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Quantitative metrics in clinical radiology reporting: a snapshot perspective from a single mixed academic-community practice

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Abstract

Quantitative imaging has emerged as a leading priority on the imaging research agenda, yet clinical radiology has traditionally maintained a skeptical attitude toward numerical measurement in diagnostic interpretation. To gauge the extent to which quantitative reporting has been incorporated into routine clinical radiology practice, and to offer preliminary baseline data against which the evolution of quantitative imaging can be measured, we obtained all clinical computed tomography (CT) and magnetic resonance imaging (MRI) reports from two randomly selected weekdays in 2011 at a single mixed academic-community practice and evaluated those reports for the presence of quantitative descriptors. We found that 44% of all reports contained at least one "quantitative metric" (QM), defined as any numerical descriptor of a physical property other than quantity, but only 2% of reports contained an "advanced quantitative metric" (AQM), defined as a numerical parameter reporting on lesion function or composition, excluding simple size and distance measurements. Possible reasons for the slow translation of AQMs into routine clinical radiology reporting include perceptions that the primary clinical question may be qualitative in nature or that a qualitative answer may be sufficient; concern that quantitative approaches may obscure important qualitative information, may not be adequately validated, or may not allow sufficient expression of uncertainty; the feeling that "gestalt" interpretation may be superior to quantitative paradigms; and practical workflow limitations. We suggest that quantitative imaging techniques will evolve primarily as dedicated instruments for answering specific clinical questions requiring precise and standardized interpretation. Validation in real-world settings, ease of use, and reimbursement economics will all play a role in determining the rate of translation of AQMs into broad practice.

Keywords: Quantitative imaging; Quantitative techniques; Quantitative metrics; Advanced quantitative metrics; Numerical measurement; Radiology reporting; Apparent diffusion coefficient; Perfusion imaging; Gestalt interpretation; Naturalistic decision-making; Workflow limitations; Technology assessment; Reimbursement economics

1. Introduction

Radiology thought leaders have called for an increased focus on extraction of quantitative information from clinical images [1] and the imaging literature is replete with studies investigating new quantitative techniques, yet conventional wisdom holds that clinical radiology remains an overwhelmingly qualitative discipline. In this preliminary study attempting to characterize and understand this potential disconnection, we evaluate a sample of randomly selected clinical reports from a single mixed academic-community radiology practice for the presence or absence of quantitative metrics (QMs) and advanced quantitative metrics (AQMs), to be defined below. Our study tests the following hypotheses:

(1) Despite calls for more quantitative imaging in radiology practice, prevalence of QMs and AQMs in routine clinical radiology reporting remains low.
(2) Most QMs in routine clinical radiology reporting are simple descriptors of lesion size, with lower

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prevalence of AQMs such as perfusion parameters or apparent diffusion coefficient (ADC) values.

(3) Due to the disproportionate use of QMs to describe lesion size, prevalence of QMs is higher in scans performed for assessing one or more space-occupying lesions, including cancer follow-up scans and scans performed to evaluate a mass or fluid collection.

(4) Prevalence of QMs is higher for scans performed in the academic setting by subspecialty radiologists than for scans performed in the community setting by generalist radiologists.

2. Methods

2.1. Data collection and categorization

Institutional Review Board (IRB) exemption was obtained, and the informed consent requirement was waived for this purely retrospective study. Two non holiday weekdays during 2011 (4/28/11 and 10/24/11) were randomly selected for analysis. All radiology reports from our practice for these two days were accessed from our Picture Archiving and Communication System (PACS) and were filtered to select only reports for computed tomography (CT) or magnetic resonance imaging (MRI). These data were then further filtered to remove irrelevant results including scans from outside institutions that had been archived in our PACS on those days, scans for which no report was available, scans of MRI phantoms (i.e., quality control scans), scans for CT-guided or MRI-guided biopsies, scans for which no report or only a limited report was available (e.g., for MRIs that were discontinued due to patient claustrophobia), and duplicate reports.

Table 1
Parameters used for categorization of scans

Parameter	Possible values
Date	4/28/11
	10/24/11
Modality	CT
	MRI
Body part	Body
	Breast
	Cardiac
	Musculoskeletal
	Neurological
	Vascular
Imaging site	Hospital-Adult
	Hospital-Pediatric
	Community
Scan indication	"Cancer follow-up"
	"Evaluate mass"
	Other
Presence of quantitative metrics (QMs)	Present
	Absent
Presence of advanced quantitative metrics (AQMs)	Present
	Absent

The remaining reports were then reviewed by a board-certified radiologist (R.A.) and were categorized across a set of parameters (Table 1), as follows:

- *Body part* – Scans were categorized as Body, Breast, Cardiac, Musculoskeletal, Neurological, or Vascular. Body scans included all imaging of the chest, abdomen, or pelvis with the exception of dedicated musculoskeletal or vascular imaging. Breast consisted mostly of breast MRI (mammography was not included in this study). Cardiac included all dedicated CT or MRI imaging of the heart. Musculoskeletal included all extremity bone, joint, or soft tissue imaging. Neurological included brain, head/neck, and spine imaging. Vascular included all CT and MR angiography with the exception of neuroangiography, which was included in Neurological.
- *Imaging site* – Ours is a multispecialty radiology practice with its primary presence at a tertiary-care academic medical center but with additional professional activity at several outpatient centers in the surrounding community. The academic medical center has separate adult and pediatric facilities. Scans were therefore categorized as Hospital-Adult, Hospital-Pediatric, or Community.
- *Scan indication* – The primary indication for each scan was abstracted either from the submitted clinical history or from the report details. Similar indications were then grouped into high-level categories; for example, all follow-up scans for specific malignancies were grouped together as "cancer follow-up." The Appendix lists all high-level indication categories and provides examples of individual indications within each category. From this list of high-level indication categories, scans were categorized as having been performed for "cancer follow-up," "evaluate mass," or some other indication. The "evaluate mass" category included all scans for characterization of space-occupying lesions, including solid masses/nodules, fluid collections, hematomas, and aneurysms.
- *Presence of quantitative metrics (QMs)* – Each report was categorized as either containing or not containing one or more QMs. A QM was defined as any numerical descriptor of a physical property other than quantity in either the Findings or Impression sections of the report. Examples of QMs include numerical descriptions of lesion size (e.g., diameter of a mass) or distance (e.g., distance of subfalcine herniation). Quantitative descriptors in the Technique section (e.g., scan collimation, contrast dose) were excluded. In the case of reports that implied some quantitative or semi-quantitative analysis having taking place but did not include numbers in the text, we categorized such reports as having contained QMs if it was clear that an analysis had taken place with reference to a certain numerical threshold (e.g., a Hounsfield Unit threshold