Risks and Rewards of Advanced Practice Providers in Cardiothoracic Surgery Training: National Survey

Short Title: Risks and Rewards of Physician Extenders

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Abstract

Background. Changes in healthcare have led to increasing utilization of Advanced Practice Providers (APPs), but their role in Cardiothoracic Surgery (CTS) education remains undefined. This study aimed to analyze the extent of APP utilization on the CTS team, their role within the hierarchy of clinical care, and the impact of PEs on CTS training from the resident perspective.

Methods. CTS residents' responses to the 2017 Thoracic Surgery Residents Association (TSRA)/Thoracic Surgery Directors Association (TSDA) In-Service Training Examination (ITE) survey regarding the role of APPs in specific clinical scenarios, and perception of APP contribution to residents' educational environment were analyzed. Statistical analysis of categorical variables was performed in SPSS using a Fisher's exact test and Pearson Chi-Square with statistical significance set at $p<0.05$.

Results. Response rate was 82.1% (280/341). The median number of employed APPs was 16-20 and 50.4% (n=141) reported 11-25 PEs at their institution. The median forAPPs in the operating room, floor, and intensive care unit was 3, 3, and 2 respectively. Overall impression of APPs was positive in 87.5% (n=245) of respondents, with 47.7% (n=133) being "very positive" and 40.1% being "positive" (n=112). In general, residents reported greater resident involvement in post-operative issues and operative consults and greater APP involvement in floor issues. 72.5% of residents had not missed a surgical opportunity due to APPs while, 9.6% missed an opportunity due to a APP despite being at an appropriate level of training. Of those that reported missed opportunities, 44% were I-6 residents. There were no significant differences in APPs' operative role based on resident seniority.

Conclusions. The overall impression of APPs among CTS residents is favorable, and they more commonly are involved assisting on the floor or the operating room. Occasionally, residents report missing a surgical opportunity due to APPs. There is further opportunity to optimize and standardize their role

within programs, in order to improve clinical outcomes and enhance the CTS educational experience for residents.

With the implementation of resident work-hour restrictions, advanced practice providers (APPs), in the form of both nurse practitioners and physician assistants, became an increasingly important part of the healthcare delivery team.[1-3] Currently, APPs have become fixtures in the clinical setting, serving a critical role across the spectrum of medical disciplines, from delivery of primary care in rural settings to assisting in the operating room in highly specialized surgery.[4-11]

There have been numerous studies examining the impact of APPs, with the majority demonstrating equivalent financial and clinical outcomes between teams that do employ APPs and those that do not.[12,13] Other studies quantifying the effects of APPs in field found APPs increase the efficiency of attending surgeons.[14-17] The investigation of the impact of APPs on resident education, particularly surgical resident education, has been limited. Surveys of both surgical faculty and residents have acknowledged that APPs offer benefits in managing the clinical workload while posing a potential threat to resident education. [17-21]

Given recent trends, the role of APPs is likely going to expand. In light of this, it is important for surgical educators and trainees to remain cognizant of the impact that APPs have on surgical education and strive to optimize their role within the specialty. To this end, in the present study, we utilized a national survey of cardiothoracic surgery (CTS) residents to assess the role of APPs in a highly specialized cardiac surgery team and their impact on CTS residents' educational environment.

Material and Methods

Since 2003, the Thoracic Surgery Residents Association (TSRA) in collaboration with the Thoracic Surgery Director's Association (TSDA) has administered an annual survey of all ACGME CTS residents in conjunction with the annual In-Service Training Examination (ITE). Institutional Review Board approval was obtained prior to conducting the survey. The 2017 ITE survey included questions investigating

resident perception of the role of APPs in CTS training as the specific question. All responses were anonymous to both the residents' identities and that of their training institution. Results were stratified by postgraduate year (PGY) and training pathway. PGY year was classified specifically by year of clinical training, not including research time. Senior residents included Integrated thoracic surgery (I-6) residents who were PGY-5 and above, combined general surgery-cardiothoracic (4+3) residents who were PGY-6 and above, traditional fellows in 2-year programs (2Y) that were PGY-7 and above, and traditional fellows in 3-year programs (3Y) that were PGY-8 and above.[22] The total number of APPs at each institution was assessed, as was the various roles of APPs within the resident's institutions. Differing clinical scenarios were presented to further assess the role of APPs on the CTS care team. Comparisons between groups were made using Chi-squared and Fisher exact testing with statistical significance set at $p<0.05$. Analysis was performed using commercially available software (SPSS, version 22.0, IBM, Chicago, IL.).

Results

All CTS residents completed the survey. After removing surveys with conflicting or omitted responses, there were 280 completed (response rate 82.1%). Females comprised 24.6% of the respondents. Looking at respondents by training pathway, most were in I-6 programs (38.6%), followed by 2Y (33.6%), 3Y (20.7%), and 4+3 (7.1%) (Table 1). The majority (99.6%) of those surveyed stated that their programs employed APPs on the cardiac surgery service at its primary training site. The median number of APPs employed in the operating room, floor/step down units, intensive care unit (ICU), and clinic was 3, 3, 2, and 2 respectively. APPs take on a combination of these roles in 50.7% of programs. The use of personal APPs assigned to individual attendings was less common, with 37.9% of respondents reporting the use of this practice.

Clinical Scenarios

Respondents were asked to consider ten different clinical scenarios and report which provider would receive the first call in those scenarios. The scenarios and potential first-call providers are listed in Table 2. Responses to the clinical scenario questions are presented based on the time of the day, either daytime (Figure 1) or night time (Figure 2).

Residents in the 2Y, 3Y and 4+3 pathways were more likely to report that the resident who scrubbed a case would be called for the scenario of daytime post-operative decompensation (p=0.01). The residents in the 2Y and 3Y pathways were also more likely to report that the attending surgeon on call would be called for a night time post-operative decompensation (p=0.046). For the case of a night time floor issue, residents in the I6 pathway reported that junior CT surgery residents with a pager were significantly more likely to receive the first call (p=0.036). For I6 residents, the resident who assisted in the operation or "scrubbed the case," was more likely to receive the first call for a daytime floor issue (p=0.039). For this same scenario, 2Y, 3Y, and 4+3 residents were more likely to report APPs receiving the first call (0.022). In the case of a night time post-operative emergency department visit, I6 residents reported that junior CTS residents with a pager were more likely to receive the first call (p=0.005) and 2Y or 3Y residents reported that APPs were more likely to receive this call (p=0.011). For the daytime post-operative emergency department visit, 2Y and 3Y residents were more likely to report that APPs would receive the first call (p=0.019). In the scenario of a home call, I6 residents reported that the CTS resident on call was more likely to receive the first call (0.002), or the junior CTS resident with a pager (p=0.048). For this same scenario, 2Y and 3Y residents reported that the on-call CTS attending (p=0.041) or the attending for the case (p=0.024) was more likely to receive the first call.

APP Impact on Surgical Experience and Training

Respondents were asked to describe specific functions of APPs in the operating room for their training program. The most common role was “vein harvest assistant” which 250 respondents (89.3%) stated was a role of APPs in the operating room. The other operating room roles assessed and reported included first assistant (n=122, 43.6%), second assistant (n=179, 63.9%), and cannulation/decannulation/closing assistant (n=141, 50.4%). There were 17 respondents (6.1%) who reported that APPs had no role in the operating room at their training institution. There was no significant association based on resident seniority and APP role as second assistant (p=0.42), vein harvest assistant (p=0.102), or cannulation/decannulation/closing assistant (p=0.182). There was a trend of a relationship between resident seniority and APP role as first assistant (p=0.074). There was no significant association between resident training pathway and APP as a first assistant (p=0.211). There was a significant association between resident training pathway and APP role as second assistant (p=0.014), with this role being more common among I6 and 2Y fellows. Residents in I6 programs were also more likely to report that APs served as cannulation/decannulation/closing assistant (p=0.016). There was a trend for residents in the 4+3 pathway to report no role for APPs in the OR (p=0.052).

The majority (n=203, 72.5%) of respondents stated they had never missed a surgical opportunity because of the involvement of a APP. For those that had missed a surgical opportunity due to APP involvement (n=77), there were 50 of the 280 respondents (17.9%) who stated that they were not at an appropriate stage of training or equipped to participate. For the 27 of 280 respondents (9.6%) who had missed a surgical opportunity despite being at an appropriate stage of training, faults in communication, attending comfort, and attending preference were the most common reasons for these missed opportunities.

When asked to assess how APPs impact CTS training, 232 respondents (82.9%) stated that APPs allow them to concentrate more on operative training, 139 (49.6%) stated that APPs play a role in advancing

their operative skills, 128 (45.7%) stated that APPs allow CTS residents to comply with duty hour regulations, and 104 (37.1%) stated that APPs allow them to be more productive academically.

When asked how APPs could be better utilized at their respective institution, 132 respondents (47.1%) would hire more APPs to divide the workload, 60 (21.4%) would have APPs focus on helping CTS residents comply with duty hour regulations, 89 (31.8%) would teach APPs to perform simple procedures such as chest tube insertion or thoracenteses. There were 104 residents (37.1%) who would give APPs more floor or ICU coverage to allow residents to focus on operative skills, and 75 (26.8%) who would give APPs more coverage of clinic duties. There were 16 residents (5.7%) who would have APPs provide more operating room assistance.

Comment

The investigation of the impact of APPs on resident education, particularly surgical resident education, has been limited up to this point. In a survey of faculty from 13 general surgery programs across the United States, the majority stated that APPs decreased resident workload (88%), but half felt that APPs reduced resident exposure to educational opportunities (53%) and limited resident exposure to valuable post-operative care experience (48%). In that same survey, a majority (70%) of faculty stated that they sometimes make clinical decisions with APPs rather than discuss with residents, and one third (33%) stated that APPs sometimes limit resident opportunities in the operating room.[17] Surveys of residents have been mixed with positive effects on resident workload but negative reports on impact on clinical experience.[18-21] The mixed, but overall positive, perception of APPs' impact on CTS training is also present in our results. The pattern in which APPs receive first call for floor issues during the day while residents received first call for ICU and immediate post-operative issues reflects the need for balance in

relieving resident work load while also creating learning opportunities that are critical to their education.

education.

For residents that did miss surgical opportunities due to APP involvement, a common reason was issues with communication. Communication issues, in general, have been described in previous survey studies as well, wherein residents report lapses in communication between APPs and residents or attending surgeons state that they have made clinical decisions while rounding with APPs that they do not communicate with residents.[17,21] These results underscore the importance of effective communication to optimize clinical care and resident education. Lapses of communication coincide with the role of first responder, which has been discussed above. Partially clouding the picture is differences in the perception of the status of APPs within the surgical hierarchy. In one survey of APPs and residents, A majority (68.3%) of residents felt that APPs function at the level of an intern, whereas the greatest percentage of APPs (35.7%) felt they functioned at the level of a chief resident.[20] Even if roles on the CTS team are well delineated, the question of the surgical hierarchy plays an important role in team communication and will require further definition as APPs take on an increasingly larger role on the CTS team.

Other common causes for missed surgical opportunities included attending comfort and attending preference. This is certainly a multivariate issue. Faculty are justified in being more comfortable with APPs, who remain on the CTS team full-time throughout the academic year, versus CTS residents who rotate on and off the service. Furthermore, faculty face constant pressure to be clinically productive, and APPs have been demonstrated to improve surgeon efficiency in multiple studies.[14-17] While these excuses for residents missing surgical opportunities are justified, training programs and individual

faculty should remain cognizant of their effect. Just as faulty communication can lead to missed opportunities, strong communication between all members of the CTS team can ensure that residents are seeing the benefits of APPs and minimizing the potential disadvantages.

Standardization of the APP role across all CTS traning programs would be an unrealistic goal, but standardization of the role within a program is critical to ensuring optimal patient care and resident experience. Establishing defined roles for APPs and residents on the CTS team as well as defined roles within the hierarchy of the CTS team is an important first step in this process. Communication between APPs, residents, and faculty is the next critical step in this process. Assessing, and then periodically reassessing, the team dynamic as well as satisfaction with the responsibilities of the team members ensures continued satisfaction with these roles over time.

Limitations of this study include the nature of its design as a survey. This study does not specifically investigate objective data on experience. Instead, this study is based on self-reported data on APP role and resident perception, all of which is susceptible to bias. In particular, this bias is present in the assessment of missed opportunities within the OR. This in particular is a subjective response and fails to incorporate the attending perception, which is particularly important in the OR setting. In addition, as a result of the anonymity of the training programs, the analysis was not able to account for clustering or site-specific effects and it was also unable to analyze the relationship between the number of residents at a program, the number of APPs, and any clinical impact. Furthermore, this survey was not equipped to address the educational environment, the diversity of programs in terms of APP roles, and the size of residency programs as potential confounders.

While other studies have attempted to address residents' perception of APPs and their impact on surgical education, they have focused on specific contexts such as the ICU, or only looked at single institutions and across multiple surgical subspecialty residency programs. To our knowledge, our study is

the first national study assessing the perception of APPs across multiple residency programs within a specific surgical subspecialty. This study highlights the important role that APPs have come to assume as members of the CTS team. This role is diverse within and across residency programs. Training programs vary in the training pathways offered, the number of residents, the number of faculty and the surgical volume. As such, the role of APPs will vary across the training programs, and this is reflected in varying roles for APPs reported by residents. While APPs can be a valuable part of any team that aims to provide high quality care, any program that aims to do so while also producing well trained surgical trainees should exert caution and be deliberate in how they employ APPs. When done appropriately, all members of the CTS team, and most importantly patients, can be assured of an outstanding experience.

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Table 1. Respondent Characteristics

	Training Program, No. (%)			
	I-6 4+3	2Y		3Y
	n = 108 (38.6)	n = 94 (33.6)	58 (20.7)	20 (7.1)
Senior residents	29 (26.9)	65 (69.1)	26 (44.8)	13 (65)

I6 = integrated 6-year; PGY = postgraduate year; 2Y = traditional 2-year; 3Y = traditional 3-year; 4+3 = combined general and thoracic residency.

Table 2. Clinical Scenario First Responders

Scenario	*Time of Event*	*First responder, No. (%)*							
		On call CTS resident	On call CTS attending	Jr CTS resident with pager	On call CTICU resident	On call CTICU attending	Resident who scrubbed the case	Attending for the case	PE
Post-Op Decompensation	At MIDNIGHT: A patient in the CT Intensive Care Unit (CTICU) POD0 status/post (S/P) coronary artery bypass grafting (CABG) with rising pressors requirements, falling mixed venous and rising lactate.	152 (54.3)	19 (6.8)	14 (5.0)	100 (35.7)	59 (21.1)	30 (10.7)	46 (16.4)	100 35.7)
	During the DAY: A patient in the CTICU POD1 S/P CABG with rising pressors requirements, falling mixed venous and rising lactate.	84 (30.0)	15 (5.4)	17 (6.1)	95 (33.9)	98 (32.1)	63 (22.5)	73 (26.1)	139 (49. 6)
Post-Op Bleed	At MIDNIGHT: A patient in the CTICU POD0 with copious bloody chest tube output.	170 (60.7)	31 (11.1)	14 (5.0)	82 (29.3)	59 (21.1)	43 (15.4)	71 (25.4)	86 (30. 7)
	During the DAY: A patient in the CTICU POD0 with copiousbloody chest tube output.	104 (37.1)	20 (7.1)	22 (7.9)	84 (30.0)	83 (29.6)	93 (33.2)	90 (32.1)	123 (43. 9)
Floor Issue	At MIDNIGHT: A patient on the floor 3 days out from CABG who suddenly becomes hypotensive.	156 (55.7)	18 (6.4)	43 (15.4)	28 (10.0)	16 (5.7)	20 (7.1)	33 (11.8)	99 (35. 4)
	During the DAY: A patient on the floor 3 days out from CABG who suddenly becomes hypotensive.	91 (32.5)	13 (4.6)	42 (15.0)	18 (6.4)	15 (5.4)	38 (13.6)	59 (21.1)	205 (73. 2)
Post-Op ED Visit	At MIDNIGHT: A patient who arrives in the	211 (75.4)	27 (9.6)	32 (11.4)	14 (5.0)	6 (2.1)	5 (1.8)	25 (8.9)	52 (18.

	emergency department S/P CABG with hypoxia and pleural effusions on chest X-ray (CXR).								6)
	During the DAY: A patient who arrives in the emergency department S/P CABG with hypoxia and pleural effusions on CXR.	164 (58.6)	16 (5.7)	40 (14.3)	14 (5.0)	6 (2.1)	13 (4.6)	45 (16.1)	125 (44.6)
Home Call	A patient who was discharged 3 days ago S/P aortic valve replacement calling from home during business hours for increasing sternal wound drainage and fevers.	65 (23.2)	15 (5.4)	13 (4.)	4 (1.4)	3 (1.1)	4 (1.4)	37 (13.2)	194 (69.3)
Consult	Consult during the DAY from Medical Intensive Care Unit (MICU) for a patient who presents with 3rd degree atrioventricular block and diagnosed with mitral valve infective endocarditis.	171 (61.1)	44 (15.7)	43 (15.4)	6 (2.1)	1 (0.4)	2 (0.7)	17 (47.1)	132 (47.1)

Figure Legend

Figure 1. APP Impact on CTS Trainees

Figure 2. Overall Impression of PEs

Figure 3. First Call in Daytime Clinical Scenarios

Figure 4. First Call in Nighttime Clinical Scenarios