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Trainee Characteristics, Subspecialty Choice, and Program Usage for the American Board of Pediatrics Resident Research Pathways, 2000-2019

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Physician-scientists are individuals with a medical degree (MD, DO, equivalent degree) who dedicate professional time to the generation of new knowledge through research related to health, disease, and patient care.[1] Physician-scientists are uniquely positioned to leverage their experiences as both physicians and researchers to identify research questions and translate scientific advances into improved disease prevention, identification, and/or treatments.

Despite the importance of physician-scientists to the workforce, concerns have been raised about the state of this workforce broadly. The dearth of pediatric physician-scientists has been a significant concern.[2-8] Furthermore, the number of pediatric subspecialists engaged in research has been relatively stagnant in recent years.[9] The pediatric physician-scientist workforce faces multiple barriers reflecting decreased National Institutes of Health (NIH) pediatric research expenditures, an aging workforce, a concentration of R01 awards among select institutions, and disparities in awards by gender.[3,5,10] Beyond pediatrics, barriers for minority physician-scientists in all specialties have been improving, but are not fully removed.[11] When considering the earliest point of medical training, medical school trainees' intentions to pursue a career path in research were lowest among minorities.[12] Similar findings are reported for women entering the physician-scientist workforce compared with those entering medicine overall, further supporting the notion of pipeline issues related to racial and gender diversity.[13] Given these obstacles, understanding the outcomes of programs and initiatives to support this vulnerable component of the pediatric workforce is an important area of research.

Multiple reports have discussed best practices and innovative training models to support physician-scientists.[6,7,14-16] A common recommendation has been to integrate research experiences into clinical training for residents and fellows who have expressed interest in a career as a pediatric physician-scientist. Starting in 2000, the American Board of Pediatrics (ABP) approved the Integrated Research Pathway (IRP) to support aspiring pediatric physician-scientists during their clinical training; this was followed in 2003 by the introduction of the Accelerated Research Pathway (ARP).[17] Both pathways provide more research time during training (≤3 years) with the aim of producing highly competitive early career pediatric physician-scientists. The IRP, designed for residents with a PhD or an equivalent research experience, provides 11 months of research time during residency.[18] During fellowship, IRP trainees often pursue 2 years of research as well. The ARP offers residents the opportunity to shorten clinical training during residency to 2 years to allow for greater time in research during a subspecialty fellowship.[19] Our aim was to describe participation of trainees and residency programs in the ABP research pathways. We specifically characterize trainees, subspecialty choices, and training programs to inform future efforts to increase the pediatric physician-scientist workforce, complementing work conducted by our adult counterparts.[20]

Methods

Procedures

In September 2020, historical and current ABP trainee data were obtained from the ABP's Certification Management System tracking database and In-training Exam surveys. The ABP uses Certification Management System data primarily to verify completion of training before initial certification in general pediatrics and/or a pediatric subspecialty. Residents and fellows in US training programs accredited by the Accreditation Council for Graduate Medical Education or the Canadian Royal College of Surgeons and Physicians are captured in the ABP's system.

ARP	Accelerated Research Pathway
ABP	American Board of Pediatrics
AMG	American medical school graduates
IRP	Integrated Research Pathway
NIH	National Institutes of Health

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Inclusion criteria for these analyses were trainees whose first residency training day began between May 1, 2000, and December 31, 2019, (ie, academic years 2000-2001 through 2019-2020). The 2018-2020 In-training Exam surveys provided information related to race/ethnicity for these analyses. These survey data are captured to help eliminate bias in ABP examinations and for workforce reporting.[21] ARP/IRP training requests and approvals were still in process for the 2020-2021 academic year at the time of analyses and were not included.

Measures

Aggregated trainee tracking data included gender, medical school graduation location (international or American), and training status. Those currently in training were defined as having any current or planned training after August 30, 2020 (2020-2021 academic years or beyond). Those not in training consisted principally of those who had graduated residency or fellowship but may have included other reasons for no further training (eg, transfers to other disciplines). Data availability for race/ethnicity was limited to the past 3 years and is only presented for those in-training. Age was not analyzed because most trainees were within a ±5-year range of 35 years of age (93% for those currently in a research training pathway). Current fellows and graduates of subspecialty training were identified from the ABP Certification Management System. Training program names and geographic location were identified to examine how trainees participating in research pathways were distributed. Specific permission was granted to use the institutions name in these analyses. Information on institutional or training program resources (eg, funding, physician-scientist training programs, number of mentors) were not available.

Outcome measures included training pathway chosen (ARP, IRP, categorical general pediatrics, all other training pathways [eg, medicine-pediatrics, pediatric-neurology, special alternative pathway]) and fellowship area. Before the IRP/ARP pathways, the special alternative pathway provided an avenue for training options, including, but not limited to research; this discipline was grouped under other training pathways for the purposes of these analyses. Beyond training, comprehensive outcome data (eg, faculty position, grant funding) were not available for inclusion in this study.

Statistical Analyses

Pathway participation data were aggregated in total and cross-tabbed by demographic characteristics, subspecialty choice, and training program. Results were displayed over time based on an individual's first year of residency. Given the small size of the research pathways, statistical analyses comparing the overall pediatric training population to those in research pathways were not undertaken. SAS 9.4 (SAS Institute) and Tableau 2020.3 (Tableau Software) was used for analyses. The study was exempted by the ABP Institutional Review Board of record.

Results

Overall, 69 378 trainees were included. Of these, 58 890 (85%) participated in a categorical pediatrics training program and were eligible to apply to a research pathway. Of those, 10 949 (19%) were currently in training (residency or fellowship) at the time of analysis. Of the 58 890 categorical residents since 2000, 286 trainees had participated in one of the IRP/ARP pathways, corresponding with a 0.49% of eligible pediatric trainees Those currently in training (ie, any current or planned training after August 30, 2020) in a research pathway accounted for 39.5% of all IRP/ARP participants since 2000, with 56 and 57 currently in the IRP and ARP pathways, respectively (**Table I**, available at www.jpeds.com). The remaining 10 488 residents participated in other training pathways (eg, medicine-pediatrics, pediatrics-neurology, pediatrics-neurodevelopmental disabilities, pediatrics-anesthesiology) and were not eligible for the research pathways.

Overall, total participation in the research pathways was approximately split between the IRP (n = 152 [53.1%]) and ARP (n = 134 [46.9%]). Of those participating, nearly one-half were female (44.4%) and the majority were American medical school graduates (AMGs) (92.3%). Of the 113 currently in training, where data were available, 60% were White, 19% were Asian, 5% were Hispanic/Latinx/Spanish origin, 1.8% were Black/African American, 0.9% were American Indian/Alaskan Native, none were Native Hawaiian/Pacific Islander, and 8% selected more than 1 race/ethnic group. These findings differ from those currently in categorical pediatrics training, where 50% identified as White, 10.% lower than the percentage for research pathway trainees.

The number of residents participating in these pathways have fluctuated over time, with an average of 14.3 residents entering annually (**Figure 1**; available at www.jpeds.com). The 3-year moving average in 2004—9.3 trainees—has increased to 25 trainees in 2019. The proportion of trainees identifying as female reached a peak of 67% in 2011 and has remained between approximately 40%-60% since then. This number is lower than the stable 72%-74% seen in categorical pediatrics over the same period. No differences were noted over time in the proportion who were AMGs.

Fellowship Training and Subspecialty Areas

Four subspecialties accounted for two-thirds of all the pediatric subspecialists certified or currently in IRP/ARP training: hematology-oncology (n = 79 [32.8%]), infectious diseases (n = 30 [12.4%]), neonatal-perinatal medicine (n = 29 [12.0%]), and cardiology (n = 26 [10.8%]) (**Figure 2**; available at www.jpeds.com).

Results by Training Program

A total of 43 training programs since 2000 have accounted for all trainees who are in or have completed an ABP research pathway; 14 programs accounted for 81% of these trainees, with 2 programs representing 30% of the trainees

(Table II; available at www jpeds com). Although many of these are among the largest pediatric training programs, these same 14 programs accounted for 8036 (13 6%) of the total number of pediatric residents since 2000, demonstrating relatively low research pathway use across most programs.

When analyzing trainee demographics based on their first-year residency program region (excluding Canadian programs and those transferring in from other specialties), the South had the most categorical pediatric residents at 30.4% and the Northeast the second most at 28.4%. Conversely, the Northeast had the most pediatric trainees in ABP research pathways (36.7%) and the South had the least number in research pathways (17.5%). The West and Midwest programs were more closely aligned in representation of those in research pathways and in categorical training. Distributions by state shows a relatively uneven spread of research pathways among the 4 regions (Figure 3; available at www jpeds com).

Discussion

A relative low number of trainees have participated in the IRP/ARP research pathways despite trainee participation gradually increasing over the past 2 decades. In nearly all circumstances, IRP/ARP participation led to the pursuit of subspecialty training. Hematology/oncology was the most frequent area of focus for residents participating in the IRP/ARP pathways, with infectious disease and neonatology being a distant second and third, respectively. Of all the pediatric training programs across the US, only 10 institutions have had 10 or more trainees participate in the IRP/ARP training pathways. There are also notable regional variations in the distribution of IRP/ARP trainees.

Given concerns about the aging pediatric physician-scientist workforce and the dearth of investigators focused on child health, our findings echo the national emphasis placed on increasing the number of trainees entering the pediatric physician-scientist pipeline.[9,15] Although the NIH rates of MDs and MD/PhDs working as physician-scientists are limited, data from 1998 to 2012 show a relatively small growth from 6175 to 8278, respectively.[22] The current level of participation in the IRP/ARP pathways may reflect an underuse of these established pathways, perceived or real requirements regarding prior research training or experience to participate in these pathways, the slow increase of physician-scientists entering the pediatric workforce, or other factors. A significant number of trainees pursue research outside the ARP/IRP pathway and are doing so through dedicated research time created within the categorical pediatrics program, regardless of whether a formal physician-scientist track exists.[23] It is unclear if these individuals would be well-suited for the ARP pathway given no prior research experience, which is needed to participate in this dedicated research time. Many programs using the ARP/IRP pathways or other mechanisms face barriers related to financial and personnel resources, mentorship, professional identity challenges as dual clinician and scientist, and a limited pipeline.[23] Although a few training programs may be excelling, there is concern that programs across the country may not be using these pathways sufficiently to maintain a pediatric research presence and that creative solutions (eg, expansion of research opportunities and training in medical school, virtual mentorship, linkages between smaller and larger institutions, and networking) need further exploration.[18,19]

The limited diversity of individuals in the research pipeline and within the pediatric physician-scientist workforce must also be addressed. Gender, race/ethnicity, and subspecialty choice are important factors to consider when discussing the pediatric physician-scientist workforce and pipeline. Ideally, the diversity of these pathways would align with the diversity of the overall pediatric trainee pool, the trainee pool of physicians, and ultimately, the US population overall. Within categorical pediatric trainees, approximately 70% identify as female; however, the proportion of females in the ABP research pathways is lower at 44%. Although 44% is notably low when compared with categorical pediatric trainees, this is higher than the active NIH-funded female physician-scientist workforce, documented at 35% in 2020.[24] Nevertheless, one would expect a higher percentage given the shifting composition and growth of subspecialty fellows over the last 20 years is largely due to the increasing proportion of female AMGs seeking to subspecialize.[25,26] The current ARP/IRP trainees are also racially/ethnically less diverse compared with other training pathways, which has been highlighted among other specialties.[11] The disparity in gender and racial/ethnic diversity is multifactorial. Along with other investigators, we hypothesize that the lack of mentorship and basic role modeling (seeing someone like you who is more senior) caused by historically lower participation by these underrepresented groups is having a lasting, negative impact.[13] This factor may be exacerbated among women, regardless of race/ethnicity, who frequently encounter challenging parenting roles during an already strenuous training time.[13,27]

The diversity of subspecialty distribution is similar to prior findings where hematology/oncology and infectious disease are the disciplines most likely to have R01 funding and participate in these research pathways.[3,9] The choice of subspecialty among ARP/IRP participants is heavily mismatched compared with the subspecialty choice of non-ARP/IRP trainees (eg, neonatology would be listed as the top discipline if based solely on the numbers of filled fellowship positions).[25] One might only expect the distribution reported if there were factors driving these outcomes (eg, strong mentorship, funding opportunities).

One proven method to increase the diversity of the physician pipeline is to have intentional outreach efforts. The Frontiers in Science program emphasized participation of underrepresented individuals in medicine in 2018 and saw an increase in females applying from 55% in 2017 to 75% in 2019 and 65%-70% of applicants identifying as underrepresented in medicine in 2018-2019 (race/ethnicity had previously not been collected).[21] Specific activities

supported by the NIH have decreased the racial/ethnic differences in award funding, but gaps persist.[28] The mentorship and coaching components of those activities should be explored to ensure success for individual trainees.[11,15] Furthermore, to increase the number of individuals who choose subspecialties with less historical physician-scientist representation and funding, major innovation and resources will be needed across the training and career continuum.

There is a notable overlap between institutions using the IRP/ARP pathways and those with pediatric R01 equivalent awards. This observation may reflect robust institutional resources and mentorship components, which are attractive to applicants. Institution-specific physician-scientist training programs may be another driver toward the increased physician-scientist development and pathway use.[23]

As the field of pediatrics seeks to expand the physician-scientist workforce and increase geographic diversity, further study of the facilitators and barriers of the top institutions may prove a useful next step, including the perspectives of trainees, faculty members, department chairs, and academic medical center leadership. Collaborating with other national programs that are committed to increasing the pediatric physician-scientist pipeline—such as the Frontiers in Science program, the Pediatric Scientist Development Program, the New Century Scholars, and the Research in Academic Pediatrics Initiative in Diversity Scholars, as well as organizations committed to growing the physician-scientist workforce, like the Society of Pediatric Research, the American Pediatric Society, and the Academic Pediatric Association—may represent an opportunity to increase awareness and participation.[15,29-31] For example, the Society of Pediatric Research has collaborated with other organizations to compile a list of dedicated pediatric physician-scientists training programs.[32] Similarly, the National Resident Matching Program lists pediatrics/physician-scientist training slots (eg, pediatrics/physician-scientists training programs, pediatrics/research) but a limited number have utilized this functionality.[33]

There are multiple limitations associated with this study. One is the absence of comprehensive outcome data (eg, faculty appointment, grant funding) for those partaking in these research pathways. Another limitation is the inability to capture other efforts to support the pediatric physician-scientist trainee pipeline through non-IRP/ARP pathways, such as those elicited by Burns et al or for those interested in pursuing research in general pediatrics/health services research areas.[23] Last, the ABP individually tracks those who have discontinued a research pathway, transferred pathways, or have been disapproved before entering the program; however, these factors could not be analyzed because the data were captured only in individual records used for credentialing and not in the main ABP database.

In conclusion, participation in the ABP sponsored research pathways has gradually increased, but remains limited. Further work should delineate how to better facilitate participation, particularly in resource-limited settings. Similarly, future investigation may help elucidate how these pathways interact with other programs supporting the physician-scientist pipeline. With an increase in pathway participation, it will be important to consider how to diversify the program by gender, race/ethnicity, program location, and subspecialty. ■

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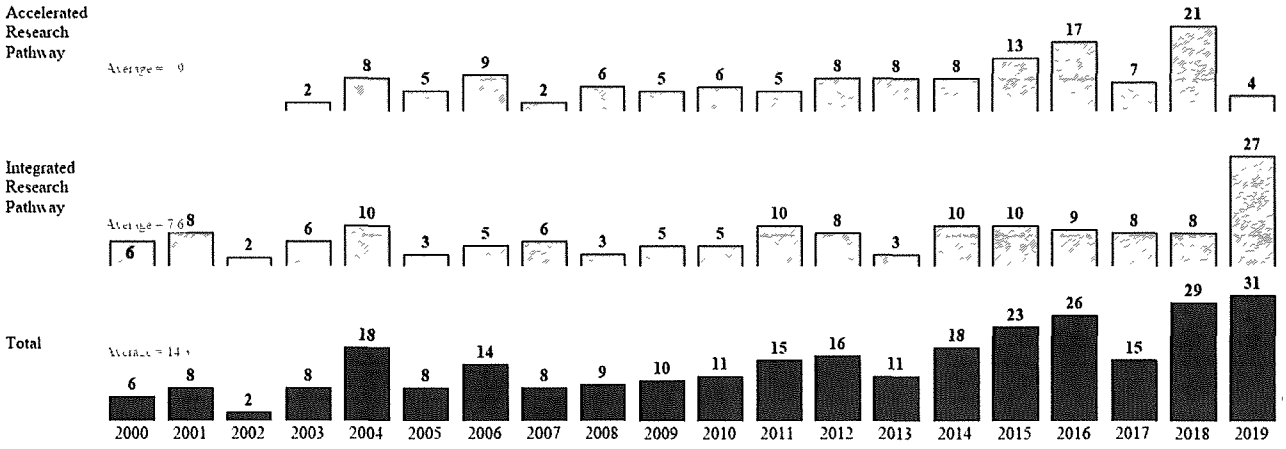

Figure 1. ABP research pathways use over time *Counts are based on first year of residency in an ABP Research Pathway

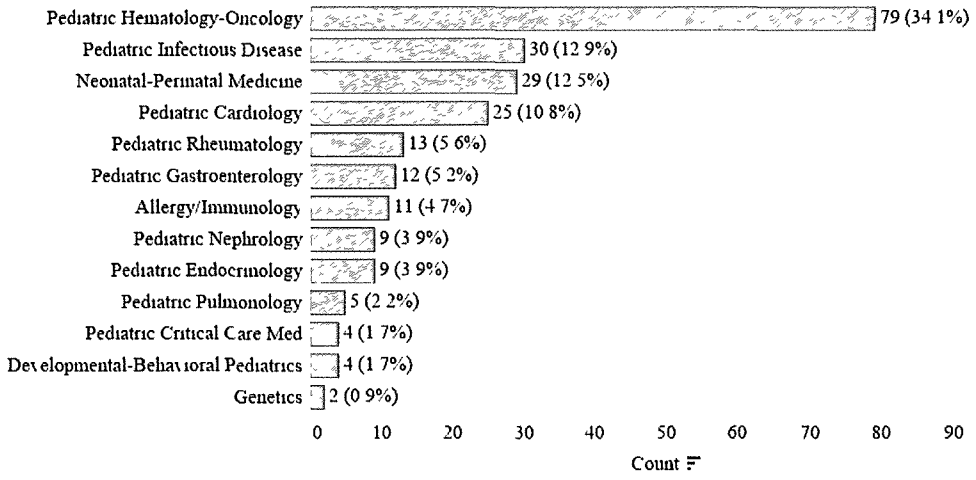

Figure 2. Top subspecialty choices among those in an ABP research pathway since 2000 Only showing subspecialties with more than 1 individual. Includes those certified in these areas and those currently in fellowship

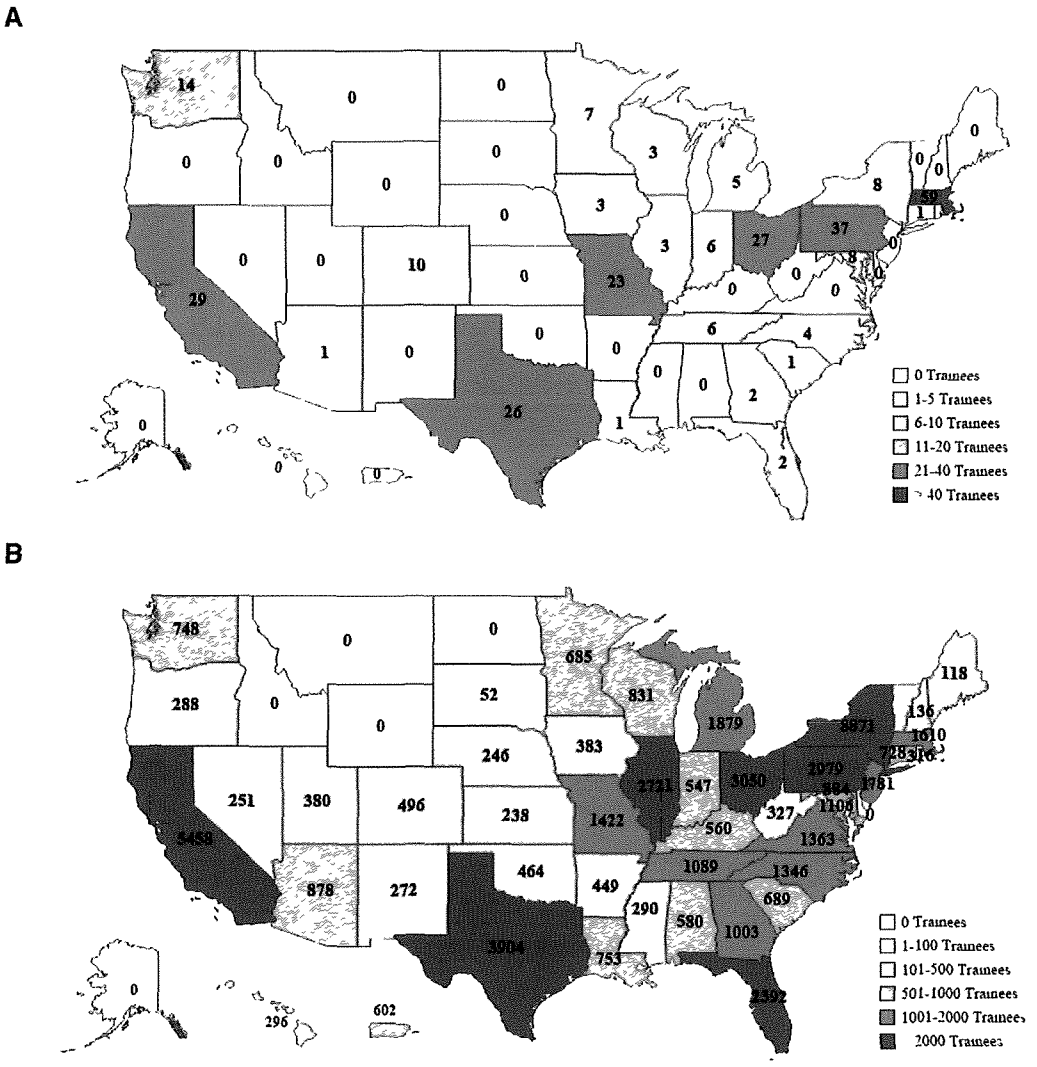

Figure 3. Distribution of first-year residents by state of training program and type of training * **A,** Accelerated research pathway and IRP trainees. **B,** Categorical pediatric trainees *Excludes Canadian programs and those receiving a waiver in their first year of training.

Table I. Sociodemographics for those in ABP research pathways and all pediatric training pathways since 2000*

Characteristics	ARP		IRP		Categorical pediatrics		All other residency pathways	
	Not in training	In training	Not in training	In training	Not in training	In training	Not in training	In training
Personal sociodemographics								
Gender								
Female	29 (37 7)	29 (50 9)	40 (41 7)	29 (51 8)	34 398 (72 0)	7743 (71 5)	5088 (57 9)	1049 (61 8)
Male	48 (62 3)	28 (49 1)	56 (58 3)	27 (48 2)	13 370 (28 0)	3093 (28 5)	3702 (42 1)	649 (38 2)
Medical school graduate location								
AMG	73 (94 8)	52 (91 2)	89 (92 7)	50 (89 3)	37 250 (78 0)	8463 (78 1)	7393 (84 1)	1506 (88 7)
International medical school graduate	4 (5 2)	5 (8 8)	7 (7 3)	6 (10 7)	10 518 (22 0)	2373 (21 9)	1397 (15 9)	192 (11 3)
Race/ethnicity†								
White	–	38 (66 7)	–	30 (53 6)	–	5428 (50 1)		935 (55 1)
Asian	–	11 (19 3)	–	10 (17 9)	–	2186 (20 2)		309 (18 2)
Black or African American	–	1 (1 8)	–	1 (1 8)	–	532 (4 9)		91 (5 4)
Hispanic, Latino, or Spanish Origin	–	1 (1 8)	–	5 (8 9)	–	740 (6 8)		69 (4 1)
Middle Eastern or North African	–		–	2 (3 6)	–	373 (3 4)		46 (2 7)
American Indian or Alaska Native	–		–	1 (1 8)	–	12 (0 1)		2 (0 1)
Native Hawaiian/other Pacific Islander	–		–		–	5 (0 0)		(0 0)
Some other race, ethnicity, origin	–		–		–	38 (0 4)		4 (0 2)
Two or more	–	6 (10.5)	–	3 (5 4)	–	593 (5 5)		86 (5 1)
Decline to answer/missing	–		–	4 (7 1)	–	929 (8 6)		156 (9 2)
Residency program factors								
Region (first year of training)‡								
Non-US (received waiver)					20 (0 0)	13 (0 1)	208 (2 4)	39 (2 3)
Canada					2428 (5 1)	555 (5 1)	24 (0 3)	1 (0 1)
Northeast	36 (46 8)	24 (42 1)	23 (24 0)	23 (41 1)	13 612 (28 5)	3054 (28 2)	2046 (23 3)	369 (21 7)
Midwest	14 (18 2)	17 (29 8)	32 (33 3)	14 (25 0)	9899 (20 7)	2155 (19 9)	2801 (31 9)	531 (31 3)
South	12 (15 6)	5 (8 8)	22 (22 9)	11 (19 6)	14 307 (30 0)	3494 (32 2)	2826 (32 2)	598 (35 2)
West	16 (20 8)	11 (19 3)	19 (19 8)	8 (14 3)	7502 (15 7)	1565 (14 4)	885 (10 1)	160 (9 4)
Total	*77 (100)*	*57 (100)*	*96 (100)*	*56 (100)*	*47 768 (100)*	*10 836 (100)*	*8790 (100)*	1698 (100)

Values are number (%)
*n = 69 378
†Race/ethnicity was unavailable for the majority of those not in training, therefore, it has not been displayed here See Methods for more details
‡Region was analyzed based on the first place of residency, as transfers do occur Occasionally, trainees will enter accredited pediatric residency program after completing training in other disciplines or outside the US In these cases, the trainee may apply for a portion of that training (ie, part of PGY-1) to count toward their required training

Table II. Top 14 training programs with residents in an ABP Research Pathway since 2000, by count*

Training program (first-year trainee in a research pathway)	ARP	IRP	Total
Children's Hospital/Boston Medical Center (2001)	29 (21 6)	30 (19 7)	59 (20 6)
Children's Hospital of Philadelphia (2000)	18 (13 4)	8 (5 3)	26 (9 1)
Baylor College of Medicine (Houston) (2001)	5 (3 7)	17 (11 2)	22 (7 7)
Washington University/B-JH/SLCH Consortium (2000)	19 (14 2)	2 (1 3)	21 (7 3)
University of California (San Francisco) (2001)	16 (11 9)	2 (1 3)	18 (6 3)
Cincinnati Children's Hospital Medical Center (2000)	3 (2 2)	13 (8 6)	16 (5 6)
University of Washington (2009)	2 (1 5)	12 (7 9)	14 (4 9)
UPMC Medical Center (2015)	6 (4 5)	5 (3 3)	11 (3 8)
University of Colorado (2008)	3 (2 2)	7 (4 6)	10 (3 5)
Nationwide Children's Hospital/Ohio State University (2002)	–	10 (6 6)	10 (3 5)
Johns Hopkins University (2001)	1 (0 7)	7 (4 6)	8 (2 8)
Vanderbilt University Medical Center (2003)	3 (2 2)	3 (2 0)	6 (2 1)
Indiana University School of Medicine (2000)	1 (0 7)	5 (3 3)	6 (2 1)
University of Minnesota (2014)	2 (1 5)	3 (2 0)	5 (1 7)
Total of top 14 program (percent of all programs)	108 (80 3)	124 (81 7)	232 (81 0)

Values are number (%)
*Table only includes residents based on first year of training and does not include fellows or later years of training