Radiology Order Entry: Features and Performance Requirements

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Radiology has benefited from the progress in information technology perhaps more than any other medical specialty. Stunning progress has been made in the way that images are created, stored, and retrieved. These advances have brought imaging ever closer to the core of medical practice and decision making.

However, systems to manage workflow, ensure patient safety, optimize device and modality utilization, and improve business efficiency remain relatively primitive. Perhaps the inattention to these functions is because they are less impressive and glamorous than the new methods of seeing the body. However, the rapid growth of high-tech imaging has led to increasing appreciation of the need to conserve resources. It has been our impression that information technology vendors are relatively unaware of the scope of these needs and how to satisfy them within the context of common radiology and medical practice.

In this column, we describe the features that we think an electronic order-entry system should have. Some of these are incorporated in a prototype system developed at and already functioning in our institution. Other features are awaiting additional development, and still others are more accurately described as wishes rather than plans. We hope that others will be stimulated to do the same, so that information technology vendors will understand the need.

GENERAL REQUIREMENTS

An order-entry system should be web-based and work over an intranet, and it should also be accessible on the Internet for external referring clinicians. It is very important that when it is used, such a system replace (not supplement) prior methods of ordering. Thus, a telephone call should not be required to verify or confirm an electronic order.

Because an order-entry system will be one of the primary points of contact between a radiology department and its referring clinicians, it should provide an opportunity to market services and communicate through the use of banners or other postings. This feature might be used for notifications of various sorts, such as changes in procedures and examination availability. The system should also provide "feedback" capabilities to allow users to easily communicate with the radiology department concerning matters unrelated to a specific examination, such as requests for changes, inquiries, and so on. The order-entry system may also offer an effective means of distributing examination results back to the ordering physician for each examination ordered.

RELATION TO RADIOLOGY INFORMATION SYSTEMS (RIS) AND HOSPITAL INFORMATION SYSTEMS

Should an order-entry system be part of an RIS? It is clear that it must be very tightly integrated with the RIS. A two-way flow of information is needed. Thus, patient demographics, the results of prior examinations, and known allergies will probably be obtained from the RIS, whereas histories and scheduled examinations must be transferred to the RIS.

The transfer of information from the order-entry system to the RIS and from the RIS to the order-entry system must be electronic to minimize time and the possibility of errors. Additionally, a variety of electronic interfaces to other hospital systems for user authorization, patient registration, physician dictionaries, and billing may be necessary for effective examination scheduling.

SECURITY AND PRIVILEGES

All interactions with an order-entry system must be secure and compliant with the Health Insurance Portability and Accountability Act. The system must identify the individual placing an order and verify that the individual is authorized to do so. The individual who places an order may be either the responsible physician or a designate of the physician (nurse, physician assistant, resident, etc), but the responsible physician must be identified in each case. The system must also allow the designation of other individuals to whom reports should be delivered, such as consultants.

Order entry should permit 2 modes of interaction: 1 for physicians and 1 for administrative personnel. Thus, interactions requiring medical expertise (history

and decision support—see below) should be reserved for physicians, whereas appointment selection or the rescheduling of previously ordered examinations could be done by others.

EXAMINATION SPECIFICATION AND PROVISION OF HISTORY

Order entry should require all information necessary to completely specify and perform an examination. For example, when spine imaging is requested, the order-entry system should require that the level (cervical, thoracic, lumbar) be specified. For extremity imaging, it should not be possible to complete an order without indicating the side. When it is variable, the components that are included in an examination should be made clear to the ordering physician (eg, the "views" included in a plain film examination of the shoulder). The system should be able to handle requests to modify an examination. It should provide a means for indicating whether contrast material is desirable, but it should also offer default procedures, in the event that the referring clinician does not wish to specify this aspect of the examination.

Adequate information should be collected to permit a protocol to be chosen and an examination to be billed correctly. This means that enough clinical information must be available to assign an *ICD9* (*International Classification of Diseases*, Ninth Revision) code. In our experience it has been impossible to teach referring practices to distinguish between known conditions and conditions to be "ruled out." Therefore, it is probable that this must be accomplished by the use of examination-specific lists of indications, from which a user may select 1 or more. These lists must be long enough to capture all or virtually all of the reasons for which an examination is requested, but they must be short enough so that a user is not forced to hunt excessively. We think that the provision of a "free-text" field is important, because many important details may not fit into the lists of common indications. However, we believe that the use of the free-text field should supplement, not replace, the use of the examination-specific lists because of the requirement for *ICD9*, coding mentioned above and also because of the needs of the "decision-support" function (see below).

These lists should be easily edited by a radiology department, making it possible to add choices and to delete them. This is necessary to comply with changing insurance requirements and to take local practice variations into account.

Few users are likely to be conversant with the range of possible *ICD9* and *CPT* (*Current Procedural Terminology*®) codes, and therefore an order-entry system should use common medical terms to designate examinations and indications. It should not burden users with details that are unlikely to be known outside the radiology department. For example, the identification of specific "resources" used to perform an examination should be invisible to a user.

Finally, as with any system, there must be a manual "escape valve" to permit the scheduling of cases that do not fit into the constraints of electronic order entry and for referrals from clinicians who do not have access to computers.

DECISION SUPPORT

An order-entry system should assist users in making correct decisions about the selection of imaging tests. It should suggest the preferred methods for evaluating the indications listed and should be capable of handling multiple indications. Advice of this type is necessarily painted with the broadest brush possible, because it is based on the limited clinical information provided along with whatever can be retrieved from the RIS (such as patient age).

A decision-support system should alert a user if potential duplicate examinations have been previously performed or are currently scheduled. What constitutes a duplicate examination? Certainly the same examination would qualify, but so would similar examinations. For example, head magnetic resonance imaging (MRI) with contrast would be considered to possibly duplicate head MRI with and without contrast. However, duplicate examinations may also be those in which the same anatomy is covered by another examination that might yield comparable information. For example, a head computed tomographic scan may potentially duplicate a head MRI scan. Furthermore, the time window for which an examination may be considered to be duplicative may vary with the indication. For example, a chest computed tomographic scan performed to evaluate a nodule may be considered duplicative if done within several months, whereas a plain radiograph to evaluate a pneumothorax may not be a duplicate examination even if performed within the same day.

A decision-support system also needs to include checks and balances to minimize attempted or inadvertent "system gaming." As users become familiar with the logic of decision-support rules, they may tend to enter indications likely to provide positive decision-support scores. The system needs to moni-

tor selections and provide mechanisms to correlate patients' history with entries provided when selecting examinations.

INSURANCE COVERAGE

The crazy quilt of insurance that provides funding for most health care is difficult for both referring clinicians and radiology departments to manage. Therefore, an ideal order-entry system would prompt users for any required insurance preauthorization before permitting examinations to be scheduled. If an indication does not meet the "medical policy" of a third-party payer, the system should provide a warning that the patient may be responsible for the bill.

Radiology departments, referring physicians, and patients are often burdened with the need to obtain preauthorization from payer groups. A benefit to all parties is the capability of an order-entry system to provide preauthorization codes through electronic feeds to the payer systems. Order-entry systems should have the capability and flexibility necessary to communicate with various payer systems and have reporting capabilities to help prove to payers that appropriate examinations are being ordered.

Some examinations, such as mammography and bone densitometry, can be repeated only on an annual or biannual basis. When a requested examination violates the insurance requirement, the user should be alerted. Order-entry systems should also facilitate the ordering of annual and biannual examinations by providing a copy feature to facilitate the prescheduling of the same examination.

SPECIAL BILLING REQUIREMENTS

An order-entry system should allow users to specify common special billing circumstances, such as research funds, liability insurance coverage, and patient self-pay. The information recorded should then be correctly routed to the billing system to so that the correct charges are applied.

SCHEDULING

Once a physician has entered an order and used the decision-support tool, it should be possible for office staff members to schedule appointments for examinations with the patient. This capability is a great convenience and time saver. A scheduler and patient can quickly work together to select the best time and location available. To work appropriately, the scheduling system should provide immediate access to scheduling at 1 or multiple sites. In addition, it should permit searches based on the earliest available appointment, appointments within a given time or facility window, and multiple linked appointments (eg, multiple MRI appointments, MRI followed by computed tomography, etc).

When rescheduling is required, if the same examination is to be rescheduled for a different date, the system should save and transfer all of the information that has been entered. If a different examination is to be scheduled, this might not be possible because of the need for examination-specific histories.

Once the examinations are scheduled, the order-entry system should provide the patient with a printout of the date and time of the examinations, directions to the examination location, and examination-specific preparatory instructions. Ideally, the instructions can be printed and faxed or e-mailed to patients and the information automatically updated if any changes occur before the scheduled date.

SAFETY

If a known contraindication is present in a patient's medical record (such as a contrast allergy or a documented previous contrast reaction), the system should provide a warning but still permit scheduling. In other instances, such as MRI examinations, the system may provide intelligence to block the scheduling of examinations for patients with implanted devices or other potential risks.

When multiple prior examinations have been performed on one side (eg, the right knee) and a new request is made for the opposite site, the requesting individual should be alerted to the possibility of error.

MAINTENANCE

Over time, an order-entry system will require updates and modifications to stay current with changes in examinations, changes in technology, and changes in practice. On a regular basis, a system should summarize the rates of use of each of its components (including histories, examinations, and requested modifications to examinations) so that unused elements can be removed, and defaults can be adjusted to take into account changes in practice. An ongoing continuous improvement process will help streamline the application and ensure that the ordering process is fast and effective for users.

SUMMARY

Order-entry systems have the potential to improve department workflow, patient safety, device and modality utilization, and business efficiency in radiology. The systems can also improve accuracy of examinations ordered, save work for schedulers, save

time for patients, and improve the quality of care physicians offer their patients. The order-entry process has an impact on many aspects of health care delivery and offers many opportunities to introduce tools that can enhance the use of medical imaging services.

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