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Standing on the Shoulders of Giants: Results From the Radiation Oncology Academic Development and Mentorship Assessment Project (ROADMAP)

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Summary

Mentorship is believed to be a crucial component of success in academic medicine; however, data regarding the prevalence and effect of mentorship in academic radiation oncology are few. We surveyed current academic radiation oncology faculty and collected data regarding the presence and nature of their mentoring relationships. We correlated these data with objective measures of academic productivity and found that faculty with mentors had higher numbers of publications, citations, h-indices, m-indices, and rates of funding by US National Institutes of Health.

Purpose: To analyze survey information regarding mentorship practices and cross-correlate the results with objective metrics of academic productivity among academic radiation oncologists at US Accreditation Council for Graduate Medical Education (ACGME)-accredited residency training programs.

Methods and Materials: An institutional review board-approved survey for the Radiation Oncology Academic Development and Mentorship Assessment Project (ROADMAP) was sent to 1031 radiation oncologists employed at an ACGME-accredited residency training program and administered using an international secure web application designed exclusively to support data capture for research studies. Data collected included demographics, presence of mentorship, and the nature of specific mentoring activities. Productivity metrics, including number of publications, number of citations, h-index, and date of first publication, were collected for each survey respondent from a commercially available online database, and m-index was calculated.

Results: A total of 158 academic radiation oncologists completed the survey, 96 of whom reported having an academic/scientific mentor. Faculty with a mentor had higher numbers of publications, citations, and h- and m-indices. Differences in gender and race/ethnicity were not associated with significant differences in mentorship rates, but those with a mentor were more likely to have a PhD degree and were more likely to have more time protected for research. Bivariate fit regression modeling showed a positive correlation between a mentor's h-index and their mentee's h-index ($R^2 = 0.16$; $P<.001$). Linear regression also showed significant correlates of higher h-index, in addition to having a mentor ($P=.001$), included a longer career duration ($P<.001$) and fewer patients in treatment ($P=.02$).

Conclusions: Mentorship is widely believed to be important to career development and academic productivity. These results emphasize the importance of identifying and striving to overcome potential barriers to effective mentorship. © 2014 Elsevier Inc.

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Introduction

The adage it takes a village to raise a child can also be appropriately applied to the career development of an aspiring academician. A successful career in academic medicine, although firmly rooted in personal drive, dedication, and hard work, also requires input and advice from those who are more seasoned and experienced. Mentorship is often cited as a key component of successful academic career development and has been studied in several disciplines of medicine (1-12). Although several nuanced definitions of a mentor exist, a mentor is most often described as an experienced and trusted advisor. The main difference between a teacher and a mentor is the depth of the relationship as well as the degree of trust between mentor and mentee. Wisdom, as well as knowledge, is often imparted.

Most of the existing literature on mentorship in academic medicine consists of qualitative studies and structured interviews (3). One small qualitative study reported that 98% of faculty interviewed identified the lack of mentoring as either the first or second most important factor to hinder career progress. Respondents in this study cited clout, knowledge, and interest as important factors for an effective mentoring relationship and reported same gender and same race matches were not necessary (4). In addition to mentor-specific factors, institutional factors also play a role in fostering effective mentoring relationships. A survey of 55 institutions receiving a US National Institutes of Health (NIH) Clinical and Translational Science Award assessed the formal mentoring programs and activities that were in place at these institutions. Established criteria to qualify as a mentor, policies on mentor responsibilities, written agreements between mentor and mentee, incentives and processes by which mentors are evaluated were all commonly cited (13). Although qualitative survey- and interview-based studies provide interesting fodder for discussion, quantitative data have also been sought to provide more objective evidence as to the role of mentorship in the careers and productivity of academic physicians (5, 14).

With much competition for departmental and institutional funds, objective data are needed to support time and resources spent on programs fostering mentorship. Additionally, there is a paucity of data specifically regarding mentorship within radiation oncology. This study both describes the prevalence and nature of mentoring relationships among academic radiation oncologists and reports objective measures of productivity including number of publications, number of citations, h-index, m-index, and NIH funding of those faculty who reported having a mentor compared with those who reported not having a mentor.

Methods and Materials

Inclusion criteria

Institutional review board approval was obtained, and an email inviting participation in the Radiation Oncology Academic Mentorship Assessment Project (ROADMAP) was sent in May of 2012 to 1031 current radiation oncology faculty with clinical affiliations with US Accreditation Council for Graduate Medical Education (ACGME)-accredited residency training programs. Current faculty were identified by compiling a comprehensive list of 82 domestic radiation oncology residency training institutions by using the Association of Residents in Radiation Oncology (ARRO) directory. Publically available departmental websites were accessed between February 14, 2012, and February 28, 2012, to obtain a list of 1031 current faculty as listed by individual institutions. All clinical faculty with MD, DO, or MD/DO-PhD credentials were included.

Survey instrument

For those faculty who chose to participate, a link contained in the email directed them to an online survey administered using Research Electronic Data Capture software (REDCap,Vanderbilt University, Nashville, TN). After reading the consent statement, participants answered questions regarding demographic information, clinical workload, protected research time, and whether or not they have or have ever had a mentor. For the purpose of this survey, a mentor was defined as “A more experienced, senior, or knowledgeable individual with whom you have/had a long-term relationship that fosters scientific/academic development.” Further information was then obtained regarding the mentoring relationship. The full survey instrument is available in Supplemental Figure e1 (available at www.redjournal.org).

Data collection

Survey data were exported to a spreadsheet from the REDCap software. Subsequently, for each survey respondent, a customized search was performed using a commercially available online database (Web of Science, version 5.9; Thompson Reuters, New York, NY). Distinct author record sets were then evaluated to ensure all records attributable to the author were included in the analysis. Outputs included number of publications, number of citations, and h-index. The Hirsch (h)-index is a surrogate for publication quality and is calculated by the number of publications cited at least that many times (15). For example, a person with 5 papers, each cited 5 or more times, would have an h-index of 5. A person with 5 papers, each cited only once, would have an h-index of 1. Web of Science includes all papers for which a given individual is listed as an author when calculating the h-index. There is no weighting for authorship number; therefore, all publications for which an individual is first author, second author, senior author, or something in between count equally toward the h-index. Additionally, date of first publication was recorded and used as an approximate surrogate for inception of academic career. A single data collector (EBH) performed the searches in a pre-determined interval between January 26, 2013, and January 27, 2013, to minimize temporal bias in data collection. M-index was calculated by dividing h-index by career duration. Finally, a customized search was performed in the NIH Research Portfolio Online Reporting Tools (RePORTER) website to assess the receipt of NIH funding.

Data analysis

Descriptive analyses were performed to calculate the median, range, mean, and confidence interval for number of publications, citations, and h- and m-indices for those respondents with and without a mentor. A multivariate logistic regression analysis was performed to determine which variables were best associated with h-index. Candidate covariates that were included were academic rank, gender, PhD status, career duration, and number of patients in treatment. Bivariate fit regression modeling was performed to evaluate the relationship between the respondent's h-index and the h-index of their indicated primary mentor. Post hoc statistical analysis was performed for between-group comparisons. All statistical analyses were performed using JMP, version 7, software (SAS Institute Inc, Cary, NC).

Results

Invitations to participate in the ROADMAP survey were sent via email to a total of 1031 radiation oncology faculty, of which 35 were returned as having invalid email addresses. A total of 183 responded to the survey, yielding an 18.4% response rate; 158 responses were complete and could be included for analysis.

Respondent characteristics

Respondents were affiliated with 64 of 82 ACGME-accredited radiation oncology residency training programs. The top participating institutions were Harvard (n=12, 7.6%) and Mayo (n=7, 4.4%). Respondents consisted of 115 men (72.8%) and 43 women (27.2%); 70.9% identified themselves as White/Caucasian; 19% reported having a PhD; 13.3%, 15.8%, 20.9%, 46.8%, and 3.2% of respondents were chairpersons, professors, associate professors, assistant professors, and instructors, respectively. The median career duration was 12 years and ranged from 2 to 44 years. Additional respondent demographic information can be found in Table 1.

Table 1 Demographics of respondents

Demographic	Response
Gender	72.8% Men (n=115)
	27.2% Women (n=43)
Race/ethnicity	70.9% White/caucasian (n=112)
	22.8% Asian/Pacific Islander (36)
	1.9% African American/Black (n=3)
	1.3% Hispanic/Latino (n=2)
	1.3% Multiracial (n=2)
	1.9% Other (n=3)
Academic degree	66.5% MD/DO (n=105)
	19.0% MD/DO and PhD
	11.5% MD/DO and other degree
Rank	13.3% Chair (n=21)
	15.8% Professor (n=25)
	20.9% Associate professor (n=33)
	46.8% Assistant professor (n=74)
	3.2% Instructor (n=5)
Career duration (y of residency graduation subtracted from 2013)	Median 12 (range, 2-44) y
Administrative responsibilities	13.9% Residency program director (n=22)
	5.1% Medical student clerkship director (n=8)
	19.0% Clinical director (n=30)
	24.1% Other (n=38)
	38.0% No additional administrative responsibilities (n=60)
Clinical workload	19.6% Primarily a clinician (n=31)
	49.4% More a clinician than scientist/researcher (n=78)
	22.2% Equivalently a clinician and scientist/researcher (n=35)
	6.3% More a scientist/researcher than a clinician (n=10)
	2.5% Primarily a scientist/researcher (n=4)
Patients on treatment	Median: 16 (range, 0-20) patients
Half-days of clinic	Median: 6 (range, 0-10) days
Protected research Time	78.5% had protected research time (n=124)
	21.5% had no protected research time (n=34)
	Median no. of half-days of protected research time: 2 (range, 0-10)
How well is research time protected? (for those with protected time)	14.5% Very well (n=18)
	37.9% Reasonably well (n=47)
	37.9% Poorly (n=47)
	8.1%% Not at all (n=10)
	1.6% No answer (n=2)

Mentorship among respondents

Ninety-six respondents (60.8%) reported having had an academic/scientific mentor; 53 and 23 respondents (55.2% and 24%, respectively) found it easy or very easy to find a mentor. The majority of respondents started the mentoring relationship either during residency/fellowship or during years 1 to 5 as faculty (43.8% and 40.6%, respectively). The median duration of the mentoring relationship was 9 years (range, 2-50 years). Table 2A and 2B outline the specific characteristics of the mentoring relationship and how frequently they were reported among respondents.

Academic productivity metrics among respondents

The mean h-index, number of publications, number of citations, and m-index of all respondents were 15.3 (95% confidence interval [CI], 12.8-17.5), 84.9 (95% CI, 69.1-100.7), 1720 (95% CI, 1452-1988), and 0.78 (95% CI, 0.69-0.86), respectively. The median h-index, number of publications, number of citations, and m-index for all respondents were 8 (range, 0-75), 41 (range, 0-498), 351.5 (range, 0-22,484) and 0.6875 (range, 0-2.5), respectively. Respondents with a mentor had significantly higher mean h- and m-indices (17.6 [95% CI, 14.4-20.7] vs 11.2 [95% CI, 7.3-15.2]; $P=.038$ and .92 vs $P=.62$; $P=.001$, respectively). Median h-index was also higher among respondents with a mentor (12 [range, 0-75] vs 6 [range, 0-61]). The number of publications and citations tended to be higher among those with a mentor. Median numbers of publications and citations for those with a mentor were 67.5 and 666, respectively, versus 22.5 and 183, respectively, for those without a mentor. A total of 28.1% of respondents (n=27) with a mentor received NIH funding versus 16% of respondents (n=10) without a mentor. A total of 44.7% (n=43) of those with mentors had another degree in addition to MD/DO versus 16.1% (n=10) of those without a mentor ($P<.001$). Respondents with a mentor also reported increased time allocation toward research ($P<.001$). Table 3 shows the details of productivity metrics of the cohort by mentorship status. Bivariate fit regression modeling showed a positive correlation between a mentor's h-index and their mentee's h-index ($R^2 = 0.16$; $P<.001$). Linear regression also showed significant correlates of higher h-index with having a mentor ($P=.001$), a longer career duration ($P<.001$), and having fewer patients in treatment ($P=.02$). Additionally, respondents who reported their time allocation was either "equivalently a clinician and a scientist/researcher," "more researcher, some clinic," or "primarily a scientist/researcher" (n=49) had higher mean h-indices (20.7 [range, 0-56] vs 12 [range, 0-75]; $P=.002$), higher numbers of publications (123.2 [range, 0-413] vs 67.7 [range, 0-498]; $P=.002$), higher number of citations (2536.5 [range, 0-22,484] vs 1352.4 [range, 0-18,174]; $P=.06$), and higher m-indices (1.00 [range, 0-2.50] vs 0.68 [range, 0-2.5]; $P=.0004$) than those respondents (n=109) who reported their time allocation was either "primarily a clinician" or "more clinician, some research."

Table 2 Characteristics of the mentoring relationship

	No. (%) of respondents who stated…			
A. How much has your mentor…	A lot	Quite a bit	A little bit	Not at all
Served as a role model?	32 (33.3%)	36 (37.5%)	27 (28.1%)	1 (1.1%)
Promoted your career through networking?	38 (39.6%)	36 (37.5%)	16 (16.7%)	6 (6.2%)
Advised about preparation for advancement?	29 (30.2%)	17 (17.7%)	39 (40.6%)	11 (11.5%)
Advised about getting your work published?	27 (28.1%)	31 (32.3%)	32 (33.3%)	6 (6.2%)
Advised about obtaining funding or other resources?	16 (16.7%)	25 (26%)	43 (44.8%)	12 (12.5%)
Modeled professional and ethical behavior?	33 (34.4%)	37 (38.5%)	20 (20.8)	6 (6.2%)
Advised you about balancing work and family?	12 (12.5%)	13 (13.5%)	42 (43.8%)	29 (30.2%)
Committed to mentoring you?	24 (25%)	46 (47.9%)	23 (24%)	3 (3.1%)
Contributed to the research in your field?	43 (44.8%)	32 (33.3%)	17 (17.7%)	4 (4.2%)
Been available and accessible?	31 (32.3%)	42 (43.8%)	20 (20.8%)	3 (3.1%)
Connected to others of importance in your field?	51 (53.1%)	20 (20.8%)	19 (19.8%)	6 (6.2%)

B. Has your mentor been involved in…	No. (%) who responded Yes
Discussing career path, including applying for jobs and/or promotions	11 (11.5%)
Discussing and brainstorming ideas for potential research projects	18 (18.8%)
Advising on potential sources of funding for research/grant applications	7 (7.3%)
Collaborating on research projects as a listed author	14 (14.6%)
Collaborating on research projects where your mentor is NOT a listed author	4 (4.2%)
Reviewing grant applications or manuscripts as a co-PI/coauthor	11 (11.5%)
Reviewing grant applications or manuscripts when NOT a co-PI/coauthor	3 (3.1%)
Recommendations for committees, panels, speaking, or scientific sessions	13 (13.5%)
Providing sources of employment and a recommendation letter(s)	8 (8.3%)
Providing research or training grant monies (eg, serving as PI on T- or K-series from which you received monies)	3 (3.1%)
Serving as joint PI on a grant application(s)	3 (3.1%)
Serving as joint PI on a cooperative group clinical trial	1 (1.04%)

Abbreviations: PI = principal investigator; T-series = Research Training Awards; K-series = Career Development Awards.

Table 3 Differences in productivity, degree, and time allocation by mentorship status

Productivity	With mentor (n=96)	Without mentor (n=62)	P
No. of publications			.042
Mean (95% CI)	102.2 (82.1-122.2)	58.2 (33.2-83.1)	
Median (range)	67.5 (0-498)	22.5 (0-357)	
No. of citations			.070
Mean (95% CI)	2105 (1438-2773)	1122 (292-1953)	
Median (range)	666 (0-22,484)	183 (0-1489)	
h-index			.038
Mean (95% CI)	17.6 (14.4-20.7)	11.2 (7.3-15.2)	
Median (range)	12 (0-75)	6 (0-61)	
m-index	0.92 (0.80-1.03)	0.63 (0.51-0.77)	.001
	0.52 (0-2.5)	0.52 (0-2.47)	
No. of respondents receiving NIH funding (%)	27 (28.1%)	10 (16%)	.042
No. of degree(s) (%)			<.001
MD/DO	53 (55.2%)	52 (83.9%)	
MD/DO, PhD	27 (28.1%)	3 (4.8%)	
MD/DO, other degree	16 (16.6%)	7 (11.3%)	
No. provided with time allocation (%)			<.001
Primarily research	3 (3.1%)	1 (1.6%)	
More research, some clinic	9 (9.3%)	1 (1.6%)	
Equivalent research and clinic	28 (29.1%)	7 (11.3%)	
More clinic, some research	49 (51%)	29 (49%)	
Primarily clinic	7 (7.3%)	24 (38%)	

Discussion

Results of the ROADMAP study show that radiation oncology faculty who reported having a mentor had higher objective measures of academic productivity in a small, competitive field with a strong research focus. Publication productivity metrics, such as h-index, have been shown to correlate with academic advancement in radiation oncology (16, 17). The importance placed on research and publishing by many departments and institutions when considering faculty for appointment, promotion, or resource allocation may drive young faculty to seek any potential advantage or resource to improve their productivity. This is reflected by the substantial percentage of radiation oncology faculty respondents who reported having a mentor (60.8%); published series from other specialties report that number is often as low as 20% (18). The high prevalence of mentorship in radiation oncology appears to begin early, as most medical students are not routinely exposed to the field. A recent study reported 76.6% of Canadian radiation oncology residents were influenced to pursue a career in radiation oncology because of an early experience with a mentor (19).

Because many academic physicians report difficulty with finding a motivated mentor and developing a fruitful mentoring relationship, there has been interest across several fields in developing formal programs to pair mentors and mentees. Some have published data showing increases in both participant satisfaction and self-reported productivity with participation in such a program (5). A case-control study showed gynecological oncology faculty and fellows from more productive institutions were not only more likely to have a research mentor but also were more likely to have a formal program in place at their institution that connected mentors and mentees (2). One study performed at the University of California San Diego evaluated a formal mentorship program as 1 of the 4 National Centers of Leadership in Academic Medicine (10). This was a highly structured program where a junior faculty member was assigned to a senior faculty mentor. Interestingly, this program also included compensation for both junior and senior participants to equal 5% of their base salary. Mentees reported increased confidence in their academic roles. The reported cost of the program was $10,000 per junior faculty member over 4 years, although it was still felt to be cost-effective given the improved faculty retention rates and decreased funds spent for new faculty recruitment. This is one of the few studies showing tangible benefits of a mentorship program to the institution as well as to the individual mentees. The Canadian Institute of Health Researchers recently funded a training program specifically for interdisciplinary radiation oncology researchers (20). Mentors for this program were chosen based on a successful track record of receiving peer-reviewed funding, publications, and prior mentoring activities. P'ng et al (20) published results from a survey sent to trainees, mentors, and lecturers to assess effective components of the program. Structured brainstorming sessions were felt to be the most useful component, but that study did not include any objective data to assess efficacy of the program.

Despite the prevailing attitude that mentorship is instrumental to a successful academic career that is supported by qualitative data from many single-institution or single specialty studies, definitive evidence as to any objective, measurable, benefit is lacking (18). A systematic review reported that the overall level of evidence for mentorship is weak and that most studies consisted of surveys and other qualitative assessments. One reason for a lack of measurable benefit noted in the systematic review of mentoring studies is the heterogeneity that exists between fields. There may be a larger tangible benefit of mentorship in a smaller, more specialized field, such as radiation oncology, in which so much of academic career advancement depends on publication productivity.

When asked about a hypothetical program that would match faculty desiring an academic/scientific mentor with an experienced faculty willing to mentor, 145 (92%) of respondents agreed that such a program would be helpful, 24 (15%) would participate as a mentee, 45 (28%) would participate as a mentor, and 59 (37%) would participate as both. The most common sentiment expressed by ROADMAP respondents was that a mentor must have a desire and willingness to commit to the role. Experience, effective communication skills, and networking were other commonly cited traits of an ideal mentor. One respondent stated eloquently that being a good mentor means "putting the career needs of the mentee first, ensuring that the mentee is fully involved in all aspects of the work, promoting the mentee at the national level, teaching research and administrative skills, helping the mentee identify their own passions." This is in keeping with published survey results from other specialties (3, 4).

When collecting ROADMAP survey results, we found some potential sources of error inherent in the database from which those objective productivity metrics were collected. The h-index as reported by Web of Science (Thompson Reuters) reflects citations only of source items indexed within Web of Science. Additionally, abstracts presented at conferences are included as well as published manuscripts. Although considerable efforts were made to include all published works by an author and exclude those written by authors with a similar name by also evaluating the title, journal, and institution, it is possible that an individual's h-index might be artificially inflated if works by another author with a similar name were included. Conversely, an individual's h-index and other metrics might have been recorded as artificially low if they had published under similar names (ie, including or excluding a middle initial) or had changed their name (as in the case of marriage or divorce). Finally, the groups were analyzed based on the self-reported presence of absence of a mentor and were not corrected for the extent of mentor involvement.

Although the response rate was low, which certainly introduces the possibility of selection bias, respondents to the survey reasonably approximated the intended study population as a whole. The survey was sent to 1031 academic radiation oncologists, 742 (72%) of whom were men and 289 (28%) of whom were women. The gender breakdown was nearly identical in survey respondents, which included 72.8% men and 27.2% women. The breakdown of the entire intended cohort by rank included 232 (22.5%) professors/chairpersons, 160 (15.5%) associate professors, 391 (37.9%) assistant professors, and 248 (24.1%) instructors/other. This is similar to the breakdown of survey respondents which included 13.3% chairpersons, 15.8% professors, 20.9% associate professors, 46.8% assistant professors, and 3.2% instructors/other. There was a slight bias observed that radiation oncologists of higher rank (ie, professor or chair) were more likely to complete the survey. Additionally, 30 (19%) of respondents reported holding an additional administrative responsibility related to teaching and mentorship such as residency program director or medical student clerkship director. This indicates that those who are inherently more invested or interested in education and training may have been more likely to complete this survey. The mean h-index, number of publications, and number of citations for the entire intended cohort were 10.8 (95% CI, 10.1-11.5), 46.6 (95% CI, 42.4-50.8), and 1225 (95% CI, 1086-1364), respectively. The mean h-index, number of publications, number of citations and m-index of all respondents were 15.3 (95% CI, 12.8-17.5), 84.9 (95% CI, 69.1-100.7), 1720 (95% CI, 1452-1988), and 0.78 (95% CI, 0.69-0.86), respectively. This shows a slightly skewed population, where more academically productive individuals were more likely to respond. A total of 17% of the entire cohort had received NIH funding, which is slightly lower but similar to the 23.4% of respondents who had received NIH funding. However, the ROADMAP's strengths include the novel collection of the prevalence and specific characteristics of mentorship between radiation oncology faculty and their mentors. This information was collected in a systematic way by a voluntary survey. Additionally, this study correlated objective measures of academic productivity with self-reported mentorship information.

As with any observational study, caution must be applied when considering whether correlation implies causation. It is, of course, possible that the associations we observed between academic productivity and having a mentor were confounded by the likelihood that a highly motivated individual might be more likely to both seek out mentorship and be more productive than others. Still, we find it unlikely that such motivated individuals would seek out mentorship were it devoid of actual positive impact.

Conclusions

The results of the ROADMAP survey confirm in a quantifiable way what many have long suspected. Academic physicians and scientists who have mentors involved in their careers tend to be more productive. Radiation oncology faculty at domestic academic departments with mentors had higher numbers of publications and citations as well as higher h- and m-indices. They were also more likely to have received NIH funding. Interestingly, more academically productive mentors tended to be associated with more academically productive mentees, with a positive correlation between mentor and mentee h-indices. The next steps are to use the information from this project to stimulate discussion of the importance of mentorship at academic training institutions and potentially move forward in creating a national mentorship development program for academic radiation oncologists who have difficulty identifying mentors at their institutions.

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