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**Examining the critical role of advanced practice providers on a
multidisciplinary transplant team**

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Abbreviations

Advanced Health Provider (AHP)

Advanced Practice Clinicians (APC)

Advanced Practice Provider (APP)

Advanced Transplant Providers (ATP)

American Association of Surgical Physician Assistants (AASPA)

American Society of Transplant Surgeons (ASTS)

American Society of Transplantation (AST)

Model for End-Stage Liver Disease (MELD)

Nurse Practitioner (NP)

Physician Assistant (PA)

Registered Nurse First Assistant (RNFA)

Relative Value Unit (RVU)

The Organization for Donation and Transplant Professionals (NATCO)

Abstract

It is well documented that Physician Assistants (PAs) and Nurse Practitioners (NPs), collectively known as Advanced Practice Providers (APPs), have a beneficial role beyond the field of primary care. APPs broad spectrum of knowledge make them particularly well suited for specializing in complex fields such as transplant. Variations in practice across transplant centers lead to questions regarding optimal use of APPs. Using job descriptions from transplant centers

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currently employing APPs, we sought to examine the critical role of transplant APPs beyond clinical care alone. In this review, we explore not only the general training of APPs and current utilization of APPs in transplant, but also safety, cost effectiveness, and comparison of APPs to other transplant providers. We aimed to highlight the importance of recruitment and retention of transplant specific trained APPs to provide continuity in transplant programs. Additionally, APPs expansion into transplant research, quality improvement, leadership, and management must be considered. We challenge transplant centers utilizing APPs to consider these important aspects when seeking ways to expand and optimize the critical role APPs provide on the transplant team.

Overview of Advanced Practice Providers

Advanced Practice Providers (APPs) may also be referred to as Advanced Health Providers (AHP), Advanced Practice Clinicians (APC) and Advanced Transplant Providers (ATP). While the nomenclature may vary the fundamental importance surrounding the utilization of APPs in transplant is evident. The PA profession was established in 1967 with over 255 programs. They are educated at a Masters' degree level and undergo 2,000 hours of clinical rotations.¹ The scope of practice for PAs requires physician supervision in 47 states and is determined by the supervising/collaborating physician. Upon program completion, they are certified to provide care across all specialties.

The NP profession was also established in 1967. NPs have first met the requirements to work as registered nurses and subsequently complete a Masters or Doctoral program.² The scope of practice for NPs varies depending on the state in which they practice. As of 2019, NPs have full practice authority in 23 states, reduced practice in 16 states, and restricted practice in 12 states.³ Education programs and certification exams require NPs to select an area of practice. These include but are not limited to pediatrics, family practice, adult primary care, gerontology, psychiatric-mental health and acute care.

Broad theory-based education combined with clinical exposure provided to NPs and PAs during training allows them to function autonomously with state dictated limitations upon hire.

Kleinpell et al. explored the care provided by NPs over a 5 year period, including discussing care with families, ordering and interpreting tests and labs, initiating specialty consultations, discharge planning, and tasks that promote continuity of care.⁴ These are essential functions to any area in which an APP elects to practice.

Utilization of APPs in Transplant

Transplant as a specialty is well suited to utilize APPs as providers. Centers have seen sustained growth over time, with an increasing number of waitlisted patients and more transplants being performed.⁵ With a growing number of transplant patients, centers need non physician providers capable of keeping up with this demand in a way that is safe, effective, and cost efficient.⁶⁻⁸ Incorporating APPs in the care of transplant patients can lead to overall improvement of the patient experience and outcomes.^{6-7,11} They provide consistent clinical care to patients across the transplant continuum. This is becoming increasingly important as hospital fees for service is becoming more intertwined with the patient experience and outcome.

While the need for additional transplant providers has steadily increased at many centers, there is no universal set of roles and responsibilities of an APP. This adds to lack of clarity around optimal utilization of APPs within the specialty. A review of job descriptions from various transplant centers demonstrates just how vast the duties of APPs in transplant are (Appendix A). Although we will describe areas of practice separately, it is important to note overlap between each area of practice exists with some practicing solely in one setting and others in multiple settings.

As inpatient providers, APPs are responsible for daily care of admitted patients. Hours vary but can include after-hours and weekend coverage.⁹ Completing admission H&Ps, daily progress notes, and discharges are often primary responsibilities. APPs ability to adhere to pathway driven practices helps ensure care is evidence based. The Centers for Medicare and Medicaid

Conditions of Participation require transplant centers provide multidisciplinary care to transplant recipients and an APP helps ensure these discussions occur daily and no discipline is excluded.¹⁰

As outpatient providers, APPs manage patients as part of a multidisciplinary team and serve as the primary provider typically in a clinic setting.^{6-7,10-11} Early in the post-transplant course, the focus is on acute recovery from surgery with careful monitoring for organ specific complications. For instance, readmissions after liver transplantation are common with increased morbidity and cost and APPs can be effective in reducing this risk. University of Pennsylvania performed a retrospective cohort study of all liver transplant patient from 2014 to 2017. A NP based post-transplant care program and clinic were initiated in 2016. Post-discharge readmission rates were compared between the pre- and post-exposure groups while adjusting for associated risk factors. They found that there was no significance in demographics of the patients; however, they significantly decreased readmission rates in the post-exposure group at 30 days (hazard ratio 0.60, 95% confidence interval, 0.39-0.90; P = 0.02) and 90 days (hazard ratio 0.49, 95% confidence interval, 0.34-0.71; P = <0.001). They felt that these results were mediated through increased NP outpatient clinics and phone calls to patients.¹⁰ The long term management of post-transplant patients requires knowledge of potential chronic complications related to organ transplant. A major focus is immunosuppressive management both early and late in the post-transplant phase as this requires a skilled transplant specific provider to understand each patient's particular risk.

In some transplant programs, APPs primarily function in organ procurement and practice in the operating room. Some states require NPs to also have their Registered Nurse First Assistant (RNFA) certification to function as first assist in the operating room leading to more PAs performing in this function. Certain APPs are exceptionally skilled with the surgical techniques that optimize organ recovery based on the transplant program's requirements. APPs in the procurement operating room provide the fellows with assistance in the procedure as well as troubleshooting inevitable difficulties based on well-founded experience. APPs can also serve an important role as first assist in elective cases as the common denominator with ever-

changing fellows and residents. They ensure the proper equipment is available, the patient is checked in properly, and the OR staff is aware of any changes and communication between OR rooms with simultaneous living donor and recipient surgeries.

Safety of APPs as providers

There has been controversy about the quality of care provided by APPs compared to physicians. Newhouse and colleagues' policy paper stated outcomes of care provided by NPs in collaboration with a specialist or primary care physicians are similar to, or in some cases better than, the outcomes of care provided by a physician alone.¹² The Institute of Medicine claims there is a large body of evidence that does not support the conclusion that NPs are less able than physicians to provide safe, effective, and efficient care.¹³

Safe and effective use of APPs within transplant is also documented. In a retrospective study from 1998 to 2013, Mayo examined all of the liver transplants performed at their center. In that time, there was increased MELD score from 16 to 25, suggesting that patients were sicker at time of transplantation. They implemented the use of inpatient APPs and found that even with sicker patients, the median length of stay did not increase and remained at 7 days. The median warm ischemic time did not increase but actually decreased from 33 to 30 over the study period ($p < 0.001$). Furthermore, the outcomes for patient and graft survival improved.⁶ They concluded that APPs were essential for optimal patient outcomes.

A review of 287 consecutive lung procurements at Columbia University compared fellows and a PA who performed lung procurements over a 5 year period of time. They both functioned as the lead donor surgeon with fellows in 90 cases (31.4%) and the PA in 197 cases (68.6%). The PA had significantly lower injury rates compared to the fellows 1/197 (0.5%) vs 22/90 (24%) respectively. Rates for pulmonary graft dysfunction grade 2&3 were also significantly lower compared to the fellows 19/197 (9.6%) vs 29/90 (32.3%).¹⁴ They found that using a PA in donor procurement was a safe, cost effective, and viable alternative to using surgeons.

Cost effectiveness of APPs as providers

Faza et al. performed a regression analysis of patients in 130 Veterans Affairs (VA) facilities who were being seen for a primary care visit. They confirmed cost-effective care by APPs in patients with complex conditions such as diabetes and cardiovascular disease. They also showed that only 50-57% of patients met combined effectiveness measures which indicated an area for improvement in the future.¹⁵⁻¹⁶

A systematic review of 29 articles by Johal and Dodd demonstrated the addition of APPs to surgical teams resulted in decreased length of stay, an improvement in operating times and reduction in cost. The morbidity and mortality were unchanged but two studies found complication rates decreased, while one study showed an increase in rate of diagnosis of deep vein thrombosis. All of the studies in this review reported specific cost outcomes with APPs compared to physicians showing cost savings, though the savings varied dramatically. The decrease length of stay of patients was shown to increase cost savings in two studies, while Bohm et al. showed similar costs with APPs, there was added benefit of an increase in surgical volumes and decreased surgical wait times.¹⁷

In 1981, the Office of Technology Assessment, conducted an extensive analysis of NP practice and found the hourly cost of an NP was one-third to one-half that of a physician. The difference in compensation between these two types of providers has not changed for 30 years.¹⁷

Resident salaries are less and they work longer hours than APPs; however, they have work-hour limitations. Residents reported APPs decrease the amount of non-educational activities lightening their overall workload.¹⁸ Pezzi et al found that the use of APPs was cost effective and a good alternative to physicians in assisting with increased work demands caused by resident work hour restrictions.¹⁸

Transplantation is expensive and programs are trying to lower costs while maximizing productivity.¹⁹ Centers increasing the use of APPs are establishing ways to capture billable APP services to help cover the salaries and benefits of these individuals, including H&P's, progress notes, and performing procedures. The majority of these functions are reimbursed by insurers. Additional ways APPs add value that may not generate RVUs but are essential functions of

transplant care include disability or insurance paperwork, clinical research, global visits for pre- and post-operative care, counseling, triage, and patient education.

Benefits of utilizing APPs compared to other care providers

Residents/Physicians

APPs are well suited to help overcome challenges faced by academic medical centers when considering resident education as it pertains to transplant. There is a steep learning curve for interns and residents on the transplant service. With constant rotations during their postgraduate years, the challenges of learning the nuances of the transplant patient population is difficult. The advantages of residents are that they have lower salaries and can provide 24 hour coverage; however, they do require increased teaching needs and are sometimes limited secondary to surgery schedules and lack of exposure to transplant medicine. Surveyed University HealthSystem Consortium academic centers reported the primary reasons for hiring APPs was not only to satisfy the resident duty hour restrictions, but also to improve access and to improve continuity, safety and quality of care.^{4,6-7,9-11} The APPs possess a different wealth of knowledge than a resident from being consistently on the transplant service.

Nurses

Nurses are extremely important to manage transplant patients both on the transplant floor and in the outpatient setting (pre- and post-operatively). They are utilized at the bedside, as case managers, discharge planners, as clinic support staff, and as coordinators. Their knowledge helps them to further educate patients on a daily basis as well as be the contact person for patient and family questions. Their scope of practice is limited by education and licensure.

Coordinators

Transplant centers employ transplant coordinators to serve in various roles, with focus on clinical care and organ procurement. Some centers hire transplant APPs to serve in this capacity. Perhaps the greatest strength is the ability of APPs to order and interpret testing, diagnose and treat conditions and have prescriptive authority. Nurse coordinators are limited

and unable to practice in this capacity independently, requiring provider approval for decision making.²⁰ Centers must be careful to have oversight if APPs do serve as transplant coordinators. Care must be taken to ensure APPs are not unfairly advocating for their personal patients to undergo transplant. Active multidisciplinary participation in selection conferences ensures this risk is mitigated.

APP Recruitment and Retention

There are a number of different strategies that can be utilized to recruit and hire the appropriate APP for a transplant team. Contacting an accredited PA/NP educational program to locate new graduates and residents can be helpful. Advertising internally at one's institution and externally on national organization websites such as: ASTS, AST, AASPA, and NATCO will also increase the pool of candidates. There are several APP transplant fellowship programs that can also be utilized for hiring APPs trained specifically in transplant.

There is risk of burnout with transplant APPs secondary to high patient acuity and increased workload. There is a large loss of investment when a transplant APP leaves the department. The estimate cost for turnover for an APP is approximately \$250,000-\$300,000. Recruiting and hiring a new employee is typically 50%-60% of the employee's salary; however, the total cost of the turnover (including lost revenue and disengagement) can average 90%-200% of the employee's salary.²¹ This amount does not include the cost of training or onboarding a new APP which can take months to years to train. This is why retention is vital.

Onboarding is vital for retention and should include a process or program that has general information about not only the job but also the organizational culture. The new APP can shadow key individuals currently working with the team to learn other roles and duties of the transplant department. The length of orientation will be dependent on experience of the new APP and the roles that they will be undertaking. Prior to completion of orientation, both the new APP and the team should outline a transition plan and submit the Focused Professional Practice Evaluation for privilege-specific competence.

New graduate APPs have a steep learning curve. A transplant specific onboarding plan builds a strong foundation for longevity and adds stability to the transplant program. Major milestones should be celebrated as a team for both individual and team accomplishments. Both the APP and their leadership need to invest in professional development and help the APP seek opportunities for them to advance. An open line of communication is essential in practicing integrity and offering respect for all employees.

Challenges of utilizing and expanding the role of APPs in transplant

Anticipated challenges to increasing APP utilization include training and mentorship, cost, scope of practice, and regulatory requirements. Advanced practice providers offer longevity on the transplant team and allow for continuity of care, but also may be viewed as competition for educational opportunities by the house staff. It has been suggested that increased use of APPs in transplantation has led to decreased engagement by trainees in the field of transplantation and could have a negative impact on recruitment of physicians to the field.²² However, APPs routinely contribute to house staff education therefore minimizing interference with trainee education.²³⁻²⁵ APPs are trained as generalists, and as such, adequate clinical onboarding of the APP into the clinical complexities of transplantation is critical, particularly if the APP is a new graduate or comes from a role outside of transplantation.²⁶⁻²⁷ Mentorship is required, as the practice expectations include care of complex patients in addition to expectations unique to transplantation, including multi-organ transplants, immunosuppression regimens, and the ability to function as a transplant coordinator when needed. Given the fairly recent emergence of the APP role in transplantation, the lack of experienced APPs to mentor incoming APPs can be a significant challenge within itself. Both national transplant organizations, AST and ASTS offer educational opportunities to APP members. Additionally, ASTS offers a Certificate of Educational Achievement for APPs. Following successful onboarding, mentorship is fundamental for the APPs to grow in the field and prevent disengagement and turnover.²⁸

Cost is an area of concern in healthcare, and cost of APPs in transplant is no exception. Considerations of APP cost include salary, licensing renewal, night call, etc. APPs receive from CMS 85% of the reimbursement of physicians and 100% of billing outpatient services rendered in a location separate from the physician. When exploring costs, there are other factors that must be taken into consideration. Shah et al. described the following financial benefits of APP's working in transplant; mean length of stay APP vs house staff to be 29.4 % vs 32.1 %, respectively, 6% decrease in deaths during hospitalization, 10% decrease in ICU transfers, documented pneumonia 15% vs 28% APP vs house staff, respectively.²⁹ Costas et al demonstrated Injury rate was significantly lower for the physician assistant compared with the resident cohort (1 of 197 [0.5%] vs 22 of 90 [24%], respectively).¹⁵ While salaries and associated costs of APP are important to consider the above-mentioned examples demonstrate the costs are negligible from a patient care as well as financial perspective.

Finally, a significant challenge to expanding the role of APPs in transplantation is the lack of a uniform scope of practice across states as well as required regulatory requirements. Documentation requirements of collaboration/supervision differ in each state as well. APPs require the same regulatory requirements as their physician colleagues including licensing, DEA and continuing education. Larger transplant centers often employ an APP office to assist with regulatory requirements, but confusion and regulatory oversight remain a challenge to APP practice in transplantation.

Expansion of APPs in research, quality improvement, leadership and management

APPs are ideal candidates for expansion into Quality, Research, and Management in transplant centers as they possess clinical acumen, operational knowledge, and innovative contributions to the field of research and can easily identify areas of improvement. Allowing the expansion of these highly qualified APPs in these leadership roles provides an avenue for professional growth and development while reducing attrition. As APPs become fully integrated providers at transplant centers, participation in research and quality improvement maximizes role and responsibility.

APPs have played a key role in Quality because many quality initiatives require a vast understanding of policy and procedures at a local, state and federal level. An APP leading an area of Quality Improvement is effective as they have a solid foundation in clinical workflow and protocol development. These are imperative skills to identify areas in need of improvement and provide solutions to maintain compliance. This clinical knowledge bridges the gap between quality and effective implantation of measures to assure best outcomes as well as reducing the time to implementation to develop successful programs.

APPs understand the gap in knowledge and would be key in helping to pose questions and help design research to address them. APPs can serve in a variety of research capacities, some as directors, principal investigators and others in participating in joint efforts with physicians, nursing and other allied providers.³⁰ As APPs are active across the transplant continuum, they are well suited to ensure transplant research protocols are followed, manage complex research projects and grants, organize resources, develop budgets, ensure regulatory rigor, laboratory management, education and can identify patients who could be recruited based on criteria of active studies.

APPs are increasingly being used in leadership roles as transplant center managers and directors. Morse notes this role may feel uncomfortable at first, as APPs are traditional seen as clinical care providers.³¹ They have clinical competency and experiences which allows them to understand and lead a multidisciplinary team that includes but is not limited to surgeons, physicians, nurses, social workers, dieticians, pharmacists and financial counselors. They can also develop a program with policies and clinical protocols to meet regulatory demands.²³ In 2011, LaPointe Rudrow detailed the role of nurse practitioner as director of center for living donation. The combined clinical expertise with professional multidisciplinary approach makes APPs excellent candidates to drive centers forward in a patient centered manner while maintaining regulatory compliance. ²³

Conclusion

The increasingly complex multidisciplinary care required to manage transplant patients is complemented by APPs. Varied practice patterns combined with unique needs at each transplant center means APPs are performing a variety of duties across the discipline. This may lead to limited opportunities for APPs while not fully optimizing their role. In using job descriptions of APPs currently in practice as a base for comparing APP duties, we demonstrate the vast clinical and nonclinical roles APPs can play within transplant. We encourage transplant centers to consider exploring and optimizing the use of APPs at their center to maximize the benefits of these unique transplant providers.

Disclosure

The authors of this manuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation*.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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Appendix A

Duties	Inpatient	Outpatient	Procurement/ Operating Room
Management of Patient Care			
Carry out plan of care for each patient daily with consensus of physicians, nurses, and patients	▲		
Initiate complex referrals to home care agencies	▲	▲	
Organize follow-up visits with transplant team and other specialties	▲	▲	
Perform and record comprehensive history and physical exams and formulates a differential diagnosis	▲	▲	
Manages medical issues of post-transplant patients in the clinic, including policies and protocolized care		▲	
Participates in outreach clinics as needed		▲	
Perform approved procedures as needed	▲	▲	▲
Provides assessment for medical suitability for transplantation	▲	▲	▲
Functions as first assist for procurement of organs as well as training fellows in the OR			▲
Prepares patient for surgery including education of the patient, positioning, skin preparation, administration of local anesthetic, and ensuring the correct equipment is available			▲

Functions as first assistant to surgeon including performing surgical exposure, surgical dissections, layer closure of wounds, holding retractors, tying off vessels and tissues, pulling drains, etc			▲
Diagnosis and Treatment			
Write orders throughout the day to adjust therapies as appropriate	▲		
Writing orders including medications, activity, diagnostic testing, physical therapy, diet, consultations	▲	▲	
Arrange for radiologic and other diagnostic tests and follow-up on results	▲	▲	▲
Documentation			
Write daily progress notes during daily work rounds	▲		
Coordinate discharges with multidisciplinary team including discharge summaries and paperwork	▲		
Ensures complete and accurate documentation regarding donor information in computer system		▲	
Education			
Provides pre- and post-op patient education to patient and their families	▲	▲	
Collaborates with other health care providers on specific patient care issues and educational programs	▲	▲	
Communication			

Perform accurate hand off at end of each day including current condition and study results	▲		
Facilitate transfers to other facilities by communicating with social workers and receiving health care team	▲		
Communicate with consultants, surgeons, fellows, residents, pharmacists, and social workers to discuss goals and formulate treatment plan	▲	▲	
Communicates changes in patient status or adjustments to treatment plan	▲	▲	
Inform other team members of significant changes in clinical status	▲	▲	▲
Provide back-up support for colleagues during times of absence	▲	▲	▲
Problem Solving			
Make initial assessment of new complaints of pre-op and post-op patients and report findings	▲		
Perform triage	▲	▲	
Leadership			
Cross cover residents and fellows when they are called off the floor or in operating room	▲	▲	
Practice safety, environmental, and/or infection control methods	▲	▲	▲
Participates in continual quality improvement	▲	▲	▲

Exhibits independence, self-direction, and accountability to the patient, family, and transplant team



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