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Early Experience With Implementation of a Commercial Decision-Support Product for Imaging Order Entry

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Clinical decision support platforms for imaging order entry have recently been mandated by the federal government. Little data exists outside of the convener sites on how to go about the implementation process. As an early adopter of a commercially available clinical decision support program for imaging order entry, we present our initial experience.

History of Clinical Decision Support

The study of systems to assist physicians with clinical decision making dates back to the 1950s.[1] To navigate the increasingly complex landscape of medical knowledge, physicians required new tools beyond the intuitive knowledge they had gleaned in clinical training. To supplement this intuitive knowledge, diagnostic and therapeutic algorithms were developed. The introduction of readily available computing power in the 1980s led to the development of electronic versions of these algorithms to assist physicians in making clinically appropriate decisions. Systems that incorporate these electronic algorithms into order entry are collectively known today as computerized physician order entry with decision support.

Over the last 3 decades, a broader range of imaging modalities has become available to physicians. In parallel, specialized protocols to leverage these emerging imaging modalities were developed leading to a large number of imaging choices for the referring physician creating an opportunity for a decision-support algorithm for imaging selection akin to decision support for other aspects of clinical care.

In response to the rapid increase of imaging utilization in the 1990s, the American College of Radiology (ACR) developed Appropriateness Criteria (AC) to guide physicians when ordering imaging tests.[2] The goal was to outline clinical scenarios and review the available literature to develop multidisciplinary evidence-based recommendations to guide selection of studies most appropriate for the given clinical setting.[3] Eventually, these AC were digitized and coupled to existing electronic health records (EHRs) to provide imaging decision support at the time of order entry.

Legislative Changes

Beginning in 2003, the Federal Government began mandating quality reporting programs in health care.[4] The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 included the Hospital Inpatient Quality Data Reporting program, which established a system of rewards and penalties for the reporting of quality measures at the hospital level. Although not directly affecting radiology, this established a precedent for a system of incentives and disincentives tied to quality measures.

The Physician Quality Reporting Initiative, passed in 2006 as a part of the Tax Relief and HealthCare Act of 2006,[5] focused on physician reporting, and was the first to include quality metrics relevant to radiology. The reporting of prior comparison, radiation exposure, and designated pertinent positives and negatives were a few of the measures included, with financial incentives tied to their reporting. The Medicare Imaging Demonstration Project, spurred by the Medicare Improvements for Patients and Providers Act of 2008, was created to develop support tools to assist in the ordering of the 12 highest cost studies at the time. Contracts were awarded to 5 consortia to function as demonstration sites and to develop clinical decision support (CDS) systems to guide licensed independent providers (LIPs) when ordering imaging studies.[6] As these demonstration projects were being carried out, the American Recovery and Reinvestment Act[7] passed in 2009 contained a plan to incentivize the adoption of EHRs with financial incentives to be paid upon demonstration of "meaningful use," as assessed through clinical quality measures.[8] Momentum was building toward more electronically driven health care decisions in all aspects of clinical care.

The most recent sustainable growth rate patch contains legislation that mandates the implementation of imaging order CDS by 2017, and ties its implementation to Medicare and Medicaid reimbursement.[9] This inclusion is in part because of the lobbying efforts of the ACR that believes that such systems would increase the value of radiology services to the medical community. As the

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US Secretary of Health and Human Services recently stressed the importance of quality over quantity in health care, with a plan for 85% of Medicare fee-for-service reimbursements to be tied to quality by 2016 and 90% by 2018,[10] an opportunity exists for the imaging community to implement such decision-support systems to improve the quality of imaging services.

Practices would be expected to implement CDS programs by 2017 to meet the mandates set forth by the federal government, but scant literature exists outside of the convener sites on how to go about the implementation process. As an early adopter of a commercially available CDS program for imaging order entry, we present our initial experience.

Implementation

There are currently 3 commercially available imaging CDS platforms—ACR Select, HealthFortis, and Medicalis; all of which use the ACR AC to assist LIPs when ordering imaging studies.[11-13] All systems allow for the tracking of data related to these orders for research and quality purposes. At the University of Virginia, ACR Select was chosen and integrated into our existing EHR (Epic version 2014, Epic Systems, Verona, WI). Although functional as a standalone product, it also integrates with the EHR, incorporating ACR AC with a series of structured indications to determine the appropriateness score of each study ordered. The scores correspond to the ACR AC scores where a score of 1-3 indicates that the order is usually not appropriate; a score of 4-6 indicates that the study may be appropriate; and a score of 7-9 indicates that the study is usually appropriate.

The program can run in several modes: in *silent mode*, the program only collects data such as the study ordered, indication, appropriateness score, and ordering specialty. In *feedback mode*, the program provides an evaluation when the study is ordered, displaying the appropriateness score and links to ACR white papers, as well as alternative studies that may be more appropriate. In *denial mode*, hardstops can be turned on that would prevent referring providers from ordering studies below a set appropriateness threshold. Implementation was scheduled for June 28, 2014, and planned in a staged fashion.

At launch, our system ran in silent mode (June 28, 2014-January 12, 2015), prompting the ordering provider for information about the patient and indication, storing these data, but not providing feedback. At this stage, order entry began to include structured indications that are necessary to map to specific data points. Ordering providers included residents, attending physicians, physician assistants, and nurse practitioners working under the direction of physicians. Rationale for beginning in silent mode was to (1) limit the number of potential sources of problems to ensure they would be manageable, (2) facilitate cultural adoption by easing providers' exposure to changes, and (3) allow the institution to collect “pre” data for future comparison to see how decision-support application affected ordering patterns.

In January 2015, the system was switched to feedback mode, which provided the ordering provider with the appropriateness score, cost, and relative radiation dose, as well as the alternative examinations and their appropriateness scores and relative radiation doses. The system also allowed the provider to switch to an alternative examination without having to enter a new order. After several months in feedback mode, information regarding the relative cost of each examination was provided as well. To date, feedback is only provided for adult inpatient and Emergency Department (ED) orders. Orders on patients less than 18 years of age are not covered because of concerns that the underlying database providing feedback was limited in regard to pediatric content. We understand that this content would be delivered in the future. We intend to go live with outpatient orders soon, but these were initially excluded simply to provide a transition period where not all orders were affected.

Before launch of each stage, clinical leaders were informed at key meetings to pass the information to their constituents. The goal of these sessions was to improve buy-in from the ordering providers. During these sessions, feedback was encouraged. Information was disseminated more broadly via email blasts to ordering providers. Additionally, a dedicated internal web resource was created to answer frequently asked questions. A link to this web resource was embedded in order entry and was also shared via the instructional email blasts.

Initial Experience

From June 2014-January 2015, while running in silent mode, the reporting software captured a total of 55,302 imaging studies performed at the University of Virginia. Of these, 25,291 were computed tomography scans, 18,979 were magnetic resonance imaging scans, and 13,058 were ultrasound scans. Of the total number of studies performed, 74% or 41,141 studies were unscored because of insufficient data entered by the ordering provider.

Ultimately, 14,161 total studies had sufficient data for scoring. Of the total number of scored studies, 65% ($N = 9258$) of studies were indicated (with a score of 7, 8, or 9), 22% ($N = 3099$) were marginal (with a score of 4, 5, or 6), and 13% ($N = 1804$) were not indicated (with a score of 1, 2, or 3) as judged by the ACR AC. Results for the highest volume departments are shown in Figure 1. For Internal Medicine, 70% of scored studies (655 of 942 studies)

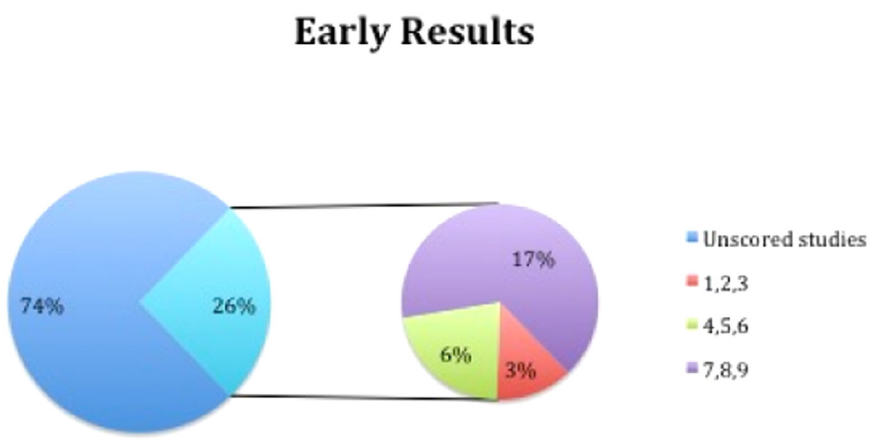

Fig. 1. Summary of early results from June 2014-January 2015.