Radiology Reporting: A Closed-Loop Cycle from Order Entry to Results Communication

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With the increasing prevalence of PACS over the past decade, face-to-face image review among health care providers has become a rarity. This change has resulted in increasing dependence on fast and accurate communication in radiology. Turnaround time expectations are now conveyed in minutes rather than hours or even days. Ideal modern radiology communication is a closed-loop cycle with multiple interoperable applications contributing to the final product.

The cycle starts with physician order entry, now often performed through the electronic medical record, with clinical decision support to ensure that the most effective imaging study is ordered. Radiology reports are now almost all in electronic format. The majority are produced using speech recognition systems. Optimization of this software use can alleviate some, if not all, of the inherent user inefficiencies in this type of reporting. Integrated third-party software applications that provide data mining capability are extremely helpful in both academic and clinical settings. The closed-loop ends with automated communication of imaging results. Software products for this purpose should facilitate use of levels of alert, automated escalation to providers, and recording of audit trails of reports received. The multiple components of reporting should be completely interoperable with each other, as well as with the PACS, the RIS, and the electronic medical record. This integration will maximize radiologist efficiency and minimize the possibility of communication error.

Key Words: Reporting, speech recognition, computerized physician order entry (CPOE), decision support, results communication, data mining

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OVERVIEW

Accurate and timely communication of patient care-related information among medical professionals represents a major challenge in prevailing health care delivery systems, which typically involve multiple providers and auxiliary sources of information, such as laboratory and imaging data. Knowing that information sent has been successfully received and understood by the intended recipient is important for each participant in patient care. This type of communication is called "closed-loop" because the information is first sent out to its intended recipient to start the cycle and then a message comes back to the originator, confirming that the information was received and completing the loop.

Confirmation of receipt and understanding is easy when communication is synchronous (ie, both participants involved in the communication physically participate in the activity at the same time via telephone, online meeting, etc.), but when communication is asynchronous (eg, e-mail) and separates participants in space and time, confirmation of successful communication may be more difficult. Additionally, permanent documentation of successful and timely communication is often critical for medicolegal and quality assurance activities, despite the challenges of asynchronous communication.

Radiologists are particularly susceptible to the consequences of failures in closing the communication loop. With speech recognition software, reports can be created

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and finalized in near real time. Such reports are immediately available in the RIS and, if an electronic health record is present, may become available in a patient's electronic medical record (EMR) soon thereafter. However, no built-in confirmation mechanism ensures that the ordering and consulting physicians have read (and completely understood) the report. In many instances, reports are still distributed to referring physician offices via fax or other analog means. In rare instances, an imaging examination may have been requested by a third party, such as an insurance company, in connection with employment or immigration procedures. In those instances, an ordering physician may not have been recorded, and the radiologist may have entered what is normally a direct doctor-patient relationship, with all of the associated responsibilities. This relationship may require direct communication of results of the examination to the patient [1]. In addition, a specific radiologist's recommendations in a given report may be overlooked; as a result, failure of communication is one of the most common sources of litigation against radiologists [2].

When emergent or urgent findings are discovered, radiologists may decide to use synchronous communication tools to convey the critical information (eg, a telephone call to the ordering physician). However, even this system may succumb to closed-loop failures when the ordering physician is unavailable and a proxy, such as a nurse or physician assistant, must be used. Furthermore, synchronous communication methods are resource intensive for both the radiologist and the ordering physician, and they require physician time; therefore, such methods cannot be applied universally to radiology interpretations. Direct radiologist-to-patient communication is one method of addressing this issue, but it does not solve the underlying problem that the ordering physician may not have received the needed information. Additionally, patients may not be able to fully understand the information given to them by their radiologist.

Ensuring that routine results and long-term follow-up recommendations are received and understood is a universal challenge in medical imaging. To ensure complete and timely relay of relevant information, the entire communication loop must be considered, from the decision to order a radiologic test to image creation, report creation, report dissemination, and confirmation of receipt. Seamless interoperability of software systems is a necessary foundation for success, as is a data model that allows for quality control and benchmarking of successful closed-loop communication.

ORDER ENTRY

Order entry or request for a radiology consultation by the clinician is, ideally, the start of a closed-loop communication instance that ends with the clinician receiving the finalized radiology report.

RIS or EMR

The number and complexity of imaging procedures are increasing. Many clinicians, especially nonspecialists, may find that selecting the most appropriate examination is a challenge. In many cases, the study eventually performed is not the correct or most appropriate one. Telephone communication between clinician and radiologist may be required to determine what procedure best answers the clinical question.

Computerized Physician Order-Entry Software with Decision Support

A description of the computerized physician order-entry (CPOE) process is as follows:

- Clinician chooses patient's signs and symptoms as well as reason for study from menu;
- Clinician chooses imaging study from menu;
- CPOE software analyzes the entered data as well as patient demographics and presence of prior examinations;
- ACR Appropriateness Criteria® rank is assigned to the examination order entered;
- Clinician is notified at the time of order entry if the study is deemed appropriate, questionable, or inappropriate. Often an empiric sliding scale is used to express level of appropriateness;
- The system may suggest an alternative imaging study if the initial study requested is considered inappropriate;
- Clinician can override the suggestion if so desired, but this action may be logged and can be subjected to peer and/or administrative review.

Current ACR Appropriateness Criteria combine consensus-based or evidence-based approaches to arrive at decision rules. Advantages of CPOE with decision support include the following:

- Clinician receives assessment of choice at the time of order entry, which provides guidance and an educational opportunity;
- The software process is accepted by some insurance companies in place of authorization by radiology benefit-management companies;
- The database of historic physician orders is available for process management by authorized administrators. Outliers and undesirable ordering patterns can be identified, and physicians may be counseled on better choices;
- Substantial decreases in the growth rate for imaging utilization have been described after deployment of such systems, documenting a potential sustained effect on ordering behavior [3].

The CPOE software ideally should be embedded within the EMR for seamless physician ordering; however, standalone technology is available from several companies engaged in this domain. Ordering rules should be