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Enhancing the Case Log by Coding the Level of Trainee Participation in Vascular Interventional Radiology Procedures

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Abstract

OBJECTIVE.—The purpose of this article is to describe a new method for coding trainee participation in vascular interventional radiology procedures.

MATERIALS AND METHODS.—From July 2008 through June 2009, all interventional radiology fellows maintained an enhanced case log at our institution; 748 unique cases were logged by procedure type, supervising physician, and level of participation in the case. Level of participation was classified on a 5-point scale that included designations for observation, first assistant, performance of basic techniques, performance of advanced techniques, and primary operation. Descriptive statistics of participation scores were calculated for each quarter and were analyzed by procedure type and by teaching faculty member.

RESULTS.—As expected, analysis by procedure type showed that average participation scores increased from one quarter to the next in most cases. By the fourth quarter, the modal participation score was 5, indicating primary operation or performance of multiple critical steps. Analysis by teaching faculty member revealed three patterns: those attending physicians facilitating increasing levels of participation in every quarter, those facilitating maximal growth within the first 6 months, and those with irregular trainee participation profiles.

CONCLUSION.—Data from a 5-point participation scale add information to the procedure case log that could be used to quantitatively track the technical progress of trainees while providing education quality feedback to both teaching physicians and program directors.

Keywords

case log; education; interventional radiology; participation; trainee

Over the course of the fellowship year in vascular and interventional radiology, trainees undergo apprenticeship-style training, gradually assuming increasing levels of responsibility for patient care until, at the completion of training, they are deemed competent to practice independently. Trainees typically document their procedural experience in a case log, recording the number and types of procedures in which they have participated, along with relevant outcomes data such as major and minor complications. This information may be

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used to claim competence for credentialing purposes and to satisfy requirements for subspecialty certification in vascular interventional radiology.

The number and type of cases in which the fellow has taken part may be a useful indicator of overall exposure, but case volume alone does not indicate the level of procedural involvement or competence [1]. A more detailed and uniform description of level of participation achieved in each patient encounter could alleviate this limitation. Such data might provide useful information to evaluate trainee progress during the year, aid in documentation of fellow competence on completion of training, and provide important quality feedback both to teaching faculty and training program directors. We piloted a simple scoring method to capture details regarding level of trainee procedural participation during a recent fellowship year to evaluate the potential utility of such a system.

Materials and Methods

From July 2008 through June 2009, all interventional radiology fellows maintained an enhanced case log at our institution, a rotating site for an Accreditation Council for Graduate Medical Education (ACGME)–accredited vascular interventional radiology fellowship. Each of the four trainees spent 25% of their fellowship at our hospital, divided equally among the four quarters of the year. All our faculty members have completed a vascular interventional radiology fellowship and practice full-time interventional radiology. Radiology residents were not present on our service during the study period; 748 unique cases (representing 116, 198, 223, and 211 observations contributed by the four trainees, respectively) were prospectively logged by procedure type, supervising physician, and level of participation in the case. Procedures were classified into nine categories: lung biopsies, nonlung biopsies, venous access, inferior vena cava (IVC) filter insertion or removal, exchange of indwelling percutaneous catheters, drainage of fluid collections, organ drainage (nephrostomy and biliary drainage), angiography and embolization, and tumor ablation. Participation was graded by the fellow on the 5-point scale depicted in Table 1. This scale was created by one author to distinguish among various levels of trainee participation in a procedure. The scoring system was explained to the fellows during their orientation. Attending physicians did not review or influence the participation score.

In the 5-point scale, “basic technical components” were defined as arterial and venous access, image-guided needle placements for biopsies and abscess drainages, wire exchanges and over-guide-wire catheter exchanges, and first-order catheterizations. “Critical technical components” were defined as needle placements for nephrostomy or biliary drainages, second-order or higher vascular catheterizations, administration of embolic agents, and primary operation during placement of devices such as stents, vascular coils, and IVC filters. When entire procedures were assembled from basic technical components or from fewer than three critical components, a score of 5 was recorded if the fellow performed all steps (primary operation).

For example, percutaneous biliary drainage can be deconstructed into a series of discrete technical tasks. First, one must place a needle within an appropriate bile duct. We deemed this to be one of the highly skilled components of the procedure and therefore defined it as a

critical technical component. If the attending physician placed the needle into the bile duct, and the trainee then performed subsequent over-wire exchanges, the trainee's level of participation was coded as basic technical skills (level 3). If the trainee placed the needle into the bile duct, however, the level of participation was coded at least 4 (minimum of one critical component performed); if the trainee placed the needle into the bile duct, catheterized the obstruction, and performed all wire and catheter exchanges to completion, participation was coded at level 5. Participation scores were retrospectively analyzed by quarter for procedure type and supervising physician.

Results

As expected, the average participation score increased from each quarter to the next (Table 2). By the final quarter of training, the most common score (the modal score) was a 5, indicating primary operation or performance of three or more critical procedural steps. The SD of scores, range of scores, and number of procedures reported were similar across quarters.

Average scores increased for each category of procedure in each quarter (Table 3), except for an unexplained decrease in score from third to fourth quarter for level of involvement in nonlung biopsies. In the first quarter, scores were lowest for participation in tumor ablation and lung biopsy, and highest scores were found for vascular procedures (venous access, IVC filters, and angiography and embolization). In the last quarter of training, the lowest participation score was for tumor ablation, and the highest score was for IVC filter insertion or removal procedures.

Descriptive statistics of fellow participation scores in the last quarter of training (Table 4) revealed that the most common participation in angiography or embolization and tumor ablation procedures was at level 4 (performance of one or two critical technical components). In all other procedure classes, the most common participation score was 5, the highest possible score. There were 14 instances of observation-only in the final quarter of training. Fellows reported explanations for this low level participation in only five of these cases. In one case, a patient specifically requested that the attending physician perform the procedure. One difficult biliary drainage was performed completely by an attending physician. In two cases, fellows asked to observe a new or unusual technique. In the final reported instance of observation during the final months of training, the fellow arrived to the procedure room after the procedure had already begun and therefore only watched.

Radar graphs in Figure 1 compare the average participation score received in cases with each attending physician for each quarter. The overall average participation score for each quarter is indicated on each graph in red, permitting comparison of individual physicians to the mean as well as to each other. The radar graph in Figure 2 superimposes the attending physician performance graphs for each quarter. Analysis of these graphs revealed several distinct teaching profiles.

Teaching physicians A–C showed clear increases in trainee participation from one quarter to the next for the entire year. Within this group composed of physicians with both more and

less than 10 years of experience, individual styles were apparent. Physician A, although showing a pattern of graduated delegation of responsibility, had below-average participation scores until the fourth quarter. Physician C, with the lowest first quarter participation score, showed substantial increases in fellow involvement across all quarters and had the highest average fourth quarter participation score. Physician B, with the highest first quarter participation score, permitted small increases in participation from one quarter to the next but always exceeded the teaching group's average level of participation.

Teaching physicians D–F, on the other hand, showed clear increases in level of fellow involvement during the first half of the year, followed by either stable participation levels or smaller increases in participation thereafter. Some attending physicians within this group had more and others less than 10 years experience. Physician D permitted better-than-average participation in all quarters except the first and showed a leveling off in participation, with third-quarter scores similar to those in the fourth quarter. Physician E showed a similar pattern of leveling off in the second part of the year, but with average or better participation during all quarters. Physician F exceeded average participation in the first three quarters of the year but overall showed stabilization of participation scores at second-quarter levels.

Teaching physicians G–I showed more disordered or irregular patterns characterized by retreats in fellow involvement during the year, lack of increasing fellow participation during the year, or both. Attending seniority in this group included individuals with both more and less than 10 years' experience.

Third- and fourth-quarter data were further analyzed by attending physician–fellow combinations for the number of procedures performed and average participation score. During the third quarter, in only two of nine combinations did the fellow performing the greatest number of procedures with an attending physician also record the highest participation score with that attending physician. During the fourth quarter of training, this occurred in only three of nine instances.

Discussion

Historically, the record of experience recorded in a case log has served as an important indicator of readiness. Quality and Safety Guidelines of the American College of Radiology for performance of diagnostic arteriography [2] and abscess drainage [3], for example, specify experience with a prescribed number of cases, with a particular number as primary operator, as a criterion for professional qualification. At least 500 logged fellowship cases are required to sit for the initial subspecialty examination in vascular and interventional radiology [4]. Hospital credentialing boards typically use number-based criteria. In some cases, such numbers can be generated from formal learning curve analysis [5–7], but in many instances the metrics are less evidence based.

Role delineation in procedural logs has traditionally been recorded as primary operator or assistant. In the current implementation of the ACGME Resident Case Log System for Surgery, for example, trainees designate their role as First Assistant, Teaching Assistant,

Surgeon (junior years), and Surgeon (chief year) [8]. HI-IQ (Conex-Sys), a commonly used interventional radiology database program, permits designation of Supervisor, Primary Operator, and First and Second Assistant [9]. Such labels, however, do not describe the actual technical content of trainee participation. Tetzlaff [10] notes that the approach to evaluation of competence has evolved from global impressions to an understanding of the elements of performance that determine competence. We sought to enhance the reporting of involvement to more accurately portray the difficulty of technical elements accomplished by trainees during invasive procedures.

Five levels of participation were defined to capture the spectrum of trainee involvement, ranging from observation to primary operation. Observation levels of participation were recorded in each quarter of trainee experience in our program. When, during the final quarter, trainees were asked to explain instances of observation, various explanations emerged, some with specific educational motives such as the observation of new or unusual techniques. The second level of participation we distinguished was as first assistant. In our training program, as might be expected in many programs, competent service as a first assistant involves anticipating the needs of the primary operator by providing the correct tools and imaging fields necessary to complete a procedure. Full participation at this level signals to the supervising physician that the fellow has mastered the sequence of steps and equipment needs of a particular procedure and is ready to advance. Participation at the third level indicated performance of basic techniques, whereas participation scores of 4 or 5 signaled increasing technical sophistication. Levels 1 and 2 can be construed as appropriate for actively teaching and demonstrating a technique (and therefore might be used at any level of training, especially when novel or difficult techniques are used), whereas technical skills are acquired and practiced by participation at levels 3, 4, and 5. Coding the level of participation on a 5-point scale therefore captures more precise information on the content of participation than can be meaningfully extracted from designations such as “first assistant” or “primary operator.”

As anticipated, average participation scores across all procedures increased from 2 to nearly 4 over the fellowship year. By the final quarter of training, fellows most commonly rated their level of participation as 5 (primary operation, or performance of multiple critical steps), as would be expected. During all quarters, there were instances of level-1 participation, and five of 14 such instances were explained during the last 3 months of fellowship. Except for an unexplained decrease in level of participation during nonlung biopsies from the third to fourth quarters, mean participation scores increased for each procedure type from quarter to quarter. Descriptive statistics of fourth-quarter participation showed that, in seven of nine procedure types, performance of multiple critical steps and primary operation was the most common level of fellow involvement. These data portray expected results—namely, that there is a gradual and stepwise transfer of procedural responsibility from attending physician to trainee during the fellowship experience.

The ability to sort trainee participation scores by teaching physician yielded other potentially useful information. As individual teaching physicians cede procedural responsibility to trainees, their individual participation scores increase, and this is represented as outward movement on the radar graphs. Two general patterns were observed: those whose teaching

was characterized by continuous increases in trainee participation across all quarters (physicians A–C) and those whose teaching was characterized by growth to a maximal level of participation reached around 6 months (physicians D–F). The explanations for those with less regular patterns of growth are not clear in this retrospective analysis but could relate to a more complex case mix of these physicians or their relative underexposure to trainees. Dijksterhuis et al. [11] have noted that both the audacity of the individual supervisor and patient safety concerns influence supervisory decisions on progressive independence. The ability to compare individual teaching physicians to each other and to overall group performance, however, appears to form a potentially important basis for faculty feedback and teaching quality assessment.

Our study has several limitations. During the period of evaluation, ours was a rotating site for fellows from an ACGME-accredited vascular interventional radiology fellowship program. Individual fellows were present for only 3 weeks each during a quarter, and fellows selected the teaching physicians with whom they worked. Intermittent exposure to trainees was therefore the norm, and evidence suggests that decreased exposure to trainees correlates with decreased resident involvement in the work of teaching faculty [12]. Inconsistent exposure of our vascular interventional radiology faculty to trainees will be remedied by the establishment of our own fellowship program as of July 2010. In addition, the description of fellow participation was made by the trainee only. Zorn et al. [13], in describing residents' involvement in open radical prostatectomy, concluded that residents' perception of their level of participation was likely accurate, with a global level of agreement between staff and resident assessments of nearly 95% in that series. Yap et al. [14], however, found significant disagreement regarding the degree of resident involvement in laparoscopic nephrectomy, with attending physicians reporting greater levels of trainee involvement for most components of the procedure than the trainees themselves. Itemization of the technical tasks required for each intervention and reconciliation of trainee and supervisor impression of level of participation will fortify this process going forward.

In summary, coding trainee procedural involvement on a 5-point participation scale appears to be a useful addition to the typical interventional radiology case log. This is a first step toward further deconstruction of procedures into their individual modular technical components, with the aim of producing a circumscribed menu of elemental skills that forms the core technical repertory of a fully trained interventional radiologist. An explicit library of elemental technical skills, from which almost all interventional radiology procedures could be assembled in a modular fashion, would help to systematize both the teaching and evaluation of trainees as they acquire the skills of our profession. A scoring system, such as the one we propose, is one way to quantitatively track both the acquisition of these skills and the contribution of teaching faculty in facilitating the trainee's transition to technical independence.

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Fig. 1—
Average participation score for individual attending physicians (*blue lines*) with group-wide average (*red lines*) for each quarter. Individual teaching physicians correspond to rays on graphs lettered A through I, and higher levels of fellow participation map toward periphery of graph.

A, Radar graph shows first quarter participation, by physician. Number of procedures per physician: A, 16; B, 33; C, 16; D, 17; E, 27; F, 34; G, 6; H, 24; I, 16.

B, Radar graph shows second quarter participation, by physician. Number of procedures per physician: A, 27; B, 26; C, 39; D, 10; E, 31; F, 34; G, 4; H, 9; I, 9.

C, Radar graph shows third quarter participation, by physician. Number of procedures per physician: A, 33; B, 25; C, 21; D, 9; E, 26; F, 26; G, 5; H, 26; I, 7.

D, Radar graph shows fourth quarter participation, by physician. Number of procedures per physician: A, 70; B, 22; C, 20; D, 12; E, 32; F, 17; G, 5; H, 10; I, 4.

Fig. 2—.
Mean fellow participation score, by quarter and by attending physician. Transfer of responsibility to trainee operators is depicted by outward movement of participation scores on graph from one quarter to next.

TABLE 1:
Five-Point Scale for Coding Level of Participation in Interventional Radiology Procedures

Participation Score	Explanation
1	Observation
2	First assistant
3	Performed basic technical components
4	Performed one or two critical technical components
5	Primary operation (or performed three or more critical technical components)

TABLE 2:

Fellow Participation Scores, by Quarter

Parameter	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Mean	2.5	3.1	3.4	3.7
Median	2	3	4	4
Mode	2	2	4	5
SD	1.2	1.2	1.4	1.3
Range	1–5	1–5	1–5	1–5
Total no. of procedures	189	189	178	192

TABLE 3:

Mean Participation Score, by Major Procedure Types

Procedure Type	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Biopsy, lung	2.0	2.3	2.5	3.8
Biopsy, nonlung	2.7	3.1	4.3	3.3
Venous access	3.0	3.7	4.1	4.3
IVC filters	3.0	3.1	4.0	4.6
Catheter exchanges	2.6	3.5	3.9	4.0
Collection drainage	2.3	3.2	3.4	3.8
Organ drainage	2.3	2.9	3.1	3.5
Angiography or embolization	3.1	3.4	3.4	3.5
Tumor ablation	1.8	2.5	3.0	3.2

Note—IVC = inferior vena cava.

TABLE 4:

Fourth Quarter Participation Scores, by Procedure Type

Procedure Type	Score			Total No. of Procedures
	Median	Mode	Range	
Biopsy, lung	4	5	1–5	21
Biopsy, nonlung	4	5	1–5	42
Venous access	5	5	1–5	16
IVC filters	5	5	4–5	8
Catheter exchanges	4	5	1–5	21
Collection drainage	4	5	1–5	31
Organ drainage	4	5	1–5	16
Angiography or embolization	4	4	1–5	24
Tumor ablation	4	4	2–5	14

Note—IVC = inferior vena cava.