Introduction

• There has been increased interest in reducing healthcare costs through decreasing the amount of services provided and imaging services have been specifically targeted [1].
• Mechanisms include prior授权, radiology benefits management services (RBMS), computerized physician order entry (CPOE) and decision support software [1].
• All physicians, and especially radiologists, should take leadership to reduce unnecessary imaging utilization while maintaining appropriate access to those services that are known to improve patient outcomes and may reduce downstream healthcare costs [2].
• Clinical effectiveness of an imaging examination can often be empirically measured, however, the appropriateness of that same procedure may be debatable and often can only be estimated using expert consensus opinion [3].
• The American College of Radiology Appropriateness Criteria® (ACR AC) are one set of evidence-based guidelines representing the expert consensus of multiple subspecialty physicians and other healthcare stakeholders advertised as “evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition” [4].
• Appropriateness is defined by the RAND/UCLA Health care utilization criteria:
  • “The indication to perform a medical procedure is appropriate when the expected health benefit (i.e., increased life expectancy, relief of pain, reduction in an existing condition) exceeds the expected negative consequences (i.e., mortality, morbidity, anxiety of anticipating the procedure, pain produced by the procedure) by a sufficiently wide margin that the procedure is worth doing” [4].
• Appropriateness in the ACR AC is scored on a 9 point scale.
• Scores of 1-3 are considered “usually not appropriate” and are believed to have a negative impact on quality-adjusted life year (QALY) measurements.
• Scores of 4-6 are “uncertain/equivocal” because QALY impact is difficult to define.
• Scores of 7-9 are “usually appropriate” and have a positive impact on QALY measurements through evidence-based outcomes or expert opinion.
• The ACR AC are regularly updated and can be downloaded online at http://www.acr.org/Quality-Safety/Appropriateness-Criteria.
• The database can be manually searched (http://acsearch.acr.org) or licensed (http://www.acselect.org) for incorporation into computerized provider order entry (CPOE) systems and decision support (DS) software.

Methods

• Between October 1, 2011 and April 1, 2012, all CT, MR, SPECT MPI, and VQ ROE requests were scored by the DS software according to ACR AC guidance documents.
• After IRB approval, electronic examinations and their corresponding clinical scenario were extracted from the study database to evaluate baseline appropriateness scores.
• There were 41,124 imaging requests using the ROE system for 9,433 unique patients during the study period, on average there were 2.3 advanced imaging examinations per patient. Of these requests, 11,161 (27%) were scored as appropriate in the corresponding guidance.
• Appropriateness was scored using the ACR AC 1-9 scale and any corresponding guidance document available in 2012, requests without an applicable ACR AC were scored -1.
• 50 random cases were manually scored to verify the computer algorithm accuracy.
• Two requests were reclassified from -1 based on an available ACR AC guidance document that was not properly mapped by the scoring algorithm to the sniffiff of the requested examination type in the ROE server.
• Thirty-seven requests (74%) were reclassified based on the additional clinical history (free-text comments), in all cases the ordering provider had selected “other” in the “clinical scenario” and/or “signs and symptoms” box.
• No previously scored requests were identified as mischaracterized during the review.
• Based on this discrepant scoring, a random sample of 3000 requests initially scored by the DS algorithm were manually rescored using the searchable ACR AC online database.
• 114 of these requests were for image-guided procedures and excluded.
• Rescoring was based only on the clinical information provided in the ROE portal free-text boxes; review of the medical record or prior imaging was not performed.
• Requests clearly recommended as follow-up imaging either by radiology or another consulting service in the free-text comments were categorized separately.
• Some requests initially scored -1 had matching DS guidance documents, however the modality requested was not identified in the document and were categorized separately.

Results

• After initial automated scoring, 73.7% of imaging requests were appropriate. 19.3% were uncertain. 6.9% were inappropriate and 74.6% had no applicable guideline document.
• After manual rescoring, 1543 requests were reclassified based on the free-text data.
• 82.2% of requests were considered appropriate, 14.4% uncertain, 3.4% inappropriate and 3.4% of requested modalities had no score in the ACR AC guidance document.
• 13.0% of requests had no applicable guideline in the available ACR AC.
• 4.7% of requests represented recommended follow-up by the provided comments.
• 3 (0.1%) and 4 (1.5%) of these were directly attributable to radiology and consulting services respectively, the remaining requests could not be classified.
• When comparing the rescoring results to the initial, automated scoring (Figure 2)
  • 1330 more requests were considered appropriate (1871 vs. 541).
  • 187 more were considered uncertain (329 vs. 142).
  • 26 more requests were considered inappropriate (77 vs. 54).
  • 1678 fewer requests were listed as “No guidance available” (474 vs. 2152).
  • This includes 375 requests without guidance documents and 99 requests without a modality score in the corresponding guidance.
  • The absolute number of scored requests increased from 734 to 2277.

Conclusions

• Embedded DS software has been shown to reduce medication related errors in pharmacies [6] and similar tools may allow informed providers to decrease unnecessary imaging and therefore overall healthcare utilization and costs.
• The ACR AC should be used by clinicians in deciding appropriate imaging utilization [13], limited ability of medical house staff to choose appropriate imaging examinations [14] and a reluctance of providers to accept changes suggested by decision support [15].
• When properly integrated, DS can be widely accepted, reduces low utility imaging, improves workflow efficiency, and increases adherence to guidelines [9,15,16].
• A perceived negative impact on clinical workflow or disruption of physician autonomy are significant barriers to DS acceptance [7,8].
• Two critical features of DS systems identified by Kawamoto include 1) provision of routine appropriateness assessments and 2) provision at the time and location of clinical decision making [7].
• Neither were available in the study and may have decreased overall CPOE utility.
• Over 82% of imaging requests were appropriate by available guidelines.
• In an outpatient setting, these requests would likely be validated by RBMS or pre-authorization mechanisms with little delay.
• This number is comparable to the 74% rate found among outpatient CT and MR requests from primary care physicians [11].
• Only 4.7% of requests were identified as follow-up imaging, the 1.6% recommended by either radiology or another consulting service are expected to have high levels of appropriateness by DS, although this is not always the case [12].
• Several rescoring requests had matching guidance documents, however the ordering provider selected a non-related ‘clinical scenario’ or ‘signs and symptoms’ such as requesting CT/MR for “altered mental status” but choosing “Headache” for a -1 score.

References