Objective Evaluation of a Didactic Curriculum for the Radiation Oncology Medical Student Clerkship

BY

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Master of Health Professions Education
in the Graduate College of the
University of Illinois at Chicago, 2017

Chicago, Illinois

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This thesis is dedicated to my wife, Lisa, whose unwavering support and encouragement made this accomplishment possible.

ACKNOWLEDGEMENTS

This project would never have succeeded without assistance at numerous points along the way. I would like to thank my thesis committee Alan Schwartz, Yoon Soo Park, and Jeanne Farnan for their guidance and advice throughout the course of my thesis project. Also a special thank you to the faculty, staff, and students at the University of Illinois at Chicago Department of Medical Education for many stimulating discussions and thoughtful insights throughout my MHPE coursework.

Thank you to Ralph Weichselbaum, Steven Chmura, and the University of Chicago Department of Radiation and Cellular Oncology for allowing me to implement the clerkship curriculum as a pilot study during my residency training and continuing to support my interest in medical education once I joined the faculty.

Thank you to Anne McCall, my clinic partner, for always covering our clinic with a smile while I was completing my coursework or attending conferences that provided me with the knowledge and skills required to complete this project.

Invaluable contributions were provided by the Radiation Oncology Education Collaborative Study Group (ROECSG) members from across the United States who took time out of their busy schedules to implement the ROECSG curriculum and coordinate data collection at their individual sites. These collaborators included Ariel Hirsch at Boston University, Rachel Jimenez, Laura Warren, and Alexander Spektor at Harvard University, Lauren Colbert, Jillian Gunther, and Prajnan Das at University of Texas MD Anderson Cancer Center, Neil Taunk and Abraham Wu at Memorial Sloan Kettering Cancer Center, Kevin Du at New York University, Tim Kruser at Northwestern University, Nima Nabavizadeh and Charles Thomas Jr. at Oregon

Health and Science University, Wendy Hara at Stanford University, Andrew McDonald at University of Alabama, Steve Braunstein at University of California San Francisco, Mark Amsbaugh at University of Louisville, Raphael Yechieli, Mary Dean, and Cristiane Takita at University of Miami, John Vargo and Sushil Beriwal at University of Pittsburgh, Matthew Ballo at University of Tennessee, Jeffrey Brower and Kristin Bradley at University of Wisconsin, Yuan Rao at Washington University, John Stahl and Susan Higgins at Yale University, Sonali Rudra at Georgetown University, Eric Chang at University of California Los Angeles, and Jason Ye and Leslie Ballas at University of Southern California. Countless other staff at these institutions helped to coordinate medical student clerkships, distribute pre-clerkship and post-clerkship assessments, and coordinate lectures and workshops. Thank you to all of the radiation oncology faculty and residents across the United States that delivered the curriculum content including the lectures and planning workshops at their institutions.

A special thank you to Ryan McKillip and Greg Kauffmann at the University of Chicago who contributed invaluable assistance with data collection and analysis.

Funding was provided by the Department of Radiation and Cellular Oncology at the University of Chicago (survey incentives) and NIH CTSA UL1 TR000430 (REDCap).

Finally, thank you to the medical students that took the time to complete the pre-clerkship and post-clerkship knowledge assessments and the clerkship experience survey. I hope that their participation in the curriculum enhanced their knowledge about radiation oncology, helped them make the right career choice, and helped ease the transition into residency training.

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LIST OF ABBREVIATIONS

MCQ	Multiple choice question
NRMP	National Resident Matching Program
REDCap™	Research Electronic Data Capture
ROECSG	Radiation Oncology Education Collaborative Study Group
SD	Standard deviation
USMLE	United States Medical Licensing Exam

SUMMARY

A study was conducted to determine if a structured didactic curriculum for the medical student radiation oncology clerkship improved objective knowledge compared with clerkships not utilizing a structured curriculum. Medical students completing a radiation oncology clerkship at participating institutions received a structured didactic curriculum consisting of three lectures and a hands-on treatment planning workshop. The students were asked to complete a pre-clerkship and post-clerkship objective knowledge assessment. A cohort of students applying to residency in radiation oncology were then surveyed approximately six months after completion of the curriculum using the same objective knowledge assessment.

The standardized curriculum for the radiation oncology clerkship was implemented at 22 academic medical centers in the United States during 2016. 146 students completed the curriculum from July through November 2016. 109 students completed paired pre-clerkship and post-clerkship objective knowledge assessments (response rate 74.7%). Assessment scores increased from pre- to post-curriculum for overall knowledge and specific knowledge subdomains. Post-scores for students rotating de novo at participating institutions were higher compared with pre-scores for students with ≥1 prior rotations at non-participating institutions (77.3% vs. 68.8%, p=0.01) suggesting a benefit to utilizing a structured curriculum for the radiation oncology clerkship. Students who completed rotations at participating institutions continued to demonstrate a trend towards improved performance on the objective knowledge assessment at approximately six months after curriculum exposure (70.5% vs. 65.6%, p=0.11).

I. INTRODUCTION

Medical student clinical rotations such as internal medicine (Jablonover et al. 2000), surgery (Wisniewski et al. 2013), emergency medicine (Tews et al. 2015), dermatology (Cipriano et al. 2013), urology (Slaughenhoupt et al. 2014), and palliative medicine (Shaheen et al. 2014) have structured didactic curricula to complement the clinical experience. In 2012 and 2013, a national survey of students applying to radiation oncology revealed that medical students complete a median of three clerkships at multiple institutions before applying to residency (Golden et al. 2013; Jagadeesan et al. 2014). For each clerkship completed, students reported on curriculum experiences and self-assessed their post-clerkship knowledge and confidence in various facets of radiation oncology. The survey results demonstrated a high degree of variability in clerkship educational experiences and that the majority of clerkships had no structured didactic curricula. However, students who completed clerkships with formal didactic components reported greater self-perceived preparedness to function as radiation oncology residents (Jagadeesan et al. 2014). Radiation oncology curricula exist for the third year of medical school (Hirsch et al. 2007, 2009, 2012; Zaorsky et al. 2012) and student primers are available (Berman et al. 2013). However, no structured didactic curriculum was publicly available or reported in the literature in 2012.

In response to these national survey data, a structured didactic curriculum was developed and implemented at two institutions in the United States (Golden et al. 2014). In a subspecialty such as radiation oncology, the yearly sample size of trainees at any single institution is too small to acquire meaningful objective results on the impact of the curriculum (Thomas et al. 2015). To overcome the small number of medical students at single institutions, the multi-institutional collaborative group research model was adapted. The collaborative model has demonstrated

effectiveness in other settings such as treatment of rare diseases by pooling patients from multiple institutions treated in a given timeframe (Timmerman et al. 2010). Initially piloted at two institutions in 2012 (Golden et al. 2014), the curriculum was expanded to 11 institutions in 2013 (Golden et al. 2014; Ye et al. 2015) and to 14 institutions in 2014, thus forming the Radiation Oncology Education Collaborative Study Group (ROECSG; https://roecsg.uchicago.edu). Upon completion of a clerkship at a participating institution, each student voluntarily and anonymously evaluated the ROECSG curriculum. Subjective evaluations from students were positive (Golden et al. 2014; Radiation Oncology Education Collaborative Study Group et al. 2015; Ye et al. 2015) and students that completed at least one clerkship at an institution that had instituted the ROECSG curriculum reported greater post-clerkship confidence in their radiation oncology knowledge and their ability to function as a radiation oncology resident (Oskvarek et al. 2017). However, these initial reports did not evaluate the efficacy of the curriculum using an objective measure such as a knowledge assessment.

To further increase adoption or adaptation of the structured curriculum within radiation oncology departments, objective evidence demonstrating a benefit to utilizing the curriculum over the traditional model is needed. This study tests the hypothesis that students who complete a radiation oncology clerkship with a structured didactic curriculum demonstrate improved fundamental radiation oncology knowledge at the end of the clerkship compared with the beginning of the clerkship and greater fundamental radiation oncology knowledge compared with a control group not exposed to the curriculum (phase 1) and improved long-term knowledge retention of fundamental radiation oncology knowledge (phase 2) as measured by a multiple choice question (MCQ) knowledge assessment.

II. MATERIALS AND METHODS

To test the hypothesis that students completing the curriculum demonstrate improved objective knowledge and improved knowledge compared with peers not completing the curriculum, the standardized ROECSG curriculum (Radiation Oncology Education Collaborative Study Group et al. 2015) was implemented in 2016 at 22 academic medical centers within the United States. Primary data collection and analysis occurred at the University of Chicago. Phase 1 pre- and post-clerkship data were obtained from participating ROECSG member institutions. A 20 question validated MCQ knowledge assessment was used for the pre and post-clerkship assessment. Phase 2 (long-term) knowledge assessment data was obtained electronically using the University of Chicago REDCap™ server to distribute an anonymous survey as previously described (Jagadeesan et al. 2014).

The phase 1 study population consisted of students completing a radiation oncology clerkship at ROECSG member institutions between 7/1/2016 and 10/31/2016 that voluntarily completed a pre- and post-clerkship objective MCQ knowledge assessment. The phase 2 long-term knowledge assessment study population included all students applying to the University of Chicago Radiation Oncology residency in the 2016-17 National Resident Matching Program (NRMP). These students were invited to complete an anonymous survey regarding their 2016 clerkship experiences that included the same validated objective knowledge MCQ assessment. Given the competitive nature of the radiation oncology match and small number of residency positions, we have previously estimated that approximately 75% of radiation oncology applicants within the United States apply to the University of Chicago radiation oncology residency program each year (Jagadeesan et al. 2014).

The primary aim of this study was to objectively assess knowledge of students at the start of a ROECSG clerkship (phase 1), completion of a ROECSG clerkship (phase 1), and approximately six months after their clerkship (phase 2). The phase 1 pre- and post-knowledge assessment was obtained as a usual component of the students' clerkships. ROECSG site directors distributed the pre-test via e-mail before or on the first day of the rotation. The objective test was in electronic format and was coded with the student's unique identification code as assigned by the ROECSG site coordinator. The pre-assessment (**Appendix A**) included a brief survey collecting basic demographics (degree track, number of prior radiation oncology rotations, and whether or not the student had completed a prior rotation at another ROECSG institution). The same MCQ assessment (**Appendix B**) was re-administered by the ROECSG site coordinator at the end of the clerkship coded with the student's unique identification code allowing the study team to link pre- and post-assessments by individual in an anonymized fashion. REDCap™ data were anonymous with only each ROECSG site coordinator having access to the identification key. Thus, the study team was unable to link an individual with the objective data. Pre- and post-assessment scores were not used as a component of assessment of student clerkship performance. Optional submission of United States Medical Licensing Exam (USMLE) step 1 scores linked to anonymized subject unique identifiers was requested from site coordinators.

For phase 2 of the study, to assess long-term (approximately six month) knowledge retention, the same objective knowledge assessment was administered during the annual clerkship survey conducted since 2012 by investigators in the Department of Radiation and Cellular Oncology at the University of Chicago (**Appendix C**) (Golden et al. 2013; Jagadeesan et al. 2014; Oskvarek et al. 2017). An initial invitation was sent via e-mail on February 24,

2017, with two reminder e-mails. The survey closed on March 12, 2017. To improve the response rate, a five dollar coffee card was given as a survey completion incentive to each student completing the anonymous clerkship survey.

Anonymous clerkship survey data for phase 1 and 2 were collected and managed using REDCap™ electronic data capture tools hosted at University of Chicago (Harris et al. 2009). REDCap™ (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.

The MCQ assessment was initially developed as a draft MCQ assessment with input from multiple stakeholders including a radiation oncology residency program director, a radiation oncology medical student clerkship director, a radiation oncology resident, and a medical student. The initial assessment included 66 items testing content from the three curriculum lectures and planning session that make up the ROECSG curriculum (Radiation Oncology Education Collaborative Study Group et al. 2015). The initial 66-item MCQ test was then distributed to 10 senior radiation oncology residents around the United States. Questions with a resident proportion correct of 0.9-1.0 were deemed to be testing knowledge basic enough to include in a post-clerkship medical student objective knowledge assessment. A total of 26 items were included in the pilot MCQ medical student assessment. These questions were then included in the 2016 clerkship survey to obtain summary and individual item statistics within a fourth year medical student cohort applying to radiation oncology.

Calculation of individual item statistics, option statistics, point biserial correlation, and overall test reliability was used to determine the final set of MCQs to constitute the pre/post assessment. The final MCQ assessment includes 20 items (see **Appendix A**) blueprinted to the structured curriculum. Questions are classified as level I-III based on difficulty and discrimination (Haladyna 2004). There are n=15 level I, n=3 level II, and n=2 level III MCQs.

Data were analyzed using descriptive statistics of students participating in the ROECSG clerkships based on completion of the pre-clerkship demographic survey, paired and unpaired t tests, Pearson's correlation coefficient, and regression analysis. Effect size was calculated using standardized mean difference: [(mean of the experimental group) – (mean of the control group)]/(standard deviation of the entire group) (Cohen 1988). Time since first rotation and USMLE step 1 scores were used as covariates when analyzing the matched data.

No attempt was made to link the phase 1 pre- and post-assessment individual responses to the phase 2 clerkship survey objective assessment data. Rather, phase 2 means between groups (prior ROECSG curriculum yes vs. no) were compared to assess overall long-term knowledge retention. A one-tailed t-test was used to compare means (it is assumed the ROECSG students will score higher on the knowledge assessment).

This study was approved as exempt by the University of Chicago and University of Illinois at Chicago Institutional Review Boards.

III. RESULTS

In phase 1 of this study, 146 students at 22 AMCs completed the ROECSG curriculum from July 2016 through November 2016. 109 students completed pre- and post-clerkship MCQ knowledge assessments (response rate 74.7%). Student characteristics are summarized in **Table I**. 24 students reported a prior rotation at a ROECSG institution. Subsequent data are reported for the 85 students receiving the curriculum de novo. Student performance on objective assessment before and after rotations is summarized in **Table II**. Mean pre- and post-curriculum assessment scores were 63.9 ± 16.7% and 80.2 ± 13.0%, respectively (t paired(84)=-10.7, $p<0.01$). The MCQ assessment demonstrated reasonable reliability (20 items; $\alpha = 0.66$). Subset analysis did not demonstrate a correlation between USMLE step 1 score and pre-test score (n=50, r=0.21, p=0.14). Additionally, for students with prior clerkships at non-ROECSG institutions, time since first rotation did not correlate with pre-test score (n=55, r=-0.09, p=0.51).

TABLE I
DEMOGRAPHICS OF PARTICIPATING STUDENTS

Overall	n=109
Number of prior rotations	
0	30 (28%)
1	36 (33%)
2	35 (32%)
3	7 (6%)
4	1 (1%)
Degree	
MD	80 (73%)
DO	2 (2%)
MD PhD	23 (21%)
Other	4 (4%)
Year in medical school	
Third year	6 (6%)
Fourth year	103 (94%)

TABLE II
OBJECTIVE ASSESSMENT PERFORMANCE BEFORE AND AFTER CLERKSHIP

	n	Pre-rotation assessment score Mean ± SD	Post-rotation assessment score Mean ± SD	t test p value
Overall (n=20 MCQs)	85	63.9 ± 16.7%	80.2 ± 13.0%	<0.01
Overview talk (n=5 MCQs)		74.8 ± 18.3%	87.1 ± 15.3%	<0.01
Radiation Biology/Physics (n=6 MCQs)		58.4 ± 22.3%	80.2 ± 19.1%	<0.01
Simulations and Emergencies (n=7 MCQs)		63.2 ± 21.1%	77.4 ± 16.1%	<0.01
Treatment planning (n=2 MCQs)		55.9 ± 41.1%	72.4 ± 34.1%	<0.01
No prior rotation	30	55.0 ± 15.6%	77.3 ± 13.3%	<0.01
Prior rotation at non-ROECSG site	55	68.8 ± 15.4%	81.7 ± 12.6%	<0.01
Prior rotation at ROECSG site	24	78.5 ± 18.0%	86.5 ± 14.2%	0.10

Mean MCQ knowledge assessment subdomain scores pre- and post-curriculum were 74.8 ± 18.3% vs. 87.1 ± 15.3% for "Overview of Radiation Oncology" (t paired(84)=-5.4, $p<0.01$), 58.4 ± 22.3% vs. 80.2 ± 19.1% for "Radiation Biology and Physics" (t paired(84)=-9.2, $p<0.01$), 63.2 ± 21.1% vs. 77.4 ± 16.1% for "Simulations and Radiation Emergencies" (t paired(84)=-6.4, $p<0.01$), and 55.9 ± 41.1% vs. 72.4 ± 34.1% for "Treatment planning" (t paired(84)=-5.0, $p<0.01$; **Table II**).

Post-scores for students completing their first rotation at ROECSG institutions were compared to pre-scores for students with ≥1 rotation at non-ROECSG institutions to investigate whether the ROECSG curriculum improves post-clerkship objective knowledge (**Table III**). Post-scores for students rotating de novo at ROECSG institutions (n=30) were significantly

higher compared with pre-scores for students with ≥1 prior rotation at non-ROECSG institutions (n=55), 77.3 ± 13.3% vs. 68.8 ± 15.4% (t unpaired(83)=2.6, p=0.01) with an effect size of 0.8. The 24 students who completed a prior ROECSG rotation did not demonstrate significant score improvement (pre-rotation 78.5 ± 18.0% vs. post-rotation 86.5 ± 14.2%, t paired(23)=3.2, p=0.10).

Table III
COMPARISON OF POST-ASSESSMENT SCORES FOR STUDENTS COMPLETING A ROECSG CLERKSHIP AS THEIR FIRST ROTATION VERSUS STUDENTS WHO COMPLETED ≥1 PRIOR NON-ROECSG CLERKSHIP

MCQ assessment section (number of questions)	**Post-clerkship; no prior rotation (ROECSG = first rotation)** n=30	**Pre-clerkship; prior non-ROECSG clerkship(s)** n=55	t test p value	Effect size
Overall (20)	77.3 ± 13.3%	68.8 ± 15.4%	0.01	0.8
Overview talk (5)	85.3 ± 14.8%	77.8 ± 16.2%	0.04	0.5
Radiation Biology/Physics (6)	75.5 ± 22.6%	63.3 ± 20.8%	0.01	0.6
Simulations and Emergencies (7)	75.0 ± 15.4%	67.5 ± 20.8%	0.10	0.4
Treatment planning (2)	71.7 ± 31.3%	67.3 ± 37.5%	0.58	0.1

On subset analysis based on training year, six students completed rotations as third year medical students with a significant increase in pre- vs. post-clerkship performance from 49.2 ± 22.7% to 78.3 ± 13.7% (t paired(5)=-4.0, p=0.01). The 103 students who completed pre- and post-assessments as fourth years demonstrated a pre- vs. post-clerkship increase from 68.2 ± 17.2% to 81.8 ± 13.5% (t paired(102)=-10.2, p<0.01).

For phase 2, a total of 220 applicants to the University of Chicago/University of Illinois at Chicago radiation oncology residency program were invited to complete the 2017 annual

clerkship experience survey (Golden et al. 2013; Jagadeesan et al. 2014; Oskvarek et al. 2017). A total of 77 complete responses were returned for a response rate of 35.0%. Students completed a median of three clerkships (range 1-5). MCQ assessment scores for students completing at least one rotation at a ROECSG institution were 70.5 ± 18.0% compared with 65.6 ± 16.3% for students who did not complete a rotation at a ROECSG institution (t unpaired(75)=-1.3, p = 0.11, one-tailed t-test). Mean knowledge assessment subdomain scores with and without a ROECSG clerkship were "Overview of Radiation Oncology" 77.0 ± 21.0% vs. 69.7 ± 24.3% (t unpaired(75)=-1.4, p=0.08), "Radiation Biology and Physics" 69.6 ± 25.0% vs. 66.7 ± 21.9% (t unpaired(75)=-0.54, p=0.29), "Simulations and Radiation Emergencies" 68.9 ± 21.7% vs. 62.1 ± 17.6% (t unpaired(75)=-1.5, p=0.07), and "Treatment planning" 62.5 ± 38.8% vs. 63.5 ± 40.2% (t unpaired(75)=-0.11, p=0.46). One student in the ROECSG group scored 20% on the MCQ assessment. Review of this student's responses indicated the answers were chosen with the goal of completing the study to obtain the survey incentive. When this outlier score was discarded, the respective p values become significant for the overall assessment, "Overview of Radiation Oncology," and "Simulations and Emergencies" (**Table IV**).

Table IV

ASSESSMENT SCORES FOR THE PHASE 2 LONG-TERM ASSESSMENT DIVIDED BY STUDENTS COMPLETING OR NOT COMPLETING ANY ROECSG CLERKSHIP

MCQ assessment section (number of questions)	**ROECSG students** n=39[a]	**Non-ROECSG students** n=37	t test (one tail) p value	Effect size
Overall (20)	71.8 ± 16.3%	65.6 ± 16.3%	0.05	0.4
Overview talk (5)	78.5 ± 19.1%	69.7 ± 24.3%	0.04	0.4
Radiation Biology/Physics (6)	70.5 ± 24.6%	66.7 ± 21.9%	0.24	0.2
Simulations and Emergencies (7)	70.3 ± 20.0%	62.1 ± 17.6%	0.03	0.5
Treatment planning (2)	64.1 ± 38.0%	63.5 ± 40.2%	0.47	0.0

[a]Single outlier excluded

IV. DISCUSSION

The traditional radiation oncology medical student clerkship is an audition elective (Halperin 1988) with a majority of students reporting limited didactic education (Golden et al. 2013; Jagadeesan et al. 2014; Oskvarek et al. 2017). Although prior studies showed an improvement in students' subjective perceptions of preparedness for residency training (Jagadeesan et al. 2014) and subjective radiation oncology knowledge (Oskvarek et al. 2017), this study demonstrates improved short-term and long-term objective knowledge of radiation oncology topics. These results suggest that a structured didactic curriculum should be a standard component of any radiation oncology clerkship elective.

Others have reported improved student knowledge using structured didactics. A structured curriculum for the urology clerkship at a single institution demonstrated significant improvement when using core learning objectives and student oriented didactic sessions (Slaughenhoupt et al. 2014). Other groups have pursued curriculum development at the national level. The American Academy of Dermatology developed a series of online modules to complement clinical experiences during a two week introductory clerkship for fourth year medical students (Cipriano et al. 2013). Although there was an improvement in objective knowledge, there was no control group to determine the efficacy of the curriculum over a standard clerkship. The Society for General Internal Medicine developed a Core Medicine Clerkship Curriculum Guide and surveyed clerkship directors across the United States. Although the guide was being used by a majority of clerkship directors, many reported insufficient faculty time and need for faculty development (Jablonover et al. 2000). Radiation oncology departments experience similar problems with limited faculty time for didactic

teaching of medical students and limited faculty development. Thus, adoption of the ROECSG curriculum may help to overcome these barriers.

The finding on subset analysis that students who completed a second clerkship at a ROECSG institution did not have a significant improvement from pre- to post-clerkship assessment suggests that additional radiation oncology rotations may provide diminishing educational benefit. Many students may be using their second and third clerkships as audition electives, the drawbacks of which include reducing their ability to gain a broad medical education and that the practice of using audition electives to select future residents may be fundamentally discriminatory (Halperin 1988). Radiation oncology educational leaders should consider methods by which to ensure students pursuing radiation oncology are utilizing their fourth year of medical school to gain a broad education rather than complete multiple audition electives.

The second phase of this study demonstrates that students completing the clerkship curriculum maintain a trend for improved objective radiation oncology knowledge. Review of individual answer sets suggests that some respondents may have completed the survey with the intention of receiving the incentive at the end without attempting to answer questions correctly as indicated by low scores and only selecting alternating B and C answer choices. As noted above, exclusion of one marked outlier from the ROECSG subset leads to a significant difference between the two groups. Regardless, the long-term results provide additional evidence that a structured didactic curriculum should be considered a standard component of a radiation oncology clerkship.

This study has several limitations. First, the curriculum content at each ROECSG institution is standardized, but may not be identical in content. Additionally, we cannot guarantee all students at ROECSG institutions received the curriculum. The clerkship survey showed that 30% of ROECSG clerkships were reported as not having lectures at the medical student level (data not shown). This may be due to recall bias with some students not remembering the lectures or not identifying them as specifically at the "medical student" level. Alternatively, it is possible that some ROECSG sites are not administering the curriculum to all rotating students. Finally, some survey respondents may be completing the survey with the intention of obtaining the survey incentive and not answering correctly. This appeared to be the case with at least one significant outlier on the long-term MCQ assessment. Another limitation is that this objective assessment is testing basic knowledge of radiation oncology. However, a major component of the curriculum is a hands-on treatment planning computer-based simulation exercise. The MCQ format is not conducive to testing objective knowledge gained from this exercise, thereby limiting the applicability of this study's results. Lastly, due to the study design for the assessment of long-term knowledge retention, individual students' pre- and post-clerkship performance was not linked directly to an assessment of delayed knowledge. Rather, means of the groups were compared providing a rough estimate of decay (or lack thereof) of knowledge.

Overall, this study demonstrates improved objective knowledge at short-term and long-term time points when utilizing a structured curriculum for the radiation oncology clerkships. Radiation oncology medical student clerkship directors should implement a structured curriculum (ROECSG or other) to provide an optimal learning environment to rotating medical students.

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APPENDICES

APPENDIX A

Confidential

Pre-rotation assessment

Dear Student,

Welcome to your radiation oncology rotation! This rotation will include a structured curriculum consisting of three lectures and a hands-on treatment planning workshop. This curriculum is currently being used at multiple institutions around the United States. To improve the content of the curriculum, we are conducting a national evaluation of medical student knowledge before and after completion of the curriculum. Your responses on the following questions are for curriculum improvement and will not be used as a component of your rotation assessment. All responses are anonymous.

You will be asked several general background questions followed by 20 multiple-choice questions.

We ask that you complete the multiple-choice questions without the use of outside materials.

If you have any questions or concerns, please speak with your clerkship director or contact Dan Golden at dgolden@radonc.uchicago.edu.

Thank you in advance for your assistance improving radiation oncology medical student education.

Sincerely,

The Radiation Oncology Education Collaborative Study Group
https://roecsg.uchicago.edu/

Anonymized institution and student ID (pre-populated)

_____

What is your degree track?

◯ MD
◯ DO
◯ MD/PhD
◯ Other

What is your degree track?

_____
(Degree track examples are MD/MPH, MD/JD, etc.)

What year in school are you?

◯ M3
◯ M4
◯ Other

What is your year in school?

_____

APPENDIX A (continued)

Confidential

How many prior radiation oncology rotations have you completed?

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4 or more

In what month and year did your FIRST radiation oncology rotation start?

_____
(Please enter as MM/YYYY)

In what month and year did your SECOND radiation oncology rotation start?

_____
(Please enter as MM/YYYY)

In what month and year did your THIRD radiation oncology rotation start?

_____
(Please enter as MM/YYYY)

In what month and year did your FOURTH radiation oncology rotation start?

_____
(Please enter as MM/YYYY)

Have you completed a radiation oncology rotation at one of the following institutions?

- Boston University
- Cornell
- Georgetown
- Harvard (DFCI or MGH)
- MD Anderson
- Memorial Sloan Kettering
- New York University
- Northwestern University
- Oregon Health & Sciences University
- Stanford
- University of Alabama
- University of California, Los Angeles
- University of California, San Francisco
- University of Chicago
- University of Louisville
- University of Miami
- University of Pittsburgh
- University of Southern California
- University of Tennessee
- University of Wisconsin
- VCU
- Washington University in St. Louis
- West Virginia University
- Yale University

◯ Yes
◯ No

Did this prior rotation at one of the above institutions include three lectures and a treatment planning session for medical students?

◯ Yes
◯ No

APPENDIX A (continued)

Confidential

How comfortable are you with your decision to pursue radiation oncology as a specialty?

- ◯ Not at all comfortable
- ◯ Slightly comfortable
- ◯ Moderately comfortable
- ◯ Quite comfortable
- ◯ Extremely comfortable
- ◯ I am not planning to pursue radiation oncology as a specialty

What medical specialty are you planning to pursue?

_____

(If not sure at this time, please put "Still deciding")

APPENDIX A (continued)

Confidential

Pre-Rotation Knowledge Assessment

Please select the single best answer to each question below.

1. Which normal physiologic process is used to repair double strand DNA breaks?

◯ Mismatch repair
◯ Non-homologous end joining
◯ Nucleotide excision repair
◯ Base excision repair

2. When starting steroids for a symptomatic brain metastasis, what additional medication should be started?

◯ Insulin sliding scale to prevent hyperglycemia
◯ Proton pump inhibitor to prevent gastric ulcers
◯ Benzodiazepine for agitation and anxiety
◯ ACE inhibitor to prevent hypertension

3. What is the best definition of the "isocenter?"

◯ Three-dimensional point in space at which all radiation beams coincide and about which the gantry, couch, and collimator pivot
◯ The point within a patient that is most amenable to targeting radiation
◯ The central point of the planning target volume
◯ The point on the treatment couch where all treatment beams intersect

4. Which of the following benign conditions was historically treated with radiation?

◯ Cataracts
◯ Oral candidiasis
◯ Ankylosing spondylitis
◯ Irritable bowel syndrome

5. What is an advantage of a fluoroscopic simulator?

◯ Inexpensive relative to other simulation devices
◯ Three dimensional imaging of the target volume
◯ Simulation images can be fused with diagnostic images
◯ No ionizing radiation exposure

6. When treating a whole brain radiation field, what is an appropriate inferior border?

◯ Tentorium cerebelli
◯ Bottom of foramen magnum
◯ Bottom of C1
◯ Bottom of C4

7. Which of the following is one of the "4 R's" of radiobiology?

◯ Release of energy
◯ Repopulation
◯ Regeneration
◯ Radiation damage

8. To completely cover a region of interest (ROI) with the 100% isodose line, how should you prescribe your dose?

◯ ROI Maximum
◯ ROI Mean
◯ ROI Minimum
◯ Point dose

APPENDIX A (continued)

Confidential

9. Which of the following physical properties of a photon beam leads to the "skin sparing" effect?

◯ Build-up region
◯ Beam hardening
◯ Inverse square law
◯ Polyenergetic photon energies

10. In a treatment planning system, what does "BEV" stand for?

◯ Bremsstrahlung entrance vision
◯ Beam energy value
◯ Border electron variation
◯ Beam's eye view

11. An "isodose line" is defined as what?

◯ The line on a treatment plan that is equal to the prescription dose
◯ The line on a treatment plan that is equal to the maximum dose
◯ The line on a treatment plan that is equal to 50% of the prescription dose
◯ The line on a treatment plan that defines radiation dose of equal intensity

12. What critical structure can be spared radiation dose by using a prone belly board?

◯ Spinal cord
◯ Lungs
◯ Rectum
◯ Small bowel

13. Which of the following is considered a "good" performance status?

◯ Karnofsky performance status (KPS) 20
◯ KPS 80
◯ Eastern Cooperative Oncology Group (ECOG) 3
◯ ECOG 4

14. Which of the following tumors causing superior vena cava syndrome is likely to respond quickly to systemic chemotherapy?

◯ Small cell lung cancer
◯ Non-small cell lung cancer
◯ Metastatic colorectal cancer
◯ Thymic carcinoma

15. What isodose line falls at the block edge of a single photon beam?

◯ 25%
◯ 50%
◯ 75%
◯ 100%

16. Which of the following is specified on a radiation simulation order?

◯ Fractionation schedule
◯ Patient treatment position
◯ Radiation prescription dose
◯ Planning target volume expansion

APPENDIX A (continued)

Confidential

17. As a linear accelerator X-ray beam's energy increases, what happens to the Dmax (depth of maximum dose)?

◯ It is unchanged
◯ It depends if the beam is passing through bone or soft tissue
◯ It gets shallower beneath skin (less skin sparing)
◯ It gets deeper beneath skin (more skin sparing)

18. Image-guided radiotherapy (IGRT) is used for what purpose?

◯ To help define the target volume when contouring
◯ To assist with patient localization on each day of treatment
◯ To verify that the radiation treatment field is shaped correctly
◯ To ensure that the linear accelerator delivers the correct dose

19. Tissue equivalent bolus is used for what purpose during external beam treatment?

◯ To reduce the skin-sparing effect
◯ To protect the skin from harmful effects of radiation
◯ To preferentially block critical structures
◯ To prevent late effects of radiation

20. 1 Gray (Gy) is defined as what?

◯ 1 Sievert/gram
◯ 1 rad/cubic millimeter
◯ 1 electronvolt/cubic centimeter
◯ 1 Joule/Kilogram

APPENDIX B

Confidential

Post-rotation assessment

Dear Student,

We hope you found this rotation to be an educational experience. This rotation included a structured curriculum consisting of three lectures and a hands-on treatment planning workshop. This curriculum is currently being used at multiple institutions around the United States. To improve the content of the curriculum, we are conducting a national assessment of medical student knowledge before and after completion of the curriculum. Your responses on the following questions are for curriculum improvement and will not be used as a component of your rotation assessment. All responses are anonymous.

We ask that you complete the multiple-choice questions without the use of outside materials.

If you have any questions or concerns, please speak with your clerkship director or contact Dan Golden at dgolden@radonc.uchicago.edu.

Thank you in advance for your assistance improving radiation oncology medical student education.

Sincerely,

The Radiation Oncology Education Collaborative Study Group
https://roecsg.uchicago.edu/

Post-Rotation Knowledge Assessment

Anonymized institution and student ID (pre-populated)

_____

Please select the single best answer to each question below.

1. When treating a whole brain radiation field, what is an appropriate inferior border?

◯ Tentorium cerebelli
◯ Bottom of foramen magnum
◯ Bottom of C1
◯ Bottom of C4

2. Which of the following is considered a "good" performance status?

◯ Karnofsky performance status (KPS) 20
◯ KPS 80
◯ Eastern Cooperative Oncology Group (ECOG) 3
◯ ECOG 4

APPENDIX B (continued)

Confidential

3. What is an advantage of a fluoroscopic simulator?

◯ Inexpensive relative to other simulation devices
◯ Three dimensional imaging of the target volume
◯ Simulation images can be fused with diagnostic images
◯ No ionizing radiation exposure

4. When starting steroids for a symptomatic brain metastasis, what additional medication should be started?

◯ Insulin sliding scale to prevent hyperglycemia
◯ Proton pump inhibitor to prevent gastric ulcers
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◯ ACE inhibitor to prevent hypertension

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◯ 1 Joule/Kilogram

7. Which of the following is specified on a radiation simulation order?

◯ Fractionation schedule
◯ Patient treatment position
◯ Radiation prescription dose
◯ Planning target volume expansion

8. Image-guided radiotherapy (IGRT) is used for what purpose?

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◯ To assist with patient localization on each day of treatment
◯ To verify that the radiation treatment field is shaped correctly
◯ To ensure that the linear accelerator delivers the correct dose

9. What isodose line falls at the block edge of a single photon beam?

◯ 25%
◯ 50%
◯ 75%
◯ 100%

10. In a treatment planning system, what does "BEV" stand for?

◯ Bremsstrahlung entrance vision
◯ Beam energy value
◯ Border electron variation
◯ Beam's eye view

11. What critical structure can be spared radiation dose by using a prone belly board?

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◯ Lungs
◯ Rectum
◯ Small bowel

APPENDIX B (continued)

Confidential

12. Which of the following is one of the "4 R's" of radiobiology?

◯ Release of energy
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◯ Regeneration
◯ Radiation damage

13. As a linear accelerator X-ray beam's energy increases, what happens to the Dmax (depth of maximum dose)?

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◯ The line on a treatment plan that defines radiation dose of equal intensity

19. Which of the following tumors causing superior vena cava syndrome is likely to respond quickly to systemic chemotherapy?

◯ Small cell lung cancer
◯ Non-small cell lung cancer
◯ Metastatic colorectal cancer
◯ Thymic carcinoma

APPENDIX B (continued)

Confidential

20. To completely cover a region of interest (ROI) with the 100% isodose line, how should you prescribe your dose?

- ◯ ROI Maximum
- ◯ ROI Mean
- ◯ ROI Minimum
- ◯ Point dose

APPENDIX B (continued)

Confidential

Course feedback

This course was _____ well organized.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

This course provided me with _____ useful knowledge, skills, or insights.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

The content material was presented at a(n) _____ appropriate level.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

The content material was _____ well paced.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

The relevance of the course material to this clerkship was made _____ apparent.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

Course instructors were _____ enthusiastic about teaching.

○ Not at all ○ Slightly ○ Moderately ○ Quite ○ Extremely

Overall, how useful was the medical student clerkship curriculum (three lectures and radiation planning workshop) to help you understand radiation oncology as a specialty?

○ Not at all useful ○ Slightly useful ○ Moderately useful ○ Quite useful ○ Extremely useful

Overall, how useful was the medical student clerkship curriculum (three lectures and radiation planning workshop) as an educational experience?

○ Not at all useful ○ Slightly useful ○ Moderately useful ○ Quite useful ○ Extremely useful

How comfortable are you with your decision to pursue radiation oncology as a specialty?

○ Not at all comfortable
○ Slightly comfortable
○ Moderately comfortable
○ Quite comfortable
○ Extremely comfortable
○ I am not planning to pursue radiation oncology as a specialty

How did the three medical student lectures and radiation planning workshop during this rotation change your comfort with your decision to pursue radiation oncology?

○ Significantly less comfortable
○ Slightly less comfortable
○ No change
○ Slightly more comfortable
○ Significantly more comfortable
○ I am not planning to pursue radiation oncology

Please comment on any of the above and/or on the strengths of the medical student curriculum (three lectures and planning workshop) and how it might be improved:
(optional)

APPENDIX B (continued)

Confidential

Please describe any changes that could be made to improve the educational value of this rotation:
(optional)

Please provide any final comments:
(optional)

APPENDIX C

Confidential

The Medical Student Radiation Oncology Clerkship Experience: A Targeted Needs Assessment

Upon completion of this survey, you will be asked to submit your e-mail separately to receive a $5 Starbuck's e-card.

Thank you for taking time out of your busy schedule to participate in this survey.

We are conducting an educational needs assessment for the radiation oncology MS4 clerkship. We are specifically surveying fourth year medical students pursuing radiation oncology as a specialty.

You likely spent at least four weeks in a radiation oncology department on a clinical rotation, and you likely did two or more radiation oncology rotations. The goal of this survey is to assess your medical school and clerkship experiences related to radiation oncology. We estimate that this survey will take you approximately 30-45 minutes to complete, but feel free to spend longer. Questions or comments can be addressed to Dan Golden (dgolden@radonc.uchicago.edu).

There are three sections: (1) General questions, (2) Rotation-specific questions, (3) MCQ knowledge assessment. Your responses are completely anonymous. We appreciate your thoughtful and honest answers.

NOTE: You can save your responses and return at a later time to complete the survey.

The survey will remain open through 10pm Eastern time, Sunday March 12th.

Thank you in advance for taking the time to fill out this survey.

Sincerely,

The Radiation Oncology Education Collaborative Study Group

APPENDIX C (continued)

Confidential

Section 1/11

GENERAL QUESTIONS

What is your medical school education track?

◯ MD
◯ DO
◯ MD/PhD
◯ Other

Please specify your medical school track:

_____
((optional))

Where was your medical school located?

◯ United States
◯ Outside the United States

What is your current age (in years)?

_____
((optional))

What is your gender?

◯ Female
◯ Male

APPENDIX C (continued)

Confidential

Section 2/11

ROTATION GENERAL QUESTIONS

Does your medical school hospital or a hospital directly affiliated with your medical school have a radiation oncology residency program?

◯ Yes
◯ No

Prior to your first radiation oncology rotation, did you do any of the following?
((check all that apply))

☐ Worked in a radiation oncology department conducting research (clinical, translational, or basic science)
☐ Spent time in a radiation oncology department shadowing physicians
☐ Had a lecture on radiation oncology during M1 or M2 year
☐ Other radiation oncology experience
☐ Prior to your first rotation, you had no radiation oncology clinical or research experience

Please describe your "other" pre-rotation experience related to radiation oncology:

_____
((optional))

Does your medical school have a radiation oncology clinical experience that is mandatory for all medical students?

◯ Yes
◯ No

Please briefly describe this experience
((optional))

Including your home institution, how many radiation oncology departments did you rotate through?
(Count all departments, even an experience that was shorter than 4 weeks)

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5 or more

Prior to beginning your clinical radiation oncology rotations, how confident were you in your decision to pursue radiation oncology as a specialty?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

Prior to beginning your first radiation oncology rotation, were you DEFINITELY going to apply for a radiation oncology residency position?

◯ Yes
◯ No

APPENDIX C (continued)

Confidential

Did any of your radiation oncology rotations include a formal lecture curriculum specifically for rotating medical students?

◯ Yes
◯ No

Please briefly describe the structure of the curriculum

What was your PRIMARY reason for choosing sites for your clinical radiation oncology rotations?

◯ Unique educational opportunities
◯ Historical prominence of the institution
◯ To work with a specific faculty member
◯ To obtain letters of recommendation for your residency application
◯ To evaluate the residency program
◯ To gain exposure to a specific technology
◯ To impress the faculty to obtain a residency position at this institution
◯ Unique research opportunities
◯ Because the institution is in a location you wanted to explore
◯ Other

Please describe the "other" primary reason for choosing your rotation sites:

On the following questions please rate your comfort level with different aspects of radiation oncology PRIOR to beginning your clinical rotations.

How confident were you in your ability to take a full and complete oncologic history and physical?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to integrate evidence-based medicine into radiation oncology treatment decisions?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation biology?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation physics?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment setup and positioning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment planning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

APPENDIX C (continued)

Confidential

How confident were you in your ability to evaluate a dose-volume histogram?

○ 1. Not at all ○ 2. Somewhat ○ 3. Moderately ○ 4. Quite ○ 5. Extremely

APPENDIX C (continued)

Confidential

Section 3/11

ROTATION 1

Please consider your FIRST radiation oncology rotation when responding to the following questions.

This rotation was at a(n)
(Choose the choice that BEST fits the department)

◯ University medical center (i.e. affiliated with a medical school)
◯ Academic medical center NOT affiliated with a medical school
◯ Community practice
◯ Other
◯ You did not complete any formal radiation oncology clinical rotations

Was this rotation completed at one of the following institutions:
- Boston University
- Harvard University - MGH
- Harvard University - DFCI
- MD Anderson Cancer Center
- Memorial Sloan Kettering
- New York University
- Northwestern University
- Oregon Health & Sciences University
- Stanford
- University of Alabama
- University of California, San Francisco
- University of Chicago
- University of Louisville
- University of Miami
- University of Pittsburgh
- University of Tennessee
- University of Wisconsin
- Washington University
- Yale University
- Georgetown
- UCLA
- USC

◯ Yes ◯ No

What was your PRIMARY reason for choosing this institution for a clinical rotation?

◯ This was your home institution
◯ Unique educational opportunities
◯ Historical prominence of the institution
◯ To work with a specific faculty member
◯ To obtain letters of recommendation for your residency application
◯ To evaluate the residency program
◯ To gain exposure to a specific technology
◯ To impress the faculty to obtain a residency position at this institution
◯ Unique research opportunities
◯ Because the institution is in a location you wanted to explore
◯ Other

Please specify the other reason for choosing this institution for a rotation.

APPENDIX C (continued)

Confidential

This rotation began in

◯ Before 2016
◯ January 2016
◯ February 2016
◯ March 2016
◯ April 2016
◯ May 2016
◯ June 2016
◯ July 2016
◯ August 2016
◯ September 2016
◯ October 2016
◯ November 2016
◯ December 2016
◯ After 2016

How many weeks was this rotation?

◯ 1
◯ 2
◯ 3
◯ 4
◯ Other

How many weeks was this rotation?

_____

How many residents were in this program?
(Include the total number of residents, not the number per training year.)

◯ 4 or fewer
◯ 5-11
◯ 12-15
◯ 16 or greater
◯ This department had no residents

At the beginning of the rotation, were you given clear goals and objectives?

◯ Yes
◯ No
◯ I do not recall

When answering the following questions, please consider any SCHEDULED and/or STRUCTURED educational activities.

During this rotation, in which of the following examples of a formal educational curriculum specifically for medical students did you participate?

For example, a lecture given only to medical students should be counted, but not a resident lecture that you attended.
(Check all that apply)

☐ Lecture specifically for medical students
☐ Prepared case discussion (note: this excludes informal discussions in clinic)
☐ Hands-on didactic session (i.e. contouring at a planning station on a pre-set plan; this excludes contouring for a patient during the actual planning process)
☐ Other (please specify)
☐ None of the above

Please specify the "other" educational activity:
((optional))

APPENDIX C (continued)

Confidential

During this rotation, how many lectures specifically designed for medical students did you have?
(Only count lectures that were designed for you, not residents.)

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5 or more
◯ I do not recall

During this rotation, medical student lectures were given by which of the following?
(Check all that apply)

☐ Residents
☐ Clinical faculty
☐ Basic science faculty
☐ Physicists
☐ Dosimetrists
☐ Other
☐ You do not recall

Who else gave medical student lectures?

Please specify.

_____

During this rotation, did you give a lecture to the department?

This would have been a formal lecture to multiple residents and/or faculty. An informal presentation does not count.

◯ Yes
◯ No

What was the lecture you gave about?

◯ A clinical topic of your choice.
◯ An assigned clinic topic.
◯ Clinical research you have conducted.
◯ Basic science research you have conducted.
◯ Other

Please specify your lecture topic.

_____
((optional))

Please add any additional comments regarding structured educational experiences on this rotation:
((optional))

CLINICAL EXPERIENCE

Please consider your clinical experience during your FIRST rotation when answering the following questions.

APPENDIX C (continued)

Confidential

While rotating in this department, which of the following were you given the opportunity to do? (Check all that apply)

☐ Perform an oncologic history and physical independently (no resident or faculty supervision)
☐ Write or dictate a consult
☐ Contour at a planning station for a clinical case
☐ Participate in a brachytherapy case
☐ Participate in a stereotactic radiosurgery (SRS) case
☐ Participate in a SBRT/SABR case
☐ Review port films
☐ Other

Please specify the other opportunity: _____

Please describe any clinical experiences that were particularly educational during this rotation. ((optional))

On the following questions please rate your comfort with different aspects of radiation oncology upon completing your FIRST rotation.

How confident were you in your ability to take a full and complete oncologic history and physical?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to integrate evidence-based medicine into radiation treatment decisions?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation biology?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation physics?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment setup and positioning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment planning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to evaluate a dose-volume histogram?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

At the end of this rotation, how confident were you in your decision to pursue radiation oncology as a specialty?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

Please describe why you were or were not confident in your specialty decision when completing this rotation. ((optional))

APPENDIX C (continued)

Confidential

Did you complete a SECOND radiation oncology rotation?

◯ Yes
◯ No

APPENDIX C (continued)

Confidential

Section 4/11

ROTATION 2

Please consider your SECOND radiation oncology rotation when responding to the following questions.

You did not complete a second rotation. Please click "Next Page."

This rotation was at a(n)
(Choose the choice that BEST fits the department)

◯ University medical center (i.e. affiliated with a medical school)
◯ Academic medical center NOT affiliated with a medical school
◯ Community practice
◯ Other
◯ You did not complete any formal radiation oncology clinical rotations

Was this rotation completed at one of the following institutions:
- Boston University
- Harvard University - MGH
- Harvard University - DFCI
- MD Anderson Cancer Center
- Memorial Sloan Kettering
- New York University
- Northwestern University
- Oregon Health & Sciences University
- Stanford
- University of Alabama
- University of California, San Francisco
- University of Chicago
- University of Louisville
- University of Miami
- University of Pittsburgh
- University of Tennessee
- University of Wisconsin
- Washington University
- Yale University
- Georgetown
- UCLA
- USC

◯ Yes ◯ No

What was your PRIMARY reason for choosing this institution for a clinical rotation?

◯ This was your home institution
◯ Unique educational opportunities
◯ Historical prominence of the institution
◯ To work with a specific faculty member
◯ To obtain letters of recommendation for your residency application
◯ To evaluate the residency program
◯ To gain exposure to a specific technology
◯ To impress the faculty to obtain a residency position at this institution
◯ Unique research opportunities
◯ Because the institution is in a location you wanted to explore
◯ Other

Please specify the other reason for choosing this institution for a rotation.

APPENDIX C (continued)

Confidential

This rotation began in

- ◯ Before 2016
- ◯ January 2016
- ◯ February 2016
- ◯ March 2016
- ◯ April 2016
- ◯ May 2016
- ◯ June 2016
- ◯ July 2016
- ◯ August 2016
- ◯ September 2016
- ◯ October 2016
- ◯ November 2016
- ◯ December 2016
- ◯ After 2016

How many weeks was this rotation?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ Other

How many weeks was this rotation?

_____

How many residents were in this program?
(Include the total number of residents, not the number per training year.)

- ◯ 4 or fewer
- ◯ 5-11
- ◯ 12-15
- ◯ 16 or greater
- ◯ This department had no residents

At the beginning of the rotation, were you given clear goals and objectives?

- ◯ Yes
- ◯ No
- ◯ I do not recall

When answering the following questions, please consider any SCHEDULED and/or STRUCTURED educational activities.

During this rotation, in which of the following examples of a formal educational curriculum specifically for medical students did you participate?

For example, a lecture given only to medical students should be counted, but not a resident lecture that you attended.
(Check all that apply)

- ☐ Lecture specifically for medical students
- ☐ Prepared case discussion (note: this excludes informal discussions in clinic)
- ☐ Hands-on didactic session (i.e. contouring at a planning station on a pre-set plan; this excludes contouring for a patient during the actual planning process)
- ☐ Other (please specify)
- ☐ None of the above

Please specify the "other" educational activity:
((optional))

APPENDIX C (continued)

Confidential

During this rotation, how many lectures specifically designed for medical students did you have?
(Only count lectures that were designed for you, not residents.)

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5 or more
◯ I do not recall

During this rotation, medical student lectures were given by which of the following?
(Check all that apply)

☐ Residents
☐ Clinical faculty
☐ Basic science faculty
☐ Physicists
☐ Dosimetrists
☐ Other
☐ You do not recall

Who else gave medical student lectures?

Please specify.

_____

During this rotation, did you give a lecture to the department?

This would have been a formal lecture to multiple residents and/or faculty. An informal presentation does not count.

◯ Yes
◯ No

What was the lecture you gave about?

◯ A clinical topic of your choice.
◯ An assigned clinic topic.
◯ Clinical research you have conducted.
◯ Basic science research you have conducted.
◯ Other

Please specify your lecture topic.

_____
((optional))

Please add any additional comments regarding structured educational experiences on this rotation:
((optional))

CLINICAL EXPERIENCE

Please consider your clinical experience during your SECOND rotation when answering the following questions.

APPENDIX C (continued)

Confidential

While rotating in this department, which of the following were you given the opportunity to do? (Check all that apply)

☐ Perform an oncologic history and physical independently (no resident or faculty supervision)
☐ Write or dictate a consult
☐ Contour at a planning station for a clinical case
☐ Participate in a brachytherapy case
☐ Participate in a stereotactic radiosurgery (SRS) case
☐ Participate in a SBRT/SABR case
☐ Review port films
☐ Other

Please specify the other opportunity: _____

Please describe any clinical experiences that were particularly educational during this rotation. ((optional))

On the following questions please rate your comfort with different aspects of radiation oncology upon completing your SECOND rotation.

How confident were you in your ability to take a full and complete oncologic history and physical?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to integrate evidence-based medicine into radiation treatment decisions?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation biology?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation physics?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment setup and positioning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment planning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to evaluate a dose-volume histogram?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

At the end of this rotation, how confident were you in your decision to pursue radiation oncology as a specialty?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

Please describe why you were or were not confident in your specialty decision when completing this rotation. ((optional))

APPENDIX C (continued)

Confidential

Did you complete a THIRD radiation oncology rotation?

◯ Yes
◯ No

APPENDIX C (continued)

Confidential

Section 5/11

ROTATION 3

Please consider your THIRD radiation oncology rotation when responding to the following questions.

You did not complete a third rotation. Please click "Next Page."

This rotation was at a(n)
(Choose the choice that BEST fits the department)

◯ University medical center (i.e. affiliated with a medical school)
◯ Academic medical center NOT affiliated with a medical school
◯ Community practice
◯ Other
◯ You did not complete any formal radiation oncology clinical rotations

Was this rotation completed at one of the following institutions:
- Boston University
- Harvard University - MGH
- Harvard University - DFCI
- MD Anderson Cancer Center
- Memorial Sloan Kettering
- New York University
- Northwestern University
- Oregon Health & Sciences University
- Stanford
- University of Alabama
- University of California, San Francisco
- University of Chicago
- University of Louisville
- University of Miami
- University of Pittsburgh
- University of Tennessee
- University of Wisconsin
- Washington University
- Yale University
- Georgetown
- UCLA
- USC

◯ Yes ◯ No

What was your PRIMARY reason for choosing this institution for a clinical rotation?

◯ This was your home institution
◯ Unique educational opportunities
◯ Historical prominence of the institution
◯ To work with a specific faculty member
◯ To obtain letters of recommendation for your residency application
◯ To evaluate the residency program
◯ To gain exposure to a specific technology
◯ To impress the faculty to obtain a residency position at this institution
◯ Unique research opportunities
◯ Because the institution is in a location you wanted to explore
◯ Other

Please specify the other reason for choosing this institution for a rotation.

APPENDIX C (continued)

Confidential

This rotation began in

- ◯ Before 2016
- ◯ January 2016
- ◯ February 2016
- ◯ March 2016
- ◯ April 2016
- ◯ May 2016
- ◯ June 2016
- ◯ July 2016
- ◯ August 2016
- ◯ September 2016
- ◯ October 2016
- ◯ November 2016
- ◯ December 2016
- ◯ After 2016

How many weeks was this rotation?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ Other

How many weeks was this rotation?

_____

How many residents were in this program?
(Include the total number of residents, not the number per training year.)

- ◯ 4 or fewer
- ◯ 5-11
- ◯ 12-15
- ◯ 16 or greater
- ◯ This department had no residents

At the beginning of the rotation, were you given clear goals and objectives?

- ◯ Yes
- ◯ No
- ◯ I do not recall

When answering the following questions, please consider any SCHEDULED and/or STRUCTURED educational activities.

During this rotation, in which of the following examples of a formal educational curriculum specifically for medical students did you participate?

For example, a lecture given only to medical students should be counted, but not a resident lecture that you attended.
(Check all that apply)

- ☐ Lecture specifically for medical students
- ☐ Prepared case discussion (note: this excludes informal discussions in clinic)
- ☐ Hands-on didactic session (i.e. contouring at a planning station on a pre-set plan; this excludes contouring for a patient during the actual planning process)
- ☐ Other (please specify)
- ☐ None of the above

Please specify the "other" educational activity:
((optional))

APPENDIX C (continued)

Confidential

During this rotation, how many lectures specifically designed for medical students did you have?
(Only count lectures that were designed for you, not residents.)

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5 or more
◯ I do not recall

During this rotation, medical student lectures were given by which of the following?
(Check all that apply)

☐ Residents
☐ Clinical faculty
☐ Basic science faculty
☐ Physicists
☐ Dosimetrists
☐ Other
☐ You do not recall

Who else gave medical student lectures?

Please specify.

_____

During this rotation, did you give a lecture to the department?

This would have been a formal lecture to multiple residents and/or faculty. An informal presentation does not count.

◯ Yes
◯ No

What was the lecture you gave about?

◯ A clinical topic of your choice.
◯ An assigned clinic topic.
◯ Clinical research you have conducted.
◯ Basic science research you have conducted.
◯ Other

Please specify your lecture topic.

_____
((optional))

Please add any additional comments regarding structured educational experiences on this rotation:
((optional))

CLINICAL EXPERIENCE

Please consider your clinical experience during your THIRD rotation when answering the following questions.

APPENDIX C (continued)

Confidential

While rotating in this department, which of the following were you given the opportunity to do? (Check all that apply)

☐ Perform an oncologic history and physical independently (no resident or faculty supervision)
☐ Write or dictate a consult
☐ Contour at a planning station for a clinical case
☐ Participate in a brachytherapy case
☐ Participate in a stereotactic radiosurgery (SRS) case
☐ Participate in a SBRT/SABR case
☐ Review port films
☐ Other

Please specify the other opportunity: _____

Please describe any clinical experiences that were particularly educational during this rotation. ((optional))

On the following questions please rate your comfort with different aspects of radiation oncology upon completing your THIRD rotation.

How confident were you in your ability to take a full and complete oncologic history and physical?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to integrate evidence-based medicine into radiation treatment decisions?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation biology?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation physics?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment setup and positioning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment planning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to evaluate a dose-volume histogram?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

At the end of this rotation, how confident were you in your decision to pursue radiation oncology as a specialty?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

Please describe why you were or were not confident in your specialty decision when completing this rotation. ((optional))

APPENDIX C (continued)

Confidential

Did you complete a FOURTH radiation oncology rotation?

○ Yes
○ No

APPENDIX C (continued)

Confidential

Section 6/11

ROTATION 4

Please consider your FOURTH radiation oncology rotation when responding to the following questions.

You did not complete a fourth rotation. Please click "Next Page."

This rotation was at a(n)
(Choose the choice that BEST fits the department)

◯ University medical center (i.e. affiliated with a medical school)
◯ Academic medical center NOT affiliated with a medical school
◯ Community practice
◯ Other
◯ You did not complete any formal radiation oncology clinical rotations

Was this rotation completed at one of the following institutions:
- Boston University
- Harvard University - MGH
- Harvard University - DFCI
- MD Anderson Cancer Center
- Memorial Sloan Kettering
- New York University
- Northwestern University
- Oregon Health & Sciences University
- Stanford
- University of Alabama
- University of California, San Francisco
- University of Chicago
- University of Louisville
- University of Miami
- University of Pittsburgh
- University of Tennessee
- University of Wisconsin
- Washington University
- Yale University
- Georgetown
- UCLA
- USC

◯ Yes ◯ No

What was your PRIMARY reason for choosing this institution for a clinical rotation?

◯ This was your home institution
◯ Unique educational opportunities
◯ Historical prominence of the institution
◯ To work with a specific faculty member
◯ To obtain letters of recommendation for your residency application
◯ To evaluate the residency program
◯ To gain exposure to a specific technology
◯ To impress the faculty to obtain a residency position at this institution
◯ Unique research opportunities
◯ Because the institution is in a location you wanted to explore
◯ Other

Please specify the other reason for choosing this institution for a rotation.

APPENDIX C (continued)

Confidential

This rotation began in

◯ Before 2016
◯ January 2016
◯ February 2016
◯ March 2016
◯ April 2016
◯ May 2016
◯ June 2016
◯ July 2016
◯ August 2016
◯ September 2016
◯ October 2016
◯ November 2016
◯ December 2016
◯ After 2016

How many weeks was this rotation?

◯ 1
◯ 2
◯ 3
◯ 4
◯ Other

How many weeks was this rotation?

_____

How many residents were in this program?
(Include the total number of residents, not the number per training year.)

◯ 4 or fewer
◯ 5-11
◯ 12-15
◯ 16 or greater
◯ This department had no residents

At the beginning of the rotation, were you given clear goals and objectives?

◯ Yes
◯ No
◯ I do not recall

When answering the following questions, please consider any SCHEDULED and/or STRUCTURED educational activities.

During this rotation, in which of the following examples of a formal educational curriculum specifically for medical students did you participate?

For example, a lecture given only to medical students should be counted, but not a resident lecture that you attended.
(Check all that apply)

☐ Lecture specifically for medical students
☐ Prepared case discussion (note: this excludes informal discussions in clinic)
☐ Hands-on didactic session (i.e. contouring at a planning station on a pre-set plan; this excludes contouring for a patient during the actual planning process)
☐ Other (please specify)
☐ None of the above

Please specify the "other" educational activity:
((optional))

APPENDIX C (continued)

Confidential

During this rotation, how many lectures specifically designed for medical students did you have?
(Only count lectures that were designed for you, not residents.)

◯ 0
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5 or more
◯ I do not recall

During this rotation, medical student lectures were given by which of the following?
(Check all that apply)

☐ Residents
☐ Clinical faculty
☐ Basic science faculty
☐ Physicists
☐ Dosimetrists
☐ Other
☐ You do not recall

Who else gave medical student lectures?

Please specify.

_____

During this rotation, did you give a lecture to the department?

This would have been a formal lecture to multiple residents and/or faculty. An informal presentation does not count.

◯ Yes
◯ No

What was the lecture you gave about?

◯ A clinical topic of your choice.
◯ An assigned clinic topic.
◯ Clinical research you have conducted.
◯ Basic science research you have conducted.
◯ Other

Please specify your lecture topic.

_____
((optional))

Please add any additional comments regarding structured educational experiences on this rotation:
((optional))

CLINICAL EXPERIENCE

Please consider your clinical experience during your FOURTH rotation when answering the following questions.

APPENDIX C (continued)

Confidential

While rotating in this department, which of the following were you given the opportunity to do? (Check all that apply)

☐ Perform an oncologic history and physical independently (no resident or faculty supervision)
☐ Write or dictate a consult
☐ Contour at a planning station for a clinical case
☐ Participate in a brachytherapy case
☐ Participate in a stereotactic radiosurgery (SRS) case
☐ Participate in a SBRT/SABR case
☐ Review port films
☐ Other

Please specify the other opportunity: _____

Please describe any clinical experiences that were particularly educational during this rotation. ((optional))

On the following questions please rate your comfort with different aspects of radiation oncology upon completing your FOURTH rotation.

How confident were you in your ability to take a full and complete oncologic history and physical?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to integrate evidence-based medicine into radiation treatment decisions?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation biology?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation physics?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment setup and positioning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your knowledge of radiation treatment planning?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

How confident were you in your ability to evaluate a dose-volume histogram?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

At the end of this rotation, how confident were you in your decision to pursue radiation oncology as a specialty?

◯ 1. Not at all ◯ 2. Somewhat ◯ 3. Moderately ◯ 4. Quite ◯ 5. Extremely

Please describe why you were or were not confident in your specialty decision when completing this rotation. ((optional))

APPENDIX C (continued)

Confidential

How many rotations did you complete in addition to the 4 you have already described?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 or more

If you wish to provide data about additional rotations, please contact Dan Golden at dgolden@radonc.uchicago.edu.

APPENDIX C (continued)

Confidential

Section 9/11

OVERALL CONFIDENCE

Having completed your radiation oncology rotations, how well prepared do you feel to function in the clinic as a PGY-2 radiation oncology resident?

◯ 1. Not at all prepared
◯ 2. Somewhat prepared
◯ 3. Moderately prepared
◯ 4. Quite prepared
◯ 5. Extremely prepared

APPENDIX C (continued)

Confidential

SECTION 10/11

KNOWLEDGE ASSESSMENT

Please answer each of the following questions to the best of your ability. Do not use outside resources (books, internet, etc). If you are unsure regarding a correct answer, take your best guess. All responses are anonymous.

1. Which normal physiologic process is used to repair double strand DNA breaks?

◯ Mismatch repair
◯ Non-homologous end joining
◯ Nucleotide excision repair
◯ Base excision repair

2. When starting steroids for a symptomatic brain metastasis, what additional medication should be started?

◯ Insulin sliding scale to prevent hyperglycemia
◯ Proton pump inhibitor to prevent gastric ulcers
◯ Benzodiazepine for agitation and anxiety
◯ ACE inhibitor to prevent hypertension

3. What is the best definition of the "isocenter?"

◯ Three-dimensional point in space at which all radiation beams coincide and about which the gantry, couch, and collimator pivot
◯ The point within a patient that is most amenable to targeting radiation
◯ The central point of the planning target volume
◯ The point on the treatment couch where all treatment beams intersect

4. Which of the following benign conditions was historically treated with radiation?

◯ Cataracts
◯ Oral candidiasis
◯ Ankylosing spondylitis
◯ Irritable bowel syndrome

5. What is an advantage of a fluoroscopic simulator?

◯ Inexpensive relative to other simulation devices
◯ Three dimensional imaging of the target volume
◯ Simulation images can be fused with diagnostic images
◯ No ionizing radiation exposure

6. When treating a whole brain radiation field, what is an appropriate inferior border?

◯ Tentorium cerebelli
◯ Bottom of foramen magnum
◯ Bottom of C1
◯ Bottom of C4

7. Which of the following is one of the "4 R's" of radiobiology?

◯ Release of energy
◯ Repopulation
◯ Regeneration
◯ Radiation damage

APPENDIX C (continued)

Confidential

8. To completely cover a region of interest (ROI) with the 100% isodose line, how should you prescribe your dose?

◯ ROI Maximum
◯ ROI Mean
◯ ROI Minimum
◯ Point dose

9. Which of the following physical properties of a photon beam leads to the "skin sparing" effect?

◯ Build-up region
◯ Beam hardening
◯ Inverse square law
◯ Polyenergetic photon energies

10. In a treatment planning system, what does "BEV" stand for?

◯ Bremsstrahlung entrance vision
◯ Beam energy value
◯ Border electron variation
◯ Beam's eye view

11. An "isodose line" is defined as what?

◯ The line on a treatment plan that is equal to the prescription dose
◯ The line on a treatment plan that is equal to the maximum dose
◯ The line on a treatment plan that is equal to 50% of the prescription dose
◯ The line on a treatment plan that defines radiation dose of equal intensity

12. What critical structure can be spared radiation dose by using a prone belly board?

◯ Spinal cord
◯ Lungs
◯ Rectum
◯ Small bowel

13. Which of the following is considered a "good" performance status?

◯ Karnofsky performance status (KPS) 20
◯ KPS 80
◯ Eastern Cooperative Oncology Group (ECOG) 3
◯ ECOG 4

14. Which of the following tumors causing superior vena cava syndrome is likely to respond quickly to systemic chemotherapy?

◯ Small cell lung cancer
◯ Non-small cell lung cancer
◯ Metastatic colorectal cancer
◯ Thymic carcinoma

15. What isodose line falls at the block edge of a single photon beam?

◯ 25%
◯ 50%
◯ 75%
◯ 100%

APPENDIX C (continued)

Confidential

16. Which of the following is specified on a radiation simulation order?

◯ Fractionation schedule
◯ Patient treatment position
◯ Radiation prescription dose
◯ Planning target volume expansion

17. As a linear accelerator X-ray beam's energy increases, what happens to the Dmax (depth of maximum dose)?

◯ It is unchanged
◯ It depends if the beam is passing through bone or soft tissue
◯ It gets shallower beneath skin (less skin sparing)
◯ It gets deeper beneath skin (more skin sparing)

18. Image-guided radiotherapy (IGRT) is used for what purpose?

◯ To help define the target volume when contouring
◯ To assist with patient localization on each day of treatment
◯ To verify that the radiation treatment field is shaped correctly
◯ To ensure that the linear accelerator delivers the correct dose

19. Tissue equivalent bolus is used for what purpose during external beam treatment?

◯ To reduce the skin-sparing effect
◯ To protect the skin from harmful effects of radiation
◯ To preferentially block critical structures
◯ To prevent late effects of radiation

20. 1 Gray (Gy) is defined as what?

◯ 1 Sievert/gram
◯ 1 rad/cubic millimeter
◯ 1 electronvolt/cubic centimeter
◯ 1 Joule/Kilogram

APPENDIX C (continued)

Confidential

SECTION 11/11

FINAL COMMENTS AND SURVEY SUBMISSION

Please provide any additional comments or suggestions for the radiation oncology clerkship:
((optional))

If you are satisfied with your survey responses, click "Submit" below to complete the survey. You will receive a separate e-mail with instructions to receive a $5 Starbuck's e-card.

If you would like to modify your responses, please navigate back to the appropriate page.

APPENDIX D

UNIVERSITY OF ILLINOIS
AT CHICAGO

Office for the Protection of Research Subjects (OPRS)
Office of the Vice Chancellor for Research (MC 672)
203 Administrative Office Building
1737 West Polk Street
Chicago, Illinois 60612-7227

Exemption Granted

June 17, 2016

Daniel Golden, MD
Medical Education
5522 S Hyde Park Blvd
Chicago, IL 60637
Phone: (815) 300-5849 / Fax: (815) 463-8565

RE: Research Protocol # 2016-0613
"Objective evaluation of a didactic curriculum for the radiation oncology medical student clerkship"

Sponsors: None

Please be reminded of the need to address institutional approval requirements at the University of Chicago.

Dear Dr. Golden:

Your Claim of Exemption was reviewed on June 15, 2016 and it was determined that your research protocol meets the criteria for exemption as defined in the U. S. Department of Health and Human Services Regulations for the Protection of Human Subjects [(45 CFR 46.101(b)]. You may now begin your research.

Exemption Period:	**June 15, 2016 – June 15, 2019**
Lead Performance Site:	UIC
Other Performance Site(s):	University of Chicago (see text box above)
Subject Population:	Adult (18+ years) subjects only
Number of Subjects:	100

The specific exemption category under 45 CFR 46.101(b) is:
(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

You are reminded that investigators whose research involving human subjects is determined to be exempt from the federal regulations for the protection of human subjects still have responsibilities for the ethical conduct of the research under state law and UIC policy. Please be aware of the following UIC policies and responsibilities for investigators:

APPENDIX D (continued)

1. Amendments You are responsible for reporting any amendments to your research protocol that may affect the determination of the exemption and may result in your research no longer being eligible for the exemption that has been granted.

2. Record Keeping You are responsible for maintaining a copy all research related records in a secure location in the event future verification is necessary, at a minimum these documents include: the research protocol, the claim of exemption application, all questionnaires, survey instruments, interview questions and/or data collection instruments associated with this research protocol, recruiting or advertising materials, any consent forms or information sheets given to subjects, or any other pertinent documents.

3. Final Report When you have completed work on your research protocol, you should submit a final report to the Office for Protection of Research Subjects (OPRS).

4. Information for Human Subjects UIC Policy requires investigators to provide information about the research to subjects and to obtain their permission prior to their participating in the research. The information about the research should be presented to subjects as detailed in the research protocol and Claim of Exemption application utilizing the approved recruitment and consent process only.

Please be sure to use your research protocol number (listed above) on any documents or correspondence with the IRB concerning your research protocol.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact me at (312) 355-2908 or the OPRS office at (312) 996-1711.

Sincerely,

Charles W. Hoehne, B.S., C.I.P.
Assistant Director, IRB #7
Office for the Protection of Research Subjects

cc: Ilene B. Harris, Medical Education, M/C 591
Alan Schwartz, Medical Education, M/C 591

APPENDIX E

Golden, Dan MD [RAO]

From: _aura-irb@uchicago.edu
Sent: Thursday, June 09, 2016 3:35 PM
To: dgolden@uchicago.edu
Subject: AURA IRB: IRB16-0808 Notification of Exempt Determination - rad onc clerkship eval

AURA | THE UNIVERSITY OF CHICAGO

BSD IRB
The University of Chicago Biological Sciences Division/University of Chicago Medical Center
5751 S. Woodlawn Ave., 2nd floor, Chicago, IL 60637
FWA00005565

Notification of Exempt Determination

Date of Letter: 6/9/2016
Protocol Number/Submission Link: IRB16-0808
Type of Submission: New Study
Status: **Exempt**
Principal Investigator: Daniel W. Golden
Protocol Title: Objective evaluation of a didactic curriculum for the radiation oncology medical student clerkship
Risk Level: Minimal Risk
Funding: Internally Funded

Determination Date: 6/9/2016

The above-referenced new study was determined to be exempt from further IRB review, under the Federal Regulations (45 CFR 46.101(b)), category:

46.101(b)(1)	Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
46.101(b)(2)	(If the research involves children, this category cannot be used as an exemption) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures

APPENDIX E (continued)

or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects financial standing, employability, or reputation.

You may begin your research as described.

If you need assistance, please contact the IRB from the submission workspace by clicking the "Send Email to IRB Team" activity.

Please refer to your IRB's current policy and procedure manual available at: http://humansubjects.uchicago.edu/.

VITA

Name: Daniel W. Golden, M.D.
Date of Birth: 10/09/1980
Place of Birth: Berkeley, California
Nationality: U.S.A.

Education

1998 - 2001	University of California, Berkeley	BA	Molecular Cell Biology with an emphasis in Immunology
2003 - 2007	University of Illinois at Chicago	MD	Medicine (with Honors)

Post-graduate training

2007 - 2008	Internship	Internal Medicine, Preliminary, Kaiser Permanente Medical Center, Oakland, CA Michael J. Clement, M.D., Program Director
2009 - 2013	Residency	Radiation Oncology, University of Chicago Medical Center, Chicago, IL Steven J. Chmura, M.D. Ph.D., Program Director; Ralph R. Weichselbaum, M.D., Chair
2011 - 2012	Fellowship	Medical Education, Pritzker School of Medicine, University of Chicago, Chicago, IL Holly J. Humphrey, M.D., Dean for Medical Education

Principal Positions Held

7/2013 - present	University of Chicago	Assistant Professor	Radiation and Cellular Oncology
7/2009 - 6/2013	University of Chicago	Resident Physician	Radiation and Cellular Oncology

Other Positions Held Concurrently

2013 - present	University of Chicago	Medical Student Clerkship Director	Radiation and Cellular Oncology
2013 - present	University of Chicago	Associate Residency Program Director	Radiation and Cellular Oncology
2016 - present	University of Chicago	Core Faculty for Residency	Radiation and Cellular Oncology
2012 - 2013	University of Chicago	Chief Resident	Radiation and Cellular Oncology

Appointments at Hospitals/Affiliated Institutions

7/2013 - present	Attending Physician	Radiation Oncology	University of Chicago Medicine, Chicago, IL
7/2013 - present	Attending Physician	Radiation Oncology	University of Illinois Hospital, Chicago, IL
7/2013 - present	Attending Physician	Radiation Oncology	Silver Cross Hospital, New Lenox, IL
7/2017 - present	Attending Physician	Radiation Oncology	Little Company of Mary Hospital, Evergreen Park, IL
7/2013 - 4/2017	Attending Physician	Radiation Oncology	Sherman Hospital, Elgin, IL

Scientific and Medical Societies

Elected or invited membership:
Alpha Omega Alpha Honor Medical Society (AOA)
Gold Humanism Honor Society
Other:
American Society for Radiation Oncology (ASTRO)
American Society of Clinical Oncology (ASCO)
Radiological Society of North America (RSNA)
American Association for Cancer Education (AACE)

Awards and Honors

2017	Best Abstract in Education, Canadian Association of Radiation Oncology (CARO) Annual Scientific Meeting
2016 - present	Associate Junior Faculty Scholar, Bucksbaum Institute for Clinical Excellence, University of Chicago, Chicago, IL
2016	Visiting Faculty Scholar, Dept. of Radiation Medicine, Oregon Health & Science University, January 19, 2016
2015	Outstanding Teacher of the Year, Radiation and Cellular Oncology, University of Chicago, Chicago, IL
2015	2014 Best MHPE 505 Core Course Paper Award, University of Illinois College of Medicine
2013	American College of Radiology Radiation Oncology In-service Training Exam 100th percentile overall
2013	ABS/Nucletron HDR Brachytherapy Scholarship, Sunnybrook Health Sciences Centre, Toronto, Canada
2012 - 2013	Chief Resident, Department of Radiation and Cellular Oncology, University of Chicago, Chicago, IL
2012	ASTRO/AANS Stereotactic Radiosurgery Course for Residents, invited attendee
2011 - 2012	Medical Education, Research, Innovation, Teaching and Scholarship (MERITS) Fellowship University of Chicago, Pritzker School of Medicine, Chicago, IL
2007	Granville Bennett Award for senior medical student contributing to medical education University of Illinois College of Medicine, Chicago, IL
2007	Student Service Award, University of Illinois College of Medicine
2007	University of Illinois Alumni Association Student Leadership Award
2006	Gold Humanism Honor Society, member
2006	Memorial Scholarship (Class of 1954), University of Illinois College of Medicine
2006	Association of Pathology Chairs Pathology Honor Society, member
2005	Junior inductee, AOA (Alpha Omega Alpha) National Medical Honor Medical Society
2005	Student Leadership Award, University of Illinois College of Medicine
2004 - 2007	James Scholar Program for Independent Study, University of Illinois College of Medicine
2004	Arnold Zimmerman Award (highest cumulative score in medical gross anatomy) University of Illinois College of Medicine, Chicago, IL
1998 - 2001	California Alumni Scholar, University of California Alumni Association
2000	Student Research Fellowship, Crohn's and Colitis Foundation of America

Research Support (past, current, pending)

Current:

1. "Illustrated versus textual radiotherapy education for patients."
   Principal investigator
   Bucksbaum Institute for Clinical Excellence 2017 Pilot Grant, University of Chicago: $7,200, Funding period 7/2017-6/2018

Pending:

1. "Scholars in Oncology-Associated Research (SOAR)" NIH/NCI R25
   Co-Investigator (PI OI Olopade, MD)
   PAR-15-152 Cancer Research Education Grants Program - Research Experiences (R25). *Resubmission pending*

Past:

1. R25CA225515 "Scholars in Oncology-Associated Research (SOAR)" NIH/NCI R25
   Co-Investigator (PI OI Olopade, MD)
   PAR-15-152 Cancer Research Education Grants Program - Research Experiences (R25). Submitted 5/25/2017 Received score of 46, not funded

2. R25CA200511-01 "Scholars in Oncology-Associated Research (SOAR)" NIH/NCI R25E
   Co-Principal Investigator (Co-PI OI Olopade, MD)
   PAR-12-049 Cancer Education Grants Program (R25), Submitted 1/25/15, Received score of 32, not funded

3. "Development of an introductory structured didactic radiation oncology curriculum for medical students pursuing a career in radiation oncology"
   Principal Investigator
   Radiologic Society of North America (RSNA) Education Scholar Grant #ESCH1308 (RO), Funding period 7/2013 - 6/2014, funding $75,000 towards salary support for 20% FTE. Awarded 5/2013, Funding 8/2013 - 7/2014

4. "Multi-modality image-based assessment of treatment response after ionizing radiation to determine the correlation between tumor metabolic activity and the DNA damage response using a xenograft model of squamous cell carcinoma"
   Co-Investigator (PI: RR Weichselbaum, MD)
   University of Chicago Imaging Research Institute Pilot Project: $21,500 funding. Project completed 6/2009.

5. Student Research Fellowship, Crohn's and Colitis Foundation of America (CCFA)
   Principal Investigator, Summer 2000, ($2,000 funding)

Original Peer-Reviewed Publications

* Corresponding author
† Co-first author

1. Harmatz P, Butensky E, Quirolo K, Williams R, Ferrell L, Moyer T, **Golden D**, Neumayr L, Vichinsky E. "Development of iron overload in patients with sickle cell disease receiving chronic red blood cell transfusion therapy." Blood 2000 Jul 1; 96(1): 76-9. PubMed PMID: 10891433.

2. **Golden DW**, Flik KR, Turner DA, Bach BR Jr, Sawyer JR. "Acute compartment syndrome of the thigh in a high school soccer player: indications for expedient action." Phys Sportsmed. 2005 Dec;33(12):19-24. doi: 10.3810/psm.2005.12.276. PubMed PMID: 20086344.

3. Holland N, Harmatz P, **Golden D**, Hubbard A, Wu YY, Bae J, Chen C, Huen K, Heyman MB. "Cytogenetic damage in blood lymphocytes and exfoliated epithelial cells of children with inflammatory bowel disease." Pediatric Research 2007 Feb; 61(2): 209-214. PubMed PMID: 17237724.

4. **Golden DW**, Jhee JT, Gilpin SP, Sawyer JR. "Elbow range of motion and clinical carrying angle in a healthy pediatric population." Journal of Pediatric Orthopaedics B 2007 Mar; 16(2): 144-9. PubMed PMID: 17273043.

5. **Golden DW**, Wojcicki JM, Jhee JT, Gilpin SL, Sawyer JR, Heyman MB. "Body mass index and elbow range of motion in a healthy pediatric population: a possible mechanism of overweight in children." Journal of Pediatric Gastroenterology and Nutrition 2008 Feb; 46(2): 196-201. PubMed PMID: 18223380.

6. **Golden DW**, Lamborn KR, McDermott MW, Kunwar S, Wara WM, Nakamura JL, Sneed PK. "Prognostic factors and grading systems for overall survival in patients treated with radiosurgery for brain metastases: variation by primary site." Journal of Neurosurgery 2008 Dec; 109 Supplement: 77-86. PubMed PMID: 19123892.

7. Khodarev NN, Roach P, Pitroda SP, **Golden DW**, Bhayani M, Shao MY, Darga TE, Beveridge MG, Sood RF, Sutton HG, Beckett MA, Mauceri HJ, Posner M, Weichselbaum RR. "STAT1 pathway mediates amplification of metastatic potential and resistance to therapy." PLoS ONE 2009 Jun; 4(6): e5821. PubMed PMID: 19503789.

8. James EB, Vreman HJ, Wong RJ, Stevenson DK, Vichinsky E, Schumacher L, Hall J, Simon J, **Golden DW**, Harmatz P. "Elevated Exhaled Carbon Monoxide Concentrations in Hemoglobinopathies and Its Relation to Red Blood Cell Transfusion Therapy." Pediatric Hematology and Oncology 2010 Mar; 27(2): 112-21. PubMed PMID: 20201692.

9. Efimova EE, Mauceri HM, **Golden DW**, Sutton HG, Labay E, Bindokas V, Darga TE, Chakraborty C, Barreto-Andrade JC, Crawley C, Sutton HG, Kron S, Weichselbaum RR. "Poly(ADP-Ribose) Polymerase Inhibitor Induces Accelerated

Senescence in Irradiated Breast Cancer Cells and Tumors." Cancer Research 2010 Aug 1;70(15):6277-82. Epub 2010 Jul 7. PubMed PMID: 20610628.

10. Labay E, Efimova EV, Quarshie BK, **Golden DW**, Weichselbaum RR, Kron SJ. "Ionizing Radiation Induced Foci (IRIF) persistence screen to discover enhancers of accelerated senescence." Int. J. High Throughput Screening 2011(2):1-13, 201.

11. Hasselle MD, Haraf DJ, Rusthoven KE, **Golden DW**, Salgia R, Villaflor VM, Shah N, Hoffman PC, Chmura SJ, Connell PP, Vokes EE, Weichselbaum RR, Salama JK. "Hypofractionated image-guided radiation therapy for patients with limited volume metastatic non-small cell lung cancer." J Thorac Oncol. 2012 Feb;7(2):376-81. PubMed PMID: 22198429.

12. **Golden DW**, Novak CJ, Minsky BD, Liauw SL. "Radiation dose ≥54 Gy and CA 19-9 response are associated with improved survival for unresectable, non-metastatic pancreatic cancer treated with chemoradiation." Radiat Oncol. 2012 Sep 13;7:156. doi: 10.1186/1748-717X-7-156. PubMed PMID: 22974515.

13. **Golden D***, Stepaniak C, Chmura S. Radiation Oncology Self-Directed Dosimetry Workshops: AP/PA Spine, 3-Field Breast, and IMRT . MedEdPORTAL Publications; 2012. Available from: https://www.mededportal.org/publication/9297 http://dx.doi.org/10.15766/mep_2374-8265.9297

14. **Golden DW***, Raleigh DR, Chmura SJ, Koshy M, Howard AR. Radiation oncology fourth-year medical student clerkships: a targeted needs assessment. Int J Radiat Oncol Biol Phys. 2013 Feb 1;85(2):296-7. doi: 10.1016/j.ijrobp.2012.05.012. Epub 2012 Jun 17. PubMed PMID: 22713834.

15. **Golden DW***, Rudra S, Witt ME, Nwizu T, Cohen EE, Blair E, Stenson KM, Vokes EE, Haraf DJ. "Outcomes of induction chemotherapy followed by concurrent chemoradiation for nasopharyngeal carcinoma." Oral Oncol. 2013 Mar;49(3):277-82. doi: 10.1016/j.oraloncology.2012.10.003. Epub 2012 Oct 25. PubMed PMID: 23102863.

16. Rudra S, Malik R, Ranck MC, Farrey K, Golden DW, Hasselle MD, Weichselbaum RR, Salama JK. Stereotactic body radiation therapy for curative treatment of adrenal metastases. Technol Cancer Res Treat. 2013 Jun;12(3):217-24. doi: 10.7785/tcrt.2012.500320. Epub 2013 Jan 25. PubMed PMID: 23369155.

17. Corbin KS, Ranck MC, Hasselle MD, **Golden DW**, Partouche J, Wu T, Chmura SJ, Weichselbaum RR, Salama JK. Feasibility and toxicity of hypofractionated image guided radiation therapy for large volume limited metastatic disease. Pract Radiat Oncol. 2013 Oct-Dec;3(4):316-22. doi: 10.1016/j.prro.2012.08.006. Epub 2012 Oct 3. PubMed PMID: 24674404.

18. Ranck MC, **Golden DW**, Corbin KS, Hasselle MD, Liauw SL, Stadler WM, Hahn OM, Weichselbaum RR, Salama JK. Stereotactic body radiotherapy for the treatment of oligometastatic renal cell carcinoma. Am J Clin Oncol. 2013 Dec;36(6):589-95. doi: 10.1097/COC.0b013e31825d52b2. PubMed PMID: 22868242.

19. Mattes MD, Kharofa J, Zeidan YH, Tung K, Gondi V, **Golden DW**; ARRO Education Subcommittee. Results of the 2012-2013 Association of Residents in Radiation Oncology (ARRO) Job Search and Career Planning Survey of Graduating Residents in the United States. Int J Radiat Oncol Biol Phys. 2014 Jan 1;88(1):25-32. doi: 10.1016/j.ijrobp.2013.09.033. Epub 2013 Nov 1. PubMed PMID: 24189129.

20. Jagadeesan VS, Raleigh DR, Koshy M, Howard AR, Chmura SJ, **Golden DW***. A national radiation oncology medical student clerkship survey: didactic curricular components increase confidence in clinical competency. Int J Radiat Oncol Biol Phys. 2014 Jan 1;88(1):51-6. doi: 10.1016/j.ijrobp.2013.11.206. PubMed PMID: 24331651.

21. **Golden DW***, Spektor A, Rudra S, Ranck MC, Krishnan MS, Jimenez RB, Viswanathan AN, Koshy M, Howard AR, Chmura SJ. Radiation Oncology Medical Student Clerkship: Implementation and Evaluation of a Bi-institutional Pilot Curriculum. Int J Radiat Oncol Biol Phys. 2014 Jan 1;88(1):45-50. doi: 10.1016/j.ijrobp.2013.10.041. PubMed PMID: 24331650.

22. Widau RC, Parekh AD, Ranck MC, **Golden DW**†, Kumar KA, Sood RF, Pitroda SP, Liao Z, Huang X, Darga TE, Xu D, Huang L, Andrade J, Roizman B, Weichselbaum RR, Khodarev NN. RIG-I-like receptor LGP2 protects tumor cells from ionizing radiation. Proc Natl Acad Sci U S A. 2014 Jan 28;111(4):E484-91. doi: 10.1073/pnas.1323253111. Epub 2014 Jan 13. PubMed PMID: 24434553; PubMed Central PMCID: PMC3910628.

23. Brower JV, Mohindra P, Bradley KA, **Golden DW**. Radiation oncology residency selection: a targeted assessment of factor importance among fourth-year medical students. Int J Radiat Oncol Biol Phys. 2014 Mar 15;88(4):967-8. doi: 10.1016/j.ijrobp.2013.12.020. PubMed PMID: 24606856.

24. Mattes MD, **Golden DW**, Mohindra P, Kharofa J; ARRO Education Subcommittee. Results of the 2013 Association of Residents in Radiation Oncology career planning survey of practicing physicians in the United States. J Am Coll Radiol. 2014 Aug;11(8):817-23. doi: 10.1016/j.jacr.2013.12.027. Epub 2014 Apr 4. PubMed PMID: 24709553.

25. Salama JK, **Golden DW**, Yom SS, Garg MK, Lawson J, McDonald MW, Quon H, Ridge JA, Saba N, Smith RV, Worden F, Yeung AR, Beitler JJ. ACR Appropriateness Criteria® thyroid carcinoma. Oral Oncol. 2014 Jun;50(6):577-86. doi:10.1016/j.oraloncology.2013.12.004. PubMed PMID: 24824115.

26. Akthar AS, **Golden DW***, Nanda R, Sharma MR, Te HS, Reddy KG, Zhang X, Malik R. Early and Severe Radiation Esophagitis Associated With Concurrent Sirolimus. J Clin Oncol. 2016 Mar 20;34(9):e73-5. doi: 10.1200/JCO.2013.50.1643. Epub 2014 Jul 14. PubMed PMID: 25024081.

27. Oskvarek JJ, **Golden DW***. In response to "surviving surveys". J Oncol Pract. 2015 Mar;11(2):163-4. doi: 10.1200/JOP.2014.002121. Epub 2014 Dec 23. PubMed PMID: 25538085.

28. Byun J, **Golden DW**. Readability of Patient Education Materials From Professional Societies in Radiation Oncology: Are We Meeting the National Standard? Int J Radiat Oncol Biol Phys. 2015 Apr 1;91(5):1108-1109. doi: 10.1016/j.ijrobp.2014.12.035. PubMed PMID: 25832701.

29. Ye JC, Mohindra P, Spektor A, Krishnan MS, Chmura SJ, Howard AR, Viswanathan AN, MacDonald SM, Thaker NG, Das P, Mancini BR, Higgins SA, Braunstein S, Haas-Kogan D, Bradley KA, Hung AY, Thomas CR Jr, Kharofa J, Wheatley M, Currey A, Parashar B, Du K, Jimenez RB, **Golden DW***. Medical Student Perspectives on a Multi-institutional Clerkship Curriculum: A Report From the Radiation Oncology Education Collaborative Study Group. Int J Radiat Oncol Biol Phys. 2015 Jun 1;92(2):217-9. doi: 10.1016/j.ijrobp.2015.01.043. PubMed PMID: 25968822.

30. Oskvarek J, Braunstein S, Farnan J, Ferguson MK, Hahn O, Henderson T, Hong S, Levine S, Rosenberg CA, **Golden DW***. Medical Student Knowledge of Oncology and Related Disciplines: a Targeted Needs Assessment. J Cancer Educ. 2015 Jul 8. [Epub ahead of print] PubMed PMID: 26153490.

31. Gunther J, Liauw S, Choi S, Stepaniak C, Das P, **Golden D**. Post-Operative Prostate and Seminal Vesicle Fossae Contouring Module: Evaluation of Medical Student Target Delineation Before and After a Teaching Intervention. MedEdPORTAL Publications; 2015. Available from: https://www.mededportal.org/publication/10199 http://dx.doi.org/10.15766/mep_2374-8265.10199

32. Radiation Oncology Education Collaborative Study Group, Radiation Oncology Education Collaborative Study Group Writing Committee: **Golden DW***, Braunstein S, Jimenez RB, Mohindra P, Spektor A, Ye JC; Collaborators: Bradley KA, Chmura SJ, Currey A, Das P, Du K, Haas-Kogan D, Howard AR, Higgins SA, Hung AY, Kharofa J, Krishnan MS, MacDonald SM, Mancini BR, Parashar B, Thaker NG, Thomas CR Jr, Viswanathan AN, Wheatley M. Multi-Institutional Implementation and Evaluation of a Curriculum for the Medical Student Clerkship in Radiation Oncology. J Am Coll Radiol. 2016 Feb;13(2):203-9. doi:10.1016/j.jacr.2015.06.036. PubMed PMID: 26410347; PubMed Central PMCID: PMC4744090.

33. Ye JC, Thomas CR Jr, Braunstein S, Hirsch AE, Gunther JR, **Golden DW***. In Regard to Ahmed et al. "Attracting Future Radiation Oncologists: An Analysis of the National Resident Matching Program Data Trends From 2004 to 2015." Int J Radiat Oncol Biol Phys. 2016 Apr 1;94(5):1221-2. doi:10.1016/j.ijrobp.2016.01.004. Epub 2016 Mar 17. PubMed PMID: 27026323.

34. Gunther JR, Liauw SL, Choi S, Mohamed AS, Thaker NG, Fuller CD, Stepaniak CJ, Das P, **Golden DW**. A Prostate Fossa Contouring Instructional Module: Implementation and Evaluation. J Am Coll Radiol. 2016 Jul;13(7):835-841.e1. doi: 10.1016/j.jacr.2016.02.030. Epub 2016 May 18. PubMed PMID: 27210232; PubMed Central PMCID: PMC4935569.

35. Oskvarek JJ, Brower JV, Mohindra P, Raleigh DR, Chmura SJ, **Golden DW***. Educational Impact of a Structured Radiation Oncology Clerkship Curriculum: An Interinstitutional Comparison. J Am Coll Radiol. 2017 Jan;14(1):96-102. doi:10.1016/j.jacr.2016.07.017. Epub 2016 Sep 18. PubMed PMID: 27652570; PubMed Central PMCID: PMC5222702.

36. Akthar AS, Hellekson CD, Ganai S, Hahn OM, Maggiore RJ, Cohen EE, Posner MC, Chmura SJ, Howard AR, **Golden DW***. Interdisciplinary Oncology Education: a National Survey of Trainees and Program Directors in the United States. J Cancer Educ. 2016 Nov 21. [Epub ahead of print] PubMed PMID: 27873183.

37. Lee AY, **Golden DW**, Bazan JG, Kopec M, Pelizzari CA, Aggarwal S, Chang DT, Liauw SL. Hematologic Nadirs During Chemoradiation for Anal Cancer: Temporal Characterization and Dosimetric Predictors. Int J Radiat Oncol Biol Phys. 2017 Feb 1;97(2):306-312. doi: 10.1016/j.ijrobp.2016.10.010. Epub 2016 Oct 19. PubMed PMID: 28068238.

38. Das LC, **Golden DW**, Perevalova E, Wong AC, De Nardo K, Stepaniak C, Joyce DS, McCabe BP, Hasan Y, Chmura SJ, McCall A. A feasibility study of 2-mm bolus for postmastectomy radiation therapy. Pract Radiat Oncol. 2016 Oct 24. pii: S1879-8500(16)30242-9. doi: 10.1016/j.prro.2016.10.015. [Epub ahead of print] PubMed PMID: 28089526.

39. Gillespie EF, Panjwani N, **Golden DW**, Gunther J, Chapman TR, Brower JV, Kosztyla R, Larson G, Neppala P, Moiseenko V, Bykowski J, Sanghvi P, Murphy JD. Multi-institutional Randomized Trial Testing the Utility of an Interactive Three-dimensional Contouring Atlas Among Radiation Oncology Residents. Int J Radiat Oncol Biol Phys. 2017 Jul 1;98(3):547-554. Doi: 10.1016/j.ijrobp.2016.11.050. Epub 2016 Dec 9. PubMed PMID: 28262474.

40. Brower JV, Liauw SL, Reddy AV, **Golden DW***. Radiation oncology residency selection: A postgraduate evaluation of factor importance and survey of variables associated with job securement. Pract Radiat Oncol. 2017 Apr 26. pii: S1879-8500(17)30125-X. doi: 10.1016/j.prro.2017.04.017. [Epub ahead of print] PubMed PMID: 28666900.

41. Neeley BC, **Golden DW**, Brower JV, Braunstein SE, Hirsch AE, Mattes MD. Student Perspectives on Oncology Curricula at United States Medical Schools. J Cancer Educ. 2017 Aug 7. doi: 10.1007/s13187-017-1265-9. [Epub ahead of print] PubMed PMID: 28782081.

42. McKillip RP, Hahn OM, Bartkowiak B, Rosenberg CA, Olopade OI, Arora VM, **Golden DW***. Implementation of a Novel Medical School Multidisciplinary and Interprofessional Oncology Curriculum: a Mixed Method Study. J Cancer Educ. 2017 Aug 22. doi: 10.1007/s13187-017-1264-x. [Epub ahead of print] PubMed PMID: 28831669. http://rdcu.be/vckd

43. Akthar AS, Koshy M, Ferguson MK, Murgu S, Hogarth DK, **Golden DW**, Connell PP, Davies EM, Kowalski E, Malik R. Effect of Endoscopic Bronchial Ultrasound on Outcomes for Stage I Non-Small-Cell Lung Cancer Patients Receiving Hypofractionated Radiotherapy. Clin Lung Cancer. 2017 Aug 31. pii: S1525-7304(17)30231-0. doi: 10.1016/j.cllc.2017.08.003. [Epub ahead of print] PubMed PMID: 28939097.

Book Chapters

1. **Golden DW*** and Ingledew PA. (*in preparation*) "Radiation Oncology Education" In Halperin EC, Brady LW, Perez CA, and Wazer DE (Eds.). *Perez & Brady's Principles and Practice of Radiation Oncology*. Seventh edition. Philadelphia, PA: LWW.

2. Zaorsky NG, Trifiletti DM, **Golden DW**. (*in preparation*) "General Principles of Radiation Oncology" In Zaorsky NG and Trifiletti DM (Eds.). *Absolute Clinical Radiation Oncology Review*. First edition. New York, NY: Springer.

Editorials

1. **Golden DW***, Langer M. "Education: the third, but not last, pillar of academic radiation oncology." Int J Radiat Oncol Biol Phys. 2012 Aug 1;83(5):1353-4. PubMed PMID: 22768987.

Non-Peer Reviewed Publications

1. "Do you evaluate patients for low health literacy prior to discussing treatment options?" Expert response. Published August 24, 2017 https://www.themednet.org/mednet/index.php/question/2315. (Viewed by 160 people at 135 institutions as of 9/28/17)

2. "What is your technique for simulating and treating patients who have difficulty lying fully supine (due to shortness of breath, pain, or other symptoms despite optimal medical management)?" Expert response. Published February 28, 2017 https://www.themednet.org/mednet/index.php/question/1762. (Viewed by 207 people at the 169 institutions as of 9/28/17)

3. Introduction to Radiation Oncology seminar series, "Lecture 1 - Introduction to Radiation Oncology" Published May 2, 2016, https://www.youtube.com/watch?v=dO2-upHgt0o, 11,563 views as of August 3, 2017

4. Introduction to Radiation Oncology seminar series, "Lecture 2 - Introduction to Radiation Biology and Physics" Published May 2, 2016, https://www.youtube.com/watch?v=ipZTSCoWSv4, 7,715 views as of August 3, 2017

5. Introduction to Radiation Oncology seminar series, "Lecture 3 - Practical Aspects of Radiation Oncology" Published May 2, 2016, https://www.youtube.com/watch?v=jElPGm6ywS8, 1,584views as of August 3, 2017

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