

# COMPARING THE SUPPLY OF PEDIATRIC SUBSPECIALISTS AND CHILD NEUROLOGISTS

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**Objective** To examine physician workforce characteristics and workforce projections of one vulnerable pediatric subspecialty, child neurology, and compare this subspecialty with other pediatric subspecialties, general pediatrics, and adult neurology.

**Study design** National survey of child neurologists compared with other pediatric specialties in the Community Tracking Study Physician Survey (CTS) and the American Medical Association (AMA) Masterfile, and input-output workforce projections.

**Results** Child neurologists are more likely than other specialists to report that the complexity or severity of patients' conditions at the time of referral is less than it should be and that the number of patients being referred to them has increased. Projections of the future workforce reveal that by 2022 the number of pediatric subspecialists and pediatricians will increase substantially, to almost 180% and 150% of the current workforce, respectively. Among child neurologists and adult neurologists, practicing physicians will be only 109% and 105% of the current workforce by 2022.

**Conclusions** Child neurologists are more likely to face future workforce shortages than other pediatric subspecialists. To reduce future shortages, recruitment efforts need to be concentrated on the at-risk subspecialties such as child neurology. In the short-term, addressing the high prevalence of inappropriate low-acuity referrals to child neurologists may ease the gap between supply and demand. (*J Pediatr* 2005;146:20-5)

Despite numerous predictions of a surplus of physicians,<sup>1</sup> particularly of pediatricians,<sup>2</sup> there has been recent concern that the supply of pediatricians and pediatric subspecialists does not meet the demand. The American Academy of Pediatrics' most recent pediatric workforce statement suggests that the need for pediatricians has increased and will continue to expand.<sup>3</sup> A survey of residency program directors found no evidence of an oversupply of pediatricians, with only 2% of recently trained pediatricians having difficulty finding positions.<sup>4</sup> Recently, the Future of Pediatric Education II Project reported that the supply of pediatric subspecialists will not meet the demand in the future.<sup>5</sup>

Not all pediatric subspecialties seem equally susceptible to workforce shortages. A workforce survey of pediatric gastroenterologists predicted a significant surplus of gastroenterologists by the year 2006.<sup>6</sup> Similarly, studies of pediatric cardiologists and neonatologists do not predict workforce shortages in their subspecialties.<sup>7,8</sup>

However, other pediatric subspecialists have been singled out as being particularly susceptible to future workforce shortages. The Future of Pediatric Education II Project suggested that pediatric genetics, neurology, nephrology, and rheumatology may experience workforce shortages based on the excess number of faculty positions and the declining number of people planning to start careers in these subspecialties.<sup>5</sup> A survey found that pediatric geneticists, neurologists, and developmental-behaviorists were most likely to predict that they would need additional physicians in the future.<sup>9</sup>

In 1998, a Workforce Task Force of the American Academy of Neurology reported a total of 1080 active child neurologists, which translated into 819 full-time equivalent patient-care child neurologists.<sup>10</sup> The Task Force found that staffing was 20% below the demand for child neurology services, a shortage projected to remain unchanged through 2020.

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We examined physician workforce characteristics and workforce projections of one vulnerable pediatric subspecialty, child neurology, and compared this subspecialty with other pediatric subspecialties, general pediatrics, and adult neurology.

## METHODS

### Data Source for Child Neurologists

We surveyed all child neurologists in the United States in 2002. This population was identified as physicians who were members of the Child Neurology Society (CNS) (n = 1051) and non-CNS member physicians in the American Medical Association (AMA) Masterfile who listed child neurology as their primary or secondary specialty (n = 433). In March of 2002 a survey was sent to all identified child neurologists (n = 1484). Three waves of surveys were mailed to increase the response rate.

Of the 1484 surveys mailed, 52 were undeliverable because of incorrect addresses. We received surveys from 936 physicians, giving an overall response rate of 65%. Of the 936 completed surveys, 604 met the eligibility criteria for the study (65%). Exclusions included physicians who were practicing outside of the United States (2), were semi-retired or retired (20), were deceased (1), were not finished with residency or fellowship (30), worked <20 hours per week in patient care (120), did not spend the majority of their time in child neurology (149), and returned incomplete surveys (10).

To estimate the current total number of active patient-care child neurologists from the survey, we add an estimate of the number of active patient-care child neurologists among the nonresponders to the 604 responders. To estimate the number of active patient-care child neurologists among the nonresponders, we estimated the likelihood of active status among the responders. We used this estimate to predict the likelihood of active status among the nonresponders using a logistic regression based on variables known for both responders and nonresponders (available on the AMA Masterfile.) These variables are international medical graduate (IMG) status, CNS membership, age, and whether child neurology was listed as a secondary specialty only. We determined 300 of the 548 nonresponders were active in patient care. The proportion active in patient care among the nonresponders (55%) was lower than among the responders (65%) because of the high prevalence of characteristics associated with ineligibility: IMGs, non-CNS members, over the age of 65, and those with child neurology as a secondary specialty. Thus, we estimate that 904 child neurologists currently provide patient care in the United States.

### Data Sources for Comparison Specialties

**WORKFORCE CHARACTERISTICS.** Responses to questions in the child neurology survey were compared with the responses of pediatric subspecialists, pediatricians, and adult neurologists to the same questions in the Community Tracking Study Physician Survey (CTS). The survey, designed to provide an in-depth look

at the issues and challenges that physicians face, covers questions over a range of topics, including financial incentives, care management, and income, and it includes questions identical to those contained in the child neurology survey.

The CTS was designed to be representative of physicians providing direct patient care in the United States, and it followed a complex design drawn from 60 sites as well as a small, independently drawn national sample.<sup>11</sup> The sample included active office- and hospital-based physicians, not employed by the federal government, who spent at least 20 hours per week in direct patient care in the continental United States.<sup>12,13</sup>

The first two rounds of telephone interviews of physicians for the CTS were included in our analysis. The first round took place between August 1996 and August 1997. A sample of 23,096 physicians was obtained, of whom 18,947 were estimated to be eligible for the survey. Physicians interviewed by telephone numbered 12,385, representing a response rate of 65%.<sup>12</sup> The second round of CTS took place between August 1998 and November 1999. A sample of 25,627 physicians was obtained, of whom 20,205 were estimated to be eligible for the survey. For round 2 of the survey, 12,304 physicians completed the telephone interview, giving an overall response rate of 60.9%.<sup>13</sup> The findings reported in our study are based on all physicians in round 1 or round 2 whose primary specialty was defined as primary care pediatrician (n = 3232), adult neurologist (n = 251), or all other pediatric subspecialists (allergy and immunology, cardiology, critical care, endocrinology, gastroenterology, hematology and oncology, infectious disease, neonatology, pulmonology, or rheumatology; n = 280). Primary specialty was defined as the specialty where the physician spent the majority of time.

Item nonresponse was very low in the CTS, typically less than 3%. Missing values for some of the variables were imputed. Additional information on the survey is available.<sup>14,15</sup>

**NUMBER OF ACTIVE PATIENT-CARE PHYSICIANS.** Data on the number and characteristics of active patient-care pediatric subspecialists, pediatricians, and neurologists came from the December 2001 AMA Masterfile. The AMA Masterfile defines primary specialty as the specialty where the physician spends the majority of time. Physicians were excluded from the sample if their main practice activity was not patient care. Because retirement is not accurately recorded on the AMA Masterfile,<sup>16</sup> we code all physicians over 65 as "retired" and therefore not in patient care. We identified 6515 pediatric subspecialists, 34,839 pediatricians, and 7379 neurologists.

The number of active patient-care child neurologists was estimated at 904 based on the child neurology survey, as outlined earlier. Because of concerns about the methodological differences between the AMA Masterfile and our survey of child neurologists, we identified child neurologists from the AMA Masterfile as well. We found 692 child neurologists in the AMA Masterfile using the criteria outlined earlier. Because the AMA Masterfile provided an underestimate of the number of child neurologists identified in our survey, we estimated the number of active patient-care child neurologists

**Table I. Characteristics of physician specialties**

	Child neurologists n=604	Pediatric subspecialists n=280	Pediatricians n=3232	Adult neurologists n=251
Female (%)	30.8	29.3	43.7***	13.6***
White (%)	80.5	87.2	73.9***	87.1
IMG (%)	23.8	27.1	26.4	25.1
Age (mean)	50.7	50.3	51.3	50.9
Years of experience (mean)	16.0	14.0*	15.6	13.9*
Board Certified in subspecialty (%)	87.3	90.3	89	82.1*
Income (mean)	150792	168643**	125131***	172123**
Hours per week on patient care (mean)	42.7	44.4	41.4	47.0***

\*p<.05 compared to child neurologists.

\*\*p<.01 compared to child neurologists.

\*\*\*p<.001 compared to child neurologists.

to be 904 because in this case a larger number represents a more conservative estimate of the size of the workforce.

Trends in number and characteristics of physicians entering each specialty were further characterized using data published annually on the characteristics of graduate medical education.<sup>17-26</sup> These data were used to examine the degree to which training programs in each specialty have complete enrollment and the percentage of IMGs enrolled in each program.

### Statistical Analyses

First, we compared physician characteristics and attitudes toward their practice environment between specialty groups using responses to the child neurology survey and the CTS. We compared the physician characteristics of sex, race, IMG status, age, experience, board certification, income, and hours in patient care. For these descriptive analyses,  $\chi^2$  tests were performed for categorical variables and one-way analysis of variance was performed for continuous variables.

We hypothesized that child neurologists were more likely than other pediatric subspecialists and adult neurologists to feel that too many patients were being referred to them because of the limited supply of child neurologists, and that child neurologists would feel that the complexity or severity of patients' conditions at the time of referral is less than it should be. To test this hypothesis, we compared responses to attitudinal questions about rates and types of referral. Participants in the child neurology survey and the CTS were asked to rate the complexity or severity of patients' conditions at the time of referral overall, the complexity or severity of patients' conditions during the past 2 years, and the number of patients referred to them during the past 2 years on a 5-point Likert scale (ie, "In general, would you say that the complexity or severity of patients' conditions at the time of referral to you by primary care physicians is: much greater than it should be, somewhat greater than it should be, about right, somewhat less than it should be, or much less than it should be"). For the descriptive analysis, these responses were collapsed into three categories (ie, "greater than it should be, about right, or less

than it should be") and differences in responses across subspecialties were tested using  $\chi^2$  tests.

Second, we conducted an input-output analysis to project the number of physicians in active patient-care in each specialty group over the next 20 years. For this analysis we assumed that the rate of input was equal to the number of physicians who completed residency and who then became active in patient care in the United States. We used the average of the number of physicians completing residency annually between 1996 and 1998 in each specialty who were active in patient care in 2001 according to the AMA Masterfile (33 child neurologists, 405 pediatric subspecialists, 1686 pediatricians, and 247 neurologists). We display the change in the number of physicians in each specialty by indexing the supply at 1.0 as of 2002 and showing the change in that index over the next 20 years.

## RESULTS

### Workforce Characteristics and Environment

Overall, practicing child neurologists in the United States were less diverse than pediatricians, with a higher proportion of men and white physicians ( $P < .0001$ ) but were similar in demographics to other pediatric subspecialists (Table I). Child neurologists had a similar proportion of IMGs and were of similar age compared with the other specialties. Child neurologists had 2 more years of experience than other pediatric subspecialists ( $P = .02$ ) and adult neurologists ( $P = .03$ ). The average income of child neurologists was close to \$18,000 lower than that of other pediatric subspecialists ( $P = .01$ ) and over \$21,000 lower than that of adult neurologists ( $P = .006$ ). On average, child neurologists spent similar hours per week on patient care compared with other pediatric subspecialists and pediatricians but significantly less than adult neurologists ( $P < .001$ ). Child neurologists were much more likely to report having adequate time to spend with their patients than the other specialties ( $P < .001$  for all comparisons) (Table II).

Over three times as many child neurologists felt that in general the complexity or severity of patients' conditions at the

**Table II. Career satisfaction and scope of care among specialists (%)**

	Child neurologists n=604	Pediatric subspecialists n=280	Pediatricians n=3232	Adult neurologists n=251
I spend adequate time with my patients				
Agree	82.7	75.8***	67.3***	75.7***
Neutral	7.9	2.6	2.1	2.8
Disagree	9.4	21.6	30.6	21.5
In general, the complexity or severity of patients' conditions at the time of referral is:				
Greater than it should be	17.5	27.0***	†	34.7***
About right	58	65.6	†	50.0
Less than it should be	24.5	7.4	†	7.4
In the last 2 years, the number of patients referred to you has:				
Increased	65.0	45.6***	†	38.2***
Stayed the same	31.1	33.2	†	31.7
Decreased	3.9	21.2	†	30.1

\*\*\* $p < .001$  compared to child neurologists.

† Question not asked to primary care physicians.

time of referral was less than it should be compared with the other specialties (Table II). Of child neurologists, 24.5% reported that complexity or severity of referrals was less than it should be compared with 7.4% of pediatric subspecialists and 7.4% of neurologists ( $P < .001$  for both comparisons). A larger proportion of child neurologists also felt that the number of patients referred to them had increased in the last 2 years compared with the other specialists (65% of child neurologists vs 45.6% of pediatric subspecialists vs 38.2% of adult neurologists;  $P < .001$  for both comparisons).

### Number of Physicians Entering the Workforce

Trends in graduate medical education suggest that there are declining numbers of physicians entering child neurology, pediatric subspecialties, and adult neurology. Child neurology experienced the largest decline in the proportion of residency slots that were filled. A decade ago close to 70% of residency slots for child neurology were filled. In 2001, only 55% of residency slots were filled, despite a relatively steady number of positions being offered (Figure 1A).<sup>17-26</sup> Pediatric subspecialists and adult neurologists have followed a similar downward trend in the proportion of filled residency slots. However, both have remained relatively high compared with child neurology, at 73% and 79% respectively.

The proportion of residency slots that are being filled by non-U.S. medical graduates has been increasing in all pediatric subspecialties, child neurology, and adult neurology over the past decade (to 37%, 50%, and 40%, respectively). At the same time, the number of non-U.S. medical graduates entering pediatric residency programs has declined to 19% (Figure 1B).

### Workforce Projections

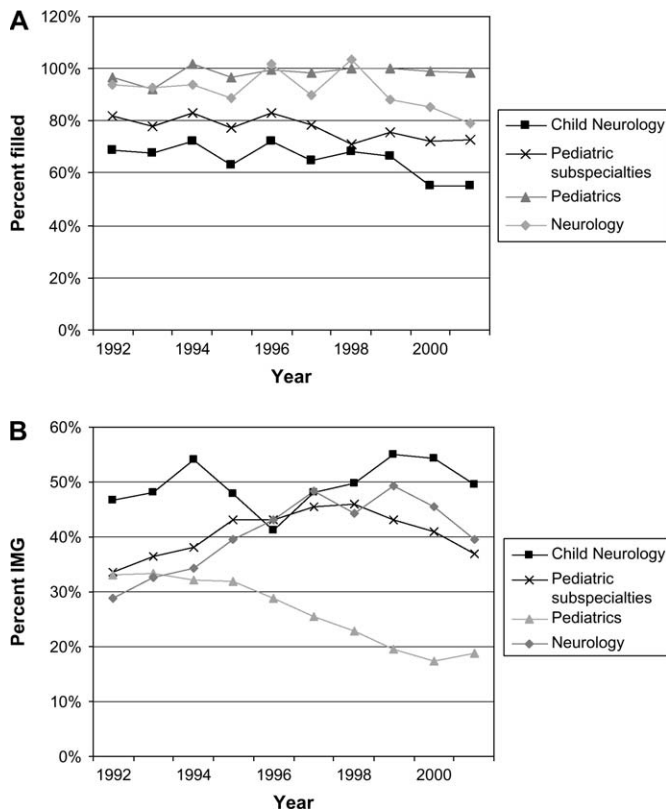
Projections of the number of physicians entering specialties show stable growth in pediatric subspecialists and

pediatrics (Figure 2). Over the next 20 years, the number of practicing pediatric subspecialists will increase substantially, growing to almost 180% of the current supply. Pediatricians as a group also will experience growth, reaching almost 150% of the current supply in 2022. This contrasts sharply with the projected growth in child neurology and neurology. Among child neurologists and adult neurologists, the number of practicing physicians initially grows a small amount, peaking in 2011 at 112% of the current workforce. However, both specialties will then experience a decline in their workforce. By 2022 there will be only 9% more child neurologists than the number that exist today and only 5% more adult neurologists.

## DISCUSSION

Although there has been overall consensus that pediatric subspecialists will experience a workforce shortage in the future, we are aware of no prior research that has compared workforce projections across subspecialties. Our research suggests that not all pediatric subspecialties will experience a declining workforce. As a group, the workforce of pediatric subspecialists and pediatricians will grow substantially over the next 20 years. However, our research suggests that child neurology will not experience the same growth as the entire cohort of pediatric subspecialties. The number of child neurologists is expected to increase only a small amount.

Our research also suggests some clues as to why child neurology differs from other subspecialties. With respect to income and hours worked, child neurologists have a lower income than other comparably trained subspecialists, yet they do not work fewer hours. Effectively this translates to less income per hour worked. Although we were unable to compare rates of reimbursement as a potential source of this wage difference, a different potential source did emerge. Child neurologists are more likely to report spending adequate time

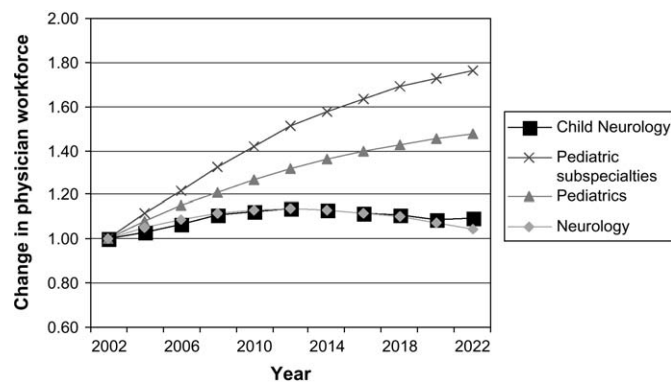


**Figure 1.** (A) Percentage of residency slots filled between 1992 and 2002 among child neurology, pediatric subspecialty, and pediatric and adult neurology training programs. (B) Percentage of IMGs in residency programs between 1992 and 2002 among child neurology, pediatric subspecialty, and pediatric and adult neurology training programs.

with their patients. Given that reimbursement is typically tied to the number of office visits and not adjusted for the length of visit, lower incomes may be related to longer visits.

The ability to maintain adequate time with their patients may change given that almost two-thirds of child neurologists feel that the number of patients being referred to them has increased, whereas less than half of other pediatric subspecialists report such an increase.

If referrals to child neurologists are increasing at a faster rate than in other pediatric subspecialties and the number of physicians choosing the specialty is not growing, the burden on existing child neurologists will increase. This will cause the number of hours worked to increase, the time with each patient to decrease, and possibly more job positions for child neurologists to become available or remain open. If the labor market responds to this pressure, the income of child neurologists should increase to reflect the increased work. Given the high debt burden faced by many medical students, if child neurology offered higher incomes, it may attract prospective medical students and young pediatricians to enter the specialty.<sup>27-29</sup> Curiously, however, this upward pressure on income and number of hours worked and the downward pressure on time with patients is not evident now. Given that reimbursement rates for office visits often are not negotiated separately for each subspecialty, the market may not be responding to changes in supply and demand occurring in



**Figure 2.** Projections of the number of physicians active in patient care in each specialty: child neurology, pediatric subspecialty, pediatrics, and adult neurology. Each specialty's workforce is indexed to the size of their workforce in 2002, showing relative changes in workforce size over the next 20 years.

a particular subspecialty. As a result, projections of shortfalls require action rather than waiting for market forces to correct the shortfall.

We also found that child neurologists were more likely than other pediatric subspecialists to feel that the complexity or severity of patients' conditions at the time of referral is less than it should be. A possible explanation for the difference in the appropriateness of referrals to child neurologists compared with other pediatric subspecialists may be related to the distinct relationship the specialty of child neurology has with the specialty of pediatrics. Most departments of child neurology are in departments of adult neurology rather than pediatrics. Similarly, unlike most other pediatric subspecialties, board certification in child neurology is not offered by the American Board of Pediatrics. Rather, board certification is offered by neurology.<sup>5</sup> Finally, most people who enter the field of child neurology choose to do so during medical school, rather than during pediatric residency.<sup>30</sup> This may cause the coordination between child neurologists and pediatricians to be below that of other pediatric subspecialties. As a result, referral patterns to child neurology may differ from other pediatric subspecialties, with more patients with low-complexity conditions being managed by child neurologists rather than by pediatricians.

The increased market power of health maintenance organizations might also be related to child neurologists seeing more patients and patients with inappropriately low-acuity conditions. Health maintenance organizations have been associated with physicians feeling more pressured for time.<sup>31</sup> Primary care physicians who once cared for patients with complex conditions who require longer visits might be increasingly referring such patients to specialists in an attempt to decompress their schedule for routine patients. This would increase the number of referrals to child neurologists, predominantly through more referrals of patients with low-complexity conditions.

Several limitations should be considered in interpreting our findings. First, we compare responses of two different surveys in this study, the child neurology survey and the CTS. These two surveys had different sampling methods and also

were conducted in different time periods—the child neurology survey took place in 2002 and the CTS spanned 1996 to 1999. Although this increases the possibility of measurement error, other studies have documented that responses to job satisfaction surveys during this time period remained stable.<sup>32</sup> Additionally, the question on career satisfaction was worded differently between the two surveys, with the child neurology survey asking about overall career satisfaction and the CTS asking about current career satisfaction. This makes comparisons between groups subject to error.

A second limitation to our comparisons is that we compare one pediatric subspecialty, child neurology, with all other pediatric subspecialties. It is possible that pediatric subspecialties differ from each other in important ways and, by averaging the responses, differences between the specialties are lost. It is possible that other subspecialties that have been identified as facing future labor shortages would closely resemble child neurology. Because we are limited by the sample size of pediatric subspecialists included in the CTS, we are unable to do further analyses. By comparing responses of child neurologists with those of both pediatric subspecialists and adult neurologists, we attempt to capture the important comparison groups for child neurologists.

Finally, we do not predict demand for physician services, and our workforce predictions could be inaccurate if the demand for physician services changes differentially between subspecialties over the next two decades. However, based on other demand predictions<sup>3,5</sup> and an increase in the pediatric population predicted by the U.S. Census, it is reasonable to assume that the demand for all subspecialty services will increase with time. In this setting, a commensurate increase in the child neurology workforce would be needed.

The future of pediatric subspecialties depends on attracting new physicians to the field. The good news is that pediatric subspecialties in general can expect a robust growth in the number of physicians entering their fields, alleviating concerns about future workforce shortages. The bad news is that some pediatric subspecialists, such as child neurologists, appear not to benefit from the growth in other fields.

Research on the factors that attract medical students to a given subspecialty is only beginning.<sup>30</sup> These factors need to be further investigated and efforts to attract physicians to pediatric subspecialties need to be concentrated in the subspecialties that expect to face workforce shortages, such as child neurology. In the short-term, however, addressing the high prevalence of inappropriate low-acuity referrals to child neurologists may ease the gap between supply and demand.

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