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The professions of Medical Physics and Clinical Engineering should be combined into a single profession “Clinical Science and Technology”

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OVERVIEW

In North America, Medical Physics and Clinical Engineering are two separate professions, represented by different professional and scientific organizations, and different departments in hospitals and universities. In other parts of the world, however, especially in Europe, these two professions are represented by combined professional and scientific organizations and single departments. It has been suggested that the professions of Medical Physics and Clinical Engineering should be combined into a single profession “Clinical Science and Technology,” and this is the premise debated in this month’s Point/Counterpoint.

Arguing for the Proposition is Wilhelm J. M. van der Putten, Ph.D. Dr. van der Putten was awarded an M.Sc.(Eng) degree in Applied Physics from Eindhoven University of Technology (The Netherlands) in 1980. After National Service, he subsequently moved to Ireland where he was awarded a Ph.D. from Trinity College Dublin in 1987. Since then, he has worked in all areas in medical physics in both Ireland and Canada. He has been in Galway since 1995, where he developed a department of medical physics and bioengineering from scratch. The department covers radiotherapy, medical imaging, radiation protection as well as clinical instrumentation. He is currently Chief Physicist in Galway University Hospitals and Associate Professor of Medical Physics in the National University of Ireland, Galway. He is currently Chair of the Professional Matters Committee of EFOMP. He is a Fellow of both the Institute of Physics and Engineering in Medicine (UK) and the Canadian College of Physicists in Medicine. He is a consultant to the IAEA.

Arguing against the Proposition is Chadd E. Smith, Ph.D. Dr. Smith received his Ph.D. in Physics from Johns Hopkins University in 2002 for his work in high-energy physics involving a search for supersymmetric particles at Fermilab. After four years of postdoctoral research at the University of Illinois at Chicago, he completed two years in the medical physics residency program at the University of Michigan in 2008. He is currently a Senior Associate Physicist and Associate Director of the newly CAMPEP-accredited Medical Physics Residency Program at the Henry Ford Health System in Detroit. He is the current President of the AAPM Great Lakes Chapter.

FOR THE PROPOSITION: Wilhelm J. M. van der Putten, Ph.D.

Opening Statement

Medical Physics is a branch of Applied Physics which is the study of physics and physical methods in all branches of science, engineering, and technology. Medical physics is the application of physics and physical methods to problems in the field of medicine. Applied physics and ipso facto medical physics are thus closely related to engineering.

Engineering in turn is the discipline dealing with the art or science of applying scientific knowledge to the design,
building, and use of machines. As such, clinical engineering is the application of engineering principles and technology to medicine and medical devices.

It is clear that both applied physics and engineering do not exist in a separate environment but that there is a continuum in science and technology with “pure” engineering on one side and applied physics on the other. These two apparent extremes are linked through the use of equipment and technology. The “physics” side may concern itself with knowledge obtained through modeling and measurements using technology and instrumentation whereas, in contrast, engineering typically concerns itself with the actual technology in use. In order to properly support the entire spectrum of medical technology in a hospital, it should be apparent that knowledge from the whole continuum ranging from medical physics to engineering is required.

Having established that medical physics and clinical engineering are different only to a degree and that, in fact, most medical physicists and clinical engineers utilize principles from both areas in their everyday work, it is useful to consider where these two disciplines are applied in health care. Currently, medical physics appears to have limited itself almost exclusively to the use of ionizing radiation in medicine. For example, about 107 AAPM reports relate to the use of radiation in medicine, whereas only 19 are in topics such as MR and ultrasound and fewer still in other areas of medical physics. In practice, this means that medical physics is typically confined to radiology or radiotherapy departments. This implies that large areas of medicine are not supported by medical physics.

This arrangement of separate departments and narrow focus was considered adequate in the past. Rapid advances in health care technology, however, require now a broad scope of knowledge from other disciplines. Examples of this are biologically based radiotherapy treatment planning, molecular imaging, and an increasing pervasiveness of information technology with patient-connected devices.

Medical physics will in the future have to become involved in areas such as nanotechnology, molecular biology, and genetics if it is not to whither on the vine. This will increasingly require individuals with different education, knowledge, and skills compared that of the “traditional” medical physicist or clinical engineer. Boundaries between professions will disappear. Medical physics and clinical engineering should broaden their perspectives and be combined in a single profession, that of Clinical Scientist. If this does not happen, the profession of medical physics will be in trouble.

AGAINST THE PROPOSITION: Chadd E. Smith, Ph.D.

Opening Statement

For medical physicists in the United States and Canada, the proposal to form a combined profession with Clinical Engineering may seem a foreign concept. In fact it is. Literally, in the United Kingdom and parts of Europe, the two disciplines often share academic departments, professional bodies (the Institute of Physics and Engineering in Medicine and the Institute of Physics and Engineering in Medicine), and coordinated training schemes such as the Modernising Scientific Careers programs in the United Kingdom. Even on this side of the pond, there exist commonalities between the two fields that could be leveraged. Yet an attempted merger would ignore fundamental differences in the roles each play in healthcare, dramatically reverse recent developments in training and certification, and create confusion for the public and practitioners.

Physicists are from Venus, engineers are from Mars

How clinical engineers and medical physicists self-identify provides insight into the subtle distinctions between them. “A clinical engineer is a professional who supports and advances patient care by applying engineering and managerial skills to healthcare technology,” whereas the “essential responsibility of the Qualified Medical Physicist’s clinical practice is to assure the safe and effective delivery of radiation to achieve a diagnostic or therapeutic result as prescribed in patient care.”

Both professions require similar skills and responsibilities for management of the technology utilized in patient treatment. The essential difference is that the physicist assumes additional responsibility in the actual care of the patient. Treatment planning and evaluation, quality assurance, and chart review have no counterparts in clinical engineering. Subspecialization into “physicist” or “engineer” roles would likely continue even within a combined academic or clinical department.

Diverging pathways

The career pathway for medical physicists is asymptotically approaching that of our physician colleagues. The so-called “2014 Initiative” introduced changes to board certification eligibility that have driven CAMPEP accreditation of medical physics residency programs and altered the landscape of pathways into the field. The AAPM Work Group on Coordination of Medical Physics Residency Programs has created the Common Application Program in order to ease the application process for both applicants and programs, as a first step toward a system similar to the National Resident Matching Program. In the future, graduate degrees in medical physics could come to be viewed as the equivalent of medical school, thus completing the parallel with physician training.

What is in a name?

Adoption of the umbrella term “Clinical Science and Technology” would result in the equivalent of “brand dilution” for medical physics. The meaning of “medical physicist” is well-established in the public consciousness, while uncertainty over terms such as “biomedical engineer” and “clinical engineer” persists. Earlier this year, the Association for the Advancement of Medical Instrumentation “Future Forum” recommended a new, official name for the field—“healthcare technology management”—yet this has introduced even greater confusion.
Medical specialties are also grappling with issues of organization and subspecialization. Proper recognition of specific training and skills must be balanced with perceived patient benefit, issues of professional image, clinical need, and market forces. Emerging cross-disciplinary subspecialties have employed bridges across specialties and avoided shoehorned integration. As Cassel and Reuben noted regarding proliferation of specialties in internal medicine, “a proliferation of specialties with inadequate justification may simply confuse the public without creating a social good.”

Rebuttal: Wilhelm J. M. van der Putten, Ph.D.

A physicist in my department plans procedures, calibrates his equipment, ensures quality assurance of devices and reviews charts and vital signs of patients during treatment. He is not a radiotherapy physicist but works in the intensive care unit. The activities mentioned by Dr. Smith are obviously not uniquely related to ionizing radiation. Some people call this clinical engineering. However, what is important is not what it is called but the level of professionalism applied to the task. The definition of a professional encompasses many things, but amongst the more important ones are an ability to deal with complex and uncertain situations’ and the requirement to reflect on ones actions and decisions.

Dr. Smith contends that career paths are diverging because the education/training of medical physics is converging to that of physicians. The fact that medical physicists in the United States are certified by the Board of a specific medical specialty as well as economic factors may be the reason. In fact, this might actually not be a good thing as it can be argued that this will force medical physics into a scientific cul-de-sac! Medical Physicists should be first and foremost physicists and not physicians.

If we accept that medical physics as a science is applicable in all areas of medicine and that there is considerable overlap with clinical engineering, then a name change is appropriate. Finally, no one is an expert in all areas of medical science and technology. It is now well recognized that even in radiotherapy a medical physicist will require significant knowledge of other areas of medical technology such as imaging, information technology and possibly others in the future. Dr. Smith mentions subspecialization and the existence of bridges between these. Such bridges will have to be built between all areas which apply physics and technology to health care. Medical physics and clinical engineering can be used to great effect in the whole spectrum of medicine.

The current job demarcation is an artificial one which does not benefit the professions and certainly does not benefit patients or the organizations for which these professionals work.

Rebuttal: Chadd E. Smith, Ph.D.

I concede that medical physics and clinical engineering are “different only to a degree.” The fact remains, however, that they are not the same. Physics and Chemistry were classically intertwined but today are separate branches of science incorporating vastly different training and application. Similarly, Radiology and Radiation Oncology originated as a single discipline yet emerged as distinct specialties in the late 1960s and early 1970s as the scope of knowledge and clinical practice expanded.

Medical physics may have “limited” itself to the therapeutic and diagnostic use of ionizing and nonionizing radiation, but it has also carved out a distinct and important role in patient care. Clinical engineering has done the same. These roles must be allowed to develop organically and should not be artificially manipulated.

Medical physics is continually expanding its horizons. This has been achieved through cross-collaboration with other disciplines (such as molecular biology, gene therapy, etc.) rather than mergers or assimilations. While large areas of medicine may remain untapped by medical physics, these are already supported by clinical engineers, vendor service engineers, biologists, or existing medical staff with completely different backgrounds and training. The fact that medical physics and clinical engineering developed independently is a strong indication that combining the two is neither desirable nor advantageous to those in either profession.