THE CHANGING ROLE OF HEALTH PHYSICISTS AS REFLECTED BY CHANGES IN PROFESSIONAL HEALTH PHYSICS TRAINING COURSES

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Background

Health Physics is a profession with long, honourable traditions; and this paper could be subtitled "Health Physics - The First 100 Years". The discovery of X-rays by Conrad Roentgen in 1895, and of natural radioactivity by Henri Becquerel in 1896, was followed two years later by the isolation of radium by Marie and Pierre Curie; and then, during the last years of the nineteenth century, by explosive world wide growth in the utilisation of both these new discoveries for medical diagnostic and therapeutic purposes. The fact that these new medical tools carried associated risks was very quickly learned. Physicians who most enthusiastically adopted them often experienced severe skin injuries to heavily exposed digits, and there are numerous photographs of the hands of such individuals after experiencing several amputations. Regrettably many ultimately fatal radiation induced cancers also began to appear before the end of the last century, by the first world war there were 200 of these and the death toll already exceeded 50. In the face of this two edged weapon it is not surprising that many of the physicians and medical physicists working in this area turned a great deal of their attention from the exploitation of the new technologies to the protection of their colleagues. These individuals were the pioneer health physicists and, although this name was not used at the time, their background experience in both medicine and physics laid scientific foundations for the new discipline which have remained its keystone ever since.

Initially attempts to develop improved safety standards for radiology concentrated on the development of equipment and procedures which would minimise inadvertent exposure to X-ray beams. A Boston dentist, Dr. William Rollins, was particularly active in this respect, and he has been referred to as "the father of health physics". By the summer of 1915 such developments led the British Roentgen Society to pass a resolution recommending the universal adoption of stringent safety rules designed to ensure the personal safety of operators conducting roentgen-ray examinations. In November of the same year the Society followed up this resolution by publishing what appears to have been the first comprehensive set of such rules. However at this time monitoring for scattered radiation was still carried out either with fluoroscopic screens or by photographic means and any formal scientific basis for health physics awaited the development of appropriate units and instruments for the measurement of radiation exposures. This development took place at the Second International Congress of Radiology in Stockholm in 1928 where a Committee was appointed to study the introduction of an appropriate unit for dose measurements. The Committee was responsible for the introduction of the Roentgen as a unit of measurement. It subsequently developed into what became known as the "International X-Ray and Radium Protection Committee", and in 1934 under this name it recommended the universal adoption of a daily personal dose limit for radiation workers, a requirement that had been first introduced in the USA in 1929. Later it was this committee that developed into the International Commission on Radiological Protection in 1950.

The Evolution of Health Physics as a Profession

It is almost certainly true that during the inter-war years these organizational developments were of less significance in the evolution of health physics as a profession in its own right, than the dedicated work of many extremely competent physicians and medical physicists in hospitals throughout the world. Both fundamental research in radiobiology and sophisticated investigations of dose distributions within the body played a necessary part in the development of improved radiotherapy practices. They also laid a foundation for the safe control of artificial radionuclides when these became available in quantity following the development of the nuclear reactor, and equally important they ensured the availability of the core of expert scientists who were responsible for the safety of workers engaged in the development of atomic weapons during the second world war. These scientists were the first group to be formally referred to as health physicists, partly in order to conceal the exact nature of the work in which they were engaged. At this time the total quantity of radium which had been isolated for use throughout the world would have comprised less than a one inch cube, yet they all knew that experience in the luminising industry had shown that lethal internal doses of radium could be very quickly absorbed. It has been reported that, when first recruited, they were given a realistic and frightening impression of the scientific problems they faced by a comparison of this quantity with the quantities of artificially produced long life alpha emitters which would be generated during the program to develop atomic weapons! There is no doubt that when the veils of secrecy were finally lifted fifty years ago their dedicated efforts had led to the development of a fully fledged health physics profession. During the next few years general expectations developed that nuclear power would be quickly and almost universally adopted, and consequently a significant number of additional health physicists would need to be trained. The first University M.Sc. courses in health physics were therefore established at this time. Numerous shorter courses were also introduced by a variety of training institutes, these were mostly intended for various groups of workers of very different academic capabilities who used radiation sources in their employment.

Health Physics as an Academic Discipline

Not only the ICRP itself but also national regulatory bodies in many countries have paid a great deal of attention to the need to ensure that all workers exposed to sources of ionizing radiation receive comprehensive training covering both the associated risks and the safety procedures that must be followed. Until recently the development of such training courses has tended to be emphasised at the expense of formal academic training of the senior staff responsible for designing and implementing complete radiation safety programs in large institutions. For example in 1979 the Health Physics Society devoted its Mid-year Topical Symposium to Health Physics Training, and an examination of the proceedings for this meeting shows that it was largely devoted to the training of health physics technicians, and of workers incidentally involved with the uses of ionizing radiations, relatively few papers discussed the academic training of personnel expected to be responsible for conducting health physics programs. This is perhaps not surprising as most such programs were already under the control of very experienced personnel who had learned on the job. Some of the early academic courses even found it difficult to recruit enough students and not all of them have survived. However most of these senior personnel have now retired, or are close to retirement, and the way to senior positions in the profession is no longer readily open to those who have not undergone a formal academic training. A review of the changing syllabus followed by such training courses therefore provides an easy way to assess how the issues of most importance to professional health physicists have changed over the years. The author attended a University M.Sc. course in radiation safety during the 1960's, and has subsequently been involved in both teaching and syllabus preparation for three further academic courses of the same type. It was only an incidental review of the subject matter covered in his first course which led him to full recognition of the substantial changes in the type of work undertaken by a health physicist that have occurred during the past four decades.

Syllabus Evolution in Academic Health Physics Training

The earliest academic courses covering radiation safety were designed for trainee medical physicists. They provided extensive coverage of the fundamental scientific disciplines of anatomy, physiology and biochemistry, together with training in the interaction of gamma radiation with matter, radiation dosimetry, radiobiology, dose distributions in tissue, medical imaging, etc. These courses also usually included a limited amount of information about ICRP recommendations, radiation control regulations and personal monitoring, but they were strongly directed towards students expected to make their career in a hospital. More general radiation safety courses first evolved from such medical physics courses to meet the needs of students planning to work in research centres, industry, or government. In addition to the fundamental scientific disciplines referred to above, these courses included a great deal more emphasis on instrumentation of all types, on the design of radiation shielding, on the in-house calibration of equipment, and on radiation measurements. Generally such topics as the operation of personal monitoring programs, contamination of materials, low level counting, bioassay procedures and whole body counting were covered in some detail. There was also some discussion of the role and recommendations of the ICRP, but regulatory requirements did not loom large at this time. Visits from government inspectors to research centres or industrial operations were relatively infrequent, and at this time the requirements of such inspectors were usually easily complied with.

About ten years after participating in such a course, I became involved in developing the syllabus for another course designed for a similar class of M. Sc. students. The most important changes from the type of syllabus outlined above which were felt to be necessary included increased emphasis on compliance with regulatory requirements, some coverage of the need to maintain adequate documentation of all procedures followed, an introduction to the rapidly increasing role of computers (e.g. for record keeping, calculating shielding requirements, contributing to the design of research projects, etc.), and adequate treatment of the many new developments in radiobiology - particularly at the cellular level. To make time for these topics to be fully addressed it was necessary for some of the material relating to medical imaging to be eliminated, but since many of the students would continue to be involved with work in hospitals, a comprehensive treatment of quality assurance procedures for medical imaging equipment remained.

The third such course with which I was directly involved put much more emphasis on both regulatory requirements and record keeping, since these were matters which were beginning to occupy more and more of the time of a program manager. The increasing power and availability of computers led to more attention being paid to their use in meeting such requirements. Questions of the potential legal liability of the responsible organization, and consideration of the problems encountered in ensuring that all workers complied with required operating procedures, assumed increasing importance. For the first time the public concerns, which were evident following the Three Mile Island accident, and had became much more acute after Chernobyl, led to a considerable amount of attention being devoted to techniques for communicating with the public. To compensate for this, less attention was paid to the work which it was by then assumed would normally be carried out by a health physics technician, and to the development of specialised health physics services such as personal monitoring and whole body counting which had begun to become readily available from commercial suppliers.

Further such changes have gradually continued over the last decade, and have tended to mark the evolution of the role of the radiation safety program manager from that of an operating scientist to one which has become largely program management. In the most recent course with which I have been involved it was found necessary to begin to reduce the attention given to the three fundamental sciences of anatomy, physiology and biochemistry to make room for an extended treatment of risk assessment, risk communication, and risk acceptability. Communication with both the public and employees assumed a very high importance and much more attention needed to be paid to legal issues including probability of causation. The documentation required of a typical organization has mushroomed out of all proportion, a considerable amount of time now needed to be spent both in reviewing these requirements and in considering how best to meet them. Major organizations now have to establish much more complex health physics programs than in the past, and this means that program direction and management has now become an important topic in its own right.

Future Directions in Health Physics and in Health Physics Training

The most critical question which is likely to arise before the end of this century is probably how the somewhat rigid structure that has been developed for radiation safety can best adapt to the implications both of new research and of the changing expectations of society. Examples of such issues are the possible development of techniques for the identification of individuals with abnormally high radiation sensitivity, and the conflicting expectations of some women's groups concerned about risks during pregnancy with those of others more concerned about the impact of pregnancy dose restrictions on their career prospects. Risk communication will lie at the heart of such societal decision making processes. Similarly increasing sensitivity to all forms of pollution in the environment is likely to lead to increasing importance being attached to the effective communication of information about the relative significance of all the associated risks. Answers to such questions will demand familiarity with an extremely broad range of scientific expertise. Society is now being faced with recognition that world energy needs are increasing dramatically, and that the greenhouse effect is a serious threat. This will necessitate a re-examination of the future role of nuclear power. The decisions on all such issues will ultimately have to be made by the public following extensive discussions in the media, and later in legislative assemblies. The professionally trained health physicist will inevitably be at the centre of such discussions. This strongly suggests that the most important professional credential will probably be ability to communicate effectively with the public. The role of the typical health physicist will then have completely reversed from that of a scientist essentially working alone to that of an administrator working largely in the area of public communication.