Chapter 43. Advanced Practice Registered Nurses: The Impact on Patient Safety and Quality

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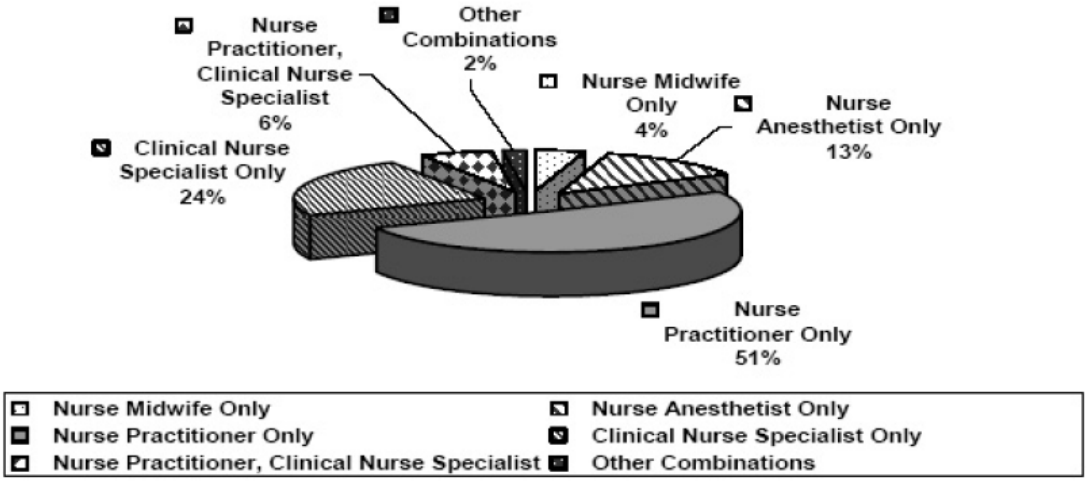
Background

This chapter will define the role of advanced practice nurses (APNs), review a selected sample of the literature regarding what we know about APNs and patient safety/quality, and describe the research gaps and limitations. Advanced practice registered nurse is a term used to encompass certified nurse-midwife (CNM), certified registered nurse anesthetist (CRNA), clinical nurse specialist (CNS), and nurse practitioner (NP). Advanced practice nursing is broadly defined as nursing interventions that influence health care outcomes, including the direct care of individual patients, management of care for individuals and populations, administration of nursing and health care organizations, and the development and implementation of health policy.[1] In 2004, the number of registered nurses (RNs) prepared to practice in at least one advanced practice role was estimated to be 240,461, or 8.3 percent of the total RN population. As noted in figure 1 below, the largest group among the APNs was NPs, followed by CNSs. The APN movement has been growing exponentially with APNs employed in every health care sector. According to the Bureau of Labor Statistics,[2] the demand for APNs is expected to continue to increase over the next decade and beyond, as the need and demand for effective health care increases, especially in rural, inner-city, and other underserved areas.

Figure 1. Registered Nurses Prepared for Advanced Practice, March 2004



Source: 2004 National Sample Survey of Registered Nurses, U.S. Department of Health and Human Services, Health Resources and Services Administration. http://bhpr.hrsa.gov/healthworkforce/reports/rnpopulation/preliminaryfindings.htm.

Direct clinical practice is a core competency of any APN role, although the actual skill set varies according to the needs of the patient population.[3] APNs build on the competence of the

RN skill set and demonstrate a greater depth and breadth of knowledge, a greater synthesis of data, increased complexity of skills and interventions, and significant role autonomy. The APN is prepared to assume responsibility and accountability for health promotion and the assessment, diagnosis, and management of patient problems, including the use and prescription of pharmacologic and nonpharmacologic interventions.[4]

Advanced Practice Nurses Evolve to the Doctoral Level

The American Association of Colleges of Nursing envisions all APN master's-level programs will evolve to a doctorate of nursing practice (DNP) by 2015.[5] This evolution to the doctoral level for APN education stems from the three Institute of Medicine (IOM) reports, *Too Err is Human*,[6] *Crossing the Quality Chasm*,[7] and *Health Professions Education: A Bridge to Quality*,[8] which emphasized widespread problems related to patient safety and called for dramatic restructuring of traditional health professions education. These reports recommended all health professionals should be educated to deliver patient-centered care as members of an interdisciplinary team, emphasizing evidenced-based practice, quality improvement, and informatics. It was emphasized that the best-prepared senior-level nurses should be in key leadership positions and participating in executive decisions. Complex practice and delivery system demands create a mandate to expand the clinical education and leadership capacity of APNs. Graduates of DNP programs are expected to use advanced communication skills/processes to lead quality improvement and patient safety initiatives in health care systems.

Research Evidence

Certified Nurse-Midwife

CNMs are licensed health care practitioners educated in the two disciplines of nursing and midwifery. They provide primary health care to women of childbearing age, including prenatal care, labor and delivery care, care after birth, gynecological exams, newborn care, assistance with family planning decisions, preconception care, menopausal management, and counseling in health maintenance and disease prevention. CNMs attend more than 10 percent of the births in the United States; 96 percent of these are in hospitals.[9]

What we know. MacDorman and Singh[10] used logistic regression models to examine differences between CNMs and physician-delivered births in infant perinatal mortality on all singleton vaginal births between 35 and 43 weeks gestation in the United States (n = 810,790) in 1991. After controlling for all social and health risk factors, the CNM risk of infant death was 19 percent lower, neonatal mortality was 3 percent lower, and low-birth-weight infants were 31 percent fewer than with the physician-delivered babies. The mean birth weight was 37 grams heavier for the CNM-attended births. The researchers concluded that CNMs provide a safe and viable alternative to maternity care in the United States, particularly for low- to moderate-risk women. The retrospective study design could not address the inherent selection bias of mothers who choose midwives versus mothers who choose physicians to assist with delivery.

Rosenblatt and colleagues[11] compared a random sample of records of Washington State obstetricians, family physicians, and CNMs for low-risk women over a 1-year period (n = 1,322). The researchers found that CNM patients were less likely to receive continuous fetal monitoring and had lower rates of labor induction, epidural injections, and caesarean sections

and overall used fewer resources. The researchers concluded that overall, in Washington State, low-risk patients of CNMs received fewer obstetrical interventions than similar patients cared for by family physicians or obstetricians, especially lower cesarean rates and resource use. There was no controlling for maternal risk factors such as maternal age and birth weight in this study, and the degree of selection bias in pregnant women choosing a CNM versus a physician could have influenced these results.

Oakley and colleagues[12] compared the pregnancy outcomes (n = 1,181) of low-risk pregnant women cared for by either an obstetrician or a CNM. After controlling for maternal risk and selection bias, the nurse-midwife group had statistically significant fewer infant abrasions, perineal lacerations, and complications; higher satisfaction with care; and lower hospital and professional fee charges. The researchers concluded that important significant differences were found between the CNMs and obstetricians and that CNMs are contributing significantly to lowering maternity care costs and improving maternal outcomes of low-risk women.

While most of the research on CNM quality covered low-risk women, Davidson[13] explored the effectiveness of CNM care for high-risk women. Outcomes of high-risk women cared for by CNMs in an inner-city hospital (n = 803) were compared with all women who delivered in the United States in 1994. The comparison suggests that CNMs can provide safe care to women with high-risk conditions. The single site of the study sample and lack of a controlled pair group make generalizability of these findings difficult.

Nurse Anesthetist

A CRNA is a registered nurse who is educationally prepared for and competent to engage in the practice of nurse anesthesia. CRNAs administer approximately 27 million anesthetics in the United States each year, practice in every setting where anesthesia is available, and are the sole anesthesia providers in more than two-thirds of all rural hospitals.[14] CNRAs can also administer every type of anesthetic and provide care for every type of surgery or procedure, from open heart to cataract to pain management. CRNAs are both responsible for and accountable to others for their individual professional practices. In addition, CRNAs are capable of exercising independent professional judgment within their scope of competence and licensure.[3] CRNAs provide anesthetics to patients in collaboration with surgeons, anesthesiologists, dentists, podiatrists, and other qualified health care professionals. When anesthesia is administered by a nurse anesthetist, it is recognized as the practice of nursing and is not a medically delegated act.[14]

What we know. In 1988, the Centers for Disease Control and Prevention (CDC)[15] conducted a pilot study to explore anesthesia outcomes. The study concluded that anesthesia-caused mortality and severe morbidity were too low to warrant a broader study. The CDC found that precise estimates would require studying 290 hospitals and would cost $15 million over 5 years, which was not deemed feasible. According to the IOM,[6] it is estimated that death occurs only once for every 200,000–300,000 anesthetics administered. This low incidence of error makes studying the safety of CRNAs as a distinct provider group extremely difficult as it would require an enormous number of study subjects.

To answer questions about surgical patients' safety with regard to CRNAs versus anesthesiologists, Pine and colleagues[16] studied 404,194 anesthesia cases across 22 States. Risk adjustment was conducted for case mix, risk factors, hospital characteristics, geographic location, and surgical procedure. The study found no statistically significant difference in the mortality rate for CRNAs and anesthelogists working together versus working individually. There was no statistically significant difference between hospitals staffed by CRNAs (without

anesthesiologists) versus hospitals in which anesthesiologists provided or directed the anesthesia care. The researchers concluded that, based on the surgical procedures included in the study, inpatient surgical mortality is not affected by whether the anesthesia provider is a CRNA or an anesthesiologist.

Anesthesia-related accidents are infrequent, largely due to systemic quality improvements in applied technology, anesthetic agents, multimodal pain management, and development and adoption of practice guidelines in the broad field of anesthesiology over the last 40 years. The dramatic decrease in anesthesia-related deaths since 1960 may be largely attributable to the disciplinewide sharp focus on safety issues such as increased vigilance during long operations and rapid response teams. The pulse oximeter, standardization of equipment, and changes in education, including the use of simulation, have also contributed to threshold improvement in patient safety. In fact, anesthesia as a health care discipline is an exemplar case study of how local but complex, high-risk, dynamic patient care has noticeably reduced its error rate[6] (p. 164). The administration of anesthesia is built on a foundation of sound safety principles and has been a strong leader in creating systems built around patient safety.

Clinical Nurse Specialist

The CNS is an expert clinician in a specialized area of nursing practice. The specialty may be a population (e.g., pediatrics), a setting (e.g., critical care), a disease (e.g., cardiovascular or mental health), or a type of problem (e.g., wound or pain). CNSs are engaged in direct clinical practice; function as consultants in their area of expertise; provide expert coaching and guidance; interpret, evaluate, and participate in research; provide clinical and professional leadership; collaborate; and employ ethical decisionmaking.[3]

What we know. In 2001, a randomized controlled clinical trial by Brooten, Youngblut, and colleagues[17] looked at prenatal, infant (194) and maternal (173) outcomes where half of the prenatal care was delivered in the home by CNSs. Results found that the group cared for in the home by CNSs experienced fewer fetal/infant deaths, fewer preterm infants, fewer prenatal hospitalizations, and fewer rehospitalizations compared to the control group. Researchers concluded that the CNS prenatal home care saved 750 hospital days or about $2.5 million dollars.

Topp, Tucker, and Weber[18] conducted a retrospective chart review on 491 hospitalized congestive heart failure patients over a 12-month period. Results indicated that length of stay and hospital charges were significantly less in patients who were case-managed by a CNS.

Naylor and colleagues[19] conducted a randomized clinical control trial with 276 patients and 125 caregivers to show the effects of a comprehensive discharge planning protocol. The discharge planning protocol was specifically designed for elderly medical and surgical patients and implemented by a gerontological CNS. From the initial discharge until 6 weeks after discharge, the medical intervention group had fewer readmissions, fewer total days of rehosptilization, lower readmission charges, and lower charges for all health care services after discharge compared to the control group and the surgical intervention group.

Brooten, Kumar, Brown, and colleagues[20] conducted a randomized clinical trial on the effectiveness of CNS home care on the early hospital discharge of very low-birth-weight infants (n = 79). The researchers found that hospital costs were 27 percent less than for the control group. The researchers concluded that early hospital discharge for very low-birth-weight infants was safe with CNSs conducting home followup care.

Nurse Practitioner

NPs are registered nurses who are prepared, through advanced education and clinical training, to provide a wide range of preventive and acute health care services to individuals of all ages. NPs take health histories and provide complete physical examinations; diagnose and treat many common acute and chronic problems; interpret laboratory results and x-rays; prescribe and manage medications and other therapies; provide health teaching and supportive counseling, with an emphasis on prevention of illness and health maintenance; and refer patients to other health professionals as needed.[21] Hughes and colleagues[22] have categorized the 40-year history of NP research into succinct eras, chronicling the evidence base on NPs, by far the largest of all of the four APN roles. The current era is characterized by strategies to combat rising costs and tension-building between NPs and the medical profession. The authors provide keen insight into why benchmarking NP care against physician care may have taken us to the end of that research road.

What we know. Lambing and colleagues[23] sought to build the evidence base for NP effectiveness in the acute care setting. They conducted a descriptive, comparative research design on 100 randomly selected hospitalized geriatric patients and a sample of 17 professional providers who staffed 3 hospital units over a 1-month period. The researchers found that the patients of NPs were older and sicker at the time of discharge and that readmission and mortality rates were similar amongst NPs and physicians. The researchers concluded that NPs provide effective care to hospitalized geriatric patients, particularly to those who are older and sicker.

Mundinger, Kane, and colleagues[24] conducted the most definitive research on NPs and quality by exploring the outcomes of care in patients randomly assigned either to a physician or to a nurse practitioner for primary care after an emergency or urgent care visit. The NP practice had the same degree of independence as the physicians, making this study unique. Patient interviews and health services utilization data were used on a total of 1,316 patients, and it was determined that the health status of the NP patients and the physician patients were comparable at initial visits, 6 months, and 12 months. A followup study conducted in 2004[25] showed that patients 2 years later confirmed continued comparable outcomes for the two groups of patients. No differences were identified in patient outcomes such as health status; physiologic measures; satisfaction; and use of specialists, emergency room, or inpatient services. The researchers concluded that NP care and physician care was comparable.

A study by Avorn and colleagues[26] used a sample of 501 physicians and 298 NPs who responded to a hypothetical scenario regarding a patient with epigastic pain (acute gastritis). They were able to request additional information before recommending treatment. If adequate history taking was performed, the provider would have learned that the patient ingested aspirin, coffee, and alcohol, and was under a great deal of psychosocial stress. Compared to NPs, the physician group was more likely to prescribe a medication without seeking the relevant history. NPs, in contrast, asked more questions, obtained a complete history, and were less likely to recommend prescription medication. This study suggests that NP-delivered care may be superior to that of physicians when a diagnosis is history dependent.

Summary of APN Research on Quality

A selected sample of research on APNs and quality and safety was conducted because much of the APN research lacked randomization, had sample sizes too small to be generalizable to the national health care system, or was not relevant to quality or safety. The summary of the preceding research samples suggests that APN[*]-delivered care, across settings, is at least equivalent to that of physician-delivered care as regards safety and quality. In the case of the CNSs, it appears that CNSs demonstrate competence and cost savings as case managers for patients transitioning from acute care to home care. Overall, however, the study designs and sample sizes are too limited to draw conclusions that are generalizable to the United States population. Widely accepted methodological techniques and research best practices outlined in the report of the Agency for Healthcare Research and Quality (AHRQ), *Evidence Report to Rate the Strength of Scientific Evidence*[27] (see Table 1), have not been applied to the emerging research on APN practice and quality. Methodologic quality has been defined as the extent to which all aspects of a study's design and conduct can be shown to protect against systematic bias, nonsystematic bias, and inferential error. Not met were certain design elements in the preceding APN research design, conduct, or analysis that have been shown through empirical work to protect against bias or that are long-accepted practices in epidemiology and related research fields. These research evaluation criteria include quality, quantity, and consistency that are well-established variables for characterizing how confidently one can conclude that a body of knowledge provides information on which clinicians or policymakers can act. As the research on APN and quality evolves over time, the rigor of the research and its capacity to influence policy will improve.

Table 1. Important Domains and Elements for Systems To Grade the Strength of Evidence

Quality:	The aggregate of quality ratings for individual studies, predicated on the extent to which bias was minimized.
Quantity:	Magnitude of effect, numbers of studies, and sample size or power.
Consistency:	For any given topic, the extent to which similar findings are reported using similar and different study designs.

These studies are also limited in looking specifically at patient safety as a subset of health care quality. According to *Crossing the Quality Chasm*,[7] the American health care system is in need of fundamental change because health care frequently harms and fails to deliver its potential benefits. The preceding literature compared APNs to physicians within the context of a health care system that is not necessarily patient safety focused. Comparing APN to physician outcomes was an important validation of APN practice as these professions evolved. Given the current mandate for fundamental system change, new research questions on APN practice as they relate to patient safety have emerged. Most outcome studies to date have focused on acute care

[*] No studies comparing CNSs to physicians have been conducted.

nurse staffing and nursing-sensitive outcomes such as decubitus ulcers.[28] The research to measure APN outcomes with valid tools has yet to be developed.

While the summary of research related to the safety and quality of APNs validates them as competent and comparable to physicians in many aspects, more research is needed to reduce errors and enhance patient safety. Threshold improvement cannot be accomplished without interdisciplinary practice approaches—which are going to require revolutionary change to flatten the educational and cultural silos between medicine and nursing education.[29] It is crucial that APNs are separated out as distinct provider types in all interdisciplinary research and administrative and clinical datasets. It has taken the nursing profession decades to untangle nursing's unique role and value within the hospital and decouple professional registered nursing from the "hotel costs" of a hospital stay. RNs have historically been characterized as a cost center rather than a highly valued revenue source within hospitals. If all professional nursing activity was billed for separately, such as is done with physician care, nursing's value would not have to be debated. As the evidence base on interdisciplinary teams is built, APNs must not become invisible on the health care team. Building a research portfolio on APN practice will require adherence to methodological quality that explores APN practice within an interdisciplinary context. Practice Implications—Barriers to APN Practice

Lack of Collaboration

Health professionals work together in small groups providing care, be it oncology, the operating room, end of life, or primary care. These team members, however, are educated in their health professional silo and likely have little knowledge of their team members' skill sets. The IOM report, *To Err is Human*,[6] suggested that health professionals should be educated in teams using evidenced-based methods employed in aviation such as simulation and checklists. People make fewer errors when they work in teams because it forces processes to be planned and standardized, forces team members to have a clear role and to look out for one another, noticing errors before they become an accident. In an effective interdisciplinary team, members come to trust one another's judgments and attend to one another's safety concerns.

In no uncertain terms, the IOM declares that most care delivered today is done by teams of people, yet training often remains focused on individual responsibilities, leaving practitioners inadequately prepared to enter complex settings. The silos created through training and organization of care impede safety improvements.[6]

The *Quality First* report highlighted "… the need for clinicians to develop a broader systems perspective. Specifically, the commission states that '… in health care organizations, much of the learning is aimed at improving individual physicians learning to become better physicians, nurses learning to become better nurses, rather than learning how the system as a whole can improve.'"[30] Irrespective of health care setting, there is a high premium placed on medical autonomy and perfection and a historical lack of interprofesional cooperation and effective communication.[6]

Learning and working in a true interdisciplinary context is a requirement for improved patient safety, and the silo systems in place now are viewed as wholly inadequate. It is the space between the disciplines that may create the most opportunity for patient safety improvement. The following quote expresses the opportunity created in this interdisciplinary space as John Brown, an information technology leader, discusses how his company lost the commercial market share on the world's first personal computer solely due to a lack of interdisciplinary collaboration:

> First of all, we were fundamentally noncollaborative, there was surprisingly little cross-disciplinary work. There were turf wars and physicists, for example, were not allowed to talk to computer scientists . . . To me the white space between fields is the place to explore. . . . If you get multiple disciplines together working around the root of a problem, it pulls you out of your own discipline and fuses different points of view that lead to a reframing.[31]

Exemplars in collaborative models have demonstrated quality and safety improvements in two divergent settings, acute and chronic care. The Rapid Response Team (RRT)—known by some as the Medical Emergency Team (MET)—is a team of clinicians who bring critical care expertise to the patient's bedside (or wherever it is needed) in the acute care setting. The concept is relatively simple: create a small but powerful team experienced at assessing patients' symptoms and make that team continuously and readily available to any provider who wants a second opinion about a patient, particularly a patient showing signs of potential decline, as patients often exhibit signs and symptoms of physiological instability for some period of time prior to a cardiac arrest.[32]

Another model, the Chronic Care Model, also has great potential to improve health care quality by employing a team of providers to apply a high standard of scientific evidence to groups of patients with a chronic illness.[33] Yet the role of providers, the community, and patients with chronic care needs can be unclear and at times disjointed.

Missing in the APN research is the notion of team-delivered care as it relates to quality. One study[34] explored only cost implications, and not quality per se, of multidisciplinary teams of hospitalists, nonhospitalist attending physicians, and NPs. The study model employed NPs to supplement physician care and ensure continuity of care, comparing this approach for managing 581 general medicine patients in one unit of a large academic medical center during hospitalization and for 30 days after discharge with usual care for 626 patients in another general medicine unit. The research findings indicated that reduced hospital length of stay (LOS) and increased hospital profits occurred in the collaborative model when compared with physician-only care. This approach reduced the average LOS from 6 to 5 days. By reducing the number of hospital days after the first 4 days, which are the most profitable ones, hospital profits increased by $1,591 per day for each patient without increasing hospital readmission or mortality rates.[34]

State Regulation of APN Practice

The 50 States and the District of Columbia have vastly different laws governing APN practice. The 51 nurse practice acts currently lack any clear framework or congruence amongst each other.[35] This high degree of variation suggests that the regulatory framework for APN practice is not evidence-based and that States are not promulgating APN regulations with a coherent patient safety orientation.

By way of example, some States employ a joint board of nursing-board of medicine to regulate APNs, while others require physicians and APNs to be in collaborative or even supervisory relationships with each other. Some States consider APN practice a medically delegated act and require physician, dentist, or podiatrist supervision of APNs, while other States require physicians to be in contact with the APN periodically throughout the week or to be physically within a defined radius (defined in miles) of the NP. Some States require APNs with doctorates to "hide" their doctoral degree credential from patients, and other States do not require APNs to be nationally certified to practice. These practice acts vary even within States

(urban or rural) and can specify the types of medical conditions APNs are permitted to treat. The current APN regulatory environment has numerous issues that foster poor quality or impair patient safety. Regulatory barriers that directly impact patient safety include onerous entry into APN practice; cryptic scope of practice regulations; polices that restrict APN hospital and prescriptive privileges and impede continuity of care, the capacity of NPs to serve as primary care providers (NP empanelment), to receive third-party payment, or the pharmacist from printing the prescribing APN name on the prescription bottle, making it difficult for pharmacists or patients to contact the prescribing APN. The APRN Joint Dialogue Group[36] of the National Council of State Boards of Nursing (NCSBN) recommends sole board of nursing regulation for APN practice and that APNs be independent practitioners with no regulatory requirement for supervision from another discipline across all States. Standardizing nurse practice acts will establish the groundwork necessary to move to a mutual recognition (interstate compact) for APNs.

This high degree of variation across the States for APN regulation has spotlighted the need to ensure that regulation serves the public, promotes public safety, and does not present unnecessary barriers to patients' access to care. Likewise, the regulatory bodies overseeing APN practice are slow or unable to keep pace with changes in health care. Moreover, the Internet has rendered geographic boundaries irrelevant, and as technology and national delivery systems infiltrate care delivery, these practice acts will strangle innovation. The *Crossing the Quality Chasm* report notes that State practice acts that limit nonphysician providers, e-health, and multidisciplinary teams act as a barrier to innovative health care because these innovations can help care for patients across settings and over time[7] (p. 215). *Crossing the Quality Chasm* recommends greater coordination and communication among professional boards, both within and across States, as the patchwork of NP regulations are resolved over time.

The IOM's *Crossing the Quality Chasm* recommends that regulators create an infrastructure to support evidence-based practice, facilitate the use of information technology, align payment incentives, and prepare the workforce to better serve patients in a world of expanding knowledge and rapid change[7] (p. 5). The report stresses that if innovative programs are to flourish, regulatory environments will be required to foster innovation in organizational arrangements, work relationships, and use of technology. The 21st century health care system described in *Crossing the Quality Chasm* simply cannot be achieved in the current environment of regulation and oversight. The report summarizes the current patchwork of regulatory frameworks as inconsistent, contradictory, duplicative, outdated, and counter to best practices. Moving the NCSBN's vision for APN regulation into reality across all of the States is requisite to promote APNs and patient safety.

APN Invisibility

Many polices have rendered APN practices "invisible" or established barriers that adversely impact accurate measurement of quality-related data. By way of example, Medicare has a policy that allows physician practices to bill Medicare for NP-provided services as "incident-to" the physician. This allows medical practices to bill for NP care through a physician, creating perverse incentives to make NPs invisible, as NPs are reimbursed 100 percent of the physician rate when billing Medicare "incident-to." When APNs bill Medicare directly, they bill at 85 percent of the physician rate. The cost savings of using a less expensive provider are passed onto the physician practice, not the patient or the payer.

Another startling example of APN invisibility is that the most comprehensive ambulatory care data, the National Ambulatory Medical Care Survey (NAMCS) produced by the National Center for Health Statistics, does not include APNs. This important national survey is conducted annually on the provision and use of ambulatory medical care services in the United States. Findings are based on a sample of visits to nonfederally employed office-based physicians who are primarily engaged in direct patient care. Each physician is randomly assigned to a 1-week reporting period. During this period, data for a systematic random sample of visits are recorded by the physician or office staff on an encounter form provided for that purpose. Data are obtained on patients' symptoms, physicians' diagnoses, and medications ordered or provided. The survey also provides statistics on the demographic characteristics of patients and services provided, including information on diagnostic procedures, patient management, and planned future treatment. APNs practicing in ambulatory care are not surveyed or discussed in the 906 million visits to physician offices.[37]

In that same vein, the Center for Studying Health System Change (HSC), whose mission is "to inform policy makers about how local and national changes in the financing and delivery of health care affect people … strives to provide high-quality, timely and objective research and analysis that leads to sound policy decisions, with the ultimate goal of improving the health of the American public."[38] HSC employs rigorous surveys and in-depth case studies and chronicles trends in the health care system; however, their provider surveys include only physicians. HSC unquestionably influences decisionmakers on all sides of the issues and guides those crafting health care policy in Government and private industry. More must be done to encourage thought leaders to think about health system change more broadly.

APNs are also invisible in the basic county-specific Area Resource File (ARF), a database containing more than 6,000 variables for each of the Nation's counties. ARF contains information on health facilities; health professions; and measures of resource scarcity, health status, economic activity, health training programs, and socioeconomic and environmental characteristics. In addition, the basic file contains geographic codes and descriptors that enable it to be linked to many other files and to aggregate counties in various geographic groupings. This database is used to establish Health Professional Shortage Areas (HPSAs), using criteria of population-to-clinician ratios. It is difficult to include APNs in the ratio as there is no uniform data source at the ZIP Code level on APNs. HPSA designation is important to communities because of the enormous funding priority they receive in more than 34 Federal programs that depend on the shortage designation to determine eligibility.[39] About 20 percent of the U.S. population reside in primary medical care HPSAs, and APNs are not considered full-time equivalent providers in the designation because of the lack of data. Fully counting APNs could thus impact the distribution of Federal funds to counties.

The Federal requirement that CRNAs must be in a supervisory relationship with anesthesiologists creates enormous barriers to adequate measuring of patient safety data, as the CRNA may not be identified as a distinctive provider group, rendering CRNA-delivered anesthesia invisible. This policy also has a detrimental effect on rural States that cannot staff their hospitals with anesthesiologists; therefore, many States have opted out of the Federal requirement for CRNA supervision in order to meet their patients' needs.

These policies, in each of the preceding examples, remove or marginalize the APN from all administrative and clinical data systems or survey designs. This lack of inclusion in these national research endeavors makes it impossible to understand the full dimensions and value of NP practice.

Practice Implications

The intense drive to measure quality is a deep concern for payers, regulators, and increasingly consumers. As data systems evolve and payers insist on "paying for performance," a level of accountability and transparency will be required regardless of provider type or health care setting. As these quality measures are developed, the current focus seems to be entirely on physician-delivered care. Quality data will be embedded with health information systems, so it will be imperative that APNs are involved in both the development of quality measures and the inclusion of APN practice as distinct from that of other providers. The database on nurse-sensitive indicators is being built at the inpatient level of hospitals. As many APNs practice in settings outside of the hospital, the need to create APN-sensitive measures cannot be overemphasized. The Medicare objective to align quality incentives through payment creates enormous opportunity for APNs. As Medicare gathers the evidence on effective strategies, it will phase in new payment systems intended to promote transformational quality improvement in the health care industry. This realignment will encourage innovation and efficiency and promote coordination of care across time and settings.[40] These activities are central to the APN function and have historically been undervalued and invisible in the fee-for-service model.

Pay-for-performance initiatives are occurring outside of Government as well. Bridges to Excellence (http://www.bridgestoexcellence.org/) is a multistate, multiemployer coalition developed by employers, physicians, health care services researchers, and other experts. Its mission is to reward quality across the health care system. In Bridges to Excellence's three program areas, physicians are targeted exclusively by certifying physicians in diabetes, cardiac care, and electronic office systems. The physician receives a financial bonus of up to $180 per year per patient treated. There are no other providers included in this program, despite the claimed mission to improve health care across the health care system.

Health Services Research Field Gains Strength

Over the last 20 years, the evolution of health services research (HSR), a distinct area of scholarship, has grown dramatically in both resources and influence and is currently funded publicly at $1.5 billion annually. HSR is important to APNs because it addresses questions that require observational or quasi-experimental design. This form of research includes determining the comparative effectiveness of interventions across a range of different settings, economic evaluation of different financing and organizational decisions, and qualitative designs that help us understand the how and why of social interactions.[41] The HSR field is uniquely suited to exploring APN practice because it provides a mixing bowl of interdisciplinary perspectives working on similar problems. As HSR methods become increasingly more prestigious and influential, APN research must be framed within a broader HSR and patient safety context.

Research Implications

The rapid growth and success of the APN movement has been described as a disruptive innovation—in that APNs can in many ways provide the same care or better care than physicians, at a lower cost in a more convenient setting. This disruption has contributed to professional turf battles that do not promote quality and patient safety. Strong leadership to study

innovative models on interdisciplinary team approaches that foster patient safety, including how to eliminate barriers to interdisciplinary education and practice, is required.

Turning the disruption of APNs toward improved patient safety will require a more robust evidence base and laser beam focus by these professionals. APNs must demonstrate specific clinical performance and patient outcomes. To develop this research agenda, stakeholders must convene and map out a vigorous research agenda that distinguishes APNs in the context of interdisciplinary practice. APN organizations along with the governmental and private research enterprise must come together and build a strategic plan identifying the most critical research questions. This research agenda would address strategies for APN inclusion in electronic administrative and clinical data systems, quality measurement, cost containment, as well as influential surveys such as the NAMCS and HSC. As pay-for-performance initiatives are transformed into payment policy, it is essential that researchers include APNs in the quality measurement process. This research agenda must be highly relevant to address today's health care problems and overcome APN invisibility; it must recognize APNs' unique contribution and discipline.

APN research must expand to an HSR orientation. This includes developing a research agenda that has methodological dialogue with other disciplines and fits within a framework of agreed-upon methods in the field of HSR. This research agenda must consistently and systematically translate APN research into sound health policy. Applying randomized thinking to nonrandomized problems is seldom useful to inform public policy because the researcher cannot expose a randomized group to the policy on a qualitative problem. The research must help the policymaker see the intended and unintended consequences that follow enactment of policies over time.

The Agency for Healthcare Research and Quality (AHRQ) has emerged as the premier funder for HSR, and this funding source should be explored to a far greater degree by APN researchers. While the National Institutes of Health focus on the biomedical aspect of diseases, AHRQ focuses on patient outcomes, cost, use of services, access disparities, quality of care, and patient safety. The focus of AHRQ is becoming increasingly important as the delivery system undergoes transformation, driven by transparency and quality. AHRQ's goal is to ensure that the knowledge gained through HSR is translated into measurable improvements in the health care system and better care for patients.[42] This goal could be shared by members of the APN community by sharpening and aligning the APN research focus on systems of care.

There are a number of informational or empirical issues lacking in the current APN evidence base. Future research must be independent, longitudinal, and directed to authoratitively answer the most urgent policy-relevant questions concerning APNs. Following are some of the questions that research into APN practice should address.

Cost and Quality

- Do APNs create value for payers to improve the quality in health care? Is APN practice economically efficient and effective? Are APNs a competitive advantage in the health care marketplace? Does APN practice demonstrate a threshold improvement in lowering cost, reducing misuse, overuse, and errors?
- What is the most reliable, valid, and feasible approach(es) to measuring quality of care delivered by APNs?
- Are there certain settings (acute care, palliative care) or content areas (obesity, cardiac disease) that APNs are most effective?

- How does APN practice uniquely respond to patient preferences?
- What are the outcomes of APN interventions targeted at changing patient behaviors and lifestyle? Do APNs uniquely or qualitatively employ effective strategies to promote health and human wholeness and prevent disease?
- What is the most effective health care team composition for acute care? Primary care? Palliative care? How do we build an evidence base on interdisciplinary approaches or "collaboratories" to function as incubators and disseminators of team-delivered care?
- How do State nurse practice acts enhance or create barriers to safe, effective, and innovative APN-delivered care?

Medicare

- What is the advantage to Medicare to include APNs in its pay-for-performance initiatives? Do APNs, as central members of the health care team, demonstrate threshold quality improvements? How do these findings inform Medicare's Graduate Medical Education program currently targeting primarily physicians?
- How can the cost savings on APN practice be passed onto consumers, Medicare, and other payers?

Access

- What impact do APNs have on vulnerable segments of the population? How do they impact the uninsured? Elderly? Children? Rural residents? How do APNs participate in the safety net?
- How are access and quality of care impacted once a State has adopted NCSBNs regulatory vision for APN practice, which eliminates barriers to APN practice?
- Does APN practice improve health care disparities? Do improvements benefit minority populations preferentially?

Educational Issues

- How are APNs demonstrating interdisciplinary patient safety curricula with educational simulation techniques for use early in professional schooling, continuing throughout training, and at intervals during professional practice?
- How do APNs maintain continued competence throughout their career trajectory?
- What would be included in a curriculum that demonstrated competency in patient safety?

Data and Dissemination Issues

- How can the Health Resources and Services Administration's National Sample Survey of RNs be conducted more frequently, expanded and designed to include a sample of APNs? How frequently should the survey be conducted in order to yield the most timely workforce projections?
- How do APNs get built into the Area Resource File?
- How can a database on APNs answer the following questions?
    - How many ANPs are there?
    - Where do they practice, what do they practice, and who do they care for?
    - What constitutes a full-time equivalent APN?

- When do APNs enter the workforce, and when and how to they leave/retire?
- How should APNs be included in shortage designation methodologies?
- What would a national, integrated workforce planning initiative look like?
- What is the best way to communicate APN-related research to the public, policymakers, payers, and media?

Conclusion

In addition to developing a robust APN research agenda, APN organizations must strategize to have APNs appointed to Federal and private advisory commissions that oversee or develop quality improvement measures. APN organizations must also identify key corporate boards and develop long-term strategies and political capital to get APNs appointed to those influential boards. This sector of the health policymaking process is increasingly influential as payers seek to know more about what they are getting from their health care dollar vis-à-vis pay-for-performance initiatives.

Findings from APN research must be published in journals outside of nursing to reach a broader policymaking and public audience. Key policymakers as well as the public could be made more aware of the contributions that APNs make in reducing health care costs and improving access and quality of care. Achieving broader recognition, reducing APN invisibility, and removing barriers to APN practice will be contingent on APNs communicating methodologically sound APN research that produces results that are generalizable to the larger delivery system.

Search Strategy

Both MEDLINE® and CINAHL® databases were searched to locate literature for this review. The search terms were “advanced practice nursing,” “certified nurse midwives,” “certified registered nurse anesthetists,” “clinical nurse specialists,” “nurse practitioners,” “quality,” “safety,” and “outcomes.” For both databases, the searches were limited to research articles published in the English language between 1991 and 2006 and restricted to research within the United States.

There were 97 articles identified in the CINAHL search and 54 identified by the MEDLINE search, with some duplication in the citations identified by the two databases. All abstracts were reviewed and most were eliminated from further consideration because they were not evidence based or there were methodology concerns. For example, articles about advanced practice roles, delivery models, theoretical papers, educational and curriculum issues, international issues, advanced practice nursing in defined specific populations (e.g., rural, emergency departments, gerontological) or diseases (e.g., sexually transmitted infection, heart disease), and all meta-analyses and studies with fewer than 70 subjects were omitted from this review. Once the unrelated articles were eliminated, a complete copy of each of these papers was acquired and read. Four professional associations were contacted to obtain the strongest research papers on the four APN roles (American College of Nurse Midwives, American Association of Nurse Anesthetists, the American Association of Clinical Nurse Specialists, and the American College of Nurse Practitioners). Dominant among the reasons for excluding papers were that they were not research based, they were short reports that were lacking essential details, or there were methodological concerns.

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Evidence Table. Advanced Practice Nurses: Impact on Safety and Quality of Care

Source	Safety/Quality Issue Related to Clinical Practice	Study Design, Study Outcome Measure(s)	Study Setting & Study Population	Study Intervention	Key Finding(s)
Quality Evidence on CNMs					
Davidson 2002[13]	High-risk obstetrical care	Level 3. Univariate analysis on vaginal births after cesarean, forceps, and vacuum-assisted deliveries, cesarean delivery, 5 minute Apgar score, maternal fever, and meconium stained amniotic fluid outcomes.	High-risk mothers who received care from an urban, mid-Atlantic hospital-based OB clinic during a 10-year period from 1988 to 1998, N = 803.	Risk factors managed by CNMs compared to the national population.	83% of the CNM deliveries were spontaneous vaginal births, compared to the national average of 79%. Seventy four percent of the CNM births after cesarean births delivered vaginally, significantly higher than the national average of 28%. Instrument delivery rates were considerably lower for the CNM group (4%) compared to the national average (9%). Only 12% of the CNM group had cesarean sections, compared to the national average of 21%. The researcher concludes that CNMs provide high-quality care to high-risk women in an urban setting.
MacDorman 1998[10]	Birth outcomes and infant survival	Level 3. Logistic regression on infant, neonatal, post-neonatal mortality and risk of low birth weights.	All singleton vaginal births at 35–43 weeks gestation in the United States in 1991, N = 810,790.	CNM care compared to physician-delivered births.	After controlling for medical and social risk factors, the risk of experiencing an infant death was 19% lower for CNM-attended than for physician-attended births, the risk of neonatal mortality was 33% lower, and risk of delivering a low-birth-weight infant was 31% lower. National data demonstrate that CNMs have excellent birth outcomes amongst low- to moderate-risk women.
Oakley 1996[12]	Pregnancy/ perinatal outcomes	Level 3. Logistic regression analyzed outcome measures: infant and maternal outcomes, 30 clinical indicators, satisfaction with care, and monetary charges.	At intake, all women qualified for CNM care and a convenience sample identified 710 low-risk, singleton pregnant women cared for by obstetricians and 471 cared for by CNMs in private practice.	CNM care compared to obstetrician care.	After controlling for social and health risk factors, multivariate analysis found statistically significant ($P \leq 0.05$) differences between obstetricians and CNMs on 7 outcome measures. Infant abrasion (7% OB vs. 4% CNM), infant remaining with mother for the entire hospital stay (15%OB vs. 27%CNM), 3rd or 4th degree perineal lacerations (23% OB vs. 7%CNM), number of complications (0.7 OB vs. 0.4 CNM), satisfaction with care, average hospital charges ($5,427 OB vs. $4,296 CNM), average professional fee charges ($3,425 OB vs. $3,237 CNM). It was concluded that CNMs provide a safe, effective maternity care for low-risk women and that CNMs contribute to lowering maternity care costs and improving maternal outcomes of low-risk women.

Source	Safety/Quality Issue Related to Clinical Practice	Study Design, Study Outcome Measure(s)	Study Setting & Study Population	Study Intervention	Key Finding(s)
Rosenblatt 1997[11]	Patterns of obstetric care	Level 3. Provider behavior pattern was the unit of analysis; outcomes included cost of prenatal and intrapartum care.			In Washington State, CNMs were more likely to deliver babies without an operative intervention. Obstetricians were more likely to conduct amniocentesis in the prenatal period (7%) compared to family physicians (1%) or CNMs (2%). Obstetricians were far more likely to perform C-section (15 %) than family physicians (14%) or CNMs (9%). CMNs were far less likely to induce or augment (episiotomy, epidural, fetal monitoring) their patients during delivery. The authors conclude that CNMs have a different approach to intrapartum care than their physician colleagues, which uses fewer resources.
Quality Evidence on CRNAs					
Pine 2003[16]	Surgical patient safety related to type of anesthesia provider	Level 3. Surgical mortality restricted to carotid endartectomies, cholecystectomies, herniorrhaphies, mastectomies, hysterectomies, prostatectomies, and knee replacements.	Retrospective observation on Medicare patients, N = 404,194, from 22 States from 1995 to 1997.	Anesthesia-related deaths among anesthetists vs. nurse anesthetists.	There is no statistically significant difference in the mortality rate for CRNAs and anesthesiologists working together or individually. Inpatient surgical mortality is not affected by whether the anesthesia provider is a CRNA or an anesthesiologist.
Quality Evidence on CNSs					
Brooten 2001[17]	Prenatal, maternal, and infant outcomes	Level 1. Randomized clinical trial n = 173 women and 194 infants.	1-year study period in one delivery system of women at high risk for delivering low-birth-weight infants.	Half of the study sample received prenatal care in the home by CNS while they received traditional obstetrical care.	Group cared for in the home had 2 fetal infant deaths compared to the control group (9); fewer preterm infants, 78% of twin pregnancies carried to term (9), control group = 33%); 4 prenatal hospitalizations, 18 infant rehospitalizations (control group = 24). CNS home care saved 750 total hospital days or about $2.5 million.

Source	Safety/Quality Issue Related to Clinical Practice	Study Design, Study Outcome Measure(s)	Study Setting & Study Population	Study Intervention	Key Finding(s)
Brooten 1996[20]	Safety and cost effectiveness of care by CNSs.	Level 1. Randomized clinical trial, n = 79 patients in one system. Outcomes included hospital costs, physician fees, home followup care by CNSs.	Very low-birth-weight infants discharged from a hospital early.	Home care followup by CNS.	Mean hospital costs were 27% less than the control group ($47,520 vs. $64,940, $P < 0.01$); the mean physician charge was 22% ($P < 0.01$) less in the group cared for in the home by CNS. The mean cost of home care was $576, yielding a net savings of $18,560
Naylor 1994[19]	Hospital transition to home for frail elderly	Level 1. Randomized clinical trial; initial hospital discharge until 6 weeks after discharge.	Medical and surgical patient and caregiver posthospital discharge outcomes and cost of care, N = 276 patients and 125 caregivers	Comprehensive CNS-delivered discharge planning protocol.	The medical patient group had fewer hospital readmissions, fewer total days of hospital readmission, lower readmission charges. The surgical intervention group showed no significant differences with the control group during the discharge period.
Topp 1998[18]	Effect of CNS case management	Level 4. Quasi-experimental comparative, correlational. Outcomes included nursing interventions, length of stay, complication rate.	Chart review of 164 post-op total knee replacements in one delivery system.	CNS case management	Patients in the units with CNSs received more nursing interventions, had shorter lengths of stay.
Quality Evidence on NPs					
Avorn 1991[26]	Treatment comparisons between NPs and MDs	Level 4. Randomized selection of MDs and NPs given a case vignette.	501 MDs and 298 NPs were presented a case vignette.	Hypothetical scenario involving epigastic pain	More than one-third of the physicians chose to initiate therapy without seeking a relevant history. Nearly half of all physicians indicated that a prescription would be the single most effective therapy; 65% recommended a histamine antagonist. By contrast, only 19% of NPs opted to treat without taking further history; the nurse sample asked an average of 2.6 questions vs. 1.6 for physicians. These findings suggest that NPs ask more questions and were less likely to recommend prescription medication when not indicated by clinical circumstances.

Source	Safety/Quality Issue Related to Clinical Practice	Study Design, Study Outcome Measure(s)	Study Setting & Study Population	Study Intervention	Key Finding(s)
Lambing 2004[23]	Acute care outcomes of frail elderly	Level 4. Descriptive comparative, research using a convenience sample of providers and self report. Outcomes measures obtained from claims data include charges for length of stay, hospital readmission, and mortality rates.	Random selection of 100 inpatient geriatric patients and a convenience sample of 17 professional providers who cared for them in one hospital in the Midwest over 1 month.	MD vs. NP provider	NP patients were older ($P < 0.022$) and sicker at admission ($P \leq 0.001$) and discharge ($P \leq 0.001$). Charges for length of stay were lower ($P \leq 0.001$) for the physician provider group, and patients in that group had shorter stays ($P = 0.001$). Readmission and mortality rates were similar for both MD and NP groups. The authors conclude that NPs provide effective care to hospitalized geriatric patients, particularly to those who are older and sicker.
Mundinger 2000[24]	NP outcomes in primary care after an urgent or urgent care visit.	Level 2. Randomized clinical trial between August 1995 and October 1997 with patient interviews at 6 months after initial appointment and health services utilization.	Four community-based primary care clinics (17 physicians) and 1 primary care clinic (7 NPs) at an urban academic medical enter, N = 1,316.	NP practice with the same degree of independence as MDs, compared to MD process outcomes.	No significant differences were found in patients' health status at 6 months. Physiologic status for patients with diabetes or asthma were no different. For hypertensive patients, the diastolic value was significantly lower for NP patients (82 vs.88 mg Hg; $P < 0.04$). No significant differences were found in health services utilization after 6 months or 1 year. There were no differences in satisfaction ratings following the initial appointment. Satisfaction ratings at 6 months differed for 1 of 4 dimensions measured (provider attributes), with MD rates higher(4.2 vs. 4.5 on a scale where 5 = excellent; $P = 0.05$). Authors conclude that primary care outcomes of NPs are comparable to MDs when NPs have the same level of authority, responsibilities, productivity, and administrative requirements.
Lenz 2004[25]	2-year followup of outcomes on patients followed by NPs and MDs	Level 2. Randomized clinical trial (of same sample in Mundinger, 2000)	N = 406 adults	Health status, disease-specific physiologic measures, satisfaction or use of specialist, emergency or inpatient services.	Results consistent with 6-month findings (see Mundinger, 2000). The body of evidence suggests that the quality of primary care delivered by NPs is equivalent to that of MDs.

CNM = clinical nurse midwife; CRNA = clinical registered nurse anesthetist; CNS = clinical nurse specialist; NP = nurse practitioner.