Title: A Nationwide Assessment of the Needs for Pediatric Physician-Scientist Training as Reported by Residency Program Directors

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Keywords: physician-scientist, pipeline, resident education

Running Header: Pediatric Physician-Scientists and Residency Education

Abstract Word Count: 250

Main Text Word Count:

Funding Source: The authors did not receive any financial support to conduct this study.

Conflict of Interest: none

Abstract:

Background: Threats to the physician-scientist pipeline continue to strengthen in pediatrics. Efforts to protect this pipeline are hindered by limited information about the training structure during residency, how physician-scientists are supported, and barriers specific to this training period. Our study assessed the current state of training for pediatric physician-scientists during residency through a nationwide survey.

Methods: A survey of pediatric physician-scientist training was disseminated to pediatric program directors through the Association of Pediatric Program Directors. The data were analyzed with descriptive statistics, Pearson chi-square, or Fisher's exact test.

Results: Out of 200 pediatric residency program directors, 76 responded to the 24/26 closed-ended items in the survey (38% response rate). The response rate was 68 out of 200 for the remaining 2/26 qualitative open-ended items identifying program barriers and subject comments. There was no statistically significant difference between responders (n=76) and non-responders (n=123) by program setting (p=.08) or by geographic region (p=.16). No significant differences were found between program settings using the American Board of Pediatrics Integrated Research Pathway (43%) and Accelerated Research Pathway (29%). University respondents reported health services and translational research as the most available research options for their trainees. Identified barriers including lack of institutional resources, challenges fostering dual professional identity, and insufficient human capital were identified across institutions.

Conclusions: Program directors utilize diverse pathways to train pediatric physician-scientists. The majority of pediatric physician-scientist trainees follow the categorical

pathway. Identified barriers as perceived by pediatric program directors focus on institutional climate and support for physician-scientist development.

What's New:

Pediatric physician-scientist training varies widely amongst residency programs capitalizing on the flexibility of pathways provided by the American Board of Pediatrics. Understanding current training practices allows for strategic dialogue on next steps to develop best practices for future workforce development.

Body of Article:

Introduction

Addressing the precipitous decline and near extinction of the pediatric physician-scientist workforce has been a paramount objective for the academic pediatric community during the past half-century [1]. Physician-scientists are an essential link between medical sciences and clinical practices critical to the discovery of paradigm-shifting biological insights and life-saving therapies. Reduction of the National Institutes of Health (NIH) budget by 22% along with decreased pediatric research support in terms of training and individual grants has significantly compounded the problem of a declining pediatric physician-scientist workforce [3-6].

Pediatrics is the third most selected specialty, following internal medicine and pathology, by MD/PhD graduates from the Medical Scientist Training Program (MSTP). To enhance opportunities for pediatric trainees to develop as physician-scientists, the American Board of Pediatrics (ABP) has created two alternative research pathways--the Accelerated Research Pathway (ARP) and the Integrated Research Pathway (IRP) (https://bit.ly/35BTPvt) that provide flexible clinical training experiences. In order to bolster the pipeline, the pediatric physician-scientist community must strategically foster the development of a mixed workforce in which approximately half of trainees are MSTP graduates with substantial prior research experience and the other half are "late bloomers" who have no to limited prior research experience before entering residency training [12].

Whereas there have been accrued reports of best practices and outcomes of internal medicine physician-scientist residency training programs [21,22], little is known about training a distinct and

unique pediatric physician-scientist workforce. Physician-scientist training in pediatrics is more diverse than in other specialties in terms of type of training pathways, programs, and candidates, which may present unique challenges to strategic planning. At the same time, this variety in training approaches may provide a fertile ground for innovating best practices and determining how differing training programs impact outcomes. The National Pediatric Scientist Collaborative Workgroup (NPSCW), a committee of leaders in research and education across sixteen pediatric institutions, has begun to address this unmet need to formulate best practices in pediatric physician-scientist training. A unifying theme from engagement with leaders at the Pediatric Academic Societies (PAS) and Association of Pediatric Program Directors (APPD) was that challenges and training experiences could vary greatly depending on institution size, program structure, and geographic region[1].

To address this knowledge gap, the NPSCW conducted a survey to describe the existing training structure, resources, and supports across the Accreditation Council of Graduate Medical Education (ACGME)-accredited residency programs. Our goal was to better understand through the lens of program directors, training approaches, barriers and experiences that may enhance physician-scientist training programs.

Methods

We conducted a needs-assessment survey of pediatric residency program directors of the ACGME-accredited residency programs in the United States. The goal of this needs assessment was to describe the current landscape of physician-scientist training during residency relating to approaches, mechanisms of support, curricula, and tracked versus perceived outcomes

(descriptive purpose). We also sought to gain contextual insights of the program directors into their perceived barriers in developing opportunities for physician-scientist training (clarification purpose). More specifically, we aimed to answer the following questions:

1. What is the extent of physician-scientist training available to pediatric residents across ACGME-accredited residency programs?
2. Given the diverse training pathways afforded by the residency programs, what is the program structure of physician-scientist training?
3. How may we use the information about trainee characteristics, program settings, program structure and mechanisms of support to inform our strategic planning to strengthen the pipeline for the physician-scientist workforce in pediatrics?
4. What are perceived barriers or lessons learned, through the lens of a program director, to developing a physician-scientist training during residency?

Survey Development

We used a systematic approach to guide the development of the survey[2,3]. The 26 members of the NPSCW, comprising content experts in training physician-scientist residents in pediatrics and survey methodological experts, formed a subcommittee to develop the survey. Through an iterative process, we derived 26 question stems in four domains: demographics, curricula, support, and funding (Supplementary Figure). One qualitative, overarching open-ended question was used to identify barriers to developing a pathway or track for training physician-scientist residents at the respondent's institution. 6 definitions were included at the beginning of the survey to ensure a shared mental model on key terms such as the definition of a physician-scientist resident. We conducted cognitive interviews with NPSCW members who were not involved in survey development and revised the survey questions according to feedback. Skip

logic was incorporated to tailor survey questions based on the programs' experience in training residents.

We sent out an invitation to all 200 pediatric program directors to participate in the study via the APPD mailing list. The respondents were instructed to consider consulting others within the programs overseeing the training of physician-scientist residents. The survey, disseminated via Survey Monkey platform (SurveyMonkey Inc), along with three reminder emails were sent between September 2019 and October 2019.

Using a respondent's identification number, the APPD provided demographics of the corresponding program including the program geographical region, program setting ([a]university-based, [b] nonprofit, [c] community-based, university-affiliated, [d] community based and [e] military), and total residency program size.

The study was approved by the Baylor College of Medicine Institutional Review Board.

Data Analysis

We used descriptive statistics to summarize program demographics. Pearson chi-square or Fishers'-exact test were used for comparing responder vs. non-responder programs, and programs with vs. programs without physician-scientist training. The median number of total, categorical, and combined residents in the university based and community-based, university affiliated were compared using Wilcoxon rank-sum test. All analyses were conducted on SAS statistical software, version 9.4 (SAS Institute Inc., North Carolina). Qualitative responses were analyzed using an interpretivist approach to thematic analysis[4]. Sensitized by the quantitative

survey results (e.g., program demographics), two independent investigators (AB and WP) used in-vivo coding software to facilitate generation of a list of codes and preliminary themes. We used constant comparative method to derive themes, subthemes and selected representative quotes.

Results

Demographics

Responses were received from 76 program directors (38% response rate) representing 76 individual programs. Table 1 includes characteristics of the programs. 31 programs (41%) reported having a pediatric physician-scientist training program and either currently have or have had physician-scientist residents in their programs (Table 1). There was no statistical difference between the program setting (p=.051) or the region (p=.697, data not shown) of those who had a physician-scientist trainee (n= 31) versus who did not (n=45).

A significantly larger proportion of the 31 programs with physician-scientist training were university-based than community-based programs (68% vs. 32%,p=x). The majority of programs train physician-scientist residents within the categorical program and not through a separate physician-scientist track (within categorical) as noted by only 19% of program directors indicating that they have a separate NRMP (National Residency Match Program) match number.

Non-Response Bias Analysis

No statistically significant difference was found between responder (n=76) and non-responder (n=123) by program setting (p=.08), or by geographic region (p=.16). There were a higher

number of total residents (p=.03), categorical residents (p=.04), and combined residents (p=.04) in the responder versus non-responder programs.

Trainee Background

To determine the research backgrounds of physician-scientist residents, we inquired about prior research experience and additional degrees obtained by pediatrician-scientist trainees that had ever trained within the program (Table 1). The two most common degrees of all (past and current) are MD/PhD and MD/MPH reported by 26 and 17 programs, respectively. Prior research experience varied greatly from no research experience (n=14), to 0-1 years' experience (n=13), and to 2-3 years' experience (n=11) (data not shown). Only 23% of programs, which were all university-affiliated programs, allowed physician-scientist trainees to pursue a graduate degree.

Training Program Structure

Overall, the most common training pathway available to physician-scientist residents within this sample was the categorical pathway with protected research time, used by 84% of the programs. 58% of programs reported having a separate physician-scientist track. Figure 1 shows the different pathways offered to residents on the categorical track (Fig 1A) or on a separate research track (Fig 1B) pursuing a physician-scientist career. Residents can participate in the nonstandard pathways through categorical and though a separate physician-scientist track. Out of the two non-standard research pathways, the ARP and IRP, the IRP was more frequently used in both the pediatric physician-scientist track (48% IRP vs. 33% ARP, p=) and the categorical program (42% IRP vs. 26% ARP, p=). An equal percent of community-based, university-affiliated (50%), and university-based (48%) programs offered the IRP pathway for the pediatric

physician-scientist track. Similarly, there was no significant difference in percentage of IRP pathway use by community-based, university-affiliated (40%), and university-based (43%) for categorical track. As pursuing the IRP or ARP requires pre-approval by the ABP, in which a commitment to research is demonstrated through prior research training, we inquired around the graduate degrees held by current trainees that are pursuing various pediatric physician-scientist pathways at responding programs. Interestingly, the current majority of MD/PhD residents (n=31, total number from responding programs) were on a categorical pathway with protected research time in comparison to the ARP (n=12) and IRP (n=5). Similarly, the majority of MD-only trainees (n=298 total number shown) or DO degree (n=37) used the categorical pathway. Upon inquiring how protected research time is defined, an insufficient number of programs responded to perform analysis.

Program Curricula

To understand distinct curricula for pediatric physician scientist residents, we inquired around all the types of research that could be pursued at their own or affiliate institution. Residents could pursue a broad range of research across all programs (Fig. 2). The three most common types were health services research ( ), epidemiology research ( ) and translational research ( ). The least common type was basic laboratory research, which was available in only x% of the programs overall, 14% and 20% in university- and community-based programs, university-affiliated, respectively. Health services research was more commonly available in university-based than community-based programs (100 vs. 70%, p=.03).

Program Resources and Supports

The majority of the programs reported having both a core research curriculum (81%) within the department, research publication support (65%) and resources to attend an academic meeting (94%). Approximately half of programs provided curricula to support career transition to becoming a fellow or junior faculty (58%) and social events with either physician-scientist peers (48%) or faculty (45%) (Table 2). More university-based than community-based programs provided research resources, such as training in grantsmanship, to support transition to fellowship (71% vs. 30%, p=.05).

Most programs (94%) provided assigned physician-scientist research mentors (i.e., physician-scientists) whereas only 40% of the programs provided assigned mentors for the entirety of residency, and 37% provided assigned mentors only for support of research curriculum-specific activities. There were no significant differences in the community-based, university-affiliated versus university-based programs in the type of mentorship provided (p=.54)

Administrative and Financial Supports

Only 19 (61%) of programs have a dedicated physician-scientist program director (combining those with and without protected effort), and only 8 (27%) have part-time (or certain time of year) administrative coordinator (Table 3). Additional support was also noted from departmental leadership as program directors agreed with the statement that executive leadership, including the Physician-in-Chief and the Vice-Chair for education, were involved in institutional support and recruitment of physician-scientist trainees (data not shown). Additional salary support and research funding to physician-scientist residents was available in only 3 and 4 programs, respectively. Most programs (77%) provided funding for travel expenses and 32% of the programs provided book and supply fee support. The largest portion of funding support for

salary and research of physician-scientist residents was from hospital funds (median 100%, range x-y), followed by funds from the department (median a%, range x-y) (data not shown). Only a small portion of support (median x%, range) was from medical schools, the NIH through the new StARR (R38) mechanism, philanthropy, and other (data not shown).

Pediatric Physician-Scientist Trainee Outcomes

To monitor the outcomes of the training programs, many programs tracked manuscript publications (48%), awarded grants (35%), and subsequent academic positions (55%) (data not shown). Program directors were asked what outcomes they thought their physician-scientist program has facilitated. In comparing responses between university-based and community-based, university-affiliated programs, no significant differences were found in terms of ability to obtain a first-choice fellowship position (76% vs 70%), extramural funding as measured by NIH-mentored and independent awards (14% vs 20%), or tenure and promotion across appointment levels (instructorship to full professor) (data not shown). Upon seeking to identify the number of physician-scientist trainees that have transitioned to faculty with independent funding, an insufficient number of programs responded to perform analysis.

Barriers to Pediatric Physician-Scientist Training

We derived three distinct themes from comments pertaining to the challenges related to both a lack of resources and support to meet the demands or address logistical barriers to building a pathway/track for physician-scientist training. Theme one pertains to lack of institutional resources (i.e., finance, human resources, infrastructure). Theme two describes challenges to fostering the dual professional identity formation as a physician-scientist. The last theme refers

to the human capital, specifically the entry pipeline of candidates into the profession. Figure 3 illustrates a conceptual synthesis derived from these interrelated themes.

Figure 3 highlights subthemes for institutional resources or lack thereof (theme one). For theme two, program directors shared their struggles and challenges in accommodating clinical and research experiences without compromising the objectives of both. This theme was highlighted by one program director in the following quote: "We certainly could have a resident do research for some part of their usual individualized curriculum time, but that would be at the expense of other educational elective opportunities, not at the expense of inpatient rotations." their comments reflected the learning economy between clinical medicine and research as mutually exclusive learning experiences imposing difficulties to program logistics. One program director shared in the following quote: "….The only barrier has been the need to limit time in deference to their need to have a proper education to be an unsupervised provider of pediatrics." Physician and researcher development are seen as two separate entities, rather than an integrated identity formation, resulting in contention between the two. Thus, some program directors even viewed physician-scientist training as misaligned with the program mission given their institutional identity as a community-based, clinical service-oriented program.

Mentorship, the most critical element of professional identity formation for residents committed to a dual identity of a physician and scientist, was highlighted as a limited resource by many program directors. Furthermore, programs noted the challenges in "building a structure of support" or a "small number of individuals [trainees]" and "lack of available mentors".

The last theme highlighted the issue of the limited physician-scientist pipeline, as program directors noted that all programs were competing for the same small pool of applicants. In

particular, several program directors echoed the lack of trainees.. These barriers lead to a precarious physician scientist workforce in which it is difficult to sustain training for residents interested in pursuing a career as a physician scientist..

Discussion

Program directors shed light into four core areas of investigation for our study that inform strategic planning:(1) the availability of training, (2) use of training pathways, (3) program characteristics, and (4) perceived barriers.

Availability of Physician-Scientist Training Opportunities

Many professional organizations (e.g., APS, ABP, SPR, AMSPDC, APPD) have provided diverse forms of support for developing pediatric physician-scientists during residency aimed at preventing further corrosion of the pediatric physician-scientist pipeline. Despite these advances and increased momentum in recent years, our needs-assessment survey demonstrates that physician-scientist training is available in fewer than half of the programs in this survey sample (Permar, et al 2020 cite). With those programs that have undertaken such training, a categorical track with protected research time is the most commonly used, rather than other special training pathways, as a program structure. There is a vast mixture of trainee backgrounds, and a significant portion of trainees are “late bloomers” who are MD/DO without significant research experiences. We also report varying levels of institutional support across programs, reflected in the survey results and substantiated by program directors’ narrative comments.

The pediatric physician-scientist workforce is a niche community within academic pediatrics. At the residency training level, formalized curriculum has only been documented in the literature

from a few programs within the past five years[18,19]. All documented programs are primarily at large university settings (Pediatric Academic Societies, 2019 Annual Meeting Scholarly Session Presentations, session #313009 http://bit.ly/pasmtg2019#). Similarly, all responding programs in our study were or are affiliated with universities. The lack of pediatric physician-scientist trainees at community, not-for-profit or military settings supports recent studies highlighting the limited number and type of institutions that have been awarded NIH mentored-K grants[3]. To this end, in dialogue at the 2019 APPD workshop titled "Developing Physician-Scientists During Pediatric Residency", critical feedback was received from pediatric program directors that specific strategies are needed to support trainees at small to mid-sized institutions where there are usually fewer trainees and limited to no research infrastructure(https://bit.ly/2RHr2h0). Furthermore, it was a consensus from the workshop participants, as reflected in our study, that collective dialogue and expertise from Program Directors at diverse programs is essential for providing tailored solutions to unique challenges (unpublished).

Utilization of Diverse Training Pathways

Training for pediatric physician-scientists primarily occurs in the categorical track with non-standard IRP being second and the ARP being the least used option. Furthermore, in support of our second hypothesis, the majority of programs do not have a separate NRMP match number. As a separate NRMP match number usually represents additional allocated slots, the fact that the majority of programs do not have separate numbers for their research tracks suggests that this may be a significant financial item that is not feasible at most institutions. The ABP requirement for proof of prior research experience may present a challenge to utilize these pathways by most pediatric physician-scientist trainees and therefore limit the number of program directors

submitting applications on behalf of their trainees. This was noted in our finding that pediatric physician-scientist residents primarily trained through categorical pathways do not have a graduate degree, as indicated by our findings for either MD or DO trainees. Furthermore, the IRP allows for truncation of clinical experiences to 25 months and up to 11 months of protected research time. Programs with smaller resident numbers may have clinical coverage challenges as noted in the qualitative question around identified barriers for developing one's training program/pathway. That being said, trainees utilizing the ABP pathways have demonstrated early success as measured by continued research productivity and extramural funding during fellowship ([20], unpublished). Measures to enable programs to support a feasible number of trainees could be beneficial to early steps in infrastructure development.

Program Characteristics to Inform Future Planning

Conventionally, medical school students from Medical Scientist Training Programs are provided with resources for considering how to continue research momentum during residency. Our study suggests that expansion of opportunities of early career exploration into academic pediatric careers that combine scientific investigation with clinical practice available for all medical school students as the majority of pediatric physician-scientist trainees have limited to no prior research experience. Often referred to as "late-bloomers", this cohort of residents is often overlooked in terms of tailored programming as only one pediatric residency program highlighted their support through the new NIH StARR (R38) mechanism[18]. As only a limited number of R38 grants are available, creative strategies for supporting residents at smaller and limited resource settings is paramount. One such option may be exemplar pediatric physician-scientist pipeline programs that promote vertical integration, or cross-departmental resources, activities, mentors, and administrative support across the organization [23,18]. Vertical integration

and institutional resource maximization may be more sustainable than support of an advanced graduate degree as 2/3rds of responding programs in our study do not offer this feature. Expectedly, in a third of programs, mentors are only assigned for the duration of residency. Mentorship is a critical component of pediatric physician-scientist training, an interesting area of future investigation would be to evaluate the efficacy of mentorship models through virtual platforms. Mentorship models could also provide critical support for the majority of pediatric physician-scientist trainees that have limited to no research experience. This could be created through models of institutional collaboration and partnership that could expand the faculty pool for trainees and elucidate the challenges that program directors face in supporting a continuity mentorship experience. Partnership with existing mentorship infrastructures through professional societies such as partnership with APSA who have successful UME mentorship programs, may further fill this gap and sustain the pipeline nationally[25]. Furthermore, AMSPDC sponsors the Frontiers in Science (FIS) program, which provides late-bloomer pediatric-resident trainees with mentorship and support to continue research during residency and transition to continuing research during fellowship training [26–28]. Additionally, FIS can be extremely beneficial to trainees at smaller institutions who may lack local mentors.

Interestingly, our survey demonstrated that there are pediatric physician-scientist trainees engaged in a variety of areas of research, including health services research, anthropology, and history and sociology of science, in addition to the more conventional domains of basic and translational research. This trend reflects the flexibility to perform research in non-resource rich environments or departments that have limited extramural funding. Currently, there are not any published reports of pediatric physician-scientist programs that have documented experiences or

training structures for developing research skills in socio-behavioral research through tailored didactic similar to what is available for the biomedical sciences. Given the wide range of reported areas of investigation across these institutions, a follow up needs assessment of NIH funded physician-scientist leaders in each of these interdisciplinary research areas to identify what skills are essential for success could lead to strengthened curricula and training resources to serve as guideposts for program directors.

At this early career stage, developing both peer and vertical networks are key elements of support. Resources such as curriculum support, conference attendance, and social events with peers and faculty were available to residents primarily at university-affiliated institutions and less available to those affiliated with community institutions. merging reports highlight the precarious financial frameworks for academic health centers that have been further challenged by the COVID pandemic. Along with significant shrinkage of pediatric research budgets from the NIH, there is a need for creative measures to continue to support pediatric physician-scientist curriculum such as national resources for grantsmanship versus institutionally supported ones[5], (https://acd.od.nih.gov) (cite recent commentaries).

Barriers to Developing Physician-Scientist Training Structures

Extensive reports over the past half-century have documented the interconnected and challenging barriers to a sustainable pediatric physician-scientist pipeline that included the predominant themes identified in our open-ended qualitative item. Although all responding institutions noted a predominant subtheme of financial resources and a limited pipeline of applicants entering into residency, interestingly community, university-affiliated settings uniquely reported institutional culture as a barrier to training. These program directors reported that training pediatric

physician-scientists does not align with the mission of the institution. Notably, 38% of responding university-based organizations reported subtheme challenges in a lack of mentorship. These responses are valuable as they support extensive studies highlighting similar challenges, but also reveal challenges that are distinct at community versus university-based institutions.

One limitation of our study is the lack of detailed information about current and past trainee demographics including gender, ethnicity, age, and productivity outcomes during residency such as research awards, publications, post-graduate plans, and current roles. As the training community is small, development of standardized national collection mechanisms can support ongoing efforts to better understand the continued leak at pre-and post-residency known attrition points in the pipeline nationally. Data collection through such mechanisms will provide a starting point for understanding how to tailor institutional needs based on historical demographics of program-specific physician-scientist cohort numbers, particularly for fragile communities such as women and underrepresented in medicine groupss[24].

Conclusion

In contrast to other specialties that train physician-scientists such as internal medicine, we found strong diversity in the structure, numbers, and challenges of pediatric physician-scientist training during residency. All programs are affiliated with a university, which speaks strongly to the need to conduct a more in depth needs assessment to address unique challenges to non-university program settings including community, not-for-profit, and military institutions as it is critical for all residents interested in combining a dual career as a pediatric physician-scientist have ample opportunities unique to their institutional milieu. Pediatric Program Directors note limited

resource infrastructure, human capital, and competing priorities that limit dual professional identity formation as barriers to build pathways. As COVID highlights these current constraints, a deeper dive into providing sustainable and tailored solutions that provide new intersections between small institutions with larger partners along with increased engagement and dissemination of pediatric society initiatives such as mentorship programs, travel awards, and small grant mechanisms. Despite these challenges, 31 programs have experience training pediatrician-scientists primarily within the categorical pathway, which will lead to an impetus for training. Increased dialogue amongst pediatric societies and engagement with the stakeholders, namely at those institutions that desire, but are currently unable to train physician-scientist trainees can provide a new inflection point for deeper insight.

Acknowledgements: The authors would like to acknowledge the Association of Pediatric Program Directors (APPD) Research and Scholarship Learning Community for their expert feedback and dissemination of the needs assessment survey. We also would like to thank the program directors for providing insightful feedback into how pediatric physician-scientists are trained at their institution. Furthermore, we would like to thank the Center for Research, Innovation, and Scholarship in Medical Education at Baylor College of Medicine for providing statistical analysis and support.

Figures and Tables:

Table 1: Demographic Characteristics of 76 Responding Programs

	n (%)	p (if applicable)
Physician-scientist training		
Yes (Currently have or not have a resident in the program)	31 (41)	
No	45 (59)	
Program Setting		
University-based		.0511
Community-based- university-affiliated	21 (68)	
Community	10 (32)	
Non-profit	0 (0)	
Military	0 (0)	
	0 (0)	
Separate NRMP Match Number		P?
Yes	6 (19)	
No	25 (81)	
*Degree of all (past and current) Pediatric Physician-Scientist		P?
MD/PhD		
MD/MS	26 (84)	
MD/MPH	9 (29)	
Other**	17 (55)	
	6 (19)	
Opportunity to Pursue Graduate Degree:		P?
Yes	7 (22)	
No	21 (68)	

*options to select all that apply so percentages do not add up to 100
**other- i.e., DO, DO/MS, DO/PhD
All percentages may not equal to 100% as a result of rounding to the nearest whole number.

Figure 1b. Training Pathways Available to Pediatric Physician-Scientist Track Residents

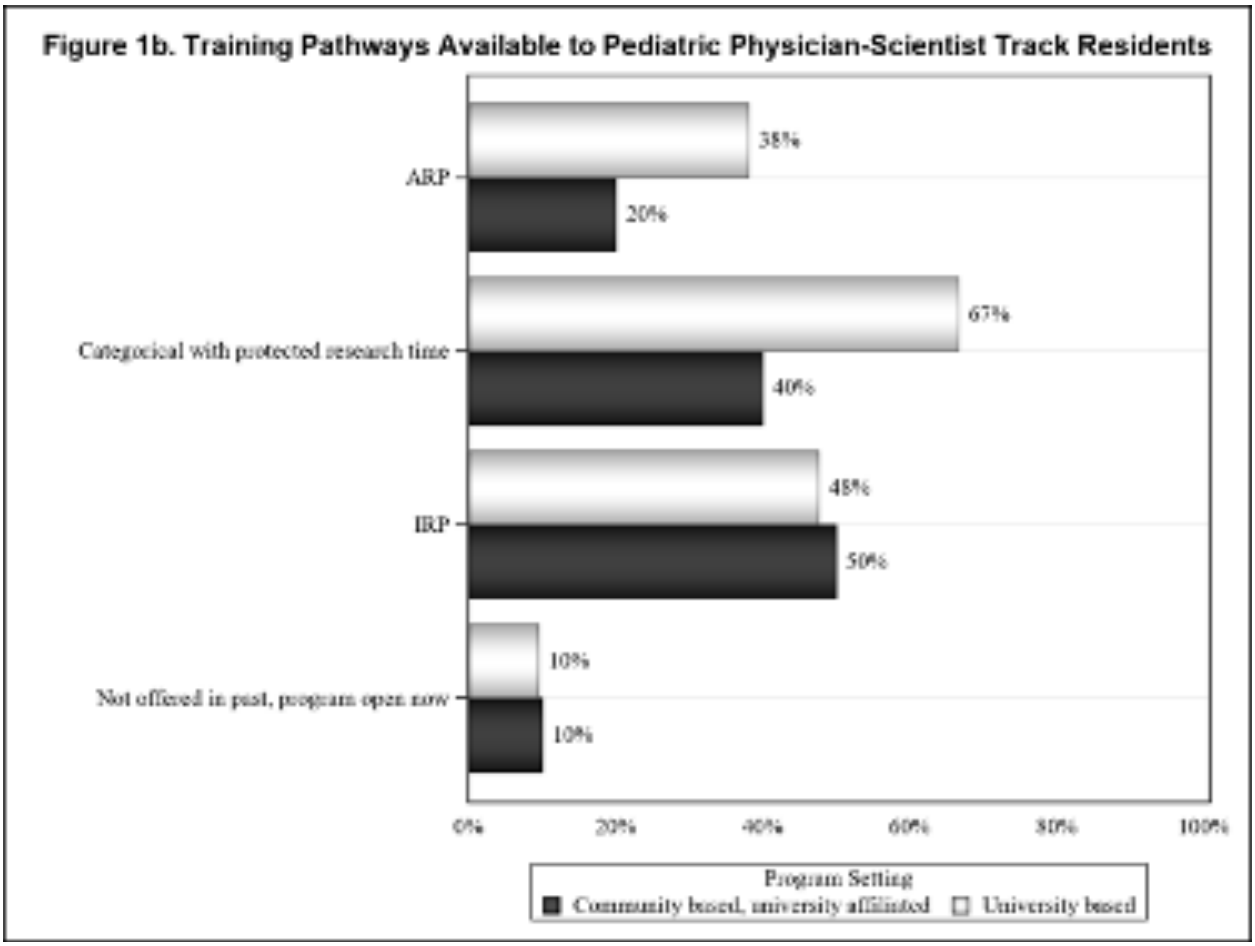
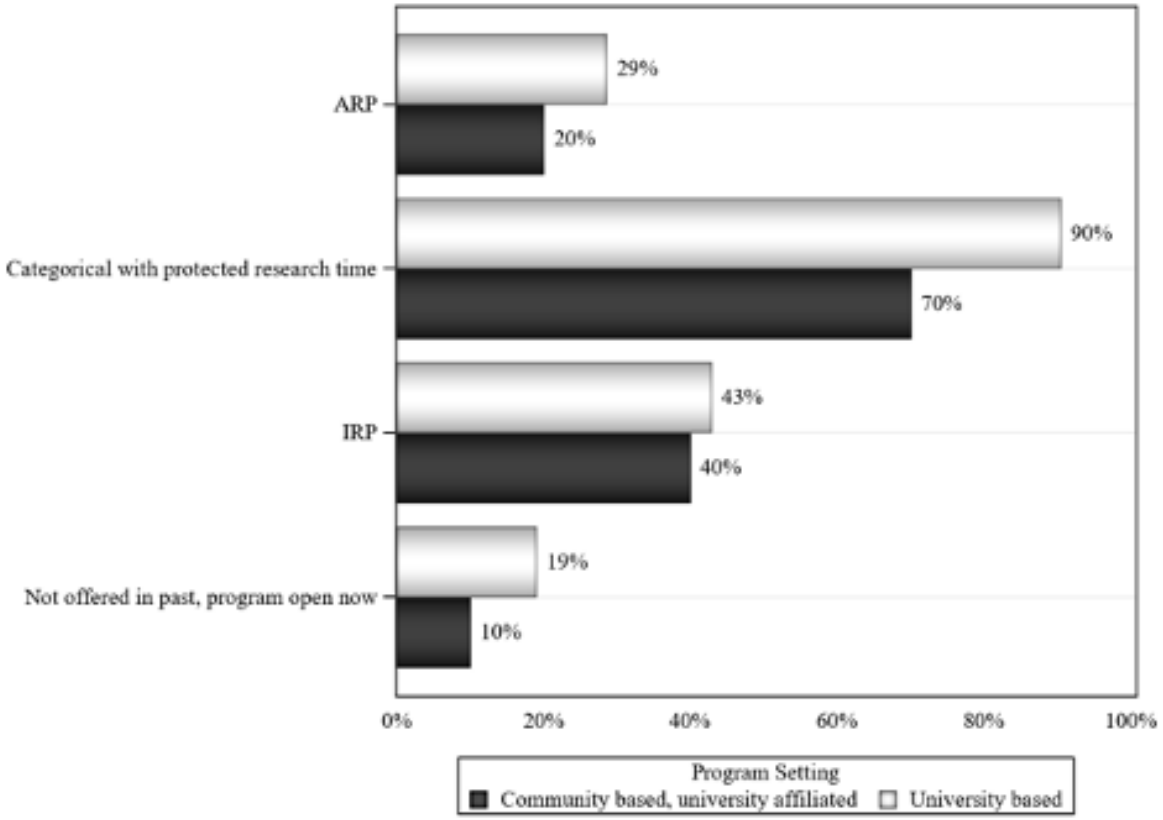
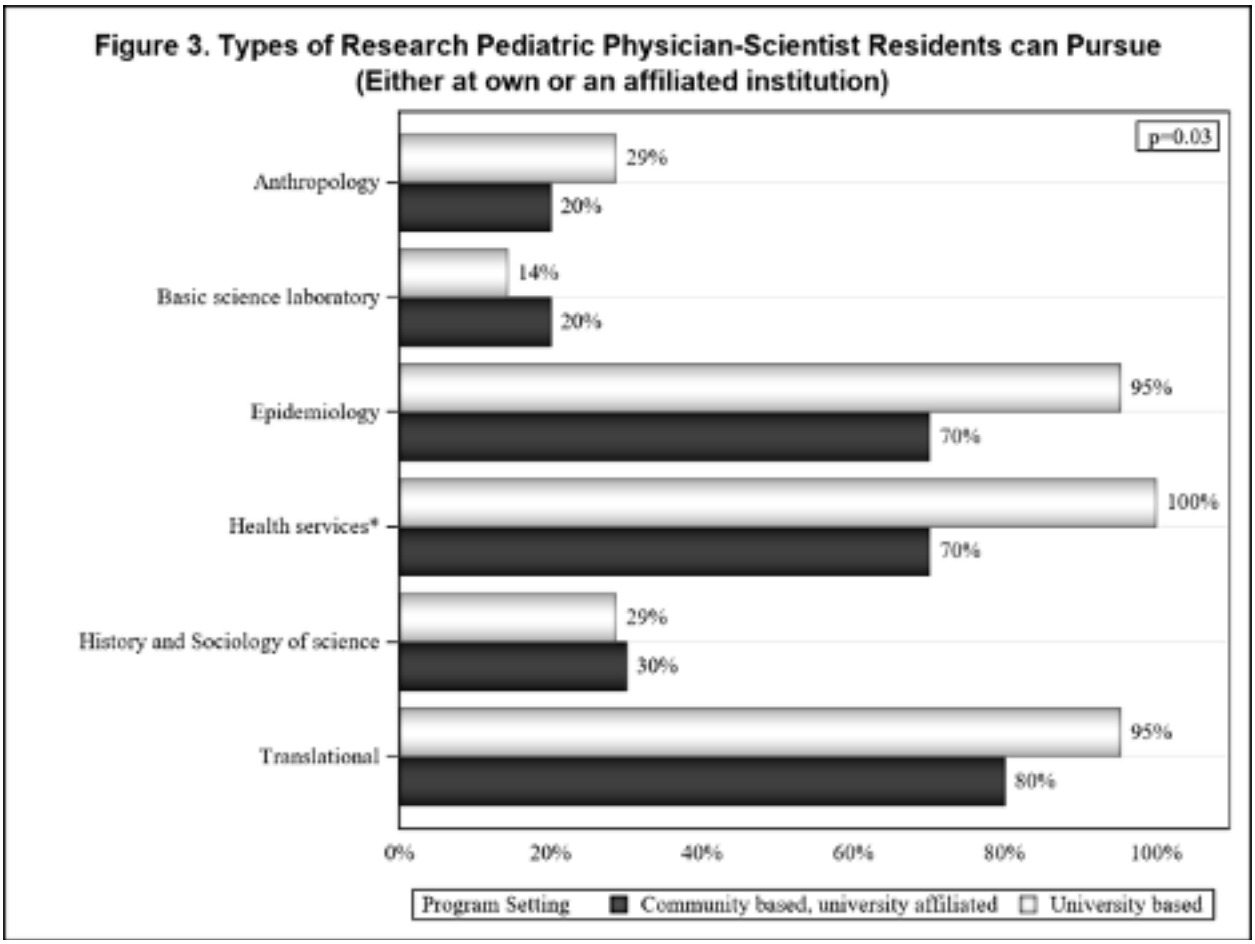


Figure 1a. Training Pathways Available to Categorical Residents Pursuing Pediatric Physician-Scientist Careers





This figure is really Figure 2, " types of research", it has to be modified in SAS

Table 2: Available Resources and Mentorship for Pediatric Physician-Scientist Residents

Available Research and Mentor Resources	All programs (n=31)	Community-based, university-affiliated (n=10)	University-based (n=21)
	n (%)		
Research Resources			
Core curriculum within pediatric department	25 (81)	8 (80)	17 (81)
Core curriculum outside of pediatric department	12 (39)	3 (30)	9 (43)
Transitional curricular support for pediatric physician-scientists when they become fellows (i.e., grantsmanship)	18 (58)	3 (30)	15 (71)
Transitional curricular support for pediatric physician-scientists when they become junior faculty (i.e., grantsmanship)	14 (45)	4 (40)	10 (48)
Scientific or academic conference attendance	29 (94)	9 (90)	20 (95)

Research publication support (i.e., manuscript editing, payment of submission fees, etc.)	20 (65)	8 (80)	12 (57)
Social events with pediatric physician-scientist peers	15 (48)	4 (40)	11 (52)
Social events with pediatric physician-scientist faculty	14 (45)	4 (40)	12 (48)
Mentor Resources			
Research Faculty (pediatric physician-scientist) mentoring	29 (94)	9 (90)	20 (95)
Assigned Mentor for duration of residency (entire curriculum)	12 (40)	5(50)	7 (35)
Assigned mentor for support of research curriculum-specific activities only (i.e., research mentor)	11 (37)	4 (40)	7 (35)

All percentages may not equal to 100% as a result of rounding to the nearest whole number.

Table 3: Institutional Financial and Administrative Support for Pediatric Physician-Scientist Training

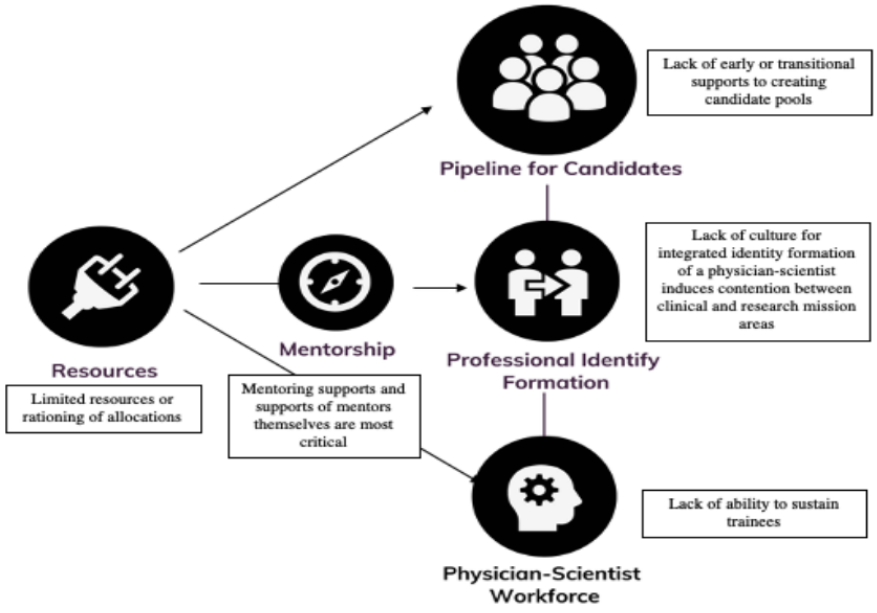
Administrative personnel and available financial support for Pediatric Physician-Scientist residents	n (%)
Program Director with Protected time without protected time No program director	 13 (42) 6 (19) 12 (39)
Administrative Coordinator Yes Yes, but only certain time of year No	 6 (20) 2 (7) 22 (73)
Sources of Salary and Research Support*[s] Hospital Department	 17 (74%) 10 (43%)
Pediatric Physician-Scientist Resident Additional Supplements	
Additional Resident Salary support Yes No	 3 (10) 28 (90)

Additional Research funding support Yes No	 4 (13) 27 (87)
Travel funds Yes No	 24 (77) 7 (23)
Book and supply fee Yes No	 10 (32) 21 (68)

*The percentages will not add up to 100 since the categories are not Independent

[s] Medical school, NIH StARR (R38) grant funding, and Philanthropy were all insignificant sources of salary support (<1%)

Fig. 3. Barriers To Developing A Pediatric Physician-scientist Program*



*The Integration Of Quantitative Survey Results And Narrative Comments.

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Figures and Tables:

Table 1: Demographic Characteristics of 76 Responding Programs

	n(%)	p (if applicable)
Physician-scientist training		
Yes (Currently have or not have a resident in the program)	31(41)	
No	45 (59)	
Program Setting		.0511
University-based		
Community-based- university-affiliated	21 (68)	
Community	10 (32)	
Non-profit	0 (0)	
military	0 (0)	
	0 (0)	
Separate NRMP Match Number		P?
Yes	6 (19)	
No	25 (81)	
*Degree of all (past and current) Pediatric Physician-Scientist		P?
MD/PhD	26 (84)	
MD/MS	9 (29)	
MD/MPH	17 (55)	
Other**	6 (19)	
Opportunity to Pursue Graduate Degree:		P?
Yes	7 (22)	
No	21 (68)	

*options to select all that apply so percentages do not add up to 100
**other- i.e., DO, DO/MS, DO/PhD
All percentages may not equal to 100% as a result of rounding to the nearest whole number.

Figure 1a. Training Pathways Available to Categorical Residents Pursuing Pediatric Physician-Scientist Careers

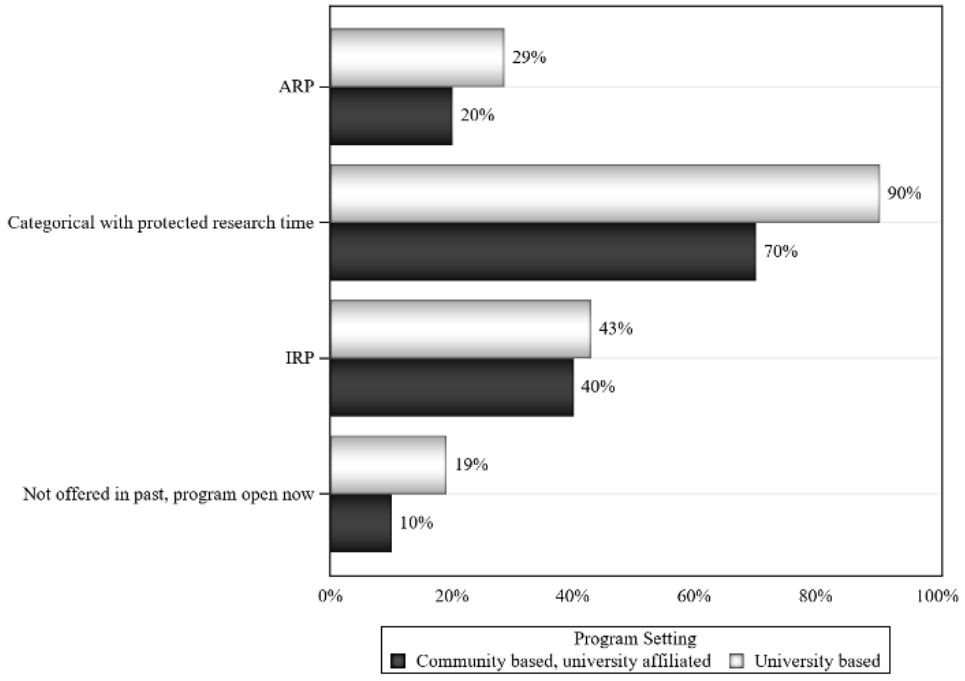

Figure 1b. Training Pathways Available to Pediatric Physician-Scientist Track Residents

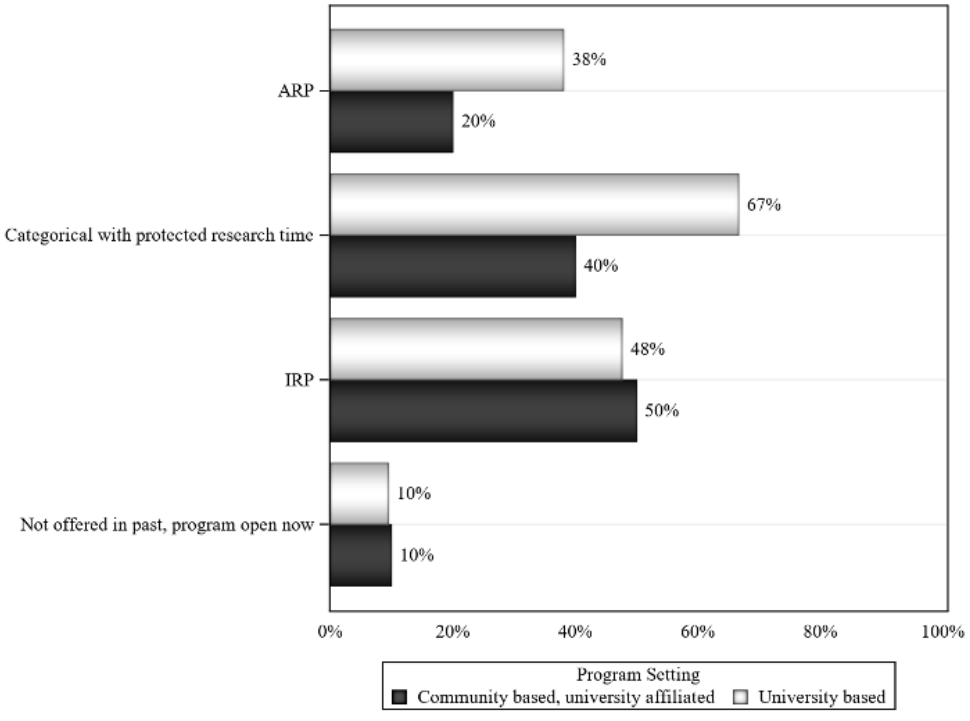

Figure 2. Types of Research Pediatric Physician-Scientist Residents can Pursue (Either at own or an affiliated institution)

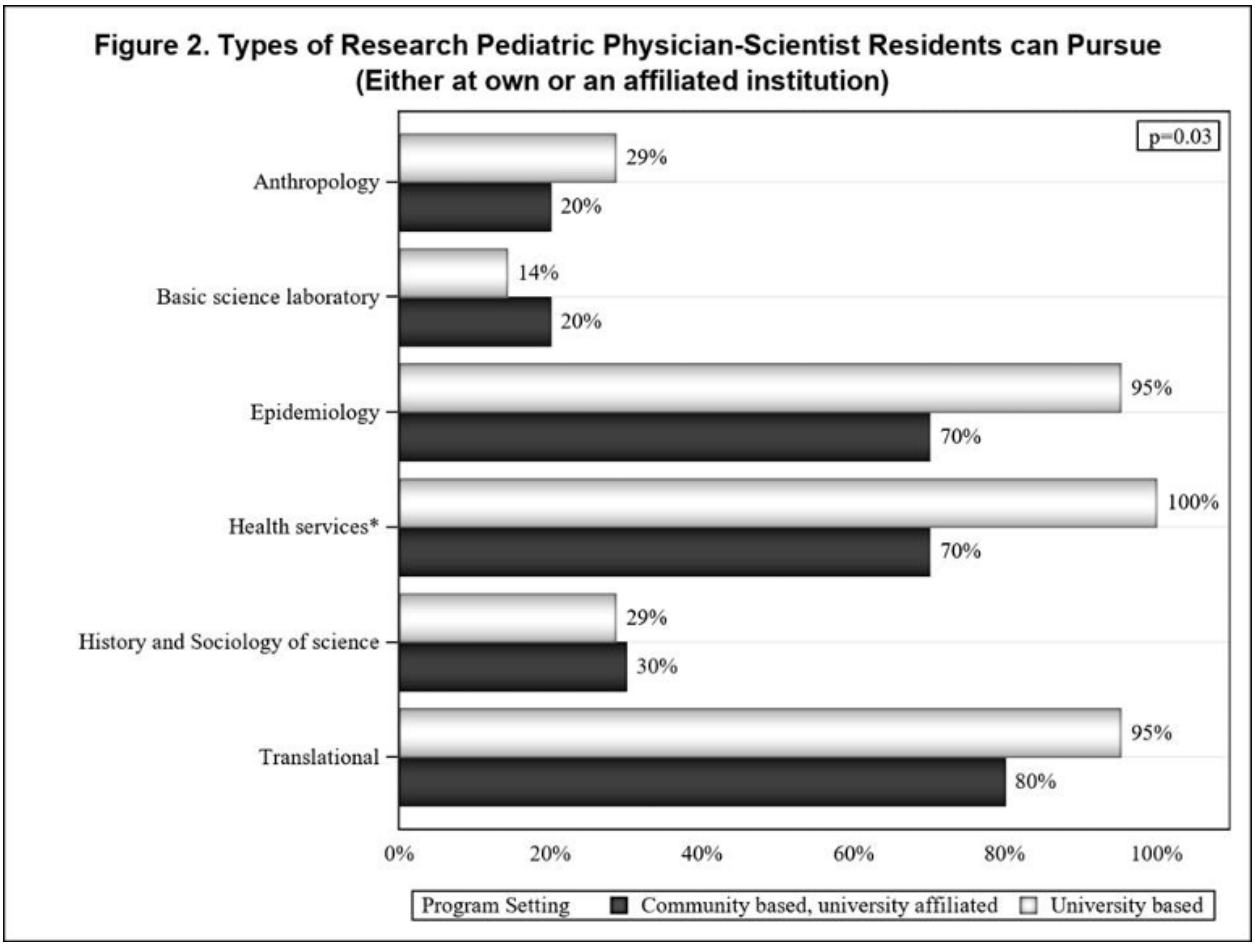

Fig. 3. Barriers To Developing A Pediatric Physician-scientist Program*

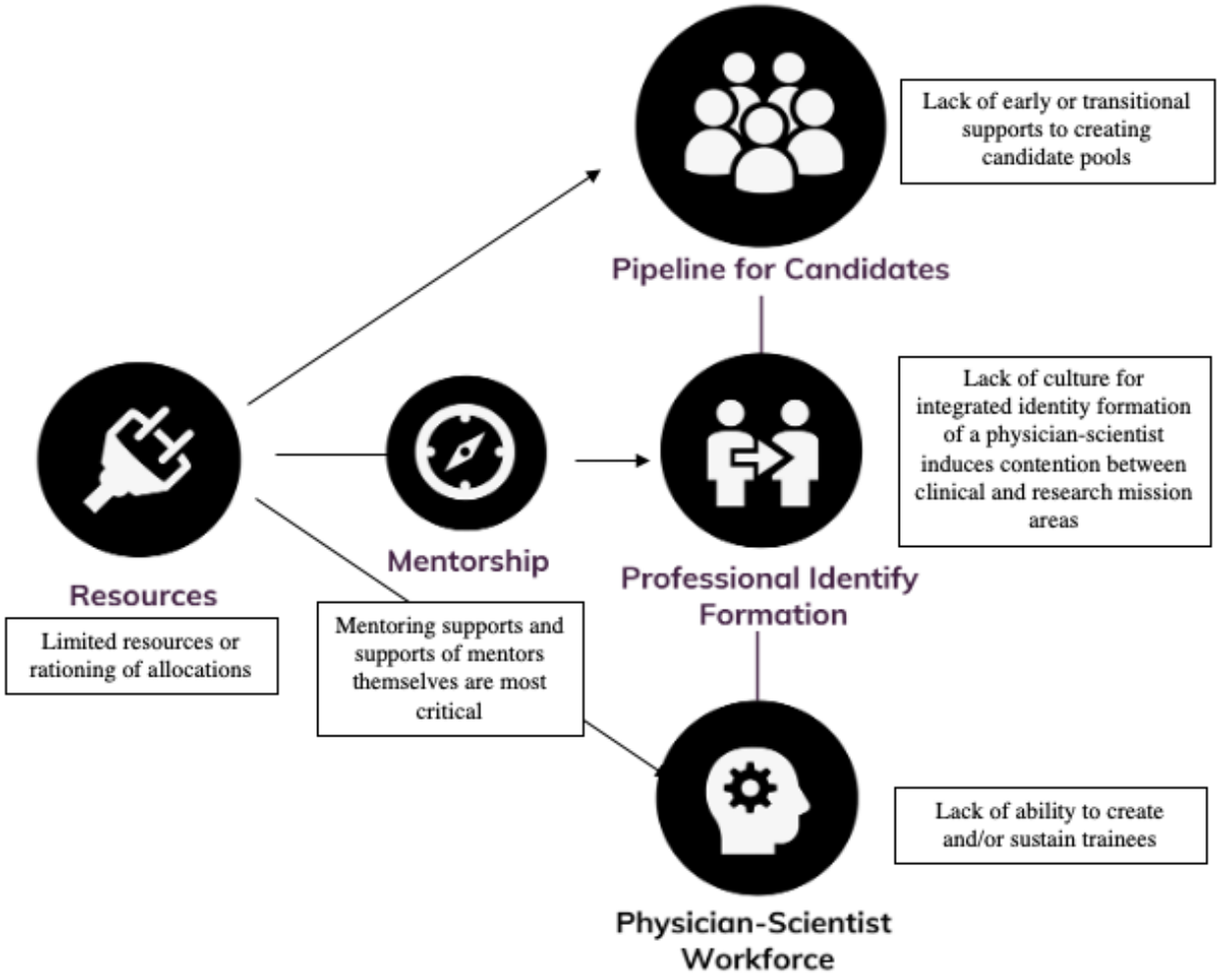

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Table 3: Institutional Financial and Administrative Support for Pediatric Physician-Scientist Training

Administrative personnel and available financial support for Pediatric Physician-Scientist residents	n (%)
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Pediatric Physician-Scientist Resident Additional Supplements	
Additional Resident Salary support Yes No	 3 (10) 28 (90)
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Travel funds Yes No	 24 (77) 7 (23)

Book and supply fee Yes No	 10 (32) 21 (68)

*The percentages will not add up to 100 since the categories are not Independent

$ Medical school, NIH StARR (R38) grant funding, and Philanthropy were all insignificant sources of salary support (<1%)

Supplementary Figure: The Survey

Instructions: Thank you for participating in this survey. This survey aims to gather information about the physician-scientists training that is offered at your residency program. We define physician-scientist training as any form of educational program or track that are in alignment with the American Board of Pediatrics (ABP) Non-Standard Pathways. It should take approximately 15 minutes to complete this survey.

Definitions:

§ Physician-Scientist Trainee- a pediatric resident in one of the research tracks or any trainee with a strong interest in beginning an academic research career during residency
§ Non-Standard Pathways- The American Board of Pediatrics (ABP) has approved two non-standard pathways—The Integrated Research Pathway (IRP) and the Accelerated Research Pathway (ARP). ABP definitions of both can be found here: https://www.abp.org/content/non-standard-pathways. In the survey they will be referred to as the IRP and the ARP.
§ Categorical: Primarily Clinical- This pathway refers to residents that complete the ACGME clinical requirements for pediatric residency training **WITHOUT additional** protected research time.
§ Categorical: Clinical w/ Protected Research Time- This pathway refers to residents that complete the ACGME clinical requirements for pediatric residency training **WITH additional** protected research time.
§ Program Director- A department of pediatrics faculty member that serves in one of the following roles within the residency program: program director, physician-scientist track program director, research track/research pathway program director
§ Protected Research- Protected research is defined as the ability to have **minimal clinical coverage (i.e., jeopardy, back up call,) and the only reoccurring** clinical duties being continuity clinic as required by the ACGME.

PROGRAM DEMOGRAPHICS

1. Do you have or ever had a physician-scientist resident(s)? (Yes/No/N/A -if no, then skip to question 25)

2. Do you have a physician-scientist track/pathway with a separate NRMP match number from the categorical track? (Yes/No/Na- if no, then skip to question 4)

3. Did you fill all of your physician-scientist slots during the previous match year? (Yes/No,)

4. Which of the following degrees have physician-scientist residents in your program had? (check all that apply)
    a. MD/PhD
    b. MD/MS
    c. MD/MPH
    d. MD with 0-1 years of research experience during medical school

e. MD with 2-3 years of research experience during medical school
f. MD with 3+ years of research experience during medical school
g. MD self-identifying as seeking a research career but with no formal training
h. Other (i.e., DO, DO/MS, DO/PhD)

5. Which pathways are available to ***categorical residents*** that identify as physician-scientists in your program? (check all that apply)

a. Primarily clinical w/protected research time
b. IRP
c. ARP
d. Previously offered IRP/ARP, but no longer do so
e. These pathways have not been used in the past, but our program is open to offering them for the right candidates
f. N/A

6. Which pathways are available to ***residents on physician-scientist track/pathway*** that identify as physician-scientists in your program? (check all that apply)

a. Categorical: primarily clinical w/protected research time
b.IRP
c. ARP
d. Previously offered, but no longer do so
e. These pathways have not been used in the past but our program is open to offering them for the right candidates
f. N/A

Logic: If for question 5 or 6 B,C,D or E were checked show questions 7&8

7. How many residents do you ***currently have*** in a non-traditional pathway (i.e., ARP, IRP)? (text box number 0-70)?

8. What *are the* ***maximum number*** of residents per class that you can accommodate in a non-traditional pathway (i.e., ARP, IRP)? (text box number 0-70)?

Logic: If for question 5 or 6 A, D, or E were checked show questions 9&10

9. How many residents do you ***currently have*** in the **categorical program that includes protected research time** (text box number 0-70)?

10. What *are the* ***maximum number*** of residents per class that you can accommodate in the **categorical program that includes protected research time** (text box number 0-70)?

11. Please complete the table below. List the ***current*** number of physician-scientist resident participants in each pathway? (if none, please indicate "0")

	MD	MD/MS	MD/PhD	MD/MPH	DO	DO + combined degree
Categorical - Clinical w/protected research time						
ARP						
IRP						

	0 shifts (no call, backup coverage, jeopardy)	1-2 shifts (any of the following: call, backup coverage, jeopardy)	3-5 shifts (any of the following: call, backup coverage, jeopardy)	6+ shifts (any of the following: call, backup coverage, jeopardy)	N/A (just mark "x" below)
Non-traditional pathway residents					

Categorical residents with protected research time					

12. How is protected research time defined at your institution for physician-scientist residents during a research month? Please note the number of months that include shifts that include any of the following: call, backup coverage, jeopardy)

PROGRAM CURRICULA

13. Please complete the table below. List the ***maximum*** number of months dedicated to protected research during each year of residency. (if all categories are 0, can make optional)
Logic: if question 5 or 6 selected C show:

	PL-1	PL-2
Accelerated Research Pathway		

Logic: If question 5 or 6 selected A show first row, if selected B show second row

	PL-1	PL-2	PL-3
Categorical -Clinical with protected research time			
IRP			

14. What ***are all the types*** of research that physician-scientist residents can pursue during residency at either their own or an affiliated/accessible institution? *(check all that apply)*

a. Clinical research
b. Basic science laboratory research
c. Translational research

d. Epidemiology research
e. Health services research
f. Anthropology
g. History and Sociology of science
h. Other (small text box)
i. N/A

15. Which are available for physician-scientist residents? *(check all that apply)*

a. Core curriculum within pediatric department
b. Core curriculum outside of pediatric department
c. Transitional curricular support for physician-scientists when they become fellows (i.e. grantsmanship)
d. Transitional curricular support for physician-scientists when they become junior faculty (i.e., grantsmanship)
e. Research Faculty (physician-scientist) mentoring
f. Scientific or academic conference attendance
g. Research publication support (i.e., manuscript editing, payment of submission fees, etc.)
h. Social events with physician-scientist peers
i. Social events with physician-scientist faculty
j. Other (medium text box field)
k. N/A

16. What types of mentorship are available to physician-scientist residents? *(select the one that is the best fit)*

a. Assigned mentor for duration of residency (entire curriculum)
b. Assigned mentor for support of research curriculum-specific activities only (i.e., research mentor)
c. No formal mentor assignment, but facilitate students in finding a mentor
d. No formal mentor assignment, residents independently find mentor
e. N/A

SUPPORT

17. Is there a designated program director that has protected effort for the physician-scientist track and/or research pathway?

a. Yes, the program director has protected effort
    i. If yes checked, (free text box for percent effort)
b. Yes, the program director does not have protected effort
c. No, there is no designated program director
d. N/A

18. Is there a designated administrative coordinator for the physician-scientist track and/or research pathway?

a. Yes, the program has a full-time coordinator

a. If yes checked, (free text box for percent effort)

b. Yes, the program has a part-time coordinator

c. Yes, the program has a coordinator for certain times of the year only (i.e. recruitment, onboarding)

a. If yes checked, (free text box for percent effort)

d. No, the program does not have a coordinator

e. N/A

19. Please use the following prompts to note the involvement of pediatric departmental leadership in programming for physician-scientist residents:

Scale
1- Strongly disagree
2- Disagree
3- Somewhat disagree
4- Neither agree or disagree
5- Somewhat agree
6- Agree
7- Strongly agree
n/a

A. DEPARTMENT CHAIR:

The physician-in-chief is involved in the ***recruitment***:

1	2	3	4	5	6	7	n/a

The physician-in-chief is involved in ***curricula design***.

1	2	3	4	5	6	7	n/a

The physician-in-chief is involved in providing and/or facilitating program/track ***institutional support.***

1	2	3	4	5	6	7	n/a

B. VICE CHAIR FOR EDUCATION:

The vice chair for education is involved in the ***recruitment***:

1	2	3	4	5	6	7	n/a

The vice chair for education is involved in ***curricula design***.

1	2	3	4	5	6	7	n/a

The vice chair for education is involved in providing and/or facilitating program/track ***institutional support.***

1	2	3	4	5	6	7	n/a

C. VICE CHAIR FOR RESEARCH

The vice chair for research is involved in the ***recruitment***:

1	2	3	4	5	6	7	n/a

The vice chair for research is involved in ***curricula design***.

1	2	3	4	5	6	7	n/a

The vice chair for research is involved in providing and/or facilitating program/track ***institutional support.***

1	2	3	4	5	6	7	n/a

20. For physician-scientist residents, does your program include the following? ***(check all that apply):***

a. Opportunity to pursue graduate degree:
   i. MS
   ii. PhD
   iii. Other (i.e., MPH, M.Ed, MBA) (short text box)

b. Additional financial support during residency:
   i. Salary support (if checked: how much?-free text box)
   ii. Research funding support if checked: how much?-free text box)
   iii. Travel funds
   iv. Book and supply fee (if checked, how much?- free text box)

c. Requirement to apply for the following grant award
   i. NIH career development award (i.e. K or F)

ii. Other award (short text box)

d. Commitment of fellowship position in subspecialty of choice

e. Additional financial support when residents advance to fellowship:

i. Salary support (if checked, how much?- free text box)

ii. Research funding support (if checked, how much?- free text box)

iii. Travel funds

iv. Book and supply free (if checked, how much?-free text box)

f. Commitment of junior faculty position after completion of training

i. Research funding support (if checked, how much?- free text box)

ii. Others : (Short Text box)

g. N/A

21. What are the sources of salary/research support for ***current*** physician-scientist residents? (indicate the percentage): (if all categories are 0, can make optional)

	Percentage (all columns should total 100%)
Hospital	
Department	
Medical school	
NIH R38 StaRR	
Philanthropy	
T32	
Other (please indicate)	
Other (please indicate)	

OUTCOMES OF PROGRAM TRAINING

22. Of the following metrics, what do you track in the graduates of your physician-scientist training program? (check all that apply)

a. Manuscripts published
b. Grants obtained
c. Academic positions
d. Other outcome measures (please specific, short text box field)
e. N/A

23. In reflecting on your physician-scientist alumni, which, if any, of the following outcomes do you think training in your physician-scientist program has facilitated? *(check all that apply)*

a. Obtaining first choice fellowship position
b. Obtaining NIH Career Development Award
c. Obtaining NIH independent Investigator ("R funding)
d. Appointment to instructorship
e. Appointment to assistant professorship
f. Obtaining >50% protected research time in junior faculty appointment
g. Obtaining >75% protected research time in junior faculty appointment
h. Promotions to Associate Professor
i. Promotion to Professor
j. Other (please specific)
k. N/A

24. Over the past 10 years, how many of your physician-scientist trainees have transitioned to faculty with independent funding either at their home or another institution? (if all categories are 0, can make optional)

	# of physician-scientist trainees	Total # of physician-scientist trainees
Categorical-Primarily Clinical		
Categorical - Clinical with protected research time		
IRP		
ARP		

25. What barriers have you encountered in developing your pathway/track for physician-scientist residents (Large open field text box, if no barriers, please indicate “no barriers encountered”)

26. Additional comments are welcome: (large textbox)