A Dedicated General Competencies Curriculum for Radiology Residents:

Development and Implementation

Annemarie Relyea-Chew, JD, MS, Lee B. Talner, MD

Rationale and Objectives: The Accreditation Council on Graduate Medical Education (ACGME) through its Outcome Project requires training programs in all medical specialties to integrate six general competencies into residency training: patient care, medical knowledge, professionalism, interpersonal and communication skills, practice-based learning and improvement, and systems-based practice. In response, a required, or dedicated general competencies rotation for diagnostic radiology residents was instituted.

Materials and Methods: We describe the development and implementation of this rotation. The rotation augments the core curriculum, with primary emphasis placed on resident-initiated quality improvement (QI) and quality assurance (QA) projects.

Results: Between academic years 2003 and 2009 diagnostic radiology residents completed 38 QI/QA projects and performed clinical float coverage for the department. Residents met requirements of the systems-based practice and practice-based learning competency domains. In this process, residents improved their medical knowledge, interpersonal communication skills, professionalism, and provided patient care.

Conclusions: A dedicated general competencies rotation can be successfully implemented, and complement the requirements of the core curriculum. In combination with coverage for clinical services, the rotation makes a substantive contribution to resident education to further the goal of improved patient care.

Key Words: Competencies; residents; quality improvement; curriculum.

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The Accreditation Council on Graduate Medical Education (ACGME) through its Outcome Project requires training programs in all medical specialties to integrate six general competencies into residency training: patient care, medical knowledge, professionalism, interpersonal and communication skills, practice-based learning and improvement, and systems-based practice (1). The Outcome Project initiative has been phased in since 2001 with the expectation that after June 2011, full integration of the general competencies into program curricula will have occurred (1). In 2005, the Radiology Residency Review Committee revised training program requirements with input from the American Medical Association , American College of Radiology (ACR), and the American Board of Radiology, as well as the Association of Program Directors in Radiology (2). The new requisites include teaching and assessment of the six general competencies; curriculum innovation is encouraged. This article describes ongoing curriculum development and implementation of a general competencies rotation into the diagnostic radiology residency program of our department. The rotation augments the core curriculum, with primary emphasis placed on resident-initiated quality improvement (QI) and quality assurance (QA) projects.

METHODS

Rotation Design

In response to the ACGME Outcomes mandate, an 8-week rotation designed to address components of the general competencies was created as a requirement of the core curriculum for University of Washington diagnostic radiology residents in 2003. Sited in Seattle at Harborview Medical Center (HMC), the major level 1 trauma center in a five-state region, the main program objective was to immerse residents in QI and QA processes. Support for the rotation is provided by the radiology department and institution to enhance the mission of HMC, not only as a major trauma center, but also as a safety-net hospital. As a safety-net hospital, HMC provides health care for the poor, uninsured, and most vulnerable in the community it serves (3). The volume and patient mix of this busy trauma center broadens learning opportunities for residents. The HMC emergency department (ED) radiologists and workstations are located physically within

the ED. Residents gain enough exposure to operations in the radiology department, ED, and hospital to become cognizant of system shortcomings, problems, and redundancies—all potential topics for QI/QA projects.

Two residents are assigned to the rotation to provide clinical day "float" coverage in the department for at least 4 hours in the morning, and pursue a QI/QA project during the remainder of the day. Implementation of float coverage helps meet the ACGME resident work-duty requirements, and is a measure taken by programs nationally in an effort to balance patient care with educational objectives (4). Residents are assigned to this rotation after their postgraduate year-2, and only when qualified to perform independent on-call duties at night. During the first 3 years, QI/QA topics were solicited from faculty, trainees, and hospital staff, and focused on after-hours and on-call discordances between preliminary resident interpretations and final faculty interpretations. Determination of discrepancy rates, particularly during overnight on-call rotations, functions to assess, educate and improve resident performance (5) (Table 1). Resident-initiated projects were also generated studying system QI/QA issues, such as the effectiveness of "routine" ED radiology protocols and practices. Projects that reviewed procedures directly affecting patient safety such as contrast extravasations and informed consent policies were conducted, resulting in revised policies and improved patient care (Table 1).

All curricula are dynamic and should evolve in response to institutional, learner, and societal needs (6). In 2007 we expanded the scope of the rotation, introducing additional educational opportunities, administrative resources, and focused faculty guidance. The basic elements of the rotation remain constant: during the 8-week rotation at HMC, two radiology residents are assigned for 4 hours in the morning to cover clinical services where needed, and the remainder of the day engaged in academic and competency-based activities for the QI/QA study. The structure and expectations of the rotation include: prerotation activities, orientation, project designs and data acquisition, project completion and dissemination, and assessment. The curricular goals and performance objectives are clearly stated (Appendix 1).

Prerotation

In advance of the rotation, the administrative staff determines initial clinical coverage needs for each service and coordinates the schedule with incoming residents. The rotation director communicates with the residents advising them to consider and propose, as a team, a QI/QA project and faculty mentor(s). We stress that ideally, the study and collaboration should be one of mutual professional and scholarly interest, and benefit patient care and safety. A familiarization with bioethical principles of patient autonomy and privacy is required, and residents complete the online human subjects (CITI) recommended by our human subjects division before access to datasets or databases for the QI/QA project (7). These projects are initiated as QI/QA and education as

defined by the Revised Code of Washington, Chapter 70.41, and are considered part of ongoing continuous health-care QI (8).

Orientation

At orientation, residents receive a written syllabus with expectations and goals of the rotation. Resident expectations are solicited for both the clinical coverage and the competencies component, as well. A tentative schedule with benchmarks for the rotation is tailored to integrate the residents' respective clinical and departmental responsibilities. Half of each day is devoted to covering radiology clinical services; therefore, the actual time allotted to QI/QA and academic activities is approximately 4 weeks. The schedule is flexible, because residents have competing obligations, including late-stay and night-call for the ED, preparation for examinations, professional conferences, personal issues, and family matters.

Required conferences, didactic sessions, and tutorials are also incorporated into the schedule. Opportunities and resources for self-directed learning are made available, including the radiology department library, the institution online library, the Competencies Office collection, and suggested reading (Appendix 2). Required reading of direct relevance includes topics in basic study design, analysis, the process of QI, basics of information technology, ethics and professionalism, and making scientific presentations (Appendix 2). During the first week of the rotation, a university librarian meets with the residents to conduct training for online library research. Residents review and perform a critical assessment of the literature related to the QI/QA topic.

Project Design and Data Acquisition

All QI/QA competency projects in this rotation are observational, retrospective, and include creation of datasets, dataset analysis, medical record review, surveys, and interviews. The study designs vary and, if necessary, application to the institutional review board (IRB) is made on a case-by-case basis. As in most preliminary or pilot projects, study designs are usually modified during the course of acquiring and analyzing data. Residents are encouraged to be creative, communicate, and collaborate with other departments, specialists, hospital services, to consult with mentors, and to investigate resources outside the institution if appropriate.

Residents participating in this rotation are postgraduate year-3 or more senior; therefore, they are familiar with, and have privileges to access the clinical and proprietary department and hospital databases. These include the Radiology Information System, Picture Archiving and Communication System, and zVision (Clario) (9). zVision is a proprietary software product designed to search and retrieve imaging reports and run analysis. Data acquisition and analysis occur behind a firewall, protected within the institution's information technology department.

TABLE 1. Selected Resident Projects Completed During Dedicated Competencies Rotation (2003–2009)

Year	Title	Presentation, Publication, and Outcome
2003	Resident versus attending errors on trauma chest films	Presented at AUR (San Francisco, 2004). Co-Winner of the Best Resident Paper Award
2003	Resident errors on after-hours neuroradiological exams, including impact of error on patient management and outcome	Presented at AUR (San Francisco, 2004). Co-Winner of the Best Resident Paper Award
2004	Reviewed and presented issues regarding informed consent; reviewed and revised HMCRAD policy on contrast extravasations in CT	Now implemented HMC
2004	Resident error patterns in diagnosing cervical spine injuries after hours	Presented at AUR (Montreal, Canada, 2005). Winner of the Memorial Award
2005	Resident and attending errors on thoracolumbar spine radiographs and CT	Presented at AUR (Austin, TX, 2006)
2005	Yield of CT KUB (noncontrast abdominal CT) in emergency and urgent care clinic patients presenting with flank pain	Didactic: Findings on CT KUB in patients with stones
2005	Assessing for mediastinal hematoma: a tutorial	Presented as Education Exhibit at ARRS (2006). Winner of the Silver Medal
2005	Evaluation of Subarachnoid Hemorrhage: CTA versus DSA in the detection of aneurysms	Presented as scientific exhibit at AUR (Austin, TX, 2006); Presented at ASNR (San Diego, CA, 2006)
2006	Head CT in minimal and minor head injury	Pilot data for larger IRB-approved research
2006	Screening for cervical spine injury in low risk patients	Pilot data for larger IRB-approved research
2007	Usefulness of CT in assessing injuries to the globe	Presented at RSNA (Chicago, IL, 2007) as "The role of CT imaging in the diagnosis of globe injuries"; published in: *Contemporary Diagnostic Radiology*
2007	Resident interpretation errors on emergency department abdominal/chest CT	Electronic poster presentation at RSNA (Chicago, IL, 2008); Published in *Academic Radiology*
2007	Triaging patients with nontraumatic intraparenchymal hemorrhage	Poster and scientific presentation
2007	Utility of repeat head CT after blunt head trauma with intracranial hemorrhage	Winner ASER scientific presentation (2009); IRB-approved research
2008	Utility of the radiographic evaluation of ventricular shunts in the emergency department at Harborview Medical Center	Presented at AUR (2008); IRB-approved research
2008	An analysis of tunneled catheter-associated infections at Harborview Medical Center: natural history and opportunities for improvement	Presented at HMC IR rounds
2008	Overnight interpretation of torso CT at a level 1 trauma center: analysis and review of the literature	Presented at AUR; Published in *Academic Radiology*; winner of the 2010 Stauffer Award (Best Education Paper)
2008	Negative appendectomy rate and imaging at Harborview Medical Center	Presented at AUR; IRB-approved research
2008	Radioiodine treatment of benign hyperthyroidism: outcomes from a county hospital population treated between 2000 and 2006	Presented at AUR; second study presented at SNM
2009	SPOX (surgical postoperative x-ray): Preventing retained surgical material at Harborview Medical Center	Creation of macro in reporting SPOX
2009	Use of serial CTs in traumatic hemorrhagic brain injury: a qualitative and quantitative analysis	Pilot; IRB-approved research
2009	Structured reports in ER CTA neck stroke protocol reports; utility of structured reports in ER and outpatient spine CT reports	Used for online protocols
2009	MRI reporting for low back pain studies	Pilot; ongoing study; RSNA research award
2009	Clinical utility of routine chest radiographs for intubated patients at Harborview Medical Center	Presented at ARRS (San Diego, CA, 2010); Winner of the ARRS Executive Council Award

ARRS, ; ASER, ; ASNR, ; AUR, ; CT, computed tomography; CTA, ; DSA, ; ER, ; HMC, ; HMCRAD, ; IR, ; IRB, institutional review board; KUB, ; MRI, magnetic resonance imaging; RSNA, .

Project Completion and Dissemination

Residents are encouraged to complete data acquisition, analysis, and collaborative activities with other services within 2 weeks of the end of the rotation. After preview and editing, residents present their QI/QA findings and recommendations using PowerPoint (Microsoft) or Keynote (Apple) as they would in a more formal setting (ie, a national meeting). The initial 1-hour presentation is before peers and faculty at HMC, and transmitted contemporaneously to other radiology department sites. This venue provides an opportunity for critique, recommendations, and refinement; findings can then be presented to individual services or hospital quality and patient safety committees. Later in the year, the residents again present their work to peers and faculty during the department's Health Services Research conferences.

Assessment

Resident performance is assessed in three ways: 1) evaluations with both objective and subjective criteria for the six competency domains are submitted by faculty to the residency director through an online system; 2) the successful completion of the QI/QA project and presentations; and 3) evidence of follow-through after the rotation ends (eg, submission of an abstract, manuscript, educational exhibit as a scholarly activity, or presentation of findings and recommendations to other services or within the institution).

RESULTS

Between academic years 2003 and 2009, diagnostic radiology residents completed 38 QI/QA projects during the dedicated general competencies rotation. All residents met their clinical float obligations. Evidence from the QI/QA studies was shared interdepartmentally, in interdisciplinary forums, with the institution, and collaboratively with other medical or surgical services. Most projects continued formally in scholarly endeavors such as ongoing research, publications or presentations at national meetings (Table 1).

DISCUSSION

The goal of this rotation is to 1) provide essential clinical coverage that contains its own educational component and 2) develop and complete a QI/QA project as a means to integrate multiple domains of the general competencies requirements (Table 2). It is a pragmatic solution designed to augment the existing core curriculum and meet the requirements of the ACGME. To date the literature indicates that there is no method to assess each of the ACGME competencies as independent constructs (10). In addition, the psychometric properties of tools being employed to assess competence are weak. This is not surprising (11,12).

Engaging residents in the QI/QA process meets the goals of the Systems-based Practice (SBP) and Practice-based

TABLE 2. ACGME General Competencies in Relation to Performance Objectives

1. Patient Care	Complete QI/QA project
	Dissemination to other services
	Clinical float coverage
	Bioethics tutorial
	IRB
2. Medical Knowledge	Design QI/QA project
	Complete QI/QA project
	Didactic sessions
	Clinical float coverage
	HSR lectures
3. Practice-Based Learning	Design QI/QA project
	Complete QI/QA project
	Clinical float coverage
	Dissemination of QI/QA results
4. Communication	Interactions with other services
	Design QI/QA project
	Presentation of QI/QA project
	Clinical float coverage
5. Professionalism	Medical-legal conference
	IRB application drafts
	Clinical float coverage
	Presentation of QI/QA project
	Bioethics tutorial
6. Systems-based Practice	Design QI/QA project
	Complete QI/QA project
	Medical-legal tutorial
	Clinical float coverage

ACGME, Accreditation Council on Graduate Medical Education; HSR, Health Services Research; IRB, institutional review board; QA, quality assurance; QI, quality improvement.

Learning and Improvement (PBLI) competency domains, and advances the quality of health care. As described by the author of "Involving Residents in Quality Improvement: Contrasting 'Top-Down' and 'Bottom-Up' Approaches," primary drivers for resident involvement in QI/QA processes are: 1) the appeal of QI/QA to residents, faculty and institutional leaders, 2) an infrastructure that embeds QI/QA in the residents' daily experiences, and 3) and effective curricula, role models and mentors (13). The so-called "bottom-up" approach permits residents the autonomy to use experience and common sense to identify and remedy system errors within the health care setting.

We observed that residents will initiate QI/QA projects on topics in which they have interest and, in concert with faculty mentors and administrative guidance, complete the projects and rotation successfully. Resident skills and interests differ,

and are often complementary. Working as a team for 8 weeks can enhance the generation and exchange of ideas, produce more discussion and debate of working hypotheses, and foster a healthy collaborative approach to the project. Most residents have an interest in an equitable sharing of the work necessary to the successful completion of the project. Once completed, residents present findings jointly at inter and intradepartmental conferences to peers and faculty. Projects have also provided a vehicle for interdisciplinary clinical research.

In partnership with faculty mentors, and one another, residents are engaged in an intellectual activity that increases their level of medical knowledge and professional confidence (14). Scholarly activities, both for the residents and faculty mentors, are facilitated, as well as an emphasis on the ethics of human subjects' research. Further, with its focus on improved patient care, safety, and resource use, QI/QA projects provide a practice quality improvement (PQI) experience and working template with which to perform their own PQI for Maintenance of Certification (15).

There are challenges to this curriculum design, and support by the institution and department is essential. Ongoing recruitment of faculty mentors or advisors is necessary, but benefits of mentorship, particularly for clinician-teachers, can be rewarding. The key components of prerotation preparation and follow-up, or sustainability of projects after the rotation ends require administrative and faculty resources. Integration of the myriad activities built into the schedule can be daunting: residents have multiple obligations, late-stay and night-call responsibilities, national examinations, professional meetings, and personal matters. These are not uncommon themes (13,16,17). Nevertheless, the record of successful QI/QA projects, and continued scholarly activity demonstrated in manuscripts, presentations and exhibits authored by residents, suggests that the challenges can be overcome.

CONCLUSION

A dedicated general competencies rotation can be successfully implemented, and complement the overall requirements of a diagnostic residency program. In combination with coverage for clinical services, the rotation makes a substantive contribution to resident education to further the goal of improved patient care.

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