It is important that medical physicists be involved in the development and implementation of integrated hospital information systems

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OVERVIEW

It is becoming increasingly difficult to operate a hospital without an integrated hospital information system (HIS) that streamlines the collection, management, and distribution of information necessary for health professionals to function efficiently. Such electronic data processing systems are used to manage information from such diverse sources as laboratories and radiology departments. Laboratories typically do not have staff that is highly knowledgeable about data collection and exchange. On the other hand, radiology departments often have medical physicists experienced in managing PACS systems, and it has frequently been these medical physicists who have evolved into local HIS experts. Some hospitals realized the importance of hospital information systems early on and employed dedicated medical informatics specialists for the development and implementation of their information systems. In these hospitals, medical physicists have often been only marginally involved in information technology, and some have suggested that this marginal involvement is detrimental to our profession. They have recommended that medical physicists should spend more time and effort developing their expertise in medical informatics so as not to relinquish this responsibility. Others have suggested, however, that medical physicists do not, and should not, take on these extra duties because they have neither the training nor the time for such endeavors. This controversy is the topic of this month’s Point/Counterpoint debate.

Arguing for the Proposition is George C. Nikiforidis, Ph.D. Dr. Nikiforidis received his Laurea in Physics and his M.Sc. in Atomic and Nuclear Physics both from the University of Milan, Italy in 1973 and 1980, respectively. He received the Ph.D. in Medical Physics from the University of Patras, Greece in 1981. He is currently Professor of Medical Physics and Director of the Department of Medical Physics at the University of Patras, where he is also the Dean of the School of Health Sciences and director of the postgraduate course on Medical Physics. He has been the principal investigator or been involved in a variety of national or European research and development projects.
FOR THE PROPOSITION: George C. Nikiforidis, Ph.D.

Opening Statement

Hospital information systems have become key elements of the infrastructures of modern hospitals in the developed world. Their role in a hospital’s main function of providing health services is twofold: they act both as a tool for managing the entire spectrum of activities within the hospital organization, and as mechanism for integration of newly acquired data and knowledge into clinical routines.1–5 With regard to the former, a medical physicist (MP) has little to contribute. Information technology scientists are natural protagonists in fields where technological development in hardware and software is so rapid. The latter, however, forms a new dimension of development for an HIS. Its dynamic character lies in the process of continuously including new types of data emerging from new diagnostic methodologies. This continuous updating of HIS constitutes a challenge for modern medicine. First, technological advances offer the opportunity to perform diagnostic examinations at increasingly subtle levels of pathology; from the organism to the tissue, the cell and—nowadays—the molecule. Extrapolating present trends, it is quite probable that in the ensuing years a diagnostic procedure might simultaneously include data originating, for example, from multislice CT, PET, microarrays, and proteomics.6,7 Second, a new need is formed for combining data optimally and maintaining a holistic approach to clinical problems. Approaching the clinical problem from diverse diagnostic aspects should strengthen our perception of the problem at hand without leaning towards technological fetishism.

Medical physicists can play significant roles in this framework. Their firm scientific knowledge of the physical principles of data acquisition from a number of diverse diagnostic modalities (making use of ionizing as well as nonionizing radiation) can assist them not only in filtering out sources of noise convolved to the measurements, but also in bringing out the additional value of specific diagnostic methodologies over others.8 As the hospital environment becomes more molecular, new entities such as microarrays and molecular imaging are emerging. The fragmentary character of information calls for integrative initiatives that will combine the scientific backgrounds of basic sciences such as physics, chemistry, and biology.

Exploiting their background knowledge of the mechanisms of data acquisition, medical physicists are able to perform data reduction in the form of extracting characteristic features from the data, i.e., variables that contain summaries or inferential information from highly complex raw data. The MP can thus be actively employed in the process of learning from data originating from heterogeneous sources of information and aiming at various groups of end users. Medical decisions are intrinsically of statistical character, and pursuing plausible hypotheses involves inference from complex data structures.

HIS can become an indispensable tool for such tasks, and MPs can act as moderators for diverse medical needs met through inference inside the hospital. Their role among end users can provide better exploitation of the knowledge gathered in a medical setting, and can serve as an effective inter-science collaboration between physicians and physicists. I strongly believe that by playing an active role in the ever-evolving HIS environment, MPs can exert a positive influence in hospital organization. This gives MPs the opportunity to offer better services to the hospital and to patients.

AGAINST THE PROPOSITION: George C. Kagadis, Ph.D.

Opening Statement

The development and implementation of integrated hospital information systems is a very interesting issue. Getting involved with this task requires a strong background in medical informatics science and is highly workintensive. My position is that medical physicists have neither an adequate background in this science nor the time to devote to it, and hence should not assume such a responsibility. Medical physicists usually have an undergraduate education in Physics and an advanced degree in medical physics. According to AAPM Report Number 79, there should be a core curriculum in which all medical physics trainees should be well grounded. In addition, there should be subsequent training in the more specific aspects associated with subspecialties such as imaging or radiation therapy.9 Medical physicists have a variety of obligations such as acceptance tests, shielding design, radiation dosimetry, treatment planning, image quality, etc. Being either a diagnostic or therapy physicist demands devotion and responsibility in everyday practice. Medical physicists’ obligations have significantly increased recently with the advent of new technological advances such as multidetector CT, PET, IMRT, MLC, and Gamma Knife, as well...
as hybrid machines CT-SPECT, MR-PET, etc. Thus specialization and dedication are crucial if medical errors are to be avoided.

Development and implementation of an integrated HIS alter the way clinical enterprises operate, and require specialists who have a solid background in medical informatics. These individuals should have in-depth training in PACS, database design and management, interfaces to imaging modalities, communication protocols DICOM, TCP/IP, as well as higher-layer HL7 protocols, etc. An HIS will make the outcome of a radiological, laboratory, or other physical examination readily available to referring physicians. A well-developed and implemented HIS will increase the operability and consequently the performance of the healthcare enterprise.\(^{11-13}\)

The current medical physics curriculum does not provide sufficient tools to enable medical physicists to have a key role in the development and implementation of an integrated HIS. Additionally, medical physicists have little (or at best, fragmentary) knowledge of medical informatics issues, and thus any attempt to be involved in the development and implementation of an integrated HIS would distract them from their specialized work and thus decrease productivity and efficiency in their daily clinical practice. The partnership of medical physicists with radiologists, other physicians, and medical informatics specialists is essential in an integrated HIS, where each individual has a discrete role and cannot have knowledge of everything.\(^{14}\)

**Rebuttal: George C. Nikiforidis, Ph.D.**

It would be unrealistic not to admit the need for greater specialization of MPs in individual aspects of medical physics so that they can embrace the new technologies and methodologies that enter our everyday practice in the hospital. If, however, this were not accompanied by efforts to link the physicist’s routine work to the broader goals of modern medicine, then the very act of specializing would cause their marginalization. Their role would become ancillary and MPs would undoubtedly narrow their scientific role to one of simply striving to follow continuous technological advancements.

Hospital information systems are the means for a solid attachment of MPs to the roadmap of advancement in medical science, as they are the key factor for the integration of scientific knowledge. Giving MPs the opportunity to be involved in the development and implementation of an HIS makes them active contributors to this roadmap. Registration and fusion of medical images constitute good examples for such integration. Taking advantage of the HIS infrastructure, the information is combined to produce fused images. Interpreting them comprises a challenging task for the clinicians, since they are required to evaluate a new, unfamiliar representation of the information. It calls for collaboration among experts, opinion exchange and, frequently, argumentative reasoning. The MP, aware of the physical principles involved in the image acquisition mechanisms, can effectively assist the clinicians in this task.

Being able to take part in such schemes undoubtedly requires proper education in fields that lie at the interface between scientific disciplines. Knowledge of the mechanisms of novel acquisition methodologies, as well as aspects of computer science, is only a part of the technologies necessary to allow MPs to perform information integration and implement statistical learning procedures. Armed with such qualifications, the role of MPs as knowledge facilitators would be enhanced. This would promote the importance of medical physicists in the hospital environment.

**Rebuttal: George C. Kagadis, Ph.D.**

I agree with my colleague that hospital information systems have become key infrastructures of modern health care enterprises. I also agree that the role of the current medical physicist is expanding to new fields according to medicine’s development. However, I disagree with his statements that the medical physicist can act as a moderator for the diverse needs for medical inference in the hospital setting. Such an approach would add more tasks to the daily workload of medical physicists and would divert them from their important duties. They have to be efficient in their daily clinical work as well as stay up-to-date with new technological developments in either imaging or radiation therapy. These tasks demand devotion in order not to decrease productivity and efficiency.

I also agree that active participation of medical physicists in either the development and/or implementation of an integrated HIS may positively influence both their status (strategic role) and the clinical enterprise function. On the other hand, medical physicists are evaluated and acknowledged for their services as medical physicists, and any possible recognition with regard to HIS services might just be transitory. Additionally it is not likely that this new involvement would lead to an increase in medical physics department personnel. This means that if medical physicists do assume HIS responsibilities in either development and/or implementation, they will inevitably have less time to dedicate to their traditional tasks and thus compromise their quality of service or, in the worst case, leave them more vulnerable to making errors.

For these reasons I believe that medical physicists should not be directly involved in the development and implementation of an integrated hospital information system but should be active participants in this environment. They should, however, collaborate with other healthcare professionals serviced by the integrated HIS in order to refine their occupational proficiency and meet the challenging applications of new technical advances.


AAPM Report Number 79: Academic Program Recommendations for Graduate Degrees in Medical Physics, Education and Training of Medical Physics Committee (American Association of Physicists in Medicine, College Park, MD, 2002).


