Special Review

# Radiology Education of Physician Extenders: What Role Should Radiologists Play?

Jamie L. RiChard, MD, Benjamin P. Liu, MD, David D. Casalino, MD, Eric J. Russell, MD, Jeanne M. Horowitz, MD

**Abbreviations**

**AC** Appropriateness Criteria
**CT** computed tomography
**GFR** glomerular filtration rate
**IR** interventional radiology
**NPs** nurse practitioners
**PAs** physician assistants
**PE** physician extender

As physician extenders (PEs) enter the medical community in large numbers, they have an increasing impact on imaging utilization and imaging-based procedures. Physician assistants (PAs) and nurse practitioners (NPs) have an advanced level of education and some practice autonomously. However, PA and NP programs are not required to provide any basic radiology education. For PEs who did receive basic radiology education during their graduate program, the curriculum is nonstandard and there is a wide variation. PEs working in primary care and nonradiology specialties place imaging orders, review report findings, and answer patient questions. Other PEs working within radiology practices operate as liaisons with patients in diagnostic radiology or perform an increasing number of interventional procedures. Basic radiology education in formal PE certificate programs as well as on-the-job education about radiology may benefit patients, radiologists, and the health-care system. What role, if any, should the radiologist assume for educating PE students and practicing PAs and NPs? This review analyzes the benefits and drawbacks of radiologists educating PEs.

**Key Words:** Physician extenders; education; diagnostic imaging.



## INTRODUCTION

The emergence of physician extenders (PEs) across all medical specialties to meet increasing demands for health care has changed the delivery of primary care and specialty services. Two main groups of PEs, physician assistants (PAs) and nurse practitioners (NPs), have seen a dramatic increase in career growth and some practice autonomously (1–3). As both primary care and specialty PEs assume greater responsibilities in patient care, they may interact with radiology in new capacities such as reviewing imaging report findings, discussing recommendations with patients, and assisting with or performing basic interventional procedures within a radiology practice. However, despite advancements in radiology over the past several decades and increasing responsibilities of PEs, there are no formal radiology education requirements for PA and NP certification programs (4).

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From the Department of Radiology, McGaw Medical Center of Northwestern University and Northwestern Memorial Hospital, Chicago, Illinois (J.L.RC.); Department of Radiology, Northwestern Memorial Hospital, 676 N St. Clair St, Suite 800, Chicago, IL 60611 (B.P.L., D.D.C., E.J.R., J.M.H.). Received August 8, 2016; revised November 17, 2016; accepted November 21, 2016. Institutional review board approval is not needed for this review article. **Address correspondence to:** J.M.H. e-mail: j-horowitz@northwestern.edu


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PA and NP programs were originally created in 1965 at Duke University and the University of Colorado, respectively, to combat a shortage of primary care physicians (5). Currently, over 95,000 PAs and 192,000 NPs work in all 50 states, with more than 6000 new PAs graduating from 219 national programs each year (1,6). Both professions have experienced higher-than-average growth; the U.S. Bureau of Labor Statistics projects continued growth at 30% for PAs and 31% for NPs between 2014 and 2024 (2,3). By contrast, the average growth for all occupations is 7% (3). Although matriculation prerequisites including minimum degree requirements vary between PA programs, the Accreditation Review Commission on Education for the Physician Assistant and the Physician Assistant National Certifying Exam set standards for all PAs. Both organizations require the ability to generate a differential diagnosis, to order, and to interpret laboratory and diagnostic studies (7,8). NP certification is awarded by The Accreditation Board for Specialty Nursing Certification, which similarly describes an ability to order, perform, supervise, and interpret laboratory and imaging studies (9). However, neither PA nor NP certification agency requirements refer to principles of radiology, radiological procedures, radiation safety, or radiobiology (4). The extent of radiology education is thus school dependent and variable.

The majority of PAs accept positions in family medicine or general practice (1). In such a context, these providers

perform much of their own diagnostic workups, including what type of imaging, if any, is warranted. PEs working as part of a specialty team may also have a primary role in ordering and following up with imaging results. On the other hand, some PEs may find employment within a radiology group, where he or she may be expected to learn to perform basic fluoroscopy examinations on the job and without required formal training or certification in at least 20 states (4). Some may be expected to learn and perform basic procedures on the job in interventional radiology (IR). Given that many PEs may have had minimal or no radiology education yet impact imaging utilization, what role, if any, can the radiologist assume in diagnostic and IR education for PEs?

## EDUCATION OF PES WORKING IN PRIMARY CARE OR NONRADIOLOGY SPECIALTIES

Determining the type of diagnostic imaging to order, answering patient questions, and understanding radiology report findings may be a difficult or uncomfortable process for PEs without sufficient prior radiology education. Inappropriate imaging studies may delay patient care, increase health-care costs, or expose patients to unnecessary ionizing radiation (10). Unfamiliarity with common radiology report findings may also lead to misunderstanding, miscommunication, and improper patient management. Targeted radiology education of PEs focusing on a few key points within the diagnostic radiology workflow may reduce the possibility of these negative consequences (Fig 1).

### Order Appropriateness

PEs in primary care utilize more resources than their physician counterparts, with significant differences for computed tomography (CT) or magnetic resonance imaging, and for ultrasound (11). A recent study demonstrated that primary care PAs and NPs ordered more radiography examinations for both new and established patients (odds ratios: 1.36 and 1.33, respectively) and advanced imaging for established patients (odds ratio: 1.28) when compared to primary care physicians (12). Lack of radiology education for PEs, including when a diagnosis must be based on clinical history and physical exam rather than on imaging, may contribute to the difference in ordering patterns.

The American College of Radiology recognized the need for improved understanding and standardization of imaging ordering, releasing a database of Appropriateness Criteria (AC) in 2000 that now covers over 200 medical conditions (13). Although the AC and AC Select Software are available to assist with electronic order entry, studies show that they are underutilized among nonradiologists (14). Radiologists are well positioned to educate PEs about utilizing AC to assist with imaging orders, as well as determining patient eligibility such as reviewing allergy history and renal function before ordering contrast-enhanced imaging.

Educating PEs to order appropriate imaging exams has potential to eliminate workflow delays for patients and radiologists alike. Inappropriate imaging examination orders often detract from efficiency by requiring the radiologist to complete a chart review and often to call the PE or supervising physician to clarify the order. Further communication with the radiology technician to confirm or adjust the imaging order contributes to patient and workflow delays. Time would have been saved if the correct examination was initially ordered.

An unnecessary or inappropriate radiography-based imaging ordered by a PE or a physician that is not noticed before completion of the exam can increase ionizing radiation exposure to the patient. A study from 2009 found that nearly 4 million American adults received an excess of 20 mSv of radiation from medical imaging annually, the majority from cardiac catheterization, chest CT, and abdominal and pelvic CT (15). From 1996 to 2010, there was a doubling of the mean per capita radiation effective dose (1.2–2.3 mSv), the percentage of patients receiving 20–50 mSv (1.2% vs 2.5%), and the percentage of patients receiving >50 mSv radiation doses (0.6% vs 1.4%) in a review of HMO patients (16). Education of PEs on imaging appropriateness and radiation dose has the potential to decrease radiation exposure for the general population as well as for individual patients.

### Addressing Patient Questions

As they are often the first clinical contact for patients, PEs should have sufficient background knowledge in radiology to address patient questions before and after an imaging examination. Common patient questions and concerns about imaging examinations, including contrast reactions, allergy premedication, radiation exposure, imaging of pregnant patients, and what to expect during the examination may all be encountered by PEs and should be included in the curriculum. Furthermore, patients are increasingly requesting copies of the report, and PEs may need to explain report findings after the examination.

### Understanding Report Findings

Radiology reports have the potential to be confusing to PEs and patients. Although steps are being taken in the radiology community to make reports more understandable to nonradiologists (17,18), certain terms may seem obscure or unclear to PEs who are inadequately educated in radiology. This may lead to concern over radiologically benign findings or dismissal of important findings. Education in some of the more commonly used radiology terms would undoubtedly aid with communication between the radiologist and ordering PEs, and also would be of great help when radiologists report urgent findings to PEs or when radiologists contact PEs for issues related to a patient currently in the radiology department.

Despite the benefits of educating PEs, there are several potential concerns. For radiologists to improve the knowledge

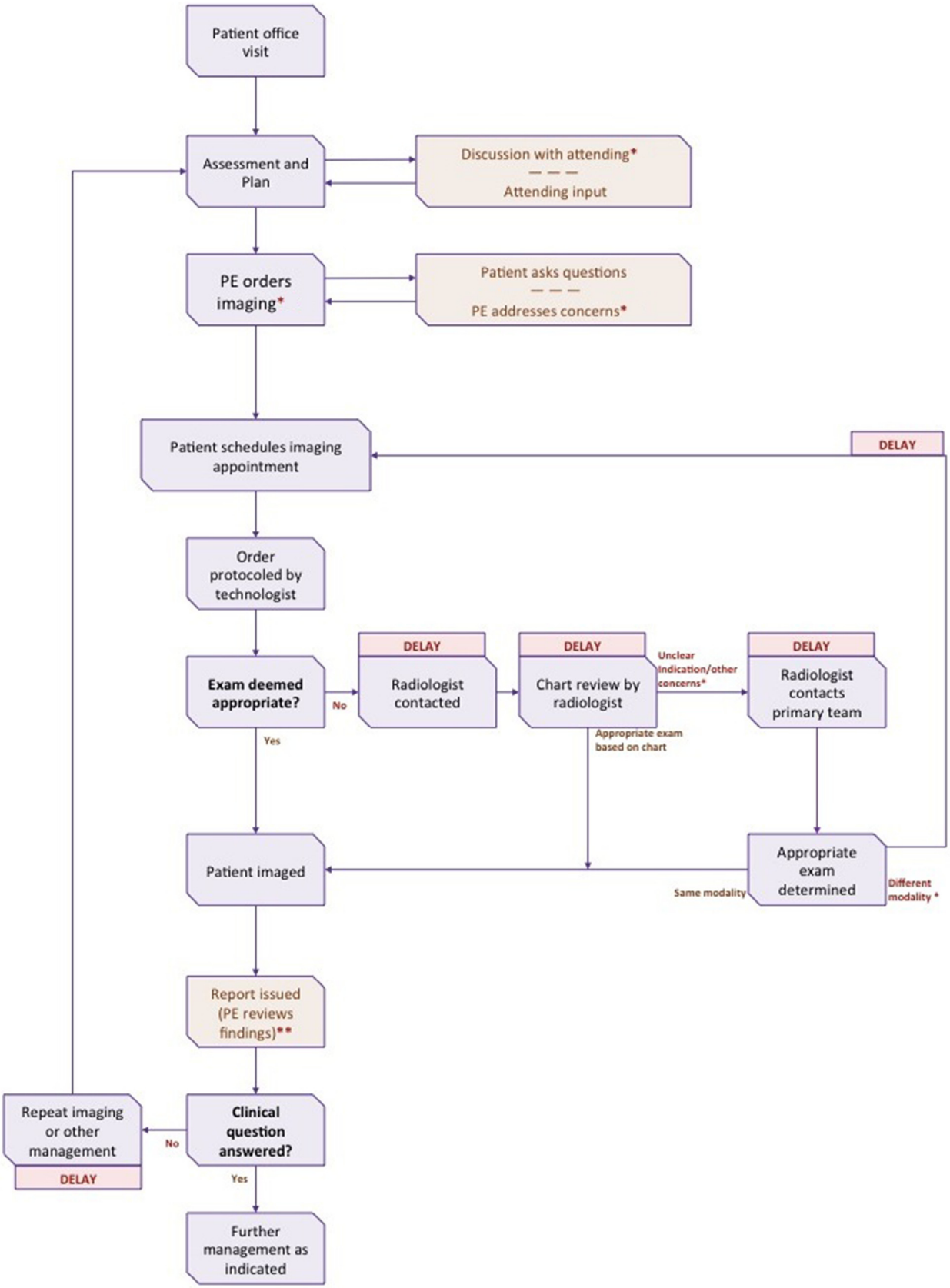


**Figure 1.** Typical imaging order workflow: points of interception for radiologists to educate nonradiology PEs and to minimize potential delays in patient care. "DELAY" indicates potential delay in patient care. * Education of nonradiology PE may improve radiology workflow. PE, physician extender.

base of PEs, significant time commitment would be required. Radiologists would need to be available as a resource for PE instructors and students. In an academic setting, the time commitment could detract from research and education of medical students, residents, and fellows. In a private practice setting, although imaging centers are encouraged to prioritize value-based services, radiologists would presumably not be given additional time, compensation, or incentive to educate PEs over interpreting large volumes of imaging studies. Even in universities, productivity-based compensation makes protected time for these important efforts more difficult to secure.

## EDUCATION OF PES WORKING IN RADIOLOGY DEPARTMENTS

Many radiology groups now use PEs in some capacity, whether to operate as a liaison with patients in diagnostic radiology or to perform an increasing number of procedures in IR (19,20). There are potential areas to incorporate PEs into radiology departments to decrease noninterpretative work burden (Fig 2). An additional benefit of radiologists engaging with and helping to educate future PAs and NPs during their formal schooling is attracting students to work in a radiology department.

### Protocols and Contrast Material Issues

Noninterpretative tasks such as protocoling cross-sectional studies, investigating potential contrast allergies, and determining appropriate management for patients with decreased renal function needing contrast-enhanced imaging examinations could be managed by a radiology-trained PE. These tasks interrupt radiologists' interpretations and may contribute to reporting errors (21,22). Introductory education during PE degree programs would provide some of the foundation for such a position. Additional education by the radiologist tailored to the institution's protocols could be provided onsite after hiring.

### Direct Patient Care

Other tasks of a radiology-trained PE may include direct patient care, such as consenting pregnant patients and evaluating patients after contrast media extravasation. Additionally, PEs may play a role in assessing patients with mild contrast allergies, with input from the supervising physician. PEs can also perform rounds on inpatients and participate in care teams.

### Fluoroscopic and IR Procedures

Fluoroscopic exams can be time consuming. PEs performance of fluoroscopy with radiologist image interpretation could decrease noninterpretative work burden. However, routine fluoroscopic exams have steadily decreased over the past two decades due to an increase in endoscopy and cross-sectional imaging (14,23). Currently, at our institution, the complexity of fluoroscopic exams has increased and the exams require detailed oversight and troubleshooting, such as in assessing for a bowel leak. More complex examinations may need direct oversight or performance by a radiologist, and the number of independent cases that are appropriate for a radiology-trained PE may be fewer than that in the past.

Incorporation of PEs into IR procedures is dramatically increasing. Functions variably include pre- and postprocedural visits, nonvascular invasive procedures, and placing peripherally inserted central catheters and subcutaneous chest ports (19,24). A recent study found a faster proportional increase in Medicare claims by PEs compared to all providers, including a greater than 3000% increase for paracentesis, thoracentesis, and fine needle aspirations between 1994 and 2012 (20). PEs claims for lymph node, abdominal, and thoracic biopsies, and abdominal drainage have increased as well. A retrospective review of PEs compared to physicians has demonstrated similar procedure complication rates between the two groups (25).

Whether or not and in what capacity PEs should be incorporated into radiology departments have created much discussion over the past decade. Many specialties that originally incorporated PEs to combat physician shortages are now faced with increased conflict over the scope of practice and desire for increased autonomy from PEs. For example, long-established clashes between anesthesiologists and certified registered nurse anesthetists (CRNAs) are well known within the medical community. Twenty-five states and Washington, DC, now allow CRNAs to practice without written collaborative agreement, physician supervision, or conditions for practice (26). Recently, CRNAs in South Carolina lobbied to perform and interpret transesophageal echocardiography without physician supervision, which was approved by the South Carolina Board of Nursing but ultimately rejected by the South Carolina Board of Medical Examiners (27). There are other conflicts in cardiology over whether certified PEs should be allowed to interpret electrocardiograms without physician oversight (28).

Opponents of incorporating PEs into radiology cite encroachment of anesthesiologist and cardiologist duties as foreshadowing events for the future of radiology. Indeed, radiology has started to see the beginning of the interpretation of imaging procedures by PAs. Some radiology groups have started to train PEs in limited examination interpretation, either as preliminary or final interpretations. Preliminary trials at some institutions have had PAs provide preliminary reports on chest and abdominal radiographs and orthopedic and spine trauma radiographs, and perform and interpret ultrasound (29). The impact that PEs will have on report quality has yet to be determined. Even with preset delegation of duties for PEs in radiology, the momentum of a growing number of extenders could turn a colleague into a rival (14).

Irrespective of the potential for future rivalry, there are current real threats to the commoditization of radiology such as image interpretation outsourcing. Training PEs to assume other tasks traditionally performed by the radiologist could

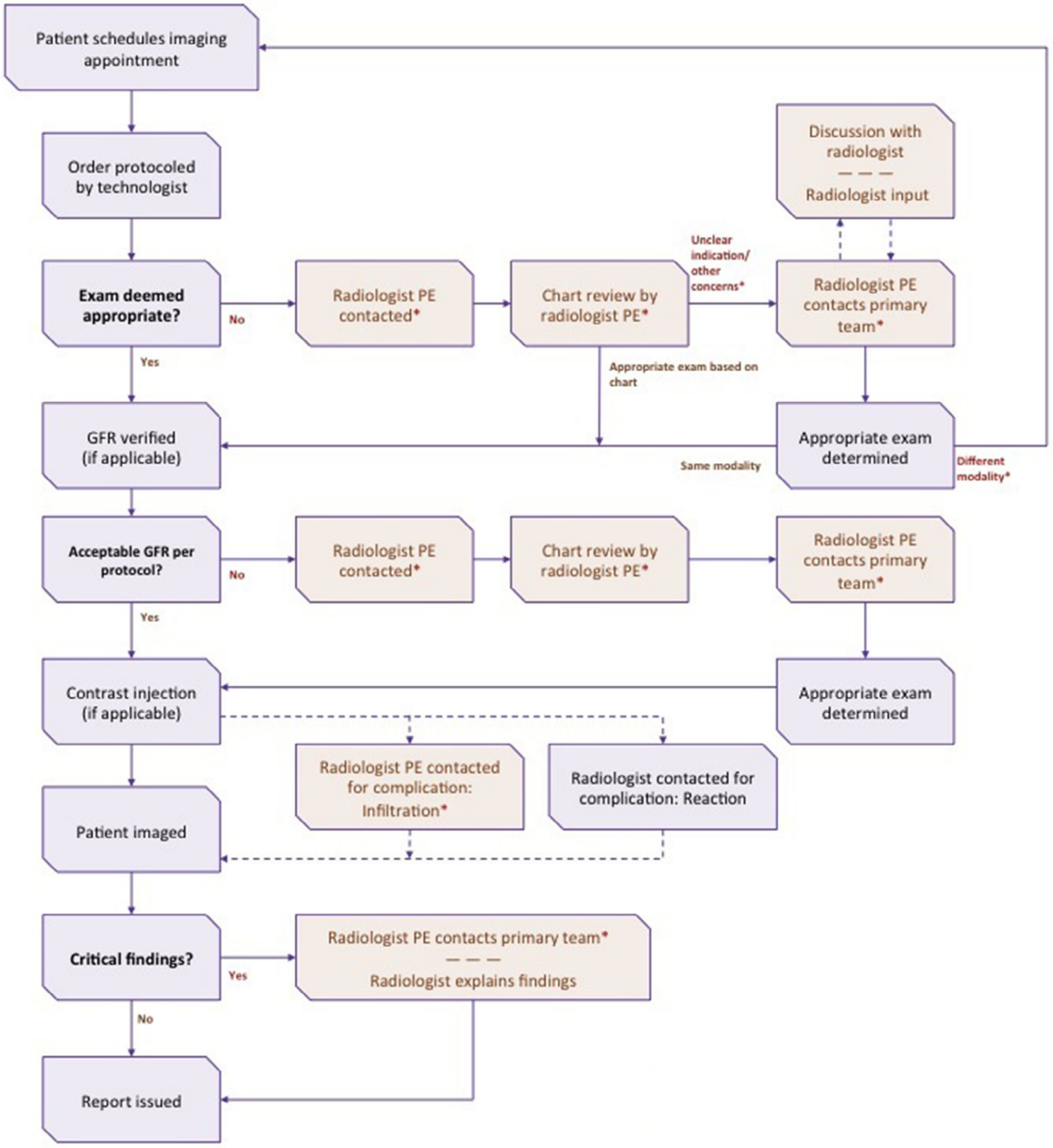


**Figure 2.** Typical diagnostic radiology workflow: points for physician extenders (PEs) working in a radiology department to assist. * Tasks assumed by radiology PE to improve radiologist efficiency. GFR, glomerular filtration rate; PE, physician extender.

further accelerate commoditization. Recent changes in healthcare emphasis from volume to value encourage radiologists to be present and visible to both physician colleagues and patients (30,31). The American College of Radiology's Imaging 3.0 Initiative was started with the new value era in mind, encouraging radiologists to make themselves available as expert consultants to help ordering providers determine appropriate imaging, discuss test results, and practice patient-centered scheduling and response (32). There is an opportunity for radiology PEs to add to value-based radiology, but it needs to be balanced with adequate radiologist presence.

Finally, the monetary costs vs the benefits of employing PEs must be weighed. Average PA and NP salaries were $97,280 and $97,990 in 2014, respectively (33). Some of the

tasks potentially assignable to PEs may already be performed by lower compensation employees such as nurses, radiology technicians, and technologist assistants. Without sufficient benefit to the efficacy of workflow, hiring PEs may result in lowering the radiologists' compensation.

## CONCLUSIONS

PEs have become a large part of the medical workforce and have a considerable impact on imaging utilization and image-guided procedures typically without receiving basic radiology education. Providing introductory radiology education during the formal certificate program training periods for NPs and PAs could benefit patients, radiologists, and health-care systems in many aspects including more appropriate imaging examinations, decreased costs, decreased radiation exposure, and improved radiologist workflow. Incorporating NPs and PAs into a radiology department may also have many direct benefits to radiologists but should be considered based on the circumstances of individual radiology practices.

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