Under the auspices of the Association for Radiologic & Imaging Nursing

Advanced Practice and Leadership in Radiology Nursing

Kathleen A. Gross
Editor

ARIN ASSOCIATION FOR RADIOLOGIC & IMAGING NURSING
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To my husband, Richard J. Gross, MD, and sons, David and Jonathan, who have taught me much about life and professional dedication through their own work. Also, to Abigail, Whitney, and Evan who give me cause to laugh and remind me of balance in living.

Foreword 1

Evidence-based practice (EBP) is widely considered the foundation of quality health care practice. EBP is no longer just a buzzword but a requirement that clinical practice is based on scientific evidence. As health care professionals, we have a duty to be concerned that we are achieving the best patient outcomes from our interventions and that those interventions, protocols, and policies are based on scientific evidence and best practices.

It was these very concerns that led to the development of the Johns Hopkins Nursing EBP Model and Guidelines that has driven nursing practice across all specialties at the Johns Hopkins Medical Institutions for the last 15 years. The JHNEBP Model defines EBP as a problem-solving approach to clinical decision-making within a health care organization that integrates the best available scientific evidence with the best available experiential (patient and practitioner) evidence, considers internal and external influences on practice, and encourages critical thinking in the judicious application of such evidence to care of the individual patient, patient population, or system [1].

The goals of EBP are to assure the highest quality of care by using evidence to promote optimal outcomes and to create a culture of critical thinking, ongoing learning, and a spirit of inquiry for clinical decision-making. The benefits of implementing the latest clinical evidence in practice are overwhelming for providers and make sense for so many reasons. Evidence-based interventions are more likely to produce positive results and hence improve patient outcomes. They very often eliminate ineffective practices that have become obsolete but are used by clinicians because "that is the way we have always done it." Instead, using EBPs can differentiate your practice and your organization as a high quality provider, and consumers are looking for those providers. The current focus on value-based reimbursement demands that providers use EBP as the Medicare program and many state quality improvement agencies are incorporating EBPs into their reimbursement mechanisms. And, they are making the data public that support those differentiated reimbursement methods.

What does this mean for radiology nursing? First, this book makes an important contribution by presenting a strong evidence base for radiology nursing practice. The focus on clinical effectiveness, efficiency, cost-effectiveness, safety, and quality is evident throughout. Radiology nursing involves critical skills in assessment and monitoring. The availability and use of evidence-based checklists and assessment tools to measure a variety of patient outcomes have become essential to quality care. In addition, accepted scien-

tific evidence used in general nursing practice, such as turning schedules to prevent the development of pressure sores, requires the radiology nurse to use the evidence and their assessment skills to determine their patient's needs based on the individual's risk for skin breakdown. There are many topics relevant to radiology nursing that need to be addressed. What about safe injection of contrast media or extravasation of contrast media? What is the latest evidence, the strength of that evidence, and how will you use it in your practice? Finally, radiology nursing deals with advanced technology and the ongoing acquisition of new technology that requires the development of and dissemination of new scientific knowledge to accompany the new practice. This creates many challenges to develop and maintain an EBP when health care delivery is constantly and rapidly changing. However, the opportunities to contribute in your specialty abound! Be that change leader who questions practice, discusses concerns with other members of the team, and is an early adopter who searches for evidence that will contribute to the delivery of better health care and improve patient outcomes.

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Foreword 2

It is a privilege to be able to introduce this new book which is specifically designed to meet the needs of the advanced practice provider and manager in the radiology setting and will be a useful resource to any nurse regardless of area or location of practice. It is a first of its kind in the radiology nursing literature. Historical and current influences have molded today's practice in radiology. Radiology is synonymous with change, and practitioners in this environment need to be open to new technology, procedures, and outside influences on all the modalities as radiology is constantly evolving and advancing. This book will enable the nurse to be informed.

This book is divided into sections that include roles, clinical issues, safety topics, topics of importance to the patient, and professional topics that are essential to the changing imaging environment. The breath of the authors' knowledge and abilities is a very positive aspect of this book; readers will learn from experts in their respective areas as relevant information is presented that will influence the nursing process. The emphasis on topics in addition to the clinical practice topics, including the patient's perspective and professional and system concerns, makes this book unique as a source for information.

The editor of this text has shown professional nursing leadership through advancing the literature for radiology professionals. With the knowledge and skills discussed in this book, the practitioner and manager will be better able to lead a highly functional and cohesive team and cope with changes that occur. Nurses can then be the change agents that are needed to improve quality radiology nursing care to all patients in a variety of settings.

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Preface

No nursing specialty has piqued my interest as much as radiology nursing because of its relative newness as a nursing specialty and evolving nature but mostly because of the demands it places on the nurse. It is *very* challenging to be a radiology nurse. I once said that working in radiology was like "practicing in a sea of contrast media: the environment is fluid, the situations can be 'sticky,' and all actions and reactions are highly visible" [1].

Radiology nurses do not have the advantage of a specific academic career path for radiology nursing but use combined education and past experiences such as critical care and emergency or peri-anesthesia nursing to guide quality patient care. The nurse must be very curious and able to absorb new information quickly. Continuous on-the-job learning is an important part of working in the radiology department. This factor is highly variable based on the setting and mentor, if one is available. In addition to the nuances of all the procedure-related care, radiology nurses need to learn the language of radiology, understand principles of radiation safety, understand the chemistry and physiological effects of the contrast media or isotopes that are used, and be aware of new occupational hazards, all largely foreign to nurses prior to entry into the department. Conceptually, the radiology department is organized and run differently than traditional hospital departments where nurses have past experience. Radiology nurses interact with patients of all ages who have a vast array of problems for which they need diagnostic tests or interventions in a variety of imaging modalities.

A developing nursing specialty faces many growing pains, not the least of which is the development of a specialized knowledge base and available literature resources. Radiology nursing is further challenged by the rapid growth in imaging and introduction of new diagnostic imaging examinations and therapeutic procedures which the nurse needs to understand to be able to provide safe and effective patient care. The nurse's critical thinking skills are constantly challenged. Although the radiology nurse's practice may be very autonomous, being *a member of the team* is also an important aspect of being a radiology nurse. The two features are not mutually exclusive. Good communication skills and interdisciplinary collaboration are important attributes for the nurse working as part of the skilled radiology team. Involvement in coordination of care, whether within a hospital system or with outside agencies, is increasingly needed as patient acuity is higher. This is not likely to change. Radiology nurses also function as educators, researchers, and resources to others in and outside the department.

Radiology nursing is also affected by challenges that face all specialties in health care. Regulatory influences change, cybersecurity threats to patient care and welfare take place, new legal and ethical issues arise and healthcare insurance companies exert power on patient care. Radiology nurses do impact patient care outcomes and the ability to demonstrate that is essential to the influence nurses can have on quality. Radiology nurses are leaders in the department and can bring about positive changes by role modeling and *proactive* leadership. Radiology nurses are in an excellent position to be spokespeople for services offered within the radiology department and to promote new less invasive procedures to providers in many medical specialties. Engaging in research to demonstrate better outcomes is another role which the nurse can fulfill.

The nursing advanced practice provider and radiology nurse manager need a text which addresses topics of unique interest to them. The expert authors who have written in this text speak to this audience, as well as, to all radiology nurses, even those who might just be starting in the radiology department. Reading many chapters will make the reader feel as if a colleague is speaking with them about issues or concerns. Other chapters are more tutorial in nature, laying out new information. Areas where radiology nursing needs some work are discussed candidly. It is important that we can look critically at our specialty and identify needs and opportunities for change and growth. The book is divided into five sections as place markers to aid the reader.

Section I addresses the roles of the advanced practice provider and also the nurse manager.

Section II assists the provider in understanding best practices in clinical care.

Section III focuses on topics related to patient safety in the imaging modalities.

Section IV adds the dimension of the patient experience, whether it be understanding how literacy impacts outcomes, the process of consents or communications, or guiding children and young people in radiology.

Section V focuses on professional issues of interest to nursing and also highlights future horizons in radiology that will impact nursing and radiology.

I wish to thank all the authors who have persevered to complete the work needed to produce a chapter in this first edition. It is no easy task as it takes much time and genuine hard work to write for publication. Early on I placed my trust in each of the authors. While there is no paper on the cutting floor our computers house many revised versions of the chapters. Each author, regardless of their discipline, was given the freedom to approach the topic in a way they deemed most appropriate. I am sure that all would agree it is difficult to say with finality, "The chapter is complete*." There is always one more piece of information authors and editors wish to add as a publication progresses but I assure the readers all have tried their best to provide a current, concise, and informative chapter with emphasis on associated society standards where applicable.

My goal was to provide a text that was not only informative to improve patient care but also inspirational to radiology nurses, regardless of role. We are the gatekeepers and advocates for patients in radiology. We can help avert problems, triage adverse events of all types, and provide follow-up as needed.

We assess and monitor during procedures. We communicate with other providers and staff. We provide 1:1 care for the patient and share in the patient's *lived* experience. We are often there when "news" is delivered and provide emotional support for the patient and significant other. We greet and discharge patients leaving a first and last impression of radiology on their minds. Radiology nurses can and do make an incredible difference in patient care and experience in the radiology department and need to be recognized for their value.

My hope is that radiology nurses and leaders will also share this text with related professionals who care for radiology patients, e.g., the intensive care nurse, the peri-anesthesia nurse, the emergency nurse, the medical surgical nurse, the pediatric nurse, and others as dissemination of knowledge will only serve to enhance the nursing profession as a whole and improve patient care. We need to practice in collaboration not in silos.

Radiology nursing is dynamic; this theme should be foremost in our thoughts. Radiology nurses can be creative and innovative in so many ways. That is part of the essence and pure joy in being a radiology nurse.

*Editor's note: Careful editing of the information was carried out but the professional is advised to always question, if needed, as new information is constantly forthcoming as knowledge expands.

Owings Mills, Maryland
October 10, 2019

Kathleen A. Gross, MSN, BS, RN-BC, CRN

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I also want to thank Dina A. Krenzischek, PhD, RN, CPAN, FAAN, FASPAN, and Sharon L. Kozachik, PhD, RN, FAAN, for their encouragement and professional advice throughout the course of this project and at other times in my career.

Contents

About the Editor

Kathleen A. Gross, MSN, BS, RN-BC, CRN is the Editor-in-Chief of the *Journal of Radiology Nursing (JRN)*, which publishes works relevant to all imaging modalities across the life span. Kathleen's experience includes working as a clinical radiology nurse in interventional radiology for 21 years. She taught nursing students and radiology technology students. She also served as an adjunct faculty for a university nursing program.

She served in a national capacity as secretary, president-elect, president, and past president of the Association for Radiologic and Imaging Nursing (ARIN).

Kathleen has served on the American College of Radiology's (ACR's) Safety Committee and is currently on the ACR Commission on Patient and Family-Centered Care Education Committee. Kathleen has held committee appointments with the Society of Interventional Radiology (SIR), serving since 2006 as a committee member of the Safety Committee as well as SIR's Standards Committee. Her knowledge and skills contributed to her work as one of the founding members of the Peripheral Arterial Disease (PAD) Coalition; she served on the PAD coordinating committee and nominating committee. She is a member of the Committee on Publication Ethics (COPE) and the International Academy of Nursing Editors.

Professional contributions as a nurse leader are evidenced by her numerous publications. She has authored and coauthored articles specific to radiology and/or radiology nursing in peer-reviewed journals and written columns, editorials, and book chapters. She edited the *Core Curriculum for Radiologic and Imaging Nursing, 3rd edition.*

Kathleen was instrumental in the development of the first radiologic nursing certification examination and served on the Radiologic Nursing Certification Board. Kathleen is the recipient of the *Johns Hopkins School of Nursing Dean's Award for Outstanding Nurse Leader* 2018, the 2018 Maryland Nurses Association *Outstanding Pathfinder Award* (for excellence and creative leadership in nursing), and the *Albert Nelson Marquis Lifetime Award*, 2018. She is a member of Sigma Theta Tau International.

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Section I

Radiology Roles

Advanced Practice Providers

1

Randi L. Collinson

1.1 Introduction

In the field of radiology, technology has aided the growth of radiology departments to become one of the largest departments within the medical arena. Radiology offers a plethora of services and revolutionary procedures to assist with patient diagnosis and innovative treatments. As the field of radiology continued to develop and grow so did the need for multiple medical professionals to form the radiology team of today. The focus of this chapter is to discuss the role of the advanced practice provider (APP) in radiology primarily addressing the nurse practitioner (NP) and physician assistant (PA) role in the realm of interventional radiology.

1.2 Discovering the Diagnostic X-Ray

In the late 1800s, Wilhelm Rontgen, a German engineer and physicist, produced and detected radiation which became known as X-rays. The first machines that produced X-rays were used by professional photographers for the curious public to see their own boney structures. In the early 1900s, X-ray equipment became an additional medical tool, purchased by physicians, to assist in diagnosing and treating illness. Quickly a need for additional professionals to manage, maintain, and perform the radiologic images was recognized. Many of the first X-ray assistants were nurses since they were already professionally trained and educated. In the years that followed, perfecting X-ray techniques, developing positioning guidelines, and educating radiology specific professionals became the goal in radiology. The role and profession was organized to form the professional known as a radiologic technologist who then replaced the first nurses in radiology [1].

In the years that followed, radiology developed from a service dependent on referrals to a true clinical practice. As the clinical practice continued to emerge into the radiology service of today, it became evident there was an overwhelming need to incorporate several other medical professionals to the radiology team. The significance of nurses and advanced practice professionals, along with several other medical professionals, has shown to provide an advantage to the radiology department and the patients they serve.

1.2.1 Radiology Infancy

Radiology departments in the early 1960s consisted mainly of radiologic technologists (RTs), certified to assist radiologists with noninvasive

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and minimally invasive procedures. Some of the noninvasive imaging would include X-rays of body parts, with minimal to no introduction of a contrast media. The minimally invasive imaging procedures would include entering the skin or body cavity with a needle, tube, or catheter with minimal to no damage to those structures, while imaging the specific body parts with some form of radiation [2] (see Chap. 15).

1.2.2 CT and MRI Influences

Radiology advancement in the early 1970s was related to the development of the *first* computerized axial tomography (CAT) scanners or CT scanners, as they are called today, for medical imaging. This expanded the radiologist's ability to visualize abnormal and normal conditions, including soft tissue via cross section views aided by the computer, allowing a more accurate plan to diagnose and treat the patient. Similarly, the magnetic resonance imaging (MRI) scanners which were being used in the field of science were now being transitioned to medicine. This newer imaging modality was considered safer since there was no radiation exposure to the patient while providing an additional noninvasive imaging tool to aid radiologists with diagnosing and planning for patient treatment [3, 4].

1.2.3 Interventional Radiology Expansion

While these newer imaging modalities were on the rise, advancement continued evolving within the radiology area. A vascular radiologist, Dr. Charles Dotter, began experimenting and discovering the potential treatment use of catheters within the intravascular anatomy. This became known as minimally invasive procedures which led to additional treatment possibilities. The radiologist could perform a specific treatment within the blood vessel, at the site of the problem with the use of fluoroscopy to guide the procedure while providing a quicker recovery for the patient [5, 6].

The development of this section of radiology historically known as "Special Procedures" has come to be known as "Interventional Radiology" or IR. This development led to the formation of what is now called the Society of Interventional Radiology (SIR) in the late 1980s. The SIR then established specific IR training, which was then approved for medical education and incorporated into accredited programs. The IR departments encompass board-certified radiologists specializing in minimally invasive treatment which include subspecialties of Interventional Cardiology, Interventional Radiology, and Neuro Interventional Radiology [5, 6].

Today in the IR department, there are many more minimally invasive procedures. These procedures are performed on a daily elective and emergent basis with the use of catheters, guide wires, balloons, occlusive materials, implantable devices, and medications.

The procedures vary from ballooning an area with stenosis, implanting a stent to assist with vessel patency, creating dialysis access, placing a percutaneous drainage tube, ablating tumors, and embolizing tumors prior to surgical tumor removal just to name a few. In addition to vascular treatments there are special spinal procedures performed to assist with pain alleviation or diagnosis. Even though the procedures that are performed are minimally invasive and considered safe, there is always a risk of complications with any procedure; pre, during, and post procedure [7]. As the procedures performed by the radiologists, known as interventionalists, became more involved and more complicated, the need for nurses and more recently advanced practice professionals was evident.

1.3 Evolution of Radiology Nursing

The radiology nursing role began to evolve in the late 1940s when a nurse visionary, named Charlotte Louise Goodwin, RN, joined the radiology team at The Johns Hopkins Hospital in Baltimore, Maryland. She went on to become the director of radiology nursing at Johns Hopkins

with a goal to provide recognition, education, and information to the nursing profession. She conducted a national survey by reaching out to other nursing professionals within the radiology field of medicine in 1979 with a surprising positive response. This response was the motivation she needed to present her goals to the Johns Hopkins radiology team and the Radiological Society of North America (RSNA) to obtain recognition, support, and time for the radiology nursing professionals at the RSNA meeting in Chicago, Illinois, November 1981. Thus, the first meeting was held to create the American Radiologic Nurses Association (ARNA) in November 1981 which continued to evolve and focus attention with recognition on nursing in the field of radiology on a national scale [8].

1.3.1 Professional Responsibilities Advance in Radiology

As stated above, nurses were hired in radiology as early as the 1940s for patient care management, which then continued to develop into administering conscious sedation during procedures along with short-term recovery of the patient. The nursing responsibilities expanded to include a pre-procedure assessment, history and physical, pretesting review prior to proposed procedure, along with discussion of any abnormal findings with the performing physician. As the nursing responsibilities for providing conscious sedation developed, the required credentialing began to emerge, with many radiology departments requiring nurses to obtain critical care certification and/or advanced cardiac life support with conscious sedation certification [9].

The registered nurse's role in the radiology department has continued to evolve with nurses managing every aspect of the radiology department (see Chap. 3). Nursing coverage may be present in any area that could or may involve intravenous injection, which predominately includes IR, CT, MRI, diagnostic radiology, and nuclear medicine (NM) areas but may also include virtually all modalities. Depending on the size of the department there may also be a designated team of nurses who travel throughout the radiology department medically managing any issues that may develop [9].

1.3.2 Recognition as a Specialty

Radiology nursing was recognized by the American Nurses Association as a nursing specialty in 1991 [10]. The organization for radiology nurses is now known as the Association for Radiologic & Imaging Nursing (ARIN), which transitioned from The American Radiologic Nurses Association in September 2007. The ARIN's goal is to promote quality patient care while providing radiology nursing professionals with support and continuing education within the radiology environment [11]. *The Scope & Standards of Practice—Radiologic & Imaging Nursing* was first published by the American Nurses Association (ANA), with the second edition copublished in 2014 by the ARIN and the ANA. The association's official journal, *Journal of Radiology Nursing* (formerly *Images*), continues to provide current evidence-based information for professional radiology nurses within the many aspects of radiology [12–14].

1.4 Development of the Advanced Practice Roles in the USA

From 1940 to 1960s the nursing profession developed such a severe shortage resulting in a government solution by signing into law the Nurse Training Act of 1964. This act was developed to provide federal funding to colleges throughout the country to encourage the nursing professions into advanced educational nursing degrees. This federal assistance resulted in the development of several advanced educational programs for nurses, which expanded their knowledge base along with the development of requirements of advanced certification in certain specialized areas [15].

The nurse anesthetist role was developed in the late 1800s, to assist the physicians with anesthetic patient care with the first nurse to administer

anesthesia in 1861. The first trained nurse anesthetist to assist with performing patient anesthesia was Sister Mary Bernard employed at a hospital in Erie, Pennsylvania, in 1877 [16].

The clinical nurse specialist (CNS) role was established in the 1950s influenced by the need in the field of psychiatry. Professor Hildegard Peplau at Rutgers University established the first master's program to provide additional assistance in the area of mental health. Then the CNS role continued to evolve into specialty areas of today, as experts in evidence-based practice providing assistance and education for the medical team [17] (see Chap. 2).

Following World War II, an acute shortage of physicians was noted in the United States compared with the growing population and demanding health care needs. As early as 1961, an article was published by Dr. Charles Hudson regarding the concept of using physician extenders to address the growing shortage of primary care providers. Thus, the physician assistant (PA) role was established in the early 1960s while the nurse practitioner (NP) role was conceived in 1965 by a nurse and physician in Colorado to assist with this national physician shortage [16, 17].

1.4.1 Education for the Nurse Practitioner

The current requirements to apply to become a NP in the United States (US) include prerequisites of a current nursing license, preferable 1–2 years of nursing experience and a bachelor's degree preferably in nursing science. Additional requirements are a completion of advanced education at a nationally recognized school and accredited curriculum with a completion of certification in the specific designated specialty areas of education. The specialty areas that are accepted in 2019 are patient population focused and include Family/Individual Across the Lifespan, Pediatric (acute or primary), Neonatal, Women's Health and Psychiatric/Mental Health. Upon completion of the advanced education of the Masters in Nursing Science program and passing the national certification exam, practicing as an NP in that specialty is awarded on a state level, with variable state regulations [18]. In an attempt to remedy the varied state level requirements, the National Council of State Boards of Nursing (NCSBN) created an APRN Consensus Model to move to uniform state laws which has been slowly adopted with legislation in some states [19]. Since 2004, The American Association of Colleges of Nursing (AACN) has been recommending to require the standard for entry level NP to become a Doctor of Nursing Practice (DNP) by 2015 but as of 2019 this is not a requirement to practice [20].

1.4.2 Education for the Physician's Assistant

The current preferred requirements to apply to practice in the USA as a PA include prerequisites of some type of medical experience as a nurse, paramedic, or emergency medical technician. The training for the PA curriculum requires completion at an approved, accredited physician assistant program with many offering a Bachelor of Science in PA studies or a Master of Science in PA studies with some opportunity to specialize in subspecialties, completion of clinical supervised training, and completion of PA national certification exam. This completion allows the PA to practice in any state in the USA after completing each state regulatory requirement [21].

1.5 Need for Advanced Practice Providers

In a survey from 2000 to 2001 performed by the SIR it was reported by interventional radiologists that 65% conducted preprocedure visits, with only 53% performing post procedure follow-up visits. In the same survey, while 84% had admitting privileges only 75% utilized them with 70% mainly accepting direct referrals [22]. Thus, revealing the interventional practices that would prosper would need to expand into a full clinical service by including advanced practice providers to the radiology team. As a clinical service the interventional radiology sections must provide

alternative patient treatment options with current and future patient management. In a literature review published in 2018, evidence supported positive benefits of advanced practice providers in reducing patient waiting times, decreased workload on physicians, cost-effectiveness, and job satisfaction [23].

The advanced practitioner is an ideal addition to the radiology team by assisting with patient clinic consultations, performing specific percutaneous procedures, along with continued patient management in the hospital setting and with the continued outpatient follow-up responsibilities.

1.5.1 Types of Advanced Practice Provider Roles in Radiology

The term "Advanced Practice Providers" (APP) is used to describe a medical professional with advanced academic and clinical education in a specific specialty or general medicine that allows them to diagnose and manage common or chronic illnesses. The APP is required to obtain advanced certifications and may work in collaboration or independently as per their state requirements. APPs incorporate certain areas of education and expertise, which include the nurse practitioner (NP), the nurse anesthetist (NA), the clinical nurse specialist (CNS), and the physician's assistant (PA). The APPs best suited for the interventional roles are mainly the NPs, CNSs, and the PAs [24].

In 1999, the first NPs were hired into the IR team at the University of New Mexico, having completed a 6-month radiology training program providing additional education and final credentialing on completion [25]. An article located on the American Academy of Physician's Assistant website, noted a PA, scheduled his own rotation with the IR team while in PA school, and began employment in 1999 for Mecklenburg Radiology Associates, located in Charlotte, North Carolina [26].

In some radiology departments another role was being developed and recognized by the American College of Radiology (ACR), the American Registry of Radiologic Technologists (ARRT), and the American Society of Radiologic Technologists (ASRT) in early 2002 [27]. The role was an advanced role for the radiologic technologist referred to as a radiology assistant (RA) and radiology practitioner assistant (RPA). The RPA role is considered *mid-level provider* working *under the supervision of a radiologist* with additional education. The RPA acts as a radiologist "extender" and can perform specific radiologic procedures under direct radiologist supervision. The RPA typically receives Bachelors of Science degree upon completion of approved curriculum and obtains certification.

The RA is considered an *advanced level* radiologic technologist who can lead in patient management, patient assessment and perform exams and procedures with image evaluation but not final written reporting. The RA curriculum requires a baccalaureate degree with 1 year full-time clinical experience, preceptorship of 18–21 months, and certification [28].

The RA is certified by the Certifying Board for Radiology Practitioner Assistants (CBRPA) and registered by the American Registry of Radiologic Technologists (ARRT) following the completion of the advanced curriculum. The RA/RPA work with the radiologist's supervision, and guidance as delineated in the Joint Policy Statement of the American College of Radiology (ACR) and the American Society of Radiologic Technologists (ASRT). As of today there are 31 states in the USA that recognize or license the RA/RPA [27, 28].

1.6 Advanced Practice Providers Billing for Services

Non-physician advanced practitioners in the United States employed by interventional radiology can obtain history and physical exams, deliver clinical care and participate with radiology physicians in forming a clinical assessment and plan. After credentialing and appropriate training the non-physician practitioners can perform minor interventional procedures that otherwise would require the radiologist to perform as guided by the regulations of each state. The NP and PA practitioners are recognized by Centers