

Ethics and professionalism in medical physics: A survey of AAPM members

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Purpose: To assess current education, practices, attitudes, and perceptions pertaining to ethics and professionalism in medical physics.

Methods: A link to a web-based survey was distributed to the American Association of Physicists in Medicine (AAPM) e-mail membership list, with a follow-up e-mail sent two weeks later. The survey included questions about ethics/professionalism education, direct personal knowledge of ethically questionable practices in clinical care, research, education (teaching and mentoring), and professionalism, respondents' assessment of their ability to address ethical/professional dilemmas, and demographics. For analysis, reports of unethical or ethically questionable practices or behaviors by approximately 40% or more of respondents were classified as "frequent."

Results: Partial or complete responses were received from 18% (1394/7708) of AAPM members. Overall, 60% (827/1377) of the respondents stated that they had not received ethics/professionalism education during their medical physics training. Respondents currently in training were more likely to state that they received instruction in ethics/professionalism (80%, 127/159) versus respondents who were post-training (35%, 401/1159). Respondents' preferred method of instruction in ethics/professionalism was structured periodic discussions involving both faculty and students/trainees. More than 90% (1271/1384) supported continuing education in ethics/professionalism and 75% (1043/1386) stated they would attend ethics/professionalism sessions at professional/scientific meetings. In the research setting, reports about ethically questionable authorship assignment were frequent (approximately 40%) whereas incidents of ethically questionable practices about human subjects protections were quite infrequent (5%). In the clinical setting, there was frequent recollection of incidents regarding lack of training, resources and skills, and error/incident reporting. In the educational setting, incidents of unethical or ethically questionable practices were only frequently recollected with respect to mentorship/guidance. With respect to professional conduct, favoritism, hostile work/learning environment, and maltreatment of subordinates and colleagues were frequently reported. A significantly larger proportion of women reported experiences with hostile work/learning environments, favoritism, poor mentorship, unfairness in educational settings, and concerns about student privacy and confidentiality.

Conclusions: The survey found broad interest in ethics/professionalism topics and revealed that these topics were being integrated into the curriculum at many institutions. The incorporation of ethics and professionalism instruction into both graduate education and postgraduate training of medical physicists, and into their subsequent lifelong continuing education is important given the nontrivial number of medical physicists who had direct personal knowledge of unethical or ethically questionable incidents in clinical practice, research, education, and professionalism. © 2013 American Association of Physicists in Medicine. [<http://dx.doi.org/10.1118/1.4797463>]

Key words: ethics, professionalism, ethics/professionalism education

I. INTRODUCTION

Formal recommendations for the inclusion of ethics and professionalism instruction into medical physics graduate programs have evolved over the past two decades, especially for those programs receiving funding from government agen-

cies such as the National Institutes of Health (NIH) or National Science Foundation (NSF) which mandate their inclusion. Although the education and training recommendations for medical physics published by the American Association of Physicists in Medicine (AAPM) in 1993 did not include any recommendations for ethics instruction, the revised and

updated 2002 report entitled “Academic Program Recommendations for Graduate Degrees in Medical Physics” promulgated a core curriculum that included ethics and professionalism.^{1,2} Five main subjects to be taught under the special core topic of “Professional ethics/conflict of interest/scientific misconduct” were specified in the revised report: (1) Data, patient records, measurement results, and reports; (2) Publications and presentations; (3) General professional conduct; (4) Medical malpractice; and (5) Research.² Although the need for a specific course on research and clinical practice ethics in medical physics curricula continued to be debated in the medical physics community,³ the 2002 report served as the basis for accreditation by the Commission on Accreditation of Medical Physics Education Programs (CAMPEP), and its requirements were reaffirmed in 2009 when the report was revised and updated as AAPM Report No. 197.⁴ In 2010, AAPM Task Group 159 published its report on “Recommended Ethics Curriculum for Medical Physics Graduate and Residency Programs.”⁵ This report proposed a list of subjects relevant for the ethics education of medical physicists as well as a curriculum outline detailing each subject (ethical principles and historical perspectives, ethical encounters or dilemmas, professional conduct, clinical practice ethics, research ethics, and education ethics).⁵ In 2011, the American Board of Radiology Foundation, with the support of various professional organizations including the AAPM, developed web-based educational modules on ethics and professionalism issues that arise in the training, research, and practice of radiologists, radiation oncologists, and medical physicists.⁶

This paper describes the results of a 2012 survey of AAPM members that was conducted to assess current practices, attitudes, and perceptions pertaining to ethics/professionalism education as well as ethical/professional challenges, issues, and concerns in research, educational, and clinical settings in the practice of medical physics. The data identify topics that would be of broad interest for existing training programs as well as for continuing education programs.

II. METHODS

A web-based survey was developed for distribution to AAPM members. The survey included questions about ethics/professionalism education, respondents’ experiences with ethically/professionally questionable practices in clinical, research and educational settings, and assessment of their ability to address ethical/professional dilemmas in their current position. Participants were also given the opportunity, in two optional questions, to provide general comments on ethics/professionalism education and to describe an example, whether actual or hypothetical, of ethical/professional misconduct or ethically/professionally questionable behavior that they would like to discuss with colleagues in an ethics session at a scientific/professional meeting (they were asked to maintain the anonymity of the individuals or institutions involved). General demographic information about the respondents including age, gender, training, specialty, and years of experience was also collected. Descriptive statistics were analyzed

and cross-tabulations were performed between individual demographic factors and respondent concerns to determine if there were any issues unique to subgroups of respondents. Logistic regressions were also performed to control for colinearity of demographic factors (e.g., gender, degree, and training level).

The survey was endorsed by the AAPM Ethics Committee and recommended for distribution to the AAPM membership. An initial invitation e-mail sent in January 2012 by the AAPM to members with an e-mail address in the membership database was followed by a second reminder e-mail two weeks later. The sunset date for the survey was specified as four weeks after the date of the initial e-mail, but the survey was kept open until May for late responders.

Responses to the survey were collected anonymously using the Web Link collector of the Internet-based survey tool SurveyMonkey. Respondents were told that their participation was voluntary and anonymous. The University of Chicago Institutional Review Board approved the study with waiver of written consent.

Data analyses were performed using IBM SPSS Statistics, Version 19.0.0 for Mac OS X (SPSS, Inc., Chicago, IL). For analysis, direct personal knowledge of unethical or ethically questionable behaviors or practices reported by approximately 40% or more of respondents was classified as “frequent.”

III. RESULTS

III.A. Demographics

The e-mail link for the survey was sent by the AAPM to 7708 members, and 1394 (18%) members provided partial or complete responses. Respondent demographics are summarized in Table I. Approximately 25% (333/1352) of the respondents were female. The mean age of the respondents was 46.6 years. About half were trained at the doctoral and half at the master’s level. Twelve percent (161/1346) were currently under training as a graduate student, resident, or postdoctoral candidate/fellow. The vast majority of respondents (93%, 1282/1376) did their training in the United States and/or Canada, and 95% (1145/1208) had practiced in the United States and/or Canada at least for part of their professional experience. Respondents who had completed training had an average of 17.4 years of experience. International affiliates who had never practiced in the United States or Canada made up only a small number of the respondents (5%, 63/1208).

III.B. Ethics/professionalism education

Responses to questions about ethics/professionalism education are shown in Table II. Overall, 60% of the respondents (827/1377) stated that they had not received ethics/professionalism education during their medical physics training. Those currently in training were more likely ($P < 0.001$) to have received instruction in ethics/professionalism (80%, 127/159) versus those who were

TABLE I. Respondent demographics.

Demographic	% (n)
Highest degree (N = 1375)	
Masters	48 (659)
Ph.D.	51 (698)
Other	1 (18)
Current training level (N = 1346)	
Trainee	12 (161)
Post-trainee	87 (1172)
Other	1 (13)
Country of training (N = 1376)	
U.S. and/or Canada	93 (1282)
Other	7 (94)
Country of practice (N = 1208)	
U.S. and/or Canada	95 (1145)
Other	5 (63)
Gender (N = 1352)	
Female	25 (333)
Male	75 (1019)
Age (N = 1278)	
Mean = 46.6, Median = 46	
Years of experience (N = 1187)	
Mean = 17.4, Median = 16	

post-training (35%, 401/1159). Among post-trainees, those with 15 years or less of experience in the field were more likely ($P < 0.001$) to have received ethics education (45%, 263/579) than those who had more than 15 years of experience (23%, 138/594).

Among five options presented, the most preferred method of instruction in ethics/professionalism was periodic structured group discussions involving both faculty and trainees (ranked first by 32% of all respondents, 422/1338), with the least interest expressed for a separate course (ranked fifth by 40%, 532/1341). Structured group discussions involving only students/trainees and *ad hoc* seminars, lectures, or workshops were ranked very closely in second and third place, respectively; online modules were ranked bimodally with about one-fourth of the respondents ranking it the highest and one-fourth ranking it the lowest.

TABLE II. Ethics/professionalism education.

Question	Response	% (n)
Did you receive any instruction in ethics/professionalism during your medical physics training? (N = 1377)	Yes	40 (550)
	No	60 (827)
Should ethics/professionalism be a component of continuing education in medical physics? (N = 1384)	Yes, mandatory	44 (612)
	Yes, voluntary	48 (659)
	No	8 (113)
Would you attend workshops or seminars offered during scientific/professional meetings that focused on ethics/professionalism? (N = 1386)	Yes	75 (1043)
	No	25 (343)

Support for continuing education in ethics/professionalism was above 90% (1271/1384), and about half of respondents preferred such education to be mandatory and half voluntary. Support for continuing education was stronger among women (95%, 313/328 vs 91%, 923/1016 for men; $P < 0.05$). 75% (1043/1386) of the respondents expressed interest in attending ethics/professionalism sessions held during professional/scientific meetings.

91% (1254/1385) of the respondents considered themselves moderately-to-very competent to address ethical/professional dilemmas in their current positions.

III.C. Direct personal knowledge of unethical or ethically questionable behaviors or practices

Figure 1 shows the responses to multiple questions that asked whether the respondents had direct personal knowledge of any ethical misconduct or ethically questionable behavior in clinical practice, research, or educational practices; and whether they had direct personal knowledge of any professional misconduct or professionally questionable behavior. Many reported direct personal knowledge of one or more instances of a variety of ethical/professional challenges.

In clinical practice, the two areas in which respondents most frequently reported incidents of unethical or ethically questionable practice or behavior were (1) performing procedures without adequate training, resources, or skills expressed by 46% (572/1247) and (2) error/incident reporting expressed by 38% (479/1255) of the respondents.

In research, authorship assignment was the only issue that was reported frequently (38%, 359/944). Reporting of potentially unethical behavior in human subjects protection in research, confidentiality of research subjects, animal research, and vulnerable populations/subjects were infrequent (3%–7%).

In education (teaching and mentoring), the most frequent report of questionable ethical behavior related to poor mentorship/guidance as expressed by 39% (476/1221) of respondents.

In professional conduct, there was frequent direct personal knowledge of a variety of issues. Favoritism was reported by 41% (546/1320) of respondents, followed by reports of hostile work/learning environment (40%, 540/1332), maltreatment of subordinates (40%, 531/1338), and maltreatment of colleagues (38%, 508/1332).

We performed cross-tabulations between participant report of questionable behavior/misconduct with demographics to determine if any particular factors were of greater significance for one demographic group than another (e.g., gender, highest degree, experience, subspecialty, etc.). A significant difference was found between men and women in their direct personal awareness of unethical or ethically questionable incidents in both education and professional conduct as depicted in Fig. 2 ($P < 0.05$ for all). Proportionally, women expressed greater knowledge than men of cases of hostile work/learning environment (48%, 153/320 vs 38%, 371/975), favoritism (47%, 147/316 vs 39%, 381/967), as well as poor mentorship/guidance (46%, 133/288 vs 37%, 329/898), lack of

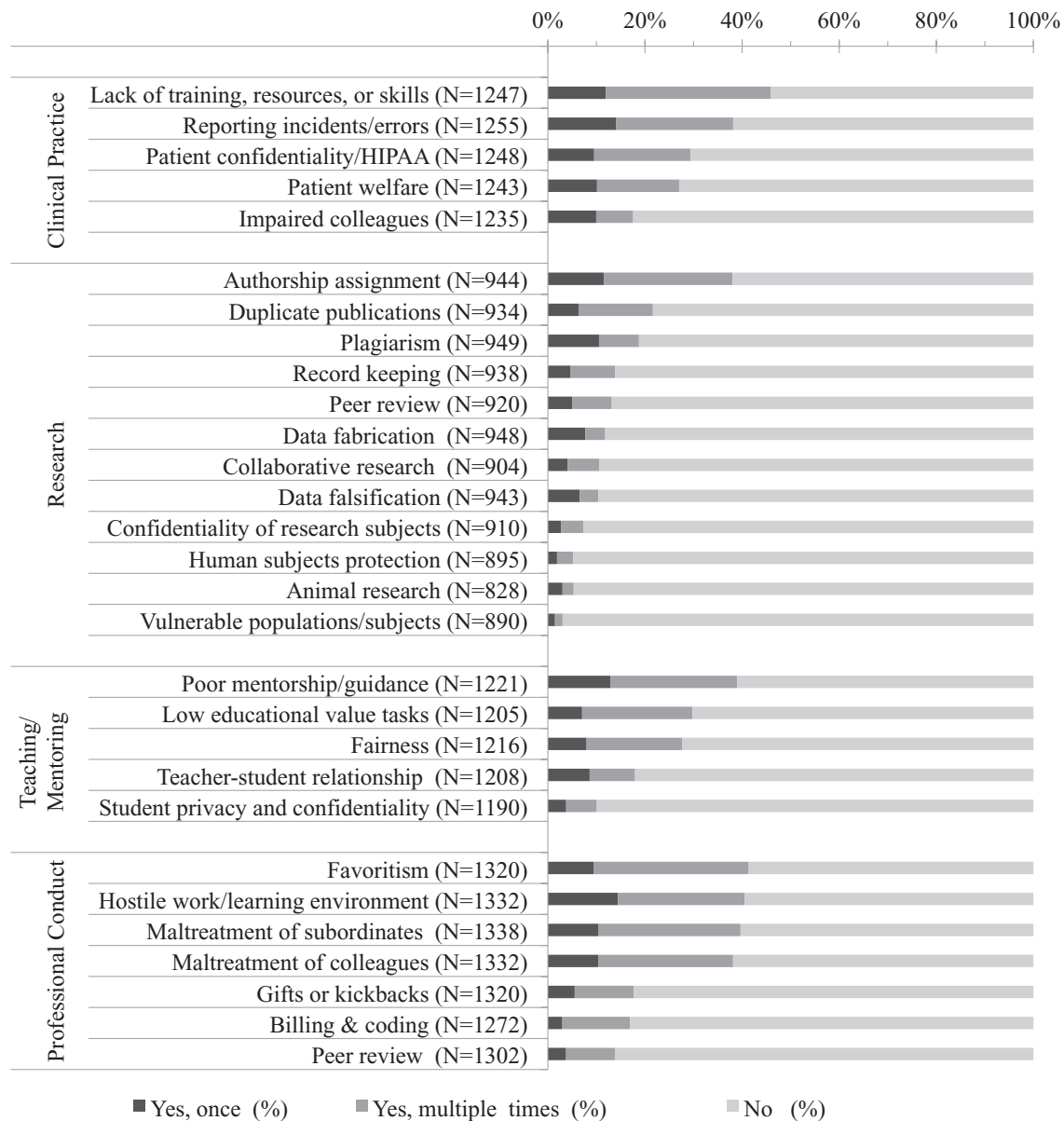


FIG. 1. Responses to multiple questions that asked if the respondents had direct personal knowledge of any ethical misconduct or ethically questionable behavior in (a) clinical practice, (b) research, (c) teaching and mentoring practices, and (d) if they had direct personal knowledge of any professional misconduct or professionally questionable behavior.

fairness in educational settings (33%, 95/289 vs 26%, 228/891), and concerns about student privacy and confidentiality (14%, 40/281 vs 9%, 78/875). Logistic regression was performed with various demographic variables found to be significant on bivariate analyses including gender, highest degree, experience, and certification which showed that the observed differences in these reports were predicted by gender (data not shown).

Two hundred forty-nine responses were received in response to a question that asked the respondents to describe ethically/professionally questionable cases that they would like to discuss with colleagues in ethics sessions during scientific/professional meetings. Responses ranged from brief statements about perceived unethical/unprofessional behaviors (e.g., “research funding attached to major equipment

contracts”) to articulating ethically/professionally challenging cases/scenarios with varying degrees of detail. Top issues reported in the responses were related to patient welfare and safety ($n = 40$ comments), lack of training, resources and skills ($n = 40$), error/incident reporting ($n = 24$), authorship ($n = 23$), maltreatment by colleagues or superiors ($n = 19$), billing ($n = 19$), and work/employment ($n = 15$). Respondents also reported knowledge of issues related to falsification of reports ($n = 12$; mostly related to quality assurance/commissioning work in the clinic), conflict of interest ($n = 12$), professional conduct ($n = 10$), and vendor relations ($n = 10$) in clinical, research, and educational contexts.

One hundred sixty-seven responses were received in response to a question that asked respondents to provide comments on ethics/professionalism education in medical physics

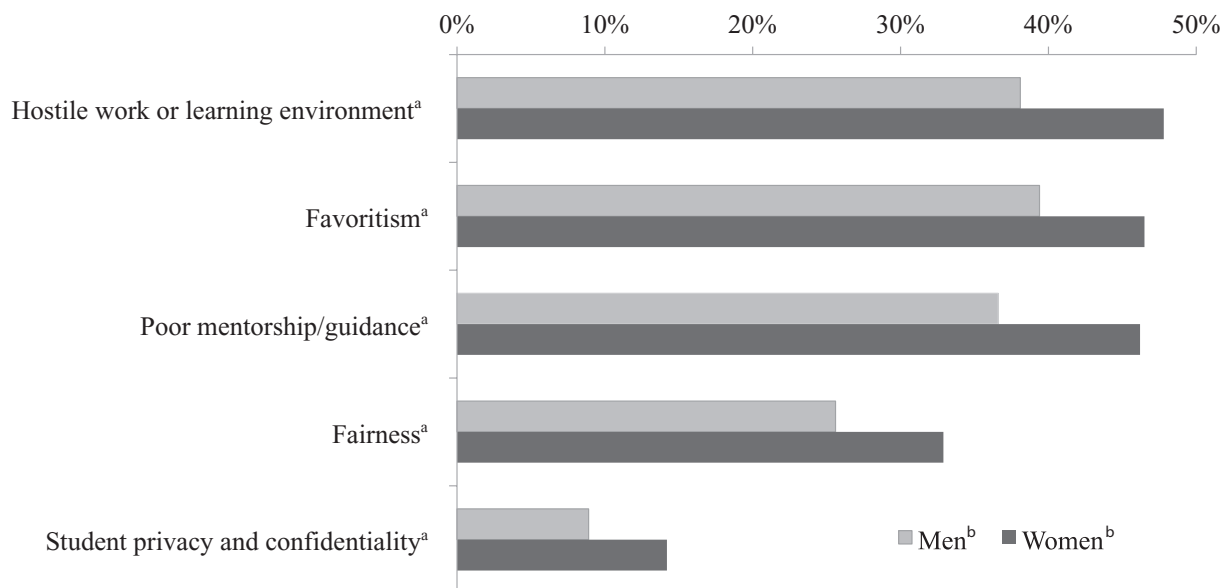


FIG. 2. Gender differences in ethical/professional concerns. Percentages of women vs men who answered “yes” to questions that asked whether they had direct personal knowledge of one or more instances of ethical/professional misconduct or ethically/professionally questionable behavior in various contexts. ^aP < 0.05, ^bN values are different for each category due to nonresponse; minimum values are N = 875 for men and N = 281 for women.

training. Of those, 91 (54%) respondents were in favor of some form of ethics/professionalism instruction, with comments ranging from “absolutely needed” to “would be beneficial,” and 17 respondents (10%) did not favorably view such instruction for various reasons (e.g., ethics is best taught by example).

IV. DISCUSSION

A 2007 survey of 61 medical physics graduate and residency programs in the United States and Canada revealed that only about half of 24 programs that responded to the survey offered formal ethics instruction in various formats (e.g., didactic or online courses, seminars).⁵ A survey of CAMPEP-accredited programs in 2009 found that a higher percentage of the medical physics programs (74% (14/19) of the graduate and 61% (16/26) of the residency programs) that responded to the survey required some form of ethics education.⁵ The number of CAMPEP-accredited residency and graduate programs in medical physics has almost doubled since 2009 (Ref. 7) due to the recent American Board of Radiology (ABR) initiative that requires that one must be enrolled in a CAMPEP-accredited education, certificate or residency program in medical physics to sit for Part 1 and must have completed a CAMPEP-accredited residency program to become eligible for Parts 2 and 3 of the board certification exam.⁸

The present data show that the requirement for ethics and professionalism curricula for CAMPEP accreditation has led to more ethics and professional training among current trainees. Whereas only 40% of the respondents had any formal training in ethics/professionalism overall, 80% of current trainees (graduate students, residents, and postdoctoral candidates/fellows) stated that they received such training. The

actual percentage could be higher, since those early in their training might receive instruction in ethics and professionalism later in their training.

The most recent AAPM Report on Education and Training (Report No. 197) recommends seminar-style ethics instruction using a case-based approach with faculty participation.⁴ The present survey shows that periodic discussions involving faculty and trainees is the method of instruction most favored by the respondents. This finding, combined with strong support (>90%) for continuing education in ethics and professionalism and strong interest (75%) in attending ethics and professionalism sessions held during national meetings, suggests that respondents view ethics and professionalism education not as a one-time isolated event, but rather as a subject that requires continuing education. Concerns raised by the respondents regarding a variety of ethically/professionally questionable practices in clinical, research, and educational settings indicate that the medical physics community should continue to support and expand ethics/professionalism instruction in graduate, residency, and continuing education programs.

Incidents of unethical or ethically questionable behaviors are not unique to medical physics but plague the scientific community at large. For example, in a self-reporting survey of more than 3000 NIH-funded scientists, 33% of the respondents reported that, during the previous three years, they themselves had engaged in at least one of ten behaviors that included falsifying research data, ignoring human subject protection requirements, and failing to present data that contradict one’s previous research, among others.⁹ Furthermore, about 28% of those scientists admitted to inadequate record keeping, 15% to dropping data points that they deemed inaccurate based on a gut feeling, 10% to assigning

inappropriate authorship credit, and 5% to duplicate publications.⁹ A recent systematic review and meta-analysis of survey data on research misconduct showed that on average, about 2% of scientists admitted to fabrication and falsification of data at least once; up to one-third admitted to various other questionable practices.¹⁰ When asked about questionable research practices by others, on average about 14% of the respondents reported observations of fabrication, falsification, and modification of data, and up to 72% reported observations of other questionable research practices by their colleagues.¹⁰ Since self-reports are expected to underestimate the frequency of questionable conduct, it is predicted that misconduct such as data fabrication and falsification as well as other questionable practices in research are more prevalent than suspected.¹⁰

The ethical concerns reported in this survey are informative. In the research setting, frequent awareness of questionable authorship assignment was reported. Respondents also commented *ad lib* about the practice of including more-senior department members who did not make a significant contribution in the authorship list and on the difficulty of facilitating a discussion on authorship for a graduate student or a postdoc who is in a vulnerable position. It might be helpful in this regard if departments/laboratories/research groups developed authorship guidelines, or adopted available guidelines such as the International Committee of Medical Journal Editors (ICMJE) uniform requirements for papers,¹¹ and set policies to discuss authorship issues initiated by supervisors at the initial stages of collaborative work. Similarly, medical physics journals could formally adopt guidelines such as the ICMJE uniform requirements for papers. The ICMJE specifies that all contributors delineate their contribution in an attempt to reduce the issue of over- and undernaming authors.

A promising finding in the research context is the infrequent reports (3%–5%) of unethical behavior regarding the treatment of vulnerable populations, human subjects protection, and animal research and relatively infrequent reports of data fabrication and falsification (10%–12%) and confidentiality of research subjects (7%).

In clinical practice, lack of proper training, skills, and resources was frequently reported. Until recently, medical physics was the only medical specialty that did not require a residency training; physicists traditionally developed their clinical skills working as junior physicists under more experienced physicists.¹² Shortcomings in the clinical training of medical physicists have been recognized for some time,¹³ and steps already have been taken by the medical physics community to address this challenge, such as the new accredited residency requirements for board certification.⁸

A second frequent concern in clinical practice is error/incident reporting, expressed by 38% of respondents. During recent years, papers on errors and accidents that caused serious adverse effects on radiation patients focused the attention of the public as well as professional organizations on safety in the delivery of radiation treatments.¹⁴ In a review of radiotherapy errors worldwide, the World Health Organization (WHO) estimated that between 1976 and 2007 adverse events due to errors in radiotherapy affected 3125 pa-

tients worldwide, leading to 38 deaths secondary to radiation overdose.¹⁵ Radiotherapy errors could potentially lead to serious adverse outcomes, but available data seem to indicate that most errors are minor incidents without serious clinical consequences.¹⁶ Error rate in radiotherapy is thought to be comparable to the rate of other medical errors,^{15,17} though there are also estimates that suggest it may be higher than the error rates in some areas of medicine.¹⁸ In reality, actual error rate in radiotherapy is difficult to know due to lack of data;¹⁹ although it has been suggested that available data most likely underestimate the actual rate as many errors/incidents might not be discovered and/or reported.²⁰ In a recent survey of radiotherapists and dosimetrists, 12% of the respondents stated there was not a system in place for reporting errors in their clinic.²¹ Although a majority of the respondents (about 90%) stated they were encouraged to report errors, they also had issues reporting errors and cited fear of reprimand, poor communication, and hierarchical structure as major obstacles to reporting errors.²¹ Recent efforts by various professional organizations toward a safer radiotherapy environment emphasize the importance of moving from a culture of blame to a culture of safety. A nonpunitive incident reporting system to facilitate learning from mistakes and a collaborative, as opposed to a top-down hierarchical, environment where all members of the radiotherapy team are encouraged and empowered to contribute to improving the process of care are important elements of a culture of safety.²² Some of the comments in the present survey point to hierarchy in the clinic as a barrier to incident/error reporting. More educational efforts will be needed to realize the paradigm shift from a culture of blame to a culture of safety in the radiotherapy clinic.

In the education domain, direct personal knowledge of poor mentorship was frequently reported. Effective, high-quality mentoring is important at every stage of education and training from undergraduate through postdoctoral levels.²³ In a study of the misconduct cases involving trainees, the Office of Research Integrity (ORI) found that three-quarters of the mentors had not reviewed the source data and two-thirds had not set research standards.²⁴ It has been suggested that effective and close mentoring is essential to address the issue of research misconduct and misbehavior and that the quality of mentorship should be a factor in the evaluation of training grants for funding.²⁵ Women reported greater awareness than men with regard to poor mentoring (Fig. 2). Such findings are not unique to medical physics; lack of or limited mentoring support is often cited as one of the constraints for the advancement of female healthcare professionals in academia and clinic.^{26–28}

In the area of professional conduct, nearly 40% of respondents complained about favoritism, hostile work/learning environment, and maltreatment of subordinates and colleagues. Proportionally, women expressed greater direct personal knowledge than men of instances of hostile work/learning environment and favoritism (Fig. 2). These issues are seen in other healthcare fields as well with women reporting greater exposure to gender discrimination and harassment in educational, academic, and clinical contexts.^{26,28–31}

One limitation of our study is that we may be overestimating misconduct/misbehavior because our respondents reported on their cumulative experiences and not on experiences that occurred within a particular time frame. This limitation also prevents a direct comparison with available data from other healthcare/biomedical fields. There is also the possibility that multiple people are reporting on the same particular instance of questionable conduct at a given institution. Even with these caveats, certain questionable practices were frequently reported (where “frequent” is defined as being reported by approximately 40% or more respondents) to suggest that the problems are real and must be addressed. A second limitation is our low response rate (18%). Although this is a good response rate for surveys distributed in this manner and the demographics of our respondents are similar to the AAPM membership as a whole,³² there may be biases regarding who elected to participate in the survey.

V. CONCLUSIONS

The present survey found broad interest in ethics/professionalism topics and revealed that these topics were being integrated into the curriculum at many institutions. The incorporation of ethics and professionalism instruction into both graduate education and postgraduate training of medical physicists, and into their subsequent lifelong continuing education is important given the nontrivial number of medical physicists who had direct personal knowledge of unethical or ethically questionable incidents in clinical practice, research, education, and professionalism.

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