

The Profession

# Results of the 2013-2015 Association of Residents in Radiation Oncology Survey of Chief Residents in the United States



Nima Nabavizadeh, MD,<sup>\*</sup> Lindsay M. Burt, MD,<sup>†</sup>  
Brandon R. Mancini, MD,<sup>‡</sup> Zachary S. Morris, MD, PhD,<sup>§</sup>  
Amanda J. Walker, MD,<sup>||</sup> Seth M. Miller, MD,<sup>¶</sup> Shripal Bhavsar, MD,<sup>#</sup>  
Pranshu Mohindra, MD,<sup>\*\*</sup> Miranda B. Kim, MD, MBA,<sup>††</sup>  
and Jordan Kharofa, MD<sup>‡‡</sup>, on behalf of the ARRO Executive Committee

<sup>\*</sup>Department of Radiation Medicine, Oregon Health and Science University, Portland, Oregon; <sup>†</sup>Department of Radiation Oncology, University of Utah, Salt Lake City, Utah; <sup>‡</sup>Department of Therapeutic Radiology, Yale University, New Haven, Connecticut; <sup>§</sup>Department of Human Oncology, University of Wisconsin, Madison, Wisconsin; <sup>||</sup>Department of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins University, Baltimore, Maryland; <sup>¶</sup>Department of Radiation Oncology, University of North Carolina Chapel Hill, Chapel Hill, North Carolina; <sup>#</sup>Department of Radiation Oncology, Integris Cancer Institute, Oklahoma City, Oklahoma; <sup>\*\*</sup>Department of Radiation Oncology, University of Maryland, Baltimore, Maryland; <sup>††</sup>Harvard Radiation Oncology Program, Boston, Massachusetts; and <sup>‡‡</sup>Department of Radiation Oncology, University of Cincinnati, Cincinnati, Ohio

Received Jul 6, 2015, and in revised form Sep 23, 2015. Accepted for publication Oct 6, 2015.

## Summary

The 2013 to 2015 Association of Residents in Radiation Oncology (ARRO) chief resident survey identified poor resident exposure to brachytherapy, high levels of clinical adequacy for all malignancies except pediatrics and lymphoma, and increasing adequacy in

**Purpose:** The purpose of this project was to survey radiation oncology chief residents to define their residency experience and readiness for independent practice.

**Methods and Materials:** During the academic years 2013 to 2014 and 2014 to 2015, the Association of Residents in Radiation Oncology (ARRO) conducted an electronic survey of post-graduate year-5 radiation oncology residents in the United States during the final 3 months of training. Descriptive statistics are reported.

**Results:** Sixty-six chief residents completed the survey in 2013 to 2014 (53% response rate), and 69 completed the survey in 2014 to 2015 (64% response rate). Forty to 85% percent of residents reported inadequate exposure to high-dose rate and low-dose rate brachytherapy. Nearly all residents in both years (>90%) reported adequate clinical experience for the following disease sites: breast, central nervous

Reprint requests to: Nima Nabavizadeh, MD, Department of Radiation Medicine, Oregon Health and Science University, 3181 SW Sam Jackson Park Rd, KPV4, Portland, OR 97239. Tel: (503) 494-8756; E-mail: nabaviza@ohsu.edu

Conflict of interest: none.

Supplementary material for this article can be found at [www.redjournal.org](http://www.redjournal.org).

**Acknowledgments**—We thank Cristin Watson, American Society for Radiation Oncology, for administrative support and assistance. We also thank Drs Bruce Haffty, Colleen Lawton, Brian Kavanagh, and Lawrence Marks for manuscript review.

stereotactic treatments. Residency working conditions and duty hours were stable compared to previous ARRO reports. Additionally, private practice remains the most sought-after career choice. We hope these results will be used by governing bodies to further improve residency training.

system, gastrointestinal, genitourinary, head and neck, and lung. However, as few as 56% reported adequate experience in lymphoma or pediatric malignancies. More than 90% of residents had participated in retrospective research projects, with 20% conducting resident-led prospective clinical trials and 50% conducting basic science or translational projects. Most chief residents reported working 60 or fewer hours per week in the clinical/hospital setting and performing fewer than 15 hours per week tasks that were considered to have little or no educational value. There was more than 80% compliance with Accreditation Council for Graduate Medical Education (ACGME) work hour limits. Fifty-five percent of graduating residents intended to join an established private practice group, compared to 25% who headed for academia. Residents perceive the job market to be more competitive than previous years.

**Conclusions:** This first update of the ARRO chief resident survey since the 2007 to 2008 academic year documents US radiation oncology residents' experiences and conditions over a 2-year period. This analysis may serve as a valuable tool for those seeking to improve training of the next generation of oncology leaders. © 2016 Elsevier Inc. All rights reserved.

## Introduction

Founded in 1982 at the American Society for Radiation Oncology (ASTRO) annual meeting, the Association of Residents in Radiation Oncology (ARRO) represents all radiation oncology residents in the United States and has conducted multiple surveys documenting trainee demographic characteristics, perceptions of the training environment, career aspirations, and motivation. These surveys provide unique insights into the perceived quality of radiation oncology residency training and have been invaluable sources of information for governing bodies to further improve the resident experience (1-9).

Since 2003, ARRO has specifically surveyed chief residents at the end of their training to better define their perspectives on their residency programs and readiness for independent practice. The most recent report of the chief resident survey was based on surveys administered between 2005 and 2008 and was published in 2011 (9). Since then, the field has experienced wider availability of newer technologies (10, 11), changes in the role of radiation therapy in the treatment of malignant and nonmalignant diseases (eg, extracranial stereotactic treatments and brachytherapy) (12, 13), rapid expansion of residency programs (14), continued competitiveness of residency programs (15, 16), and new residency duty hour requirements (17). Given these and other factors, radiation oncology residency training in the United States is rapidly changing, and an updated report of chief resident perspectives was warranted. Here, the results from the chief resident survey from the 2013 to 2014 and 2014 to 2015 academic years are presented.

## Methods and Materials

In the spring of 2014 and 2015, surveys were distributed to chief residents at each radiation oncology program in the

United States (Appendix E1; available online at [www.redjournal.org](http://www.redjournal.org)). Surveys consisted of questions assessing clinical experience (disease site and technology specific), availability of educational resources, research experience, and level of independence. Additional questions were added to the 2015 survey to further characterize resident duty hours, extracurricular activities, and future career plans. Chief residents were contacted by electronic mail to encourage participation and ensure a maximal response rate. Respondents of the 2014 to 2015 survey were entered into a drawing for free registration to the ASTRO annual spring refresher course.

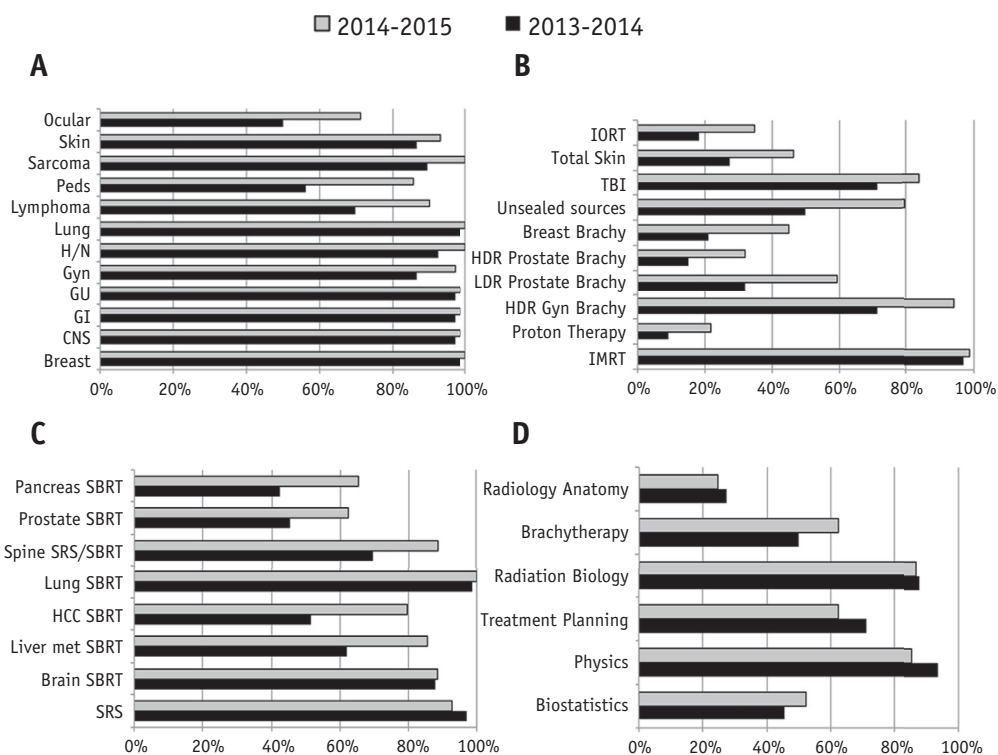
Statistical analyses were performed using SPSS version 21 software (SPSS IBM, Chicago, IL). Descriptive statistics were used to analyze and summarize data.

## Results

Sixty-six chief residents completed the survey in 2013 to 2014 (53% response rate), and 69 chief residents completed the survey in 2014 to 2015 (64% response rate).

### Clinical experience in disease sites

Figure 1A demonstrates the percentage of respondents reporting an adequate level of exposure to particular disease sites. Disease sites for which greater than 90% of respondents reported adequate exposure for both years included breast (98.5% and 100% in 2013-2014 and 2014-2015, respectively), central nervous system (CNS; 97.0% and 98.6%), gastrointestinal malignancies (GI) (97.0% and 98.6%), genitourinary malignancies (GU) (97.0% and 98.6%), head and neck cancer (H/N) (92.4% and 100%), and lung (98.5% and 100%). In 2014 to 2015 only, 100% of respondents reported adequate exposure for breast, CNS, H/N, lung and sarcoma disease sites. In 2013 to



**Fig. 1.** Percentage of respondents in each year who reported receiving adequate experience in (A) clinical disease sites, (B) radiation therapy procedures, (C) stereotactic radiation therapy, and (D) formal didactic courses. *Abbreviations:* Brachy = brachytherapy; CNS = central nervous system; GI = gastrointestinal; GU = genitourinary; Gyn = gynecologic; HCC = hepatocellular carcinoma; HDR = high-dose rate; H/N = head and neck; IMRT = intensity-modulated radiation therapy; IORT = intraoperative radiation therapy; LDR = low-dose-rate; met = metastasis; SBRT = stereotactic body radiation therapy; SRS = stereotactic radiation surgery; TBI = total body irradiation.

2014, 30.3%, 43.9% and 50% of respondents reported no or inadequate level of exposure for lymphoma, pediatric and ocular malignancies, respectively.

### Clinical experience in radiation therapy procedures

Figure 1B illustrates the percentage of respondents reporting an adequate level of exposure to particular radiation therapy procedures. For both years, the majority of respondents reported no or an inadequate level of exposure to intraoperative radiation therapy (81.8% and 65.2% in 2013-2014 and 2014-2015, respectively), total skin electron therapy (72.7% and 53.6%), breast brachytherapy (78.8% and 55.1%, respectively), high-dose-rate (HDR) prostate brachytherapy (84.8% and 68.1%, respectively), and proton therapy (90.9% and 78.3%, respectively). In 2013 to 2014, 68.2% of respondents reported no or inadequate level of exposure in low-dose-rate (LDR) prostate brachytherapy, compared to 40.6% in 2014 to 2015.

### Clinical experience in stereotactic procedures

Figure 1C shows the percentage of respondents reporting an adequate level of exposure to particular stereotactic

radiation therapy procedures. More than 85% of respondents in both years reported an adequate level of exposure for intracranial stereotactic radiation surgery (SRS) and stereotactic body radiation therapy (SBRT) and lung stereotactic body radiation therapy SBRT. More residents reported clinical adequacy in 2014 to 2015 than in 2013 to 2014 for all other stereotactic sites, including liver metastasis SBRT (86% vs 62%, respectively), hepatocellular carcinoma SBRT (80% vs 52%, respectively), spine SRS/SBRT (88% vs 70%, respectively), prostate SBRT (62% vs 46%, respectively), and pancreas SBRT (65% vs 42%, respectively).

### Opinion of quality of formal courses provided by the program

Figure 1D documents the opinion of chief residents on the adequacy of formal courses (ie, a series of lectures or didactic sessions to cover an organized curriculum of topics) provided by their residency program. Greater than 85% of residents in both years reported adequate formal courses in radiation biology and physics, with a quarter of departments providing radiologic anatomy didactics.

### Resident education and research resources/ experience

Figure 2 shows types of research projects conducted throughout residency. Every responding chief resident participated in a research project during residency. Greater than 90% of respondents reported participation in at least a retrospective chart review (95.5% and 94.2% in 2013-2014 and 2014-2015, respectively), followed by a physics/dosimetry project (60.6% and 58.0%). Nearly one-fifth to one-quarter of residents conducted a resident-led prospective trial (22.7% and 20.3%, respectively).

Table 1 details various components of residency education and research experience. Median dedicated research time allotted during residency was 6 months (range: 0-12 months for residents not enrolled in the American Board of Radiology Holman Research Pathway). Greater than 80% of respondents reported that their institutions offered mock oral examinations yearly, provided biostatistical support within the department, and required or recommended a quality improvement project. Few respondents (16% to 22%) reported that their institutions offered formal instruction on how to be a teacher. Additionally, greater than 75% of respondents reported an adequate level of independence as a chief resident.

### Residency duty hours, service obligations, and extracurricular activities

Table 2 details residency duty hours, service obligations, and extracurricular activities of chief residents surveyed in 2014 to 2015. Only 8.7% of respondents reported that moonlighting or locums tenens was approved by their institution for all years, 26.1% reported approval of moonlighting or locums tenens for more senior residents only, whereas 14 residents (20.3%) actually participated in moonlighting or locums tenens activities.

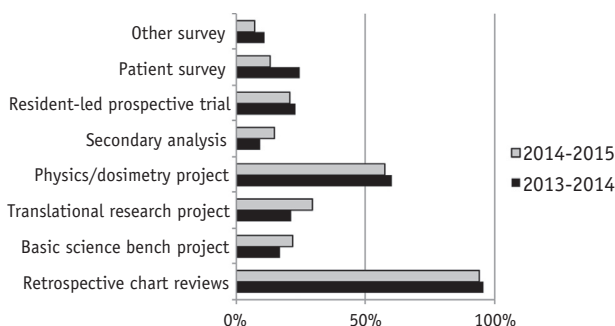
Greater than three-fourths of respondents (82.6%) reported institutional affiliation with a satellite facility for radiation treatments outside of the main facility. The

**Table 1** 2013 to 2015 residency education and research resources and experience

Query	2013-2014	2014-2015
How many months of research did you have during residency?		
None	4.5%	2.9%
1-3 months	18.2%	10.1%
4-6 months	31.8%	40.6%
7-9 months	13.6%	11.6%
10-12 months	30.497%	29.0%
Greater than 12 months (ie, Holman Pathway)	1.5%	5.8%
Are mock orals offered at your institution?		
Yes and they are useful		79.7%
Yes but they are not useful		4.3%
No		16.0%
Is a quality improvement project required or recommended?		
Required	45.5%	71.0%
Recommended	36.4%	21.8%
Neither recommended nor required	18.1%	7.2%
Is biostatistics support available for residents with research projects?		
Available within the institution	71.2%	60.9%
Available within the radiation oncology department	21.2%	24.6%
None available	7.5%	14.5%
Have you had formal instruction on how to teach?		
Yes	21.5%	15.9%
No	78.5%	84.1%
How would you rate your level of independence as a chief resident?		
Adequate	78.8%	84.1%
Would like more independence	21.2%	15.5%
Would like more supervision	0.0%	0.0%

majority of the residents are required to rotate through the satellite facilities (56.4%) with a median of 5 months spent at these facilities. A quarter of residents (26.7%) who rotated at satellite facilities reported being left alone at the facility for longer than 4 hours. Of these, the majority of respondents (87.1%) reported that rotations in satellite facilities were useful to their education.

Most chief residents spent 41 to 60 hours per week on required clinical duties, with most respondents spending 10 or fewer hours on activities considered to have little or no educational value (eg, nonclinical administrative or clerical work). The time required for other activities such as preparing for case or conference presentations was not captured. Additionally, Accreditation Council for Graduate Medical Education (ACGME) work hour limits (no more than 80 hours per week averaged over a month, at least 10 hours between shifts, and an average of 4 days off per month) were obeyed for the majority of respondents (82.6%).



**Fig. 2.** Percentage of respondents in each year who participated in specific types of research projects.

**Table 2** 2014 to 2015 residency duty hours, service obligations, and extracurricular activities

Query	Percentage responding
What is your department policy on moonlighting or locum tenens?*	
Approved for all years	8.7%
Approved for more senior residents only	34.8%
No defined policy	26.1%
Not approved	30.4%
Have you moonlighted or participated in locum activities?	
Yes	20.3%
No	79.7%
Does your institution have satellite facilities?	
Yes	82.6%
No	17.4%
Are you required to rotate through satellite facilities?	
Yes	56.4%
No	43.6%
How many months have you spent at satellite facilities?	
3 months or less	35.5%
4-9 months	32.3%
10-15 months	22.6%
Greater than 15 months	9.7%
Do you find rotations at satellite facilities useful for training?	
Yes	87.1%
No	12.9%
Have you ever been left alone at a satellite for longer than 4 hours?	
Yes	26.7%
No	73.3%
How many hours per week do you spend on required clinical duties	
40 or fewer hours	1.4%
41-50 hours	39.0%
51-60 hours	40.6%
Greater than 60 hours	19.0%
How many hours per week do you spend on work considered to have little or no educational value?	
10 hours or fewer	58.0%
11-15 hours	31.9%
Greater than 15 hours	10.1%
How many times have you violated ACGME work hour limits?	
Never violated	82.6%
1-5 times	14.5%
More than 5 times	2.9%

Abbreviation: ACGME: Accreditation Council for Graduate Medical Education.

\* A substitute, for example, a locum physician works in the place of the regular physician when that physician is absent, or when a hospital or practice is short-staffed.

## Job market and future career plans

Table 3 delineates future career plans of graduating residents. The majority of chief residents planned to join an established private practice group following residency (55%), whereas 25% planned on entering into a permanent academic career. Three chief residents planned to continue

**Table 3** 2014 to 2015 future career plans of graduating residents

Query	Percentage responding
What are your plans after residency?	
Permanent academic career	24.6%
Join established private practice group	55.1%
Solo private practice	0.0%
Join an HMO	2.9%
Temporary academic career	8.7%
Military obligation	1.4%
Fellowship	4.3%
Locum tenens	0.0%
Other	2.9%
As of April 2015, have you signed a contract for your next position?	
Yes	66.7%
No	33.3%
Was this type of job your first, second, or third choice?	
First	78.3%
Second	21.7%
Third	0.0%
How do you perceive the job market compared to last year?	
Much more competitive	24.6%
Slightly more competitive	30.4%
Equally competitive	42.0%
Slightly less competitive	2.9%
Much less competitive	0.0%

Abbreviation: HMO = health maintenance organization.

training with a fellowship following residency. Reasons for entering a fellowship program varied: to be more competitive in the job market, to pursue research interests, and to gain clinical expertise. As of April 2015, two-thirds of residents had signed a contract for their subsequent position, with the majority reporting it as their first choice of career type. Finally, the majority of respondents reported that they perceived the job market in 2015 to be more competitive than 2014.

## Discussion

This report represents the first publication of the ARRO annual chief resident survey in nearly 5 years (9). Given the multiple and substantial changes in radiation oncology training over the last 5 years (increasing entry competitiveness, expanding number of residency programs, increasing utilization of extracranial stereotactic treatments, decreasing brachytherapy utilization, new ACGME work hour limits, and others), this report provides an opportunity to assess current resident clinical experience, scholarly activities, working conditions, and future career plans over a 2-year period.

It is evident that the use of brachytherapy is declining nationally (18-21); consequently, this has affected resident exposure. Compton et al (22) reported that the average number of interstitial prostate procedures logged

by residents decreased by 25% over a 5-year period. Furthermore, in the 2005 to 2008 ARRO survey, 88% of residents reported adequate clinical experience in HDR and LDR brachytherapy, which has declined to as few as 15% and 32% for HDR and LDR prostate brachytherapy, respectively. Potential explanations for this decrease in resident experience is multifold, including: competing modalities (and appropriate active surveillance) and local health care dynamics in certain markets with urology practices with integrated radiation therapy facilities (23).

Our findings identify the fact that perceived clinical adequacy in the core radiation oncology disease sites (breast, CNS, GI, GU, Gyn, H/N, and lung) remain high over both years surveyed. However in the 2013 to 2014 survey, 30% to 50% of respondents reported no or inadequate level of exposure to treatment of lymphoma, ocular malignancies, and pediatrics. This decrease in perceived experience may be explained by the decreasing role of radiation therapy in the management of these diseases and/or referral to centers offering specific radiation modalities.

Our report echoes previous accounts of the strength of resident research activity within our field (24-26), with nearly a quarter conducting resident-led prospective trials and another 40% to 50% conducting basic science or translational research projects. However, there appears to be mixed support of research activity within academic departments, as there was a marked variation in the amount of time allotted towards an intensive research experience.

In 2011, the ACGME implemented new residency duty hour restrictions, limiting residents to no longer than 80 work hours per week, 10 hours between shifts, and at least 1 day off a week averaged over a 4-week period (17). Our survey identified the fact that nearly 80% of residents work 60 or fewer hours per week on required clinical duties (not reflective of other activities such as conference preparation). We identified strong compliance to ACGME duty hour limits, in that over 80% of residents have never violated duty hour limits, while only 3% violated duty hour limits more than 5 times throughout their residency. This is in comparison to a 2011 survey of duty hour compliance in multiple residency specialties (radiation oncology not included), identifying that 53% of residents in all specialties surveyed reported non-compliance to required duty hour limits (27).

One important limitation of this study is that not all chief residents responded. However, we believe that our response rates of 53% and 64% adequately sampled the experiences and attitudes given the diversity of responses received. Additionally, as it may be difficult for chief residents to assess adequacy of training prior to entering unsupervised practice, a follow-up survey of recent graduates may be warranted to fully assess quality of training. Furthermore, there is a standard concern in all survey studies that the individuals responding to the survey differ systemically from those not responding. As our

email solicitation strategies remained the same over both years, we believe our higher response rate in 2014 to 2015 was directly related to the incentive of a chance to win a free registration to the ASTRO annual refresher course. Whether this incentive persuaded a cohort of residents with different experiences and attitudes to complete the survey as compared to the previous year is unknown, but unlikely.

## Conclusions

In conclusion, this first update of the ARRO chief resident survey since the 2007 to 2008 academic year documents US radiation oncology residency experiences, work conditions, educational opportunities, scholastic activity, attitudes, and future career plans over a 2-year period. Our intention is that program chairs, program directors, ACGME governing bodies, and current and prospective residents will use this report to evaluate their own programs and continue to improve the resident experience in hopes of fully preparing the next generation of oncology leaders.

## References

1. Radiation oncology training in the United States: Report from the Radiation Oncology Resident Training Working Group organized by the Society of Chairman of Academic Radiation Oncology Programs (SCAROP). *Int J Radiat Oncol Biol Phys* 1999;45:153-161.
2. Meredith RF, Eisert DR. 1986 Association of Residents in Radiation Oncology Survey. *Int J Radiat Oncol Biol Phys* 1987;13:1893-1895.
3. Corn BW, Taylor BW, Knox SJ, et al. Results of the 1989 Association of Residents in Radiation Oncology survey. *Int J Radiat Oncol Biol Phys* 1991;20:1363-1367.
4. Schilling PJ, Wall TJ. Results of the 1992 Association of Residents in Radiation Oncology (ARRO) survey. *Int J Radiat Oncol Biol Phys* 1994;28:1267-1270.
5. Ling SM, Flynn DF. Results of the 1993 Association of Residents in Radiation Oncology survey. *Int J Radiat Oncol Biol Phys* 1996;34:221-226.
6. Jagsi R, Chronowski GM, Buck DA, et al. Special report: Results of the 2000-2002 Association of Residents in Radiation Oncology (ARRO) surveys. *Int J Radiat Oncol Biol Phys* 2004;59:313-318.
7. Jagsi R, Buck DA, Singh AK, et al. Results of the 2003 Association of Residents in Radiation Oncology (ARRO) surveys of residents and chief residents in the United States. *Int J Radiat Oncol Biol Phys* 2005;61:642-648.
8. Patel S, Jagsi R, Wilson J, et al. Results of the 2004 Association of Residents in Radiation Oncology (ARRO) survey. *Int J Radiat Oncol Biol Phys* 2006;66:1199-1203.
9. Gondi V, Bernard JR Jr, Jabbari S, et al. Results of the 2005-2008 Association of Residents in Radiation Oncology survey of chief residents in the United States: Clinical training and resident working conditions. *Int J Radiat Oncol Biol Phys* 2011;81:1120-1127.
10. Winey B, Shih HA, Sahoo N, et al. Core physics competencies for proton therapy training of radiation oncology and medical physics residents and fellows. *Int J Radiat Oncol Biol Phys* 2014;88:971-972.
11. Simpson DR, Lawson JD, Nath SK, et al. A survey of image-guided radiation therapy use in the United States. *Cancer* 2010;116:3953-3960.
12. Lewis SL, Porceddu S, Nakamura N, et al. Definitive stereotactic body radiotherapy (SBRT) for extracranial oligometastases: An

- international survey of >1000 radiation oncologists. *Am J Clin Oncol* 2015 [Epub ahead of print].
13. Timmerman R, Paulus R, Galvin J, et al. Stereotactic body radiation therapy for inoperable early stage lung cancer. *JAMA* 2010;303:1070-1076.
  14. Shah C. Expanding the number of trainees in radiation oncology: Has the pendulum swung too far? *Int J Radiat Oncol Biol Phys* 2013;85:1157-1158.
  15. Hirsch AE, Agarwal A, Rand AE, et al. Medical student mentorship in radiation oncology at a single academic institution: A 10-year analysis. *Pract Radiat Oncol* 2015;5:e163-e168.
  16. Brower JV, Mohindra P, Bradley KA, et al. Radiation oncology residency selection: A targeted assessment of factor importance among fourth-year medical students. *Int J Radiat Oncol Biol Phys* 2014;88:967-968.
  17. Kalady MF, de Campos-Lobato LF, Stocchi L, et al. Predictive factors of pathologic complete response after neoadjuvant chemoradiation for rectal cancer. *Ann Surg* 2009;250:582-589.
  18. Gill BS, Lin JF, Krivak TC, et al. National Cancer Data Base analysis of radiation therapy consolidation modality for cervical cancer: The impact of new technological advancements. *Int J Radiat Oncol Biol Phys* 2014;90:1083-1090.
  19. Han K, Milosevic M, Fyles A, et al. Trends in the utilization of brachytherapy in cervical cancer in the United States. *Int J Radiat Oncol Biol Phys* 2013;87:111-119.
  20. Mahmood U, Pugh T, Frank S, et al. Declining use of brachytherapy for the treatment of prostate cancer. *Brachytherapy* 2014;13:157-162.
  21. Martin JM, Handorf EA, Kutikov A, et al. The rise and fall of prostate brachytherapy: Use of brachytherapy for the treatment of localized prostate cancer in the National Cancer Data Base. *Cancer* 2014;120:2114-2121.
  22. Compton JJ, Gaspar LE, Shrieve DC, et al. Resident-reported brachytherapy experience in ACGME-accredited radiation oncology training programs. *Brachytherapy* 2013;12:622-627.
  23. Mitchell JM. Urologists' use of intensity-modulated radiation therapy for prostate cancer. *N Engl J Med* 2013;369:1629-1637.
  24. Rana S, Holliday EB, Jagsi R, et al. Scholastic activity among radiation oncology residents at US academic institutions: A benchmark analysis. *J Cancer Educ* 2013;28:541-546.
  25. Gutovich JM, Den RB, Werner-Wasik M, et al. Predictors of radiation oncology resident research productivity. *J Am Coll Radiol* 2013;10:185-189.
  26. Choi M, Holliday EB, Jagsi R, et al. Citation-based estimation of scholarly activity among domestic academic radiation oncologists: Five-year update. *J Radiat Oncol* 2014;3:115-122.
  27. Drolet BC, Schwede M, Bishop KD, et al. Compliance and falsification of duty hours: Reports from residents and program directors. *J Grad Med Educ* 2013;5:368-373.