POINT/COUNTERPOINT

Suggestions for topics suitable for these Point/Counterpoint debates should be addressed to Colin G. Orton, Professor Emeritus, Wayne State University, Detroit, MI: ortonc@comcast.net. Persons participating in Point/Counterpoint discussions are selected for their knowledge and communicative skill. Their positions for or against a proposition may or may not reflect their personal opinions or the positions of their employers.

Bright young physicists should be advised to avoid careers in radiation therapy

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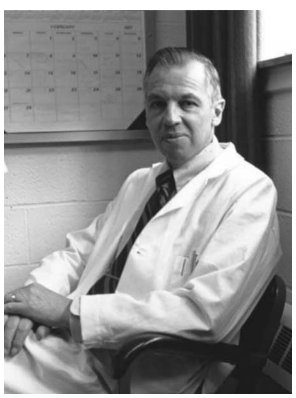
OVERVIEW

Many physicists who entered the radiotherapy field 30–40 years ago were told that their careers would be short lived because developments in genetics and chemotherapy would soon make radiotherapy obsolete. Since then, the number of physicists specializing in radiotherapy has increased about tenfold, so these doom-and-gloom forecasts were flawed. However, recent progress in genetic understanding of cancer and its treatment and prevention has caused some to believe that the heyday of radiotherapy is over, and that young medical physicists should consider careers in other subspecialties. This is the premise debated in this month's Point/Counterpoint.



Arguing for the Proposition is Robert J. Schulz, Ph.D. Dr. Schulz is a charter member and Fellow of the AAPM, Fellow of the ACR, and Diplomate of the ABR. His professional career began at Memorial Sloan-Kettering (1952–1956), developed further at the Albert Einstein College of Medicine (1956–1970), and concluded at Yale University (1970–1992) from which he retired as Emeritus Professor. His major contributions have been in radiation dosimetry, having chaired the SCRAD and TG-21 committees and twice been a recipient of Farrington Daniels Awards.

Arguing against the Proposition is Matthew B. Podgorsak, Ph.D. Dr. Podgorsak joined the faculty of Roswell Park Cancer Institute (RPCI) in 1993 and has been Chief Physicist in the Department of Radiation Medicine since 1998. He serves as Associate Professor in the Department of Biophysics in RPCI's Graduate Division of the State University of New York. Dr. Podgorsak earned his doctorate in medical physics from the University of Wisconsin, Madison, in 1993. He is Board-Certified in Radiation Oncology Physics by the American Board of Medical Physics and is licensed by the State of New York to practice Therapeutic Medical Physics. Dr. Podgorsak has served on the AAPM Board of Directors and currently is a member of the Development Committee and the Meeting Coordination Committee, where he is Chair of the Education Program subcommittee. Dr. Podgorsak is Director of RPCI's Medical Physics Residency and Medical Dosimetry Training Programs.

FOR THE PROPOSITION: Robert J. Schulz, Ph.D.

Opening statement

From a casual reading of Scientific American, it is clear that bright young physicists have innumerable opportunities to contribute to the advancement of science and industry as well as medical research. Therefore, it should come as no surprise that many are attracted to apply their unique skills to enhancing the cure rates of radiation therapy (RT). However, before making such a commitment, which would take them far outside the mainstreams of physics research, a few observations about cancer treatments and RT, in particular, may be enlightening.

As for cancer treatment, consider that surgical excision of tumors goes back over 200 years, that John Adams' daughter had a mastectomy in 1811,[1] that the first radical prostatectomy was performed in 1904,[2] and that to this day surgery remains the first treatment for upwards of 70% of all cancers.[3] Similarly, consider that the irradiation of tumors began about a century ago, and that RT is still one of the mainstays of cancer treatment. Although both surgery and RT have undergone major technical refinements, their basic rationales remain unchanged: For surgery, excise tumors, leaving no positive margins; for RT, irradiate the tumor until the fraction of surviving malignant cells is reduced to the point where, for whatever reasons, they no longer pose a viable threat to the patient's well being. As for clinical progress, mortality (deaths per 100 000) for all cancer sites decreased from 205 in 1975 to 195 in 2004, and the 5 year relative survival increased from 50% to 66% over this same period.[4] More often than not these gains can be attributed to multimodality treatments consisting of surgery supplemented by pre- or post-op RT plus adjuvant chemotherapy. Without doubt, future gains will come from improved chemotherapeutic agents and earlier tumor detection as opposed to technical refinements in surgery or RT.

One of the major contributions of physicists to RT has been the improvement of dose distributions, i.e., shaping, intensity modulating, and directing x-ray and charged-particle beams so as to more uniformly irradiate tumors while minimizing the dose to surrounding normal tissues. Despite the potential advantages of proton and carbon-ion beams,[5] however, there is a dearth of clinical data to suggest that *further* refinements to the dose distributions already provided by modern x-ray systems will have a detectable impact on mortality or morbidity. The main reason for this is that nine out of ten cancer deaths are attributable to metastases[6] even when local control of the primary has been achieved.

Clearly, the future of physicists in RT depends upon the future of that medical specialty. As with surgery, all available evidence suggests that RT has gone about as far as it can in reducing cancer mortality, and that only minor reductions in morbidity associated with aggressive treatments may now be achieved. This is not to suggest that RT will soon be replaced but only that its role will gradually but steadily diminish, to be replaced by drug-based therapies. As this inevitable transition proceeds, RT physicists will morph into system engineers, concerned mainly with overall quality assurance while looking over their shoulders as biological solutions are found to what are basically biological problems.

AGAINST THE PROPOSITION: Matthew B. Podgorsak, Ph.D.

Opening statement

I interpret the Proposition to assert that aspiring young physicists can somehow have their full potential quantified through a "brightness" scale and that those at the high end of the scale should not consider a career in radiation therapy physics. Presumably, their exceptional academic talents would be wasted were they to become radiation therapy physicists, and other branches of medical physics or even other physics specialties would better satisfy their career aspirations.

I reject this elitist assertion for the following two reasons. First, there are many illustrious members of our radiation therapy physics profession, my opponent included, who have distinguished themselves not only in clinical practice but also in academics through research, teaching, and authorship of textbooks. Simply reviewing the list of authors in this edition of *Medical Physics* and reflecting upon our own mentors or perusing our personal bookshelves will remind us of many others that enjoy inclusion in the category of great leaders. Second, opportunities for exceptional academic contributions, paralleling those achieved by our senior colleagues early in their careers, continue to develop as the technology of delivering radiation therapy evolves. In fact, the recent renaissance of radiation therapy technology has been driven largely through contributions made by our academically oriented colleagues. There is no reason to believe that these opportunities will cease to be available to our young colleagues any time soon. While my opponent has recently questioned the clinical impact of some new technologies,[7] whether or not any future modalities or treatment paradigms yet to be discovered will have any impact on a patient's treatment outcome remains unclear. This question, however, is not being debated in this exchange.

I believe that physicists with strong academic aspirations, rather than being discouraged from entering radiation therapy, should instead be advised to begin their career in large, academic centers rather than in small radiation therapy clinics. It is at academic centers where our young colleagues will be empowered to follow their academic aspirations and make significant contributions to our field. Are we to suggest that only those physicists with lesser brightness should be encouraged to join the field of radiation therapy and drive its future evolution? I think not!

I am a second generation radiation therapy medical physicist with approximately 15 years of clinical and academic experience. Although work and professional life have been very challenging at times, I can honestly say that I have enjoyed immensely most aspects of my career, and I would not hesitate to encourage my children or any aspiring young physicists to consider choosing a similar path for their own future. From a purely pragmatic point of view, the need for therapy physicists will continue to increase for the foreseeable future. With a balance of clinical responsibilities and protected time for academic work, I believe that physicists can find gainful employment in radiation therapy. Their clinical work will be coupled with an opportunity to satisfy their academic goals and they will benefit society and enjoy excellent job satisfaction through their clinical and academic efforts.

Rebuttal: Robert J. Schulz, Ph.D.

In his opening statement Dr. Podgorsak suggests that because I used the term "bright young physicists," I must have a brightness scale in mind, and that those at the top of this imaginary scale should avoid careers in radiation therapy. Let me state unequivocally that this brightness scale is news to me, and that my opening statement is aimed at *all* physicists who are on the verge of making decisions that will affect their careers.

Unfortunately, Dr. Podgorsak did not address the main points I raised in my argument. These are that the efficacy of radiation therapy has reached a plateau, further improvements in dose distributions and dose delivery will have an undetectably small impact on patient outcomes, and the role of radiation therapy, and of surgery as well, will be gradually eclipsed by new and better drug therapies that result from basic biological and clinical research. These points accepted, then young physicists who enter radiation therapy today could very well, in 20 years time, find their radiation oncologist colleagues dispensing drugs far more often than approving treatment plans while they (the physicists) devote more of their time to conducting evermore demanding quality assurance programs for a steadily diminishing number of radiation therapy patients.

In closing, one caveat: At the moment radiation therapy seems recession proof, and a well-paying job is very attractive compared with no job at all. But as budgets are inexorably reduced, the Centers for Medicare & Medicaid Services (CMS) will have to make more evidence-based decisions for its reimbursement rates than it has in the past. Evidence showing that the outcomes of proton-beam therapy are superior to those of IMRT or that those of IMRT are superior to those of 3D-CRT is at best shaky or at worst nonexistent.[8–10] This does not bode well for further research on dose distributions and dose-delivery systems or for the future of physicists in radiation therapy.

Rebuttal: Matthew B. Podgorsak, Ph.D

I agree that radiation therapy will be superseded by other clinical approaches and ultimately be documented in medical history as "the best available treatment of the time," much like the craniotomies and bloodletting used to treat some of our ancestors' afflictions. Where we disagree is on the time line and what to do as we wait.

We have two choices. The first is to simply accept *status quo* in anticipation of the development of a new treatment paradigm at some point in the future. The second, and the choice I advocate, is for our profession to continue striving to improve radiation dose delivery, either through better targeting or by implementation of more efficient radiation beams and techniques. As my opponent states, a large scale improvement in tumor control is unlikely. However, most clinicians will nevertheless acknowledge the benefit of conforming dose according to biological need, consequently resulting in improved clinical outcomes through fewer treatment-related sequelae. These further refinements will require the dedication and significant talent of our upcoming junior colleagues. Improving our patients' quality of life is certainly worth the effort.

If our senior peers had accepted *status quo* just a few short years ago, we may have never experienced IMRT, image guidance, increased access to proton therapy, and other modern approaches that have benefited so many of our patients. We must remember that these techniques, considered state of the art right now, are recent developments for which we have our academically inclined colleagues to thank. As our senior leaders retire, I look forward to working with aspiring young physicists as our profession continues to evolve and treatments are further refined. Patients will continue to appreciate our efforts, even as we wait for "the next best thing." If we give up now, who knows what potential developments on the horizon may never come to be.

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