

Implementation of a Novel Medical School Multidisciplinary and Interprofessional Oncology Curriculum: a Mixed Method Study

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Abstract As the population of patients with cancer and survivors grows, physician knowledge of oncology clinical care and research is increasingly important. Despite this patient population growth, medical students and non-oncology physicians report insufficient oncologic and survivorship care training. First-year students at a single US medical school completing a summer research experience were invited to participate in integrated Scholars in Oncology-Associated Research (SOAR) program. SOAR seeks to broaden students' understanding of multidisciplinary and interprofessional oncology clinical care and research. SOAR consists of three components: structured didactics, multidisciplinary tumor board attendance, and interprofessional shadowing. A mixed-methods approach investigated whether student knowledge improved after SOAR. Thirty-three students enrolled in SOAR (20 in 2015, 13 in 2016) and completed pre-assessments. Twenty-five (75.8%) students completed SOAR and post-assessments. Self-reported understanding of clinical (2[2, 3] vs. 4[4], $p < 0.01$) and research oncology (2[2, 3] vs. 4[4], $p < 0.01$) improved after SOAR. Understanding of individual disciplines also significantly improved. When describing clinical oncology, responses written post-SOAR were more comprehensive, averaging 3.7 themes per response vs. 2.8

on pre-assessments ($p = 0.03$). There were more references to “survivorship” as a component of oncology on post-assessments (0[0.0%] vs. 7[28.0%], $p < 0.01$) and “screening/prevention” (2[6.1%] vs. 7[28.0%], $p = 0.03$). Additionally, students more often described cancer care as a continuum on post-assessments (4[12.1%] vs. 11[44.0%], $p = 0.01$). A structured didactic and experiential introduction to oncology, SOAR, was successfully piloted. SOAR improved participant understanding of oncology and its distinct clinical and research disciplines. Future work will focus on expanding SOAR into a longitudinal oncology curriculum.

Keywords Radiation oncology · Undergraduate medical education · Cancer research · Multidisciplinary · Interprofessional

Introduction

In the USA, nearly half of men and just over a third of women will be diagnosed with cancer in their lifetimes [1]. Physicians of all specialties will encounter an increasing number of cancer patients and survivors who have unique medical and psychosocial needs [2]. Physician knowledge regarding the clinical and research aspects of oncology will become increasingly important with the growth of this patient population. Despite the growth of this patient population, non-oncology physicians and students at US medical schools report insufficient training with regard to their understanding of overall oncologic and survivorship care [3, 4]. While education pertaining to individual oncologic specialties continues to improve, a gap exists in integrated oncology education at the undergraduate and graduate medical education level [3, 5]. Additionally, single discipline educational interventions do not achieve the Institute of Medicine's stated goal of

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developing an educational program that will train a workforce prepared to optimally coordinate and deliver team-based patient-centered care [6].

Through a pilot structured educational program integrated into a pre-existing medical student summer research experience, we sought to improve first-year medical student understanding of the cancer care continuum, oncology research, and the significance of interprofessional and multidisciplinary medicine. We hypothesized that student self-reported understanding of these principles would improve after completion of the research experience and structured program.

Methods

Pilot Curriculum

The Scholars in Oncology-Associated Research (SOAR) program was developed as an educational intervention for medical students in their pre-clinical years. The curriculum was designed to train and motivate medical students to appreciate and function within an interdisciplinary and interprofessional oncology care team and sought to broaden their understanding of the cancer care continuum and oncology research, regardless of what specialty they intend to pursue. SOAR consisted of three components integrated into the pre-existing summer research experience: structured didactics, interdisciplinary tumor board attendance, and interprofessional shadowing. SOAR was integrated into an established summer research program. Students conducting oncology-related research were encouraged to participate, but the SOAR program was made available to all students participating in the summer research experience.

Students attended a seminar series of ten 2-hour lectures covering an introduction to oncology, cancer genetics, medical, surgical and radiation oncology, hospice and palliative medicine, survivorship care, drug development, cancer economics, and cancer disparities. The lectures were given by clinicians from internal medicine, oncology, surgery, radiation medicine and clinical researchers, bench scientists, and survivorship advocates to present topics from both clinical and research perspectives. A faculty was allowed to determine the content of each lecture, but was encouraged to relate their topic to patient-centered care and shared decision-making.

Students attended at least one multidisciplinary tumor board meeting at the University of Chicago (breast, neuro-oncology, or thorax/lung). This allowed students to observe different approaches to patient-centered care from medical, surgical, and radiation oncologists, as well as radiology, pathology, social work, and nursing. A faculty liaison welcomed students, explained the structure and goals of each board, and was available to answer student questions following each meeting.

Lastly, students completed a half-day interprofessional shadowing experience with either a pharmacist, radiation therapist, or palliative care-advanced practice nurse to develop a working knowledge and appreciation for the interprofessional nature of oncologic care.

Implementation

SOAR was made available in 2015 and 2016 to medical students who were participating in the summer research program between their first and second year at the University of Chicago, Pritzker School of Medicine (Chicago, Illinois).

Participating students completed anonymous online self-assessments within 2 weeks before and after SOAR (“pre-assessments” and “post-assessments,” respectively). Pre-assessments collected participant demographics. Both pre- and post-assessments asked participants to rate their understanding of oncology and its individual clinical and research disciplines. The participants were also asked to rate the importance of multidisciplinary and interprofessional collaboration on cancer care. Responses were based on a 5-point Likert-type scale (not at all = 1, somewhat = 2, moderately = 3, quite = 4, and extremely = 5). In addition, the self-assessments contained written response questions that asked students to describe each oncology discipline and describe multidisciplinary and interprofessional care using one to three sentences. Individual responses that were left blank were excluded from analysis of that item. The pre- and post-assessments are available as online resource 1 and online resource 2, respectively. Development and pre-testing of the self-assessments were performed with external reviewers experienced in survey methodology. Revisions were made accordingly to produce the final version of the self-assessment that was used in this study. The self-assessments were collected and managed using REDCap electronic data capture tools hosted at the University of Chicago [7]. REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing the following: (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 University of Chicago Institutional Review Board granted exemption from review for this study.

Analysis

A mixed-method approach was utilized to investigate whether students’ understanding of oncology and its disciplines improved after SOAR. Quantitative analysis comparing Likert-type responses on the pre- and post-assessments was

performed using Wilcoxon rank-sum tests. Results are reported as median [interquartile range].

In an effort to further characterize changes in student understanding of oncology and interprofessional and multidisciplinary medicine after SOAR, qualitative analysis of the written responses on the pre- and post-assessments was performed. Responses were anonymized and randomized to prevent raters from knowing whether a response was written pre-SOAR or post-SOAR. Thematic analysis of the anonymized transcripts was conducted using an inductive process. Microsoft Excel (Microsoft, Redmond, WA) was used to facilitate coding. Two investigators (RPM and BB) first reviewed a portion of the responses independently to develop the coding scheme, followed by comparative analysis until thematic saturation was achieved. The agreed-upon coding framework was then applied to all responses with a comparison between raters performed to establish inter-rater reliability (satisfactory kappa score ≥ 0.75). The primary outcome was to identify themes and representative quotations for each theme. A secondary analysis compared themes on pre- and post-assessments to identify significant changes in the incidence of themes. Participant responses were categorized as either including or not-including each theme that was identified in our primary analysis. Using Fisher exact testing, significant differences in themes between pre- and post-assessments were identified.

Results

Thirty-three students enrolled in SOAR (20 in 2015, 13 in 2016) and completed pre-assessments. Twenty-five (75.8%) students successfully completed SOAR and submitted post-assessments. Inability to attend at least 80% of lectures was the primary reason for withdrawing from the course. Participant demographics were derived from the 33 pre-assessments. Participants were 58% female, 24 (73%) were between the ages of 23 and 25, and 22 (67%) had an undergraduate major related to the biological sciences. Twenty-one (64%) participants expressed the intention to pursue an oncologic specialty, and 11 (33%) reported no previous research or clinical exposure to oncology. Table 1 details participant demographics.

Understanding of the Cancer Care Continuum

Overall, student self-reported understanding of oncology and its various disciplines along the cancer care continuum was higher on post-assessments (Table 2). Self-reported understanding of oncology as a general clinical discipline (2[2, 3] vs. 4[4], $p < 0.01$) and research discipline (2[2, 3] vs. 4[4], $p < 0.01$) improved after participation in SOAR. Self-reported understanding of each individual discipline was also

Table 1 2015 and 2016 SOAR participant demographics

	Participants ^a <i>n</i> = 33
Gender, <i>n</i> (%)	
Male	14 (42%)
Female	19 (58%)
Age, <i>n</i> (%)	
< 23	3 (9%)
23–25	24 (73%)
26–28	4 (12%)
> 28	2 (6%)
Undergraduate major, <i>n</i> (%)	
Biological sciences	22 (67%)
Physical sciences	3 (9%)
Social sciences	3 (9%)
Other	5 (15%)
Intend to pursue oncologic specialty, <i>n</i> (%)	21 (64%)
Previous oncology-related clinical experience, <i>n</i> (%)	15 (45%)
Previous oncology-related research experience, <i>n</i> (%)	18 (55%)

^a Participant demographics were derived from pre-assessment data

significantly improved. Among the separate disciplines, medical oncology as a research discipline (1[1, 2] vs. 4[3, 4], $p < 0.01$) and cancer economics (1[1, 2] vs. 4[2–4], $p < 0.01$) demonstrated the largest increase in median score between pre- and post-assessments. The discipline with the poorest understanding reported by students was survivorship care (1[1] vs. 2.5[2, 3], $p < 0.01$), for which the median rating went from “not at all” on pre-assessments to between “somewhat” and “moderately” on post-assessments.

In written responses, when describing oncology as a general clinical discipline, nine major themes emerged (Table 3). Participants emphasized clinical oncology as the diagnosis and treatment of cancer, which can include chemotherapy, radiation, and surgery, and can require long-term medical care. Post-assessment descriptions of clinical oncology were more comprehensive, averaging 3.7 themes per response vs. 2.8 on pre-assessments ($p = 0.03$). This is despite raters being blind to which responses were from pre-assessments or post-assessments. There were significantly more references to “survivorship” as a component of oncology on post-assessments (0[0.0%] vs. 7[28.0%], $p < 0.01$) and “screening/prevention” (2[6.1%] vs. 7[28.0%], $p = 0.03$). Additionally, students more often described cancer care as a “continuum” on post-assessments (4[12.1%] vs. 11[44.0%], $p = 0.01$).

“Oncology as a clinical discipline entails the treatment of all of the various forms of cancer through multiple modalities which including surgery, radiation, and pharmacological agents (medical oncology). In addition the clinical discipline of oncology encompasses

Table 2 Median and interquartile ranges of participant responses on pre- and post-SOAR assessments (reported as Median [Interquartile range])

	Pre-SOAR	Post-SOAR	<i>p</i> value
How well do you understand			
Oncology as a general clinical discipline?	2[2–3]	4[4–4]	< 0.01
Oncology as a general research discipline?	2[2–3]	4[4–4]	< 0.01
Cancer genetics as a general clinical discipline?	2[2–3]	3[3–4]	< 0.01
Cancer genetics as a general research discipline?	2[2–3]	4[3–4]	< 0.01
Medical oncology as a general clinical discipline?	2[1–2]	4[4–4]	< 0.01
Medical oncology as a general research discipline?	1[1–2]	4[3–4]	< 0.01
Radiation oncology as a general clinical discipline?	2[2–3]	4[3–4]	< 0.01
Radiation oncology as a general research discipline?	2[1–2]	3[3–4]	< 0.01
Surgical oncology as a general clinical discipline?	2[2–3]	4[4–4]	< 0.01
Surgical oncology as a general research discipline?	2[1–2]	3[3–4]	< 0.01
Hospice/palliative care as a general clinical discipline?	2[2–3]	3.5[3–4]	< 0.01
Hospice/palliative care as a general research discipline?	1[1–2]	3[2–3]	< 0.01
Survivorship care as a general clinical discipline?	1[1–2]	3[2–4]	< 0.01
Survivorship care as a general research discipline?	1[1–1]	2.5[2–3]	< 0.01
Drug development as a general research discipline?	2[2–3]	4[3–4]	< 0.01
Cancer economics as a general research discipline?	1[1–2]	4[2–4]	< 0.01
Cancer disparities as a general research discipline?	2[1–2]	4[3–4]	< 0.01
How important is multidisciplinary collaboration as a component of cancer care?	5[5–5]	5[4–5]	0.29
How important is interprofessional collaboration as a component of cancer care?	5[4–5]	5[4–5]	0.65

the social aspects of what has in many cases become a chronic disease/condition. This includes palliative care/hospice, survivorship, and social/psychological support.”

SOAR participant (post-assessment)

Describing oncology as “multidisciplinary” was also more common on post-assessments (6[18.2%] vs. 9[36.0%], *p* = 0.14), although this difference was not statistically significant. Including the generic description of clinical oncology as the “treatment of cancer” was more common on pre-assessments (30[90.9%] vs. 17[68.0%], *p* = 0.04). Notably, there were no other themes identified on pre-assessments that had significantly lower incidence on post-assessments.

When describing oncology as a research discipline, 12 themes emerged (Table 3). Participants often referred to the pursuit of new treatments, understanding the pathological mechanisms of cancer, and the study of cancer genetics and economics. Many participants also distinguished basic science from clinical research. There were several differences in themes between pre- and post-assessments. Similar to oncology as a clinical discipline, post-assessments for oncology as a research discipline were generally more descriptive, averaging 4.9 themes per response, compared to 4.2 on pre-assessment responses (*p* = 0.12). On post-assessments, participants more often referred to social science or study of the social

determinants of health (2[6.1%] vs. 11[44.0%], *p* < 0.01), survivorship research (0[0.0%] vs. 6[24.0%], *p* < 0.01), and research relating to the cancer patient experience (2[6.1%] vs. 7[28.0%], *p* = 0.03).

“Oncology research is extremely far-reaching across multiple disciplines, including biochemical pathways, genetics, cell cycle, clinical trial research, economic research about the costs of cancer care, or social science research about patient or physician attitudes...”

SOAR participant (post-assessment)

Themes identified on pre-assessments that were not as prevalent on post-assessments included cancer mechanisms (23[69.7%] vs. 9[36.0%], *p* = 0.02), the mention of metastasis (6[18.2%] vs. 0[0.0%], *p* = 0.03), and a generic description of oncology research as the study of cancer (9[27.3%] vs. 1[4.0%], *p* = 0.03).

Understanding of Interprofessional and Multidisciplinary Medicine

As pre-SOAR agreement was strong, SOAR did not have a significant impact on participants’ opinion as to whether multidisciplinary collaboration (5[4, 5] vs. 5[4, 5]), or interprofessional collaboration (5[4, 5] vs. 5[4, 5]) is important to cancer

Table 3 Themes identified from student written responses on pre- and post-SOAR assessments

	Pre-SOAR <i>n</i> = 33	Post-SOAR <i>n</i> = 25		<i>p</i>
Describe oncology as a clinical discipline				
The treatment of cancer	30 (90.9%)	17 (68.0%)	↓	0.04
Utilizes radiation/chemotherapy/surgery	13 (39.4%)	8 (32.0%)		0.59
Diagnosis of cancer	12 (36.4%)	10 (40.0%)		0.79
Requires long term management	7 (21.2%)	7 (28.0%)		0.76
A multidisciplinary field	6 (18.2%)	9 (36.0%)		0.14
A continuum of care	4 (12.1%)	11 (44.0%)	↑	0.01
Includes palliative care	4 (12.1%)	7 (28.0%)		0.18
Includes screening & prevention	2 (6.1%)	7 (28.0%)	↑	0.03
Includes survivorship care	0 (0%)	7 (28.0%)	↑	<0.01
Describe oncology as a research discipline				
Studying cancer mechanisms	23 (69.7%)	9 (36.0%)	↓	0.02
Searching for new treatments	21 (63.6%)	13 (52.0%)		0.43
Includes basic science	13 (39.4%)	11 (44.0%)		0.79
Includes clinical research	10 (30.3%)	6 (24.0%)		0.77
The study of cancer	9 (27.3%)	1 (4.0%)	↓	0.03
Includes genetic research	8 (24.2%)	7 (28.0%)		0.77
Understanding metastasis	6 (18.2%)	0 (0.0%)	↓	0.03
Includes cancer economics	4 (12.1%)	8 (32.0%)		0.10
Understanding the causes of cancer	4 (12.1%)	4 (16.0%)		0.72
Includes social science	2 (6.1%)	11 (44.0%)	↑	<0.01
Understanding the patient experience	2 (6.1%)	7 (28.0%)	↑	0.03
Includes survivorship research	0 (0%)	6 (24.0%)	↑	<0.01

Up/down arrows to emphasize themes that increased or decreased

care. Additionally, in written responses, participant descriptions of multidisciplinary and interprofessional care were not more detailed on post-assessments as they were when participants explained the individual disciplines of oncology. The average number of themes identified on pre- and post-assessments was not significantly different for responses describing multidisciplinary (3.5 vs. 2.9, $p = 0.19$) and interprofessional (2.8 vs. 3.4, $p = 0.16$) care. When describing multidisciplinary care, participants often referred to the collaboration between surgery, medicine, and radiation specialists. In post-assessment responses, fewer participants included primary care (5[15.2%] vs. 0[0.0%], $p = 0.06$), or a generic description of multidisciplinary as being all staff involved in patient care (6[18.2%] vs. 2[8.0%], $p = 0.45$), although these changes were not statistically significant. Participant descriptions of interprofessional care focused on coordination among team members as well, including social work, nursing, and pharmacy. Compared to pre-assessments, post-assessment responses included more references to social workers (7[28.0%] vs. 4[12.1%], $p = 0.74$) and pharmacists (5[20.0%] vs. 3[9.1%], $p > 0.99$), and fewer responses implying interprofessional care is the “same as multidisciplinary” (6[18.2%] vs. 2[8.0%], $p = 0.45$); however, these changes were not statistically significant.

Discussion

By offering a summer elective in oncology that incorporated didactics, interprofessional shadowing, and multidisciplinary tumor boards to students completing an established summer research experience, we successfully expanded understanding of cancer care and research among first-year medical students. Self-reported understanding of oncology and its individual disciplines with relation to clinical care and research improved universally on Likert-type responses. This was further supported by participants’ written descriptions of each discipline. Importantly, an increased awareness of the complete cancer care continuum was demonstrated by participant references to screening and survivorship in post-SOAR descriptions of oncology as a general clinical discipline. Furthermore, despite reviewers being blind to whether a response was pre-SOAR or post-SOAR, the number of themes identified on post-assessment written responses was significantly higher, demonstrating that SOAR helped participants develop an enriched understanding of oncology.

Our multi-pronged curriculum also attempted to teach students about the multidisciplinary and interprofessional nature of oncology care. Although receptiveness to the multidisciplinary tumor board and interprofessional shadowing was

high, so was baseline student agreement as to the importance of these aspects of care. While written descriptions of multi-disciplinary and interprofessional care did not change significantly before and after SOAR, more students made reference to these aspects when describing oncology as a general clinical discipline, suggesting an improved awareness to their importance.

We intend to enhance the SOAR program so that it can be integrated into the pre-clinical curriculum. As we evaluate the program, further research will be needed in order to overcome the limitations of this current study. Although we had the benefit of combining qualitative and quantitative data collected from participants, our measurement of participant understanding of each topic was self-reported. Additionally, because of student scheduling conflicts, there was a significant dropout rate (24.2%). Therefore, our comparison of post-assessment responses to pre-assessments may unfairly select for highly motivated students and is limited by the fact that SOAR was implemented at one institution. Future study of SOAR will expand to other schools, match participants' pre- and post-assessments, and incorporate an objective knowledge assessment. Lastly, the results may be subject to biases inherent to any survey study. A selection bias is possible with students choosing to participate in SOAR being highly motivated to learn about oncology. A social desirability bias is also of concern with students potentially responding in a manner they perceive the course directors would want rather than their true perceptions. Because these potential sources of bias may affect the magnitude of impact reported from the SOAR program, these results must be interpreted cautiously when expanding such a program to the broader group of learners.

As the number of cancer patients and survivors continues to expand, so does the complexity of cancer care. Physicians of all specialties will encounter patients with a history of cancer and must have a sufficient understanding of oncology's various disciplines and professions. SOAR represents a novel method to incorporating comprehensive education about oncology clinical care and research, which will become increasingly important in undergraduate medical education.

Compliance with Ethical Standards

Conflict of Interest Dr. Golden reports a financial interest in RadOncQuestions, LLC and HemOncReview, LLC. No other conflicts of interest are reported.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

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