PICU Provider Supply and Demand: A National Survey

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Objectives: To describe physicians' and nurse practitioners' perceptions of the national and local PICU physician and other provider supply in institutions that employ PICU nurse practitioners, assess for differences in perceptions of supply, and evaluate the intent of institutions to hire additional nurse practitioners to work in PICUs.

Design: National, quantitative, cross-sectional descriptive study via a postal mail survey from October 2016 to January 2017.

Setting: Institutions ($n = 140$) identified in the 2015 American Hospital Association Annual Survey with a PICU who employ PICU nurse practitioners.

Subjects: PICU physician medical directors and nurse practitioners.

Interventions: None.

Measurements and Main Results: There were 119 respondents, representing 93 institutions. Responses were received from 60 PICU medical directors (43%) and 59 lead nurse practitioners (42%). More than half (58%) of all respondents reported the national supply of PICU physicians is less than demand and 61% reported the local supply of PICU providers (physicians in all stages of training, nurse practitioners, and physician assistants) is less than demand. Of the respondents from institutions that self-reported a local provider shortage ($n = 54$), three fourths (78%) reported plans to increase the number of PICU nurse practitioners in the next 3 years and 40% were likely to expand the nurse practitioner's role in patient care.

Conclusions: Most PICU medical directors and lead nurse practitioners in institutions that employ PICU nurse practitioners perceived that national and local supply of providers to be less than the demand. Nurse practitioners are employed in PICUs as part of interdisciplinary models of care being used to address provider demand. The demand for more PICU nurse practitioners with expanded roles in care delivery was reported. Further evaluation of models of care and provider roles in care delivery can contribute to aligning provider supply with demand for care delivery. (*Pediatr Crit Care Med* 2018; 19:e378–e386)

Key Words: critical care; demand; nurse practitioner; pediatric; supply; workforce

In 2012, there were more than 2 million pediatric hospital admissions in the United States (1). Although the number of admissions to children's hospitals is decreasing, the number of admissions to the PICU has been increasing since the 1990s with patients presenting with higher acuity and complexity (2–5). Although national estimates of the critical care workforce predict an abundant supply of critical care providers, these estimates focus primarily on the adult critical care workforce (6). The American Academy of Pediatrics has emphasized the importance of pediatric subspecialty workforce policy and planning (7). Knowledge of the pediatric-focused critical care workforce is limited, but studies suggest that, despite recent efforts to increase the physician workforce, there may be an inadequate supply of PICU physicians (6, 8, 9).

Barriers to growing the PICU physician workforce have resulted in innovative workforce models of care to compensate for the inadequate supply of such physicians (10, 11). These models often rely on interdisciplinary teams and the involvement of nurse practitioners (NPs) to deliver patient care (12–14). As NPs are increasingly used as healthcare providers in hospital-based settings (15–19), PICU physicians have shown a willingness to incorporate NPs into provider teams (20). Given the increasing size of the acute care NP workforce and uncertainty over the adequacy of the PICU physician workforce, the current demand for NP providers in the PICU is uncertain.

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Supported, in part, by the Vanderbilt University School of Nursing PhD Student Research Award, the Iota Chapter of Sigma Theta Tau International, and Clinical Translational Science Award Research Electronic Data Capture.

Dr. Gigli received funding from Vanderbilt University School of Nursing PhD Research Award and Iota Chapter of Sigma Theta Tau International. Dr. Buerhaus disclosed receiving limited payment from Vanderbilt University for serving on Dr. Gigli's dissertation committee. Dr. Minnick partially supported mailing through her endowed chair. Dr. Dietrich has disclosed that she does not have any potential conflicts of interest.

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DOI: 10.1097/PCC.0000000000001587

The purposes of this study were to 1) describe PICU medical director and NP perceptions of the national PICU physician supply and the local supply of providers, namely physicians, NPs, and physician assistants (PAs); 2) assess differences in perceptions of the national and local supply; and 3) to describe the medical director and NPs' assessment of their institutional intent to incorporate NPs into the PICU workforce in institutions where PICU NPs are currently employed in the United States.

MATERIALS AND METHODS

A national, quantitative, cross-sectional descriptive study of PICU medical directors and lead (most senior or NP serving in a supervisory role among a group of PICU NPs) PICU NPs was conducted. A survey instrument was developed to assess the current composition of the PICU workforce and role of NPs in providing PICU care. Concepts were operationally defined based upon literature reviews and the authors' experiences. A 34-item survey was developed to assess concepts derived from a synthesis of frameworks for NP participation in care delivery (**Table 1**); this article focuses on the concept of provider demand.

Five items related to PICU provider supply and demand were included in the survey (Table 1). Questions about respondents' perceptions of the national supply of PICU physicians and of the local provider (physicians in all stages of training, NPs, and PAs who have the ability to give orders that influence patient care) supply were reported on a five-point Likert-like scale. This analysis reports a four-point scale because no respondents reported that supply was much greater than demand. Respondents assessed interventions acknowledged to address PICU provider shortages for their likelihood to occur and meaningfulness in ability to offset a local provider shortage with a five-point Likert-like scale (6). Strategic planning

TABLE 1. PICU Workforce Survey Concepts, Conceptual Definitions, and Key Variables Related to Provider Demand

Survey Concept	Conceptual Definition	No. of Survey Questions Correlating With Concept
Demand[a]	Need for PICU physician providers and intent to hire PICU NPs	9
	Perception of the supply of PICU physicians in the United States	
	Self-report of the local supply of PICU "providers"	
	"Provider" is defined as physicians in all stages of training, NPs, and physician assistants who have the ability to give orders that influence patient care	
	Likelihood to and meaningfulness of:	
	Increasing the number of PICU NPs	
	Expanding the scope of PICU NPs' role in patient care	
	Expanding the number of physician training programs	
	Improving the work/life balance for PICU attending physicians	
	Strategic plan regarding the employment of PICU NPs in next 3 yr	
Team composition	How many providers work in PICU including their professional background and direct patient care coverage models	7
Qualifications	Education, experience, and certifications of NPs	2
Patient care and other NP roles	Responsibilities related to delivering patient care and carrying out professional and administrative roles	4
Workload	The volume of patients an individual provider cares for	1
Temporal conditions/ schedule	Shift structure and call requirements	3
Organizational structure	Institutional- and unit-specific factors that foster to NP presence in the PICU	2
Work processes	Regulatory or supervisory requirements that influence advanced practice registered nurse practice	4
Capital	Building resources, equipment, and supplies that contribute to PICU care delivery	1
Financial	How workers are monetarily compensated	1

NP = nurse practitioner.

[a]Focus of article: pertinent variables further described within conceptual definition and measured on a Likert-like scale.

regarding intentions to grow the local PICU NP workforce was also examined.

Variables that have been associated with healthcare workforce size including Council of Teaching Hospitals (COTH) membership status and state scope-of-practice (SSOP) regulations were used to assess perceptions of supply and demand (8, 21). Hospital characteristics including state, hospital size, and COTH membership were obtained from the 2015 American Hospital Association Annual Survey (22). Respondents provided information about PICU size, licensed beds, and average daily census. Based upon the state that a respondent's institution was located, respondents were categorized into SSOP regulatory environments using the American Association of Nurse Practitioners classification at the time of data collection (23). The SSOP environments are 1) full practice authority, that is, NPs may evaluate, diagnose, and manage treatment of patients—including prescribing medications under the authority of the board of nursing; 2) reduced practice authority, that is, a collaborative agreement with a physician is required for at least one of the practice elements: evaluation, diagnosis, or treatment—including prescribing medications; and 3) restricted practice, that is, there must be physician supervision, delegation, or team management to prescribe, diagnose, and/or manage patient treatment (23).

Two independent researchers conducted preliminary item validity testing using a card sort method. Each survey item was assigned to a conceptual category within the study framework with greater than 75% agreement. Seven PICU providers unrelated to the study team participated in pilot testing for reliability, readability, and acceptability (24).

Institutions identified as operating a PICU in the 2015 American Hospital Association Annual Survey (21) were contacted to confirm the continued operation of a PICU. Surveys were sent to a medical director at each operational PICU ($n = 326$). Telephone calls were made to each PICU to determine the presence of a PICU NP, and if a NP was employed, the lead NP (most senior or NP serving in a supervisory role among a group of PICU NPs) was identified, and an additional survey was sent to the lead PICU NP ($n = 140$). For the purposes of this publication, only the medical directors and lead PICU NPs from institutions identified as employing PICU NPs ($n = 140$) are included in the analysis. The Vanderbilt University Medical Center's Institutional Review Board approved this study before recruitment and distribution of any study materials.

Mailings occurred between October 2016 and January 2017. After an initial introductory postcard, three separate survey mailings were sent to eligible participants. Survey packets included a cover letter; a definition of key concepts; a paper survey, which included an electronic participation option; and a self-addressed, stamped envelope. Returning a survey served as consent. Participants who returned a completed survey were eligible for a drawing for a $250 Visa gift card (one drawing for a medical directors and one drawing for lead PICU NPs). Participants returned surveys electronically via a secure, web-based platform, Research Electronic Data Capture (REDCap) ($n = 26$, 22%) hosted at Vanderbilt University (25) or by postal mail ($n = 93$, 78%). Mailed survey responses were double entered by a study team member into REDCap (Vanderbilt University, Nashville, TN).

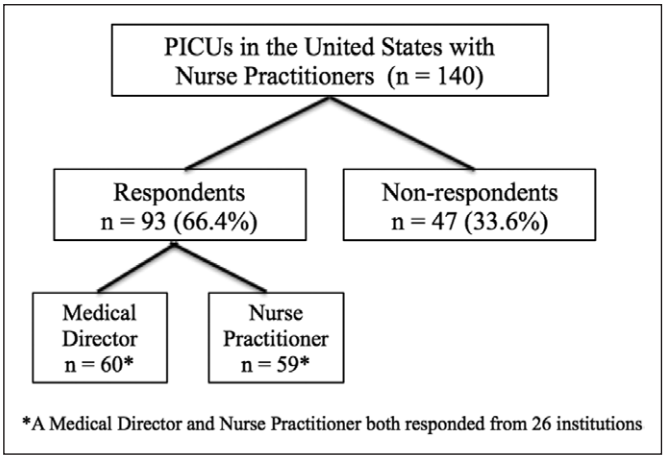

Figure 1. Institutional response rates from PICUs in the United States that employ nurse practitioners.

Data analysis were performed using IBM SPSS Statistics 23.0 (IBM Corporation, Armonk, NY). For institutional level data, institutions were included in the analysis if either a medical director or a NP responded. If both providers responded from the same institution, the medical director's response was included in the analysis of institutional level responses to have consistency in respondent roles and because of high medical director-NP pair agreement.

Most of the survey responses were nominal or ordinal in nature and thus were summarized using counts and percentages. Continuous data distributions were summarized using median and interquartile range due to skewness. Tests of differences between groups were conducted using either chi-square test of independence (nominal, ordinal data) or Mann-Whitney U test (continuous). An alpha of 0.05 ($p < 0.05$) was used for determining statistical significance.

RESULTS

Survey Respondents and Response Rates

The survey was sent to 280 potential respondents (140 PICU medical directors and 140 lead PICU NPs from 140 institutions). Responses were received from a PICU medical director and/or NP working in 93 institutions (66% of all U.S. institutions with a PICU that employed PICU NPs at the time of the survey). In total, 60 medical directors (43%) responded, 59 NPs (42%) responded ($n = 119$). Both the medical director and the lead NP responded from 26 institutions (**Fig. 1**).

Characteristics of the institutions with respondents ($n = 93$) and those not responding are summarized in **Table 2**. No statistically significant differences were observed between those institutions without respondents ($n = 47$) and institutions with respondents in terms of hospital size, region, COTH membership status, or state regulation of NP practice ($p > 0.05$) (Table 2).

Characteristics of the individual respondents are summarized in **Table 3**. Medical director and lead PICU NP respondents were employed at their current institution a median for

TABLE 2. Characteristics of Institutions Identified as Having a PICU That Employ Nurse Practitioners

Institutional Characteristics	Total Institutions That Employ PICU NPs, *n* = 140	Respondent Institutions, *n* = 93	Nonrespondent Institutions, *n* = 47	*p*
American Hospital Association region, *n* (%)				0.566
CT, MA, ME, NH, RI, VT	5 (3.6)	5 (5.4)	0 (0)	
NJ, NY, PA	19 (13.6)	11 (11.8)	8 (17.0)	
DE, KY, MD, NC, VA, WV	34 (24.3)	21 (22.6)	13 (27.7)	
AL, FL, GA, MS, SC, TN	18 (12.9)	13 (14.0)	5 (10.6)	
IL, IN, MI, OH, WI	9 (6.4)	7 (7.5)	2 (4.3)	
IA, KS, MO, MN, NE, ND, SD	12 (8.6)	8 (8.6)	4 (8.5)	
AR, LA, OK, TX	17 (12.1)	13 (14.0)	4 (8.5)	
AZ, CO, ID, MT, NM, UT, WY	12 (8.6)	8 (8.6)	4 (8.5)	
AK, CA, HI, NV, OR, WA	14 (10.0)	7 (7.5)	7 (14.9)	
Hospital size, beds, *n* (%)				0.710
0–200	14 (10.0)	9 (9.7)	5 (10.7)	
201–300	17 (12.1)	11 (11.8)	6 (12.8)	
301–400	19 (13.6)	13 (14.0)	6 (12.8)	
401–500	20 (14.3)	16 (17.2)	4 (8.5)	
501+	70 (50.0)	44 (47.3)	26 (55.3)	
Council of teaching hospitals status, *n* (%)				
Member	79 (56.4)	55 (59.1)	24 (51.1)	0.363
Nonmember	61 (43.6)	38 (40.9)	23 (48.9)	
Size of PICU, median (interquartile range)				
Average daily census		16 (9–20)		
Number of licensed beds		20 (13–28)		
NP state scope-of-practice, *n* (%)				0.663
"Full practice": AK, AZ, CO, CT, DC, HI, ID, IA, ME, MD, MN, MT, NE, NV, NH, NM, ND, OR, RI, VT, WA, WY	24 (17.1)	17 (18.3)	7 (14.9)	
"Reduced practice": AL, AR, DE, IL, IN, KS, KY, LA, MS, NJ, NY, OH, PA, SD, UT, WV, WI	49 (35.0)	34 (36.6)	15 (31.9)	
"Restricted practice": CA, FL, GA, MA, MI, MO, NC, OK, SC, TN, TX, VA	67 (47.9)	42 (45.2)	25 (53.2)	

NP = nurse practitioner.

10 years. Compared with the medical directors, the PICU NPs were more likely to be female (88% vs 35%), predominantly white (95% vs 77%), younger (40 vs 54 yr old), and board-certified PICU providers for a shorter period of time (9 vs 19 yr) (all $p < 0.005$) (Table 3).

National and Local PICU Provider Supply

Nearly three fifths of respondents (58%) stated that the national supply of PICU physicians was somewhat less (47%) or much less (11%) than demand, and only 7% reported that the national supply was greater than demand (**Table 4**). With regard to self-report of the local supply of PICU providers (defined as physicians, NPs, and PAs), a majority (61%) of respondents indicated the local supply was somewhat less (45%) or much less than demand (17%).

Within the sample of paired medical directors and lead PICU NPs working in the same institution ($n = 26$), there were no statistically significant differences between their self-reports of the local PICU provider workforce supply ($p = 0.204$) nor their perceptions about national physician supply ($p = 0.206$).

TABLE 3. Characteristics of PICU Medical Directors and PICU Nurse Practitioner Respondents

Respondent Characteristics	All Respondents, $n = 119$[a]	Medical Director Respondents, $n = 60$[a]	Nurse Practitioner Respondents, $n = 59$[a]	p
Gender, *n* (%)				**< 0.001**
Male	46 (39.0)	39 (65.0)	7 (12.1)	
Female	72 (61.0)	21 (35.0)	51 (87.9)	
Race, *n* (%)				
White	102 (85.7)	46 (76.7)	56 (94.9)	**0.004**
Other	17 (14.3)	14 (23.3)	3 (5.1)	
Age, median (IQR)	49 (40–56)	53.5 (48–58)	40 (34–51)	**< 0.001**
Years of board certification as PICU provider, median (IQR)	14 (7–20)	18.5 (14–25)	9 (4–15)	**< 0.001**
Years working at current employer, median (IQR)	10 (5–18)	11.0 (6–19)	10 (2–18)	0.161

IQR = interquartile range.

[a]Totals do not always add up to *n* because of variation in response rate per item.

Boldface values indicate findings that were statistically significantly different.

TABLE 4. PICU Providers' Perception of the National Supply of PICU Physicians Who Work in Patient Care in the United States and Self-Report of the Local Supply of PICU Providers Who Work in Patient Care in Respondent Institution That Employ PICU Nurse Practitioners in the United States

Perception of the Supply of PICU Physicians in the United States	Total	Council of Teaching Hospital Status			Provider Role			State NP Scope-of-Practice			
	$n = 114$, *n* (%)	Member, $n = 69$, *n* (%)	Nonmember, $n = 45$, *n* (%)	p	Physician $n = 58$, *n* (%)	NP, $n = 56$, *n* (%)	p	Full Practice, $n = 23$, *n* (%)	Reduced Practice, $n = 39$, *n* (%)	Restricted Practice, $n = 52$, *n* (%)	p
Greater than demand	8 (7.0)	6 (8.7)	2 (4.4)	0.115	6 (10.3)	2 (3.6)	0.540	2 (8.7)	2 (5.1)	4 (7.7)	0.854
About equal to demand	40 (35.1)	26 (37.7)	14 (31.1)		19 (32.8)	21 (37.5)		6 (26.1)	14 (35.9)	20 (38.5)	
Somewhat less than demand	53 (46.5)	33 (47.8)	20 (44.4)		27 (46.6)	26 (46.4)		11 (47.8)	20 (51.3)	22 (42.3)	
Much less than demand	13 (11.4)	4 (5.8)	9 (20.0)		6 (10.3)	7 (12.5)		4 (17.4)	3 (7.7)	6 (11.5)	
Perception of the Local Supply of PICU Providers	**$n = 119$**	**Member, $n = 73$**	**Nonmember, $n = 46$**	**p**	**Yes, $n = 60$**	**No, $n = 59$**	**p**	**Full Practice, $n = 23$**	**Reduced Practice, $n = 41$**	**Restricted Practice, $n = 55$**	**p**
Greater than demand	4 (3.4)	4 (5.5)	0 (0)	0.401	4 (6.7)	0 (0)	0.103	3 (13.0)	1 (2.4)	0 (0)	0.060
About equal to demand	42 (35.3)	25 (34.2)	17 (37.0)		23 (38.3)	19 (32.2)		6 (26.1)	13 (31.7)	23 (41.8)	
Somewhat less than demand	53 (44.5)	33 (45.2)	20 (43.5)		26 (43.3)	27 (45.8)		8 (34.8)	21 (51.2)	24 (43.6)	
Much less than demand	20 (16.8)	11 (15.1)	9 (19.6)		7 (11.7)	13 (22.0)		6 (26.1)	6 (14.6)	8 (14.5)	

NP = nurse practitioner.

Overall, 62% of the physician and NP pairs indicated the national supply was less than demand and 70% self-reported a local PICU provider shortage.

Summaries and comparisons of reports about supply by respondents' institutional COTH membership status, provider role, and state NP scope-of-practice are listed in Table 4. No statistically significant differences in respondents' perceptions of the national supply of PICU physicians in the United States or self-report of local provider supply were observed based on institutional characteristics (region, hospital or unit size, COTH membership), role (physician or NP), or NP SSOP environment ($p > 0.05$).

Intent to Employ PICU NPs

More than half of the respondents (57%) reported that they were likely to increase the number of PICU NPs and two fifths (43%) planned to expand the scope of the NP's role in patient care (**Table 5**). With the exception of their responses to the meaningfulness of increasing the number of PICU NPs, a proposed intervention in response to a provider shortage, there were not statistically significant differences between those respondents from groups that self-reported a local provider shortage and those that did not self-report a local shortage ($p > 0.05$). Among respondents from institutions that employed PICU NPs and self-reported a local provider shortage, almost all (89%) reported that increasing the number of NPs working in the PICU would be a meaningful change to address a local provider shortage. Nearly three fourths of those same respondents (74%) also agreed expanding the scope of the NP role in patient care would be another meaningful change to address a local shortage (Table 5). Formal, strategic planning aimed at increasing the number of PICU NPs was reported by more than three quarters of respondents (78%) from institutions who self-reported a local provider shortage, and nearly six out of 10 respondents (59%) from institutions that did not self-report a local provider shortage (Table 5).

DISCUSSION

This national survey of PICU physician and NP leaders assessed perceptions of the adequacy of the PICU workforce, intentions of leaders to hire NPs to address inadequate provider supply, and how NPs can be used to address provider shortages. Data on characteristics of PICU institutions and SSOP environments were gathered and analyzed to provide a reference that could frame the views of PICU medical directors and NP leaders. The study is one of only a few that have assessed the PICU provider workforce and conducted comparative analysis of the perspectives of PICU medical directors and lead NPs who make decisions affecting the size and composition of the provider workforce in the nation's PICUs.

More than half of PICU medical directors and lead PICU NPs believe the national and local supply of PICU providers is less than demand. There were no statistically significant differences between the PICU medial directors and lead NPs' perceptions of the national PICU provider supply. A majority of institutions identified that increasing the number of NPs employed in the PICU would help alleviate provider shortages. In fact, the vast majority of institutions that currently employ PICU NPs planned to increase their numbers, and almost half indicated they were likely to expand NP roles in patient care.

National and Local PICU Provider Supply

The reported shortage of physicians in the critical care workforce (6, 26, 27) is consistent with perceptions found in this study. However, our study results diverge from the 2016 Health Resources and Services Administration (HRSA) critical care workforce predictions of a surplus of providers (6). The divergence is likely related to HRSA's focus on the adult critical care workforce (6), which highlights the need for studies of the pediatric workforce to inform workforce policy development (7).

Although physicians-in-training and NPs can be used to increase the number of providers on a PICU team, prior studies suggest the addition of physicians-in-training to the care team does not necessarily reduce the workload of critical care attending physicians (8). Our results seem to bear out this finding, as there was no significant difference in self-reported local provider shortages by COTH membership, where member institutions would have the addition of physicians-in-training on their care teams. With regard to incorporating NPs as a strategy to increase PICU providers, a less restrictive SSOP is associated with decreased provider shortages in primary care studies (21). Surprisingly, this study's findings indicate no similar reports of improvement in provider supply were observed in states with less restrictive SSOP regulation on PICU NP practice. In PICUs, organizational factors that shape the NP practice environment, namely, history, culture, institutional privileges, and billing practices, may more meaningfully influence, directly or materially, NP practice and workforce size than SSOP regulations (28, 29). Future studies should include the affect of these factors on the size of the PICU NP workforce. In light of current shortages and increasing demand for PICU providers, studies are especially needed to evaluate how the PICU provider team size, composition, and practice environments can be modified to optimize the effectiveness of the current workforce and prepare for future challenges.

NP Employment

In this study, three fourths of institutions that currently employ PICU NPs reported that increasing the presence of PICU NPs would help to address PICU provider shortages. This would be expected because institutions with a provider shortage have shown a propensity to adopt innovate provider models to deliver care and to achieve similar quality outcomes as physician-only models (10–14, 30, 31). A majority of respondents reported their institutions were likely to increase the number of PICU NPs. As the use of interdisciplinary provider teams grows and new models of team care evolve, it is important to assess these changes and understand how providers can fully use their education and training to improve clinical and team outcomes.

TABLE 5. Intent to Employ PICU Nurse Practitioners for All Institutions and Among Those Institutions That Self-Report a Local Provider Shortage Compared in Institutions That Currently Employ PICU Nurse Practitioners

Anticipated Response to Provider Shortage	All Institutions That Employ PICU NPs, *n* (%), *n* = 93[a]	Institutions That Self-Report a Local Provider Shortage and Employ PICU NPs, *n* (%), *n* = 54[a]	Institutions That Do Not Self-Report a Local Provider Shortage and Employ PICU NPs, *n* (%), *n* = 39[a]	*p*
Likelihood to increase the number of PICU NPs				0.191
Very likely	29 (31.2)	17 (31.5)	12 (30.8)	
Likely	24 (25.8)	18 (33.3)	6 (15.4)	
Unlikely	22 (23.7)	10 (18.5)	12 (30.8)	
Very unlikely	18 (19.4)	9 (16.7)	9 (23.1)	
Likelihood to expand the scope of NP's role in patient care				0.279
Very likely	10 (10.8)	8 (14.8)	2 (5.1)	
Likely	30 (32.3)	14 (25.9)	16 (41.0)	
Unlikely	32 (34.4)	20 (37.0)	12 (30.8)	
Very unlikely	21 (22.6)	12 (22.2)	9 (23.1)	
Strategic plan regarding PICU NPs in next 3 yr[a]	*n* = 86	*n* = 52	*n* = 34	0.078
Increase number of PICU NPs	64 (74.4)	41 (77.8)	23 (67.6)	
Decrease number of PICU NPs	1 (1.2)	0 (0)	1 (2.9)	
No change to number of PICU NPs	21 (24.4)	11 (21.2)	10 (29.4)	
Meaningfulness of a proposed intervention in response to a provider shortage	*n* = 79	*n* = 54	*n* = 25	
Increase the number of PICU NPs				**0.027**
Very meaningful	47 (59.5)	38 (70.4)	9 (36.0)	
Meaningful	22 (27.8)	10 (18.5)	12 (48.0)	
Not meaningful	10 (12.6)	6 (11.2)	4 (16.0)	
Expand the scope of NP's role in patient care				0.107
Very meaningful	29 (36.7)	23 (42.6)	6 (24.0)	
Meaningful	25 (31.7)	17 (31.5)	8 (32.0)	
Not meaningful	25 (31.7)	14 (9.3)	11 (44.0)	

NP = nurse practitioner.

[a]Totals vary due to variation in response rate per item.

Boldface value indicates finding that was statistically significantly different.

The rate of growth in the pediatric NP workforce has been slower than other NP specialties (17). Although the size of the PICU NP workforce may be smaller than that of NPs in adult critical care medicine (6), pediatric NPs are a potentially growing sector of the PICU workforce if there are enough available pediatric NP providers. Studies of the pipeline for this segment of the workforce should be undertaken. A 2010 pediatric workforce survey found 61% of pediatric critical care physicians reported they would increase the number of PICU NPs and 34% reported they would expand the scope of the PICU NP role (20). Our study found the institutions that employ PICU NPs have an even greater desire to increase the number of PICU NPs (78%), and these institutions were also more likely to expand the scope of the NP role (43%) than was found in the prior study (20). No significant changes in employment of NPs and self-report of local shortage were associated with SSOP. As NP employment in PICUs increases, aligning PICU NPs' education and certification as acute care pediatric NPs

will be important for employers to consider when implementing successful changes in their role and scope of practice as members of the PICU team (32).

Limitations

Although the institutional response was 66%, response rates among medical director and lead PICU NPs were similar, 43%. The response rates may have been lower due to the survey being administered during a recent national presidential election and over winter holidays. Institutions were generally representative of the national distribution of institutional characteristics despite a large number of respondents from states with restricted practice and should be considered in conducting future national studies. Finally, this study only assessed a limited number of factors that contribute to institutions' employing and retaining attending physicians, which could contribute to respondents' perception of provider supply and the role NPs could contribute in the PICU setting.

Despite these limitations, the study contributes to knowledge of the national and local PICU provider supply. The role for NPs on an interdisciplinary PICU team was verified, and it is important to take into account the need for critical care pediatric NP providers in the development of NP education programs.

CONCLUSIONS

Overall, the study affirmed the role of NPs on an interdisciplinary PICU team and their potential to increase the size of the PICU provider workforce. Across the country, innovative models of care include employment NPs in PICUs. In institutions that currently employ PICU NPs, there is a substantial demand for more of these advanced practice clinicians and an expanded scope of the NP's role in patient care. Further evaluation of interdisciplinary provider models of care and provider roles in care delivery will increase knowledge on how to improve the alignment of PICU provider supply and demand for care delivery as well as help guide how the role each provider plays in PICU care delivery can be optimized.

ACKNOWLEDGMENTS

We would like to acknowledge Ruth M. Kleinpell, PhD, RN, FAAN, FCCM, for thoughtful review of the article.

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