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Research Letter

Pilot Curriculum for Continued Professional Development of Radiation Oncology Nurses

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Purpose: Limited structured educational programs are available for the continued professional development of radiation oncology nurses. In this study, we evaluated a pilot curriculum focusing on clinical workflow and toxicity management for radiation oncology nurses at a single university-affiliated medical center network.

Methods and Materials: Based on a previous multi-institutional needs assessment, a targeted curriculum on clinical workflow and toxicity management was developed, including didactic lectures, written disease-specific toxicity management guidelines, and standardized medication/laboratory order preference lists in the electronic health record. An anonymized survey was circulated to all participants pre- and postcurriculum. The survey was composed of Likert-type subjective questions and 11 objective knowledge-based questions (KBQs). Paired Likert-type data were analyzed using Wilcoxon signed ranks test. Objective question data were compared with the McNamar's mid *P* test.

Results: Thirteen nurses participated in the pilot curriculum and 100% completed pre- and post curriculum surveys. After the didactics, nurses reported a significant increase in their understanding of the responsibilities of a nurse and overall process of care and their ability to explain computed tomography simulation, as well as their ability to assess, manage, and grade radiation-related toxicities ($P < .01$). There was significant improvement in the percent of correct answers on objective KBQs from a baseline of 52% to 80% after the curriculum ($P < .01$). Qualitatively, 70% (9/13) of nurses rated the curriculum as "extremely useful" and 30% (4/13) as "quite useful."

Conclusions: Our pilot curriculum using a combination of in-person formal didactics, toxicity management guidelines, and electronic health record based order preference lists was well-received and showed promising results on KBQ assessment. This work may be used to guide the development of larger curricula for nurse onboarding and continuing education in a multicenter setting.

Introduction

Nurses are valuable members of the interprofessional oncology care team and are instrumental in improving patient outcomes. To provide the highest quality care,

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

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radiation oncology (RO) nurses require specialized knowledge of radiation therapy equipment, techniques, and toxicity.[1,2] However, a recent study found that only 5% of practicing RO nurses had prior experience with radiation therapy in training and 97% received all their RO education on the job.[3]

Although national RO nursing certification programs exist in the United States, they are not mandatory and are underused. It is estimated that less than half of RO nurses (41%) completed the Oncology Nursing Society/Oncology Nursing Certification Corporation radiation therapy course and only 5% completed the American Society for Radiation Oncology nursing module.[3] A recent literature review has also identified a lack of RO-specific interprofessional educational initiatives despite improvements in patient outcomes seen with similar programs in other medical fields.[4] Although some countries have developed standardized competencies that train nurses in the basics of RO patient care,[5-7] similar programs are lacking in the United States.

Structured educational programs for the continued professional development of RO nurses are critically needed. Recently, the first educational needs assessment of practicing RO nurses in the United States was performed.[3] Based on the results of this assessment, a pilot curriculum tailored for RO nurses was developed and implemented.

Methods and Materials

General curriculum development

A curriculum focusing on radiation treatment–related toxicity assessment and management as well as RO clinical workflow was designed based on responses from a multicenter educational needs assessment[3] and in collaboration with nursing leadership and physicians. There were 2 components to the course: (1) a structured introductory lecture and (2) review of written site-specific toxicity management guidelines/order preferences. The introductory lecture outlined the fundamentals of clinical RO and included a review of basic clinic workflow, clinical responsibilities of physicians and nurses, computed tomography simulation and equipment, and a general overview of radiation treatment–related toxicities. This was followed by more in-depth presentations of site-specific toxicity management guidelines. The curriculum was delivered in person by physicians. Nurses were eligible to receive nursing continuing professional development hours for their participation.

Content development of toxicity assessment guidelines and order preference lists

Seven separate disease sites were identified for development of individual toxicity management guidelines (central nervous system, head and neck, breast, thorax, gastrointestinal, male pelvis, female pelvis). The purpose of the guideline was to provide a high-yield quick-reference source for information on the presentation, diagnosis, and management of common radiation side effects. Working in collaboration with disease site team leaders, important acute and late toxicities related to radiation treatment of each site were identified, and a consistent evidence-based management approach was reached. These were documented using a standardized template for each specific adverse event to facilitate the ease of reading: presentation, timing, prevention, and management. Common Terminology Criteria for Adverse Events grading for each toxicity was inputted in the document. After the curriculum, standardized nursing toxicity assessments were made available to the participants.

The electronic health record at the institution, EPIC (EPIC Systems Corporation), allows for the creation of order preference lists. Based on the content from the standardized toxicity management guidelines, order preference lists for common labs and medications concordant with each disease site toxicity were generated and shared with all staff.

Pre- and postcurriculum data collection and evaluation

An anonymized web-based survey was created with input from faculty, residents, and nurse leadership. The survey was composed of 11 demographic questions evaluating prior experience and responsibilities in the clinic, 7 multilevel questions using a unipolar 5-point Likert-type scale (5 = extremely, 4 = quite, 3 = moderately, 2 = slightly, and 1 = not at all) regarding skills and knowledge related to clinic workflow and toxicity management, and 11 objective knowledge-based questions (KBQs) regarding clinical workflow and toxicity management. KBQs were developed based on consensus from disease site leaders and nursing leadership. Additional questions were asked focused on disease site-specific confidence and potential value of future educational interventions. All RO nurses at the institution were invited to participate in the curriculum and were asked to fill out the survey before and immediately after completion of the curriculum.

Statistical analysis

Paired pre- and postcurriculum Likert-type data were evaluated with the Wilcoxon signed-rank test. In addition, in the presence of ties between the pre- and postmeasurements, bootstrap sampling with replacement was used to obtain the distribution of the difference of the pre- versus postmeasurements for each

response. The P value was then calculated as 2-sided against .05 significance level. Paired pre- and postcurriculum objective data were analyzed with the McNemar's test of paired proportions. Given the small sample size, the McNemar mid P test was used instead of the exact test for better performance.[5] Statistical analysis was performed with SPSS 26 (SPSS). This study was institutional review board exempt. The study has 80% power to detect an effect size of 0.8, which is the mean of the paired post- and predifferences divided by the standard deviation of the paired difference using a significance level of 0.05 and a 2-sided paired t test. The power estimation is an approximation and may be slightly lower when a nonparametric test is used.

Results

A total of 17 nurses were invited, and 13 participated in the curriculum. Demographics are listed in Table 1. Most nurses had less than 1 year of RO experience. Most nurses reported the least confidence in gynecology (3^{2-4}) and head and neck (3^{2-4}) before the intervention (Fig. 1).

Subjective self-assessment

After completion of the curriculum, nurses reported a significant increase in their understanding of the responsibilities of a nurse, understanding of the overall process of care, ability to explain computed tomography simulation, ability to assess radiation-related toxicities, ability to manage radiation-related toxicities, and ability to grade toxicity according to the Common Terminology Criteria for Adverse Events ($P < .01$) (Fig. 2). Improvement in the ability to explain expected toxicities was marginally improved from 3^{3-4} to 4^{4-4} ($P = .052$).

Objective knowledge assessment

The overall percent correct KBQs precurriculum was 52%. At the conclusion of the course, the overall percent correct KBQs increased to 80% ($P < .01$). All questions demonstrated an improvement in understanding (Table 2). The questions that demonstrated the most improvement were questions #6 and #9.

Qualitative feedback

These questions were additionally asked with free text responses: (1) What addition or changes to this curriculum would help to better prepare you for RO clinic? (2) Are there things that could be done once you are in clinic to reinforce the concepts from your introductory curriculum? The feedback is categorized and reported in Table 3.

Overall, nurses reported a high level of satisfaction with the curriculum, with most nurses (9/13) reporting it as "extremely useful" and the rest of the nurses (4/13) reporting the curriculum as "quite useful."

Table 1 Nurse demographic and education characteristics

Demographic category	Answer (n = 13)
Site of work	Main center (5)
	Community-based satellite (8)
Biologic sex	Woman (12)
	Prefer not to say (1)
Age	25-34 (1)
	35-44 (5)
	45-54 (5)
	55-65 (2)
Education	BSN (8)
	ADN (3)
	MSN (1)
Years in radiation oncology	Less than 1 y (7)
	1-4 y (2)
	5-9 y (1)
	Greater than 10 y (3)
Specific radiation oncology training	Yes (1)
	No (12)
Phases of care	Patient education (12)
	Coordination of care (12)
	Completing history/physical (8)
	Pending orders (11)
	Psychosocial needs assessment (10)
Which do you use?	SmartPhrases (6)
	Order Preference List (1)
	Smart Order Sets (3)
	Care Pathways (2)
Population	Adult (9)
	Both adult and pediatrics (4)

Abbreviations: ADN = Associate Degree in Nursing; BSN = Bachelor of Science in Nursing; MSN = Master of Science in Nursing.

Discussion

In this study, we report the successful implementation of a pilot curriculum for the continued professional

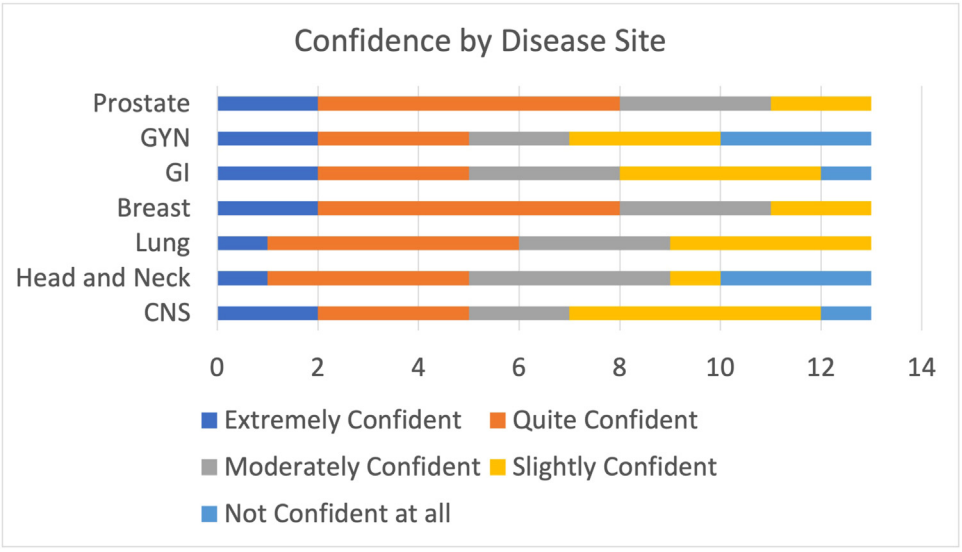

Figure 1 Pretest confidence by disease site as reported by participants.

development of RO nurses. Our results demonstrated significant improvement in knowledge acquisition based on qualitative and objective assessments as well as high rates of perceived usefulness reported by nurses. To the best of our knowledge, this is the first study reporting benefits from an RO-specific nursing educational initiative. These findings may be used to guide the development of a larger curriculum for nurse onboarding and/or continuing education in a multicenter setting.

RO nurses have an important role in the care of patients with cancer, and continuous training is needed to stay up to date. However, most nurses do not use the limited available training resources, such as the Oncology Nursing Society certification course.[3] Barriers to completion are not known, but may include cost, dedicated paid professional time for continued education, awareness of the resources, and perceived lack of benefit. Improving confidence in patient care is nonetheless critical and may improve job satisfaction, burnout, and staff turnover.[8] Of note, the domains with the lowest confidence before the curriculum were head and neck and gynecology, highlighting a specific need for additional training in these disciplines.

RO-specific curricula have been successfully developed for other members of the RO care team but are lacking for nurses. Golden et al[9] created a didactic curriculum for rotating RO medical students that has now been implemented at 22 academic medical centers. Pre- and postcurriculum multiple choice questions

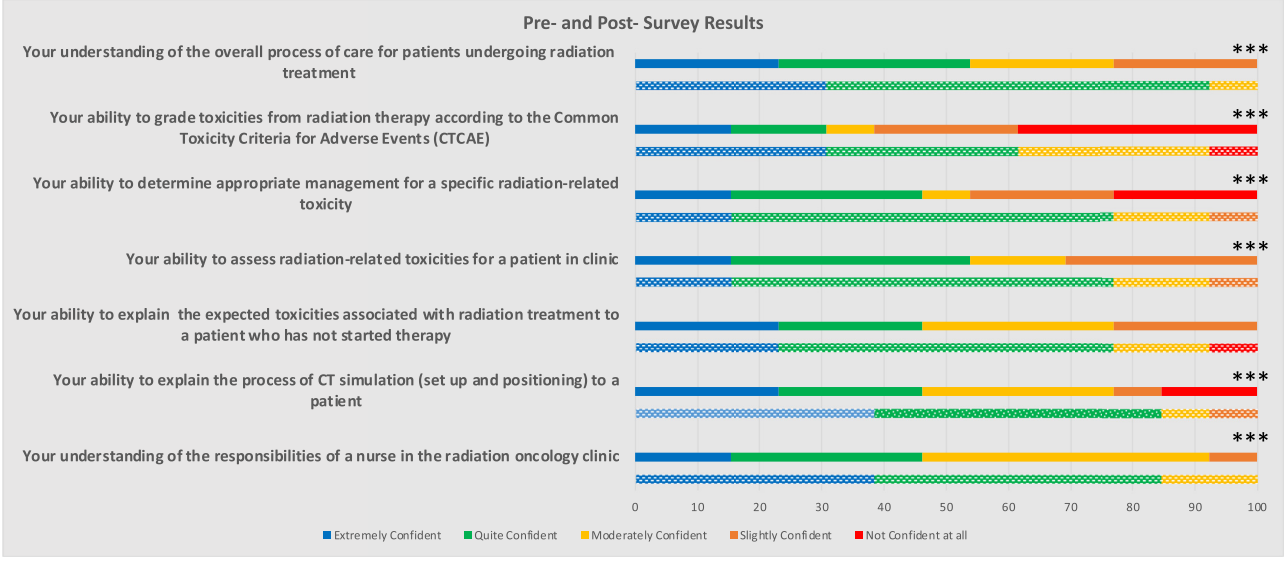

Figure 2 Results of presurvey (solid colors) and postsurvey (patterned colors) answers to subjective self-assessment questions. ***Statistically significant.

Table 2 Knowledge based questions pre- and postcurriculum

Questions	Precurriculum % correct	Postcurriculum % correct	*P* value
#1: Which of the following is required for a CT simulation order?	38	69	.18
#2: What is the standard order of events for a patient undergoing radiation treatment?	62	85	.22
#3: Why is image guided radiation therapy performed?	46	54	.75
#4: According to a randomized trial, what medication has shown to be of benefit to reduce cognitive decline in patients who have received radiation treatment to the whole brain?	46	77	.13
#5: According to a randomized trial, which cream can be prescribed at the start of breast radiation treatment to reduce skin toxicities?	77	92	.38
#6: What would be the first diagnostic test or treatment for diarrhea from pelvic radiation treatment?	8	69	.004
#7: Generally, what CTCAE v5.0 grade is hospitalization indicated?	15	77	.011
#8: What referrals should be placed at consultation for ALL patients with head and neck cancer?	100	100	1
#9: At what time point do we typically recommend starting the use of vaginal dilators for patients after finishing pelvic radiation to prevent vaginal stenosis?	31	92	.004
#10: For prostate cancer patients with urinary symptoms such as frequency and nocturia from radiation treatment, what medication is typically recommended?	77	85	.63
#11: According to the NCCN guidelines, the medications for breakthrough treatment of radiation and chemotherapyinduced emesis include all the following EXCEPT:	77	85	.69
Total correct	52	80	<.01

Abbreviations: CT = computed tomography; CTCAE = Common Terminology Criteria for Adverse Events; NCCN = National Comprehensive Cancer Network.

Table 3 Participant comments and feedback

Additional changes	Recommendations for clinic
Receiving this information when hired. I was just taught by word of mouth and had no printed information for management of symptoms.	Have handouts available.
I haven't started using the smart sets as far as looking past setting my favorites so I think looking more into the implementation of those during this curriculum and getting any questions answered will be helpful.	Maybe some hands on experience in the room using the smart sets when they arise with patients
I'm very excited to see this initiative for nurses who want to pursue a career in radiation oncology. This presentation and the opportunity for future learning will help with training and standardization. I would of liked the opportunity for questions and discussion among the different clinics. Perhaps live questions/comments via system like Teams. It appears the RN role is somewhat different at each of the sites. Handouts, copies of Power Point prior to class. If this is to be presented for new radiation oncology nurses, more time should be given. Target audience, new nurses to radiation?	Have the CTCAE readily available.
Would like to get more information on all 7 sites of radiation therapy.	Yes, more time educating the patients about their treatments

(*continued on next page*)

Table 3 (*Continued*)

Additional changes	Recommendations for clinic
Good presentation. Looking forward to future presentations.	Continue asking questions. Looking forward to working with the protocols.
Let's go into more detail regarding the toxicity assessments and how to grade.	Let's go into more detail regarding the toxicity assessments and how to grade. Have handouts for staff to reference. Need to discuss how to load the flowsheets as well.
I truly enjoyed this presentation and would like to see it presented again in the future.	When toxicity starts
A course on each radiation area by the attending who mostly works in that area to go over toxicity assessments, their preferences on care, etc	New employee orientation handouts that have this information
As a new nurse to rad/onc I found the information about memantine most helpful. It peaked my interest to learn more about the use to prevent cognitive dysfunction.	I think that shadowing the flow of the pt through rad onc is helpful, ie, consult—>CT sim—>contouring—>planning—>treatment to help understand more fully
Perfect content	To continue learning and implementing these important concepts is what I'd like to reinforce in our clinic.
	Share guidelines and more information on accessing "Preference lists." Maybe share contacts of those attending.
	Able to explain the use of memantine with brain radiation.

Abbreviations: CT = computed tomography; CTCAE = Common Terminology Criteria for Adverse Events; pt = patient; RN = registered nurse.

demonstrated significant improvement in RO knowledge. Similarly, Jimenez et al[10] developed a structured curriculum for Post-Graduate Year 2 RO residents to help orient them to the RO clinic that showed positive gains. These studies support the efficacy and feasibility of educational initiatives within RO.

There are several limitations to our study. Most of our nurses had less than 1 year of experience in RO, which may have elevated the benefit of our intervention. Our study was limited to an academic network, which may limit its extrapolation to other settings. Finally, we acknowledge a single group pre-/posttest survey has inherent limitations such as knowledge learned from independent studying and the role of the testing effect.

Disclosures

None.

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