

# Quality Outcomes of Reinterpretation of Brain CT Imaging Studies by Subspecialty Experts in Neuroradiology

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**Purpose:** To determine the clinical importance and relative value of reinterpreting brain CT imaging studies by subspecialty experts regarding changes in clinical management.

**Methods:** Computerized records were queried at two institutions during the years 2002–2003 for both primary interpretation by board-certified nonneuroradiologists and secondary interpretation by three neuroradiologists. A total of 1,081 cases were reviewed. Each case was initially interpreted as an emergent or urgent study. The reinterpreted studies were scored as concordant or discordant by the subspecialty experts. The discordant studies were then categorized as a “major discordance” if there was a change in clinical management, or as a “minor discordance” if there was no impact or change in clinical management.

**Results:** Of the 1,081 studies reviewed, 14 studies were identified as discordant (1.3%). Of those discordant studies, four were categorized as major discrepancies necessitating a change in clinical management (0.4%). Ten were categorized as minor discrepancies (0.9%). There were no permanent adverse outcomes with respect to morbidity and mortality as a result of any discrepancy.

**Conclusion:** The vast majority of interpreted head CT cases read by board-certified general radiologists do not result in discordant interpretations as verified by subspecialty experts. Discordant interpretations did not result in changes in clinical management in most cases. Double reading of head CTs by subspecialty experts appears to be an inefficient method of substantially improving imaging health quality outcomes.

**Key words:** health quality outcomes ■ medical errors

© 2006. From the Memrad Medical Group Inc., Long Beach, CA (Jordan); Departments of Diagnostic Imaging, Little Company of Mary Hospital (Jordan) and Pomona Valley Hospital Medical Center (Lightfoote), Torrance, CA. Send correspondence and reprint requests for *J Natl Med Assoc.* 2006;98:1326–1328 to: c/o Dr. John Jordan, Advanced Imaging of South Bay Inc., Little Company of Mary Hospital and Medical Center, Department of Radiology, 4101 Torrance Blvd., Torrance, CA 90503; phone: (310) 303-5750; fax: (310) 303-5738; e-mail: jjordan\_us@yahoo.com

## INTRODUCTION

Public attention and awareness have increased and amplified the focus on the quality of healthcare.<sup>1-2</sup> Medical errors are extremely costly—not only financially, but to lives as well—particularly with respect to patient morbidity and mortality. It is important to seek improvements in the quality of healthcare through two principal efforts: 1) establishing a process for the discovery of errors or problems, and 2) developing remedies or programs to reduce the chances of these errors or adverse outcomes to patients. Quality improvement programs that are used to reduce such errors in healthcare delivery offer limited success. For example, it is very difficult to measure physician perceptive and cognitive abilities. In the case of imaging, radiologists are required to have clinical judgment and an ability to “see things.” Moreover, there is no such thing as perfect human perception, so errors will inevitably occur. Since nonspecialists or general radiologists interpret most imaging studies, we sought to measure error rates in head CT interpretation, a very common examination, and one commonly interpreted by nonneuroradiologists.<sup>3-9</sup> We also sought to determine the clinical importance and relative value of reinterpreting brain CT imaging studies by subspecialty experts with respect to changes in clinical management subsequent to the discovery of discrepant interpretations (a standard method of quality improvement programs in imaging).

## MATERIALS AND METHODS

Computerized medical records were reviewed during 2002–2003 from two major community hospitals of patients undergoing head CT examinations. These studies were selected from the database of a comprehensive quality improvement program. The primary interpretation of the head CTs was conducted by board-certified nonneuroradiologists. Within 24 hours, as part of a surveillance quality improvement program, three neuroradiologists performed a secondary interpretation. In total, there were 1,081 cases reviewed. Each case was initially interpreted as an emergent study performed in the hospital, emergency room or

as an urgent care outpatient study over a PACS or digital teleradiology network. The reinterpreted studies were scored as concordant or discordant by the subspecialty experts. Discordant studies were then categorized as a "major discordance" if there was a change in clinical management, or as a "minor discordance" if there was no impact on the patient or a change in clinical management.

## RESULTS

Tables 1–3 summarize these results. Of the 1,081 studies reviewed, 14 (1.3%) were identified as discordant (Table 1). With respect to the discordant cases, four (0.4%) were categorized as major discrepancies that required a change in clinical management (Table 2) such as an arteriovenous malformation (AVM), oligodendroglioma, subdural hematoma and a stroke (MCA infarct). Ten cases were categorized as a minor discrepancy (0.9%) (not clinically significant) not requiring a change in clinical management (Table 3) such as seven chronic infarcts, one case of old granulomatous disease (probable cysticercosis) and two cases of cerebral atrophy. There were no adverse permanent outcomes with respect to the morbidity and mortality of the patients as a result of any discrepancy.

## DISCUSSION

Medical errors continue to take a significant toll on the nation's healthcare. It has been estimated that medical errors may account for up to 98,000 deaths in the United States and cost roughly \$29 billion annually.<sup>1</sup> As a result, public awareness of medical errors continues to increase as do demands for intervention. Moreover, tolerance for medical errors continues to decrease in both professional and lay circles. Quality improvement programs in the United States can trace their origin to the initial efforts of hospital inspection programs in the early 20th century. The first hospital inspection programs were performed by the American College of Surgeons (ACS) in 1918.<sup>2,14</sup> In 1951, the ACS joined with the American College of Physicians, the American Hospital Association, the American Medical Association and the Canadian Medical Association to form the Joint Commission on Accreditation of Hospitals (JCAH) to provide voluntary accreditation.

In 1952, JCAH took over the hospital quality standardization from ACS, and in 1953, it published the JCAH Standards for Hospital Accreditation. With the passage of the Medicare Act in 1965, JCAH shifted its focus becoming more aligned with government. The act provided that hospitals accredited by JCAH were eligible to participate in the Medicare program.

In 1975, JCAH broadened its scope by accrediting ambulatory healthcare facilities through the Accreditation Council for Ambulatory Health Care. In 1987, JCAH changed its name to the Joint Commission on Accreditation of Healthcare Organizations to reflect its expanded mission. Continuous quality improvement

programs or total quality improvement programs were adopted in healthcare from business models in other industries, and the JCAHO has historically played a major role in the evolution of quality improvement programs in the United States

These programs have provided a disciplined framework with which to identify and correct practices that result in errors in healthcare provision. With respect to physician quality improvement programs, certain physician practices are readily measured. Others, such as measuring cognitive or interpretive abilities, are more challenging. Proxy measures such as board certification, licensure, education and training do offer clues but often fall short of directly measuring such abilities. Hence, radiologic interpretation and other cognitive skills are often measured with double reading programs or review programs as performed here.<sup>3-13</sup> Since head CT studies are exceedingly common, especially in emergency departments where generalists are more likely to offer the primary interpretations, we felt it appropriate and desirable to more closely examine this area.

Our results indicate that primary interpretations yield a very low percentage of discordant cases. While we had 14 discordant studies, four of which were clinically significant, we were initially unsure of the quality of healthcare provided to patients undergoing head CT exams at our institutions. Our results do correspond with previous research of the reinterpretation of radiological imaging at other institutions, however.

For example, Tilleman et al. studied the reinterpretation of imaging in pancreatic CT's.<sup>10</sup> Tilleman also found a very low percentage of discordant cases. He and his team suggest that an improvement in communica-

**Table 1. Concordant and discordant cases tabulation**

Missed Diagnosis	
Clinically Significant	4
Not Clinically Significant	10
Concordant Diagnoses	1,067
Total number of Patients	1,081

**Table 2. Clinically significant cases (n=4)**

Arteriovenous malformation
Oligodendroglioma
Subdural hematoma
Infarction, middle cerebral artery

**Table 3. Clinically insignificant cases (n=10)**

Chronic infarcts (n=7)
Previous granulomatous disease, cysticercosis (n=1)
Cerebral atrophy (n=2)

tion and reinterpretation of radiological investigations can reduce such errors. In his study, a panel of four experts evaluated the quality of reinterpretation reports for 78 patients. Eighty-three percent of the cases were categorized as "in accordance," 8% was "minor discordant" and another 8% was "major discordant." The reinterpretation of the CT resulted in a change in treatment strategy for seven patients (9%). When there was an additional CT, 24 patients (30%) had to have a change in treatment as well.

Yoon also studied the quality of healthcare imaging in trauma centers.<sup>11</sup> His research focused on the reinterpretation of abdominal and pelvic CT studies. Five-hundred-twelve cases were initially interpreted by board-certified/eligible radiologists in the emergency department. The cases were then reevaluated by subspecialty abdominal imaging radiologists. This resulted in 153 cases (29.9%) showing discordant readings. Of the discordant cases, review of patient records brought forth changes in the patient care of 12 patients (7.8%). Three (2%) cases were evaluated with the morbidity and mortality records of the Department of Trauma Surgery because of the severity of the misinterpretations. Six cases (4%) underwent additional review. In two of those cases, the initial interpretations were favored. Review of the other four cases demonstrated that the quality of the initial interpretation was clinically sound based on the initial patient presentation.

## CONCLUSION

In conclusion, our study has shown that the vast majority of interpreted head CT cases performed by board-certified radiologists do not result in discordant interpretations as verified by subspecialty experts. Discordant interpretations did not result in changes in clinical management in most cases. Those with major discrepancies had no permanent morbidity or mortality in our series. Double reading or reinterpretation of head CTs by subspecialty experts appear to be unnecessary and inefficient in substantially improving healthcare quality outcomes. This also applies to the reinterpretation of CTs in other areas of the body. These conclusions might differ and warrant further study, however, if nonboard-certified physicians are the primary interpreters. Nevertheless, random surveys using subspecialty experts may be useful in confirming the expertise of primary interpreters, as well as satisfying regulatory or statutory requirements for professional quality improvement programs.

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