*Improving Safety and Quality*

# The Management of Test Results in Primary Care: Does an Electronic Medical Record Make a Difference?

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Background and Objectives: *It is unknown whether an electronic medical record (EMR) improves the management of test results in primary care offices.* Methods: *As part of a larger assessment using observations, interviews, and chart audits at eight family medicine offices in SW Ohio, we documented five results management steps (right place in chart, signature, interpretation, patient notification, and abnormal result follow-up) for laboratory and imaging test results from 25 patient charts in each office. We noted the type of records used (EMR or paper) and how many management steps had standardized results management processes in place.* Results: *We analyzed 461 test results from 200 charts at the eight offices. Commonly grouped tests (complete blood counts, etc) were considered a single test. A total of 274 results were managed by EMR (at four offices). Results managed with an EMR were more often in the right place in the chart (100% versus 98%), had more clinician signatures (100% versus 86%), interpretations (73% versus 64%), and patient notifications (80% vs. 66%) documented. For the subset of abnormal results (n=170 results), 64% of results managed with an EMR had a follow-up plan documented compared to only 40% of paper managed results. Having two or more standardized results management steps did not significantly improve documentation of any step, but no offices had standardized processes for documenting interpretation of test results or follow-up for abnormal results. There was inter-office variability in the successful documentation of results management steps, but 75% of the top performing offices had EMRs.* Conclusions: *There was greater documentation of results managed by an EMR, but all offices fall short in notifying patients and in documenting interpretation and follow-up of abnormal test results.*

(Fam Med 2010;42(5):327-33.)

Laboratory, radiology, and other testing serves multiple purposes for primary care clinicians, including screening, diagnosis, and disease and medication management. While some tests are performed in clinicians' offices, most are sent to outside facilities. Primary care providers order tests on a significant number of patients. Recent estimates are that family physicians and general internists order laboratory tests in 29% and 38% of patient visits and imaging studies in 10% and 12%, respectively.[1]

Primary care clinicians have expressed concern that their systems for managing test results are unsatisfactory.[2-5] There are multiple steps involved in the management of test results,[1,2,4,6] beginning with offices tracking their orders and the return of results to the clinician's office from the outside testing facility.  The results then go to the clinician, who reviews, signs, and interprets the result. The patient is notified, and needed follow-up is arranged. A recent study of testing process errors reported by family physicians and their staff found that errors cut across multiple result management steps and that serious harm has befallen patients by errors in results management.[6-8] While all result management steps are important and interrelated, errors in patient notification were predictive of more patient adverse events.[6]

Many practicing primary care clinicians hope that electronic medical records (EMRs) will improve medical practice.[9] In a recent qualitative study, practicing

family physicians felt that implementing an EMR was the most important thing they could do to decrease testing process errors.[3] Custom results management systems have been reported to improve both physician and patient satisfaction.[10-14] However, most commercial EMRs in use today do not have these same capabilities, and their ability to improve the quality and safety of the testing process has not been well studied.[9,15]

As part of a larger study of the testing process in primary care offices,[16,17] we studied the documentation of results management steps in patients' charts at eight primary care offices in the southwest Ohio region. While practicing physicians desire EMRs to improve testing process safety, safety experts recommend adopting standardized processes.[18,19] Therefore, we assessed whether results managed by an EMR or in systems with standardized results, management processes had improved results management documentation.

## Methods

The larger study used a multi-method protocol of observations, interviews, surveys, and chart audits to assess the testing process at eight purposefully chosen family medicine offices.[16,17] NCE (a family physician) and TRM (a human factors graduate student) performed site visits at each office for 1–4 days and collected other data before and after each visit. This study received approval from the University of Cincinnati Institutional Review Board.

### Practice Selection

Within the southwest Ohio region, we purposefully selected offices to provide variation around geographic location (rural, suburban, urban), practice size, patient insurance status, technology level (EMR, no EMR), and residency program (program, no program). A total of 10 practices were approached, and eight agreed to participate. Four offices were studied in 2007 and four in 2008–2009. Every office had some degree of affiliation with a larger health care system but functioned as an independent practice. As an exploratory study to describe results management, we had no means to know an office's results management quality prior to the study.

### Data Collection

**Chart Review.** We reviewed 25 charts at each office that contained lab or imaging results in the last 12 months. For EMRs, patient appointments from a date 2 months prior to the site visit were chosen, and one record for each clinician that day was arbitrarily chosen and reviewed for any test orders or results within the last 12 months. If no tests were done, then another record was chosen. If tests were ordered on multiple dates, then the most recent test orders (but not within the last month) were assessed. This was the simplest method to access charts for patients with recent visits within these EMRs. Once within the patient record, we did not search by clinician who ordered or managed the results but by most recent test orders or results. If multiple tests were ordered on one day, then all the tests were reviewed. We then moved backward a day at a time reviewing records until 25 charts with orders and/or results were reviewed. For paper records, the first chart on each medical records shelf section was reviewed for the presence of test orders or results within the last year but not within the last month. Again, this process was repeated until 25 charts were reviewed. To assure anonymity, we did not collect identifying patient or clinician data.

**Office Process Review.** Detailed descriptions of the multi-method data collection have been reported.[16,17] Briefly, at each office, we collected demographic data about the office and written protocols and procedures relating to the testing process. During the site visits, we observed staff and clinicians performing their tasks related to the testing process in hallways, nursing stations, the laboratory area, medical records, etc. We occasionally asked participants to "tell us what you are doing" or give opinions, ideas, and concerns about the testing process. We specifically looked for individuals performing tasks in all of the testing process steps, and when we could not find anyone actively engaged in these actions, we asked multiple individuals to describe their role and specific activities for the task.

### Data Analysis

We used chart review findings to assess the documentation of results management steps. Commonly grouped tests (complete blood counts, metabolic profile, etc) were considered a single test. We assessed five results management steps in the chart review: results in the appropriate place in the chart, clinician signature on the result, clinician interpretation of the results anywhere in the chart, and presence of and method of patient notification. For the subset of clinically significant abnormal test results, further assessment was made for the documentation of follow up plans.

From the office process review, we assessed the presence of standardized results management processes.[17] All the data sources were read, reviewed, and discussed by all the researchers. From this discussion, each step in the testing process was described in detail. We assessed standardized results management processes by the presence of written protocols and procedures and/or the presence of and adherence to office-wide practices for test tracking, clinician signature, clinician interpretation, patient notification, and, for abnormal results, follow-up plans.

An important issue in the analysis is whether the office, the clinician, the patient, or the test result is the unit

of analysis. We choose to use the test result of the unit of analysis for the following reasons. All of the offices had intra-office variability on how results were managed, and none performed all of the results management steps in a consistent, uniform manner.[16] Test results were returned to the office and to the clinician in different ways and at different times depending on the type of test and where it was performed. Clinicians managed each result as it returned and were often inconsistent in how they managed each one. Test results for a single patient were sometimes managed by more than just the ordering clinician. Therefore, we elected to use the test result as our unit of analysis, since each test result had to be independently tracked, returned, reviewed and interpreted, the patient notified, and follow-up plans documented. However, to assess for the importance of inter-office variability, we also noted the successful documentation rate of each results management step for each office.

Chi-squared analyses (using SPSS v17) were used to assess the relationship between the chart review findings and the presence of an EMR and the presence of standardized results management processes.

### Results

Table 1 details the eight offices participating in the study. Most were urban or suburban, and two were residency training sites. All the offices used more than

six centers for radiology and special testing. There were a total of 461 test results reviewed in the 200 charts at the eight offices. The number of results reviewed per office ranged from 30 to 82. Four offices had written protocols and/or adhered well to office-wide practices for two or three results management steps (Table 2). These management steps were patient notification (offices F and H) and clinician signature and test tracking (offices A, C, F, and H). The other four offices had only one or no steps with written protocols or results management practices that were well followed. None of the eight offices had standardized processes for documenting results interpretation or follow-up of abnormal results.

### Inter-office Variability

Table 2 also lists the documentation success rate by office for each of the five steps assessed in the chart review. The three steps of interpretation, patient notification, and follow-up for abnormal results had the greatest variability between offices, although three of the top four successful offices for each step were those with an EMR.

### Results Managed With EMR Versus Paper Records

When we consider each test result, there are statistically significant differences in the documentation of test results that were managed with an EMR versus

## Table 1

### Characteristics of Participant Primary Care Offices

| *Characteristic* | *Office A* | *Office B* | *Office C* | *Office D* | *Office E* | *Office F* | *Office G* | *Office H* |
|---|---|---|---|---|---|---|---|---|
| *Location* | *Rural* | *Suburban* | *Urban* | *Suburban* | *Urban* | *Suburban* | *Urban* | *Urban* |
| Number of clinicians | | | | | | | | |
|   Full time | 4 | 1 | 2 | 7 | 4 | 3 | 0 | 1 |
|   Part time | 12 | 3 | 2 | 6 | 3 | 3 | 3 | 28 |
|   Total | 16 | 4 | 4 | 13 | 7 | 6 | 3 | 29 |
| Number of women clinicians | 8 | 2 | 3 | 7 | 2 | 4 | 1 | 15 |
| Number of African-American clinicians | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 6 |
| Number of staff | | | | | | | | |
|   Full time | 16 | 1 | 9 | 23 | 9 | 14 | 2 | 14 |
|   Part time | 4 | 0 | 0 | 2 | 9 | 1 | 0 | 2 |
|   Total | 20 | 1* | 9 | 25 | 18 | 15 | 2 | 16 |
| Patient payer mix | | | | | | | | |
|   Commercial insured | 35% | 47% | 24% | 50% | 22% | 30% | 75% | 48% |
|   Medicare | 30% | 47% | 41% | 45% | 30% | 65% | 5% | 24% |
|   Medicaid | 25% | 1% | 17% | 0% | 38% | 0% | 20% | 25% |
|   Self-pay | 10% | 1% | 18% | 5% | 10% | 5% | 0% | 3% |
| Residency practice | Yes | No | No | No | No | No | No | Yes |
| Numbers of outside laboratories used | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |

\* Contracts with outside phlebotomy, receptionist, and health system billing.

Table 2

Description of Charting and Standardized Results Management Process and Success Rate
of Documentation of Results Management Step by Office Site

| Office Site | Type of Charts | ≥ Two Standardized Processes | % Successful Right Place in Chart | % Successful Clinician Signature | % Successful Interpretation | % Successful Notification | % Successful Abnormal Follow-up |
|---|---|---|---|---|---|---|---|
| A | Paper | Yes | 94 | 90 | 84 | 58 | 20 |
| B | EMR | No | 100 | 100 | 82 | 85 | 55 |
| C | Paper | Yes | 97 | 87 | 47 | 77 | 28 |
| D | Paper | No | 100 | 77 | 75 | 79 | 41 |
| E | EMR | No | 100 | 100 | 76 | 81 | 90 |
| F | EMR | Yes | 100 | 100 | 75 | 78 | 58 |
| G | Paper | No | 99 | 89 | 57 | 57 | 64 |
| H | EMR | Yes | 100 | 100 | 61 | 74 | 67 |

Successful—documentation of this step was found in the patient records.

EMR—electronic medical records

a paper chart (Table 3). While both paper and EMR systems did well in assuring that the results were in the appropriate place in the chart, all of the EMR test results had a clinician signature versus only 86% of the paper test results. Within an EMR, these two steps are both automatic digital processes that occur with little or no clinician input. In steps where active clinician and staff tasks are needed (writing an interpretation of the results in the chart and performing and documenting patient notification), the success rate drops off for both paper and EMR charted results, although the differences between them remain significant.

Table 3

Documentation of Results Management Steps
by Type of Charting System

| | Total | Results in Appropriate Place | Clinician Signature Present | Clinician Interpretation of Results | Documentation of Patient Notification |
|---|---|---|---|---|---|
| Paper | 187 | 183 (98%) | 161 (86%) | 120 (64%) | 123 (66%) |
| EMR | 274 | 274 (100%) | 274 (100%) | 201 (73%) | 218 (80%) |
| Total | 461 | 457 (99%) | 435 (94%) | 321 (70%) | 341 (74%) |
| P Value | | .027 | <.001 | .039 | .001 |

EMR—electronic medical record

Patients were notified of test results differently between those managed with an EMR and those with a paper charting system (Table 4). While mailing results was the most common method used for both charting systems, in the EMR systems, more test results were sent to patients by mail, and fewer were notified of their results only at an office visit.

For the subset of abnormal results, there were low rates of documentation of needed follow-up for both the paper and EMR managed results, although, again, the results managed with an EMR were significantly better documented than those with paper. There were 170 total abnormal test results, 82 managed in a paper chart system and 88 in an EMR. Thirty-three (40%) of the paper test results had documented follow-up, compared to 57 (64%) of the EMR results ($P=.001$)

*Results Managed With More Versus Fewer Standardized Processes*

We also analyzed each test result by whether it was managed with the presence of 0/one or two/three written protocols and/or adherence to office-wide practices. There were no statistically significant differences between the results managed with 0/one standardized processes and in the offices two/three for having results in the appropriate place in the chart, presence of a clinician signature, presence of clinician interpretation of results, or patient notification. Interestingly, the offices with fewer standardized

Table 4

Documentation of Patient Notification Methods
by Type of Charting System

|       | Total | Mail | Phone | Patient Called In | Office Visit | Unknown Method Used |
|-------|-------|------|-------|-------------------|--------------|---------------------|
| Paper | 123 | 56 (45%) | 11 (9%) | 0 | 38 (31%) | 18 (15%) |
| EMR | 218 | 143 (65%) | 36 (17%) | 8 (4%) | 29 (13%) | 2 (1%) |
| Total | 341 | 199 (58%) | 47 (14%) | 8 (2%) | 67 (20%) | 20 (6%) |

EMR—electronic medical record

*P*<.001 for notification method differences between EMR and paper managed results by chi-square analysis.

Unknown method—chart documented that patient was notified but did not document the method used.

processes were more likely to document follow-up for abnormal test results (67 (60%) of the 112 results from offices with 0/one versus 24 (40%) of the 58 results from offices with two/three, *P*=.01). However, as noted, none of the offices had any standardized processes for this step.

## Discussion

This research confirms previous findings that the testing process in primary care is complex and wrought with potential for errors and problems.[2-6,16,17,20] It is an initial attempt to relate the presence of an EMR, as well as some standardized process steps, to better documentation of results management steps. While we found that results managed by an EMR were significantly more likely to have documentation of results management steps, having a few of the processes standardized was not. Automated management steps were perfectly executed in the EMR, but those that required active staff and clinician input such as an interpretation were performed at much lower levels in both EMR and paper systems. We also found that having an EMR also changed how test results were likely to be communicated to patients. An important unresolved issue is whether an EMR really increases test result management quality or just documentation.

The use of the EMR for results management is an evolving process. Systems designed expressly for the purpose of results management have been reported to improve satisfaction for both patients and providers.[10,13] However, most primary care clinicians use "off the shelf" products,[21] for which managing test results is not occurring at full potential, because such features need to be customized and supported.[22] For example, the interpretation of findings and follow-up of abnormal

test results require clinicians and/or staff to actively enter information into the chart for these steps. There are multiple ways they can do so (separate note, copy of a letter to a patient, results attachment, etc). However, most EMRs do not automatically query for an interpretation or follow-up plan, nor make it a required field. Such reminders and forcing functions are strengths of EMRs, and more clinicians and EMR vendors need to work together to improve these systems.[21]

While standardized systems for office processes have been encouraged to improve safety and quality,[1] we found few standardized processes in results management in these eight offices, explaining and confirming previous findings of significant within-office variability on results management performance.[16,17] For example, one office documented an interpretation in 84% of their test results but follow-up plans in only 20% of abnormal test results. We also saw little effect of the presence of these few standardized processes on documentation rates. The worst performance, however, was in the two areas that had no written protocols or standardized practices—interpretation and follow-up of abnormal results. This may help explain why abnormal results with 0/one processes actually outperformed those with more—there were no standardized processes or support for these steps and therefore less importance attached to them within the office. A lack of abnormal result follow-up has been associated with important delays of diagnosis.[8,23]

Test result notification was also poor, with only 74% of results having documented notification. Previous research shows that patients are generally accepting of receiving results by phone or mail, and even though many want a personalized phone call from a clinician, others prefer whatever method has worked well for them in the past.[10,24-27] When available, patients are also generally satisfied with automated systems,[10] although none of our offices had such a system. We found that results managed with an EMR were more likely to be mailed to patients, likely due to the ease of producing letters within the EMR. While multiple notification methods may be appropriate within an office due to the variability of testing purposes and results, improving notification rates to 100% is important.

Inter-office variability was also present, especially documenting the steps of interpretation, notification, and follow-up. The EMR offices, however, seemed to have less inter-office variability than the paper offices, as well as having the better documentation rates. For example, the successful documentation rates for interpretation ranged from 47% to 84% in the offices with paper results and 61% to 82% in the EMR offices (Table

2). One benefit of an EMR for results management is that patient charts are never lost or misfiled, which may have improved documentation for all steps.

Documentation in the medical chart is not a perfect indicator of results management quality. Medical records both under- and over-document patient information.[28,29] For example, a patient may be notified of a test result, but no documentation made in the chart or a results letter may be prepared for a patient and never mailed, but the chart would "document" the notification. Automated data, such as the return of test results to an EMR and a signature automatically placed on the record after review, are more likely to be accurate than those data that are entered by hand. But, an automated signature when an EMR opens a test result does not guarantee a close reading. A documented interpretation would enhance the quality of such a finding. Even while less than perfect, though, medical records data are used to document quality of care.

This study has additional limitations. The geographic region was small, and offices in other areas might manage test results differently. There were no offices with exemplary results management process standardization, but as an exploratory study, we had no way of assessing office quality prior to their enrollment in the study. As noted above, we depended on chart review and documentation to assess completion of results management steps—additional data, including patient surveys and prolonged observations may improve the reliability of the chart review data and should be considered for future studies. Due to the pilot nature of this research, we were unable to arrange chart randomization by chart number or billing data, and by necessity, electronic charts and paper charts had to be accessed differently. However, we believe there was no systematic bias in our outcome measures in the chart selection as described.

The use of EMRs is rapidly advancing in primary care offices, although the variety and quality of the EMRs on the market today still varies greatly.[21] This exploratory study found that test results managed with an EMR were more likely to be in the right place in the chart, signed by the clinician, have an interpretation, and have patient notification documented. Abnormal results were more likely to have a follow-up plan documented in the chart. Having a few standardized processes for results management made little difference in results documentation, but there were no standardized processes for the most vulnerable steps. We believe that the EMR shows potential to assist practices in improving their test results management but that great progress still needs to be made, especially in those steps requiring staff and clinician thought and input. In these areas, the EMR still is not being used to its full potential.

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