SCOPE OF PRACTICE FOR CANADIAN CERTIFIED MEDICAL PHYSICISTS

A document prepared by the Professional Affairs Committee of the Canadian Organization of Medical Physicists (COMP).

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I. INTRODUCTION

Medical physicists are health care professionals with specialized training in the medical applications of physics. Their work involves the safe use of x-rays, radioactive materials, ultrasound, magnetic and electric fields, radiofrequency waves, infrared and ultraviolet light, heat and lasers in medical diagnosis and therapy. Most medical physicists in Canada work in cancer treatment facilities, hospital diagnostic imaging departments, or hospital-based research establishments. Others work in universities, government, and industry.

This document describes the scope of practice for medical physicists who are certified to work in clinical environments. Moreover, this document is based upon the certification structure as established by the Canadian College of Physicists in Medicine (CCPM). That structure recognizes four sub-specialties:

a) Radiation Oncology Physics
b) Diagnostic Radiology Physics
c) Nuclear Medicine Physics
d) Magnetic Resonance Imaging Physics

II. GENERAL DESCRIPTION OF MEDICAL PHYSICISTS

A. Clinical Service

Medical physicists are primarily responsible for a variety of clinical activities. Such activities include technique development, clinical consultation, facility design, optimal medical device performance through appropriate design, specification, acceptance, commissioning, testing, calibration, and troubleshooting, as well as regulatory compliance, radiation protection, and preparation of policies and procedures.

Medical physicists, due to their unique knowledge and expertise, are also often called upon to contribute to resolving issues related to complex cases, equipment malfunction or breakdown, computer hardware or software problems and human errors. Medical physicists play an important role in the interpretation of complex technical information and subsequent translation into a form that is more accessible to others such as administrators, physicians, hospital staff and the general public. Additionally, they are uniquely qualified to communicate technical requirements to representatives of the medical device manufacturing companies.

While many of the activities are generic to all sub-specialties, there are also responsibilities particular to each sub-specialty.

1. *Radiation Oncology*

Radiation oncology physicists are responsible for optimizing and ensuring the accuracy with which radiotherapy treatment can be delivered. The roles of a medical physicist in radiotherapy include treatment planning, dosimetry, and medical device performance. Fulfillment of these roles entails detailed knowledge of information systems, mathematical algorithms, software, and a diversity of complex devices such as computed tomography (CT) simulators, linear accelerators, and remote afterloading brachytherapy units.

2. *Diagnostic Radiology*

Diagnostic radiology physicists are primarily responsible for the quality and safety of diagnostic imaging modalities such as Computed Tomography (CT), fluoroscopy, radiography, mammography and ultrasound. The roles of a medical physicist in diagnostic imaging include medical device specification, acceptance testing, quality assurance, protocol development, image optimization, and troubleshooting.

3. Nuclear Medicine

Nuclear medicine physicists are responsible for many aspects of the management and use of unsealed radioactive sources for diagnosis and therapy including: medical device selection and performance assessment; design of planar, Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET) image acquisition protocols; determination of appropriate SPECT and PET reconstruction protocols; assisting in image and data analysis; and design of dosimetric studies. In addition, medical physicists act as radiation safety experts, advising on the safe handling of radioactive material and the safe use of radiation emitting devices, including performance of shielding calculations, advising on disposal techniques, and on contamination control measures.

While medical physicists participate in clinical teams comprised of a variety of professionals expert in different areas, it is the medical physicist who bridges the gaps between the diverse fields and provides continuity in the form of basic scientific understanding of the clinical processes, a systematic approach to trouble-shooting and creative problem-solving.

4. Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) physicists work with MRI scanners and are responsible for ensuring optimal image quality, magnetic field shielding, properly functioning radiofrequency shielding, and safe practices, policies and procedures for areas near a strong magnetic field. MRI physicists also play an important role in the development of acquisition sequences and protocols as well as image post-processing software and procedures. The MRI physicist may also be asked to assist with the interpretation of images or spectra, especially when image artefacts are present. The responsibilities of a MRI medical physicist include medical device specification, MRI siting design, acceptance testing, quality assurance and image artefact troubleshooting.

B. Radiation Safety

Medical physicists have expertise in radiation safety. Although subject to additional assessment, Canadian regulatory bodies do recognize medical physicists who are certified by the Canadian College of Physicists in Medicine as particularly suited to being Radiation Safety Officers for medical facilities employing radiation-emitting devices and radioactive materials.

C. Research and Development

In general, medical physicists play a central role in the design, construction, characterization, and optimization of imaging systems and radiotherapy treatment equipment. Research areas engaged by oncology physicists include the theory of radiation absorption and dose calculation, measurement of radiation dose, the use of heat and lasers in cancer treatment, and radiobiology. Imaging physics research includes the theory of image formation, detector development and characterization, development of techniques for image quality assessment and investigating the safety aspects of imaging.

D. Teaching

Many medical physicists hold academic appointments with universities and/or teach in graduate and undergraduate medical physics and physics programs. They also teach radiology and radiation oncology residents, medical students, medical physics residents, radiographers, radiation therapists and nuclear medicine technologists.

E. Employment of Medical Physicists in Canada

Historically 75-85% of Canadian medical physicists have worked in cancer treatment centres, hospitals and hospital-based research establishments. There is an approximately equal distribution of the remainder amongst government, industry, and university faculty who are not hospital-based. While medical physics is a diverse field, most medical physicists in Canada work in clinical service in one of the approximately 40 radiation treatment centres.

III. EDUCATION OF MEDICAL PHYSICISTS

With very few exceptions, medical physicists in Canada have a graduate degree in medical physics, physics or a related discipline, with the majority holding a doctorate degree. For the radiation oncology sub-specialty, a further nominally two-year period of clinical residency or on-the-job training is required. In some provinces, the end of such residencies is marked by a formal review and oral examination. After two years of clinical experience, and upon successfully passing written and oral exams, a medical physicist is eligible to apply for membership in the CCPM. The primary mandate of the CCPM is to certify that members of the College are competent medical physicists.

Certified medical physicists must participate in continuing education and demonstrate ongoing maintenance of their competency every five years through the CCPM recertification process. A point system based upon conference attendance, successfully completed courses, research and teaching activities, and development of clinical techniques ensures that the certified medical physicist keeps abreast of the rapid evolution of the profession.

Within the medical physics profession the recognized process for accrediting medical physics graduate and residency programs is through a program audit by the Commission on Accreditation of Medical Physics Education Programs (CAMPEP; www.campep.org). COMP is an official sponsor organization of CAMPEP together with the American Association of Physicists in Medicine, the American College of Medical Physics, and the American College of Radiology. Two COMP members serve on the board of CAMPEP.

IV. QUALIFIED MEDICAL PHYSICIST

For the purpose of providing clinical professional services, COMP defines a Qualified Medical Physicist (QMP) as an individual who is competent to independently provide clinical professional services in one or more of the subfields of medical physics. The subfields of medical physics are:

1. Radiation Oncology Physics
2. Nuclear Medicine Physics
3. Diagnostic Radiological Physics
4. Magnetic Resonance Imaging

where the scope of practice of each subfield is described in section V. J. *Sub Specialty Expertise*. For more information please refer to the Qualified Medical Physicist (QMP) document available on the COMP website.

V. DUTIES AND RESPONSIBILITIES OF MEDICAL PHYSICISTS

The exact duties and responsibilities of a medical physicist depend significantly upon the physicist's sub-specialty but, in general, focus on the physics and instrumentation related to diagnosis and treatment. Medical physicists have detailed knowledge of how fundamental physical principles are applied to medicine and leverage that knowledge to develop protocols to optimize both quality of care and operational efficiencies. When difficulties do arise in the delivery of optimal care, e.g., due to case complexity, equipment malfunction or breakdown, computer problems, software irregularities, or human errors, medical physicists are available to apply their expertise and problem solving abilities to rectify the situation. Medical physics is an evolving field, and the specific areas of expertise will change with new developments in the basic science and technology. Currently, medical physicists in general have expertise in at least the following areas:

A. Equipment Selection

The medical physicist must have current knowledge of developments in medical devices and related equipment used within their sub-specialty, provide critical assessment of manufacturer's claims, recommend selection of the best equipment to meet program requirements with the available resources, negotiate technical details with manufacturers, and specify equipment performance in purchase documents.

B. Facility Design and Shielding

Modern equipment for which medical physicists have responsibility has complex infrastructure and safety requirements. In siting new medical devices, a medical physicist must ensure appropriate accommodation for electrical power, ventilation, climate control, emission monitoring, shielding that ensures the proper functioning of equipment and/or protection of personnel and the public, safety interlocks, audio and video monitoring of the patient, and other safety measures to protect anyone to whom the equipment may present a risk. When required, designs must be submitted to the appropriate regulatory authorities for approval, including the results of any relevant detailed measurements performed by the medical physicist to verify those designs and their final construction.

C. Acceptance Testing

Following installation of new equipment or upgrades to existing equipment, it is the responsibility of the medical physicist to perform a series of tests and measurements to verify that equipment performance meets the requirements of the purchase.

D. Commissioning

Medical physicists perform detailed measurements to completely characterize the operation of medical equipment. Measured data are processed and compiled in a form appropriate to facilitate routine clinical use of the equipment.

E. Computer Systems and Networking

The modern imaging and therapy equipment for which medical physicists are responsible often relies on the transfer of large amounts of information between an assortment of commercial software operating on a variety of hardware platforms, such as Picture Archiving and Communications Systems (PACS), information systems, control systems such as record and verify, and custom software written in-house by physicists and programmers. Medical physicists, often working with information systems support personnel, can act as administrators for these systems, ensuring the accurate transfer of data between platforms, and the accurate operation of imaging and treatment delivery devices under software control.

F. Quality Assurance

Medical physicists establish and maintain ongoing comprehensive programs of quality assurance on all aspects of medical device performance. Medical physicists routinely perform a quality assurance review of equipment and system metrics with the goal of ensuring the intended use is safe, appropriate, and optimal for the patient.

G. Safety

The medical physicist is responsible for ensuring the safety of staff, patients, and the general public relative to any emissions arising from imaging or therapy equipment. Although, as mentioned in section II.B, certified medical physicists are recognized as being particularly suited to be Radiation Safety Officers (RSOs) for their institutions, such appointments are most common in cancer treatment facilities. Even when not designated the RSO, medical physicists contribute significantly to any radiation safety program, including application for and control of all licensing of facilities that house radiation emitting devices or materials, establishment and supervision of the personnel dosimetry program, monitoring of radiation levels through surveys and wipe tests, facility design including shielding and radionuclide storage, staff radiation safety training, radioactive material containment and inventory control, source acquisition and disposal, and assessment of, and communication with appropriate regulatory authorities regarding, any radiation incidents. Medical physicists assume a central role in the assurance that all aspects of license compliance are met.

In analogy with the RSO role, MRI physicists work with technologists and radiologists to establish policies and procedures under which patients may be safely scanned. MRI examinations are unsafe for some patients with implanted medical devices, e.g., cardiac pacemakers; for others such examinations are safe only under certain conditions. The physicist will determine, from the technical specifications for the scanner, discussions with the equipment manufacturers and a survey of the available literature, if the interaction between the MRI scanner and the medical device presents an unacceptable risk to the patient.

H. Technique Development

Clinical methods that medical physicists support are continually evolving with new technical capabilities necessitating a better understanding of the physics and biology pertinent to diagnosis and treatment of disease. Development, evaluation and clinical implementation of new techniques are part of the ongoing work of medical physicists.

I. Teaching and Research

Medical physicists are commonly involved in the teaching of undergraduate and graduate students in physics and medical physics. They also teach radiology, nuclear medicine, and radiation oncology residents, and radiology, nuclear medicine, and radiation therapy technologists. Many medical physicists have academic appointments at universities, hold research grants, supervise graduate students, present research at scientific or medical conferences, and/or publish in peer-reviewed scientific journals.

J. Sub-Specialty Expertise

In addition to the expertise outlined above, there are additional responsibilities explicit to the four sub-specialties of Medical Physics.

1. Radiation Oncology

The principal focus for Radiation Oncology physicists is radiation treatment preparation and delivery processes, including medical imaging, treatment planning, dose calculation, patient immobilization, mechanisms of operation of treatment delivery devices, interactions of radiation with matter, and the biological response of cells and tissues to ionizing radiation. The complex nature of modern radiotherapy requires that the process be overseen by professionals with an understanding of the spectrum of knowledge from the technical minutia through to the full scope of the operations. Medical physicists, with an education that emphasizes fundamental understanding of basic science and problem solving, are ideally suited for this role. Radiation Oncology physicists are typically considered the authoritative technical and scientific resource persons in a radiotherapy program.

a) Treatment Planning Systems

Sophisticated computer systems are used to model the delivery of radiotherapy, in order to accurately predict the dose delivered during treatment and to help optimize the planned treatment. The medical physicist is responsible for understanding the algorithms used by planning systems, investigating and documenting their capabilities and limitations, populating the software with valid data, verifying the accuracy of calculations, training and supervising technical staff using the treatment planning systems, performing system administration functions, and integrating computerized planning systems with other computer systems used in radiotherapy, such as imaging and treatment record and verify systems.

b) Imaging

Radiotherapy has an increasing reliance on medical imaging information for diagnosis, staging, and planning of cancer treatment using radiation. CT, magnetic resonance imaging (MRI), fluoroscopy, film and digital radiography, nuclear medicine, digital subtraction angiography (DSA), SPECT, PET, and other imaging modalities are routinely used. Medical physicists have specific expertise in the physics and technology of these imaging techniques, and ensure their optimal and appropriate use in radiotherapy.

c) <u>Absolute Dosimetry</u>

Medical physicists using precise measurement equipment whose calibration can be traced to national measurement standards laboratories perform the calibration of radiotherapy equipment and radioactive sources. Medical physicists are experts in the quantification of ionizing radiation, and have current knowledge of the latest measurement protocols recommended by recognized standards laboratories and national medical physics organizations.

d) <u>Treatment Planning</u>

The technical aspects of treatment planning are under the oversight of medical physicists. Radiation oncologists, treatment planners, and radiation therapists consult with medical physicists routinely regarding treatment strategies and details. Complex or unusual cases are often planned directly by the medical physicist and medical physicists are responsible for maintaining an appropriate level of review of plans to ensure optimal plans are being produced.

e) <u>Radiobiology</u>

The models describing the response of tumours and normal tissues to radiotherapy involve advanced mathematical models that are best understood and interpreted by physicists who have training in the biological effects of radiation, as well as statistics and mathematical modeling. For instance, medical physicists may be called upon to perform calculations based on these models to estimate dose equivalency of different radiotherapy fractionation schemes or the optimum strategy to compensate for interruptions in radiotherapy treatment delivery.

2. *Diagnostic Radiology*

Diagnostic Radiology physicists have a principal focus in optimizing the use and functionality of diagnostic imaging equipment. Such equipment includes conventional x-ray systems, fluoroscopy, mammography, computed tomography, and ultrasound. The goal is to maximize the clinically relevant information while minimizing risk to patients, personnel and the public, particularly that from radiation exposure. Diagnostic Radiology physicists are often the authoritative technical and scientific resource persons for a radiology department using such equipment.

a) <u>Accreditation of Equipment</u>

Radiology equipment may be accredited by an independent organization. This is particularly true for mammography where a medical physicist must assess equipment performance on an annual basis. Physicists who survey mammographic systems must hold a specialized accreditation in mammography given by the CCPM.

b) <u>Equipment Purchasing</u>

Hospitals have large amounts of imaging equipment that must be replaced regularly. The physicist is intimately involved in the equipment selection and must be able to make a quantitative comparison of the technical specifications provided by each vendor. To facilitate a comparison the physicist prepares a detailed technical questionnaire that is answered by each vendor. The physicist must review the answers and other literature provided to quantify each answer and make a recommendation as to which scanner to purchase.

c) <u>Acceptance Testing</u>

The medical physicist is often present during the installation of new imaging equipment. After installation it is the job of the physicist to check the equipment to ensure that all specifications are met and it is safe to use.

d) <u>Periodic Testing</u>

Performance is checked on a regular basis using phantoms to ensure that there is no degradation. The physicist performs annual tests. Quality assurance tests performed more frequently are typically conducted by technicians under the guidance of a medical physicist. As a component of testing, physicists develop phantoms and image analysis tools.

e) <u>Safety</u>

Safety includes dose estimation and radiation protection considerations such as shielding calculations, optimization of performance of image acquisition, and balancing the competing objectives of image quality and minimization of dose to the patient.

3. Nuclear Medicine

Nuclear Medicine physicists are primarily concerned with the use of unsealed radionuclides for diagnostic and, to a lesser extent, therapeutic applications. Many of the responsibilities of a nuclear medicine physicist mirror those of the diagnostic radiology physicist including the purchase of equipment, acceptance and routine testing, radiation protection, dosimetry, teaching, research and development.

a) <u>Radioactive Sources</u>

In nuclear medicine the radiation, mainly gamma photons, is emitted from a patient or patient sample. The physicist is responsible for ensuring the detectors used to measure the radiation dose given to the patient and the scanners used to detect the emissions from the patient or sample are operating as expected. Nuclear medicine physicists are proficient in handling and manipulating radioactive material into forms suitable for testing the equipment. They are also knowledgeable of the radiation safety implications.

b) <u>Research and Development</u>

Due to their detailed knowledge of radiation properties and the radiation detection process, nuclear medicine physicists are often involved in the development of new, and the optimization of existing, imaging techniques. They also take a lead in the implementation of techniques from the literature as applicable to the specific needs of their department, and in formulating methods to process data into meaningful images or information. The physicist will therefore often have programming and software development experience.

c) <u>Safety</u>

The physicist is closely affiliated with the RSO and provides guidance with regards to patient and staff radiation protection techniques, dose calculations, shielding requirements, environmental issues and legislation/regulatory issues.

d) <u>Therapy</u>

The use of radionuclides for therapy is supported either by a nuclear medicine or radiation oncology physicist. In either case, the physicist may be responsible for calculating or checking the patient dose, for ensuring associated equipment is properly functioning and calibrated, and for giving advice with regards to radiation safety of the patient, their family, the public and staff following a therapeutic administration.

e) <u>Other Areas</u>

SPECT and PET depends on the detection of high-energy photons and is therefore often the responsibility of a nuclear medicine physicist or a specialist SPECT/PET physicist. As such, the physicist role is almost identical to that in general nuclear medicine. Bone density testing may also be performed within nuclear medicine facilities and consequently also receive physics support, including advice on equipment purchasing, equipment testing, and troubleshooting on equipment and software issues.

4. *Magnetic Resonance Imaging*

Since the basic principles of MRI involve complex physical concepts, a comprehensive knowledge of many areas of advanced physics is required to properly understand the technology. The magnetic resonance imaging physicist, therefore, fulfils an important role on the medical team as a resource person. The responsibilities of the MRI physicist regarding purchasing, acceptance testing, and quality assurance mirror those of the diagnostic radiology physicist but are applied to the technical considerations of MRI. MRI physicists also apply their unique expertise to the optimization and advancement of magnetic resonance image acquisition and analysis techniques.

a) Pulse Sequence Development

MRI is a very versatile imaging technique with many possible acquisition procedures or "pulse sequences", which all provide specific advantages. The expertise of the MRI physicist is required for the development, evaluation, and optimization of these highly complex pulse sequences to optimize image contrast for the enhancement of biological features of diagnostic interest, image quality, and acquisition time.

b) Spectroscopy

Magnetic resonance spectroscopy makes use of the principles of MRI to acquire information about the chemical composition of tissues in the form of spectra. The MRI physicist plays an important role in the development of acquisition and analysis procedures for MRI spectroscopy and may be consulted regarding the interpretation of spectra.

c) High Field Imaging

There is a trend towards the use of stronger magnetic field strengths in MRI since higher signal-to-noise ratios and better image quality are inherent to these higher field systems. However, there are technological and safety issues related to using high fields. MRI physicists have the expertise to assist with the development of high field MRI scanners to take advantage of the improved image quality and faster image acquisition, and to evaluate safety aspects of these high field scanners.

d) Interventional

Magnetic resonance imaging can be used for certain interventional procedures. MRI physicists have the necessary expertise to develop the specialized procedures required to make interventional MRI feasible and safe.

e) Advanced Imaging Procedures

Certain advanced MRI procedures such as functional MRI (fMRI), magnetic resonance spectroscopy (MRS), or dynamic contrast enhancement studies, due to their complex nature, often require the MRI physicist to be part of the medical team.

VI. ACCOUNTABILITY OF MEDICAL PHYSICISTS

The primary responsibility of the medical physicist is to the patient, to assure the best possible procedure and outcome with the available technology, resources, and expertise of the medical team. Only an appropriately trained and experienced physician can prescribe therapeutic doses of ionizing radiation, whether delivered internally or externally. In radiation treatment the responsibility of the medical physicist is to ensure that radiation treatment is delivered in an accurate, safe and effective manner. Similarly, diagnostic procedures can only be performed when ordered by an appropriately trained and experienced physician. Regardless of the modality, the role of the medical physicist is to ensure that the diagnostic procedure is performed in an optimal and safe manner.

In fulfilling their responsibilities, medical physicists are accountable to the patient, the physician who has requested the procedure, other members of the clinical team, the public, and to any regulatory authorities, such as the Canadian Nuclear Safety Commission, who have a legislated mandate to protect the public and the environment from the potentially harmful effects of any emissions from the clinical equipment. In addition, a certified medical physicist is answerable to the CCPM, which has in its bylaws a mechanism to revoke membership in the College for failure to abide by the COMP/CCPM Code of Ethics.

VII. COMMITMENT TO QUALITY ASSURANCE

Quality assurance is extremely important in the operation and clinical use of imaging and therapeutic medical devices for which medical physicists are responsible. The only way to ensure that radiotherapy is actually being delivered as prescribed, or that optimal image quality is being obtained with minimal impact upon the patient, is through a routine and comprehensive program of detailed physical measurement. Medical physicists are responsible for developing, initiating and maintaining quality assurance (QA) programs to ensure that the relevant clinical procedures are delivered in a safe and effective manner. Medical physicists through organizations such as the Canadian Organization of Medical Physicists, the American Association of Physicists in Medicine, the Canadian Nuclear Safety Commission, the Canadian Association of Provincial Cancer Agencies, or even provincial entities such as the Ontario Healing Arts Radiation Protection Commission, have defined the criteria for such QA programs. Medical physicists are responsible for knowing and understanding the requirements and rationale of the QA programs recommended or mandated by these organizations, and to implement and maintain these programs to ensure optimal equipment functionality, which is safe for the patient, staff, and the public.

VIII. MEDICAL PHYSICISTS MITIGATE POTENTIAL RISK

The potential health risks of exposure to the emissions associated with imaging and therapy, for the most part, have been extensively documented. Ionizing radiations are particularly well recognized because of the tissue damage, carcinogenesis, and mutagenesis associated with their use. The expected benefit of using such emissions must outweigh the potential risk to the patient, and it is the joint responsibility of the medical physicist and the physician responsible for the procedure to ensure that the estimated benefit-risk ratio is sufficiently large to justify the procedure. In addition, use of ionizing radiation poses specific risks to the staff of health care facilities, and to members of the public. Medical physicists are specifically trained and certified in radiation safety, and are responsible for administering a radiation safety program. When high-energy therapeutic beams or radionuclides are used, this program is mandated by the Canadian Nuclear Safety Commission, and includes facility shielding design and verification, dose monitoring of personnel, wipe testing and inventory control of radioactive sources, and staff education.

Ultrasound and MR do not use ionizing radiation and consequently impose different risks such as heating of the patient, cavitation, or the physical dangers associated with strong magnetic fields. Other potential risks to the patient and staff arise from high voltage electrical systems, automatic motion of equipment, and possible exposure to hazardous materials. The medical physicist is responsible for ensuring that these risks are appropriately assessed and managed, which may require consultation with other qualified professionals, and that quality assurance programs are in place to verify the accurate and safe functioning of the equipment.

The MRI physicist in particular is responsible for the safe siting and use of the MRI scanner. The physicist must ensure that monitors on the scanner are working properly so that the patient is scanned safely. The MRI physicist must also ensure that effective policies and procedures are in place to allow only authorized and properly trained individuals to have access to the MRI magnet. The layout of the MRI suite is to comply with recognized guidelines to prevent unauthorized access to the magnet room. The physicist, in conjunction with other members of the medical team, must establish effective screening procedures to ensure that patients with implanted medical devices, e.g., cardiac pacemakers, or other contraindications are identified and appropriate steps taken to address the situation.

IX. MEDICAL PHYSICS AS A SCIENCE

Medical physicists hold graduate degrees from accredited universities and are trained in the methodology of scientific research. The field of medical physics has evolved through a century of scientific research and development to a level of knowledge that allows radiation treatment to be delivered with impressive accuracy and has facilitated incredibly rapid advances in the clinical abilities of diagnostic imaging. Medical physics has contributed to maintaining diagnostic imaging and radiation oncology on sound, evidence-based, scientific principles by virtue of its culture of sound research, meticulous attention to detail, open communication of research results at scientific conferences and in peer-reviewed journals, and active participation in national and international associations.

Advances in the field of medical physics are published in peer-reviewed scientific journals such as *Medical Physics, Physics in Medicine and Biology* (official scientific journals of COMP), and the *Journal of Applied Clinical Medical Physics* (official scientific journal of the American College of Medical Physics). Medical physicists also contribute to journals that are specific to their sub-specialty, for example the *International Journal of Radiation Oncology, Biology and Physics* (official scientific journal of the American Society of Therapeutic Radiation Oncology (ASTRO)), and *Magnetic Resonance in Medicine* (official scientific journal of the International Society for Magnetic Resonance in Medicine (ISMRM)). COMP publishes a quarterly newsletter called *Interactions* (ISSN 1488-6839), designed for and directed towards the Canadian medical physics community. These journals, along with participation in conferences such the annual scientific meetings of COMP, AAPM, ASTRO, ISMRM, and regional meetings are the primary forums for communication of research results, developments, and new practices in medical physics.

X. WORKPLACE SETTING AND CULTURE FOR MEDICAL PHYSICISTS

Large Canadian hospitals commonly employ a single imaging physicists in their radiology or nuclear medicine departments. The majority of therapy physicists are employed in outpatient radiation treatment centres. In most provinces, such centres are part of a provincial cancer agency and are attached to a host hospital, which is usually a tertiary care teaching hospital. The medical physics departments within these centres consist of at least medical physicist, but five to ten is more typical and some larger facilities employ even more. In addition, the medical physicists are typically accompanied by a complement of treatment planners, electronics technologists, physics assistants, mechanical technologists, computer support personnel, administrative staff, students, and/or postdoctoral fellows.

Medical physicists act in support of the clinical program in which they participate, with overall responsibility for the technical aspects of image acquisition and/or treatment. Development and implementation of new techniques is an important part of the medical physicist's role, and as a result most are involved in programs of research and/or development. It is common for medical physicists to have an academic appointment at a university, either in the Faculty of Medicine, reflecting their role in teaching medical residents, and/or in a Department of Physics, reflecting their involvement in teaching graduate and undergraduate courses, and supervision of medical physics graduate students. Other academic duties can include teaching radiation technology students, supervising summer and co-op students, teaching medical and medical physics residents, and providing in-service education to other members of the clinical team. The magnitude of the academic component of a medical physicist's role varies between institutions, but is strongly encouraged through the CCPM recertification process, which awards points for authoring peer-reviewed publications, teaching courses and attending conferences. Participation at scientific conferences is widely recognized as a vital method for communicating research results and keeping abreast of developments in the field.

Medical physicists work in a knowledge-based environment as part of a team whose goal is to provide excellent patient care. The rapidly evolving, high technology nature of modern radiation therapy and diagnostic imaging requires the integration of knowledge in such diverse areas as medicine, physiology, anatomy, radiation physics, MRI physics, patient care, mathematics, statistics, electronics, computer programming and networking, mechanics, radiation biology, and radiation safety.

XI. LEGAL LIABILITY AND INSURANCE IN MEDICAL PHYSICS

Given the complex nature of modern radiation treatment and diagnostic imaging, and, despite rigorous quality assurance and multiple independent checks, misadministration of therapy or sub-optimal image acquisition and analysis that results in significant compromise of the clinical intent can occasionally occur. Should an error occur upon assuming responsibility for the accuracy of radiation dose delivered or, to a lesser extent, image acquired, medical physicists place themselves in a position of potential liability. As employees of health care facilities, medical physicists performing within the scope of their employment and acting in the interests of their employers have a reasonable expectation of being shielded from liability by their employer. Of course each individual should ascertain their own status with their employer. Any medical physicist who acts as a private consultant or who is self-employed should carry liability insurance to guard against the unlikely event that an error leads to legal action against the physicist.

XII. REGULATION OF MEDICAL PHYSICISTS

Currently medical physics is largely an unregulated profession in Canada, and there is little federal or provincial legislation defining the term "medical physicist" or restricting its use to persons with specific qualifications; however, the landscape is changing as individual provinces are successful in establishing professional associations and as the instances of recognition within regulatory documentation increases. For example, CCPM certified medical physicists are recognized in Health Canada Safety Code 35 and by the Canadian Nuclear Safety Commission with regard to Class II Facility Radiation Safety Officers. Physicists certified in mammography by the CCPM are recognized by Health Canada mammography guidelines. Although hampered by the simple fact that there is a relatively small number of medical physicists practicing clinically in Canada, efforts continue on the part of the Canadian medical physics community towards establishing recognition of medical physicists in provincial Regulated Health Professions Acts. Notably, a number of jurisdictions outside of Canada have accepted Canadian certification as sufficient and appropriate to practice medical physics, and there are ongoing concerted efforts within individual provinces to pursue and establish such recognitions.