International Journal of
Radiation Oncology
biology • physics

www.redjournal.org

Education

Interprofessional Image Verification Workshop for Physician and Physics Residents: A Multi-Institutional Experience

Laura Padilla, PhD,* Jay W. Burmeister, PhD,† Omer Lee Burnett, MD,‡ Elizabeth L. Covington, PhD,‡ Robert B. Den, MD,§ Michael M. Dominello, DO,† Kevin L. Du, MD, PhD,‖ Paulina E. Galavis, PhD,‖ Stephanie Junell, PhD,¶ Jenna Kahn, MD,¶ Monica Kishore, MS,¶ Karen Mooney, PhD,§ Nitai D. Mukhopadhyay, PhD,# Matthew T. Studenski, PhD, Raphael L. Yechieli, MD,** and Emma C. Fields, MD***

Department of Radiation Oncology, Massey Cancer Center, Virginia Commonwealth University, Richmond, Virginia; †Department of Radiation Oncology, Barbara Ann Karmanos Cancer Institute, Wayne State University School of Medicine, Detroit, Michigan; ‡Department of Radiation Oncology, University of Alabama at Birmingham, Birmingham, Alabama; §Department of Radiation Oncology, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, Pennsylvania; ‖Department of Radiation Oncology, New York University Langone Health, New York City, New York; ¶Department of Radiation Medicine, Oregon Health and Science University, Portland, Oregon; #Department of Biostatistics, Virginia Commonwealth University, Richmond, Virginia; and **Department of Radiation Oncology, University of Miami Miller School of Medicine, Miami, Florida

Received Apr 2, 2021; Accepted for publication Jul 23, 2021

Purpose: Verification of patient position through pretreatment setup imaging is crucial in modern radiation therapy. As treatment complexity increases and technology evolves, physicist-physician collaboration becomes imperative for safe and successful radiation delivery. Despite the importance of both, residency programs lack formal interprofessional education (IPE) activities or structured training for image verification. Here we show the impact of an interprofessional image verification workshop for residents in a multi-institutional setting.

Methods: The workshop included a lecture by the attending physicist and physician, and hands-on image registration practice by learners (medical physics residents, MP; and radiation oncology residents, RO). All participants filled out pre- and postactivity surveys and rated their comfort from 1 to 10 in (A) selecting what type of imaging to order for a given case and (B) independently assessing the setup quality based on imaging. A paired 1-tailed t test ($\alpha = 0.05$) was used to evaluate significance;

Corresponding author: Laura Padilla, PhD; E-mail: Laura.padilla@vcuhealth.org

Disclosures: The authors have no conflict of interest or funding to report related to this project. The statistical analysis was partially supported by Award No. P30 CA016059NIH from the NCI Cancer Center Support Grant.

Research data are not available at this time. Individual data presented in this work as aggregate were shared among the participating institutions as dictated and approved by the Institutional Review Board at Virginia Commonwealth University.

Acknowledgments—The authors would like to thank all the residents who participated in these workshops.

Int J Radiation Oncol Biol Phys, Vol. 111, No. 4, pp. 1058−1065, 2021

https://doi.org/10.1016/j.ijrobp.2021.07.1706

Spearman rank correlation coefficient was used to assess correlation of ratings and RO postgraduate year (PGY). Surveys had free-response questions about IPE and image verification activities in residency.

Results: A total of 71 residents from 7 institutions participated between 2018 and 2020. Pre- and postsurveys were completed by 50 residents (38RO, 12MP) and showed an increase in (A) from 5.5 ± 2.2 to 7.1 ± 1.6 ($P < .001$) and in (B) from 5.1 ± 2.3 to 6.8 ± 1.5 ($P < .001$), with significant increases per subgroup ($A_{\Delta,\ RO} = 1.8 \pm 1.7$, $P < .001$; $B_{\Delta,\ RO} = 1.9 \pm 1.8$, $P < .001$; $A_{\Delta,\ MP} = 1.1 \pm 1.4$, $P = .012$; $B_{\Delta,\ MP} = 1.2 \pm 1.6$, $P = .016$). RO confidence scores moderately correlated with PGY. Survey responses indicated that image verification training is mostly unstructured, with extent of exposure varying by program and attending; most with little-to-no training. Time constraints were identified as the main barrier. IPE was noted as a useful way to incorporate different perspectives into the process.

Conclusions: Formal image verification training increases resident comfort with setup imaging review and provides opportunities for interprofessional collaboration in radiation oncology residency programs.

Introduction

The delivery of high-quality radiation therapy relies on many factors; careful immobilization at the time of simulation, precise contouring and treatment planning, appropriate use of image guidance, and careful review of patient setup before treatment. There are an increasing number of resources to help with contouring and treatment planning.[1,2] However, many radiation oncology medical residents (RO) are often not involved with the ordering of image guidance or the daily process of reviewing verification films or off-line images for their patients.[3] This gap between what is taught in residency and what is expected of an attending physician could lead to potential detriments in patient treatment quality, with inadequate image requests, poor patient alignment, over- or underimaging, and prolonged treatment times.

A single-institution experience of an image verification workshop for RO and medical physics residents (MP) that consisted of a comprehensive lecture and hands-on practice was previously published.[4] All participants were given surveys to measure their self-reported confidence with (A) assessing the appropriateness of an imaging modality for a given treatment and (B) independently checking verification images before and after the workshop, and significant improvements in both areas were found. When the workshop was given in a second consecutive academic year, residents retained their confidence in selecting appropriate types of imaging but had a significant dip in independently aligning images from 1 year to the next. Because residents can be involved in ordering images but are not consistently involved in image review, it is likely that the lack of continued practice between workshops affected their confidence. Therefore, continued exposure and practice is necessary to maintain confidence in these skills in advance of independent practice.

A parallel goal of the workshop design was to promote interprofessional collaboration between RO and MP residents. Recently, a systematic review of interprofessional education (IPE) in radiation oncology showed that despite radiation oncology being an intrinsically interprofessional specialty and IPE demonstrating improved health outcomes, it is rarely used in radiation oncology educational initiatives.[5] Thus, the interprofessional nature of the workshop was an important and unique aspect of this training. In the pilot study, the collaboration between medical and physics residents was very successful and seemed to enrich the value of the educational intervention based on observations and ad hoc discussions with the participants; however, the numbers were too small to formally assess the impact of IPE on their experience.

Given the success of the pilot workshop and the need to further assess the role of IPE in radiation oncology initiatives, we expanded this curriculum to a multi-institutional setting. The purpose of this work was to test our hypothesis that residents would report an increase in confidence in assessing the appropriateness of imaging orders and independently checking films after participating in the training. Our secondary aim was to determine the extent of current residency training in image review and patient setup, barriers to learning these skills, and value of IPE in this workshop, as described by the participating residents. Throughout this paper, the term "residents" or "residency" without any qualifier will refer to both MP and RO.

Methods

A pilot image verification workshop was developed and given at Virginia Commonwealth University in 2018. Six additional institutions enrolled in the program to conduct this training between March 2019 and January 2020. Each academic program identified an attending radiation oncologist and medical physicist as workshop leads. The workshop creators reviewed all the training materials with each institutional lead pair. Briefly, the workshop was comprised of 4 portions, a pretraining survey, a lecture, hands-on practice, and a post-training survey. Leads were instructed to deliver the lecture following the provided guidelines, but they were encouraged to verbally comment on institution-specific technologies or local clinical practice nuances throughout the lecture, as they thought necessary. The structure of the training and training materials were the same for all groups, as previously described,[4] except for 2 items. After reviewing the data collected in-house and from the first outside institution, we identified the need to collect more extensive data on current resident image registration training in each program and their IPE experience. Consequently, we added free-response questions to the original surveys to investigate the extent of current image verification training received by residents, perceived barriers to this training, the prevalence of IPE in their programs, and their perception of the IPE impact on the workshop. These updated surveys were given to 5 of the 7 institutions. These questions were not retrospectively given to participants in the first 2 institutions as some of these new questions were added to the preworkshop survey and these changes were made after their participation in the training. Additionally, each institution used its own patient images for the hands-on portion of the workshop, but we advised them to include an intensity-modulated treatment case for pelvis and head and neck, an abdominal stereotactic body radiation therapy (SBRT), a lung treatment, and a palliative case, if possible. This was done to try to keep the type of cases consistent across institutions, but ultimately, each group was free to select the cases they deemed most instructive. This multi-institutional study was reviewed by the institutional review board at Virginia Commonwealth University and was deemed exempt.

Self-reported confidence scores

Residents reported their confidence level on (A) assessing the appropriateness of imaging orders for a given treatment and (B) independently checking verification images using a scale of 1 (least) to 10 (most) before and after the training. We calculated the mean and standard deviation of these pre- and post-training scores both for the group as a whole, and each profession separately. Changes in the residents' confidence scores before and after the training were tested for significance using a 1-tailed paired *t* test with an alpha of 0.05. As the distribution of the scores looked non-normal, the parametric test results were supplemented with a Wilcoxon rank test. Mean, standard deviation, and *P* values were not calculated for each PGY group separately, as the sample size of each individual group is too small to yield meaningful statistical results. However, quartile 1, median, and quartile 3 were calculated per postgraduate year (PGY) for RO residents to provide a quantitative description of the distribution for each subgroup. Further, we investigated the correlation of the RO residents' scores with PGY before and after the training using Spearman rank correlation coefficient. Statistical parameters were not calculated for MP residents with respect to PGY owing to the smaller sample size. All the data analysis was done in statistical software R version 3.6.1.

Qualitative analysis

Two of the authors (L.P. and E.F.) independently performed thematic analysis for qualitative answers to identify common themes. The results were assessed to find dominant themes and frequency of appearance of these themes among the residents' answers. This process was performed for all questions relating to (1) extent of current training for image verification, (2) perceived barriers to receiving this training, (3) prevalence of IPE activities in their current training, and (4) perceived impact of IPE aspect of the workshop on their experience.

Results

Seventy-one residents from 7 institutions participated in the workshop. The number of participants varied by institution (range, 7-14), and each group had a different ratio of RO to MP residents (range, 2.5-8), including one without any participating MP residents. Table 1 summarizes the training year and profession (RO vs MP) of participating residents.

Self-reported confidence scores

We received pretraining self-reported confidence scores from 66 residents and post-training scores from 55, with full sets of pre- and post-training scores for 50 participants (70% response rate). Table 2 summarizes the scores of the paired data sets. Residents reported a statistically significant increase in confidence after the training both in assessing the appropriateness of imaging orders (pre = 5.5 ± 2.2; post = 7.1 ± 1.6; $P < .0001$; 95% confidence interval of the change in scores, 1.13-2.07) and independently checking verification images (pre = 5.1 ± 2.3; post = 6.8 ± 1.5; $P < .0001$; 95% confidence interval of the change in scores, 1.26-2.24). These findings were further successfully validated by using multiple imputation for patients with partial information (this used all data, including responses missing either pre- or postsurvey results).[6] For both groups, the spread of reported confidence scores became more narrow post-training, as evidenced by the decrease in standard deviation.

We also investigated the correlation of the reported confidence scores with respect to PGY for RO residents. Figure 1 shows a violin plot of the distribution of pre- and postresults for MP residents (PGY1 and 2 are grouped together owing to small sample size) and for RO residents per PGY. Plots include paired data sets only. Table 3

Table 1 Profession and postgraduate year of participating residents

Profession	Number of residents	PGY	% per PGY
RO	57	2	31.6
		3	21.1
		4	24.6
		5	22.8
MP	14	1	57.1
		2	42.9

Abbreviations: MP = medical physics residents; PGY = postgraduate year; RO = radiation oncology residents.

Table 2 Self-reported confidence scores for residents participating in the training

Specialty		Pre-training mean ± SD			Post-training mean ± SD			*P* value
All	Imaging orders	5.5	±	2.2	7.1	±	1.6	**<.0001**
(n = 50)	Checking films	5.1	±	2.3	6.8	±	1.5	**<.0001**
RO	Imaging orders	5.2	±	2.1	7.0	±	1.7	**<.0001**
(n = 38)	Checking films	4.9	±	2.3	6.8	±	1.5	**<.0001**
MP	Imaging orders	6.3	±	2.1	7.4	±	1.1	**.015**
(n = 12)	Checking films	5.6	±	2.4	6.8	±	1.5	**.017**

Bold *P* values indicate statistical significance.
Abbreviations: MP = medical physics residents; RO = radiation oncology residents; SD = standard deviation.

summarizes quartile 1, median, and quartile 3 for each RO PGY group. As stated in the methods, mean, standard deviation, and *P* values were not calculated by PGY for the RO resident paired data sets owing to the small sample size per year ($n_{RO,PGY2}$ = 14, $n_{RO,PGY3}$ = 10, $n_{RO,PGY4}$ = 7, $n_{RO,PGY5}$ = 7). Data for MP residents was not analyzed by year in any form owing to the even smaller sample size ($n_{MP,PGY1}$ = 8, $n_{MP,PGY2}$ = 4). The Spearman rank correlation coefficient indicated a moderate correlation between the RO confidence scores and PGY, both pre- and post-training

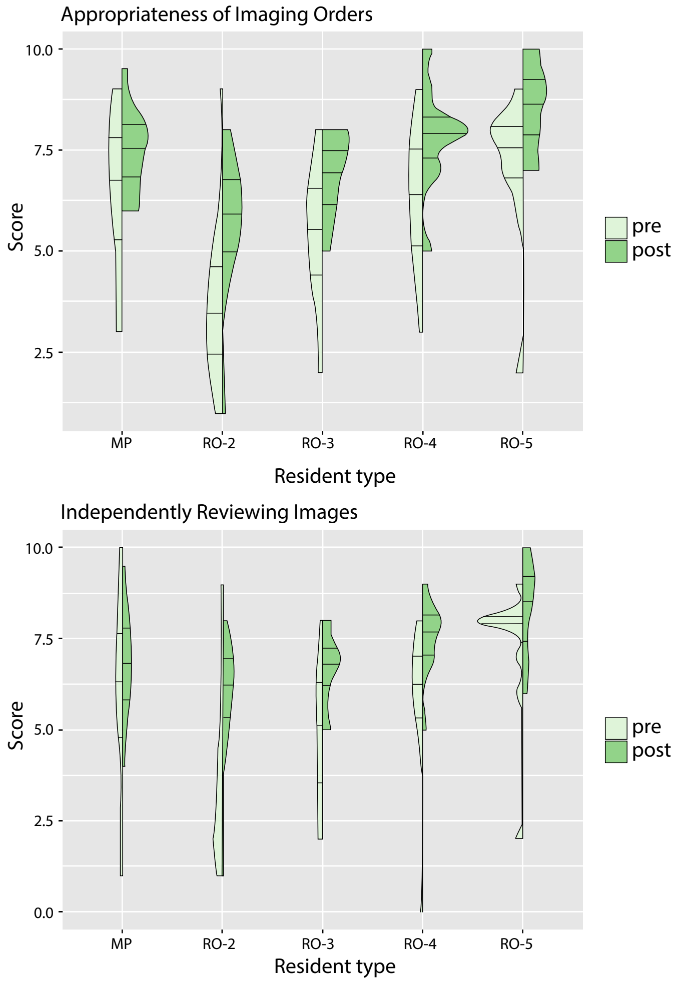

Fig. 1. Distribution of self-reported confidence scores (1-10, with 1 being least confident and 10 being most confident) for (A) appropriateness of imaging orders, and (B) independently reviewing images. The lines under the distribution curve refer to the first quartile, median, and third quartile. Medical physics residents are not split by postgraduate year owing to the small cohort size (PGY1 = 8; PGY2 = 4). *Abbreviations:* MP = medical physics residents; PGY = postgraduate year; RO = radiation oncology residents (number indicates PGY).

Table 3 Self-reported confidence scores for radiation oncology residents by PGY

		Pre-training			Post-training		
	PGY	Q1	Median	Q3	Q1	Median	Q3
Imaging orders	2	2.25	3	4.75	5	6	7
	3	4.5	6	6.5	6.25	7.25	8
	4	5	7	7.5	7.25	8	8
	5	7	8	8	8	9	9
Checking films	2	2	2.5	4.38	5.25	6.25	7
	3	3	6	6	6.12	7	7
	4	5.5	6	7	7	8	8
	5	7.5	8	8	7	9	9

Abbreviations: PGY = postgraduate year; Q1 = quartile 1; Q3 = quartile 3.

($r_{A,pre} = 0.71$, $P < .0001$, $r_{B,pre} = 0.68$, $P < .0001$, $r_{A,post} = 0.68$, $P < .0001$, $r_{B,post} = 0.59$, $P = .0002$).

Qualitative analysis: image verification training

Twenty-seven RO and 7 MP residents provided insight into their current image verification training. The extent of the training was categorized as "none/minimal," "some," and "more extensive" based on the activities described in the responses. Table 4 summarizes representative quotes for each category and their frequency. Most RO residents indicated they receive either none/minimal or some training (74.1%), and only 25.9% indicated receiving more extensive training on image verification. This is in contrast to MP residents' responses in which 85.7% described receiving some or more extensive training.

Responses about barriers to image verification training were also analyzed for themes and categorized into "no identifiable barriers," "lack of exposure," "lack of hands-on practice," "lack of instruction," "time constraints," and "clinical workflow." Table 5 summarizes representative quotes for each category and their frequency. Some residents described more than 1 barrier in their response. The barrier most cited by RO residents was time constraints (44.4%), closely followed by clinical workflow (37.0%). Medical physics residents identified lack of exposure (42.9%) as the most common barrier. Two residents in each group indicated that they did not perceive any barriers to their image verification training.

Qualitative analysis: interprofessional education

Eighty-five percent of residents indicated their residency program includes at least some activities requiring physician−physicist collaboration, most commonly didactic physics lectures and special procedures (brachytherapy,

Table 4 Summary of residents' free-text questionnaire responses describing current image review and patient setup verification training in residency

		RO (n = 27)		MP (n = 7)	
Question	Category	n	Representative quote	n	Representative quote
Please describe the training you have received thus far (excluding this workshop) on image review and patient setup verification	None/minimal	12	"Very little. We often shadow attendings who perform the task very quickly" "Orientation"	1	"None, really"
	Some	8	"Dependent on the attending and his or her willingness to allow us to participate. Otherwise there is no scheduled time" "Brief one-on-one teaching with a few attendings during rotations"	6	"I have been involved in a number of cases in which physicists were reviewing trends in patient imaging as part of their clinical work, although this was not explicitly codified into my training" "Practice in the clinic, classwork, research" "10-week observation, 10-week residency rotation"
	More extensive	7	"Reviewing offline images with attendings at end of day, reviewing images to approve with patient on table" "On the job with attending"		

Abbreviations: MP = medical physics residents; RO = radiation oncology residents.

Table 5 Summary of residents' free-text questionnaire responses describing perceived barriers to image verification training in residency

		RO (n = 27)		MP (n = 7)	
Question	Category	n	Representative quote	n	Representative quote
What do you see as a barrier to your learning these skills as a resident?	No identifiable barriers	2	"None"	2	"I cannot identify any distinct barriers"
	Lack of exposure	6	"Lack of exposure, . . . limited direct involvement of residents (at least early in training)" "Some problems are somewhat rare and you have to be in the right place/ time to troubleshoot"	3	"Adequate opportunities for physics residents" "More exposure to the clinical setups when patients are on the table"
	Lack of hands-on practice	4	"Attending does the image verification, it's hard to know when specifically to adjust it if you as a resident are not actively involved, ie, best way to learn is by doing not observing" "Lack of real-time practice at the machines, lack of opportunity to make decisions regarding whether to proceed with treatment or to resimulate and chances to get feedback regarding our decisions"	1	"Hands-on practice"
	Lack of instruction	4	"Someone teaching it" "Lack of context and background knowledge when first starting as a PGY2 and lack of formal curriculum"	1	"Lack of clear explanation from the physician as to why an image is acceptable to him or her or not"
	Time constraints	12	"Time constraints (takes longer for attendings to approve at end of day)" "Time, both mine and that of attending"		
	Clinical workflow	10	"Not getting called to the machine at the time of setup" "Attending does imaging review verification before resident view" "Most attendings perform image verification remotely and mostly at the end of the working day"	-	

Abbreviations: MP = medical physics residents; PGY = postgraduate year; RO = radiation oncology residents.

stereotactic radiosurgery, and SBRT). Five residents stated that their programs either have no activities requiring physicist-physician collaboration or that these are not required during training. Ninety-four percent of residents stated that they found the interprofessional aspect of the training helpful because it gave them insight into the other professional's perspective and they found it beneficial to collaborate with a health care team member with different expertise.

Discussion

A benefit in RO and MP resident confidence with both image ordering and image review was previously demonstrated after completing our curriculum in a single-institution pilot study.[4] Although patient setup and image verification are of crucial importance in our field, because many radiation oncology programs are small, it becomes inefficient and too resource-intensive for them to individually create task-specific curricula. This workshop is an example of how resource sharing of educational initiatives among programs can enhance the training of residents and help fill current gaps.[7] This curriculum was designed to include a standardized lecture on image guidance describing common setup verification imaging options, factors that can affect image review, and the consequences of approving or rejecting setup films. Although the didactic portion was the same for all participants, as foundational concepts of image verification and patient setup are universal, the hands-on section was designed to be flexible so the training could be easily implemented at any institution. All institutions were given proposed types of cases to use for this part, but each group was able to select its own practice cases to focus on the types of imaging it obtains routinely and the setup challenges it incurs. Through participation in this shared curriculum, residents had a statistically significant improvement in their confidence in ordering appropriate imaging studies as well as in independently reviewing verification images after completing this training.

Interestingly, confidence scores of PGY2 RO residents were considerably lower than those of more experienced residents pretraining (Fig. 1 and Table 3). After the training, scores were still moderately correlated with resident year, but differences between years decreased. Although very low confidence scores (scores of 2 out of 10) were reported by some senior residents (PGY5) pretraining, these increased to 7 out of 10 for comfort assessing the appropriateness of imaging orders and 6 out of 10 for comfort independently checking pretreatment setup verification images after participating in the curriculum. Similar low-confidence levels in some graduating residents have been previously reported in the literature. Brower et al assessed the comfort level in transitioning to independent clinical practice by radiation oncology graduates in the United States.[8] On average, recent graduates reported feeling well prepared to perform tasks such as daily offline film review and troubleshooting at the machine. However, some respondents reported feeling "not at all prepared," and the reported time to comfort during transition to independent practice was >3 months for 20% and 50% of all respondents for daily offline film review and troubleshooting at the machine, respectively. These data highlight the value of this workshop even for advanced trainees. Still, as it has been previously shown,[4] a 1-time training is not sufficient for sustainable improvement; it is important to provide residents with continued practice to create a long-lasting change.

As a field, we are increasingly relying on image guidance at the time of treatment owing to the use of more complex techniques with tighter margins and higher doses. The American Society for Radiation Oncology has defined patient setup imaging as a high priority, because misalignment can lead to a propagation of errors throughout treatment.[9] Despite the importance of imaging, most residents reported none or minimal training on patient setup and image verification. This finding correlates with the lack of involvement of trainees in image-guided radiation therapy (IGRT) verification processes previously reported in the literature.[3] Furthermore, a recent survey of Canadian radiation oncology residents of all years found that only half of their trainees reported having training on how to approach clinical IGRT challenges, 58% reported having observed cone beam computed tomography (CBCT) image verification, and as few as 11% indicated that they had independently verified CBCTs.[10] In our cohort, if there was training, residents typically characterized it as "on the job" and inconsistent between attending physicians and physicists. Of particular concern was that there were PGY5 residents among the group who reported having "none or minimal" training on image verification in different institutions. Some of the barriers to training residents in this important skill were time constraints, lack of resident involvement owing to conflicting clinical tasks, attending physicians performing setup image review outside of clinic hours, and lack of any type of formal curriculum. Time constraints and competing priorities have been identified as barriers to resident training in other studies.[11]

Despite radiation oncology being an interprofessional specialty, many educational initiatives focus only on medical residents.[5] In this workshop, we encouraged medical and physics residents to work together on the image alignment cases. Although most residents reported that their program already included at least some opportunities for interprofessional collaboration, mainly during brachytherapy, stereotactic treatments, or physics lectures, it is unclear from the responses whether physician and physics residents actively work together as part of their training during these activities. Our survey results show that residents found the interprofessional experience helpful during this workshop. They found seeing the perspective of someone with different expertise instructional and enjoyed collaborating with their colleagues. As it has been suggested in the literature, including explicit and intentional IPE activities in residency training, such as the one presented here, may help foster better interprofessional collaboration in radiation oncology clinics in the future.[12]

This larger study confirms that structured image verification training is an important aspect of resident education. However, there are some limitations to this work. As mentioned earlier, the ratio of RO to MP residents was not consistent across institutions. Although this inevitably affects the extent of IPE some of the participants' received, the workshop was still led by an attending medical physicist and radiation oncologist working together. Therefore, even RO residents who did not directly interact with MP residents during the workshop still witnessed the attendings modeling interprofessional collaboration and were able to get help and discuss any aspects of the material or the cases with the attending medical physicist involved. Ideal conditions for IPE would require more even and consistent numbers of RO and MP residents, but this is difficult to ensure in practice, as often MP residency programs have smaller cohorts than their RO counterparts. Other limitations include partial collection of full pre- and postworkshop survey sets (70% response rate), and that qualitative questions about the current extent of image verification training in residency and IPE were only included in the surveys given to 5 out of 7 institutions. Given the marked change in pre- and postworkshop confidence scores reported, the 30% missing responses could affect the magnitude of the observed changes in confidence but are not expected to affect the conclusion that participating in the workshop increases confidence in image verification tasks. However, it is possible that the 70% response rate in conjunction with only 5 of 7 institutions receiving the full set of qualitative questions could influence the qualitative results presented in this work. Although the data presented here provide valuable insight on the current status of image verification training and views of IPE by residents, more extensive studies need to be conducted to fully evaluate these areas.

Furthermore, because the participating programs were not selected at random but rather volunteered to participate, there may be a self-selection bias toward programs that wanted to strengthen their image verification curriculum and are interested in trying and incorporating new educational activities into their residencies. Finally, the data collected in this study were exclusively subjective. There are currently no training platforms in which residents can practice the skills necessary for image verification. Thus, the hands-on portion of this training relies on using existing patient records within clinical record-and-verify systems. This presents limitations as patient information cannot be easily anonymized, there is a risk of altering a treatment record, and the cases are not easily transferable among institutions. This makes it exceedingly difficult to design a methodology to consistently measure the impact of this training on the competence of residents in image verification review. Furthermore, it precludes residents from regular independent hands-on practice with real patient images without the risk of potentially altering patient records.

Given these limitations, we are working on developing an image review platform for resident training. The goal is to create a software package that is compatible with planar and volumetric images, has registration and review tools similar to those found in clinical systems, can host anonymized patient documents, can be used by residents on-demand without the need of supervision, and provides users with the ability to make and record shifts, compare their answers with others, get an estimated delivered dose based on selected alignments, and allow feedback from experts. This will facilitate ongoing practice to cement the residents' confidence and competence in their image review skills, and it will allow resident exposure to a wide range of clinical cases and scenarios that they may not otherwise have access to during training. The applications of such a program could extend beyond resident training. For instance, this platform could be used for initial board certification and maintenance of certification activities, as a quality assurance tool, and to aid in calculating department-specific margins based on the image registration variability recorded by the physicians in a given group.

Conclusions

As radiation therapy treatment modalities and technology become increasingly complex, the delivery of high-quality radiation therapy relies heavily on image guidance as well as the collaboration between radiation oncologists and medical physicists. This multi-institutional study shows that an interprofessional image verification workshop for RO and MP residents improves confidence in selecting and reviewing onboard imaging. It also demonstrates the value of interprofessional collaboration and will hopefully encourage these trainees to work together throughout their careers.

References

1. Gillespie EF, Panjwani N, Golden DW, et al. 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;98:547–554.
2. Elekta ProKnow. Solutions for radiation oncology residency programs. Available at: https://proknowsystems.com/benefits/educators-rorp?content=proknow. Accessed August 17, 2021.
3. Nabavizadeh N, Elliott DA, Chen Y, et al. Image guided radiation therapy (IGRT) practice patterns and IGRT's impact on workflow and treatment planning: Results from a national survey of American Society for Radiation Oncology members. *Int J Radiat Oncol Biol Phys* 2016;94:850–857.
4. Padilla L, Dault J, Fields E. Image registration and verification workshop: A pilot study. *Pract Radiat Oncol* 2020;10:e461–465.
5. Winter IP, Ingledew PA, Golden DW. Interprofessional education in radiation oncology. *J Am Coll Radiol* 2019;16:964–971.
6. van Buuren S. *Flexible Imputation of Missing Data*. 2nd ed. Boca Raton, FL: Chapman and Hall/CRC Interdisciplinary Statistics; 2018.
7. Jimenez RB, Johnson A, Padilla L, et al. The impact of an introductory radiation oncology curriculum (IROC) for radiation oncology trainees across the United States and Canada. *Int J Radiat Oncol Biol Phys* 2020;107:408–416.
8. Brower JV, Chen S, Ritter A, et al. Comfort level of US radiation oncology graduates: assessment of transition to independent clinical practice. *J Cancer Educ* 2021;36:278–283.
9. Marks LB, Adams RD, Pawlicki T, et al. Enhancing the role of case-oriented peer review to improve quality and safety in radiation oncology: Executive summary. *Pract Radiat Oncol* 2013;3:149–156.
10. Wang MH, Loewen SK, Giuliani M, et al. Clinical learning, didactic education, and research experiences of radiation oncology resident physicians in Canada [E-pub ahead of print]. *J Canc Educ*. doi: 10.1007/s13187-020-01799-x, accessed August 17, 2021.
11. Moideen N, de Metz C, Kalyvas M, et al. Aligning requirements of training and assessment in radiation treatment planning in the era of competency-based medical education. *Int J Radiat Oncol Biol Phys* 2020;106:32–36.
12. Schultz OA, Hight RS, Gutiontov S, et al. Qualitative study of interprofessional collaboration in radiation oncology clinics: Is there a need for further education? *Int J Radiat Oncol Biol Phys* 2021;109:661–669.