Radiology Order Decision Support: Examination-Indication Appropriateness Assessed Using 2 Electronic Systems

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Abstract

Purpose: The goal of the study was to determine the effects of guideline implementation strategy using 2 commercial radiology clinical decision support (CDS) systems.

Methods: The appropriateness and insurance dispositions of MRI and CT orders were evaluated using the Medicalis SmartReq and Nuance RadPort CDS systems during 2 different 3-month periods. Logistic regression was used to compare these outcomes between the 2 systems, after adjusting for patient-mix differences.

Results: Approximately 2,000 consecutive outpatient MRI and CT orders were evaluated over 2 periods of 3 months each. Medicalis scored 60% of exams as "indeterminate" (insufficient information) or "not validated" (no guidelines). Excluding these cases, Nuance scored significantly more exams as appropriate than did Medicalis (80% versus 51%, $P < .001$) and predicted insurance outcome significantly more often (76% versus 58%, $P < .001$). Only when the Medicalis "indeterminate" and "not validated" categories were combined with the high- or moderate-utility categories did the 2 CDS systems have similar performance. Overall, 19% of examinations with low-utility ratings were reimbursed. Conversely, 0.8% of examinations with high- or moderate-utility ratings were denied reimbursement.

Conclusions: The chief difference between the 2 CDS systems, and the strongest influence on outcomes, was how exams without relevant guidelines or with insufficient information were handled. Nuance augmented published guidelines with clinical best practice; Medicalis requested additional information utilizing pop-up windows. Thus, guideline implementation choices contributed to decision making and outcomes. User interface, specifically, the number of screens and completeness of indication choices, controlled CDS interactions and, coupled with guidance implementation, influenced willingness to use the CDS system.

Key Words: CPOE, utilization management, decision support, exam appropriateness

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INTRODUCTION

Practitioner performance improvements, complication and mortality rate reductions, and inpatient care cost decreases have resulted from use of IT in medicine [1,2]. For example, clinical decision support (CDS) has been linked to a 55% decrease in serious inpatient dosing errors [3]. For outpatients, use of CDS has led to improved compliance with immunizations and routine screening tests, as well as awareness of critical laboratory values and medication interactions [1,4]. CDS, which incorporates medical evidence relevant to the patient and task at the point of care, may be used in either paper-based or electronic form [4]. Electronically, CDS is most often implemented as pop-up alert windows that provide real-time feedback. More advanced implementations may use order validation checks or care paths [1,3,4].

Point-of-care order validation for diagnostic imaging is being evaluated by hospitals, payers, and government with the goals of reducing use, resultant health care costs, and radiation exposure [5-14]. However, whether the use of this type of imaging CDS will improve patient outcomes or health care quality is unclear [14]. Diagnostic imaging CDS, utilizing a discrete, restricted list of

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indications matched to the examination, has demonstrated reduced outpatient utilization growth in those practices that developed these tools [7,8,14-23].

Such locally developed and implemented CDS solutions may vary in their approach, integration of evidence, user interface, and workflow. These variations may influence the extent of compliance or result in heterogeneous application of guidelines. To identify such differences, we evaluated 2 imaging CDS systems by comparing the appropriateness of MRI and CT order indications, as well as the insurance disposition of these examinations. We expected similar levels and distributions of exam appropriateness, insurance approvals, and user satisfaction to result from the 2 CDS systems.

METHODS

This retrospective study was approved by our institutional review board with a waiver of informed consent and was in compliance with our institution's Health Insurance Portability and Accountability Act (HIPAA) policy.

Clinical Decision Support Systems

Two stand-alone order entry systems with integrated imaging CDS were evaluated: RadPort (Nuance Communications, Burlington, Massachusetts) in spring 2010 and SmartReq (Medicalis, San Francisco, California) in spring 2011. These commercial packages are based on imaging CDS developed by Massachusetts General Hospital and Brigham and Women's Hospital, respectively (both in Boston, Massachusetts) [8,14-23]. Both packages use SQL (Microsoft, Redmond, Washington) to store the examination, indications, appropriateness, and patient demographics. Additional data collected were the order date, insurance disposition, imaging modality, anatomic region, indications, appropriateness rating, and patient gender and age. Insurance disposition was classified using 5 categories: approved, approved after physician consult, denied, no precertification required, or worker's compensation. After extraction from SQL, Access (Microsoft, Redmond, Washington) and R statistical language were used to integrate and analyze the datasets.

Both of these imaging CDS systems can be operated in 3 modes: silent (captures ordering patterns without intervention); educational (provides point-of-care guidance and evidence-based feedback); or restrictive (requires changing the examination or indications or obtaining an override). To focus on the attributes and classification capability of the imaging CDS systems, we excluded the ordering physician and the resultant effects of learning. Instead, scheduling and reimbursement specialists entered the orders, and the software packages were configured in silent mode, thereby enabling indications to be collected and appropriateness to be assessed in a blinded, time-invariant manner. In addition, the ability to block an order (hard stop) or require an override in the event of an inappropriate or low-utility examination or indication was disabled.

Both systems incorporated the ACR Appropriateness Criteria® [24] and published evidence-based medicine from other societies [25,26]. Because these guidelines are known to be incomplete [7,9,14-27], the knowledge in the Nuance system was augmented by best-practice guidelines developed by a local clinical advisory board [21]. Both Nuance RadPort and Medicalis SmartReq assessments are provided using the 9-point ACR [24] scale with 3-level stoplight color coding: low-utility or inappropriate receives scores of 1−3 (red); marginal-utility or moderate appropriateness receives scores of 4−6 (yellow); high-utility or appropriate receives scores of 7−9 (green). However, Medicalis provides 2 additional categories: "indeterminate" (more information required) and "not validated" (no appropriateness criteria established). For the "indeterminate" and "not validated" categories, SmartReq requests additional information or clarification to better match the published guidelines. After the training session, these additional questions and pop-up windows were disabled in Medicalis at the users' request.

Study Site, Training, and Patients

Three stand-alone outpatient imaging centers that perform MRI and CT examinations participated in this study. The referring physicians were a mix of family practice and specialists, all in suburban private practice settings. No specific training of the referring physicians or their office staff was performed.

The same 2 scheduling and reimbursement specialists performed order entry for both arms of this study. A protocol was developed and provided during CDS system training to ensure that both employees followed the same workflow and decision tree for both study arms. As part of this protocol, while on the phone with the ordering clinician's office staff or with the patient, the scheduling and reimbursement specialists asked why the doctor had ordered this exam. These conversations always took place after receipt of a faxed order and usually resulted in additional clinical information being provided beyond what was documented. The additional, verbally communicated, information gathered by this practice was not a requirement of this study and was not requested from other