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ORIGINAL ARTICLE

Changes in factors influencing fellowship choices among radiology residents from 2008 to 2018 and methods that may increase interest in the pediatric radiology subspecialty

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Abstract

Background Fewer residents are choosing a career in pediatric radiology, which is contributing to an ongoing shortage of pediatric radiologists.

Objective To identify potential causes of reduced interest in pediatric radiology as a career given a projected worsening of a nationwide shortage of pediatric radiologists.

Materials and methods An online questionnaire using previously published questions was approved and distributed by the Program Directors in Diagnostic Radiology to diagnostic radiology residents on behalf of the Society for Pediatric Radiology (SPR). Descriptive statistics including means with standard error and independent t-tests were used to compare mean scores between survey years.

Results Nearly all of the 353 respondents (90.9%) planned on pursuing a fellowship. The majority (57.7%) identified their fellowship subspecialty before the 3rd year of residency with only 5.7% selecting pediatric radiology. Overall, 18.2% of survey respondents favored academic practice compared to 40% in the pediatric radiology subgroup. Fellowship choices were most strongly based on area of strong personal interest, marketability and area of strong personal knowledge, while the pediatric radiology subgroup emphasized area of strong personal interest, increased interaction with other physicians and enjoyable residency rotations. The pediatric radiology subgroup believed their impact on patient care was more significant than other subspecialties. Pediatric radiology job opportunities were thought to be more limited, geographically confining, and to have lower salaries than other subspecialties. More flexible job opportunities and higher demand were identified as factors needing to change before a resident would consider a pediatric radiology career.

Conclusion The influence on fellowship selection is multifactorial. By emphasizing the favorable job market and marketability of pediatric radiology in all practice types/geographic locations, correcting perceived salary gaps and stressing the impact on patient care as early as medical school, the number of residents choosing a career in pediatric radiology may grow.

Keywords Fellowship · Influencing factors · Pediatric radiology · Residents · Survey

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Introduction

Historically, there are ebbs and flows in the radiology job market. Currently, there are a large number of available jobs in radiology, and the projected number of jobs is expected to increase over the next several years [1]. While pediatric radiology represents only 5.5% of the radiology workforce, this pattern is readily demonstrated in this subspecialty by the increasing number of available positions advertised over the past three years on the Society for Pediatric Radiology (SPR) and American College of Radiology (ACR) job boards [2]. That being said, while the number of practicing pediatric radiologists has increased from 2012 to 2017, the overall number of residents choosing to do a pediatric radiology fellowship has steadily declined [1]. Currently, in the United States, there are 44 ACGME-accredited (Accreditation Council for Graduate Medical Education) pediatric radiology fellowship programs with an additional 3 in the initial accreditation phase. Canada has seven unaccredited fellowship programs. Since the peak of 129 fellows in 2013–2014, in which 41 out of 52 total programs had fellows (both United States and Canada), the numbers have continued to decrease. In 2015–2016, there were 101 fellows in 32/52 programs with fellows, and in 2018–2019, there were only 82 fellows in 30/51 programs with fellows [Boylan J and Davis A, Society for Pediatric Radiology, personal communication]. In 2015–2016, the fill rate of ACGME-accredited pediatric radiology fellowships was 66%, and that number decreased to 44% in 2018–2019 [3, 4]. Even the largest fellowship programs in the United States are not filling all of their fellowship spots [4]. This has resulted in a serious supply and demand gap in pediatric radiology with fewer graduating fellows available to fill the growing number of jobs. Part of the decrease in the number of fellows is related to the new restrictions on board eligibility as international physicians now are required, with rare exception, to complete an ACGME-accredited residency in order to become board certified as opposed to the previous option of the alternative pathway through multiple fellowships [5]. This problem is further exacerbated by the high number of practicing radiologists approaching retirement age, with an estimated 28% of currently practicing radiologists over the age of 55 [1]. On a 2016 survey of SPR members, the number of practicing pediatric radiologists planning on retiring within the next 10 years is even higher at 37% [unpublished data from the SPR Physician Resources Committee retirement survey 2016].

Perceptions regarding job marketability and job availability are important factors influencing radiology subspecialties. Several years ago, the numbers of available jobs in pediatric radiology were lagging behind the available jobs in other subspecialties [3]. This may, in part, explain why fewer residents are choosing pediatric radiology as a profession. However, there are a number of other factors and perceptions that may also affect the fellowship choice of radiology residents, such as salaries, geographic limitations (e.g., academic institutions in large urban areas), call demands and patient/physician interaction.

The SPR Physician Resources Committee aimed to identify the factors influencing the fellowship decisions of current radiology residents to identify potential modifiable areas with the aim of increasing the number choosing a fellowship in pediatric radiology. A similar effort was made by a workforce task force for the SPR in 2008 [6]. A survey utilizing the same questions was employed and distributed nationally.

Materials and methods

Permission was obtained from the authors of a previous publication using a questionnaire to assess factors influencing the decisions of residents on their fellowship choice [6]. The survey questions were reviewed by the members of the SPR Physician Resources Committee and determined to be applicable to residents currently in training. The survey was approved by the institutional review board at the senior author's (R.H.B.) institution. The survey was approved by the Program Directors in Diagnostic Radiology (through the Radiological Society of North America). Individual program directors were contacted and asked to distribute the link for the survey to their diagnostic radiology residents. The residents were contacted via email. The email lists were handled by the individual program directors. The goal was to contact each of the 4,690 diagnostic radiology residents. The SPR executive secretary and authors were blinded to the respondents' email addresses as well as to how many residents were contacted.

The survey was distributed through an online survey tool, SurveyMonkey.com (Portland, OR). The questions were uploaded and posted on the survey agent's website. The survey opened on April 24, 2018, and a reminder was sent to program directors on April 30, 2018. The survey closed May 18, 2018.

Twenty-four questions were included in the survey (Appendix). There were five parts to the questionnaire with the first section focusing on fellowship plans, and the second section focusing on career plans. The third section (Question 6) listed 20 factors that may affect the fellowship choice of the respondent and utilized a 5-point Likert-type scale to measure the importance of each item based on the respondents' selections. The fourth section evaluated personal perceptions that may affect the respondents' fellowship and career choices. Those respondents who had selected that they were not interested in pediatric radiology were then asked if there were circumstances that may alter their interest toward pursuing a career in that subspecialty. Respondents were also asked to enter additional thoughts about a fellowship or career in pediatric radiology (Question 18). The last section focused on demographic information, such as location, age and gender. Fellowship, as explained in Question 1, referred to a traditional fellowship after

the completion of residency and did not specify whether the fellowship was ACGME-accredited or unaccredited. A write-in option was available if a specific fellowship was not listed.

Results are reported as mean±standard error (SE) for numerical data and percentages for categorical data. To compare factors influencing fellowship choice responses in this survey to the 2008 survey, an independent *t*-test was used [6]. Chi-square Mid-P was used to determine any difference between the proportion of respondents who preferred a pediatric fellowship currently to those who did so in 2008. Statistical analyses were performed using OpenEpi Version 3.01 (OpenEpi: Open Source Epidemiologic Statistics for Public Health; Atlanta, GA) [7].

Results

The survey was distributed to diagnostic radiology residents through their program directors. There are approximately 4,690 current diagnostic radiology residents in the United States. It is impossible to know how many total residents actually received the survey; however, there were 353 responses amounting to an estimated response of approximately 7.53%. All respondents were included in the analysis. The total number of respondents was similar to the prior survey (337), which surveyed a random selection of 1,000 residents [6].

Demographics

The majority of respondents were male (73.2%). The mean age was 31 years, and only one-third had children. The residency programs were distributed throughout the United States. Most were training in academic/university settings (82.5%) compared to community programs (14.9%) or other (2.6%). There was a near even distribution of respondents in their first, second and third years of residency (27.7%, 27.6% and 25.3%, respectively) with 17.4% in their fourth year. The few remaining were interns, fellows or in a combined radiology/nuclear medicine program. These findings are summarized in Table 1.

The majority of respondents selecting pediatric radiology as a fellowship choice were also male (55.6%), although the gender gap was smaller in this subgroup. There was no difference in age, percentage of those with children or type of residency program. The geographic areas for pediatric radiology differed from the overall group with the Midwest accounting for the majority (44.4%), followed by the Northeast (27.8%), South (16.7%) and West (11.1%). The distribution of residents was also similar (Table 1).

Fellowship selection

Nearly all respondents were planning to pursue a fellowship after residency (90.9%) with an additional 6.8% stating that they would probably pursue one. The percentage of those who stated that it was doubtful that they would pursue a fellowship or that they were not planning on pursuing one was 2.2%.

The highest percentage of residents were planning on going into interventional radiology (24.9%), neuroradiology (19.0%), body imaging (13.3%) and musculoskeletal radiology (12.8%) (Table 1). Only 20 respondents selected pediatric radiology as their fellowship choice (5.7%). There was no significant difference between the proportion of respondents selecting pediatric fellowship between the 2008 survey and the current responses (P=0.41) [6]. Other selected fellowships included women's imaging/mammography, chest/cardiac imaging, MRI, nuclear medicine, cross-sectional body/interventional radiology, neurointerventional radiology and informatics. Six percent indicated that they wanted to pursue a fellowship but did not have a preference on type.

The majority of respondents indicated that they identified their fellowship choice during or before the second year of residency (57.7%). A surprising number of respondents indicated that they made their decision in medical school (18.8%) (Fig. 1). In the pediatric radiology subgroup, 75.0% made their decision before their third year of residency with 25.0% choosing during that year. Most respondents were first introduced to pediatric radiology during their third or fourth year of medical school (32.1%) or first or second year of radiology residency (50.8%) (Fig. 2).

Impact factors on fellowship choice

The most influential elements on fellowship selection among all respondents in order of most to least important included the following (Table 2): "area of strong personal interest," "marketability of the subspecialty," "area of strong personal knowledge/training/expertise," "enjoyable rotations during residency," "intellectual challenge," "job security" and "imaging modalities used."

Compared to the 2008 survey results, "area of strong personal interest" remains the most important factor [6]. "Imaging modalities used" dropped in importance from second to seventh, while "favorable work hours/vacation time" and "favorable daily workload" rose two spots to eighth and ninth most important. "Marketability of the subspecialty" rose from fifth to second and "geographic limitations" rose from 17th to 13th. "Low call responsibilities," "research," "health status of patients" and "desire to join a specific group" remain the least important [6]. There was a significant increase in the following factors' influence on fellowship preference among all respondents: "marketability of the subspecialty," "area of strong personal knowledge/training/expertise," "enjoyable rotation during residency," "favorable work hours," "favorable daily workload," "favorable financial compensation" and "domestic/geographic limitations" (Table 2). There was no significant decrease in any factor's influence on fellowship choice.

Table 1 Demographics of overall respondents and pediatric radiology subspecialty respondents

	Category	All respondents (n=353)	Pediatric radiology subgroup (n=20)
Demographics			
Age in years (range)		31 (26–43) [a]	30.6 (27–35)[g]
Male		73.2% [a]	55.6% [h]
Female		26.8% [a]	44.4% [h]
Have children		28.6% [b]	30.0% [h]
Diagnostic radiology training program setting	Academic/university setting	82.5% [c]	80.0% [h]
	Community program	14.9% [c]	10.0% [h]
	Other	2.6% [c]	0% [h]
Region of training program	Midwest	28.6% [c]	44.4% [h]
	Northeast	24.3% [c]	27.8% [h]
	South	18.4% [c]	16.7% [h]
	West	14.4% [c]	11.1% [h]
Year in residency	First	27.7% [d]	5.0% [h]
	Second	27.6% [d]	30.0% [h]
	Third	25.3% [d]	25.0% [h]
	Fourth	17.4% [d]	30.0% [h]
	Other (intern, fellow or combined program)	2.0% [d]	–
Plan to pursue fellowship	Yes	90.9% [e]	100% [i]
	No	1.1% [e]	–
	Probably	6.8% [e]	–
	Doubtful	1.1% [e]	–
Fellowship plans (subspecialty)	Interventional radiology	24.9% [e]	–
	Neuroradiology	19.0% [e]	–
	Body imaging	13.3% [e]	–
	MSK	12.8% [e]	–
	Women's/mammogram	8.5% [e]	–
	Unsure	5.9% [e]	–
	Pediatric	5.7% [e]	100% [i]
	Chest/cardiac	4.5% [e]	–
	MRI	2.0% [e]	–
	Nuclear medicine	1.7% [e]	–
	Other	1.1% [e]	–
	No plans for fellowship	0.6% [e]	–
Timing of decision	2nd-year residency	38.9% [f]	40.0% [i]
	Medical school	18.8% [f]	10.0% [i]
	3rd-year residency	8.24% [f]	25.0% [i]
	No current preference	7.4% [f]	NA
	Internship	4.6% [f]	10.0% [i]
	Before medical school	2.0% [f]	0% [i]
	4th-year residency	0.6% [f]	0% [i]
	No plans to pursue	0.6% [f]	NA

[a] n=302 respondents

[b] n=301 respondents

[c] n=303 respondents

[d] n=304 respondents

[e] n=353 respondents

[f] n=352 respondents

[g] n=17 respondents

[h] n=18 respondents

[i] n=20 respondents

MSK musculoskeletal, *NA* nonapplicable

The top factors on fellowship selection in the pediatric radiology subgroup were "area of strong personal interest," "degree of personal interaction with other doctors," "enjoyable rotations during residency, "intellectual challenge," "altruism" and "area of strong personal knowledge/training/expertise." Those in the pediatric radiology subgroup were more likely to rate their experiences on the pediatric rotation as great or good (94.4%) compared to the overall group (69.4%). These are similar to the choices of the pediatric radiology subgroup in the previous survey indicating that

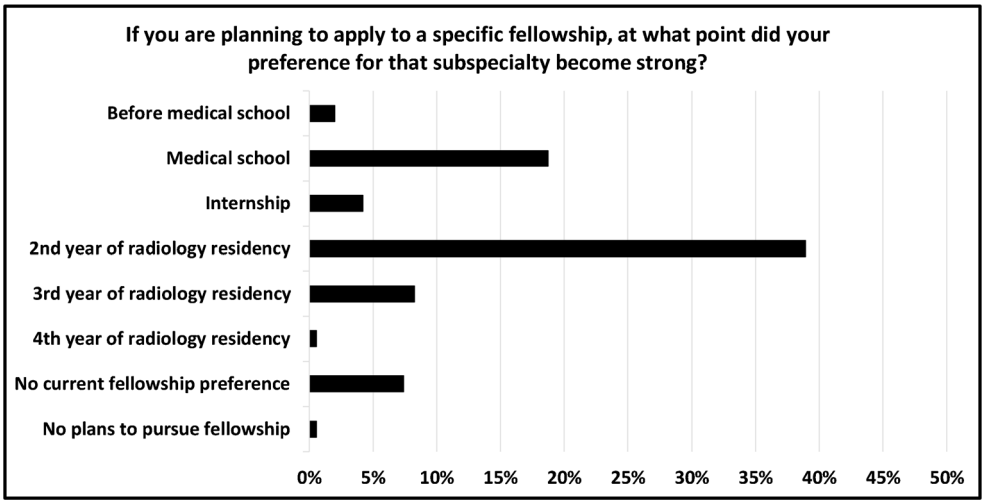

Fig. 1 Time at which preference for fellowship became strong. Distribution of answers (percentages) indicating when respondents chose their subspecialty of interest for fellowship. A high percentage (25.3%) indicated they chose their subspecialty before residency with 18.8% choosing in medical school

"feeling like part of a team" and the experience of a resident or medical student on the pediatric radiology rotation has a large influence on their affinity for pediatric radiology as a career [6]. This personal sense of importance is further supported by the fact that the current pediatric radiology respondents indicated that pediatric radiologists are significantly more impactful on patient care than other subspecialists (66.7%) as opposed to the responses in the overall group that they make the same impact as other subspecialists (67.8%). The only factor that had a significant increase in importance within the pediatric radiology subgroup from the initial survey was research (Table 2). There was no significant decrease in any factor's influence on fellowship choice within the pediatric radiology subgroup.

Perceptions on pediatric radiology as career choice

More respondents preferred a job in a mixed or private practice setting (63.2%) and did not plan on pursuing research after training (42.7%). This group also estimated that 60% of graduating pediatric radiology fellows choose positions at academic centers compared to 32% of graduating fellows in other subspecialties. On the other hand, the pediatric radiology subgroup preferred a job in an academic practice setting (40%) with an even distribution among those planning, not planning or unsure of plans to do research. The pediatric radiology group estimated that 46% of graduating pediatric radiology fellows accept positions at academic centers as opposed to only 25% of those in other subspecialties.

Most respondents believed that doing a fellowship in pediatric radiology was somewhat limiting (35.7%) or very limiting (24.9%) for future job opportunities compared to other fellowships. A large percentage of those choosing pediatric radiology believed it was somewhat limiting (66.7%) while 22.2% indicated that it was not limiting.

There was an overall perceived salary reduction of $50,000 for fellowship-trained pediatric radiologists practicing 5 years after training. This was slightly decreased from the gap in the 2008 survey of $60,000 [6]. It was interesting to see that the perceived pay gap was even higher in the pediatric radiology subgroup with an estimated salary reduction of $74,000 compared to other subspecialties.

Furthermore, approximately half (51.4%) of the respondents indicated that pediatric radiology is fairly marketable

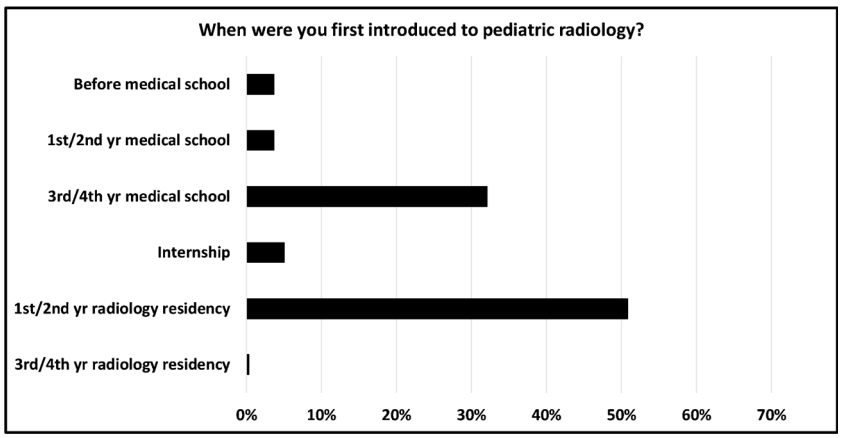

Fig. 2 Time of first introduction to pediatric radiology. Distribution of answers (percentages) indicating when respondents were first exposed to the subspecialty of pediatric radiology. The majority were exposed to the subspecialty in the first 2 years of residency (50.8%); however, a large number were first introduced to it during medical school (35.8%)

Table 2 Factors influencing fellowship selection and how they have changed compared to the 2008 survey results [6]

Factors influencing fellowship selection	All subspecialties[a] (*n*=353)	*P*-value[b]	Pediatric subspecialty[a] (*n*=20)	*P*-value[c]
Area of strong personal interest	4.61±0.04[I]	0.9	4.61±0.16 [I]	0.9
Marketability	3.99±0.05[I]	<0.05	3.5±0.22[–]	1.0
Area of strong personal knowledge/training/expertise	3.93±0.05[I]	<0.05	3.78±0.19[D]	0.9
Enjoyable rotations during residency	3.87±0.05[I]	<0.05	4.17±0.17[I]	0.6
Intellectual challenge	3.83±0.05[I]	0.8	4.06±0.22[I]	0.2
Job security	3.75±0.06[I]	<0.05	3.5±0.17[D]	0.5
Advanced imaging/ multimodality imaging	3.73±0.06[D]	0.1	3.67±0.27[D]	0.6
Favorable work hours	3.51±0.06[I]	<0.05	3.33±0.23[D]	0.4
Favorable daily workload	3.49±0.06[I]	<0.05	3.5±0.22[I]	0.6
Altruism	3.45±0.06[I]	<0.05	4.0±0.20[I]	0.8
Impact of a teacher/mentor	3.36±0.06[I]	0.08	3.39±0.21[I]	0.6
Favorable financial compensation	3.32±0.06[I]	<0.05	2.39±0.20[D]	0.3
Degree of personal interaction with other doctors	3.32±0.06[I]	0.8	4.28±0.16[I]	0.5
Domestic /geographic limitations	2.92±0.07[I]	<0.05	3.5±0.33[I]	0.2
Degree of patient contact	2.89±0.07[I]	0.5	3.22±0.29[D]	0.5
Little or no call responsibilities	2.86±0.07[I]	0.5	2.56±0.25[D]	0.4
Desire to strengthen an area of weakness	2.84±0.07[D]	0.6	2.44±0.25[D]	0.5
Research	2.58±0.07[I]	0.2	2.89±0.28[I]	<0.05
Patients' health/physical status	2.41±0.06[I]	0.1	3.0±0.27[I]	0.9
Desire to join a specific group/practice	2.33±0.07[I]	0.3	2.33±0.32[D]	0.6

Factors are listed in decreasing order of importance

[a] Expressed as mean±SE

[b] Independent *t*-test between Arnold 2008 survey and current results for all subspecialties

[c] Independent *t*-test between Arnold 2008 survey and current results for pediatric subspecialty

[I] Increased from Arnold 2008 survey

[D] Decreased from Arnold 2008 survey

[–] No change from Arnold 2008 survey

compared to other subspecialties with only 10.1% indicating that it was not very marketable. On marketability, 44.4% of the pediatric radiology subgroup believed that subspecialty was fairly marketable with an even number selecting that it is either very or not very marketable (28.8%). Both groups answered that they believed pediatric radiology would be as stable as other subspecialties if jobs in the radiology market became scarce with the pediatric radiology subgroup stating that they would be a good deal more stable (27.8%) compared to the overall group (18.1%).

When surveying the respondents who did not select a pediatric radiology fellowship choice for items/factors that would have to change in order for them to consider it for a career, the majority indicated that they would require more flexible job opportunities, a higher demand for pediatric radiologists and a stronger desire to work with children. Better compensation was the next most important followed by the need for good experiences/intellectual stimulation during their pediatric rotations. Write-in comments included concerns regarding limitations in private practice opportunities and geographic limitations, fewer relative value units than other specialties, the practice being too generalized as more residents want to focus on specific modalities (i.e. computed tomography/magnetic resonance imaging), that it's an emotionally taxing/challenging specialty, and perceived inabilities to practice other areas of radiology, such as nuclear medicine or adult radiology if fellowship trained in pediatric radiology. There were several respondents who indicated that they loved pediatric radiology, but that they loved another subspecialty more. A few also indicated that they would like to consider other subspecialty tracks in pediatrics, such as pediatric neuroradiology, nuclear medicine or interventional radiology.

Discussion

The majority of residents indicated that they selected their area of fellowship before their third year of residency (64.2%) with a surprising number saying they chose it even before starting residency (25.3%). Given the high percentage of respondents who selected a fellowship in interventional radiology and considering, historically, that many medical students choose a

radiology residency with the intention of going into interventional radiology, it may be that this group accounts for many of those who made their decision early. It will be interesting to see if and how this changes now that the integrated interventional radiology residency is available. Nonetheless, early exposure to pediatric radiology, both as students and residents, is necessary to increase the recruitment into this subspecialty.

Part of the challenge of meeting the increasing demand of pediatric radiologists is the lack of a supply, not just of residents interested in a career in pediatric radiology, but of medical students going into diagnostic radiology. Medical student interest waxes and wanes with the job market, and the large shifts in the radiology job market negatively impact the interest in radiology by medical students [8]. An oversupply of diagnostic radiology residents without available jobs can drive medical students into other specialties, and interest in radiology by U.S. medical graduates has declined in recent years.

Yen et al. [9] found that fulfilling daily work, an interest in the subject matter and work-life balance were the most important motivating factors that contributed to medical students' selection of a medical specialty. Extrinsic factors, such as the job market, incomes and prestige, were less important. This ties into the fact that the single most important factor on the selection of a fellowship was and remains that it is an "area of strong personal interest" [6]. While the previous survey results showed that emotional factors were the highest in the selection process, our results show an even distribution of practical factors, such as "marketability of the subspecialty," "job security" and "imaging modalities used," and emotional factors, such as "area of strong personal interest," "area of strong personal knowledge/training/expertise," "enjoyable rotations during residency" and "intellectual challenge."

Therefore, we as pediatric radiologists should emphasize what we love about our subspecialty as well as the sense of fulfillment we gain from our work not only with residents but also with medical students to increase recruitment into our field [9]. This is especially important with the millennial physician trainees who want to do work that gives them a sense of purpose and through which their contributions will matter to the greatest number of people [10]. We can show them the important role pediatric radiologists have in helping with and directing patient care not only in the reading room, but through our engagement with physicians who come to review studies or discuss imaging options and through our involvement in multidisciplinary conferences. This can be done by encouraging medical students to shadow pediatric radiologists. The shadowing experience should be made more valuable by making it interactive, such as having students preview examinations and look up clinical information [11].

When considering the role of gender in the subspecialty of pediatric radiology, there are more female pediatric radiologists (range: 33–45.9%) compared to women in other subspecialties (19%) or non-subspecialists (15%) [12; Davis A, Society for Pediatric Radiology, personal communication]. Therefore, focusing on raising awareness of the subspecialty to female medical students and residents, and emphasizing the fact that this particular subspecialty still has regular patient contact, may represent another way to increase recruitment into the field [12]. Another important point to emphasize with female trainees is that compared to other medical specialties in which there is a disparity in the salaries with men receiving higher salaries than women, in radiology the salaries of men and women are similar [13, 14].

Another recruitment technique that may help and that has proven successful with interventional radiology is to involve medical students in annual society meetings. The Society of Interventional Radiology (SIR) developed and implemented an educational symposium dedicated to medical students over 2 days at its annual meeting and provided 20 travel scholarships to increase medical student interest in interventional radiology [11]. While it is unlikely that these recruitment techniques are the sole reason for increased interest in interventional radiology, they still represent methods that can increase student exposure to a specialty. The SPR could develop a similar program of education and travel grants for the annual meeting to entice medical students who are not necessarily presenting at the meeting to attend and learn more about the subspecialty. They might even be invited to participate in Junior Society for Pediatric Radiology (jSPR) programs at the meeting to increase interaction with junior faculty who may act as mentors. Assigning student attendees a "meeting mentor" may also help generate more interest in the subspecialty. Moreover, many medical centers across the United States also host medical student symposia for interventional radiology [15]. Pediatric radiology could consider doing the same.

Similarly, programs that revised and increased their involvement with radiology interest groups also showed an increase in applications to diagnostic radiology residencies [11]. Increasing the involvement of pediatric radiologists in the early medical school curricula as well as helping with the radiology interest groups at their respective organizations would likely increase subspecialty interest. Participating in these activities would position pediatric radiologists where they may act as mentors to students. Mentorship has been shown to impact fellowship subspecialty selection. In fact, 43% of current pediatric radiology fellows indicated that working with a pediatric radiology mentor was a primary factor in their decision to pursue training in that subspecialty [16]. The ramifications of this are even more sobering as the number of potential mentors will only decline with a continued decline in the number of pediatric radiology fellows, thus worsening the shortage of pediatric radiologists.

Engaging interested students in research projects would also likely increase interest in radiology [11]. Early exposure to radiology research allows students not only to learn more about the radiology specialty, but it aligns them with a mentor

who can help them make informed decisions about their career choice. The exposure to research will also likely make them stronger residency candidates [17].

Traditionally, radiology residents were exposed to pediatric radiology in their second or third years of training with the idea that they would be more developed in their skills by that time to handle the diversity of the field. This approach potentially resulted in fewer choosing a career in pediatric radiology since, by that point in their training, they were more likely to have already chosen their fellowship. More recently, the focus has shifted toward exposing residents to pediatric radiology during the first year so they are prepared for independent call. Early exposure to pediatric radiology may, however, have the opposite effect as residents who are not adequately prepared or who do not have the necessary experience to read all of the imaging modalities may become frustrated, which, in turn, may lead to a bad experience on the rotation thus dissuading them from pediatric radiology. Recognizing this limitation and perhaps modifying which modalities residents are responsible for learning on the first few pediatric radiology rotations, such as focusing on fluoroscopy and radiography, may avoid or ameliorate this potential deleterious effect.

Mini-fellowships have been instituted at many residency programs since the 2008 survey was performed. While the goal of these was to better prepare 4th-year residents for their fellowships, what has transpired is that residents do mini-fellowships in other subspecialty areas so they are able to improve their skills in other areas that they might not see again during their fellowship. This is supported by the American Alliance of Academic Chief Residents in Radiology (A^3CR^2) 2018 survey in which 52% stated that the mini-fellowships are useful for general radiology or subspecialization outside of their chosen fellowship while only 29% stated they were useful in the area of chosen subspecialization, and 19% stated they were not useful at all [18]. Those residents who choose to do extra pediatric radiology rotations are typically those who want to improve their pediatric skills because they like pediatric radiology but have chosen another subspecialty fellowship. While the end result may be that they are more comfortable reading pediatric exams, they are not, by definition, pediatric radiologists and will not improve our workforce shortage.

There is, perhaps, a limitation in how we define or classify a pediatric radiologist. Understandably, we have high standards for ourselves, which we enforce by placing the requirements for becoming eligible for or attaining the Certificate of Added Qualification (CAQ) in pediatric radiology either through completion of a dedicated ACGME-accredited pediatric radiology fellowship or through the American Board of Radiology (ABR) alternative pathway to subspecialty certification. In the latter pathway, a candidate must work full-time (1.0 full-time equivalent) at an institution with an ACGME-accredited pediatric radiology fellowship program with at least 75% clinical responsibility in pediatric radiology for 2 consecutive years or with at least 50% for 3 years [19]. This does, in fact, place geographic limitations on alternative pathway candidates to practice pediatric radiology at academic centers with accredited fellowship programs. While this is done to uphold the standards of the ABR, given the current shortage, a potential modification to the alternative pathway could be made that would allow radiologists to practice at academic centers with diagnostic radiology residency programs that have a dedicated pediatric radiology division but not a dedicated fellowship program. Another limitation is that there are still some programs that have international medical graduates performing multiple fellowships to achieve ABR Diagnostic Radiology Certification through the alternative pathway. Some of these radiologists perform an ACGME-accredited pediatric radiology fellowship as part of this pathway to board certification. However, that fellowship cannot count toward both Diagnostic Radiology Certification and CAQ-eligibility, nor are radiologists able to do a second ACGME-accredited fellowship in the same subspecialty. They are then obligated to take a position at certain centers so they don't lose the potential to become subspecialty-certified, but, depending on geographic or personal limitations, they may take a job that focuses on one of their other subspecialties instead of pediatric radiology. In other words, worse, in a way, than not being able to increase the number of residents choosing pediatric radiology fellowships is that we are training some radiologists to be pediatric radiologists and then not allowing them to gain the necessary certification to practice as a pediatric radiologist without difficulty. We are, in effect, shooting ourselves in the foot.

Furthermore, while respondents believed pediatric radiologists are compensated less than other subspecialists, the survey results indicate that the financial component does not play a strong part in fellowship selection as it was tied for 12th with "degree of personal interaction with other doctors." However, 24.8% also responded that they would require better compensation before considering pediatric radiology as a fellowship, and the importance of financial compensation was significantly higher than in the 2008 survey indicating that it does play a more significant factor when it comes to choosing a fellowship. This notion is further supported by a write-in comment that stated that the respondent's spouse, who is also a physician, was against his/her choosing pediatric radiology even though he/she loved it because of the perception of reduced income compared with other subspecialties. This was in addition to the fear of being tied to a major hospital in a specific geographic location when it was already challenging enough to find two jobs together. On the other hand, the pediatric radiology group thought the pay gap was even higher and chose the specialty for a fellowship in spite of the perceived difference. Nonetheless, national data on the 50th percentile total compensation of academic salaries of radiology subspecialties does not

support the existence of a pay gap as the academic pediatric radiology salaries are on par with the majority of non-interventional subspecialties (unpublished data from the fiscal year 2019 Association of Administrators in Academic Radiology [AAARAD] Faculty Salary & Productivity Survey). Also, the salaries of private practice pediatric radiologists are generally higher than academic salaries although the relative value unit (RVU) production for both practice settings is essentially the same (slightly higher for academic practice) (unpublished data from the fiscal year 2019 Society of Chiefs of Radiology at Children's Hospitals [SCORCH]).

The other areas in which a career in pediatric radiology puts one at a perceived disadvantage are job opportunities and geographic limitations. There is a misperception that private practices do not want pediatric radiologists. In fact, there is a growing need for pediatric radiologists even in this setting as private groups are merging, resulting in increased volumes of pediatric studies and a need for fellowship-trained pediatric radiologists. The demand is also high in academic and mixed practices. In addition, the increasing volume as well as high demand for final overnight reads has resulted in more jobs to cover evening and overnight hours [3]. Ironically, this increased demand for in-house overnight pediatric subspecialty coverage, particularly in large academic practices, as well as increased demand for overnight pediatric teleradiology services, may, in fact, be serving as a potential deterrent for residents because of the stigma associated with nighttime work, although this possibility was not investigated in this survey. On the other hand, having dedicated overnight radiologists or dividing the daily work into shifts may actually reduce or eliminate what some consider to be negative aspects of pediatric radiology, such as the burden of call or longer work hours compared to some of the adult subspecialties. While the data suggest that call does not play a strong role in residents' selection of their fellowship subspecialty, increased call responsibility does, undeniably, serve as a potential deterrent. It is possible that this was not commented on as complaints about too much work do tend to raise questions about the work ethic of the complainer, even if true. As physicians, we tend to work harder when our jobs become more demanding despite the negative effects on our personal lives—a noble characteristic that may also be at the root of the reported increase in burnout in our subspecialty [20]. Residents are perceptive and may pick up on our growing frustrations related to increased clinical and nonclinical work responsibilities with less time away from work.

A review of the SPR job board falsely supports the notion that most available jobs in pediatric radiology are in academic practices as these positions are overrepresented on this website [2]. Conversely, private practice jobs are more often found on the ACR job board in a more representative distribution of the field in which half are in academic practice and half are in private practice [2, 21]. The majority of advertised jobs on the SPR website are in the Midwest, Northeast, South and West with fewer jobs listed in the Rocky Mountain region, Pacific Northwest and Southwest. A summary of the job boards in 2016–2017 showed that there are at least 1.5 jobs available per graduating pediatric radiology fellow [2]. Since then, the number of available jobs has continued to grow, and the need is only expected to increase as approximately one-third of practicing pediatric radiologists are expected to retire within the next 10 years (unpublished data from the 2016 SPR Physician Resources Committee Retirement survey). As a result, the current workforce problem will only get worse if the number of pediatric fellows does not increase, especially if the number of retiring pediatric radiologists is even higher than currently projected—a legitimate concern given the recent report on increased burnout in pediatric radiologists defined by high emotional exhaustion and depersonalization [20].

Overall, this means that a graduating pediatric radiology fellow has a very marketable subspecialty, is likely to find a job without geographic constraints in either academic or private practice, and is likely to have high job security with equitable pay.

Our study has a number of limitations. First, although the response rate is similar to the 2008 survey, we are unable to determine exactly how many residents received the survey, which limits the statistical power of the study. Second, the small response size does represent a major limitation in applying the survey results to all diagnostic radiology residents as a whole. However, when reviewing the 2018 survey results of the A^3CR^2, the relative subspecialty fellowship choices of the respondents are similar to ours suggesting that the results are valid, despite the small sample size (5% pediatric radiology, 21% interventional radiology, 18% neuroradiology, 16% musculoskeletal radiology, 14% body and 13% women's imaging) [18]. Another method of verifying the validity of our results is by looking at the 2017–2018 report on Graduate Medical Education in the Journal of the American Medical Association, which reports that only 26.2% of diagnostic radiology residents in the United States are female, similar to the percentage of female respondents in our survey [22]. Nevertheless, the small sample size does introduce an element of response bias. Third, since the title of the survey included pediatric radiology as a fellowship choice, there is likely a self-selection bias as those interested in pediatric radiology may have had a higher response rate. Conversely, those not interested in pediatric radiology may have been deterred from completing the study. The percentage of pediatric radiology respondents (5.7%) is less than that in the 2008 survey (7%) and higher than that in a 2008 survey (4.4%) [6, 23]. Fourth, while the results are anonymous, there is a chance that the importance of financial compensation was underrated because of the perceived negativity associated with motivations regarding money. The anonymous write-in comments would support that possibility.

Beyond surveys, another way to gather more information from residents on their perceptions of pediatric radiology and why they would or would not consider it as a career path would be to develop focus groups of medical students in their third and early fourth years and diagnostic radiology residents through individual institutions, the SPR or perhaps A^3CR^2, in which oral interviews could be performed to discuss the issues at hand.

Conclusion

We are on the verge of a critical shortage of pediatric radiologists in the United States. We must act now to prevent the effects that such a shortage would occur by increasing the number of residents choosing a career in pediatric radiology. While resident fellowship selection is multifactorial, increased recruitment into pediatric radiology can be achieved by exposing residents and medical students to the subspecialty earlier in order to see the impact that pediatric radiologists have on patient care and to see the importance of their role on the clinical team. Misconceptions regarding the job market (type of practice, number of jobs and locations) and salary gaps also need to be corrected by emphasizing the increased demand and variety of practice types for pediatric radiologists and commensurate pay with other subspecialties.

Compliance with ethical standards

Conflicts of interest None

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