# The Impact of Nonphysician Providers on Diagnostic and Interventional Radiology Practices: Operational and Educational Implications

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## Abstract

The numbers of nurse practitioners (NPs) and physician assistants (PAs) are increasing throughout the entire health care enterprise, and a similar expansion continues within radiology. The use of radiologist assistants is growing in some radiology practices as well. The increased volume of services rendered by this growing nonphysician provider subset of the health care workforce within and outside radiology departments warrants closer review, particularly with regard to their potential influence on radiology education and medical imaging resource utilization. In this article (the second in a two-part series), the authors review recent literature and offer recommendations for radiology practices regarding the impact NPs, PAs, and radiologist assistants may have on interventional and diagnostic radiology practices. Their potential impact on medical education is also discussed. Finally, staffing for radiology departments, as a result of an enlarging nonradiology NP and PA workforce ordering diagnostic imaging, is considered.

**Key Words:** Nurse practitioners, physician assistants, radiologist assistants, diagnostic radiology, interventional radiology, medical education

*J Am Coll Radiol 2015;12:898-904. Copyright © 2015 American College of Radiology*

## INTRODUCTION

Nurse practitioners (NP) and physician assistants (PA) have been increasing in prevalence throughout radiology departments as well as the entire health care enterprise [1-10]. Also referred to as advanced practice providers, advanced practice clinicians, midlevel providers, and physician extenders, their scope of practice, prescription privileges, and ability to practice independently have increased but continue to vary widely among practices and states [11,12]. The prevalence of RAs in the workforce, as well of their scopes of practice, is much smaller, but this group of professionals has been embraced by many radiology groups.

NPs and PAs have garnered substantial recent attention in the academic literature and radiologist assistants (RAs) much less so. The full impact of the increasing prevalence of nonphysician providers in radiology departments remains unclear, and their impact on patient safety, practice revenue, and radiology education thus warrants review and critique. Additionally, as their prevalence outside radiology departments continues to increase, referral patterns and utilization of imaging resources may also be influenced [13].

The purpose of this two-part series is to evaluate the feasibility and practicality of incorporating NPs, PAs, and RAs into radiology practices, focusing particularly on patient safety, financial performance, and their impact on medical education. A secondary purpose is to evaluate the potential impact of an enlarging nonradiology NP and PA workforce on diagnostic radiology practices, particularly as NPs and PAs increasingly order diagnostic imaging as they assume roles of primary care service providers. In the previous first segment of this series, we discussed regulatory, billing, and compliance issues related to employing NPs, PAs, and RAs in radiology practices,

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This article has not been previously published, nor is it under consideration for publication in any other journal. All listed authors are qualified for authorship and participated in data gathering, analysis, and manuscript preparation. No conflict of interest, financial or other, exists. No funding was received to conduct this study.





1546-1440/15/$36.00 ■ http://dx.doi.org/10.1016/j.jacr.2015.03.034

with a substantial focus on proper evaluation and management (E&M) coding practices [14]. In this second part of the two-part series, we review available literature regarding (1) the incorporation of NPs, PAs, and RAs into both interventional and diagnostic radiology practices; (2) potential changes in imaging resource utilization as a result of an enlarging nonradiology NP and PA workforce; and (3) how NPs, PAs, and RAs may affect medical education.

## INTEGRATION OF NONPHYSICIAN PROVIDERS INTO INTERVENTIONAL RADIOLOGY PRACTICES

One of the most common ways NPs, PAs, and RAs have been incorporated into radiology departments is through their interventional practices. Percutaneous biopsies, central venous access procedures, paracenteses, thoracenteses, and percutaneous abscess drainages are examples of interventions that may be suitable for appropriately trained nonphysicians to perform. In addition to serving as proceduralists, NPs and PAs are uniquely able to support a clinical interventional radiology (IR) service by providing billable E&M and other clinical services in both the inpatient and outpatient settings.

### Procedural Safety

The frequency with which NPs and PAs perform image-guided vascular and nonvascular procedures is increasing at the national level [15-17]. Such national validated data for RAs, however, are lacking. Given differences in training between physicians and nonphysician providers, patient safety concerns for patient care provided by such professionals have been raised and warrant consideration [18]. The economic and operational efficiencies realized by employing nonphysician providers should, of course, never trump patient safety.

Murphy et al [19] recently studied the safety of liver biopsies performed by NPs who received dedicated training in an academic radiology department and showed that 100% of liver biopsies performed by NPs were diagnostic, with only a 1.4% minor complication rate. In comparison, percutaneous liver biopsies performed by physicians were diagnostic 99.6% of the time, with a 0.7% minor complication rate. The differences were not statistically significant.

The safety of large-volume paracenteses performed by NPs and physicians was studied by Gilani et al [20]. Although not performed with imaging guidance, this series similarly identified no statistical significance between NPs and physicians with regard to the volume of ascites removed, postprocedural bleeding complications, or postprocedural infection rates.

The safety of subcutaneous chest port placement procedures performed by NPs, IR faculty members, and trainees was analyzed by Silas et al [21]. Once again, no significant difference in overall complication rates was noted between the groups. In their study, a total of 536 port placement procedures with documented follow-up were evaluated. NPs had an overall complication rate of 2%. In comparison, IR faculty members had a 1.3% overall complication rate, whereas IR fellows had an overall complication rate of 0.56%. A similar study evaluating the safety of a single RA performing central venous access procedures was performed by Benham et al [16]. In their study, the authors showed that their single RA had a 0.29% major complication rate and a 0.89% overall complication rate; these were not statistically different from the complication rates of attending physicians (major, 0%; overall, 1.71%) and IR fellows (major, 0.35%; overall, 1.06%). Of note, this study represents the only available literature rigorously analyzing the procedural safety of minimally invasive procedures performed by RAs.

Intra-arterial procedures performed by PAs have similarly been studied. In 2003, Krasuski et al [22] reported that PAs performed diagnostic coronary angiography faster ($P = .05$), with less fluoroscopy time ($P < .001$), and had similar major complication rates compared with supervised cardiology fellows. The authors concluded that under the supervision of attending cardiologists, appropriately trained PAs can safely perform diagnostic coronary angiography.

Although further rigorous comparative analyses of procedural safety of nonphysician providers versus physicians is likely forthcoming, existing literature supports outcomes similar to those of physicians when NPs, PAs, and RAs perform procedures within the limited scopes of practice for which they are appropriately trained.

### Procedural Trends

Multiple trend studies using payer claims data indicate that NPs and PAs are rapidly being adopted into IR practices across the country.

The number of abdominal drainage procedures being performed by NPs and PAs has been increasing. Using Medicare claims data from 1994 through 2012, Duszak et al [15] recently demonstrated a 1,008% increase in abdominal drainage procedures performed by NPs and PAs with, an overall increase from 0.1% to 1.2% in the

total fraction of percutaneous abdominal drainage services performed nationally. In the same study, the authors revealed dramatic increases in paid Medicare claims by NPs and PAs for paracenteses, thoracenteses, fine-needle aspirations, abdominal biopsies, thoracic biopsies, and superficial lymph node biopsies. A complementary analysis from 1993 to 2008 showed that paracenteses performed by PAs increased >1,000-fold and that thoracenteses performed by PAs increased >50-fold [23].

In a similar study analyzing trends in central venous access procedures, researchers found a 46,089% increase in the number of these procedures performed on Medicare beneficiaries by NPs and PAs between 1992 and 2011 (from 118 to 54,503) [17]. Similar trends have been observed for gastrostomy tube placement procedures and for percutaneous liver and kidney biopsies. Duszak and Mabry [24] demonstrated a 173% increase in new enteral access procedures performed by PAs between 1997 and 2000. For enteral access maintenance procedures (such as gastrojejunostomy tube exchanges and replacements), services provided by NPs and PAs increased by 1,257% and 3,090%, respectively, over the same time period. Analogous trends were recently reported by Angel et al [25]; in a nationwide study of Medicare beneficiaries between 2002 and 2012, liver and kidney biopsies performed by NPs and PAs increased by 274% and 1,267%, respectively.

Unfortunately, similar data evaluating procedural trends of RAs do not exist. As discussed in part one of this series, RAs are not recognized by CMS as independent providers and thus cannot bill for personal services. Additionally, they are not eligible for National Provider Identification (NPI) number designations. Both factors preclude the collection of objective national data from administrative claims files on services they may be rendering.

### Clinical Management

In addition to performing invasive procedures, NPs and PAs can prove valuable in fulfilling nonprocedural clinical duties vital to the day-to-day function of an IR practice. As noted in the first segment of this series, NPs and PAs are able to perform inpatient consultations and postprocedural inpatient care while billing for 85% of the Medicare Physician Fee Schedule allowable amount [14]. Preprocedural patient evaluation and consent can also be performed by NPs and PAs. Collectively, these nonprocedural functions allow IRs more time to perform procedures and/or interpret imaging studies [26,27]. Although such services could be performed by RAs, they are unable to bill for such services. In addition, their imaging-focused training likely leaves them less adept at carrying out nonradiology traditional clinical duties.

The financial benefit realized from such types of NP and PA clinical arrangements is most dependent on the complexity of the procedures performed and images interpreted by the physician. On the basis of national trends and a collective anecdotal experience from multiple practices, it is our opinion that all radiology practices should at least evaluate the potential benefits of employing these nonphysician professionals. A scenario delineating some objective and less measurable benefits potentially realized by incorporating NPs and PAs into an IR practice is provided in Table 1.

An additional value-added service provided by nonphysician providers is that of coordinating multidisciplinary teams, service lines, and clinics. Bowen et al [1] previously described an NPs role in clinical follow-up for patients who had received radiofrequency ablation procedures at Emory University. The authors described their radiofrequency ablation service line, in which an NP maintained a database of all treated patients, participated in case-review sessions, and facilitated communication with patients and referring clinicians regarding follow-up imaging and/or the need for repeat ablation procedures. Other authors have similarly noted the increasing importance of NPs and PAs in day-to-day clinical operations, particularly with regard to interventional oncology service lines [5]. Although the literature validating roles of RAs is sparse, their imaging-focused training could permit them to carry out many such coordination duties in a radiology department.

Along these lines, at our institution's tertiary-care pediatric hospital, a multidisciplinary vascular anomalies clinic is being established, which consists of physicians from multiple services (eg, IR, hematology, otolaryngology, general surgery, plastic surgery, dermatology). An IR NP will serve as the clinic coordinator, triaging the appropriateness of referrals, gathering relevant clinical information, and coordinating appropriate longitudinal care for patients evaluated in this multidisciplinary setting.

## IMPACT OF NONPHYSICIAN PROVIDERS ON DIAGNOSTIC RADIOLOGY PRACTICES

Recent literature surrounding nonphysician providers in radiology has focused predominantly on their role in IR and procedure-oriented areas of radiology. These

**Table 1.** Financial scenario related to E&M services provided by NPs and PAs

| Service | Number per Year | CPT Code | Reimbursement | Total |
|---|---|---|---|---|
| Inpatient follow-up visits (eg, drainage catheters, embolization, TIPS, thrombolysis) | 600 | 99231 | $33.50* | $20,100 |
| Inpatient consultations† | 260 | 99251 | $102.09 | $26,543 |
| Outpatient consultations (eg, ablation, embolization, TIPS, kyphoplasty/vertebroplasty) | 100 | 99242 | $42.93* | $4,293 |
| Outpatient follow-up visits‡ (eg, ablation, embolization, TIPS, thrombolysis, and kyphoplasty/vertebroplasty) | 175 | 99212 | $21.62* | $3,784 |
| Total | 1,135 | | | $54,720 |

Note: There are a number of situations in which NPs and PAs can facilitate and provide reimbursable E&M clinical services for IR practices. These include inpatient follow-up visits, inpatient consultations, new outpatient consultations, and outpatient follow-up visits. The table provides some examples for consideration on the basis of one of our former private practices (a typical, midsized, 15-member radiology group with two members performing a majority of interventional procedures). It estimates only the E&M services rendered annually by an NP or a PA and conservatively assumes the lowest reasonable reimbursable code for each situation. Increased time for physicians to perform additional procedures and/or interpret images is not considered in these calculations. A comprehensive review of E&M billing and compliance was provided in the first part of this series [14]. CPT = Current Procedural Terminology; E&M = evaluation and management; IR = interventional radiology; NP = nurse practitioner; PA = physician assistant; TIPS = transjugular intrahepatic portosystemic shunt.

*Rates represent 85% of 2014 Medicare allowable fees.

†Assuming 1 inpatient consultation per weekday. Inpatient consultations can be facilitated by an advanced practice provider. However, if a consultation is requested of the IR physician and an NP or a PA is used to facilitate the consultation, the physician must have a face-to-face encounter with the patient, and both the physician and the NP or PA must separately document and sign the portions of the consultation performed. In these instances, when both the physician and NP or PA have separate, documented, and signed face-to-face encounters with the patient, consultations can be billed as a shared visit for 100% of the Medicare Physician Fee Schedule allowable amount [48].

‡Assuming 3 follow-up visits per year for each patient (ie, 3-, 6-, and 12-month follow-up visits).

professionals, however, can also be used in the day-to-day operations of a diagnostic radiology practice. A growing NP and PA workforce outside radiology departments has potential implications for imaging resource utilization and also warrants discussion.

The concept of incorporating nonphysician providers in the daily operations of a diagnostic radiology department is not new. Although members of the 2003 ACR Intersociety Conference recommended that all image interpretation should be performed by radiologists [2], the following literature suggests that appropriately trained NPs and PAs may be able to adequately perform diagnostic interpretations within a strictly defined scope of practice. RAs, on the other hand, are strictly prohibited from performing interpretations [28].

Nearly 40 years ago, Kiernan and Rosenbaum [29] published their experience integrating PAs into their diagnostic radiology department at the University of Kentucky Medical Center. The authors concluded that PAs could perform radiographic interpretation accurately, resulting in a time savings of 34% to radiologists—time that could be spent performing tasks requiring their higher level of training and expertise.

In 1987, Hillman et al [30] published their results comparing mammographic interpretations performed by PAs versus radiologists. Although the practice of breast imaging has changed over the years, PAs at that time had greater sensitivity and equal specificity to their physician counterparts, while taking less time and offering similar follow-up recommendations.

More recently, a team from the University of Washington published their experience incorporating PAs into their practice at an academic level I trauma center [31]. After a yearlong training program throughout various sections of the department and passing an examination with a primary focus on emergency radiology, PAs began practicing in a limited scope diagnostic radiology capacity, as determined by the radiology faculty, and billing for selected radiology services. The authors reported not only a 15% increase in radiologist output when working with PAs but also improved reporting turnaround times.

It is our opinion that if practices consider such care delivery models, a well-defined training regimen first be implemented and a strict scope of practice clearly defined by supervising radiologists before employing nonphysician providers in such capacities.

NPs, PAs, and RAs additionally have the potential to provide services within radiology departments beyond diagnostic interpretations. In 2008, MacDonald [32] reported a London, Ontario, hospital's experience employing a cardiac imaging nurse coordinator to administer and facilitate the growth of a noninvasive cardiac imaging program. The nurse's roles included screening patients for imaging appropriateness, scheduling patients, providing preimaging instructions, and gathering relevant clinical information (such as prior

cardiac imaging studies and their results). Although this report described a registered nurse, an NP, a PA, or an RA could easily serve in a similar role elsewhere, while also potentially providing other interpretive, interventional, and clinical services as training and credentialing permit. As with all personnel decisions, each practice's unique economic situation and environment will dictate whether employing an NP, a PA, or an RA to provide and coordinate diagnostic services is worthwhile.

An additional dynamic that may affect diagnostic radiology practices is the enlarging NP and PA workforce throughout the entire health care enterprise. As was noted in part one of this series [14], well over a quarter million such professionals currently practice in the United States. Although it is beyond the scope of this report to critically analyze the entire body of literature pertaining to NPs and PAs in all medical subspecialties, it is important to note that the available data collectively support the notion that the quality and safety of care provided by NPs and PAs in targeted scopes of practice appears comparable with that of physicians [33-37]. What is less clear, however, is the impact that an enlarging NP and PA workforce may have on imaging resource utilization.

Hemani et al [38] revealed that resource utilization, including radiologic imaging, was statistically significantly higher in 3 of 17 measures when patients were cared for by NPs rather than by physicians in a primary care setting. Notably, the statistically significant differences between NPs and attending physicians were the number of ultrasound, CT, and MRI examinations ordered.

A recent comparative analysis of diagnostic imaging ordering patterns by NPs, PAs, and primary care physicians by Hughes et al [13] using patient-level Medicare claims showed that NPs and PAs ordered radiography 1.3 times as frequently as primary care physicians for similar new and established outpatient encounters. NPs and PAs also have a 1.3 times increased propensity to order advanced imaging studies for established patients. The study's authors suggested that clinical decision support tools may be particularly appropriate for NPs and PAs, a conclusion that is particularly timely given plans by Medicare to require clinical decision support beginning in 2017 for advanced medical imaging ordering [39].

It should be noted that this issue of nonphysician providers' ordering diagnostic tests specifically does not apply to RAs. Medicare specifically requires ordering providers to supply their NPI numbers when ordering diagnostic tests [40]. Scope-of-practice restrictions, along with the fact that RAs are not NPI eligible, preclude them from ordering diagnostic tests.

All of these findings, in combination with recent implementation of the Patient Protection and Affordable Care Act [41], suggest that an increasing demand for primary care services in light of a worsening primary care physician shortage could result in an overall increase in the utilization of imaging services. Radiology leaders are thus advised to evaluate the capacity of their current and future staffing models to respond to such potential increases in examination volume.

## THE IMPACT OF NPS, PAS, AND RAS ON MEDICAL EDUCATION IN RADIOLOGY

Although much of the discussion to this point has centered on clinical operations, the incorporation of nonphysician providers into radiology departments, particularly in the academic setting, could have considerable impact on medical education. For example, it is conceivable that as the number of procedures performed by NPs, PAs, and RAs increases in academic medical centers, similar decreases in those performed by radiology trainees, whether residents or fellows, may concomitantly occur. Competition for such hands-on experience is particularly heightened at this time, given the overall slowing of growth in radiology services nationwide [42].

Abrass et al [43] described how incorporating NPs and PAs in their internal medicine training program reduced resident workloads by 20% to 25% to fall within Diagnostic Radiology Residency Review Committee guidelines and that revenues from services provided by those NPs and PAs covered the cost of staffing. With regard to radiology, Smith and Applegate [44] reported that RAs can free radiology trainees from noneducational repetitive tasks while also providing limited instruction within their areas of expertise.

Unlike the scenario described by Abrass et al [43] in internal medicine, however, it is uncommon for radiology workloads and hours to violate those established by the ACGME. A more useful focus instead may be on what tasks in radiology are repetitive and noneducational in nature. Central venous access procedures and paracenteses, for example, are often considered less complex than many other procedures performed by fellowship-trained interventional radiologists and more suitable for performance by NPs, PAs, and/or RAs. This is supported by the trends analyses cited earlier. However, these "more simple" procedures also build the foundation for many image-guided intervention skills such as ultrasound-guided needle localization, which are necessary for trainees hoping to pursue a career in IR or more procedurally oriented careers in diagnostic radiology. This scenario regarding vascular

access procedures performed by NPs, PAs, and trainees has also been described in the surgical literature [45]. Although it is difficult to identify a critical number of procedures necessary to master basic interventional skills, it is likely that performing fewer procedures decreases the likelihood of reaching a requisite baseline skill level.

Additionally, although some studies and procedures may seem repetitive to older radiologists, they may in fact be far less commonly performed by current trainees. Baker and Merkulov [46] provided an insightful example regarding the impact radiology extenders could have on trainees' education with regard to fluoroscopic imaging studies. Using data from the 2002 to 2003 Diagnostic Radiology Residency Review Committee, they showed that an average radiology resident at that time performed only 28 barium enemas over a 4-year residency. The authors expressed concern about the ability to learn even basic radiology skills if such small samples are divided between other trainees and nonphysician providers. Today, that small sample number is likely far lower.

Rather than "replacing" residents and fellows in the procedure suite and reading room, it is important for NPs, PAs, and RAs functioning within academic radiology departments to align their work with the department's overall missions and acquire an aptitude for teaching. In a health system increasingly valuing team-based care, trainees will ideally adopt a willingness to learn from nonphysician providers [44]. In recent years, the number of diagnostic imaging studies interpreted per radiology trainee and per attending radiologist have increased [47]. Accordingly, if duties and responsibilities are appropriately apportioned, nonphysician providers may be able to relieve some of the excess clinical duties for both attending and trainee radiologists and help create more quality time for them to pursue teaching and research endeavors. For all of these reasons, more studies regarding the impact of NPs, PAs, and RAs on radiology medical education are warranted.

## TAKE-HOME POINTS

- Radiology groups should track the impact of nonphysician provider employment if and when such professionals are incorporated into a practice model. Variables to monitor may include (1) E&M services provided, (2) net revenue from minimally invasive procedures, and (3) time associated with various teaching, research, and nonbillable value-added clinical activities.
- The literature analyzing safety and trends of procedures performed by RAs is sparse. Future studies should target this group of highly trained imaging professionals.
- Emerging data suggest that an enlarging primary care NP and PA workforce outside radiology may lead to increased medical imaging resource utilization.
- Further analysis of the impact of NPs, PAs, and RAs on radiology education is warranted. The willingness of these nonphysician providers to teach and the willingness of trainees to learn from them are particularly important topics for further investigation.

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