

What Program Directors Think:

Results of the 2011 Annual Survey of the Association of Program Directors in Radiology

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Rationale and Objectives: The Association of Program Directors in Radiology (APDR) conducts an annual survey to monitor and evaluate issues pertaining to radiology residents' educational experiences, work responsibilities, and benefits. Data are used to identify emerging trends and patterns of change to plan and provide resources that support radiology residency programs and their directors.

Materials and Methods: The APDR Annual Survey Committee selected 59 items for an observational, cross-sectional study using a Web-based survey. Topics of interest included program director satisfaction, resident recruitment, social media, program requirements, curriculum, the new American Board of Radiology exam process, call, and residents-as-teachers programs. All active APDR members ($n = 296$) were invited to participate in survey between February 20 and March 11, 2011.

Results: The response rate was 47% (140 of 296). Descriptive results were tallied using SurveyMonkey software, and qualitative responses were tabulated or summarized as comments. Findings were reported during the 59th annual meeting of the Association of University Radiologists.

Conclusions: Data generated by the annual survey enable the APDR to accrue data pertaining to residents' real-time educational experiences. In 2011, program directors were satisfied with their jobs but not convinced that competency-based program requirements had positive effect on residency training. Programs plan to use the Radiological Society of North America and American Association of Physicists in Medicine Web-based physics training modules. Most radiology programs do not have residents-as-teachers programs, nor do they plan to initiate them. During recruitment, programs use an applicant's location as a proxy for true interest in the program, and interest in the program is important for granting interviews and final ranking. Qualified international medical graduate applicants have access to radiology training in the United States and Canada. Almost half of radiology programs have in-house reading by attending radiologists with residents on call. Residency programs have been slow to embrace social media.

Key Words: Survey; residency; radiology; accreditation.

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The Association of Program Directors in Radiology (APDR) has conducted an annual survey to monitor and evaluate issues pertaining to radiology residents' educational experiences, work responsibilities, and benefits in accredited diagnostic radiology residency programs in the United States and Canada since 2000. Data generated by the annual surveys enable the APDR to monitor real-time information pertaining to residents' educational experiences and detect patterns of change at the national level to plan and provide resources for program directors (PDs), foster program

improvement through exchange of ideas and experience, and inform continued discourse with the accrediting and certifying bodies (the Accreditation Council for Graduate Medical Education [ACGME], the Diagnostic Radiology Residency Review Committee, and the American Board of Radiology [ABR]). The annual survey data allow radiology PDs to compare their programs with others around the country, serving as a credible benchmark for resource allocation negotiations. The survey also sends a strong message of support to PDs that they are a part of the large APDR community undergoing similar stresses related to the education of their future colleagues in a rapidly changing and frequently challenging economic and regulatory environment. In this paper, we analyze results of the 2011 annual survey in the context of evolving economic and social milieus in order to share our findings with a wide readership of graduate medical educators who might use this information for program improvement.

MATERIALS AND METHODS

This was an observational, cross-sectional study using a Web-based survey. Members of the 2010–2011 Annual Survey

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Committee selected survey items from those written and proposed by committee members and APDR leadership. The resulting instrument had 59 items, including demographic data. Topics queried included PD satisfaction, resident recruitment, use of social media, program requirements, curricula and the new ABR exam process, call structure, and residents-as-teachers programs. The survey was designed for online administration using a commercially available survey sponsor and proprietary Web site that enables subscribers to develop and analyze online surveys (<http://www.surveymonkey.com>).

All active members of APDR, consisting of PDs in radiology, nuclear medicine, and the radiology subspecialties, as well as former PDs and others who have active roles in residency and/or fellowship training, were invited to participate in the survey between February 20 and March 11, 2011. Responses were collected electronically and recorded without personal identifiable data. Descriptive results were tallied using SurveyMonkey software, and aggregate data were reported. Qualitative responses to open-ended questions were tabulated or summarized and reported as comments.

A summary report was transmitted to the APDR Annual Survey Committee chair for discussion at the 59th annual meeting of the Association of University Radiologists, held April 12 to 15, 2011, in Boston. After the meeting, the report was archived on the "members only" portion of the APDR Web site. Results of the 2011 survey are presented in the [Appendix](#) (available online at www.academicradiology.org).

RESULTS

Demographics

Of active APDR members, 47% (140 of 296) participated in the survey. This was the largest response ever and a 40% increase over the previous year (Kristin Jacob, APDR account manager, personal communication, January 6, 2012). Most respondents were full-time faculty members, representing academic ranks from professor (29% [39 of 137]) to associate professor (32% [44 of 137]) to assistant professor (26% [35 of 137]). Those who identified themselves as "other" (14% [19 of 137]) were instructors or clinical attending radiologists. Most respondents were associated with university (60% [82 of 136]) or university-affiliated (18% [25 of 136]) programs, although community (18% [25 of 136]) and military (3% [four of 136]) programs were also represented. Geographically, more respondents were from the northeastern (40% [50 of 126]) and central (30% [38 of 126]) regions than the Pacific (17% [22 of 126]) and southeastern (13% [16 of 126]) regions.

PD Satisfaction

Almost all respondents found the job to be personally fulfilling (91% [125 of 137]), and most agreed (49% [67 of 137]) or strongly agreed (26% [36 of 137]) that their service as PDs had been beneficial to their career development and progression. The most common reported reason a predecessor left the

position was no longer wanting to be a PD (43% [58 of 135]). The majority of respondents agreed (29% [40 of 134]) or strongly agreed (60% [82 of 136]) their work was supported by their department chairs. Of the respondents affiliated with medical schools, half agreed (40% [54 of 135]) or strongly agreed (10% [13 of 135]) that their medical schools gave them the support they needed to conduct program activities effectively. A quarter of respondents did not feel well trained for their role as PDs, disagreeing (20% [27 of 136]) or strongly disagreeing (3% [four of 136]) with the statement "I believe I have adequate training in education for my position."

Resident Recruitment

Applicants' interest in specific residency programs was important in deciding on interview invitations (51% [67 of 132]) and for ranking (41% [54 of 131]). When applicants did not clearly signal their interest in programs, most (80% [106 of 132]) still invited local applicants to interview, while only half (56% [74 of 132]) did so for applicants outside their local areas. When offered an opportunity to comment on ways of decreasing program recruitment and selection costs, most respondents (81% [107 of 132]) did not favor conducting interviews at outside locations, and half (50% [63 of 127]) were opposed to increasing application costs through the Electronic Residency Application Service. Respondents were more receptive to the potential use of program-specific essays, either required (27% [35 of 132]) or optional (36% [48 of 132]). Regarding the importance of scholarly achievements in resident selection, fewer than one third of respondents considered research experience (31% [41 of 131]), formal degrees (PhD, MS, or MPH; 29% [38 of 131]), publications (28% [36 of 131]), scholarly projects (34% [45 of 131]), educational experiences (29% [38 of 131]), and formal educational training (25% [33 of 131]) important.

Alternatively, respondents thought that Step 1 United States Medical Licensing Examination (USMLE) score was very important (79% [104 of 131]) or slightly important (19% [25 of 131]) for choosing candidates and slightly important (54% [71 of 131]) or very important (34% [44 of 131]) for ranking applicants. A majority of respondents (77% [102 of 132]) were not aware that the USMLE was considering reporting Step 1 and Step 2 as pass/fail without numeric or percentile scores. When asked to consider what this change would mean to their ability to choose applicants to interview and rank, most felt that it would have an adverse effect (80% [106 of 132]).

More than half of the respondents interview international medical graduates (IMGs; 57% [75 of 131]) and/or currently had IMGs in their programs (53% [70 of 132]). Only a minority of programs based at or affiliated with medical schools offered mandatory radiology rotations in their undergraduate curricula (27% [34 of 126]).

Social Media

Fewer than half (38% [50 of 132]) of respondents said that they personally participated on electronic social media sites

(Twitter, Facebook, etc), and only a quarter (24% [32 of 131]) thought that an APDR Facebook page would be of value. Almost half (45% [59 of 131]) reported that their institutions block Internet access to social media Web sites.

Program Requirements

A few respondents (10% [12 of 118]) regarded the impact of the ACGME competencies as essential, whereas 41% (48 of 118) felt that competency-based education had little or no impact on residency training. Similarly, many ascribed little (19% [22 of 116]) or no impact (25% [29 of 116]) to reviewing with documentation competency-based goals and objectives on the first day of each rotation. At the same time, respondents felt that resident participation in hospital committees had some impact (54% [64 of 118]) or was essential (14% [17 of 118]) in residency training.

Physics Curriculum and the New ABR Exam

The majority of respondents (82% [98 of 119]) are planning to modify their physics curricula for the new ABR core exam. Many (42% [50 of 119]) were in favor of repeating the entire didactic physics curriculum annually or every 1.5 years, while others (36% [43 of 119]) plan to spread the physics curriculum over 3 years as introductory, medium-difficulty, advanced courses. Other respondents indicated that they would offer focused physics board preparation during the months prior to the ABR examination only (9% [11 of 119]) or small-group physics discussion sessions instead of formal didactic curricula (2% [two of 119]) or some other combination of experiences (8% [nine of 119]). A few reported that they were still unsure (3% [4 of 119]). There was no consensus regarding plans to send residents to a physics review course for the new ABR exam.

At the time of this survey, 46 Web-based Radiological Society of North America (RNSA) and American Association of Physicists in Medicine (AAPM) modules were accessible through the RNSA (<http://www.rsna.org/Education/physics.cfm>) and the AAPM (<http://aapm.org/education/webbasedmodules.asp>) Web sites. Modules include materials developed by a physicist-radiologist team and a self-assessment examination at the end (1). Almost all respondents plan to integrate these modules into their physics curricula, either by assigning the modules to residents while on rotations (31% [36 of 116]) or by year of training (23% [27 of 116]) or as part of the didactic conference schedule (20% [23 of 116]).

Call

Many respondents (45% [53 of 119]) reported that they had staff radiologists in house reading with residents on call. When staff radiologists were in house, plain-film (41% [23 of 56]), computed tomographic (55% [31 of 56]), magnetic resonance imaging (34% [19 of 56]), and ultrasound (39% [22 of 56]) studies got final interpretations; 64% (36 of 56)

responded that all four modalities got final interpretations. Most training programs (85% [101 of 119]) have ultrasound technologists on call, while a few (11% [12 of 110]) have technologists available in the evenings with residents scanning overnight. Very few (5% [six of 119]) have residents perform most or all ultrasound studies after hours.

Residents-as-Teachers Programs

When residents teach, their learners are primarily medical students (92% [97 of 106]) and peers (89% [94 of 106]). Residents are teaching students on elective time in radiology (64% [68 of 106]), students with declared interests in radiology (44% [47 of 106]), technology students and staff members (38% [40 of 106]), and others, including residents in other specialties (8% [eight of 106]). The majority of respondents (88% [98 of 112]) did not have formal residents-as-teachers training programs. Preferred modes of preparing residents for teaching were a designated seminar day (39% [30 of 77]), a combination of a retreat and a longitudinal program (36% [28 of 77]), or a face-to-face longitudinal program (21% [16 of 77]).

Although fewer than a third (28% [30 of 108]) plan to initiate programs in the future, when asked who designed (or will design) their residents-as-teachers programs, most (64% [40 of 63]) indicated faculty members in their radiology departments. Others did or would borrow from other programs (32% [20 of 63]) or seek input from residents (22% [14 of 63]) and educational consultants (19% [12 of 63]). Two thirds of the respondents (65% [39 of 60]) said that only radiology would participate in their programs. When asked to name the most important aspects of residents-as-teachers training, the majority of respondents identified delivery of education of teaching methods (81% [60 of 74]), identifying learner needs (60% [44 of 74]), and designing education activities (57% [42 of 74]).

DISCUSSION

The 2011 APDR annual survey generated the largest response ever. The response rate of 47% is in line with average response rates for mail surveys reported by Baruch and Brooks (2) in 2008. Like prior surveys, the 2011 survey focused on areas of concern to the membership by using a cross-sectional design observational study to answer the question, "What is happening right now?"

The study had several limitations. Because not all ACGME-accredited PDs are APDR members, there may have been a selection bias (3). Because some APDR members are associate or assistant PDs, some programs may be overrepresented. Because participation is not mandatory, voluntary response bias (4) is an issue, insofar as the responders might have stronger opinions than the average APDR member. While constructing the survey, we tried to avoid leading questions. Still, during data analysis, we were mindful that framing questions may have a significant biasing effect (5) and that even in

an anonymous survey, social desirability (6) may affect subject response.

PD job satisfaction can be viewed as a reflection of the current state of radiology training. It is no secret that the presence of trainees affects clinical productivity. Jamadar et al (7) demonstrated that high-quality resident education decreases attending physician productivity by 50%. In the era of escalating clinical workloads, this demand on faculty time is a challenge for PDs. It is encouraging that most PDs still find the job personally fulfilling and beneficial to their career development and that the overwhelming majority are supported by administration. Insofar as program success depends on the relationship between the department chair and the PD, this is cause for celebration. At the same time, only half the respondents affiliated with medical schools reported adequate support for the residencies from the schools, a finding that is not surprising. In the United States, the graduate medical education mission is traditionally carried out by hospitals, which receive funding for this purpose from the federal government, states, and other sources distinct from and unrelated to undergraduate medical training (8). Trainees at all levels require similar conditions to thrive: a rich academic milieu with adequate resources dedicated to educational mission. Residents in particular are essential to medical student education. They provide hands-on day-to-day teaching and serve as crucial role models (9). The lack of medical school support for residency programs is therefore shortsighted.

It is of concern that a significant number of PDs did not feel adequately trained to take charge of a residency program. This feeling is subjective, as there are no objective measures of "PD readiness," but it is worrisome. Existing resources including new PD courses at the annual meetings of the ACGME and the Association of University Radiologists, communiqués from these groups via e-mail and Web sites, journals such as *Academic Medicine*, *Academic Radiology*, the *Journal of the American College of Radiology*, and the *Journal of Graduate Medical Education*, as well as related publications of the ACGME, the Diagnostic Radiology Residency Review Committee, and the American Medical Association may be insufficient, difficult to access, and inadequately organized to fill the needs of PDs. Local graduate medical education offices may not provide adequate orientation, support, and resourcing for PDs. This calls for a faculty development needs assessment among the APDR membership and presents an opportunity for improvement.

Resident recruitment has changed dramatically in the past decade with the advent of Electronic Residency Application Service, the electronic application system developed by the Association of American Medical Colleges to streamline the matching process while reducing costs to applicants and programs. But by 2010, radiology applicants were applying to 47 programs on average, flooding programs with applications (Association of American Medical Colleges Electronic Residency Application Service data, 2010). As a consequence, PDs and their designees are now faced with hundreds of applications and, therefore, rising costs of resident selection. The

survey data support our hypothesis that many programs use an applicant's connection to the geographic area as a proxy for applicant attainability (likelihood that the applicant would chose the program) and Step 1 USMLE score as a proxy for applicant qualifications (likelihood that the applicant would prove to be a "good resident"). Programs are more likely to invite a qualified applicant to interview when the applicant is local than when the applicant is from outside the catchment area. Because the interview step is the most costly for the program, it is intuitively understandable that most programs would prefer to focus their resources on applicants with local connections. However, two thirds of respondents indicated that interest in the program was also important at the time of the final ranking. Ranking a highly interested candidate higher makes sense when a program believes that enthusiasm predicts positive future resident performance or if the program is under pressure to fill from the top of the rank-order list. The latter may happen when the performance of the program in the match is used as a proxy for program competitiveness. Further research is needed to understand pressures governing the applicant ranking process.

Even though a large body of evidence finds little correlation between USMLE score and global resident performance (10–13), most respondents felt that the lack of a numerical Step 1 score would have an adverse effect on resident recruitment. We speculate that in addition to serving as a convenient Electronic Residency Application Service filter for limiting the applicant pool to a manageable size, Step 1 score is the sole objective benchmark available for comparison across the entire applicant pool. It is uncertain how programs would change their recruitment strategies if this numerical score became unavailable.

Although high-quality mandatory exposure to radiology during medical school has been shown to increase the number of medical students applying to the specialty (14), the small number of training programs based at or affiliated with medical schools offering a mandatory radiology rotation is both a concern for the entire specialty and an opportunity for improvement. On the other hand, more than half of the survey respondents said that they interview IMGs and/or currently had IMGs in their programs. This is good news for qualified foreign medical graduates, particularly at the time when interest in radiology among US medical school graduates appears to be waning.

Given that today's medical students are learning in a social networking era and that radiology is a very technically advanced field, it was somewhat surprising to learn that residency programs have been slow to embrace social media. Almost half the respondents reported that their institutions block access to social media sites at work, so it is not remarkable that only a quarter of respondents saw value of an APDR presence on Facebook. This is not to say that radiology PDs are themselves social network recluses. In fact, 38% (50 of 132) participate in social networking, which is in line with reported 40% personal use of Facebook by residents in 2010 (15). Security and boundary concerns and lack of access are

the likely barriers to greater social network use in radiology training. We will monitor social media trends in future surveys.

Our survey confirms that PDs question the educational value of the ever increasing burden of ACGME requirements. Almost half of these respondents ascribe no value to reviewing goals and objectives with residents before every rotation, a requirement that is both burdensome and formulaic. Responses regarding requirements for the resident learning portfolio, self-assessment and learning plan, systems-based project, fatigue and sleep deprivation, and prohibition on independent call during the R1 year were mixed. In the era of evidence-based medicine and appropriate utilization of resources, PDs are seeking compelling evidence that the time, effort, and other resources required to maintain compliance with ever mounting program requirements will lead to better training outcomes. Such evidence is lacking. Recently published work suggests that compliance with ACGME program requirements such as work-hour restrictions may degrade residents' educational satisfaction (16), decrease their teaching experience (17), and negatively affect standardized test scores and participation in national conferences (18). It is striking, but not unexpected, that only a small minority of respondents attributed a positive impact on the quality radiology residency training to the general competencies. We hope the experienced PD members of the Diagnostic Radiology Residency Review Committee will be mindful of these findings.

After the 2006 and 2007 physics education summits sponsored by the AAPM (1,19), the RSNA and AAPM jointly funded the development of Web-based modules on the physics of imaging for radiology residents (20,21) in the hope of ensuring uniformity and quality of physics education (22). Because the overwhelming majority of PDs are planning to integrate these Web-based modules in preparation for the new ABR core examination, we expect an increase in uniformity, which will hopefully parallel improvements in quality.

Our survey suggests that nearly half of all training programs have staff radiologists in house during the off hours. The concept of 24/7 coverage has evolved since 2007, when only 10% of academic practices had on-call staff coverage (23), and is in part the result of the ever increasing complexity of imaging, requiring around-the-clock resident supervision. It is of note that the vast majority of training programs have ultrasound technologists on call. The vanishingly small minority has residents scanning off hours without any technology presence, which is in line with 2006 findings by Desser et al (24).

The need to train qualified teaching faculty members in radiology is one impetus for residents-as-teachers programs, but our survey found that few programs have formal curricula, in line with the data reported previously by Donovan (25,26). Although this can be seen as an opportunity for program improvement, fewer than a third of programs plan to implement additional curricula. In part this is due to the lack of consensus as to what constitutes the best programmatic approach to training resident teachers. Recent work by

Balmer et al (27) suggests that teaching responsibility assumption by senior residents in the presence of attending faculty members is a negotiation process reminiscent of a dance rather than a formalized assignment of specific teaching and supervision tasks and that it may be affected by clinical context and diversity of missions among training programs. Another barrier is the lack of evidence of such program effectiveness. Given increasingly limited resources, PDs may be reluctant to implement potentially costly curricular innovations without proof that their initiatives will lead to real improvement in outcomes.

CONCLUSIONS

Data generated by the annual survey enable the APDR to accrue and document data pertaining to residents' real-time educational experiences. In 2011, an overwhelming majority of PDs were satisfied with their jobs. As a group, PDs were not convinced that competency-based program requirements have had positive effect on residency training. Overwhelmingly, PDs plan to use the RSNA and AAPM Web-based physics training modules. Most radiology programs do not have residents-as-teachers programs, nor do they plan to initiate them in the future. During recruitment, programs use an applicant's location as a proxy for true interest in the program, and interest in the program is important for granting interviews and final ranking. Qualified IMG applicants do have access to US radiology training. Almost half of the respondents have attending radiologist in house reading with residents on call. Residency programs have been slow to embrace social media.

REFERENCES

1. Hendee WR. An opportunity for radiology: recommendations from the educational summit. *Radiology* 2006; 241:5-10.
2. Baruch Y, Brooks H. Survey response rate levels and trends in organizational research. *Hum Relat* 2008; 61:1139-1160.
3. Berk RA. An introduction to sample selection bias in sociological data. *Am Sociol Rev* 1983; 48:386-398.
4. Sackett DL. Bias in analytic research. *J Chron Dis* 1979; 32:51-63.
5. Tversky A, Kahneman D. The framing of decisions and the psychology of choice. *Science* 1981; 211:453-458.
6. Kreuter F, Presser S, Tourangeau R. Social desirability bias in CATI, IVR, and Web surveys: the effect of mode and question sensitivity. *Public Opin Q* 2008; 72:847-865.
7. Jamadar DA, Carlos R, Caoili EM, et al. Estimating the effects of informal radiology resident teaching on radiologist productivity: what is the cost of teaching? *Acad Radiol* 2005; 12:123-128.
8. Rich EC, Liebow M, Srinivasan M, et al. Medicare financing of graduate medical education: intractable problems, elusive solutions. *J Gen Intern Med* 2002; 17:283-292.
9. Stark R, Bordley DR, Harrell HE, et al. Improving resident teaching to enhance medical student education. Available at: <http://www.im.org/Publications/Insight/Archives/Documents/Vol5Issue2/ImproveResTeach.pdf>. Accessed September 24, 2012.
10. Wood PS, Smith WL, Altmeyer EM, et al. A prospective study of cognitive and noncognitive selection criteria as predictors of resident performance. *Invest Radiol* 1990; 25:761-762.
11. George JM, Young D, Metz EN. Evaluating selected internship candidates and their subsequent performances. *Acad Med* 1989; 64:480-482.
12. Crane JT, Ferraro CM. Selection criteria for emergency medicine residency applicants. *Acad Emerg Med* 2000; 7:54-60.

13. Bell JG, Kanellitsas I, Shaffer L. Selection of obstetrics and gynecology residents on the basis of medical school performance. *Am J Obstet Gynecol* 2002; 186:1091–1094.
14. Gunderman RB, Alexander S, Jackson VP, et al. The value of good medical student teaching: increasing the number of radiology residency applicants. *Acad Radiol* 2000; 7:960–964.
15. Black EW, Thompson LA, Duff WP, et al. Revisiting social network utilization by physicians-in-training. *J Grad Med Educ* 2010; 2:289–293.
16. Vidyarthi AR, Katz PP, Wall SD, et al. Impact of reduced duty hours on residents' educational satisfaction at the University of California, San Francisco. *Acad Med* 2006; 81:76–81.
17. Mazotti LA, Vidyarthi AR, Wachter RM, et al. Impact of duty-hour restriction on resident inpatient teaching. *J Hosp Med* 2009; 4:476–480.
18. Jagannathan J, Vates GE, Pouratian N, et al. Impact of the Accreditation Council for Graduate Medical Education work-hour regulations on neurosurgical resident education and productivity. *J Neurosurg* 2009; 110:820–827.
19. Hendee WR, Bisset GS, Amis ES, et al. An opportunity for radiology: a progress report following the second educational summit. *Radiology* 2007; 245:640–644.
20. Radiological Society of North America. Developers of physics education modules named. *RSNANews* 2008; 18:2.
21. Bisset GS, Hendee WR. Web-based physics education modules. *AAPM Newsletter* 2008; 33:22–23.
22. Hendee WR. Teaching physics to radiology residents. *AJR Am J Roentgenol* 2009; 192:855–858.
23. Hunter TB, Taljanovic MS, Krupinski E, et al. Academic radiologists' on-call and late-evening duties. *J Am Coll Radiol* 2007; 4:716–719.
24. Desser TS, Rubin DL, Schraedley-Desmond P. Coverage of emergency after-hours ultrasound cases: survey of practices at U.S. teaching hospitals. *Acad Radiol* 2006; 13:249–253.
25. Donovan A. Radiology resident teaching skills improvement: impact of a resident teacher training program. *Acad Radiol* 2011; 18:518–524.
26. Donovan A. Radiology residents as teachers: current status of teaching skills training in United States residency programs. *Acad Radiol* 2010; 17:928–933.
27. Balmer DF, Giardino AP, Richards BF. The dance between attending physicians and senior residents as teachers and supervisors. *Pediatrics* 2012; 129:910–915.