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Communication breakdowns and diagnostic errors: a radiology perspective

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Abstract

Timely and accurate communication is essential to safe and effective health care. Despite increased awareness over the past decade of the frequency of medical errors and greater efforts directed towards improving patient safety, patient harm due to communication breakdowns remains a significant problem. Communication problems related to diagnostic testing may account for nearly half of all errors made by typical primary care physicians in their medical practices. This article provides an overview of communication breakdowns in the context of radiology related diagnostic errors. In radiology, communication breakdowns between radiologists, referring clinicians, and patients can lead to failure of critical information to be relayed, resulting in delayed or missed diagnosis. New technologies, such electronic health records (EHRs), contribute to the increasing complexity of communication in health care, but if used correctly, they can provide several benefits to safe and effective communication. To address the complexity of communication breakdowns, a multifaceted sociotechnical approach is needed to address both

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technical and non-technical aspects of health care delivery. The article also provides some future directions in reducing communication breakdowns related to diagnostic testing, including proactive risk assessment of communication practices using recently released SAFER self-assessment guides.

Keywords

electronic communication; electronic health records; health information technology; medical informatics; primary care; radiology; test results

Introduction

Health care delivery is dependent on highly trained individuals from disparate backgrounds who assume complementary roles and responsibilities. Timely and accurate communication is essential for the provision of safe and effective care. Poor teamwork and communication breakdowns, even within dedicated and highly conscientious teams, might still result in medical errors that cause delays in care and harm to patients [1–3]. Communication breakdowns between radiologists, referring clinicians, and patients can lead to failure of critical information to be relayed, resulting in patient harm. A growing body of research has attempted to improve understanding of the epidemiology and root causes for such errors and sought to identify strategies to prevent or eliminate the circumstances that allow breakdowns to occur. Directing solutions towards the root causes of communication breakdowns could lead to reductions in missed and delayed diagnoses and care [4].

Communication breakdowns and medical errors

In the outpatient setting, medical errors are believed to be a significant problem, and recent studies have begun to highlight the extent of errors in the ambulatory care [3, 5–10]. A 2011 report from the American Medical Association synthesized the data in outpatient safety and found that communication breakdowns, and resulting medical errors such as missed and delayed diagnosis, were significant problems in the outpatient setting [11]. Although it is challenging to quantify the frequency and burden of preventable medical errors in outpatient care, it has become clear that error-related deaths occur much more frequently than once assumed. Greater efforts are needed to better understand the causes of these errors and identify methods to prevent or ameliorate them [12, 13]. Communication breakdowns may be relatively amenable to change as compared to other sources of error.

Communication breakdowns are responsible for about two-thirds of Joint Commission sentinel events [1]. The current environment in both hospitals and physicians' offices is rife for such failures of communication between radiologists, non-radiology physicians, and patients. Information overload also contributes [14], and research has revealed that the typical primary care physician receives 800 chemistry reports, 40 radiology reports, and 12 pathology reports a week [15]. Eighty-three percent of these physicians report delays in receipt of test results, and only 41% indicated that they are satisfied with how test results are managed. Communication problems related to diagnostic testing may account for nearly half of all errors made by typical primary care physicians in their medical practices [16]. A

recent study of communication and information transfer at hospitals found that direct communication between hospital-based physicians and primary care physicians occurred in only 3%–20% of discharges [17].

The etiology of communication breakdowns

Numerous social and technical factors interact to allow the delivery of care, and with the rapid evolution of clinical practice and emerging use of electronic health records (EHRs), the numbers of factors impacting clinical care appear to be increasing exponentially, making analysis of patient safety issues initially appear daunting. A recent eight-dimensional socio-technical model attempts to place these factors in perspective when analyzing patient safety in the context of evaluating and improving health information technology-enabled health care systems [18]. This model outlines eight interactive factors that serve as a guide when studying the design, use, implementation, and evaluation of health information technology (see Table 1).

Test result management is particularly vulnerable to communication breakdowns. The testing process is complex and requires efficient coordination and communication across multiple teams in multiple systems of care. Failures in this process can result in patient harm and malpractice litigation [3, 19]. Ineffective communication is a commonly cited factor in patient care delays, and includes failure to take action on abnormal test results [15, 20–24]. This issue led the Joint Commission to introduce a National Patient Safety Goal in 2005 (NPSG 02.03.01) requiring health care institutions to “report critical results of tests and diagnostic procedures on a timely basis.”

Communication of test results is known to be particularly vulnerable during transitions of care, which is quite the norm in radiology. Because it is impossible for individual providers to deliver continuous around-the-clock care, it is inevitable that the care of patients will transition between providers. Transitions of care have included two types of care transfers: when an incoming physician assumes care of a hospitalized patient (such as overnight coverage) and during discharge when care is effectively transferred from the hospital to the patient’s primary care physician. Both transfers require essential information to be efficiently passed from one provider to the next, the process of which is often referred to as a “handoff.” In electronic systems, final radiograph interpretations (as well as amended interpretations) are often automatically routed to the ordering provider. However, if the patient has been discharged or transitioned to another treating provider, the new provider may not be made aware of the new or amended results, resulting in a delay in follow-up action in response to the result.

Complexities around communication of test results

Although critical test results are a key focus of many efforts to improve communication processes, communications breakdowns occur across the spectrum of abnormality and severity [25–30], including those that are not immediately life threatening. For instance, many findings do not meet the usual definition of “critical” but require relatively prompt action within several days, such as a chest radiograph with a shadow suspicious for cancer. In these cases, communication delays are compounded by the fact that *synchronous*

communication (i.e. communication when all parties involved in the communication are present at the same time, such as verbal discussion, and as opposed to *asynchronous* communication when parties are not present, such as with e-mail, faxes, etc.) does not often occur as it does with more emergent findings, given the additional time and resources that would be required. These results nevertheless require prompt further diagnostic work-up and treatment, for instance, to prevent a cancer from progressing to a stage at which therapy is less effective. However, follow-up of abnormal findings, especially those communicated through asynchronous methods, might not always occur [23, 31]. It is estimated that approximately 4%–8% of electronically delivered abnormal test results fail to receive timely follow up [20, 32, 33]. Although research on follow up in non-electronic (e.g., paper-based) medical record systems is limited due to the difficultly of mining such data without the use of computerized methods, the follow-up rates in paper-based systems are likely worse [31]. In studies of malpractice claims, inadequate follow-up, including ordering of subsequent testing and developing of an appropriate follow-up plan, was commonly cited (55%) in cases of patient harm, many of which related to inadequate communication and follow-up surrounding test results, including tests indicative of a potential cancer diagnosis [3, 34].

Follow-up of abnormal test results requires a chain of events to occur reliably, including delivery of the result to the provider, identification of the abnormality and need for follow-up by the provider, and taking follow-up action. Each of these steps presents opportunities for breakdowns in the process leading to delayed follow-up. The socio-technical model [18] has helped uncover several causes for delayed action after an abnormal test result, occurring both before and after the results actually becomes available. As an example of a hardware and software-related cause the model has helped to identify, imagine the following: a CT scan without contrast is ordered via a physician's written order. However, due to poor handwriting, the clinic's secretary misinterprets the order while transcribing the test and orders it *with* contrast in the clinic's 1-way ordering system with the radiology department. The test is performed and an incidental finding suggestive of cancer is identified. Although the result is entered into the patient's electronic record, the ordering physician is not alerted and does not view the result until the patient's follow up visit several weeks later. In this instance, the lack of a direct computerized provider order entry (COPE) system created the opportunity for transcription errors, and the absence of a two-way system-to-system interface for ordering tests prevented the results from being routed to the ordering provider once it became available [35].

While it has become clear that making a diagnosis is an important step in patient care, communicating this diagnosis is equally important [36]. Failing to relay diagnostic findings jeopardizes the advantages of advanced imaging modalities and time and skills of highly trained radiologists. For example, if ambiguity exists in the responsibility for follow-up of abnormal imaging results (Organizational Policies and Procedures in the social-technical model), or if clinicians are not appropriately trained to manage test results (Personnel), appropriate follow-up action may not occur [35]. Fortunately, in addition to policy recommendations provided by the American College of Radiology (ACR), electronic systems and institutional emphasis on strong policies, procedures and processes can

potentially improve the safety and efficiency of transmitting these results and prevent delays that could lead to patient harm [37].

Four types of results are at particularly high risk for lack of follow-up [36, 38, 39]. The first includes findings that require urgent or relatively prompt action to prevent patient harm, such as a tension pneumothorax. However, these cases are often easily identified and widespread agreement exists that direct synchronous communication between the radiologist is warranted [21, 36]. The second type involves “incidental” findings that are unexpected given the patient’s history and reason for these tests. For example, a chest radiograph performed after a traumatic incident to evaluate for rib fractures may uncover a lung nodule suspicious for cancer. Because clinicians are immediately concerned with managing the trauma, the finding may go unnoticed, potentially until disease progresses. The third type involves findings that are questionable or require additional imaging to make a definitive diagnosis. The fourth type involves instances where final or amended interpretations differ significantly from an initial read. For example, the initial read may be from a resident or a non-radiologist, such as an emergency room physician who makes his own interpretation overnight before the radiologists is able to formally review the image in the morning. If the amended report arrives after the treating clinician has read the original report, it may go unnoticed and care may not be appropriately modified. Each of these cases requires additional communication practices to ensure that the critical findings are appropriately transmitted from the radiologist to the appropriate clinician to ensure follow up.

Communication of test results in EHR-based record systems

With the increasing use of EHRs, new channels of communication have become commonplace. Providers are now able to transmit asynchronous messages (and sometimes use synchronous chat functions) electronically through EHRs. The EHR has also become a medium for automatic delivery of various types of information, including lab tests, imaging reports, and patient status information [14]. Thus, the EHR has slowly transformed from a repository of clinical information into a functional communication tool for health care providers.

Compared to paper systems, EHRs carry many benefits. The most prominent benefit is the ubiquitous access to clinical information. Unlike paper records, which can be only used by one individual at a time, electronic records allow simultaneous access by many clinicians in disparate, or even remote, locations. EHRs have successfully removed bottlenecks that occur when multiple clinicians care for the same patient at a time (a common occurrence in the hospital setting), and have eliminated the need for support staff to pull and transport paper charts for patient visits, increasing the rapid availably of information. Additionally, EHRs provide automatic routing functions that automatically deliver information to the appropriate individuals. For example, EHRs permit chest radiographs to be directly routed to the radiologist responsible for reading this type of film, and automatically route the radiologist’s report back to the ordering provider. Abnormalities can be coded electronically and thus flags can be created while transmitting this information back to the referring physicians. Also, the EHR can be used to extract and identify certain types of abnormal imaging test results at risk of being lost to follow-up [40]. Furthermore, EHRs that include “portals” that

allow patients to access their clinical data have enabled greater patient engagement and satisfaction in their care [41, 42]. Unfortunately, some benefits are less universal due to differences in EHR software designs, configurations, and environments into which they are installed, as well as training provided to use them [43].

Although benefits have been gained from the transformation from paper systems to electronic records, several unintended consequences have also surfaced. First, the ease at which EHRs allow information to be created and stored has resulted in considerable quantities of information that must be searched to identify pertinent information. If system developers are not careful in managing the interface content and design, clinicians can quickly become overloaded by the vast amounts of information. In addition to increasing the difficulty of extracting pertinent information, this also raises legal concerns should a critical piece of information be missed. Information overload is a common and emerging issue in today's health care [44]. It is estimated that primary care providers receive 50–60 notifications (or "alerts") each day consisting of hundreds of data points [14, 15]. The act of processing this information alone may require approximately an hour each day, and is often performed in an interruptive environment between episodes of direct patient care. Thus, system designers must carefully consider how data is organized and presented in EHRs, and administrators must carefully consider information overload in the policies they create. For example, providing insufficient non-face-to-face time for clinicians to process notifications can compound the problem. In addition to reducing clinician job satisfaction, this may have an untoward effect of causing providers to miss critical information within the vast amounts of data [44].

The interface between human and computer is rarely seamless. The "real-world" usability of a system from the human perspective is a key consideration in patient safety and has important implications in the interfaces employed by radiology information systems and radiation therapy delivery systems, as well as the systems used to communicate diagnostic imaging results to providers and patients. Catastrophic errors have resulted in which the major contributing factor was poor system usability and human factors engineering [45–47] as well as when clinical workflow is not considered while designing these systems. Even well-intentioned and seemingly straightforward components require usability and workflow considerations. For example, a recent study identified that the use of dual notification with abnormal imaging test results (i.e., notifying two clinicians about an abnormal test result instead of one) was associated with a paradoxically lower rate of follow up [21]. This was because each clinician believed that the other person was responsible for managing the abnormal result. This study outlines the need for a real-world usability and workflow evaluation to ensure information systems support patient safety efforts. Additionally it underscores the need for a multifaceted approach to addressing the patient safety issue, such as policies and procedures that address responsibility assignment and EHR systems that support electronic assignment of responsibility. This is where the application of the socio-technical model could be especially useful.

Finally, the use of electronic systems may also lead to over-reliance on technology. When paper systems "fail", only small amounts of information are typically lost at a time. For example, a paper chart or radiograph may become misfiled; however, only the individual

record has been lost. Conversely, EHR failures, although not frequently described, tend to be significantly more widespread and may severely impact the ability to deliver care. While conducting a recent study, we incidentally identified a software configuration error at a single facility that prevented transmission of over a third of positive fecal occult blood test results to primary care providers [48]. Such instances emphasize the need for not only thorough testing and usability evaluation, but also for monitoring of the EHR-enabled health system to evaluate for unusual data trends that portend a patient safety issue.

Future directions in reducing communication breakdowns

Efforts are underway to identify preventable diagnostic errors and communication breakdowns among clinicians and between clinicians and patients. Emerging solutions have ranged from providing feedback via peer review programs to sophisticated computer algorithms that analyze thousands of EHR data points to flag records with high likelihood of a medical error [49, 50]. These methods attempt to address different types of vulnerabilities within the health care system, thereby providing a multifaceted approach to improving communication and patient safety.

Several general practices have been studied and have shown promise in ensuring accurate and effective communication. Unfortunately, these practices are not yet widespread. In synchronous communication, a technique adapted from military application, SBAR [51], can be used to structure information in a meaningful manner. SBAR stands for Situation, Background, Assessment, Recommendation, and provides a streamlined template for prompt communication:

- **Situation**: Identify yourself, Identify the patient, State the reason for the communication
- **Background**: Provide relevant history and events related to the call
- **Assessment**: Provide relevant data and a clinical impression
- **Recommendation**: Describe what action or information is needed, make suggestions on what action is to be taken, and clarify expectations.

This and other forms of communication can be followed using the “read-back” technique [52], whereby the recipient writes down then repeats back the information received to ensure accurate transmission. Realizing the importance of accurately communicating verbal information, the Joint Commission instituted a National Patient Safety Goal (NPSG 02.01.01, subsequently moved to Joint Commission Standards) requiring read-backs of certain types of verbal communication, including critical test results. Another technique to reduce errors in communication involves establishing an environment free from or with limited distractions, noise, and other interruptions. Despite the importance of these techniques, they remain time consuming in the busy clinical environment. To improve the efficiency and reliability of relaying critical imaging result to ordering providers, new services called Critical Test Result Management (CTRM) systems have emerged. Using CTRMs, radiologists are able to relay messages about critical imaging results to a centralized service, which then relays the message to the ordering provider. Successful communication is documented, allowing closed-loop communication, while undelivered

messages can be escalated via a pre-defined pathway. In this way, CTRMs have the potential to improve the communication of critical imaging results, provided they are properly installed and configured, and both the radiologist and ordering provider sign up for the service and use it consistently and appropriately.

In order to prevent delays in care after abnormal test results and reduce their potential for negative patient outcomes and malpractice litigation, resilient systems need to be in place to ensure follow-up action is performed in a timely manner and is appropriate. Several best practice recommendations have been suggested by multiple groups aimed at improving the process of communicating and following up on test results [22, 40, 53]. Recently, proactive risk assessment guides, called SAFER Guides, were released by the Office of the National Coordinator for Health Information Technology (ONC) that could help institutions assess the safety of their communication practices. Together, these recommendations encourage institutions to develop clear processes and procedures to guide radiologists and clinicians with ensuring effective communication of test results. For example, the guides recommend that clear definitions should exist for different categories of results based on urgency and severity. Such definitions promote a uniform understanding of institutional practices among all users and can help to clarify what actions are expected in response to results deemed “critical,” “abnormal,” and so forth. In order for EHRs to take full advantage of these definitions and support effective communication between radiologist and non-radiology clinicians, radiology reports should be electronically assigned a standardized structured code that relays the finding and urgency for follow up [53]. For example, just as BIRADs coding has improved the consistency of mammography reports, codes such as “finding suggestive for cancer” could allow EHRs to alert providers to more urgent information within other radiology reports and track acknowledgement and response [49, 53, 54]. However, additional work is needed to develop a set of standardized codes that would be applicable nationwide. Additional best practice recommendations from these guides encourage the promotion of clarity of provider roles in the follow-up of different categories of results by providing guidance on which modalities of communication to use and in what timeframes (e.g., hours, days, etc.), use of electronic systems that allow tracking of orders until testing has been completed and results have been acknowledged, and tools that allow assigning surrogates when an ordering provider is expected to be unavailable [55]. Wherever possible, relevant stakeholders in the process should be involved in creating policies that will be of value to those who will implement and use them. Application of these principles has already shown promising results in improving the test result communication and follow-up process [56].

Furthermore, patients are becoming increasingly involved in their own care, and the legal system has repeatedly upheld their right to receive timely information about medical tests [36, 57, 58]. The end of the “no news is good news” era is fading quickly, and patients are becoming increasingly connected to their providers. Although clinicians have traditionally relied on phone conversations and postal mail to deliver test results and other information to patients, many are increasingly adopting internet-based “web portals” to allow access to information. Thus far, patient interest in web portals has been high, likely due to dissatisfaction with existing methods of patient-provider communication [59]. However, there is an ongoing discussion around whether and how certain abnormal results should be

automatically delivered to patients without an opportunity for the ordering provider to review the results [60]. Proponents argue that the information belongs to the patient, and sending them their test results will likely empower patients to ask questions when they find concerning results, thereby averting much of the patient harm that occurs when test results are not conveyed [61]. However, concerns have been raised that many patients are unlikely to fully understand their results due to their lack of proficiency in the highly technical language used in radiology reports [62, 63]. Providers are concerned that this may result in their becoming inundated with calls about insignificant abnormalities, increase their exposure to malpractice risk, and cause unnecessary distress among patients [61, 62]. However, initial research in a setting where web portals have been implemented has not supported these concerns [64]. Additional work is needed to evaluate the impact of delivery of results directly to patients on reducing errors and delays in ambulatory care.

Finally, new techniques to identify instances where an abnormal test result has failed to receive appropriate and timely follow up are undergoing evaluation [49]. Electronic triggers, or signals to flag records where a potential patient safety event has occurred, can be used to inform clinicians that a patient is lacking follow up after an abnormal test result. Triggers use complex algorithms to scan the vast amount of clinic data within an EHR and identify patients where an abnormal test has been entered in to the patient record, but no appropriate follow up has been detected. They have been applied to both abnormal laboratory results, as well as certain types of abnormal imaging tests and have shown early promise in efficiently detecting missed cases among large numbers of patient records, thus avoiding manual review of all the records to find these missed cases [49]. Triggers may be used to not only mitigate harm to patients who have “fallen through the cracks” but also to prompt review of unsafe policies or practices that may underlie repeat errors.

Summary

Communication remains a key aspect of almost all processes involved in the care of patients. It is therefore prudent that the complex systems we employ to deliver care emphasize maximizing the accuracy and efficiency of the communication process. In the last decade, such processes have changed drastically with the increased knowledge that communication breakdowns greatly contribute to patient harm and with the widespread adoption of EHRs. A wide variety of methods to improve communication have been developed, ranging from techniques for streamlining and ensuring accurate information transmission between clinicians to systems that provide computerized support for communication processes. This includes conducting a proactive risk assessment of communication practices using recently released SAFER self-assessment guides. However, we are still only beginning our journey to eliminate communication breakdowns and as new technologies such as EHRs are implemented, the complexities will be higher. New approaches are needed that must continue to understand and address the root socio-technical system factors that allow communication-related errors to occur.

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Table 1

Dimensions of the socio-technical model (adapted from Sittig and Singh) [18].

Dimension	Description
Hardware and software	The computing infrastructure used to power, support, and operate clinical applications and devices.
Clinical content	The text, numeric data, and images that constitute the “language” of clinical applications.
Human-computer interface	All aspects of technology that users can see, touch, or hear as they interact with it.
People	Everyone who interacts in some way with technology, including developers, users, IT personnel, and informaticists.
Workflow and communication	Processes to ensure that patient care is carried out effectively.
Internal organizational features	Policies, procedures, work-environment and culture.
External rules and regulations	Federal or state rules that facilitate or constrain preceding dimensions
Measurement and monitoring	Processes to evaluate both intended and unintended consequences of health IT implementation and use.