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Transfer Patient Imaging: Current Status, Review of the Literature, and the Harborview Experience

Michael F. McNeeley, MD, Martin L. Gunn, MBChB, Jeffrey D. Robinson, MD

Patients transferred for higher levels of care often arrive with medical imaging from the outside facility, with or without accompanying radiology reports. The handling of pretransfer studies by receiving radiologists introduces several concerns regarding resource utilization, medicolegal risk, and technical quality control. The authors review the current status of transfer patient imaging, with an emphasis on the role of the receiving emergency radiologist. Practice solutions developed at the authors' level I trauma center are described.

Key Words: Outside studies, patient transfers, resident on-call responsibilities, curbstone consultations, image sharing, emergency imaging

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INTRODUCTION

When trauma occurs away from the immediate catchment area of a level I or II trauma center, the patient is often brought to a community hospital for stabilization and initial workup before transfer to a regional trauma center for definitive care. Studies performed at outside hospitals frequently arrive without finalized, typewritten reports [1,2]. Even when final interpretations do accompany a transferred patient's medical imaging, the receiving clinicians may be reluctant to act on the opinion of an unfamiliar radiologist, and they often consult the in-house diagnostic service for a second opinion [2]. This introduces the opportunity for conflicting interpretations of an imaging study, as well as duplicated expenditures of time and money. Moreover, receiving radiologists may be uncomfortable interpreting studies performed using unfamiliar scanning protocols [1].

Harborview Medical Center (HMC) is a level I trauma center in Seattle, Washington, that receives approximately 600 to 800 outside imaging studies on patients transferred to the HMC emergency department in any given month. The optimal handling of these outside studies has been the focus of prolonged debate within our department. In the absence of clear national or community standards, our emergency radiology section has developed algorithms for handling outside examinations to ensure complete diagnostic support for our clinical colleagues while minimizing unnecessary repeat imaging, undocumented interpretations, and redundant work that does not add diagnostic value. In this paper, we discuss the logistic, medicolegal, and financial implications of handling outside imaging studies of transferred patients and examine practice solutions developed at our facility.

THE DECISION TO SCAN AT AN OUTSIDE HOSPITAL

In a recent study of 500 consecutive patients who transferred to our facility, 76% had undergone at least one CT study before transfer, and 86% underwent either radiography or CT. Nearly all patients who did not undergo outside imaging had experienced burns or ophthalmic trauma [3]. The motivations for pretransfer imaging are uncertain; it has been suggested that referring clinicians perceive that the receiving hospital expects a thorough imaging evaluation before transfer [1]. Although physicians likely exhibit some inherent predilection for making a definitive diagnosis at the point of care, it also has been shown that insurance status and local culture can influence the decision of whether to perform pretransfer imaging [4]. Malpractice fears have been shown to increase the use of diagnostic tests by clinicians [5], but the specific costs of defensive pretransfer workup remain unexplored.

A misinterpretation of federal law may encourage unnecessary pretransfer imaging. Under the Emergency Medical Treatment and Active Labor Act, emergency room clinicians are required to provide "appropriate medical screening" [6]. Although medical imaging may indeed be appropriate for lower acuity patients [7], few diagnostic studies are actually needed to triage the high-

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est acuity trauma patients for immediate transfer [1, 8-11]. In fact, the American College of Surgeons' Advanced Trauma Life Support course dictates that imaging should not delay transfer when local resources are insufficient for definitive care [12]. However, compliance with national guidelines for the transfer of severely injured patients is low [4].

RECEIVING AND VIEWING OUTSIDE STUDIES

A vast majority of outside studies arrive on CD-ROMs [13]. However, only 64% of institutions represented in a recent survey of emergency radiologists [13] require these studies to be imported to and registered in their institutions' electronic medical records, PACS, or radiology information systems. Presumably, the remaining practices either repeat imaging on arrival or use the view-box software encoded on the outside CD-ROM, which is problematic for a number of reasons [3, 14-16]. First, when outside images are maintained only on a physical disc (as opposed to being housed within a local network), the patient's entire local image archive is at risk for becoming damaged or misplaced. Second, the patient's images are viewable only by those with direct access to the disc itself. Third, the image viewer software may not run on the PACS workstation, requiring the radiologist to work from a low-resolution monitor. Fourth, the multitude of unstandardized user interfaces in third-party view-box software can make the navigation of outside imaging studies cumbersome and error prone, if not impossible. Sodickson et al [17] found that importing outside images into PACS resulted in a 17% reduction in repeat imaging compared with cases in which CD-ROM import was unsuccessful. Similarly, Lu et al [18] showed that the odds of undergoing repeat imaging are significantly less for patients with outside imaging that is imported into PACS compared with patients with outside imaging that is available on CD-ROM or film but not imported (odds ratio, 31 vs 9, respectively; $P < .001$ for both). Although both of these were single-institution studies, their results suggest that significant savings in time, money, and radiation dose could be realized through improved handling of outside studies that arrive on CD-ROMs.

Evolving standards of informational compatibility can facilitate the sharing of medical images within referral regions. The Integrating the Healthcare Enterprise initiative promotes the Portable Data for Imaging profile, which is a set of technical specifications that standardizes the archiving and expression of DICOM data on physical media to make diagnostic studies and reports interchangeable across PACS from different vendors. Although this standardization facilitates CD-ROM upload, compliance with the Integrating the Healthcare Enterprise Portable Data for Imaging standard remains variable [15].

Although interfacility internet-based network transfers can reduce unnecessary patient transfers [3,14,19,20] and may reduce financial costs and radiation exposure from repeat CT imaging [3], only a small fraction of trauma centers receive the bulk of their outside studies via network transfer [13]. To this end, the Integrating the Healthcare Enterprise consortium also has released the Cross Enterprise Document Sharing profile, a standards-based and secure profile that allows facilities to share images and reports seamlessly online, regardless of their respective PACS vendors [21], potentially resulting in both fewer repeat images and fewer requests for reinterpretation of outside images. Several vendors have adopted the Cross Enterprise Document Sharing profile, developing sharing networks in a number of regions [22], although its effect on the quality of care delivery has not been rigorously assessed. The adoption of vendor-neutral archives for the storage of medical imaging studies should facilitate this process by simplifying image transfers and extending secure access to medical images across a large number of discrete archives [23].

Facilities need to become aware of the updated regulations in the Health Information Technology for Economic and Clinical Health Act, a component of the American Recovery and Reinvestment Act of 2009. While promoting the electronic exchange of images to improve the quality of health care, this act strengthens the privacy and security regulations issued under HIPAA, offering security regulations for the storage of images on CD-ROMs and during internet image transfer [24].

When transferred patients arrive with CD-ROMs bearing their images, there is little doubt that the patients will be part of the enterprise's medical record system. However, when outside studies are transferred over the internet, the images often become accessible before the patients arrive, and interpretation of these studies may be a component of the trauma team's preparation for the patients' arrival. It remains unclear what obligations persist when a patient transfer is canceled but the images arrive. Sipe and West [25] described how, under certain circumstances, merely having a study on file in a department may establish a physician-patient relationship, even in the absence of a request for its interpretation. A uniform practice policy for handling unread imaging studies may serve the legal interests of the department and radiologist alike [26].

Any practice policies regarding PACS retention of outside or unread studies should comply with state record-retention laws and Medicare conditions of participation, local physician preference, and storage budgets [27,28]. Once local policies are developed, they must be communicated to radiologists, referring facilities, clini-

Table 1. Harborview Medical Center technical standards for interpreting outside CT studies

- CT cervical spine
  - Fracture absent
    - Axial reconstruction thickness ≤3 mm
    - Axial reconstruction interval ≤3 mm
    - Algorithm: standard or bone
    - Sagittal reformations obtained from thin-section data set (≤1.5 mm) or raw data*
    - Range: skull base to T1
  - Fracture present
    - Axial reconstruction thickness ≤3 mm
    - Axial reconstruction interval ≤3 mm
    - Algorithm: standard
    - Sagittal reformations from thin-section data set (≤1.5 mm) or raw data*
    - Coronal reformats if dens fracture suspected
    - Range: skull base to T4*
- CT chest to exclude aortic injury
  - Periaortic hematoma absent
    - Axial reconstruction thickness ≤5 mm
    - Axial reconstruction interval ≤5 mm
    - Algorithm: standard
    - No reformations necessary
    - Range: thoracic inlet to diaphragm
    - IV contrast enhanced, in venous and/or arterial phase†
  - Periaortic hematoma present or questionable aortic injury
    - Axial reconstruction thickness ≤3 mm
    - Axial reconstruction interval ≤3 mm
    - Algorithm: standard
    - Coronal or sagittal reformations
    - Range: thoracic inlet to diaphragm
    - IV contrast enhanced, arterial phase
- CT abdomen and pelvis for trauma
  - Axial reconstruction thickness ≤5 mm
  - Axial reconstruction interval ≤5 mm
  - Algorithm: standard
  - No reformations necessary
  - Range: diaphragmatic dome to ischial tuberosities
  - IV contrast enhanced, venous phase
  - Delays necessary if greater than grade 2 renal injury or if periureteric fluid present‡
- CT lumbar spine
  - Axial reconstruction thickness ≤3 mm
  - Axial reconstruction interval ≤3 mm
  - Algorithm: standard or sharp
  - At least sagittal reformations from thin-section data set (≤1.5 mm) or raw data§
  - Range: T12 to sacrum
- CT thoracic spine
  - Axial reconstruction thickness ≤3 mm
  - Axial reconstruction interval ≤3 mm
  - Algorithm: standard or sharp
  - At least sagittal reformations from thin-section data set (≤1.5 mm) or raw data§
  - Range: C7 to L1 (coverage may be limited if adjacent levels are included in contiguous spine CT)

Note: IV = intravenous.
*If a cervical spine fracture is present, clearing the upper thoracic spine is essential. This is best performed by CT of this region.
†IV contrast is not essential if mediastinal hematoma can be confidently excluded on an outside noncontrast CT study or with plain films.
‡If there is no free intraperitoneal fluid and the patient is clinically stable, the necessity of repeating CT with IV contrast is debatable.
§If a 512 × 512 or smaller matrix is used, sagittal and coronal spinal views should be reformatted separately to maintain spatial resolution.

cians, and practice managers; uniform adherence should be encouraged.

REPEAT IMAGING AT THE RECEIVING FACILITY

Many studies have shown that roughly half of all transferred trauma patients undergo at least partial repeat CT scanning at the receiving facilities [2,4,13, 29-31]. Such repeated examinations have been associated with increased financial costs [2,4,29,31], delays in definitive surgical care [2,29], increased exposure to iodinated contrast agents and radiation [2], increased lengths of stay, and increased morbidity and mortality [32,33].

The most common indication for repeating CT imaging is for pretransfer scans performed with suboptimal technique or missing sequences [2,13,30,34]. In our experience, this most commonly occurs when outside facilities send CT images that are too thick for careful assessment (especially in the case of spine or skull base imaging), have inadequate scan ranges, or are missing postcontrast phases. Recognizing that scanning protocols vary by facility, we distributed a set of minimum technical CT standards to facilities throughout Washington State that transfer trauma patients to HMC [3] (Table 1).

THE IMPLICATIONS OF A SECOND RADIOLOGIC OPINION

When patients are transferred with outside imaging, the receiving clinicians often turn to their in-house radiologists to verify that outside studies are technically adequate to address the clinical questions, to determine if additional or repeat imaging is needed, and to verify the accuracy of the outside reports if they are available for review. Such requests pose a dilemma for radiologists, who must balance the virtues of patient care and clinical collegiality against a natural reluctance to assume medicolegal responsibility for imaging studies without having control over the scan parameters and overall image quality and for which there may be no financial compensation [34,35].

The potential for conflicting interpretations raises concern for medicolegal risk. Sung et al [14] discovered such interpretive discrepancies in 12% of interpretations of outside images. Zan et al [36] found a 7.7% discrepancy rate, with the second opinions confirmed as correct in 84% of such cases. The Emergency Medical Treatment and Active Labor Act details the responsibilities of referring facilities in performing patient transfers. The referring hospital must provide the receiving institution with the portion of the patient's medical record that is pertinent to the reason for transfer. This includes a record of preliminary diagnoses, therapeutic interventions, and the results of any diagnostic tests [37]. Specifically, if an imaging study has been performed at an outside hospital, then a radiologist's report (whether preliminary or finalized) must accompany the rest of the medical record upon transfer [37]. Nevertheless, as many as 16% to 34% of outside studies arrive without radiology reports [14,34].

When receiving clinicians consult their in-house radiologist for a second opinion on an outside study, it is often pursued in a casual manner, with a verbal request for a "quick once-over." Such informality sets the tone of a "curbstone consultation," in which an opinion is proffered pro bono in what typically is an undocumented exchange among providers. However, the very act of reviewing the imaging study may be sufficient to establish a formal, if temporary, physician-patient relationship [38]. Once an opinion is rendered on an imaging study, particularly in the setting of emergent care [35], the radiologist may be held legally responsible for issuing a proper interpretation, regardless of how informally it may have been delivered [39].

Another potential pitfall in rendering a casual, verbal opinion on an imaging study is the potential for asymmetric documentation of the interaction. When a radiologist provides an unwritten second opinion on an imaging study, medicolegal liability may be incurred if the interpretation is misunderstood or misrepresented in the clinician's record [7,14,39,40]. For these reasons, it is generally recommended that curbstone consultations be avoided [25, 41-43] and that even casual consultations, if at all possible, be documented by the radiologist in the medical record, even if doing so represents an unrewarded chore [44].

The actual incidence of lawsuits related to the interpretation of outside examinations is unknown. In recent surveys of emergency radiologists [13] and radiology residency program directors [34], only 1% to 2% of respondents reported knowledge of such a lawsuit.

The HMC emergency radiology section has developed an algorithm for handling outside imaging studies (Fig. 1) that delivers complete, subspecialty-level interpretations of outside imaging studies at the request of the receiving clinician. After an initial review of the technical adequacy of the transferred medical images and completeness of any accompanying radiology reports, the emergency radiologist or trainee consults with the receiving clinician to tailor a diagnostic plan for the patient that may include completion imaging or reinterpretation of the outside studies. If an outside report is deemed sufficient for the clinician's purposes (eg, a study with normal results with low clinical suspicion for a missed injury), then the images and outside report are imported into the HMC PACS under a designation of archival purposes only. Studies are not reinterpreted if they are to be repeated upon arrival; the outside examination typically is referenced in the report of the subsequent examination. Similarly, a study of higher sophistication obviates the need to reinterpret a more basic examination. For example, when a thoracic CT study is performed upon arrival, any outside chest radiographs are not reinterpreted.

After protracted discussion within our section, we have concluded that a problem-oriented consultation model (such as that described by Reis et al [45]) does not sufficiently address the expectations of diagnostic thoroughness that might be applied retrospectively in a court of law or at a morbidity and mortality conference. Therefore, whenever we are asked to review an outside examination (which meets our technical standards for transferred studies), we provide a formal, dictated report. Our clinical colleagues have voiced appreciation that they are not forced to rely on outside reports that are suspected to be incomplete or inaccurate. Meanwhile, by providing formal reports on any diagnostic opinions rendered, we avoid the aforementioned problems inherent to curbstone consultations while allowing our department to bill for the interpretive services rendered. Our decision to avoid a standing order for the interpretation of outside imaging allows us to focus our efforts on activities that provide diagnostic value and steers us clear of any activities that could be construed as inappropriate self-referral.

Operator-dependent studies (eg, ultrasound, catheter angiography, fluoroscopy) are not included in the above algorithm and may be reviewed at each radiologist's discretion.

We are currently developing a uniform feedback mechanism to promote communication between our radiologists and those at our referring facilities.

THE ROLE OF RESIDENTS IN INTERPRETING OUTSIDE STUDIES

The complexities of managing outside studies are compounded when radiology residents provide after-hours coverage, as they may find themselves in the position of "over-reading" a board-certified radiologist. In a recent survey of radiology residency program directors [34], nearly half (45%) reported that only residents review outside trauma studies, whereas 27% are over-read by an attending radiologist the following day. (The remainder

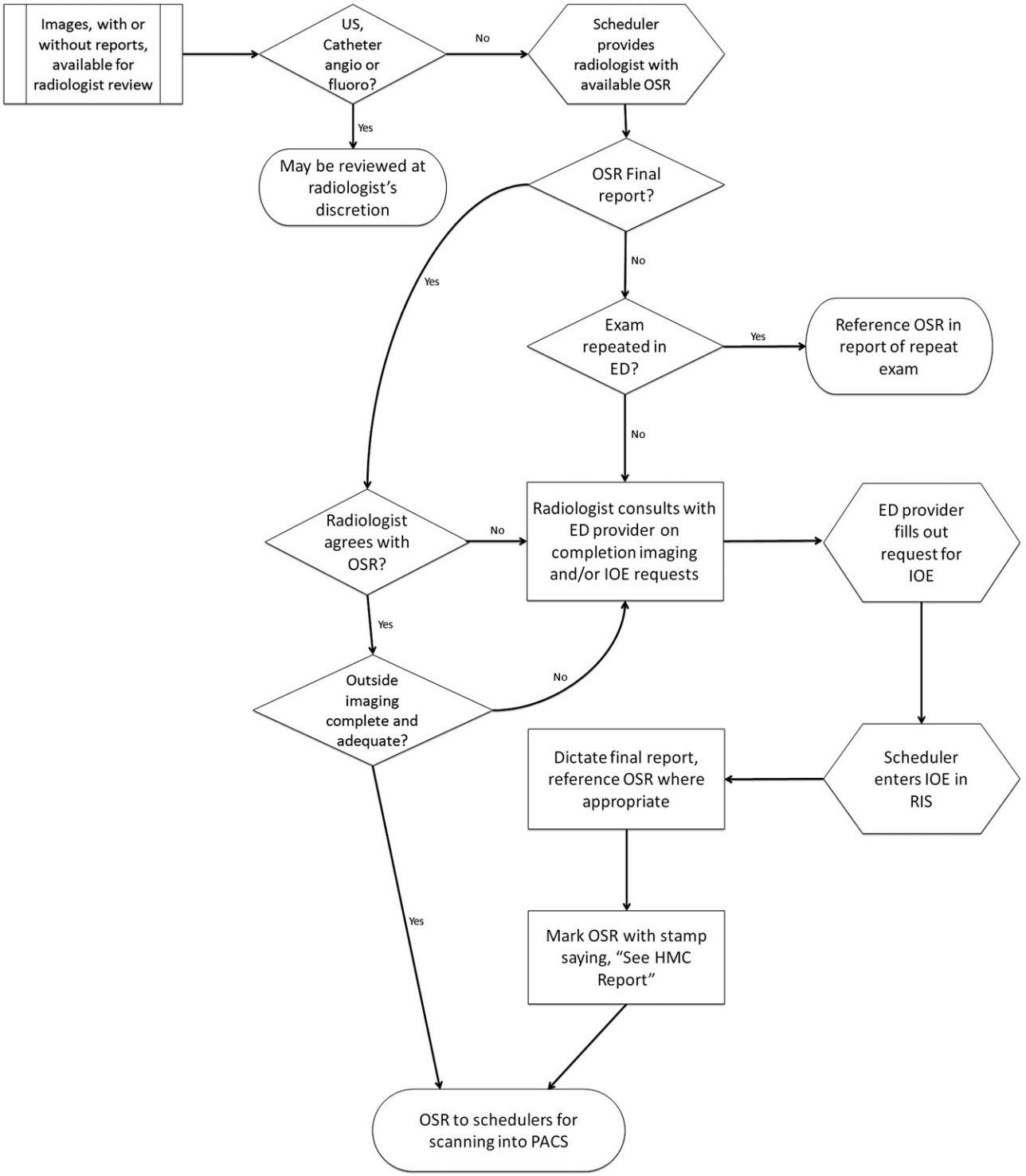

Fig 1. Harborview Medical Center (HMC) algorithm for handling outside imaging studies. angio = angiography; ED = emergency department; fluoro = fluoroscopy; IOE = interpretation of outside examination; OSR = outside report; RIS = radiology information system; US = ultrasound.

of institutions either had 24-hour attending radiologist coverage or did not review outside studies.)

Given the central role of imaging in modern clinical medicine, some clinicians have begun to call for 24-hour continuous coverage by attending radiologists [46]. However, several studies have examined the interpretive accuracy of radiology trainees operating independently, and to date, no mandate for overnight supervision has been established. In a study of 4,768 CT examinations of the torso interpreted by residents working solo in our

level I trauma center overnight, Chung et al [47] found only a 2% discrepancy rate (comprising both major and minor diagnostic errors) between resident preliminary reads and final attending radiologist reads. There were no adverse patient outcomes as a result of these discrepancies, and there was a 15% disagreement rate between attending radiologists reviewing the discrepant cases, suggesting that some of the misinterpreted cases were difficult and prone to interobserver variance. Tieng et al [48] found a comparatively high rate (10%) of major discrepancies but included attending radiologists' comments on nondiagnostic findings such as "colonic thickening," "sigmoid irregularity," and "pancreatic hypodensity" as resident false-negatives without providing any evidence that such over-reads were indicative of true pathology. Other studies have found major discrepancy rates between 0.3% and 5% [46, 49-55].

Despite their generally favorable accuracy, the existing data on overnight resident interpretations do not necessarily reflect the special situation of outside studies, in which residents must deal with more concentrated pathology, existing abbreviated or finalized reports, and the myriad technical challenges described above. Concern has been raised that allowing residents to reinterpret imaging studies without final attending radiologist review could be construed as "practicing without appropriate credentials" [7,45]. To our knowledge, no definitive statement on the practice has been issued by the ACGME or The Joint Commission.

PURSUING REIMBURSEMENT FOR SECOND OPINIONS

There is great variability in whether institutions choose to pursue financial compensation for the provision of second opinions on outside radiologic studies [13,34]. Despite popular misconception, it is entirely possible to bill for the interpretation of outside examinations, although considerable documentation barriers exist [56]. By using the same Current Procedural Terminology code for interpreting the study as if it had been generated in house, but with the addition of the -26 modifier (to signify that only professional, not technical, services were rendered), the department may be able to recoup 80% of the normal Medicare rate for these studies [7,56]. Medicare may require the -77 modifier, which specifies that the interpretation was rendered under extenuating circumstances requiring a second opinion (and these, in turn, must be duly documented) [56,57].

Among a sample of emergency radiologists who work at institutions that do bill for interpretations of outside examinations, most did not know if the studies are actually reimbursed [13]; in the same study, the number of represented institutions that usually (8.6%) and never (7.2%) are reimbursed were nearly equivalent. These figures are roughly consistent with the findings of Bagg et al [34], who reported that 79% of program directors either did not know or believed that such reimbursements were unusual.

If the interpretation of outside studies were routinely reimbursed, there might be less reluctance for attending radiologists to assume official responsibility for their final interpretation. In fact, when implemented carefully and under favorable circumstances, outside film consultations can be a financially sustainable service [58]. The ancillary benefits of an outside interpretation service, as described by Yousem [58], can include increased clinician satisfaction, fewer workflow interruptions for radiologists, and more accurate interpretations of patients' medical images.

TAKE-HOME POINTS

- Ineffective handling of transfer patient imaging can lead to departmental workflow disruptions and unnecessary delays, costs, and radiation exposure.
- When radiologists are called upon to evaluate outside imaging, their professional and clinical duties may conflict with medicolegal self-interest.
- The optimal role of residents in the interpretation of outside examinations is unclear and warrants additional research.
- The reinterpretation of outside studies is a reimbursable service, although significant logistic and documentation-related obstacles exist.

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