RSNA R&E Foundation Education Scholar Grant
Education Scholar Grant Application

Daniel Golden, MD
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NOTE: Personal information for the applicant and other investigators has been removed from this sample application.

Title: Development of an Introductory Structured Didactic Radiation Oncology Curriculum for Medical Students Pursuing a Career in Radiation Oncology

Abstract:

Traditional radiation oncology rotations have functioned as audition rotations for residency training. Medical student education frequently consists of clinical experiences without formal structured didactic education to provide a fundamental knowledge base pertaining to the specialty. A pilot curriculum for the 4-week radiation oncology clerkship was previously developed and implemented at two institutions. 18 students completed the pilot curriculum. Feedback was overwhelmingly positive with students reporting that all components of the curriculum were "quite" to "extremely" useful. The curriculum increased comfort with their specialty decision. The pilot curriculum was rated between “quite” and “extremely” useful to (1) help students understand radiation oncology as a specialty, (2) increase student comfort with their specialty decision, and (3) help students with their future transition to a radiation oncology residency. The primary goal of the proposed project is to expand the curriculum to multiple training institutions across the United States. Clinical research has used the multi-institutional collaborative model to enroll a large number of patients on clinical trials from multiple clinical centers. Similarly, this project proposes to use a multi-institutional collaborative model to implement a novel educational curriculum for the fourth-year medical student radiation oncology clerkship. Using this model, the number of medical students who complete the curriculum can be increased significantly. This will provide improved feedback for further enhancement of the curriculum. In addition, implementation of this curriculum across multiple institutions will function as a test case for developing and implementing novel radiation oncology educational materials using a multi-institutional format. If successful, this model can then be subsequently used to develop further radiation oncology educational innovations for medical students, radiation oncology residents, and oncology fellows outside of radiation oncology.

Percent of Time Dedicated to this Project:

25% of my time will be spent working on this project. I anticipate implementing the current curriculum at multiple institutions beginning in the summer of 2013. Implementation will require a significant amount of coordination and distribution of curricular materials. Subsequent time will be spent reviewing student feedback and improving the curriculum based on responses. In addition, the results of the curriculum evaluations will be published to help disseminate the curriculum to other institutions.

Priority Statement:

Academic medicine is comprised of three intertwined but distinct components: 1) clinical care, 2) research, and 3) education. As a graduating resident, soon-to-be junior faculty academic clinician, I have the opportunity to choose how to prioritize my academic endeavors. Although academic medical centers have excellent educational programs, many of the educational methods used are based on tradition and empiric observation, rather than rigorous evaluation, assessment, modification, and re-evaluation. Medical education only recently began to move in the direction of developing structured curricular enhancements based on evidence rather than tradition and observation.

A primary goal during my career is to bring the multi-institutional model used so successfully in clinical research to medical education curriculum development. Radiation oncology training programs are small. They typically range in size from just a few residents to >25, with the majority having between 6 and 12 residents. Therefore it can be difficult to develop new curricular enhancements. In addition, many radiation oncology departments have implemented novel educational practices but have not disseminated these for adoption or adaptation by other departments.
Medical student education relating to radiation oncology has generally consisted of 4-week clerkships functioning as audition rotations for residency positions. Although this is an important component of these clerkships, a structured didactic curriculum to complement the students’ clinical experiences will help to ensure that all students completing a radiation oncology rotation will have a strong fundamental knowledge of radiation oncology. I have therefore chosen to use the medical student radiation oncology clerkship curriculum as a test case for radiation oncology curricular development in a multi-institutional model. Using the knowledge gained during my medical education fellowship, I have approached this in a step-by-step approach based on David Kern’s six steps of medical education curriculum design [1].

These six steps include: 1) Problem identification and general needs assessment, 2) Targeted needs assessment, 3) Goals and Objectives, 4) Educational methods, 5) Implementation, 6) Evaluation and Dissemination.
Using these six steps, I developed and implemented a pilot curriculum for the radiation oncology medical student clerkship.

This curriculum received excellent feedback from the 18 students who completed it. Rather than consider this project completed, I am cycling through Kern's six steps again with the new goal of implementing this curriculum at multiple institutions across the country. My long-term goal is for a structured didactic curriculum to become a standard component of all medical student radiation oncology clerkships across the country.

This curriculum can be adapted to fill other deficiencies in radiation oncology education. Our specialty does an excellent job of educating our own trainees about radiation oncology. However, oncologic specialties including medical oncology, surgical oncology, and others do not receive structured didactics relating to radiation oncology. With minimal modifications, the radiation oncology clerkship curriculum can be adapted into a lecture series and hands-on didactic session to teach other oncologic trainees the fundamentals of radiation oncology. This will help to foster improved multi-disciplinary care. Ensuring that surgeons and medical oncologists have a fundamental understanding of radiation oncology will help them counsel their patients about the role and process of radiation. In addition, they will better understand how radiation works as an oncologic therapy and will be able to more effectively communicate with their radiation oncology counterparts.

Lastly, using the multi-institutional model for radiation oncology curricular development, I look forward to collaborating with other medical educators across the country to develop novel radiation oncology techniques to fill other educational deficiencies. These could include, but are not limited to, dosimetry education, treatment plan evaluation, and oncologic biostatistics.

Receiving the RSNA Education Scholar Grant will allow me to have protected time during my first year as an academic physician to further develop this curriculum, ensure that it is implemented uniformly at multiple institutions across the country, monitor evaluations and feedback from students completing the curriculum, submit the curriculum for publication through www.MedEdPORTAL.org, and publish a peer-reviewed manuscript in a peer-reviewed journal (ideally the International Journal of Radiation Oncology, Biology, Physics) documenting the process of developing and implementing the curriculum along with outcomes based on student feedback. By establishing medical education as a core focus of my career early on, I will be able to continue this endeavor with further development of curricular enhancements not only for the medical student radiation oncology clerkship but also for radiation oncology residency training and oncology fellowship training.

In conclusion, the overall goal of this project and my career in general is to improve clinical care by improving radiation oncology training through novel educational methods. By utilizing a multi-institutional model similar to clinical research, I will be able to reach a greater number of learners, receive feedback on how to improve the curriculum, and demonstrate that the multi-institutional collaborative model can be used to develop and implement a novel curriculum. By ensuring that radiation oncology trainees, whether medical students or residents, have a firm fundamental understanding of the field of radiation oncology, patient care can be improved. In addition, by disseminating novel educational methods through publication in a peer-reviewed journal I hope to stimulate debate and discussion and to motivate others to develop and disseminate novel educational materials. The RSNA Education Scholar Grant will provide the funding for protected time needed to accomplish these goals.

1. Kern DE, Thomas PA, Hughes MT, eds. Curriculum development for medical education: a six-step approach. Second Ed. Baltimore, MD: The Johns Hopkins University Press; 2009.

Budget: (*Budget details have been removed from this sample*)

Project Timeframe: 7/1/2013-6/30/2014
Total Project Budget: $75,000

Amount Requested: $75,000

Complete Budget Justification

A. Personnel	
Salary support	$73,715
B. Supplies	
Office supplies and computer software	$700
Conference calls & web conference costs; postal fees	$585
B. Other (none)	

Other Investigators:

Andrew R. Howard
Role: Dr. Howard is Associate Professor in the University of Chicago Department of Radiation and Cellular Oncology. He will serve as the scientific advisor. Dr. Howard has previously worked with Dr. Golden on a national survey of medical students applying to radiation oncology residency. He will provide input on further development of the curriculum, multi-institutional implementation, evaluation design, and data analysis.

Steven J. Chmura, MD PhD
Role: Dr. Chmura is Associate Professor in the University of Chicago Department of Radiation and Cellular Oncology. He also serves as the residency program director and the medical student clerkship director. Dr. Chmura has previously worked with Dr. Golden on a national survey of medical students applying to radiation oncology residency. He will provide guidance on further development of the curriculum, multi-institutional implementation, evaluation design, and data analysis.

Ralph R. Weichselbaum, MD
Role: Dr. Weichselbaum is chair of the University of Chicago Department of Radiation and Cellular Oncology. He will provide guidance throughout the project.

Detailed Education Plan: (See Next Page)

A. Detailed Education Plan:

Introduction:

Formal research relating to radiation oncology education has been lacking.[1] To improve radiation oncology undergraduate and graduate medical education, it is imperative to begin developing novel curricula that are implemented and evaluated in a rigorous fashion. To this end, the standard curriculum for the radiation oncology medical student clerkship generally consists of four weeks of clinical experiences with attendance at resident and departmental lectures and quality assurance rounds. In addition, students are frequently asked to give a formal presentation to the department on a clinical topic of their choice. Radiation oncology clinical rotations function well as audition rotations for residency but they frequently lack level-appropriate didactic training for medical students.

Other specialties have used multi-institutional collaboration to develop medical student curricular enhancements.[2,3] In addition, there has been one report of a multi-institutional curriculum being developed for radiation oncology residents.[4] However, there are no prior reports of radiation oncology educational materials being developed for medical students using multi-institutional collaboration.

Rationale and Purpose:

Hirsch and colleagues have developed a structured didactic session covering important aspects of radiation oncology for all medical students, not just those pursuing a career in radiation oncology.[5,6] In addition, multiple novel curricular innovations have been reported for radiation oncology residency training.[7,8] However, there have been no published reports of a structured didactic curriculum for those students choosing to pursue a career in radiation oncology. It is important to recognize that clinical training of future radiation oncologists does not begin on the first day of residency. Rather, specialty-specific clinical training of a radiation oncologist begins during the first radiation oncology clerkship as a medical student. Therefore, it is imperative to develop a structured didactic curriculum to complement the clinical experience of medical student radiation oncology clerkship.

Our survey of MS4's applying for radiation oncology found that the majority completed 3 radiation oncology clerkships. With a median of 4 weeks per clerkships, that means that the average medical student pursuing radiation oncology spends approximately three months in a radiation oncology clinic during clinical training in medical school. This represents an excellent opportunity to provide these future radiation oncologists with a strong fundamental understanding of clinical radiation oncology. In addition, ensuring that medical students have a strong foundation in all aspects of clinical radiation oncology through a structured didactic curriculum may serve to ease their transition into residency. Many PGY-2 residents report minimal or no prior experience with basic daily clinical duties such as contouring, patient positioning for simulation and/or treatment, or plan evaluation (*personal observation and communications*).

Therefore, the goal of this project is to further develop a structured didactic curriculum for the radiation oncology medical student clerkship. An additional goal is to develop a collaborative group of radiation oncology educators. Radiation oncology training programs range in size from ~4 to ~25 residents, although the majority of training programs have between 6 and 12 residents. By developing a multi-institutional collaborative group of radiation oncology educators, novel educational interventions can be developed, vetted, implemented, and evaluated. In addition, this format will allow for cross-pollination of training methods that are often innovative, but remain at a single institution due to a lack of effective means for dissemination.

Objectives:

1. Further develop a structured didactic curriculum for the 4-week radiation oncology clerkship
2. Evaluate the perceived benefit of individual components of a structured didactic radiation oncology curriculum on medical student preparation for transition to residency
3. Publish the curriculum on www.MedEdPORTAL.org for dissemination to other training programs nationwide
4. Form a collaborative group for development and implementation of novel radiation oncology educational methods

Student Population:

The specific student population served by this project will include medical students completing a four-week rotation in radiation oncology. The majority of these students will be MS4's planning to apply for residency training programs in radiation oncology. However, a fraction of students will be MS3's exploring career options or students not choosing to pursue radiation oncology. In our pilot curriculum experience 2/18 students chose not to pursue radiation oncology after completing their clerkship. This curriculum will give interested students a better understanding of radiation oncology as a specialty. By improving student understanding of radiation oncology, we may enrich the pool of applicants with those who better understand the demands of the field. Lastly, a small number of students completing the curriculum will not be interested in pursuing a career in radiation oncology. They will likely be pursuing a related field (diagnostic radiology, medical oncology, surgical oncology, etc.). Improving their understanding of radiation oncology is also important to help foster high-quality multi-disciplinary care.

Previous Experience:

During the 2011-2012 academic year, the principal investigator (DW Golden) completed the University of Chicago Pritzker School of Medicine MERITS (Medical education, research, innovation, teaching, and scholarship) fellowship. During this fellowship he learned a significant amount about educational needs assessments, curriculum development, evaluation, and dissemination. As a medical education project, a pilot curriculum for the 4-week medical student radiation oncology clerkship was developed following Kern's six steps for medical education curriculum development.[9]

As an initial step prior to developing this curriculum a targeted needs assessment was completed to characterize the radiation oncology clerkship experience of MS4's. 35 MS4's responded to an anonymous web-based survey. The MS4's reported completing a total of 97 radiation oncology clerkships prior to applying for residency. When asked about the didactic experience on their clerkships, MS4's reported that the 97 clerkship experiences included formal case discussions in 35% (34 of 97), hands-on didactic sessions (e.g. contouring) in 23% (22/97), and lectures specifically for MS4's in 35% (34 of 97). 52% of clerkships (50 of 97) were reported to have no formal lecture, case discussion, or hands-on didactic session (**Figure 1**).[10]

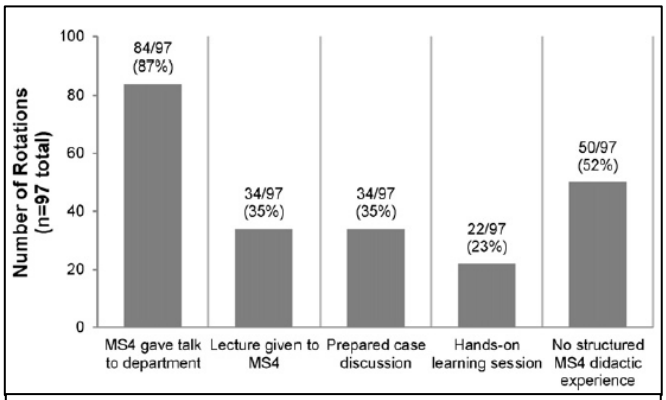

Figure 1. Fourth-year medical student (MS4) self-reported educational experiences on radiation oncology clerkships.

In the same survey, MS4's were asked to rate different educational content that they would desire in an optimal MS4 radiation oncology rotation. Educational activities that MS4s ranked moderately to extremely important to include in a clerkship curriculum were (1-5 Likert scale where 1 = not at all important, 5 = extremely important) an opportunity to perform an unsupervised history and physical examination (4.8); an opportunity to give a formal lecture (4.2); a didactic hands-on session on radiation contouring (4.1) and planning (4.1); a formal case presentation to faculty (3.9); and lectures on treatment planning (3.5), radiobiology (3.3), physics (3.2), and evidence-based medicine (3.2).

Based on these responses, a structured didactic pilot curriculum was developed to teach rotating medical students the fundamentals of clinical radiation oncology. The curriculum consisted of three lectures on (1) an overview of radiation oncology including a history of the specialty, types of treatments, and basic clinic flow, (2) fundamentals of radiation biology and radiation physics, and (3) practical aspects of radiation treatment simulation and planning. In addition, a hands-on dosimetry planning session was developed to teach students the fundamentals of radiation treatment planning in an interactive manner. Each student was provided with a Pinnacle® workstation and a standardized case of a patient with a painful bony metastasis in the sixth thoracic vertebrae. The medical student is provided with a step-by-step guide to walk them through contouring of target volumes, turning on appropriate beams, and then modifying plan parameters including beam arrangement and beam energy to achieve an optimal plan with minimal risk of toxicity. The medical student repeatedly evaluates the plan's dose volume histogram and target coverage until the target volume (i.e. the T6 lesion) is appropriately covered by the plan's prescription dose.

This curriculum was subsequently implemented at two academic teaching hospitals, the University of Chicago and the Harvard Longwood campur, for students rotating during 2012. To ensure consistency of the curriculum between institutions the lectures and planning session were standardized between the two departments. All students completed an evaluation of the curriculum using Likert scales to rate curriculum components (1 = not at all, 2 = somewhat, 3 = moderately, 4 = quite, 5 = extremely). Wilcoxon signed rank-sum was used to compare responses.

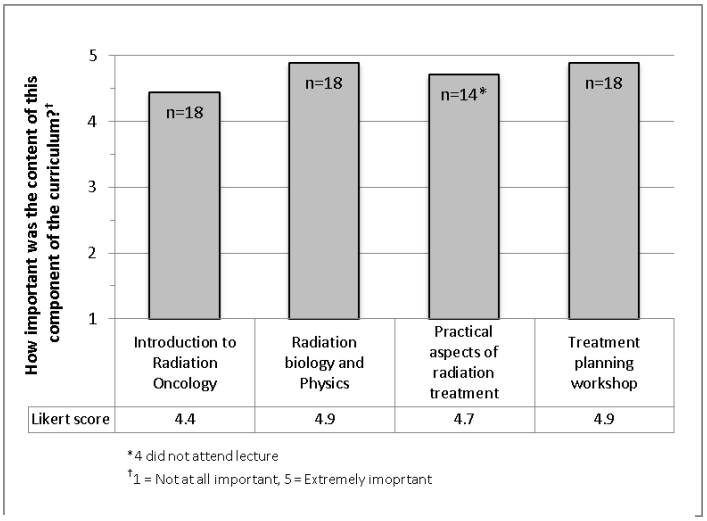

Figure 2. Student-assessed importance of individual curriculum components (rated on Likert Scale: 1 = not at all important, 5 = extremely important)

Preliminary data from the pilot implementation of this curriculum are presented subsequently. 18 students completed the curriculum during a four-week rotation (University of Chicago n=13, Harvard Longwood Campus n=5). Student medical school tracks included 13 MD, 4 MD/PhD, and 1 other. 7 students had completed no prior rotations, 7 had completed one prior rotation, 3 had completed 2 prior rotations, and one student did not respond.

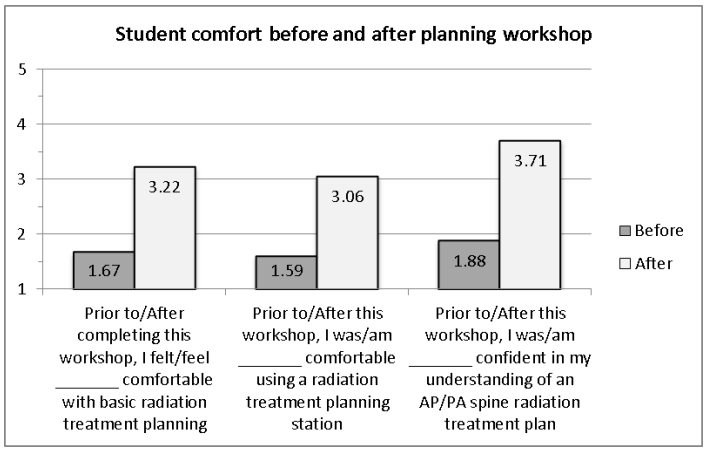

Figure 3. Student comfort with radiation treatment planning before and after the hands-on planning workshop. (Likert scale: 1= not at all, 5 = extremely)

Overall, the students rated the content of the lectures between "quite" and "extremely" important (**Figure 2**). After completing the planning workshop students reported significantly improved comfort with radiation treatment planning (1.7 vs. 3.2, $p<0.01$), comfort using a treatment planning station (1.6 vs. 3.1, $p<0.01$), and confidence in their understanding of an AP/PA spine treatment plan (1.9 vs. 3.7, $p<0.01$) (**Figure 3**). The curriculum was rated between "quite" and "extremely" useful to (1) help students understand radiation oncology as a specialty, (2) increase student comfort with their specialty decision, and (3) help students with their future transition to a radiation oncology residency.

These preliminary results demonstrate that a standardized curriculum for medical students completing a four-week clerkship in radiation oncology can be successfully implemented at two institutions. The students favorably reviewed the curriculum. As a result of completing the curriculum medical students felt more comfortable with their specialty decision and better prepared to begin radiation oncology residency. Selected free-response quotes from students completing the curriculum are presented in **Table 1**. These comments reflect the students' subjective feelings that the course provided additional knowledge that supplemented their clinical experience.

Table 1. Selected free-response quotes from students completing the pilot curriculum for the medical student radiation oncology clerkship.

"I thought the course was very well thought out and very useful. It gave an excellent overview of the background of radiation therapy, practical elements, and the physics/biology underlying radiation therapy. The planning session was extremely helpful to visualize how the plan is implemented in practice."
"This course was extremely helpful for me. As this was my first radiation oncology rotation this course gave me a very strong foundation in the field."
"This course was very important in helping me become more comfortable with my decision to go forward with radiation oncology as a career."
"I [think] a course like this would have made my first rotation much smoother."
"Excellent course, I wish my home institution had a similar one."

Although these results are promising, dissemination of curricular innovation is of the utmost importance for educational research. Collaborative efforts are common in basic science research and clinical research. The large cooperative groups (RTOG, NSABP, CALGB, SWOG, etc.) are excellent examples of clinical cooperative groups. Without collaborative multi-institutional efforts, many seminal research studies would have been nearly impossible to accomplish. Collaborative groups offer the benefit of combining small patient numbers from multiple institutions into a large group to test new clinical treatments.

Project Plans:

Activities:

The primary goal of this project will be to formalize this curriculum, prepare it for publication on www.MedEdPORTAL.org, and to implement it at multiple institutions nationwide. To accomplish this last goal, contacts are already being actively established at multiple institutions across the country. Letters of agreement have been obtained from Harvard and the Medical College of Wisconsin. Additional institutions that have been contacted and are considering implementation of this curriculum include Memorial Sloan Kettering Cancer Center, MD Anderson Cancer Center, Northwestern, University of Wisconsin, Yale, Case Western, and University of Utah. Each site will have a representative to help facilitate implementation at their respective institutions and coordinate delivery of lectures and the planning workshop. Letters of agreement will be secured from each participating institution and submitted as they become available (Harvard and Medical College of Wisconsin are already included). In addition, we have submitted this project to the University of Chicago IRB for approval/exemption (University of Chicago IRB #13-0036). The goal is to implement the curriculum for students rotating from 7/2013 – 12/2013.

To ensure that the curriculum is delivered in a similar fashion between sites, the PI will conduct a web-based conference call with each site contact to go over the three lectures and the planning session. A demonstration of the planning session will be provided via a web-based conference. This will ensure uniform implementation of the curriculum at all sites. The PI will subsequently monitor all participating sites via communications and regular review of completed curriculum evaluations. Each site will be notified on a rolling basis of any specific feedback received regarding the delivery of the curriculum at their institution. This will help to ensure consistency and quality across all sites.

At the end of each rotation students will be asked to complete a web-based evaluation of the curriculum. The web-based evaluation will be managed through REDCap, a secure, web-based application for building and managing online surveys and databases. The University of Chicago is an institutional member of REDCap and is therefore able to use it free-of-charge for this project. The evaluation will characterize the students' perception of how the curriculum impacted their understanding of clinical radiation oncology, radiation biology and radiation physics, patient positioning and immobilization, and radiation treatment planning. Although the optimal evaluation of a curriculum would include a pre and post-test of student knowledge to demonstrate retention of knowledge, because these clerkships will also continue to serve as audition rotations, no pre or post-test will be conducted to prevent increased student anxiety and to assure the students that the goal of the curriculum is not to evaluate them as a component of their residency application.

This curriculum will serve as a case study of the feasibility of implementing a novel curriculum across multiple institutions for a radiation oncology. If successful, this project will serve as a model for subsequent development of novel undergraduate and graduate medical education radiation oncology educational materials. The group of radiation oncology educators (GROE) established by this project can subsequently be utilized to test additional radiation oncology educational innovations.

Time Schedule:

January – June 2013 (pre-funding preparatory work)

1. Recruit additional participating sites
2. Obtain IRB exemption
3. Refine curriculum content including development of planning module for Eclipse® and Xio®
4. Finalize medical student evaluation
5. Coordinate implementation of curriculum

July – December 2013

1. Curriculum delivered at multiple institutions
2. PI coordinates web-based evaluation of curriculum by students using REDCap

January – June 2014

1. Analysis of student evaluations and performance
2. Modification of curriculum

3. Submission for publication at www.MedEdPORTAL.org
4. Expansion to additional sites
5. Dissemination of curriculum and GROE (Group of Radiation Oncology Educators) case study through presentation at national meetings (i.e. RSNA, ASTRO, and AAMC) and submission to the *International Journal of Radiation Oncology, Biology, Physics*

Outcomes:

This project will provide novel information in two ways. First, it will optimize and expand delivery of a structured didactic curriculum for students rotating through radiation oncology departments. As stated above, there are no prior reports of a structured curriculum for the MS4 radiation oncology clerkship. By having this curriculum evaluated by multiple faculty and students at several institutions, it can be further improved to optimally complement MS4 clinical radiation oncology experiences and provide them with a strong foundation for beginning residency.

Second, successful implementation of this curriculum at multiple institutions will provide proof of principle that a collaborative educational group can be successful in developing, implementing, and disseminating novel radiation oncology educational materials.

Statistical analysis will be done using Stata v12.1 (StataCorp, College Station, TX). Descriptive statistics will be used to summarize the curriculum outcomes. Student's T-test and Wilcoxon rank sum will be used to compare evaluation results between groups.

Evaluation:

This project will be evaluated in three ways. First, students completing the curriculum will evaluate the individual components. Student feedback is critical because, as stakeholders, if they do not perceive that each component is important to their education, they will not buy into the curriculum. As stated above, pre and post-tests of student knowledge will not be obtained to prevent undue anxiety or the perception of evaluation as a component of application for residency. Student evaluations will be completed using web-based survey software, REDCap. The University of Chicago is an institutional member of REDCap. REDCap is a secure, web-based application for building and managing online surveys and databases. REDCap provides automated export procedures for data downloads to Excel and common statistical packages (SPSS, SAS, Stata, R), as well as a built-in project calendar, a scheduling module, ad hoc reporting tools, and advanced features, such as branching logic, file uploading, and calculated fields. REDCap is provided free-of-charge to University of Chicago staff. Student responses will be de-identified prior to data analysis.

To further evaluate the curriculum, each institutional contact will be asked to evaluate their experience implementing the curriculum. This will provide information on the feasibility of developing educational materials using a multi-institutional collaborative group model.

Dissemination:

As a final component of this project, the curriculum will be disseminated so that other institutions can use it. One way to disseminate the curriculum will be through presentation at national meetings (i.e. RSNA) and publication in peer-reviewed journals. In addition, the curriculum content (i.e. slides for three Powerpoint lectures, the treatment planning guide, the CT scan used for the treatment planning workshop, the Pinnacle® contour data, and the evaluation form) will be submitted to www.MedEdPORTAL.org, a peer-reviewed repository of medical educational materials. The hands-on dosimetry component of this curriculum is already available on MedEdPORTAL along with two other self-directed dosimetry modules.[11]

Results of this project will be submitted to the *International Journal of Radiation Oncology, Biology, Physics* and presented at national meetings (i.e. RSNA). The curriculum, including all components, will be distributed via www.MedEdPORTAL.org to allow other institutions both nationally and internationally to adopt or adapt the curriculum as needed.

Lastly, this curriculum will be subsequently adapted as an introductory course for medical oncology and surgical oncology trainees.

References:

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