Missed follow-up of abnormal test results and resultant delays in diagnosis is a safety issue that is gaining increasing attention. Despite increases in the numbers and types of available diagnostic tests, current systems in health care do not reliably ensure that test results are received and acted upon by ordering physicians. This article examines the case of a patient whose diagnosis of tuberculosis was substantially delayed because of systems problems, including poor continuity (with multiple-provider involve-

tive pneumonia secondary to a lung mass. Recommend a CT

Mr. Woods was prescribed another course of oral antibiotics. Several weeks after his CT scan, Mr. Woods returned to the satellite clinic and noted that his cough had improved.

While fortuitous that the patient returned for a follow-up chest CT 3 weeks after initial antibiotic treatment, the worrisome CT findings were probably not communicated to the ordering physician. This abnormal CT result (particularly the tuberculosis aspect) merited direct communication, such as a telephone call, from the radiologist to the ordering physician. As it transpired, the patient was merely prescribed another course of antibiotics and did not undergo a work-up for tuberculosis. Mr. Woods’s experience to this point highlights a critical safety issue: the inability or failure of an ordering physician to track and react to test results in a timely manner.

Failure to follow up on abnormal diagnostic test results is a critical weakness in patient safety, particularly in outpatient care (1). One study found that 75% of physicians did not routinely notify patients of normal test results (2) and that up to 33% of physicians did not even always notify patients about abnormal test results. In addition, less than 25% of physicians had a reliable method for identifying patients who were overdue for follow-up. Several studies (2–5) underscore the ongoing need to address this quality gap. For example, 31% of women with abnormal mammograms do not receive follow-up care consistent with well-established guidelines (4), while up to 33% of women with abnormal Papanicolaou (Pap) smears are “lost to follow-up” (5).

A recent analysis by a large malpractice insurer showed
that about 25% of diagnosis-related malpractice cases were due to failures in follow-up (6). Other studies reveal that communication breakdowns are causative factors in 80% of malpractice lawsuits (7). Lawsuits alleging failure to communicate radiology results are particularly prevalent and are becoming more so (8). In nearly 60% of these suits, the referring physician was not directly contacted about urgent or clinically significant unexpected findings (9), similar to the scenario in Mr. Woods’s case.

A recent study shows that delays in reviewing test results are common, and many physicians are not satisfied with how they manage test results (10). Many reasons potentially underlie this dissatisfaction. First, the volume of data to be reviewed is large; a typical primary care provider may review up to 800 results from chemistry and hematology reports, 40 radiology reports, and 12 pathology reports per week (11). Second, test results in the outpatient setting become available at times ranging from an hour to weeks after the tests are ordered, making it easy for physicians to forget to look for their results. Third, paper-based test-reporting systems are subject to delivery delays and misfiling. Fourth, specialists in testing areas often do not have adequate clinical information about why the test was ordered and do not have clear criteria for which results require a telephone call. For example, a recent study found little agreement between pathologists and clinicians about the types of results that constitute a critical value and the degree of urgency for contacting a physician (12). Even assuming consensus as to the latter, often no information is noted about the preferred and absolutely fail-safe communication mode (for example, how to proceed when a page is not answered or when a physician is out of town).

THE CASE, CONTINUED

One month after the lung CT was performed, Mr. Woods presented to the emergency department of the teaching hospital, reporting generalized weakness, fatigue, and decreased oral intake. The patient did not have any pulmonary symptoms at admission and reported no fever or chills. Unfortunately, his ability to relate relevant information was poor, and little further history was obtained.

His vital signs at this time were normal, and his lung examination was notable primarily for scattered rhonchi. A chest radiograph again revealed evidence of previous granulomatous disease and a persistent active cavitary process that the chest radiograph again revealed evidence of previous granulomatous disease and a persistent active cavitary process. It is unclear whether the emergency department could obtain the relevant outpatient records (including the CT scan result), which would have pointed them to a diagnosis of tuberculosis. It is unclear whether the emergency department routinely contacted outpatient caregivers to obtain relevant clinical information; if not, this is, unfortunately, not unusual. One study found that information was absent in almost 33% of emergency department visits (13), consisting primarily of missing medical history and laboratory test results, and that in half of the cases the information was essential to patient care. Systems such as electronic medical records (linking the inpatient and outpatient settings) or patient-owned medical records are being evaluated as tools to improve this communication gap. Unfortunately, the high cost of these systems has led to a slow rate of adoption.

The chest radiograph on admission to the hospital was reported as “prior granulomatous disease and probable active tuberculosis.” Again, a highly clinically significant abnormal finding that warranted direct communication from the radiologist to the medical team was not communicated. Obviously, the ordering physician is responsible for obtaining the results of any tests ordered. The resident probably read the radiograph himself, which often occurs during off hours. However, a key feature of a fail-safe system is a back-up system—“planned redundancy.” The radiology attending could have been the designated back-up and, in this case, might have caught the resident’s error by directly communicating the result.

Another major issue is the error made by the night-float resident in documenting a “normal” chest radiograph. The reason for this error is unclear, although he may have looked at the patient’s old radiographs instead of the new ones. If so, this would be a classic case of human error (14), probably related to human factors such as fatigue, workload, and interruptions. Digital imaging can help sift through the confusion that may be caused by the existence of several hard copy radiographs in reading rooms, any of which could be inadvertently interchanged. Digitized images also can decrease the misreading of dates, since the
**The Case, Continued**

Mr. Woods’s admission focused on a work-up of his anemia and deconditioning. An upper endoscopy revealed atrophic gastric mucosa, and colonoscopy findings were normal. A small bowel follow-through showed only diverticulosis. His anemia was attributed to a combination of vitamin B₁₂ deficiency and diverticulosis, and his overall deconditioned state was thought to be secondary to his spinal stenosis and chronic alcohol abuse.

During his hospitalization, the patient spent most of the day with his head under the covers and was often argumentative. This erratic behavior was attributed to depression and chronic alcohol use. During hospitalization, it became obvious that he could no longer independently perform his activities of daily living. Since he lacked a stable home environment and had no family members to assist him, social services recommended long-term placement. He agreed. After 3 weeks in the hospital, Mr. Woods was transferred to a local nursing home, where he remained for the next 2 months.

At the nursing home, Mr. Woods’s medical condition began to deteriorate further, and once again he was admitted to the teaching hospital’s medical service, this time with more advanced symptoms of weight loss, fatigue, shortness of breath, and cough. A chest radiograph now revealed cavitary pneumonia with progression of the previous infiltrates. Review of the patient’s radiology profile revealed similar chest radiograph reports, several dating to 4 months before this admission. He was immediately started on 4 antituberculous medications. Sputum smears revealed 4+/H1 acid-fast bacilli, and cultures later grew out Mycobacterium tuberculosis.

Mr. Woods had poor absorption of his medications and did not respond to therapy. Intravenous antituberculous therapy was added (totaling 7 drugs). He went into respiratory failure, was intubated, and was transferred to the intensive care unit. Mr. Woods’s condition was deemed not to be futile.

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**Figure 1. Timeline of events.**

- **Patient presented to outpatient clinic with weight loss and cough**
- **Chest radiograph revealed right upper lobe pneumonia; recommend CT**
- **Patient treated for bacterial pneumonia**
- **After 3 wk: CT scan revealed cavitary pneumonia; tuberculosis also a consideration**
- **Cough improved**
- **After 7 wk: Patient presented to emergency department with weakness, fatigue, and decreased oral intake**
- **Hospitalization: Chest radiograph showed probable active tuberculosis**
- **Patient discharged to nursing home**
- **2 mo later: Patient rehospitalized, received a diagnosis of tuberculosis, then died**

CT = computed tomography.

dates are usually sorted chronologically. However, technology can also introduce new errors (15), such as accidentally selecting the wrong image.

With respect to human factors, little is known about the detrimental effects of physician workload on quality and safety, although there have been several studies of the correlation between nurse staffing and errors (16, 17). A recent study demonstrated lower error rates by medical interns working 12-hour instead of 30-hour shifts (18). These types of data have led some states (such as California) to mandate minimum nurse-to-patient ratios and the Accreditation Council for Graduate Medical Education to limit resident duty hours. However, these restrictions inevitably lead to several handoffs in care, such as the resident night float system, which create their own errors (19).

Without robust systems to prevent fumbles, this patient fell prey to the dangers inherent in multiple handoffs. The night-float resident handed the patient off to the day team resident, who was then replaced by a second resident the following day. Because of heavy workload, and the fact that Mr. Woods had no pulmonary symptoms, the first resident did not reexamine the radiographs, particularly since he had been given what he considered to be a trustworthy sign-out. His actions are not unreasonable in the context of his workload, but they again highlight the need for back-up systems (such as a recheck of the radiograph) that could have caught the error. Unfortunately, a system that might have caught this error—the classic “radiology rounds” involving the inpatient team and a radiologist—is no longer used at most academic centers, a victim of duty-hours limits, subspecialization of radiology departments, and digital technology (which allows the medical teams to view radiographs on the ward without going to the radiology department).
and aggressive interventions were continued, including 4 successful cardiopulmonary resuscitations over the next few weeks. Ultimately, an estranged daughter was located and agreed to a do-not-resuscitate order. Soon thereafter, he again went into cardiac arrest and died.

**Toward a Better System to Prevent Fumbles**

Throughout this case, several opportunities to diagnose tuberculosis occurred, with multiple systems breakdowns that rendered a fatal delay (Figure 1). The current test result tracking and follow-up systems in health care are inefficient and chaotic, with many opportunities for delays and losses to follow-up. Simply exhorting physicians to be more vigilant is not the solution. Importantly, the high level of physician dissatisfaction with existing test result-management systems (10) makes the climate ripe for change. The Joint Commission for the Accreditation of Hospital Organizations has created a new patient safety standard for 2005 to “implement and evaluate a process to improve the timeliness of reporting critical test results” for both inpatient and outpatient settings, highlighting the importance of this issue (20). Research and quality improvement efforts that focus on equipping physicians with tools to meet this new standard must be a priority.

The Massachusetts Coalition for the Prevention of Medical Error recently completed a statewide initiative to design interventions to ensure fail-safe follow-up of test results. Brigham and Women’s Hospital is a participant in this initiative and has designed a series of questions for clinicians to use to identify “gaps,” or areas where test results could fall through cracks in testing areas (Figure 2). For example, how is the ordering physician identified when requisitions are incomplete? How are results handled when the ordering physician (for example, the orthopedist) is not the person who performs the follow-up (for example, of a pulmonary nodule)? What should radiologists do if they page a physician and do not get a response? Proactive assessments, using this kind of flow diagram as a guide, can identify vulnerabilities in the test follow-up process and then multidisciplinary hospital groups can develop potential solutions (Table).

More broadly, specialties such as radiology and pathology must develop fail-safe mechanisms of results communication and explicit criteria to identify which results must be immediately communicated (12). The 1999 American College of Radiology Standard for Communication: Diagnostic Radiology states: “If there are urgent or significant unexpected findings, radiologists should communicate directly with the referring provider, other healthcare provider, or an appropriate representative who will be providing follow-up. Direct communication can be accomplished in person or by telephone to the referring physician or appropriate representative” (8). However, putting this into action is difficult. For example, what is the definition of “abnormal” or “unexpected”? In addition, as the number of tests ordered increases, the ability to directly communicate becomes more difficult because of time constraints. Hospital radiology departments (and other testing areas as well, such as laboratory and cardiology) should create explicit criteria for abnormal results that must be directly communicated and should err on the side of communication when results fall into “gray” areas. Clinical laboratories have used these types of explicit criteria-based communication recommendations because they are required to have procedures for reporting panic values, and all institutions have a published panic value list (21).

In addition, explicit communication strategies and documentation of this communication (for example, acknowledgment of receipt of communication) and clear escalation strategies (for example, contact the head of the clinic if the primary care physician is not available or the attending physician if the resident does not answer) should be devised. Furthermore, the responsibility to communicate lies not only with the radiologist but also with the ordering provider. Ordering providers must document the reasoning underlying their test orders and their personal contact information. One study showed that for panic values, the ordering physician was reached only 12% of the time, meaning that other parties, including nurses and secretaries, frequently receive these results (22). Clear guide-
lines must be instituted to ensure that abnormal results are appropriately communicated to someone who can take action.

Hospital systems that can facilitate communication by flagging abnormal results and automatically paging or e-mailing ordering physicians about results (as well as documenting acknowledgment of this communication) could be helpful. For laboratory test results, normal or abnormal results can be identified reasonably easily (given that these are numerical values). Studies have demonstrated that physicians respond sooner when prompted by automatic notification of critical laboratory test results (23). However, automatic notification about other tests, such as abnormal radiology results, is challenging for several reasons. First, radiology results are often dictated as text notes that are not classified as normal or abnormal in any kind of coded way. Therefore, it is difficult for a computer algorithm to identify abnormal results. Second, many radiology results require follow-up by several providers (for example, specialist and primary care physician), so identifying who should receive the abnormal report can be problematic. Third, the issue of re-reads complicates matters further. A radiology test can initially be read as normal by a resident but later be read as abnormal by the attending radiologist. Systems must be able to detect these changes to allow for notification that a report has been altered. Work is currently under way to create radiology systems that can manage these issues in a more sophisticated way, and research must be done to demonstrate the benefits.

Technological strategies may also improve the result-management process for ordering physicians. While some physicians are conscientious enough to invent their own mechanisms to solve the problems inherent in paper-based systems, the substantial variability in the solutions highlights the weakness of this approach. A result-management tool that is integrated with an electronic medical record system may improve the process of test result review (Figure 3). De-

![Screenshot of results manager.](http://annals.org/pdfaccess.ashx?url=/data/journals/aim/20084/)
signers of these systems can incorporate standardized features that easily allow physicians to focus their attention on abnormal test results, to track all the tests they have ordered, to ensure results are reviewed, and to be warned if patients have sent results (11). Research is under way to measure the effect of this kind of system on the test result follow-up process.

Paper systems can also be successful; even hospitals and clinics that cannot afford expensive technology can create systems that are effective and safe. Examples include logbooks or spreadsheets that are managed by centralized personnel within a clinic and track tests that are sent and results that return. For example, the Brigham and Women’s Hospital’s dermatology clinic has a nurse whose responsibility is to ensure that results for all pathology specimens sent out are received back and that the dermatologists are aware of the results. This is done with a simple manual tracking system and is highly effective, with clear lines of responsibility (Graydon-Baker E. Personal communication). Technology is helpful but can also introduce new errors, so these processes, whether paper- or technology-based, must be constantly assessed for potential failures.

Handoffs were particularly notable in this case, and a worrisome issue with handoffs is diffused responsibility, which may lead providers (across the inpatient and outpatient settings) to assume that someone else is going to follow up on a test result. Clear lines of responsibility for follow-up must be established to prevent misunderstandings. For example, if a biopsy is performed on a polyp on colonoscopy, is the gastroenterologist, pathologist, or primary care physician responsible for following up on the pathology? This should be explicitly worked out among providers and documented in provider–provider communication that establishes who has primary responsibility. This is especially important in academic medical centers, where several physicians (interns, residents, attendings, and consultants) are responsible for care.

Finally, what is the role of the patient? Involving patients in their care and ensuring that they understand what tests are ordered and when they should receive results can add another checkpoint to the test follow-up process. The traditional “no-news-is-good-news” philosophy must become a thing of the past. Ultimately, inpatient and outpatient health care facilities must create standardized processes for both ordering physicians and testing areas, with sufficient back-up to create a fail-safe system, so patients like Mr. Woods cannot fall through the cracks.

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**References**


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Robert M. Wachter, MD, Moderator: The issue of building in reminders, decision support, and ticklers might risk information overload. Are people just going to ignore all of it?

Tejal Gandhi, MD, Discussant: Let’s look at the reporting of test results. When we spoke with the primary care doctors, they said they spent over an hour a day dealing with test results, so they are already in information overload, and the problem is they don’t have systems to make things more efficient. I think the issue of overdoing it is important. We’ve got a paging system for critical results, but the list of critical results is very small. If you start paging about a sodium of 146, you will drive people crazy. You have to be selective about how you stratify these results and which ones to escalate to these higher levels.

Dr. Wachter: Isn’t there a risk that all of this discussion about systems will take away a little bit of the passion? After all, this case was a complete, unmitigated disaster. A patient died of untreated tuberculosis; we didn’t even mention the fact that there were 100, 150, 200 people who came in contact with the patient, putting themselves at risk for infection. Does systems thinking diffuse the responsibility? What is the right balance there?

Dr. Gandhi: This case could have happened anywhere. Anyone involved in these cases feels incredibly badly. These are really well-educated, hard-working physicians who are trying to do the right thing. They have all of these external forces that make it difficult to do the right thing. Thinking about systems actually starts to empower people. This is not about taking away accountability and responsibility. This is saying that, first of all, we have to make sure that your hospital has good systems, and second of all, when cases like this happen, your responsibility is to prevent it from happening again; not just to feel bad, because everyone does anyway . . . that makes it personal, but in a much more positive way.

A physician in the audience: There’s an old axiom that doctors bury their mistakes. That’s unfortunate. The lecture spoke a lot about systems and communication being very important. I think we’re all taught at one point or another that it’s not enough just to order a test but that you need to see it all the way through, which means to do the follow-up, then to act on it, whether it’s negative or positive. I heard the word “accountability” mentioned a couple of times, so I’ll say something that’s kind of unpopular. I believe that if true accountability was tied—not to the innocent mistake . . . but to some sort of physician profiling, physician report card, tied to medical staff privileges or even licensure . . . you would see doctors making a lot less mistakes.

Dr. Gandhi: Well, I’m not sure I agree with that. In this case, the night-float resident tried to do what he was supposed to do, tried to follow up on tests, but he misread an x-ray report, it was late at night, the lighting was bad, he got paged in the middle of it. Pointing blame at that particular person and [threatening] his credentialing for that kind of mistake—which ended up being catastrophic, but just as easily could have ended up being nothing—I don’t think will actually solve anything. Penalizing physicians for hospital systems that are pretty lousy at getting information out, I don’t necessarily think is going to improve things. People can only try to work harder so much. You’re never going to get to 100% with “just try harder or we’ll punish you.”