Published in final edited form as:

Cancer Res. 2017 September 15; 77(18): 4741–4744. doi:10.1158/0008-5472.CAN-17-1057.

Methods of Academic Course Planning for Cancer Biology PhD Students to Enhance Knowledge of Clinical Oncology

Malcolm D. Mattes¹, Elizabeth Swart², Steven M. Markwell³, Sijin Wen⁴, and Linda C. Vona-Davis⁵

¹Department of Radiation Oncology, West Virginia University, Morgantown, West Virginia

²Eberly College of Arts and Sciences, West Virginia University, Morgantown, West Virginia

³Department of Neurobiology and Anatomy, West Virginia University, Morgantown, West Virginia

⁴Department of Biostatistics, West Virginia University, Morgantown, West Virginia

⁵Department of Surgery and Office of Research and Graduate Education, West Virginia University, Morgantown, West Virginia

Abstract

Little is known about how clinical oncology concepts are taught to PhD students or the most effective methods of doing so. In this study, electronic surveys were sent to faculty and students at PhD training programs, assessing their institution's methods of clinical oncology education and their perspective on optimal approaches to clinical oncology education. Only 40.0% of students reported any clinical oncology component to their institution's training, and only 26.5% had a clinician on their graduate advisory committee. Forty-three percent of students believed that they had a good understanding for translating basic science research into clinical practice, and 77.2% of all participants believed dual degree MD/PhD students were superior to PhD students in this regard. Lectures on clinical oncology research topics were the most valuable type of experience for all participants and were also the most common type of experience utilized. Working with a clinician to develop a clinical trial with correlative endpoints was also highly valued, but was only utilized by approximately 10% of programs. Faculty rated the value of nearly all types of clinical

Corresponding Author: Malcolm D. Mattes, Department of Radiation Oncology, West Virginia University, PO Box 9234, One Medical Center Drive, Morgantown, WV 26506. Phone: 304-598-4706; Fax: 304-581-1151; malcolm.mattes@gmail.com; mdmattes@hsc.wvu.edu.

Note: Supplementary data for this article are available at Cancer Research Online (<http://cancerres.aacrjournals.org/>).

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Authors' Contributions

Conception and design: M.D. Mattes, S.M. Markwell, L.C. Vona-Davis

Development of methodology: M.D. Mattes, E. Swart, L.C. Vona-Davis

Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): M.D. Mattes, L.C. Vona-Davis

Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): M.D. Mattes, E. Swart, S. Wen, L.C. Vona-Davis

Writing, review, and/or revision of the manuscript: M.D. Mattes, E. Swart, S.M. Markwell, S. Wen, L.C. Vona-Davis

Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): M.D. Mattes, E. Swart, S. Wen

Study supervision: M.D. Mattes, L.C. Vona-Davis

oncology exposure significantly lower than did students. Inclusion of the approaches identified in this study is likely to enhance PhD training in oncology-related disciplines.

Introduction

Cancer is the second leading cause of death in the United States, and as such, there is considerable interest in oncology-oriented biomedical research to help facilitate advances in clinical interventions and improve patient outcomes. However, whether the average academic clinician or scientist is adequately trained to contribute in meaningful ways to translating basic science research into clinical practice is debatable. Medical students receive some degree of education in basic principles of cellular structure and function as well as mechanisms of oncogenesis during the preclinical component of medical school, and these concepts are tested on national licensing exams, but there is a lack of data describing specific methods of clinical oncology exposure for PhD students (1, 2). The purpose of this study is to better characterize current approaches to clinical oncology education for PhD students at a variety of training programs in the United States, as well as to understand student and faculty perceptions of the most effective methods for oncology-oriented cross-disciplinary education.

Materials and Methods

Two separate electronic surveys were developed and administered as part of this study. The target population of the first survey comprised faculty leadership of the Cancer Biology Training Consortium (CABTRAC) from 26 institutions, whereas the target population of the second survey comprised active PhD students in the training programs of the above faculty members whose dissertation work involves cancer. The faculty also had the option of sharing a separate survey link with other faculty involved in oncology education for PhD students at their institution. Students in dual degree MD/PhD programs were excluded as they would inherently have more clinical exposure as part of the MD component of their program. The surveys were distributed electronically between September and October 2016. Responses were anonymous, and no incentives were offered for participation.

The surveys were developed by the authors of this article, in accordance with applicable Checklist for Reporting Results of Internet E-Surveys (CHERRIES) criteria (3). The design of questions and their selection for inclusion was guided by our study group's clinical and curricular design/teaching experience. The actual survey questions can be found in Supplementary Tables S1 and S2, but briefly, in addition to collecting demographic information, the questions inventoried methods of clinical oncology education and the types of experiences currently taking place at participants' own institution along with their level of satisfaction with that curriculum, as well as participants' views on optimal approaches to clinical oncology education in general. The term "clinical oncology" was defined on both surveys as the use of surgery, radiotherapy, or systemic/chemotherapy to treat cancer in patients. Question formats were predominantly multiple choice and Likert scales (from 1 to 5, with 1 being the worst, lowest, or least likely option and 5 being the best, highest, or most likely option, depending on the question).

Descriptive statistics, including mean, SD, median, interquartile range (IQR), were used to summarize the findings. Likert-type scales were treated as ordinal variables, and the Mann–Whitney *U* test was used to compare Likert ratings between the student and faculty participants. The Fisher exact test was used to compare responses between faculty and students for categorical variables. Statistical analysis was performed using Statistical Package for Social Sciences 20.0 (IBM Corporation). Unless otherwise noted, a *P* value <0.05 was considered statistically significant. This study was considered exempt by the West Virginia University Institutional Review Board.

Results

A total of 95 responses were received, with nearly equivalent distribution between students (*n* = 49) and faculty (*n* = 46). As some students and faculty responded to a general survey link rather than an individualized survey link specific to them, a precise response rate cannot be calculated. However, among those who received an individualized survey link (*n* = 115), the response rate was 43.5%. Of the 26 institutions invited to participate, at least one response was received from 16 institutions for the faculty survey (61.5%) and 11 institutions for the student survey (42.3%). All institutions with student participants also had at least one faculty participant. All participants were from universities with an affiliated medical school. The median age of students was 26 (IQR, 24.25–29) years old and their median year in training was year 3 (IQR, 3–4.75). The median age of faculty was 50 (IQR, 42–58.5). Table 1 contains other demographic information collected from participants.

In total, 87.8% of all students were either somewhat or very satisfied with the overall educational curriculum at their institution [median Likert-type rating 4 (IQR 4–5)]. Nineteen students (38.8%) and 19 faculty (41.3%) reported that clinical oncology was a component of that curriculum. Among those students whose curriculum contained clinical oncology, 84.2% were either somewhat or very satisfied with the clinical oncology component of their curriculum [median Likert-type rating 4 (IQR, 4–5)]. Medical oncologists were involved in teaching clinical oncology for 78.9% of students, followed by surgical oncologists (73.7%), PhD/scientists (68.4%), radiation oncologists (63.2%), and pathologists (52.6%). Thirteen students (26.5%) reported having a clinical oncologist on their graduate advisory committee, and 21.7% of faculty felt that most PhD students studying cancer at their institution had a clinical oncologist on their graduate advisory committee.

The types of experiences students and faculty reported as being components of their curriculum are shown in Fig. 1. Faculty reported lower incidences of most experiences than did the students, although “lecture(s) on clinical oncology research topic(s),” and “journal club(s) on a clinical oncology topic” were most common. Among the subsets of students who had each of these experiences as part of their curriculum, the median quantity of exposure for each was: 3 lectures on principles of patient care (IQR, 2–6), 4 lectures on a clinical oncology research topic (IQR, 3.25– greater than 10), 6 journal clubs on a clinical oncology topics (IQR, 4–10), 20 grand rounds attended (IQR, 11–33.25), 15 multidisciplinary tumor board conferences attended (IQR, 3.5–35), and greater than 10 hours of clinical rotation(s)/shadowing a physician in clinic (IQR, 8–greater than 10). A total of 61% of faculty believed that students at their institution had 10 or fewer hours of clinical

oncology education over the course of their PhD program, while 15.2% did not know how much clinical oncology exposure students received. Twenty-one students (42.8%) believed that they had a good understanding for translating basic science research into clinical practice [median Likert-type rating 3 (IQR 2–4)]. However, 76.1% of students and 78.3% of faculty believed that students in a dual degree MD/PhD program had a better understanding for translating basic science research into clinical practice than students pursuing a PhD alone [median Likert-type rating 4 (IQR, 3–5) and 4 (IQR, 4–5), respectively].

All students and 98% of faculty thought that there should be some clinical oncology education as part of a PhD program; however, their perception of the most appropriate number of hours of clinical oncology exposure over the course of the program varied considerably. Twenty-eight percent of faculty and 24% of students felt that there should be greater than 20 hours, whereas 28% of faculty and 38% of students felt that there should be 11 to 20 hours, and 41% of faculty and 34% of students felt that there should be 1 to 10 hours. Table 2 shows student and faculty ratings of different types of clinical oncology exposure in terms of their perceived value to PhD training. Statistically significant differences between the faculty and student views were found for most of the experiences, with faculty consistently giving lower ratings than students throughout. “Lecture(s) on clinical oncology research topic(s)” was considered most useful by both groups, followed by “working with a clinician to develop a clinical trial with correlative endpoint(s).” Students and faculty concurred that years 2 to 4 of PhD training is the time when clinical oncology education would be more efficacious, although smaller percentages felt that it could be incorporated at any point.

Discussion

One of the major challenges in oncology is effectively facilitating cross-training between its separate but related disciplines. Integrating the basic science and clinical research communities in particular is of increasing importance, as funding for biomedical research is limited, and rapid translation of discoveries into clinical practice is essential to improve patient outcomes (4). In 2008, CABTRAC published initial guidelines for PhD training in cancer biology, which recommended that cancer biology training programs provide a bridge between the fundamental biology of cancer and clinical cancer care (1). It was suggested that this may be achieved through students’ attendance at tumor boards, observing cancer clinicians manage patients, or engaging in clinical trial development. An update in 2015 also suggested development of formal seminar series and curricula to bring together cancer center members, along with dual mentoring between a “traditional” biomedical research mentor and a physician mentor (2). However, to our knowledge, the current study is the first to attempt to better characterize how PhD candidates in the United States are actually exposed to clinical oncology, or to evaluate faculty and student perceptions of effective methods for clinical oncology training. We have found that although consensus exists on the importance of clinical oncology in a PhD candidate’s curriculum, only 40% of programs actively pursue it, and those that do may not be fully integrating the educational components of research and clinical disciplines in optimal ways for the students. On the basis of our findings, we would offer the following recommendations:

1. Invite clinicians and students to participate in curriculum development. Basic science faculty appeared to have somewhat more negative views on clinical components of education than did students. Interprofessional involvement in curriculum development may lead to greater balance. Clearly, the primary focus of a PhD program is to achieve scientific and experimental rigor, but this does not preclude efficient provision of clinical oncology education as well.
2. Offer students a variety of clinical experiences to avoid burnout or diminishing returns from attending the same style of conference repeatedly. For instance, attendance at tumor board conferences provides a valuable opportunity for students to directly observe decision making on patient management and clinical trial enrollment, but weekly tumor board attendance over multiple years may be too much.
3. Ensure that those clinicians who are involved in teaching PhD students have sufficient background knowledge and productivity in clinical and translational research such that they can share meaningful content with the students.
4. Recruit clinicians to either formally or informally serve as a mentor on students' graduate advisory committee, to provide clinical perspective to the students' dissertation work, but also to facilitate experiential learning opportunities in other forms like collaboration on correlative endpoints of clinical trials, an activity that was rated highly by faculty and students in this study but was relatively uncommon in incidence.
5. Avoid purely clinical education, as may be taught to medical students, as this is less relevant to PhD students than more "applied" clinical information in the context of clinical oncology research topics. Developing a problem-based learning style approach, as is done for medical students, may also help facilitate learning and break down language barriers between clinicians and basic scientists.
6. For PhD training programs lacking a close affiliation with clinicians at a cancer center, partner with programs that do have access to clinicians for shared educational experiences.
7. Institutional leadership should recognize contributions of faculty clinician mentors in non-revenue-generating activities like graduate/professional education. Furthermore, encouraging a medical resident or fellow rotation in laboratory research may enhance the education and communication skills for both clinician and basic science trainees.

The greatest limitation to this study is the self-selection bias inherent to any survey of this nature, in which those who chose to respond, may not be representative of the entire population of students and faculty in the United States. Another potential source of bias in this study is the inclusion only of programs that take part in CABTRAC. One would expect training programs containing CABTRAC leaders to have more robust educational programs, and as such, we would speculate that including only these programs may skew our findings toward a greater extent of clinical oncology exposure than the average school. However, this

may not actually be the case. Finally, this survey only assesses opinions on effective means of clinical oncology education for PhD candidates and did not directly assess the effectiveness of any of the types of experiences discussed nor the influence of the educator.

Laboratory-based researchers benefit from exposure to clinical oncology as much as clinically based care deliverers benefit from updating themselves on advances that will eventually impact patient care. This study has shown that clinical oncology is an underutilized component of PhD education. Clearly, a customized approach for delivering this content to students is appropriate based on available resources at different institutions, but by highlighting specific areas in need of improvement and identifying preferred approaches, we hope to facilitate a more collaborative process with the ultimate goal of facilitating high-quality translational research and improving patient outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Torti FM, Altieri D, Broach J, Fan H, Lotze M, Manfredi J, et al. Ph.D. Training in cancer biology. *Cancer Res.* 2008; 68:9122–4. [PubMed: 19010881]
2. Welch DR, Antalis TM, Burnstein K, Vona-Davis L, Jensen RA, Nakshatri H, et al. Essential components of cancer education. *Cancer Res.* 2015; 75:5202–5. [PubMed: 26627010]
3. Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of internet E-surveys (CHERRIES). *J Med Intern Res.* 2004; 6:e34.
4. Feldman AM. Bench-to-bedside; clinical and translational research; personalized medicine; precision medicine-what's in a name? *Clin Transl Sci.* 2015; 8:171–3. [PubMed: 26094565]

Figure 1. Percentage of students (black) and faculty (gray) that reported each of the following experiences as being a component of the Ph.D. students' curriculum at their institution: A, lecture(s) on principles of patient care; B, lecture(s) on clinical oncology research topic(s); C, journal club(s) on a clinical oncology topic; D, grand rounds attendance; E, multidisciplinary tumor board conference attendance; F, clinical rotation(s)/shadowing a physician in clinic; G, working with a clinician to develop a clinical trial with correlative endpoint(s); H, community service-oriented patient encounter(s).

Table 1

Participant demographics

Characteristics	Students	Faculty
Gender		
Female	28 (57.1%)	9 (19.6%)
Male	18 (36.7%)	31 (67.4%)
Other/unspecified	3 (6.1%)	6 (13.0%)
Type of institution		
Public	46 (93.9%)	31 (67.4%)
Private	3 (6.1%)	7 (15.2%)
Other/unspecified	0 (0.0%)	8 (17.4%)
Degree(s) completed		
Bachelor of Science (BS)	35 (71.4%)	13 (28.2%)
Bachelor of Arts (BA)	7 (14.3%)	4 (8.7%)
Masters of Science (MS)	7 (14.3%)	7 (15.2%)
Doctor of Philosophy (PhD)	0 (0.0%)	37 (80.4%)
Doctor of Medicine (MD)	1 (2.0%)	6 (13.0%)
Other/unspecified	1 (2.0%)	9 (19.6%)
Students per year in PhD program		
5 or fewer	17 (34.7%)	14 (30.4%)
6 to 20	15 (30.6%)	18 (39.1%)
21 or more	15 (30.6%)	5 (10.9%)
Other/unspecified	2 (4.1%)	9 (19.6%)

Students and faculty were asked to rate the following clinical oncology experiences in terms of how valuable they believe each is to a PhD student's education (1 = not at all valuable, 5 = extremely valuable)

Table 2

	Students			Faculty		
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	P	
Lecture(s) on principles of patient care	2.96 (1.18)	3 (2–4)	2.29 (1.17)	2 (1–3)	0.008	
Lecture(s) on clinical oncology research topic(s)	4.15 (0.90)	4 (4–5)	3.69 (1.00)	4 (3–4)	0.024	
Journal club(s) on a clinical oncology topic	3.55 (1.08)	4 (3–4)	3.02 (1.09)	3 (2–4)	0.016	
Grand rounds attendance	3.32 (1.11)	3 (3–4)	2.78 (1.11)	3 (2–4)	0.028	
Multidisciplinary tumor board conference attendance	3.35 (1.16)	3 (3–4)	3.05 (1.23)	3 (2–4)	0.266	
Clinical rotation(s)/shadowing a physician in clinic	3.40 (1.35)	4 (2–5)	2.65 (1.35)	3 (1–4)	0.013	
Working with a clinician to develop a clinical trial with correlative endpoint(s)	3.96 (1.16)	4 (4–5)	3.17 (1.26)	3 (2–4)	0.002	
Community service-oriented patient encounter(s)	2.57 (1.02)	3 (2–3)	2.28 (1.13)	2 (1–1)	0.173	