Concerns about the adequacy of the US healthcare workforce to meet projected national demand are widespread. Expected growth in demand for healthcare is primarily due to our aging and growing population and the expected heavy burden of chronic disease, with a relatively small additional demand due to the influx of patients newly insured under the Affordable Care Act. 

A national shortage of 46,000 to 90,400 physicians by 2025 was recently predicted in a report released by the Association of American Medical Colleges. Increased use of nonphysician providers such as physician assistants (PAs) is widely cited as a potential solution to physician shortages.

Workforce shortages in primary care are of particular concern because of the growing recognition that the pathway to a more equitable, efficient, and effective healthcare system is through a strong primary care system. Primary care physician shortfall estimates vary widely. The federal Agency for Healthcare Research and Quality acknowledged that the primary care deficit could be small (about 6,000 physicians in 2020), due in large part to continued growth in the NP and PA primary care workforce; analysts representing physician organizations, using assumptions of a smaller NP and PA effect, predict larger shortfalls.

The idea that NPs and PAs may be able to bolster the primary care system is supported by the rapidly growing NP and PA workforce and increased reliance on healthcare teams in new models of care such as accountable care.
organizations and patient-centered medical homes.\textsuperscript{3,11,12} However, a trend away from primary care practice and toward specialization, especially among PAs, could diminish their effect in primary care.\textsuperscript{13,14}

Current policy approaches to increase the number of PAs choosing primary care are similar to those aimed at physicians and include grants for primary care training programs, loan forgiveness for work in underserved primary care settings, and bonus payments for primary care practice.\textsuperscript{15} Whether these efforts have altered the trend toward PA specialization is unclear. The success of these programs may be limited by other powerful influences on PA specialty choice. In order to predict and potentially shape the specialty choices of PAs, an assessment of current trends in specialty distribution and examination of factors affecting this distribution are needed.

PA specialty distribution is affected by multiple factors, including labor supply and demand. Supply side factors are similar to those affecting physician supply, including training program culture and individual provider preferences.\textsuperscript{16} Individual choices about specialty of practice have been associated with financial factors (potential earnings by specialty), demographic background (race and ethnicity), student debt level, and personal attitudes (lifestyle and social mission).\textsuperscript{17-19}

The structure of workplace demand for PAs differs from that of physicians because PA employment depends on a physician partner. Overall demand for PAs has been strong, as evidenced by wages that have consistently risen in excess of inflation over the past 20 years.\textsuperscript{20} Demand factors that affect jobs available to PAs have not been well-described but can be expected to vary by specialty, depending on specialty-specific factors such as the adequacy of physician supply and the potential effect of a PA on practice revenue. Because physician shortages are expected to be most acute in specialties that serve older patients, such as cardiology, oncology, and a number of surgical specialties, individuals in these specialties might be motivated to attract and hire PAs.\textsuperscript{2} The potential financial contribution of a PA to practice revenue also varies across specialties and could affect specialty-specific demand for PAs. The PA contribution to revenue is determined in part by how PA salary compares with physician salary within the specialty. For example, an orthopedist who earns five times as much as an orthopedic PA might gain more financially from hiring a PA than a pediatrician who earns only twice as much as a pediatric PA.

Because the demand for PAs is expected to continue to be strong, perhaps exceeding PA supply, PAs may have a choice among positions in multiple specialties.\textsuperscript{13,20,21} This overall high demand for PAs may lead practices to create PA positions that are desirable in terms of salary and/or lifestyle, thereby increasing the supply of PAs willing to work in that specialty. In short, more positions and positions with higher salaries will be available in high-demand specialties.

The purpose of this article is to provide current information about PA specialty distribution and about factors that might affect the supply (PA salary) or demand (physician salary and physician:PA salary ratio) of PAs by specialty. We describe PA specialty distribution trends, compare the ratio of physicians to PAs by specialty, and quantify the relationship of this ratio with both PA and physician salary.

**METHODS**

**Data sources** We used data compiled from several different sources. Specialty distributions of clinically practicing PAs in the United States were obtained from the American Academy of PAs (AAPA) census reports (1997, 2001, 2005, 2009) and 2013 survey.\textsuperscript{22-26} Because of concern for selection bias due to declining response rates for the AAPA survey, we compared PA specialty distribution data from the 2013 AAPA survey with the National Commission on Certification of

![Figure 2. PAs reporting selected specialty categories, 1997-2013\textsuperscript{22-26}](image-url)
Physician Assistants (NCCPA) 2013 Statistical Profile of Certified Physician Assistants for those specialties common to both reports. Response rates for the AAPA census reports were 36% in 2005, 34% in 2009, and 17% in 2013 (response rates were not reported for 1997 or 2001); the response rate for the NCCPA 2013 statistical profile was 80%. Because we found that general trends in the data were similar between the two data sources (AAPA and NCCPA), we used AAPA data for this article because it let us compare specialty distributions over a 16-year period.

Median base salaries of PAs (that is, fixed annual income from their primary clinical employer) broken down by specialty were obtained from the 2013 AAPA salary report. The response rate to the salary survey item was lower than for the survey at large (12% of PAs surveyed) (Noël Smith, e-mail communication, May 29, 2015). We compared AAPA 2013 salary data with NCCPA salary data and found that salary patterns were similar even though dollar amounts varied slightly. Comparisons of AAPA and NCCPA data are available from the authors on request.

Specialty distributions of US active physicians involved in patient care were obtained from the Association of American Medical Colleges’ (AAMC) 2014 Physician Specialty Data Book, which uses the American Medical Association (AMA) 2014 Physician Masterfile, containing data as of December 31, 2013, as its primary source. The AMA physician masterfile includes current education, training, and professional certification information on virtually all physicians in the United States and its territories, and the 2014 Physician Specialty Data Book provides data on US physicians (MDs and DOs) who work in one of 41 specialties with more than 2,500 active physicians.

Median physician salaries by specialty in 2012 were obtained by purchasing a subscription to the AAMC Careers in Medicine publication, which presents salary data on more than 120 specialties from the Medical Group Management Association's (MGMA) Physician Compensation and Production Survey 2013 Report Based on 2012 Data. This report is based on data from 60,146 providers in 3,811 groups who voluntarily participate in the survey.

Variables Primary care was defined as family/general medicine, general internal medicine, general pediatrics, and geriatrics. Proportions of PAs in a given specialty were calculated using the raw number of PAs who reported being clinically active in that specialty as the numerator and the total number of PAs who responded to the AAPA annual survey as the denominator for each year of data analyzed. Projected numbers of PAs in these specialties were calculated by multiplying the proportion in each specialty by the total number of PAs estimated by AAPA to be in practice for each year of data analyzed. Survey weights are not available for AAPA or NCCPA data.

Examining the number of PAs per physician by specialty accounts for the relative size of the workforce in each specialty. Therefore, we calculated ratios of clinically active physicians to clinically active PAs in 2013 by specialty using the total number of physicians reported to be in patient care in that specialty as the numerator, and the projected number of clinically active PAs as the denominator. A higher ratio indicates fewer PAs relative to physicians in that specialty; a lower ratio indicates a higher presence of PAs in that specialty relative to physicians.

Ratios of physician median salaries by specialty in 2012 to PA median salaries in 2013 also were calculated. For these ratios, we used the 24 specialties for which ratios were reported from analogous sources by Morgan and colleagues to allow examination of trends over time.

Analysis The majority of our analyses for this study were limited to compilation of descriptive statistics, including comparisons of raw numbers and proportions of PAs and physicians in different specialties. We also constructed scatter plots to visually assess potential relationships between the ratio of physicians to PAs in 2013 and both PA and physician median salaries and salary ratios by specialty. Finally, we used bivariate and multivariate linear regression to better examine the association between PA median salary in 2013, physician median salary in 2012, and salary ratios (independent variables) with the ratio of physicians to PAs in 2013 (dependent variable) using data from 24 specialties. Due to the skewed distribution of the physician to PA ratios in the 24 specialties, we performed
a natural log transformation to normalize this variable and ensure the assumptions of linear regression were being met in our models. We also created a binary variable for use in one model to account for whether a specialty was surgical or nonsurgical, as we hypothesized this characteristic might influence the association between physician and PA salaries and the ratio of physicians to PAs in the 24 specialties. All linear regression models were calculated using SAS version 9.3.

RESULTS

Although AAPA and NCCPA data showed slightly different proportions of PAs working in common specialties, the results of the two surveys were roughly similar, with the proportion of PAs working in primary care at 31% and 28%, respectively. Both found the largest proportion in primary care, followed by surgical subspecialties, emergency medicine, and internal medicine subspecialties.

The growth of the PA profession was robust over the time period studied, from 31,480 active PAs in practice in 1997 to 93,098 in 2013. Due to this rapid growth, even specialties with large proportional declines saw an increase in absolute numbers of PAs. For example, the number of PAs in family medicine increased from an estimated 12,088 in 1997 to 21,692 in 2013; during that same time, the proportion of PAs working in family medicine declined from 38% to 23%. PA numbers grew faster than physician numbers during this time, leading to lower physician:PA ratios in many specialties. Again using the example of family medicine, the relative prevalence of PAs compared with physicians in family medicine increased slightly between 2005 and 2013, from one PA for every six family physicians to one PA for every five family physicians, even as the proportion of PAs practicing in family medicine continued to decline.

The proportion of PAs working in primary care (family medicine/general practice, general internal medicine, general pediatrics, and geriatrics) decreased from 51% in 1997 to 31% in 2013 (Figure 1). Among nonprimary care specialties, the proportions of PAs increased the most in surgical and medical subspecialties (Figure 2). A more detailed representation of the current distribution of PAs in major specialty categories is shown in Figure 3.

The ratios of the number of clinically practicing physicians to the number of clinical practicing PAs are shown in Table 1. Physician to PA ratios in 2013 were lowest in orthopedic surgery (2:1), neurosurgery (2:1), and cardiovascular/thoracic surgery (3:1) and higher in family medicine (6:1) and general pediatrics (29:1). All specialties that we examined show an equal or growing relative prevalence of PAs in 2013 compared with 2005, except for general internal medicine, which had a slight increase in the physician to PA ratio from 20:1 to 22:1.

Regression models showed greater numbers of PAs relative to physicians in specialties with higher PA salary, higher physician salary, and higher physician to PA salary ratio (Table 2, P<0.05):
- Model 1 found that for a $1,000 increase in PA median salary, the ratio of physicians to PAs decreased by 8% (P=0.003).
- Model 2 found that for a $1,000 increase in physician median salaries, the ratio of physicians to PAs decreased 0.4% (P=0.0003).
**TABLE 2. Results of bivariate and multivariate regression models**

<table>
<thead>
<tr>
<th>Model</th>
<th>Outcome variable</th>
<th>Independent variable(s)</th>
<th>Unadjusted R²</th>
<th>Intercept</th>
<th>β (SE)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ln(MD:PA ratio)</td>
<td>PA median salary</td>
<td>0.33</td>
<td>8.92</td>
<td>-0.000008 (0.000002)</td>
<td>0.003</td>
</tr>
<tr>
<td>2</td>
<td>ln(MD:PA ratio)</td>
<td>MD median salary</td>
<td>0.46</td>
<td>3.49</td>
<td>-0.0000004 (8.9E-7)</td>
<td>0.0003</td>
</tr>
<tr>
<td>3</td>
<td>ln(MD:PA ratio)</td>
<td>MD:PA median salary ratio</td>
<td>0.32</td>
<td>3.49</td>
<td>-0.35 (0.11)</td>
<td>0.004</td>
</tr>
<tr>
<td>4</td>
<td>ln(MD:PA ratio)</td>
<td>β₁ = MD:PA median salary ratio&lt;br&gt;β₂ = surgical versus medical specialty indicator variable</td>
<td>0.37</td>
<td>3.28</td>
<td>β₁ = -0.27 (0.13)&lt;br&gt;β₂ = -0.40 (0.32)</td>
<td>β₃ = 0.04&lt;br&gt;β₄ = 0.23</td>
</tr>
</tbody>
</table>

• Model 3 found that a one-unit increase in the ratio of physician to PA median salaries yields a 30% decrease in the ratio of physicians to PAs (P=0.004).

• Model 4 found that this relationship remains significant even after adjusting for whether a specialty is surgical or nonsurgical (P=0.04).

**DISCUSSION**

Due to the large growth in the PA profession, the absolute numbers of PAs and the numbers of PAs relative to physicians increased in almost every specialty we examined. In primary care, these results support the finding of a recent health workforce study that the growth of PAs in family medicine is expected to be well above replacement levels, even though the proportion of PAs choosing family medicine is expected to be well above replacement levels. These “extra” PAs (those beyond replacement levels) can be thought of as available to fill primary care workforce shortfalls. A similar pattern may be present in other specialties, but detailed analyses are lacking for the role of PAs in most specialties.

Although primary care remains the largest area of practice for PAs, the trend toward specialization continues. Surgical subspecialties have seen the greatest growth in absolute numbers since 2005, with some surgical subspecialties having one PA for every two physicians by 2013. Examination of the changes in physician:PA ratio across specialties raises interesting questions. These ratios changed little in some specialties and dramatically in others. Perhaps specialties with little change in this ratio are relatively saturated with either physicians or PAs.

As expected, PA salary is associated with the ratio of physicians to PAs in the specialties examined. The PA salary differential across specialties is relatively modest, with the highest paid specialties earning about 20% more than the lowest paid specialties. This contrasts with physician salary patterns, in which earnings can be five times greater in higher-paid versus lower-paid specialties.

Physician median salary and the physician:PA median salary ratio also are correlated with PA specialty. The association between the physician:PA specialty ratio and physician median salary may be because highly paid physicians can gain the most revenue from time that is freed up by shifting tasks to PAs. For example, surgeons generate more revenue performing surgery than they do seeing patients in clinic or providing preoperative and postoperative care. If a PA is available to complete some of these nonoperative tasks, the surgeon may be able to perform more surgeries per week, boosting practice income to more than offset the PA salary. Alternatively, a PA in the role of first assistant in surgery may be directly substituting for a physician, at markedly lower labor costs. Research on the effect of PAs on practice revenue by specialty is scant and dated. For example, in 1998, Grzybicki and colleagues compared a family medicine clinic with a PA to a similar clinic with only physicians, and found that the PAs compensation to production ratio was 0.36 and that the positive financial differential of the practice employing a full-time PA versus a full-time physician was $50,000 (1,998 dollars).14 Physicians, or the organizations for which they work, may create jobs for PAs because they recognize the potential that PAs have for boosting practice revenue, and this potential might be highest in specialty settings. The same reasoning applies to the relationship that we found between the physician:PA ratio and physician:PA salary ratio. The larger the salary differential between the physician and the PA, the more financially beneficial the PA’s contributions to practice revenue may be.

Consideration of the effect of the revenue-generating potential of PAs on demand by specialty can be extended by another example. For those wishing to increase the proportion of PAs choosing primary care practice, a simplistic approach to addressing our finding of a correlation between PA salary and practice would be to raise family medicine salaries. Although this approach might lure some PAs from subspecialties to family medicine, it could have the opposite effect on demand for PAs by specialty because the increased salary investment would erode the PAs contribution to practice revenue. The result of this scenario would then be that more PAs would want to work in primary care, but fewer primary care organizations would be interested in hiring them. This illustration demonstrates that policy to effect change in PA specialty distribution must consider both supply and demand factors.

**LIMITATIONS**

Several limitations are related to the data we used. The most important limitations are low and declining response
rates to the surveys used and possible response biases. As presented in the Methods section, the response rates for the AAPA surveys declined over the time period studied, to a low of 17% in 2013. AAPA analyses in 2003 and 2005 found respondents tended to be female, slightly younger, more recent graduates of a PA program, and non-white compared with those who did not respond. These traits have been associated with likelihood of primary care practice, but because they are likely to affect specialty choice in different directions, predicting the direction of any sample bias is difficult. Response rates for the salary information were lower still (12% in 2013). The general agreement between the specialty and salary data from AAPA and NCCPA suggests that the potential error due to low response rates may be small. The earnings information that we used included all earnings for physicians (including production bonuses) but only base salary for PAs. Because some specialties may be more likely than others to provide bonuses to PAs, this could have affected the reported salary differentials and their association with PA prevalence between primary care and specialty PAs.

Our study finds an association between PA specialty prevalence and earnings of both PAs and physicians, but cannot establish causality. Additional factors may influence PA specialty distribution patterns. For example, high concentrations of PAs in family medicine could depress family physician wages by direct competition for employment, and surgical specialist salaries may be high partly because the surgeons benefit from the labor of large numbers of PAs. Income may also vary for reasons other than specialty, including region, practice ownership, and urban location. For example, specialty practices are concentrated in metropolitan areas that typically have higher living costs and higher salaries than rural areas. This could exaggerate the income differential and also the association that we found between income and specialty prevalence. Our final model, which evaluated the physician:PA salary ratio, might minimize this geographic bias. We could not investigate these potentially confounding relationships due to the size and structure of our data.

This study was not designed to address a number of other factors that will likely prove important in determining the future distribution of PAs among specialties. One of these is the emergence of future physician shortages. Workforce projections suggest that a number of subspecialties, particularly those who care for problems common among older adults, may develop physician shortages as our population continues to age. These specialties might successfully compete for available PAs.

Another important consideration is the degree to which physician supervision is rate-limiting for the growth of PAs. This includes the issue of how many PAs per physician are possible before the limits of productivity are reached, and how this varies by specialty. State limitations on the number of PAs that can be supervised by a single physician might affect demand for PAs by specialty in some states. Rural areas with populations sufficient to support only one provider are more likely to have a physician than a PA, although some of these communities support a PA with remote physician supervision.

CONCLUSIONS

PAs continue to move toward subspecialty practice, although 30% practice in primary care. This study highlights some of the factors influencing PA specialty choices. The supply of PAs willing to work in each specialty is likely affected by potential earnings. The demand for PAs within a specialty may be related to the income of physicians in that specialty and to the differential between the specialty’s physician and PA income. Physicians in more lucrative specialties may have more incentive to hire PAs, and can offer PAs higher salaries.

Our study suggests that demand for PAs, driven in part by financial benefits of PAs in high-paying surgical subspecialties, may be an important factor driving the trend toward specialization. Current policy initiatives that focus on supply factors in hopes of increasing the number of PAs who wish to practice in primary care may not succeed if demand factors are not considered. This may become even more important, as physician shortages are expected in subspecialties that care for problems common among the growing population of older adults. To meet policy goals of increasing the proportion of PAs in particular specialties, such as primary care, both supply and demand factors must be addressed.

REFERENCES


