

Mentoring Medical Students in Radiation Oncology

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Mentoring in academic medicine has been described on a multitude of levels in medical literature, but seldom with respect to medical students. In fact, although some fields have addressed mentoring in the context of medical student education, radiation oncology has yet to do so in a comprehensive fashion. Furthermore, the projected domestic and worldwide epidemiologic trends in cancer cases, coupled with the frequent use of radiation-based cancer treatment regimens, make this an opportune moment to initiate such a discussion. Herein, the authors consider mentoring in the context of radiation oncology and related fields from the perspective of a medical student. They present a paradigm for promoting mentorship through traditional classroom-based and nontraditional socially and research-based initiatives. It is the authors' hope that both radiation oncology and other specialties will benefit from the initiation of this discussion, as well as build on the suggestions detailed here as we prepare the next generation of radiation oncologists.

Key Words: Mentorship, radiation oncology, medical students

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INTRODUCTION

Mentoring has long been touted as an effective paradigm for assisting the career and personal development of a mentee while mutually benefiting the mentor in some way. Indeed, when it comes to academic medicine, the concept of mentoring is hardly new [1,2] and has been recently reviewed in medical literature [3,4]. Guidelines have even been prescribed on how the mentoring relationship should be constructed [5].

Although this literature exists with the intent to improve medical practice, it is not comprehensive in the populations of mentees it considers. Notably, there has been great focus on faculty members, research fellows, and residents but relatively little discussion of mentoring medical students [4]. Furthermore, among those articles that have addressed mentoring medical students, only a subset of disciplines have been considered, including surgery, internal medicine, and emergency medicine [6-8]. Radiation oncology has not yet been discussed in this context but is a field that would likely benefit from such a dialogue.

WHY RADIATION ONCOLOGY AND WHY NOW?

The study of medicine is an inherently integrated endeavor in which issues in one field must be considered by practitioners of other specialties to provide patients with optimal care. This is no better exemplified than when considering oncology and oncology-related domains. Regardless of chosen specialty, physicians will encounter patients affected by cancer over the courses of their careers. This assertion is bolstered by the fact that approximately 1 in 2 men and 1 in 3 women in the United States will be diagnosed with or die from cancer during their lifetimes [9]. Additionally, the World Health Organization predicts that 26.4 million new cases will be reported in 2030 alone [10]. Clearly, how cancer has already affected and will continue to influence the health care landscape cannot be ignored.

To address this need for increased awareness of the science behind and treatment of various cancers, medical schools will likely need to modify their curricula to provide broader exposure, a sentiment echoed by a recent review of the literature that pertains to undergraduate medical education in radiation oncology [11]. Commonly, the preclinical years of the undergraduate medical school curriculum enable students to learn about the molecular pathogenesis of cancer, while clinical rotations in surgery, internal medicine, and other core specialties allow for exposure to various approaches to treating oncology patients. However, concern exists over whether medical students' knowledge bases about cancer are suf-

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ficient [12-15], and until recently [16,17], little has been formally reported on that provides medical students with early and substantive exposure to the theory behind and practice of radiation-based treatment strategies. This is particularly surprising given that 60% of all patients with cancer receive some form of radiation during the course of their disease treatment [18]. It also calls for an emphasis on providing exposure to and fostering students' interests in radiation oncology during their undergraduate medical education.

For these reasons, when considered in aggregate, it is necessary to establish an effective mentoring paradigm in radiation oncology for medical students. It would promote a greater general awareness of the study of oncology as well as its therapeutic implementation. These are important points to recognize given the increasing prevalence of oncologic pathologies and related complaints and in light of radiation oncology's growth and focus on optimally supporting its physician practitioners [19-21]. This will consequently lay the groundwork for effective preparation for careers of students' choosing.

As we define our mentoring paradigm, we would like to emphasize that it is meant to focus on the student being mentored and therefore is presented from that perspective. Furthermore, it may not be possible for any given institution to employ all recommendations listed here. Conversely, other academic entities may develop constructs that may not be easily implemented at our institution. Regardless, our central aim is to begin a dialogue about feasible methods to educate and mentor medical students in this small and specialized field of medicine to improve oncology patient care throughout the medical community and in a time-efficient and resource-efficient manner. However, summary recommendations are posited at the conclusion of our discussion.

TRADITIONAL FORUM: MEDICAL SCHOOL CURRICULUM

Proper academic mentoring is multifaceted and has been formally described in the literature [5], although more from the perspective of discussing how interpersonal encounters should take place. Effective communication is certainly the foundation of any productive relationship and should be developed between mentees and mentors as part of any structured mentoring program. However, it is only part of the picture and requires a supportive environment at the institution at which it is to take place [22]. Our aim is to examine what academic constructs may be implemented to effect these goals as well as make recommendations for strengthening individual mentoring efforts. To that end, we discuss our approach in two parts, the first involving modifications or additions to the standard medical curriculum and the second involving

ways to complement students' formal education, especially through research projects.

Undergraduate medical education at our institution is similar in format to other curricula established at fellow members of the Association of American Medical Colleges. The curriculum is four years in length and subdivided into preclinical studies during years 1 (normal body processes) and 2 (pathologic states of organ systems) and clinical studies during years 3 (rotations through various services in primary, secondary, and tertiary care settings) and 4 (elective rotations). Given this coursework hierarchy, it is reasonable to expect that there exist opportune moments to expose students to scientific and clinical concepts as they pertain to radiation oncology and that dovetail with the overarching curricular goals of a particular section.

In that spirit, our institution has already taken steps to integrate teaching radiation oncology into all four years of its medical curriculum, starting with its first-year introduction to clinical medicine (ICM-1) course. ICM-1 serves as an introduction to interviewing patients and learning basic physical examination skills for all organ systems. Aside from vertically integrating this course with the bulk of the first-year curriculum, the course presents many opportunities for mentorship to take place. The ICM-1 course provides for a relatively low pressure environment (in contrast to a rigorously graded clerkship) that allows students to explore their curiosities about specific fields while still accruing a basic physical examination skill set and to develop a substantive relationship with their physician supervisors. This individualized instruction allows students to receive much needed support early in their medical education. The expansion of the ICM-1 program beyond primary care has given students the opportunity to begin rotating in a variety of specialized departments during their first year of medical school, including radiation oncology. Forming a relationship with one's mentor or department during this course may then facilitate interactions in the future.

During the second year, students are immersed in a vertically integrated, systems-based course on disease and therapy, during which they learn about the pathology, microbiology, pharmacology, pathophysiology, and treatment algorithms that underlie diseases commonly encountered in modern medical practice. Beginning in the 2008-2009 academic year, our institution devoted an entire block of this course to the study of oncology instead of fragmenting the discussion over several systems-based sections of the curriculum. In this intensive oncology block, which is led by an attending radiation oncologist, several lectures are devoted to the multimodal approach to cancer management, including basic exposure to radiation-based treatment and radiation oncology. Preliminary analy-

sis of student feedback has been very positive, particularly among third-year students, who have since had a chance to apply what they have learned as they treat oncology patients during their clinical rotations (A. E. Hirsch, unpublished data). Additional investigation is currently under way.

The clinical curriculum has seen an even greater emphasis on instruction in radiation oncology, notably in the required four-week radiology block. It has recently been moved into the third year alongside core medicine and surgery clerkships. In addition, we have been able to successfully integrate formal didactics in radiation oncology into the radiology block as part of the Oncology Education Initiative [16,17,23], a program whose educational goals are in line with (and arguably the cornerstone of) those emphasized in this discussion of mentoring. This success is evidenced by significant gains in medical students' knowledge of radiation oncology as the result of only a single didactic lecture [16].

Finally, during the fourth year interested students are able to pursue elective rotations in either clinical radiation oncology or cancer-related research as well as pursue further coursework in our advanced clinical anatomy course. The clinical anatomy course is currently led in part by an anatomist who is interested in further understanding how radiation oncology may interface with anatomic features in cancer patients [24]. Furthermore, in this course we have implemented an additional radiation oncology-based lecture thereby reinforcing introductory knowledge accrued during the disease and therapy course and radiology clerkship. Gaining practical experience in radiation oncology during the clinical years is particularly important and not to be overlooked, especially given the intricate technologies of state-of-the-art methods used in the field [25]. We expect that early exposure to even the most common methods and technologies will better prepare students for their residency training as well as contributions they will make while residents and as independent physicians, regardless of chosen specialty.

Taken together, these steps throughout the undergraduate medical curriculum provide students with a continuous stream of longitudinally integrated knowledge that commences early. On being exposed to this body of information, those students who decide that a career in radiation oncology suits their interests may then plan to realize this goal. This may include seeking out learning opportunities outside the traditional classroom environment. In fact, approximately 50% of students have elected to spend additional time in the radiation oncology clinic as part of their radiology clerkships to observe treatment planning and delivery, a number far surpassing that of students hoping to match into radiation oncology, radiology, and related fields for residency [26]. In addition, since the implementation of the Oncology Education Initiative, an average of three stu-

dents per year (range = 2-5) have participated in our formal radiation oncology elective. Furthermore, an average of seven department-associated academic experiences have been pursued per graduating class since 2007 (range = 4-8; this includes ICM-1, student-directed research, and the fourth-year formal clinical elective). The classes of 2005 and 2006 had three and four clinical and research experiences, respectively. These numbers reflect the rising interest in the radiation oncology department's academic programs that has coincided with introduction of the education initiative into the medical curriculum. We also note that as interest in the specialty grows, we have observed increased interest in these activities from first-year students as well.

From a student's perspective, having such extensive and integrated learning experiences is particularly crucial for any field to gain a greater understanding of what its practice entails, much as discussed above. Additionally, and especially for radiation oncology, early and extensive exposure to the field should help students most effectively compete for residency training, especially in light of the high standards that must be fulfilled to successfully match into the field [19,27,28].

NONTRADITIONAL FORUM: OUTSIDE THE CLASSROOM

Although stimulating interest and thought among students through classroom-based initiatives is certainly important and arguably the basis for successful mentoring of students in radiation oncology, more can and should be done. Mentoring, in the broad context in which it is considered here, requires greater attention to students' needs, aspirations, and interests than even the most interactive classroom learning can provide. Therefore, we propose supplementing a school's undergraduate medical curriculum, including the recommendations provided above, with a series of programs and administrative constructs to augment the benefits accrued during formal instruction.

There are several ways to further students' interest in radiation oncology external to traditional didactic environments, some of which are more involved than others. Simpler options to achieve this goal include having faculty members participate as panelists during career forums and providing regular seminars (as infrequent as once per month) during the lunchtime hour between classes. These are discrete ways of allowing students to learn more about the field without having to invest a substantial amount of time to learn about radiation oncology beyond the basic scientific and clinical tenets they are introduced to in class.

Furthering students' interest and participation in learning about radiation oncology, similar to what has been reported for other fields [29], may also be accom-

plished by establishing a student group and hence is more time intensive. This group, under the supervision of one or more faculty members, may then help determine topic selection and scheduling of the aforementioned seminars. In fact, our institution has such a student-initiated, student-driven, and student government-funded organization, the Student Oncology Society, which was created in 2006 and is sponsored by a radiation oncology faculty member. Allowing a student group to take the initiative in organizing events that provide greater exposure to the field enables the development of leadership skills, minimizes time demands on faculty members, and is relatively inexpensive for the institution to support. The Student Oncology Society seeks to expose medical students to cancer medicine early in their education by hosting workshops and lunchtime talks by faculty members from oncology and oncology-related fields. Interactive panel discussions by physicians from the departments of internal medicine, surgery, and radiation oncology help students appreciate the multidisciplinary nature of cancer management and the collaborative efforts essential to its practice. For the first time this year, the Student Oncology Society hosted a newly created workshop that brought together faculty members from the departments of oncology, radiology, and pathology to give students an overview of cancer diagnosis and physical examination before beginning their third-year and fourth-year clerkships. Furthermore, although the mission of the organization is devoted to education in general oncology, growing student curiosity and demand has prompted the incorporation of radiation oncology in seminars sponsored during the year. In fact, these talks are among those with the highest attendance rates.

Although these programs may serve to further introduce students to radiation oncology, they only do so in a peripheral fashion. We believe that the most comprehensive out-of-classroom development occurs through one-on-one interactions with radiation oncology faculty members. Mentorship in any department in academic medicine involves people with varied ages, genders, and cultural ideals, including undergraduate and medical students, residents, fellows, and junior faculty members. In addition, a mentor is one who is not only the direct clinical or research supervisor but also an overall advocate, advisor, and role model for a mentee. A mentor should have a vested interest in the accomplishments of the mentee and be available to listen to and communicate with the mentee. A mentor must also realize that over time the relationship changes dramatically, particularly since the mentee will at some point become a colleague. It is also quite reasonable for a mentee to have more than one mentor, depending on his or her specific needs [5,30].

It is exactly this attitude toward mentorship, something we can all implement to enhance the professional development of others, that we see as being a cornerstone to strengthening the radiation oncology educational experience and also the strength of the field, both scientifically and clinically. In fact, mentorship has been studied over a substantial portion of the medical educational hierarchy [4]. Its pervasiveness and utility, however, seem to be heterogeneous with respect to specific subpopulations of medical professionals based on specialty, gender, and environment in which individuals practice: academic or private. Although this variation exists, individual mentoring has been found to benefit personal and professional development, career selection as it pertains to specialty choice, and research productivity, among other areas.

A mentor in radiation oncology is not unlike any other mentor who acts as a support system and provides guidance for the mentee. A mentor could be a clinical mentor or a research mentor or both. Indeed, for those medical students interested in matching into radiation oncology, because it is one of the most competitive graduate medical training programs to match into [19,28], many seek involvement in one or more research projects. Mentoring in this fashion often requires a substantive commitment and resource investment to complete a successful project with collaborative effort. However, educational scholarship can be created for both the mentor and mentee. The difficulty is the oft seen attitude that "it's easier for me to take care of this myself," which can deprive a mentee of valuable insights and experience moving forward.

Mentoring student-directed research can be an extremely satisfying experience and is often a substantial impetus for why people choose careers in academia. Not only can this type of mentorship advance research that faculty members may not have the dedicated time to complete, it may also afford medical students an early introduction to research methods, abstract and manuscript preparation, and critical review of the literature. Before the experience commences, it is important to explore a student's needs and the level of mentorship required and to review the skills and knowledge that can be gained from such an experience. It is also necessary to identify different kinds of medical student participation in research and outline time frames and expectations for the experience to be productive. The mentor should take into consideration a student's academic level, background in research methods, and ability to conduct research independently.

A relatively common occurrence is when a medical student expresses a general interest in research but does not have a specific idea or proposal in mind. For this, we keep a running list of our own project ideas and offer a project to a student if it seems like a good match. One

lesson learned is that it is critical to have the project rely on appropriate background knowledge and have the proper scope, because the student might become frustrated if the project involves too esoteric a topic. Furthermore, the project must be able to be completed within the time frame the individual has available or be able to survive beyond the student's involvement.

An example of early exposure to research is our formal institution-sponsored Medical Student Summer Research Program, a summer opportunity for students between their first and second years of medical school to obtain a mentored research experience. In the program, students submit research proposals and, if accepted, spend the summer working on either a basic science or clinical research project under the guidance of faculty preceptors. The program culminates in a research symposium the following spring at which the participating students develop posters with the help of their mentors and formally present their research findings to the medical school community.

This extensive list of considerations is certainly important but may not be at the forefront of every mentor's mind. For this reason, it may be most effective to establish a time-efficient and resource-efficient protocol to mentor the mentors, perhaps through a common mentoring skills workshop that aims to provide would-be mentors with a skill set aimed at optimizing their interactions with students. This program would likely have to be supported by the institution but could reach any department or program in which mentoring occurs, irrespective of emphasis on medical or graduate education. In doing so, this would allow an entire school to reap the benefits of such a program and also allow for the financial burden of such a program to be distributed in a relatively diffuse manner. In fact, our institution has established a mentoring task force to address these issues.

Finally, much of the beauty in emphasizing mentorship at a particular institution is that medical students may have mentors across the academic spectrum, including residents, fellows, and faculty members. This may help establish connections among these mentees to create additional mentoring relationships. Such interactions could be particularly helpful to medical students in that they would have mentors who are not too far displaced from their medical schooling. Hence, the mentees are more likely to identify with their mentors on certain issues. Overall, this comprehensive approach to mentoring could prove very beneficial to both individual students and the institution at which it takes place.

These strategies to enhance education and mentorship in radiation oncology are indeed integrative by advancing how traditional medical education is administered (curricular reform) and relying more on practicing physicians to nurture students' interest in oncology (mentor-

ing through research). The former is helpful in that it provides basic exposure to relevant medical concepts and patient care objectives while the latter serves to further engage those pondering careers in radiation oncology by fostering their personal and professional growth. For students with a curiosity for radiation oncology, in particular, opportunities that supplement this education in cancer medicine may additionally be sought outside their home institutions.

The Simon Kramer Externship in Radiation Oncology is one shining example of how a student's training may reach beyond the confines of their home institution. This program selects two first-year or second-year medical students to spend six weeks at an academic radiation oncology center. Each student is assigned a mentor who trained directly with Dr. Simon Kramer or his staff and works closely with that mentor on a clinical research project [31]. Over the program's duration, the mentor guides the student through data collection, organization, and analysis. This is designed to give students an appreciation for the patient-oriented research that is critical in guiding clinical practice and is fundamental to advancing the field of radiation oncology.

In addition to encouraging the pursuit of research, it is the externship's keen emphasis on clinical exposure that makes students' experiences so rich. Aside from the patients seen with their mentors, mentees are encouraged to shadow other department physicians on initial patient consultations, during follow-up clinic visits, and during treatment planning and delivery. In this way, students are exposed not only to the benign and malignant disease states in which radiation therapy can be applied but also to the variety of radiation delivery techniques that are available for use. Additionally, the opportunity to closely interact with residents and attend department and journal club meetings provides students with extensive insight into the nature of a residency in radiation oncology.

It is through both research and extensive clinical exposure that the Simon Kramer externship provides eager medical students with a unique glimpse into the professional life and practice of a radiation oncologist. This opportunity to develop a relationship with an established physician practitioner so early in the course of their medical education is perhaps the most valuable aspect of this program. Assuming a student's interest in the field is maintained, the physician may then serve as an involved mentor throughout that student's remaining years of medical school and ultimately assist the student in applying to residency programs.

Another example of how aspiring radiation oncologists may gain experience outside of their home institutions is via the Ivan H. Smith Memorial Studentship (ISMS) program. ISMS mentees spend six to eight weeks following several oncologists and rotating through vari-

ous radiation oncology departments in Ontario, Canada. Although the focus of the ISMS program is clinical exposure to radiation delivery techniques, treatment simulation and contouring, new patient consultations, and follow-up visits, students are encouraged to spend at least one day each week developing a research project [32].

Similar to the Simon Kramer externship, the ISMS program seeks to provide mentees with early exposure to this specialized field of medicine and, more importantly, fosters relationships with experienced physicians early in the students' medical educations. In fact, analysis of its participants has shown that ISMS participants are 5.9 times more likely to enter radiation oncology training than their fellow medical school graduates [32]. This ability of the program to draw students to the field likely stems from both early research involvement and the interaction it facilitates between students and physicians who may subsequently serve in a supportive capacity. Furthermore, it highlights the role that early mentorship in radiation oncology can play in assisting interested medical students successfully pursue training in this highly competitive specialty.

CONCLUSIONS

We have outlined our vision for how mentorship in radiation oncology, mainly through extensions of classroom instruction and research, can create a broad and comprehensive exposure to the field. That said, there is certainly room for continued development of the ideas posited here. It is our hope that many of the tenets described above may be useful to other institutions in enhancing the attention paid to the field of radiation oncology, including using a vertically integrated undergraduate medical curriculum across pre-clinical and clinical years that engages hopeful family practitioners and radiation oncologists alike, developing a potent approach to nurturing research interests, and providing personalized mentoring. The approach we postulate here is meant, minimally, to provide a scaffold on which modifications and additional ideas may be constructed, and we certainly welcome any constructive feedback on how this might be accomplished.

Although the aforementioned mentoring constructs, both traditional and nontraditional, have successfully generated interest in radiation oncology and also responded to the needs of those students already committed to the field at our institution, an important question becomes that of reproducing such paradigms at other academic centers. We offer some ideas on introducing mentorship in radiation oncology at other institutions,

but believe this is a topic that would benefit considerably from open dialogue.

The previously discussed ICM-1, for example, has been a strong preclinical construct at our school, as it allows exposure to the clinical practice of radiation oncology and the opportunity to form mentorships with faculty members very early in students' education. However, in creating similar programs at other academic centers, institutions may face the challenges of limited resources and time required program development and coordination. In this scenario, simpler options, some of which have been discussed above, can make significant strides in making mentorship more accessible to medical students. Institutions may start, for example, by identifying faculty members who are interested in the mentorship of students and making their contact information readily available to the student body. Similarly, as we have done, creating a running departmental list of open research projects on which a faculty member would be amenable to guiding medical student involvement can be a great resource to interested mentees.

Alternatively, although the mentoring relationships highlighted here are one-on-one in nature, the concept of group mentoring may be palatable to a conglomerate of institutions (or the field in its entirety) that may be concerned about time and other resources that must be allocated to ensure proper mentoring. In particular, the concept of "panel advising" has been described [33] and seems to be a viable alternative to developing a formal mentoring program at any single institution for a given specialty. Admittedly, it may not be an ideal substitute for individualized mentoring through research in which both individuals are in close physical proximity with each other. However, it could allow students attending professional meetings or other networking forums to receive advice on a variety of professional issues by culling it from mentors with a variety of backgrounds and interests over small discrete amounts of time in private sessions.

Finally, we believe that many of the formalized teaching and professional development programs discussed here can be applied to other fields of medicine as well, quite possibly radiology. Those that may receive the greatest benefit from these recommendations would be for reasons similar to those described here for radiation oncology, including limited exposure during standard formal undergraduate medical education. Ultimately, we expect that early and active mentoring of medical students in radiation oncology will enhance general understanding of the field as well as improve its professional base to enhance patient care. There has been no better time to satisfy these needs in oncology-related fields, as we are clearly about to move into uncharted (epidemiological) territory.

REFERENCES

- Mann MP. Faculty mentors for medical students: a critical review. *Med Teach* 1992;14:311-9.
- Stange KC, Hekelman FP. Mentoring needs and family medicine faculty. *Fam Med* 1990;22:183-5.
- Rose GL, Rukstalis MR, Schuckit MA. Informal mentoring between faculty and medical students. *Acad Med* 2005;80:344-8.
- Sambunjak D, Straus SE, Marusic A. Mentoring in academic medicine: a systematic review. *JAMA* 2006;296:1103-15.
- Detsky AS, Baerlocher MO. Academic mentoring—how to give it and how to get it. *JAMA* 2007;297:2134-6.
- Hernandez J, Al-Saadi S, Boyle R, et al. Surgeons can favorably influence career choices and goals for students interested in careers in medicine. *J Am Coll Surg* 2009;209:62-7.
- Garmel GM. Mentoring medical students in academic emergency medicine. *Acad Emerg Med* 2004;11:1351-7.
- Dorrance KA, Denton GD, Proemba J, et al. An internal medicine interest group research program can improve scholarly productivity of medical students and foster mentoring relationships with internists. *Teach Learn Med* 2008;20:163-7.
- American Cancer Society. *Cancer facts and figures 2009*. Atlanta, Ga: American Cancer Society; 2009.
- Boyle P, Levin B, eds. *World cancer report 2008*. Geneva, Switzerland: World Health Organization; 2009.
- Dennis KE, Duncan G. Radiation oncology in undergraduate medical education: a literature review. *Int J Radiat Oncol Biol Phys* 2010;76:649-55.
- Cave J, Woolf K, Dacre J, et al. Medical student teaching in the UK: how well are newly qualified doctors prepared for their role caring for patients with cancer in hospital? *Br J Cancer* 2007;97:472-8.
- Barton MB, Gabriel GS, Sutherland D, et al. Cancer knowledge and perception of skills of general practice registrars in Australia. *J Cancer Educ* 2007;22:259-65.
- Barton MB, Bell P, Sabesan S, et al. What should doctors know about cancer? Undergraduate medical education from a societal perspective. *Lancet Oncol* 2006;7:596-601.
- Gaffan J, Dacre J, Jones A. Educating undergraduate medical students about oncology: a literature review. *J Clin Oncol* 2006;24:1932-9.
- Hirsch AE, Mulleady Bishop P, Dad L, et al. An increase in medical student knowledge of radiation oncology: a pre-post examination analysis of the oncology education initiative. *Int J Radiat Oncol Biol Phys* 2009;73:1003-8.
- Hirsch AE, Singh D, Ozonoff A, et al. Educating medical students about radiation oncology: initial results of the oncology education initiative. *J Am Coll Radiol* 2007;4:711-5.
- Perez C, Brady L, eds. *Principles and practice of radiation oncology*. 5th ed. Philadelphia, Pa: Lippincott-Raven; 2007.
- Harris EE, Abdel-Wahab M, Spangler AE, et al. Results of the Association of Directors of Radiation Oncology Programs (ADROP) survey of radiation oncology residency program directors. *Int J Radiat Oncol Biol Phys* 2009;74:327-37.
- Wasserman TH, Smith SM, Powell SN. The growth of academic radiation oncology: a survey of endowed professorships in radiation oncology. *Int J Radiat Oncol Biol Phys* 2009;74:338-40.
- Buchholz TA, McBride WH, Cox JD. Preparing for the future of radiation oncology. *J Am Coll Radiol* 2007;4:560-2.
- Sambunjak D, Straus SE, Marusic A. A systematic review of qualitative research on the meaning and characteristics of mentoring in academic medicine. *J Gen Intern Med* 2010;25:72-8.
- Slanetz PJ, Mulleady P, Hirsch AE. The Oncology Education Initiative: successful incorporation of multidisciplinary oncology education into the core radiology clerkship. In: *RSNA Scientific Assembly and Annual Meeting program*. Oakbrook, Ill: Radiological Society of North America; 2008:392.
- Zumwalt AC, Marks L, Halperin EC. Integrating gross anatomy into a clinical oncology curriculum: the oncoanatomy course at Duke University School of Medicine. *Acad Med* 2007;82:469-74.
- Vikram B, Coleman CN, Deye JA. Current status and future potential of advanced technologies in radiation oncology. Part 1. Challenges and resources. *Oncology (Williston Park)* 2009;23:279-83.
- Hirsch AE, Bishop PM, Singh D, et al. Incorporation of radiation oncology into the medical school curriculum: a two-year analysis of the Oncology Education Initiative. Presented at: Meeting of the International Association of Medical Science Educators; Leiden, The Netherlands; July 2009.
- Wilson LD, Haffty BG. Evaluation of the National Resident Matching Program (NRMP) radiation oncology data (1993-2003). *Int J Radiat Oncol Biol Phys* 2003;57:1033-7.
- National Resident Matching Program. *Results and data: 2009 main residency match*. Washington, DC: National Resident Matching Program; 2009.
- Kerr JR, Seaton MB, Zimcik H, et al. The impact of interest: how do family medicine interest groups influence medical students? *Can Fam Physician* 2008;54:78-9.
- Ramani S, Gruppen L, Kachur EK. Twelve tips for developing effective mentors. *Med Teach* 2006;28:404-8.
- Dobelbower RR. Simon Kramer 1919-2002: physician, teacher, pioneer, scientist, leader. *Int J Radiat Oncol Biol Phys* 2002;54:633-4.
- Barrett K, Mistry N, Hayter C, et al. The effectiveness of the Ivan H. Smith Memorial Studentships program on encouraging medical students to pursue a career in radiation oncology. *J Cancer Educ* 2008;23:226-9.
- Chakkalakal R, Brownfield E. Panel advising: an alternative to consider. *Med Educ* 2009;43:1087.