparent. Solutions to such problems need to take into account unique organizational dynamics to tailor a clinical solution. A particular concern common for many hospitals is the need address a hospitalist-based clinical practice that involves frequent discontinuity of care, since most hospital-based providers do not provide outpatient care. Given the general need for acute care solutions and a specific need for Mayo Clinic Hospital to identify a solution, a quality improvement effort was undertaken to provide a mechanism to close the loop on post-discharge laboratory results.

Prior to the advent of the laboratory reminder system described herein, follow-up of pending laboratory studies was left to the discretion of individual providers. Many hospital medicine providers (comprising staff physicians, residents, medical students and midlevel providers) kept individualized reminder lists on paper or electronically, but there was no divisional or departmental policy defining roles or expectations in this regard. Positive cultures kept for long incubations (e.g. acid-fast bacilli cultures returning positive several weeks after collection) were routinely phoned to the ordering physician, but routine studies (whose time to complete often exceeds the patient's length of stay) were assumed to be followed to completion by the discharging provider. Anecdotal reports among hospital-based physicians about missed laboratory findings of substantial clinical significance led to a review of the existing processes and a search for a technology driven solution. Of particular concern was the need to track laboratory panels sent to outside laboratories associated with prolonged turn-around times (e.g. thrombophilia panel, a commonly-ordered panel of tests for genetic and acquired causes of increased thrombotic risks that includes review by a Mayo Clinic Rochester hematologist, but which routinely takes two weeks to become final).

Methods:

Workflow Process Assessment

The project started with an assessment of the process workflow for laboratory studies. The existing process employed at the hospital started with the provider placing an order in the system followed by laboratory sample collection and processing with a final result eventually reported in the laboratory information system. The laboratory data was integrated with the electronic medical record system which was the primary mechanism for laboratory result reporting to clinical providers.

The structure of the data included discrete data orders which were selected from an available list of predefined orders along with a free text option. Each order was placed with information on the ordering provider and a time-date stamp of the order origination. At the time of test completion, the result was recorded in the laboratory information system which was integrated with the electronic medical record for reporting. If the results were deemed critical, including positive blood cultures and laboratory results with substantial risk to patients as identified by laboratory protocol, a notification process was in place where a provider was contacted. However, in the case of patients who had left the hospital, the providers of the patient were frequently unavailable and notification might go to a nurse who would then try to identify a responsible provider. In addition, if pertinent results were finalized which did not reach the “critical value” level but were nonetheless clinically significant, no system was in place to ensure the results were reported to a responsible provider. Given the substantial volumes of results finalized for patients after discharge and the lack of an identifier designating the results as post-discharge findings, there was a critical need to identify a process which ensured a review of all pertinent findings.

Quality Improvement Initiative

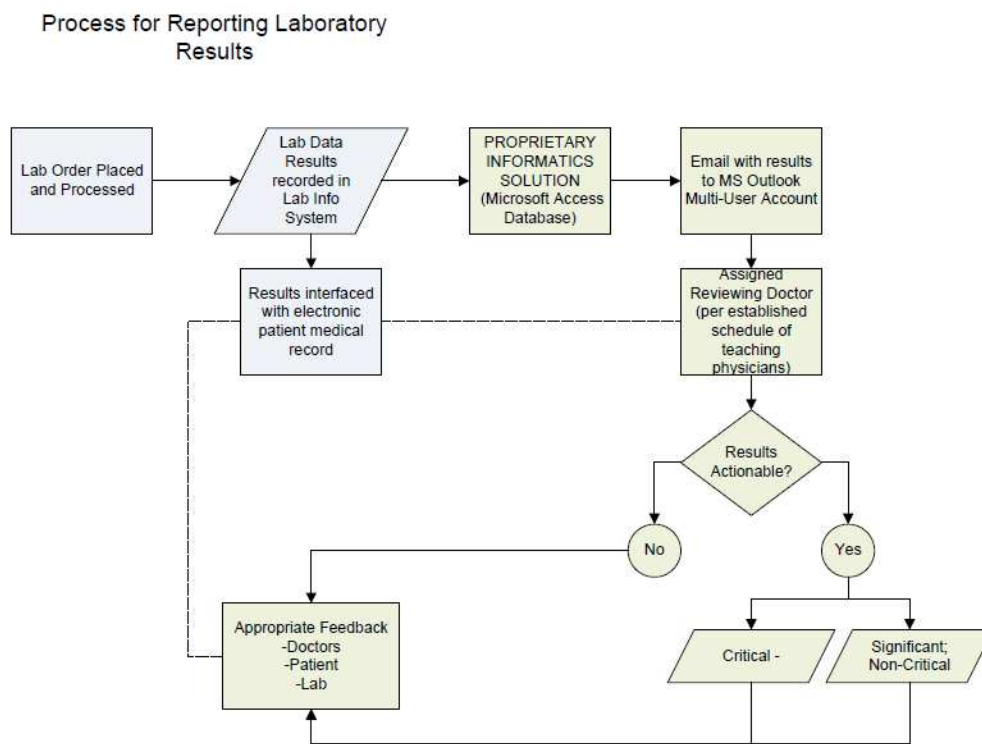
Given the challenges related to post-discharge reporting and the mix of patients and providers needing improved information reporting, a quality improvement program was created to address the need to track all post-discharge laboratory results. The key goal was to identify laboratory results completed after the patient was hospitalized and then provide a reporting mechanism to ensure timely result review would occur and that no finalized results were lost to follow-up. The needed data was available electronically in both the electronic medical record and a laboratory information system, and a subsequent feasibility assessment was completed to identify the data sources most easily adapted to electronic reporting. After assessing the potential options, the reporting of laboratory results for quality improvement was initiated with the laboratory information system.

After the primary data source was identified, the next challenge was to create a mechanism for quality improvement reporting which could identify the results of interest, place the results in a clinical report, and make the results available to a responsible provider. Given the need to support a hospitalist-based teaching practice of

revolving providers, many of whom were unavailable for extended periods of time, the clinical reporting had to generate results and regularly deliver them to responsible providers, with a management plan for when providers were not available on the clinical service. In order to meet the needs of the inpatient hospitalist practice, it was important to create flexibility and multiple user access. An additional system concern was the need to identify a solution which could work with potential changes planned in the electronic medical record vendor.

After considering potential options, a single email account with multiple provider access was created and a schedule was initiated to ensure a regular review of results. The software tools included a Microsoft Access Database program which processed the results finalized in the laboratory information system and translated the data into an email and sent the laboratory data to a multiple user email account when it became available for review. This email account is then accessed by the reviewing physician who determines what action should be taken on the result. The reviewing physicians were generally the providers assigned to a teaching role on the hospital service with a typically lighter patient work load when scheduled to review the reported results. The reviewing physicians log into the multi-user email account and identify the results with clinically actionable values. Depending on the nature of the results: patient notification, diagnostic testing and clinical follow-up is arranged and completed as needed to address patient care needs. A graphical depiction of the quality improvement process and information technology application is noted in **Figure One** below.

Figure One: Post-Discharge Laboratory Management System



Data Interface and Results

In order to provide clinical context, the laboratory results which are generated are readily interfaced with the available electronic medical records including both a web-based (Apollo) and client server system (General Electric/IDX system) to help establish if a given result is clinically actionable. The reviewer will arrange follow-up for clinically actionable items as needed with potential actions including follow-up laboratory testing, clinical consultation, readmission to the hospital, and other additional diagnostic evaluations. Inpatient and outpatient based computerized provider order entry is available to facilitate order placement and clinical documentation of management plans via provider dictation into the electronic medical record.

The completed post-discharge results usually fit into three typical scenarios for the types of actions associated with completed post-discharge results. The type of results requiring immediate evaluation, such as a positive blood cultures, are often also associated with critical laboratory values generated from existing laboratory reporting. These results need urgent evaluation for their significance and potentially urgent clinical evaluation of the patient if needed. A second type of result is one which also needs follow-up, but not necessarily urgent evaluation. Example results may be a positive cancer screen or a new medical problem which is identified in the post-discharge result which requires further patient assessment and will often require additional patient evaluations or an additional diagnostic testing. A third typical type of result is one for which no further action is required. These results may demonstrate normal values or abnormal values which are a return to the patients documented baseline status.

Conclusions

The post-discharge laboratory system has been operationalized and provides automated results for all patients admitted to an Internal Medicine hospital service at Mayo Clinic Hospital. The system provides data tracking capacity and a reminder of the importance of clinical care follow-up necessary in both care quality, as well as medical education. The tool was transitioned from a quality improvement initiative and became part of the hospital's usual clinical care. Having a standardized post-discharge result tracking process provides enhanced capability to ensure clinical care, but also provides data on the frequency of clinically significant results.

Unfortunately operational issues ensued with a change in vendor for the hospital electronic medical record. In part of the organizational efforts to standardize the information infrastructure, the Mayo Clinic in Arizona converged with Mayo Clinic in Florida on a single electronic medical record using Cerner as a platform. The process of identifying the laboratory results of discharged patients cared for by the hospitalist physicians was unchanged, but the project leadership made the decision to cease using Microsoft Access databases for clinical data reporting. Content experts from Cerner and Mayo Clinic were tasked with developing a similar functionality. The prior lab result review process remains suspended while this development continues.

Future work will include getting back to full operations after completion of EMR vendor changes. Additional efforts may include the tracking of the number of clinically significant results to help identify the significance of post-discharge lab results. Having a Microsoft Access intermediate data processing step also provides the ability to readily change the result rule filter to help screen out results which are not clinically actionable. The database also provides a mechanism to help identify clinical problems which may be a source of re-admission and has the potential for timely follow up to help reduce the risk of patient safety risk with care transitions to ambulatory care.

Clinical groups considering a similar quality improvement initiative to address pending laboratory results can take several lessons from our experience. The first is the need to make explicit the expectations about roles and responsibilities regarding actionable results. At several staff meetings, divisional leadership reinforced the group's decision that it was the reviewing physician's responsibility to contact patients and/or outside providers about results; leaving a printout of the result on an absent provider's desk would not be accepted. The second is that our decision to alternate the responsibility for results daily (in our case, between two teaching physicians) was serendipitously self-enforcing; if one physician did not address all results in the shared inbox on his or her designated day, his or her colleague would find them (date-stamped with yesterday's date) the next morning. This tended to promote compliance. Finally, the temporary suspension of our system during our EMR change provides a reminder of the fragility of homemade solutions during times of institutional technological transition. We hope to report on the success of our adaptation of system to our new platform in the near future.

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Author Biographies

Terrence Adam is an Assistant Professor in Pharmacy and Health Informatics at the University of Minnesota and practices Internal Medicine for the Minneapolis Veterans Administration. His current research work focuses on patient safety utilizing large databases for adverse event identification focused on drug-drug interactions utilizing statistical techniques and health data analytics. In addition, he has ongoing research in perioperative medicine including efforts to develop clinical decision support systems for cardiac risk assessment, high risk orthopedic surgery, and population based personalized risk assessment. Terrence is also a KL2 Scholar at the University of Minnesota focused on Computational Pharmacoepidemiology.

Adriane I. Budavari is an Assistant Professor of Medicine at Mayo Clinic. She is the Program Director of the Hospital Medicine Physician Assistant Fellowship at Mayo Clinic in Arizona and, during the time of the implementation of the above-described system, also served as Program Director of the Chief Residency in Internal Medicine.

Daniel Roberts is an Assistant Professor of Medicine at Mayo Clinic. He is the Vice-Chair of the Division of Hospital Medicine in Phoenix, AZ, and served on the Computerized Provider Order Entry Design and Executive Committees during CPOE implementation at Mayo Clinic Hospital. He also served as one of the two physician liaisons between IT and clinical leadership during that time

James A. Wilkens is an Assistant Professor of Medicine at Mayo Clinic. As past Chair of the Division of Hospital Internal Medicine, he initiated and led the quality improvement process that led to the design and implementation of the system described in this paper.