Advances in Radiation Oncology (2024) 9, 101333

advances in radiation oncology

www.advancesradonc.org

Scientific Article

Analysis of Retrospective Versus Prospective Peer Review in a Multisite Academic Radiation Department

Kevin R. Shiue, MD,[a,b,1] Namita Agrawal, MD,[a,b,1] Ryan M. Rhome, MD, PhD,[a,b] Colleen M. DesRosiers, MS, PhD,[a] Karen M. Hutchins, MS,[a] Richard C. Zellars, MD,[a,b] Gordon A. Watson, MD, PhD,[a,b,†] and Jordan A. Holmes, MD, MPH[a,b,*]

[a]*Department of Radiation Oncology, Indiana University School of Medicine, Indianapolis, Indiana; and* [b]*Indiana University Simon Comprehensive Cancer Center, Indianapolis, Indiana*

Received 3 February 2023; accepted 24 July 2023

Purpose: Our multisite academic radiation department reviewed our experience with transitioning from weekly primarily retrospective to daily primarily prospective peer review to improve plan quality and decrease the rate of plan revisions after treatment start.

Methods and Materials: This study was an institutional review board–approved prospective comparison of radiation treatment plan review outcomes of plans reviewed weekly (majority within 1 week after treatment start) versus plans reviewed daily (majority before treatment start, except brachytherapy, frame-based radiosurgery, and some emergent plans). Deviations were based on peer comments and considered major if plan revisions were recommended before the next fraction and minor if modifications were suggested but not required. Categorical variables were compared using χ^2 distribution tests of independence; means were compared using independent *t* tests.

Results: In all, 798 patients with 1124 plans were reviewed: 611 plans weekly and 513 plans daily. Overall, 76 deviations (6.8%) were noted. Rates of any deviation were increased in the daily era (8.6% vs 5.2%; $P = .026$), with higher rates of major deviations in the daily era (4.1% vs 1.6%; $P = .012$). Median working days between initial simulation and treatment was the same across eras (8 days). Deviations led to a plan revision at a higher rate in the daily era (84.1% vs 31.3%; $P < .001$).

Conclusions: Daily prospective peer review is feasible in a multisite academic setting. Daily peer review with emphasis on prospective plan evaluation increased constructive plan feedback, plan revisions, and plan revisions being implemented before treatment start.

Introduction

Ensuring high-quality radiation therapy treatment plans is an essential part of comprehensive cancer care. Radiation therapy protocol compliance studies, which assess compliance of radiation plans delivered on prospective clinical trials, demonstrate that protocol deviations significantly affect patient outcomes, including survival.[1] A robust peer review process is a central

Sources of support: This work had no specific funding.

Research data are stored in an institutional repository and will be shared upon request to the corresponding author.

[1] K.R.S. and N.A. contributed equally to this work.

† Deceased.

*Corresponding author: Jordan A. Holmes, MD, MPH; E-mail: jorholme@iu.edu

https://doi.org/10.1016/j.adro.2023.101333

component of a strong continuous quality improvement program as indicated by the joint American College of Radiology and American Society for Radiation Oncology "practice parameter for radiation oncology".[2]

Other groups have published on the importance of peer review. The University of North Carolina (UNC) has detailed their peer review process, including a focus on contouring rounds as their data demonstrate that changes occur most frequently after contours and before treatment planning occurs.[3] The group from Hofstra found that with prospective daily peer review of contours, more than one-third of cases required adjustments with contours, directives, or dose schedules.[4] Multiple departments in Canada have also reported similar outcomes.[5-7] The importance of peer review was highlighted in an American Society for Radiation Oncology white paper advocating for the implementation of peer review in all radiation oncology practices as well as advocating for further study of how peer review processes can improve.[8]

Our group, as is typical for many academic or private departments, had customarily done weekly retrospective chart rounds. However, in part due to the aforementioned publications and, in part due to our own internal quality improvement process, we initiated a methodical transition from weekly combined peer review and chart rounds to daily peer review with emphasis on prospective evaluation of treatment plans. We present our group's experience with this transition, including successes, difficulties, and avenues for future improvement.

Methods and Materials

This study was an institutional review board −approved prospective data collection of peer review when plans were reviewed weekly versus when plans were reviewed daily, with the exception of brachytherapy, frame-based radiosurgery, and some emergent plans that could not wait until peer review to be delivered. We included patients reviewed at our multisite academic institution from July 12, 2017 to January 12, 2018. Plans were reviewed weekly from July 12, 2017 to October 18, 2017 and daily from October 16, 2017 to January 12, 2018. Physics quality assurance tasks were not required to occur until after peer review. There was overlap during the week of October 16, 2017, where some plans were reviewed weekly and some plans were reviewed daily as part of our transition.

For weekly and daily peer review sessions, all physicians (including attending and resident physicians at our academic sites) and representatives from dosimetry and physics were expected to attend. Each academic site had a conference room reserved with telecommunications capability to facilitate audiovisual review of treatment plans across multiple sites.

The typical workflow during the weekly era was once-weekly evening sessions for comprehensive chart review of all new starts of the prior week, typically within the first 5 fractions of treatment start. We reviewed 3 major items for each patient chart. First, we reviewed clinical information relevant to treatment plan, radiation dose and fractionation, and appropriateness of radiation as well as screenshots of the treatment plans, which were compiled by the dosimetry team and included representative screenshots of the final beam arrangements, dose distributions, and dose-volume histograms (DVH). Second, we reviewed ARIA documentation to ensure consult note, consent, diagnosis, prescription, etc were completed appropriately. Third, we reviewed new start imaging.

During the daily era, peer review was once daily at 12:30 PM for as long as needed up to 1 PM. There were rare occasions when additional time was needed beyond 1 PM, dependent on physicians' availability and urgency of treatment start. All patients were loaded in the Eclipse Treatment Planning System (Varian Medical Systems, Palo Alto, CA). As such, a more comprehensive list of items was able to be reviewed in real time (as indicated): treatment appropriateness, prescription, fusions, contours, beam arrangements, coverage (visual and DVH assessments), organs at risk (OARs; visual and DVH assessments), and plan sums. Review of ARIA and electronic medical records documentation as well as new start imaging were delegated to each week's on-call physician outside of the peer review sessions (not studied in this manuscript). As plans were rarely reviewed prospectively in the weekly era and retrospectively in the daily era, we distinguish results based on weekly versus daily eras of review as well as retrospective versus prospective timing of review.

Information was collected about the treatment plan as follows: date of peer review, treating physician, treating facility, primary tumor/disease site, anatomic site treated, intent of treatment, treatment technique, planning method, date of simulation, and date of treatment start. Information was also collected about the peer review process as follows: timing of plan review, whether the plan was previously reviewed and why, whether concerns about the plan were raised and why, and whether recommendations were followed and why. Typical major deviations included errors in target delineation that might result in compromised disease control, or errors in OAR delineation that might result in severe toxicity. Similarly, major dose deviations were those that were likely to affect disease control (under coverage) or cause severe toxicity to OARs. All other deviations were considered minor. Deviations were considered major if plan revisions were recommended before delivering the first or next fraction and minor if modifications were suggested but not required to be implemented for that course. Data obtained from the peer review process was collected prospectively during each peer review session in real time by authors KS and NA.

Categorical variables were compared using χ^2 distribution tests of independence; means were compared using independent t tests. All statistics were performed using STATA 15 (STATA Corp, College Station, TX).

Results

In all, 798 patients with 1124 plans were reviewed in a 6-month window: 611 plans weekly and 513 plans daily (Table 1). In the weekly era, plan review primarily occurred within 1 week after treatment start (5.6% prospectively reviewed), as was standard at the time. In the daily era, plan review was performed with emphasis on prospective timing of review (75.4% prospectively reviewed). As mentioned previously, brachytherapy, frame-based radiosurgery, and some emergent plans were not reviewed prospectively.

Overall, 76 deviations (6.8% of total plans) were noted, with 31 of these being major deviations (2.8% of total plans). Rates of any deviation were increased in the daily era (8.6% vs 5.2%; $P = .026$) and with prospective review (9.7% vs 5.0%; $P = .002$), with higher rates of major deviations in the daily era (4.1% vs 1.6%; $P = .012$) and with prospective review (5.0% vs 1.4%; $P < .001$).

Deviations (N = 76) were addressed at a higher rate in the daily era (84.1% vs 31.3%; $P < .001$) and with prospective review (85.4% vs 34.3%; $P < .001$) (Fig. 1). Major deviations (90.5% vs 50%; $P = .012$) and minor deviations (78.3% vs 22.7%; $P < .001$) were addressed at a higher rate in the daily era. Among plans that were changed due to peer review (n = 47), the rate of revision after treatment start was not different across eras (11.4% vs 25.0%; $P = .136$) but decreased with prospective review (7.3% vs 28.6%; $P = .030$).

In the subset of plans excluding brachytherapy, Gamma Knife, and boosts not specifically resimulated (N = 844), median working days between simulation and treatment was the same across eras (8 days).

Discussion

The increasing complexity of radiation treatment and planning means that peer review is a critical safety step to ensure safe and high-quality radiation for patients. With emerging publications highlighting the importance of peer review, we sought to transform our department peer review process.

Since there is inherently some overlap between our retrospective and prospective data, and not all plans were reviewed prospectively after our transition to daily peer review, we analyzed data in 2 different ways. First, we compared plans during the daily era (where 75.4% were analyzed prospectively) versus our previous weekly era (where 5.6% of plans were reviewed prospectively). Second, we considered any plan reviewed prospectively versus those reviewed retrospectively, regardless of era. Rates of any deviations as well as any major deviations were significantly increased with daily era analysis and prospective analysis, suggesting that emphasis on prospective peer review increased the likelihood of peer recommendations. It is worth noting that the increase in deviations with prospective review should not be considered as negative, as the intent of quality improvement initiatives such as peer review is to focus on providing the best plan, and thus best care, for the patient. In the literature of safety culture and incident reporting, an increase in the number of reports/incidents was associated with a decrease in event severity and a decreased likelihood of a safety event.[9,10] It is hypothesized that peer recommendations increased with prospective peer review because of the challenges associated with radiation treatment plan changes once a patient has already begun treatment, as detailed subsequently.

Not surprisingly, we also found a decreased rate of plan revisions after treatment start in the prospective review era. One of the difficulties of retrospective peer review after treatment start is the "workflow inertia" that occurs. That is, once a plan has started, the bar to make changes is much higher as it requires substantial additional effort (planning time from dosimetry, physician time for plan review and approval, physics time for quality assurance, machine time for quality assurance and verification of first fraction, and therapist time to alter the patient's treatment schedule). Prospectively reviewing plans before treatment start can potentially remove much of this additional effort, and errors can be fixed before patients start treatment.

Perhaps the most important endpoint for peer review is whether recommendations are implemented, as the ultimate decision lies with the treating physician. In our data set, deviations led to plan revisions at a much higher rate with prospective peer review (84.1% vs 31.3%). With both retrospective and prospective review, major deviations were more likely to be addressed than minor deviations. Our results contrast with a recent publication from the UNC group, who found that, counterintuitively, major change recommendations were less likely to be addressed in their peer review process.[11] This difference could be accounted for by differences in how deviations were scored and potentially differences in where in the planning process peer review takes place (ie, contour review at UNC before planning vs plan review before start at our institution). We unfortunately did not have a large enough sample size to analyze deviations/changes by faculty member or other potentially important covariates.

The timing of pretreatment peer review has been reported in several variations.[3,4,12,13] We chose to implement our peer review after plan approval by the attending physician, as this fit best in our existing workflow. This approach means that we are combining contour review

Table 1 Characteristics of radiation treatment plans reviewed by era

Characteristics	Weekly era	%, range	Daily era	%, range	*P* value
n	611	54.4	513	45.6	-
% prospective	5.6%	-	75.4%	-	-
Disease site					
Benign	16	2.6	23	4.5	.106
Breast	89	14.6	80	15.6	-
CNS	34	5.6	34	6.6	-
Gastrointestinal	46	7.5	39	7.6	-
Genitourinary	36	5.9	37	7.2	-
Gynecologic	41	6.7	37	7.2	-
Head and neck	25	4.1	23	4.5	-
Hematologic	10	1.6	5	1.0	-
Other	1	0.2	0	0.0	-
Palliative	212	34.7	167	32.6	-
Pediatric	20	3.3	20	3.9	-
Sarcoma	6	1.0	2	0.4	-
Skin	8	1.3	15	2.9	-
Thorax	67	11.0	31	6.0	-
Treatment intent					
Definitive	394	64.5	326	63.5	.744
Palliative	217	35.5	187	36.5	-
Treatment technique					
3D	275	45.0	211	41.1	.327
IMRT	145	23.7	122	23.8	-
Electrons	38	6.2	43	8.4	-
Gamma Knife	23	3.8	30	5.8	-
LINAC SRS	30	4.9	20	3.9	-
SBRT	47	7.7	46	9.0	-
Brachytherapy	51	8.3	37	7.2	-
TBI	2	0.3	4	0.8	-
Median working days sim to treatment	8	(5-11)	8	(6-11)	-
Deviations					
Total	32	5.2	44	8.6	-
Major	10	31.3	21	47.7	-
Minor	22	68.8	23	52.3	-

Abbreviations: 3D = 3-dimensional; CNS = central nervous system; IMRT = intensity modulated radiation therapy; LINAC = linear accelerator; SBRT = stereotactic body radiation therapy; sim = simulation; SRS = stereotactic radiosurgery; TBI = total body irradiation.

with plan review. Some data suggest that contouring is the most important step for review in the treatment planning process, and one criticism of our approach is that we are reviewing cases after a plan has been generated. This might result in some remaining "workflow inertia" to overcome for suggested changes, particularly with respect to adjusting contours. However, at institutions that have prospective contouring rounds, final plans are usually reviewed in a weekly, retrospective session after treatment has started; this difference in approaches may ultimately just shift the inertia to different parts of the workflow. Our data suggests that, overall, our prospective process has greatly improved our peer review, and we are addressing significantly more deviations than in the past.

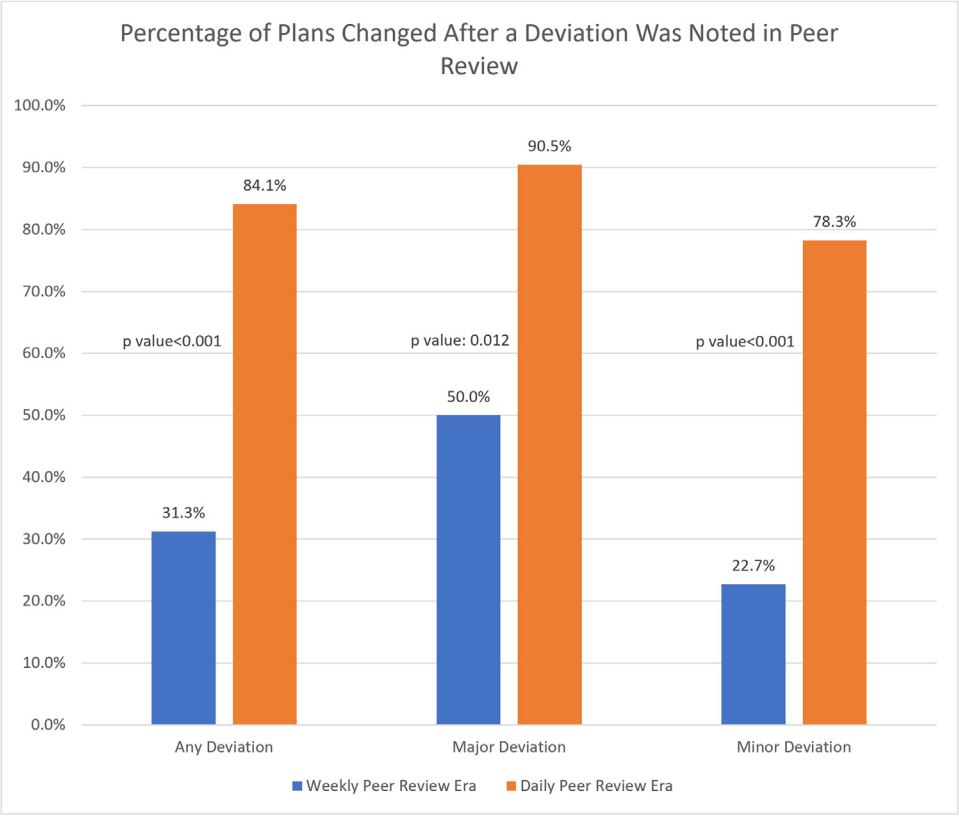

Figure 1 Deviations noted by era, also broken down by major versus minor deviation.

Several logistical concerns have been raised for why prospective peer review might not be feasible. One concern is that prospective peer review might delay the patient's start date. In our data set, there was no difference in the median number of days from simulation to start with the transition to prospective peer review (8 working days). Another potential logistical challenge is prospectively reviewing plans for multisite or community facilities. Our department staffs several hospitals, and our peer review has used a hybrid in-person/virtual format since inception (people gathered at individual sites with peer review run centrally over a virtual platform). The COVID-19 pandemic caused us to adapt, and our peer review seamlessly transitioned to a fully virtual format.[14] Finally, there is often concern about how schedules can be aligned to allow faculty/staff to attend a daily peer review conference in a busy practice. We have implemented a daily 12:30 PM meeting with restrictions on clinic and treatment scheduling during this time. As all physicians in our clinic do not have clinic responsibilities from 12-1 PM, this adjustment has led to minimal clinical disruptions due to peer review during the workday. In addition, by keeping meetings short (<30 minutes) and held during the work day, we improve attendance and likely reduce cognitive burden and loss of attention among attendees.[15] Another added benefit of daily peer review is that this meeting has become one of the main points of interactions between all our staff across all sites. It is also one of our main educational tools for residents and provides an opportunity for comprehensive teaching from physicians, dosimetrists, and physicists regarding the entire process from intent to finalizing a plan.

A potential limitation of our study is that although we increased the number of deviations and plan changes, it is hard to quantify the value added for individual patients. For example, the decrease in plan inertia might lead to suggesting small changes that are unlikely to significantly change outcomes for the patient. This could potentially lead to increased work for staff with little ultimate patient benefit. We hypothesize that the ~25% of plans with minor deviations that were not ultimately changed likely reflect this type of suggestion that was not significant enough to warrant the additional work of replanning. Additionally, it was impossible to completely blind all of our faculty to the underlying research data being collected around the transition to prospective peer review, and this might have biased some faculty to suggest more changes after transitioning to prospective review. However, all of the research data were collected by residents, who have been historically much less likely to suggest plan changes, and a limited number of faculty were aware of the underlying research question being asked (2/12 faculty).

Conclusion

Prospective peer review in a multisite academic/private setting is feasible, efficient, and improves overall plan quality for patients. We are continuing to study ways to make daily prospective review more efficient and robust.

Disclosures

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

Our beloved friend and colleague G.A.W. unfortunately passed away during the finalization of this submission. He was integral to the concept, design, planning, execution, and ultimately success of this project.

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