



The International Society of
Radiographers and Radiological
Technologists

*Guidelines for the Education
Of Entry-level Professional Practice
In Medical Radiation Sciences*

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Of Entry-level Professional Practice
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PREFACE

The radiographic profession is concerned with service to people and to their individual needs. In order to serve people effectively, the individuals cannot be separated from the culture, customs and social patterns of which they are products. It is equally important for Medical Radiation Technologists (MRT) to understand their role as members of the health care team as well as the role of other health care professionals. The guiding principles in the development of all programmes must be

- i) quality of care for patients and
- ii) quality of education for the students

This document is intended to provide a framework for the development of professional standards of education in diagnostic radiography and radiation therapy by identifying the roles, fields of knowledge and attributes that underlie competent professional performance. It is also intended to reflect the evolutionary developments relative to advances in the imaging field of medical radiation technology and changes in educational philosophy. It is the result of requests for assistance from associations and schools in the developing countries and is intended to serve as a guide for international standards of education while encouraging the free exchange of ideas. It also allows for the further development of educational programmes for medical radiation technologists (MRTs) throughout the world.

The concern of the International Society of Radiographers and Radiological Technologists (ISRRT) with quality of patient care, control of radiation and the education standards of radiographers and radiological technologists is addressed by identifying the essential and core components of an education program.

All programmes, including hospital based programmes, technical or vocational schools, universities, or other institutions, require strong professional and educational input. There are many different ways to approach the educational process but it is recommended that each must meet the essential core requirements outlined in this document.

It is strongly recommended that all programmes aspire to a degree level of education.

Professional education requires the translation of a unique body of knowledge and skills into a cohesive and practice-based education programme. Inherent in this is the need to develop attitudes appropriate for the effective performance of the professional role. Programme design should be broad based and student-centred. This should, in turn, open avenues of inquiry, research and life-

long learning skills leading to the future development of the practitioner and the profession. Emphasis should be placed on self- motivation, development of critical and evaluative skills and the encouragement of originality of thought.

The aims of an educational programme for MRT students will include:

- a) the provision of a sound foundation in the broad aspects of the respective discipline by integrating clinical experience with academic content.
- b) the encouragement of the progressive assumption of responsibility by the student for the needs of the patient to ensure a caring, patient-centred approach.
- c) the development of the ability to use knowledge and clinical experience to understand new situations.
- d) the development of the student to be self-reliant, resourceful, discrete and to act in a responsible and mature fashion.
- e) the provision of knowledge, skills and attributes that enables practitioners to proceed to advanced study thus providing for the future development of teachers, clinical supervisors, research workers and managers, through a progressive career structure.
- f) the development of the ability to assume an advocacy role for the patient and the profession

This document recognizes that academic and clinical requirements of MRTs will vary both within and between countries. Whether a country has only one programme or a number of programmes at the hospital and/or university level, it is recommended that all programmes meet the core requirements as offered in these **guidelines**. A listing of specific core subjects in detail is not provided as the main purpose of the guidelines is to identify the essential core components that should be present in all education systems, recognizing the various health care structures, and socio-economic patterns that exist throughout the world. The academic process must be integrated with the opportunity for supervised clinical practice and experience.

It is recommended that recognition of the achieved competency be granted.

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1. GLOSSARY

Unless the context requires otherwise, the following terminology is implied:

ACCREDITATION/VALIDATION: a non-governmental peer review process that assesses education programs against recognized professional standards, provides professional judgments about the quality of educational programmes, supports educational programmes in their continuing evolution and quality improvement processes, and indicates to the public, the educational institution, and to the local government or funding agency that each accredited/validated educational program is capable of producing graduates who can function at a recognized level of competence.

ADVOCACY ROLE: the willingness and ability to plead another's cause, to speak or write in support of another.

APPROVING AUTHORITY: the government body, professional organization or other persons who may have the responsibility of organizing, funding, monitoring or certifying the MRT programme

ADVISORY COMMITTEE: the committee appointed by the academic institution to provide advice in the organization and operation of the education programme

CERTIFICATION: documentation that indicates an individual has satisfied standards that define what it means to be qualified or competent to perform a given role. Standards should include such topics as education, ethics, and the knowledge and skills underlying performance of the duties expected in that role.

COURSE MONITORING: a series of activities to ensure the maintenance of the quality of education within the programme; sometimes referred to as Quality Assurance

CLINICAL SETTING: the area/situation in which the practitioner carries out his responsibilities

CLINICAL EDUCATION: a programme of clinical experience for the student in the clinical setting which involves supervised practice with patients and professional colleagues

COMPETENCY LEVEL: the level of performance required for a particular professional skill in the clinical setting

DIAGNOSTIC IMAGING: diagnostic procedures using ionizing and non-ionizing radiation

DIAGNOSTIC RADIOGRAPHY: the application of ionizing and non-ionizing radiations for the creation of diagnostic images

EDUCATIONAL INSTITUTION: the institution which organizes the education programme for MRTs

EXTENDED ROLES (Expanded Practice): Professional responsibilities for which additional education is required.

GENERAL RADIOGRAPHY: conventional radiographic procedures that are provided within the national or local radiological services utilizing ionizing and non-ionizing radiations for the creation of diagnostic images

MAGNETIC RESONANCE IMAGING : medical imaging that uses radiofrequency radiation as its source of energy

MEDICAL RADIATION SCIENCES: includes the disciplines of Radiography, Computed tomography, Magnetic Resonance Imaging, Sonography, Oncology, Nuclear medicine and all imaging systems utilizing ionizing and non-ionizing radiations for medical purposes

MRTs: Medical Radiation Technologists, Radiation Therapists, Radiographers, Radiological Technologists, Radiologic Technologists, Radiation Technologists, Imaging Technologists Diagnostic Technologists, and others who have successfully completed a recognized educational programme in the respective discipline

NUCLEAR MEDICINE: a medical discipline that uses radioactive isotopes in the diagnosis and treatment of disease. The major fields of nuclear medicine are physiologic function studies, radionuclide imaging, and therapeutic techniques.

RADIATION RISK/BENEFIT STATUS: the application of the ALARA principle (As Low As Reasonably Achievable) in assessing the potential radiation hazards to the patient against the benefit of accurate diagnosis and/or treatment

RADIATION THERAPY: the treatment of cancer and other conditions with ionizing radiation

RADIATION THERAPIST (RADIATION THERAPY MRT): is a health-care practitioner responsible for delivering a therapeutic dose of ionizing radiation for the treatment of malignant disease, and carrying out related activities as a member of the radiation therapy team

RADIOGRAPHER, (MEDICAL RADIATION TECHNOLOGIST, RADIOLOGIC TECHNOLOGIST, RADIOLOGICAL TECHNOLOGIST, IMAGING TECHNOLOGIST, DIAGNOSTIC TECHNOLOGIST, MAGNETIC IMAGING TECHNOLOGIST, NUCLEAR MEDICINE TECHNOLOGIST, SONOGRAPHER X-RAY TECHNOLOGIST): a health care practitioner responsible for the application of ionizing &/or non-ionizing radiation for the purpose of visualizing and recording anatomical and physiological images.

SCOPE OF PRACTICE: specific activities related to medical procedures and other activities for which competency has been achieved. These will vary between countries and institutions.

SPECTRUM OF PRACTICE: the range of activities usually or expected to be undertaken by professionally qualified MRT's.

STUDENT-CENTRED: opportunities for students to be actively involved in, and to assume responsibility for their own learning.

ULTRASONOGRAPHY (SONOGRAPHY): the process of imaging deep structures of the body by measuring and recording the reflection of pulsed or continuous high-frequency sound waves.

2. RESOURCES FOR AN EDUCATIONAL PROGRAM

Physical Resources

All programmes must provide adequate facilities for the number of students in the course at any one time. If the programme is set up in conjunction with a teaching hospital, it is frequently possible to share facilities. If not, the programme must ensure that a sufficient volume and variety of diagnostic and therapeutic equipment and accessories is provided. As well as providing space for formal lectures, there should be provision for seminars, small group discussion, demonstrations and experiments, computer and library facilities, and student counseling.

Financial Resources

There should be adequate financial support to provide staff, salaries and funds for equipment, books and teaching aids.

Funding for MRTs staff development should be available. It is suggested that administration encourage staff to participate in their professional associations through committee involvement, attending conferences, etc.

Human Resources

A standard of qualifications should be established for MRTs and others teaching in the clinical and/or academic setting. Adequate supporting staff should be provided in the way of office and secretarial workers, etc.

3. ESSENTIAL ORGANIZATION REQUIREMENTS

Advisory Committee

It is essential that there be an Advisory Committee. This committee provides input into the planning, implementation, assessment and on-going development of the educational programme. Its members should be especially qualified and selected to execute this task and to recommend changes to the programme that recognize new developments in professional practice.

The nature, structure and composition of this committee will depend on the local situation but should be multi-disciplinary in its composition. Care should be taken to obtain members whose interests and expertise cover a variety of different areas (technologists, educators, physicians, students, recent graduates, employers, etc.) as well as individuals from participating institutions who are in

decision-making positions. It is important that all members of the Advisory Committee are committed to the objectives of the education programme. The committee should meet regularly with minutes kept of all discussions, decisions and recommendations.

Educational Institution

Education programmes for MRTs should be based, where possible, in Universities or institutions of higher education in cooperation with medical imaging or oncology departments, as appropriate. Where this is not possible, programmes can be completely hospital based. Successful candidates are awarded degrees or diplomas. Separate educational institutions affiliated with several hospitals or integral units of a hospital that offer their own certification may also offer courses. All education programmes must provide the student with the opportunity to meet all the required competency standards.

Affiliation with clinical settings

Guided and supervised clinical experience is an essential part of the preparation of MRTs. In the clinical setting, a student must, at all times, be working under the supervision of MRTs or a health practitioner qualified in the subject area of competence. Clinical sites should be selected on the basis of specific criteria. There must be provision for achievement of the required competencies in these clinical settings together with ongoing assessment of the student's skills by a designated clinical instructor

Director/Head of education programme

There should be an identified programme director with overall responsibility for all aspects of the programme. This individual must be a(n)MRT who is qualified to assume the duties inherent in the position. The director of the MRT programme is the person directly responsible for coordinating the planning and administration of the programme, liaising with clinical staff, supervising and assessing of staff performance, and assessing the student experiences.

Research

MRTs and teaching personnel should receive the necessary education, support and encouragement to initiate and participate in research projects. These may be educational or clinical in nature and may be directed towards higher qualifications. Students would then have the opportunity to be involved in practical, applied research projects.

Program Assessment and Evaluation

Two levels of assessment and evaluation are essential. All programmes should have an ongoing internal evaluation process that constantly monitors the quality and suitability of the educational process and procedures. In addition, an external review by a recognised and established validation or accreditation programme is strongly recommended. The following points should be noted.

- It is essential that any program evaluation process is outcome driven
- Key stakeholders together with their respective roles and responsibilities must be clearly identified
- The assessment processes and procedures should be developed in conjunction with recognized stakeholders
- As far as possible evaluation must be independent of the government or employing authority
- Ongoing internal review is an essential requirement
- The process must be flexible but rigorous as well as open and transparent
- The overall objective of any assessment programme is to confirm that the educational education process is developmental, meets pre-determined professional standards, and contributes towards the production of high quality radiographers and therapists

4. SPECTRUM OF PRACTICE

The MRT is a recognized health practitioner in either the production of a broad range of diagnostic images utilizing ionizing or non ionizing radiation, or the utilization of ionizing radiation in the treatment of cancers and other conditions.

The MRT plays a central role in linking the key areas of importance in the diagnostic imaging or treatment process. These areas include:

patient care,
 imaging technique
 treatment management
 radiation safety,
 clinical responsibility,
 organization,
 quality assurance,
 education and training,
 health & safety.

The role of the Technologist/Therapist in each of these areas is as follows:

Patient Care

MRTs have both a direct and a supervisory role with regard to the welfare of the patient in their care. This includes communicating with the patient, ensuring their safety, dignity, and psychosocial needs are met while providing high level quality patient care.

Imaging Technique

The Imaging MRT has the responsibility for positioning the patient, selecting the appropriate technical factors and equipment to provide the optimum diagnostic image taking into consideration the ability and condition of the patient.

Treatment Management

The Therapy MRT has responsibility for the planning, staging, and psychosocial support of patients undergoing treatment for malignant disease or other conditions utilizing ionizing radiation.

Radiation Safety

Radiographers and radiation therapists are in a key position regarding radiation protection of the patient, public and other staff members. It is their responsibility to ensure that the amount of radiation delivered to acquire high quality diagnostic images is kept as low as reasonably achievable, and that the correct dose of radiation is delivered to the prescribed tissue for therapeutic purposes.

Clinical Responsibility

The Imaging MRT's prime expertise and responsibility is to undertake the whole range of techniques in diagnostic imaging and to subsequently assess the quality of the resulting images for diagnostic interpretation.

Organization/management

Dependent upon the level in the organization to which an MRT is appointed, the technologist has responsibility for the proper and efficient organization of work, use of resources and the application of departmental policies and protocols in the area for which responsibility is assigned. MRTs are also responsible for the

organization of their own work related to each individual examination or treatment.

Quality Assurance

All areas of the MRT's responsibility require quality assurance procedures, therefore, the MRT must be a full member of the team that develops, maintains and monitors the quality standards of the department. If no quality assurance programme is in place, the MRT has the responsibility to initiate one and to ensure its implementation.

Quality assurance is to be carried out in an efficient, caring and cost-effective manner with the objective of minimizing radiation to the patient, the MRTs, and other hospital personnel .

Education and Training

As a professional health practitioner, an MRT has the duty to:

- i) update knowledge and maintain clinical competence
- ii) apply proven research results, which will benefit patients.
- iii) where possible, be involved with the clinical education and development of the MRT student. With experience, the MRT's qualifications, abilities and role enable him to advise, instruct and supervise other staff in appropriate circumstances. In addition he may be required to participate in the theoretical education of students, other professionals and/or the general public. It is not expected, however, that the newly qualified MRT will be a competent instructor.
- iv) promote health education initiatives

5. SCOPE OF PRACTICE

The aim of this section is to illustrate integration of the major skills, fields of knowledge and capabilities inherent in competent, professional performance.

The qualified MRT will be expected to be competent to assess, examine or treat patients of all ages and conditions, from those who are ambulant and cooperative to those who are non ambulant, uncooperative, unable to understand and/or are suffering from major trauma or debilitating disease. Particular attention should be paid to the exposure of pediatric patients to ionizing radiation.

Because of socio-economic and other conditions in various parts of the world, there are other procedures/modalities that could be considered as part of the professional practice of the MRT. These include computed tomography, digital radiography, mammography, angiography, interventional, medical ultrasound, radio-nuclide imaging, and magnetic resonance imaging. Where these are included within the curriculum, specific competencies should be defined by the programme using similar and appropriate headings.

It is imperative that the scope of practice be defined at both national and/or local levels (for some, it may be defined within legislation).

Medical Imaging

The range of examinations must include general radiography (trauma and non-trauma), contrast media examinations, mobile and operating theatre radiography. All MRTs must show competence (as defined by the course team) under the headings of patient care, patient positioning, use of imaging technology, radiation safety, clinical responsibility, organization of the examination and quality assurance.

Radiation Therapy

The range of experiences must include treatment planning, delivery and simulation in routine radiation therapy procedures. A knowledge of treatment planning techniques, teletherapy and brachy-therapy is necessary. All Therapy MRTs must demonstrate competence (as defined by the course team) in patient care, treatment delivery and simulation, radiation safety, clinical responsibility, organization of the treatment and quality assurance

Competency statements (the list is not prioritized nor necessarily complete).

Patient Care

The MRT must be competent to:

- a) perform proper identification of the patient
- b) ensure that the patient gives or has given informed consent
- c) ensure that the patient has been given a clear explanation of the procedure to ensure his cooperation
- d) apply ethical/moral considerations in all dealings with the patient and co-workers

- e) ensure that no previously performed imaging procedure has already provided the information requested
- f) ensure that a relevant clinical history has been obtained
- g) ensure that no concurrent treatment or investigation will prevent a good result
- h) ensure that any preparatory instructions, pre medications or contrast media have been administered correctly
- i) ensure that an appropriate check regarding pregnancy has been performed and that appropriate action is taken when necessary
- j) utilize radiation protection aids and techniques
- k) perform appropriate after-care
- l) use appropriate facilities and methods to prevent cross-infection with particular emphasis on precaution standards for air-borne and blood born pathogens, specifically SARS, HIV and hepatitis
- m) evaluate the patient's condition prior to the examination/treatment in order to make judgment as to the best method to use
- n) initiate basic life-support methods if necessary
- o) react appropriately to other emergency situations
- p) give intravenous injections for the purpose of imaging **provided** that the appropriate training and authorization has been given

Imaging Technique

The MRT must be competent and able to:

- a) assess the examination request and confirm its appropriateness.
- b) determine the source of radiation, select appropriate image recording device and any ancillary equipment such that the final image is optimum
- c) when required, make a judgment as to necessary adaptations to departmental protocols and take appropriate action
- d) instruct/coach patient to ensure quality examination
- e) use all equipment safely and correctly
- f) ensure that any error in the final image is not due to incorrect usage of equipment
- g) apply detailed knowledge to position the patient
- h) select suitable combinations of exposure factors and image recording materials to produce optimum images allowing for the patient's condition
- i) maintain and control all the steps involved in the production and storage of a permanent or visible image
- j) assess the resultant image for suitability for interpretation and diagnosis

Radiation Therapy

The MRT must be competent and able to:

- a) assess the patient documentation and treatment method
- b) understand treatment planning techniques and methods
- c) establish the patient treatment position and undertake pre-treatment simulation procedures
- d) aid in the design and production of customized immobilization and protective devices
- e) operate radiation treatment machines and ancillary equipment safely and correctly
- f) confirm appropriate anatomy is used to localize treatment fields
- g) set machine parameters and align the patient in accordance with documentation.
- h) perform the treatment procedure and accurately record all details of treatment given.
- i) detect, document and report variations in the treatment delivery
- j) understand the most recent regulations on radiation protection and their application
- k) cooperate with the radiation oncologist and other members of the health care team

Radiation Safety

The MRT must be competent to:

- a) select and manipulate the imaging or treatment factors and materials such that the radiation dose to the patient is minimized (ALARA) whilst delivering the optimum treatment
- b) ensure all equipment to be used is operational and fully fit for its purpose
- c) use all equipment and procedures appropriately in order to minimize the radiation dose to patient, staff and public, and to ensure that no person receives unnecessary irradiation
- d) ensure all protocols relating to the imaging or treatment of patients of child-bearing capability are applied
- e) fulfill all requirements for the recording of the imaging procedure or type of treatment and dose administered.
- f) take appropriate action in radiological and medical emergency situations
- g) instruct the patient re post procedure requirements to ensure exposure to the public is minimized (for all procedures using isotopes).

Clinical Responsibility

The MRT must be competent to:

- a) be professionally accountable for personal actions
- b) make judgments as to personal professional limitations and seek assistance when necessary
- c) maintain confidentiality of information.

Organization

The MRT must be competent to:

- a) efficiently organize the performance of an individual examination
- b) efficiently organize work within the area of responsibility
- c) ensure compliance with all applicable legislation and regulations relating to assigned work.

Quality Assurance

The MRT must be competent in assessing the quality of personal work and the work of peers. Each of the above competencies should be considered for inclusion in any Quality Assurance Program.

6. STUDENT SELECTION

The student selection criteria should be outcome driven and the process must be seen to be open and fair without gender bias. **The selection should not be based on academic qualifications alone.** The selection process should not disqualify the mature student lacking the formal academic qualification who is able to demonstrate the ability to manage the course content. The health of the prospective student, both physical and mental, should be considered in relation to the job requirements. In some countries, it has become increasingly necessary to complete a criminal record check for each prospective student prior to acceptance.

It is recommended that the student should

- i) have completed the equivalent of high school (approx. 12 yrs schooling) in preparation for higher education
- ii) demonstrate an appropriate level of written and oral communication in the language of the country concerned and in the language in which the program is conducted
- iii) have some science background, to include mathematics, at the level required for entry into the program
- iv) demonstrate maturity, emotional stability, and a satisfactory attitude towards social responsibilities
- v) demonstrate an expressed interest in the chosen profession

7. ACADEMIC CURRICULUM

A formal curriculum is required to enable the student to develop the level of understanding and skill required for the technology and its application. It must be practice driven, reviewed regularly, and demonstrate that it meets the objective of developing graduates able to meet professional standards of practice. It is essential to ensure input from the clinical service in designing the overall curriculum. Consideration should be given to the development of critical thinking skills, problem solving, psychosocial, research and quantitative analysis skills.

The formal curriculum can be divided into two integrated categories, the didactic programme and clinical education. The importance of the clinical programme cannot be over-emphasized. The student must demonstrate competency in all aspects of both the didactic and clinical programme.

CLINICAL EDUCATION

Clinical education offered by a programme must be well integrated into and supported by the academic courses offered. The goal of every programme should be to bring each student to a point where they can deliver, in a consistent manner, patient care services within areas of demonstrated competence

It is recognized that learning in practice-based settings is of equal value to that in the didactic setting. In the clinical setting, a student must, at all times, be supervised by registered/accredited professionals and must be considered supernumerary to department personnel. Clinical sites should be selected on the basis of specific criteria. There must be provision for achievement of the required competencies in the clinical settings. For this reason, a formal clinical component and evaluation process is essential.

Facilities for Clinical Education

When selecting clinical placement sites, it is essential to ensure that the services offered by the site are appropriate to the clinical needs of the student. Consideration should be given to the coordinated use of multiple sites for clinical education when a gap in service, or low volume of service is apparent in a given facility. The site should have modern equipment of an adequate variety and be available for use by supervised students. The equipment should be accurately calibrated, in working order, and should meet applicable national standards. Adequate student supervision must be provided at all times and will be dependent on the clinical proficiency of the student. It is important that clinical staff have the skills and attitudes necessary to facilitate the learning process and that a supportive team structure exists. However, by participating in clinical education, the quality of care of the patient and the efficient running of the department should not be compromised.

Minimum requirements for a radiography clinical site include

- three work areas for a student (radiographic rm, OR, I.I. room, portables, etc.)
- one general radiographic room
- one radiographic, image intensifier room
- one mobile unit
- conventional or computed tomographic capability
- sufficient number of registered technologists in the department to carry on the workload without assistance from the students
- appropriate number of designated clinical instructors or senior technologists responsible for student clinical experiences

Minimum requirements for a radiation therapy clinical site include:

- minimum of 500 varied cases per year
- one superficial therapy unit
- a minimum of one Linear Accelerator
- cesium or other radioactive therapeutic sources
- Simulator and/or CT Simulator
- Computerized treatment planning facilities
- appropriate number of designated clinical instructors or senior technologists responsible for student clinical experiences
- availability of a clinical physicist
- appropriate number of qualified radiation therapists to carry the workload of the department

Measuring Student Clinical competence

- Assessment in the practice setting is an integral part of ensuring clinical competence

- Those taking primary responsibility for clinical evaluation should be clearly identified and must be provided with appropriate education and training
- Clinical supervisor/assessor objectivity should be assured
- Evaluation technique must focus on learners' development and demonstration of learning achieved
- Appropriate and robust assessment tools must be developed and the process should be made explicit (provide detailed, well defined guidance)
- It is essential to provide both formative and summative assessments, yet important not to over assess
- An evaluation process that involves students, employers and clinical staff (including upward as well as supervisory evaluations) is recommended

Didactic Program

The following list constitutes elements the student must undertake in order to satisfy the educational aims and competencies.

Radiation Safety/Protection

This course provides the student with an understanding of radiation hazards and radiation protection requirements for the staff, patient and the general public, as well as the relevant legislation, thus enabling effective application.

Quality Assurance

This course provides the student with the understanding and skills necessary to evaluate the procedures and imaging/treatment systems thus ensuring the provision of safe and efficient service to the patient, clinician, employer, and other members of the health care team

Technique/Procedures

This course provides the student with the concepts and skills required to perform required procedures under a variety of conditions. Attention must be paid to the integration of the theoretical concepts and laboratory techniques with clinical applications.

Equipment

This course provides an understanding of the operation and maintenance of all equipment used, thus enabling the student to competently use the equipment.

Human Diversity

This course is designed to promote better understanding of patients through comparison of diverse populations based upon value systems, cultural and ethnic influences, communication styles, languages, socioeconomic influences, health risks and life stages.

Health Care Environment

This course examines the Health System at the federal, provincial, regional and/or municipal levels. It includes systems theory and its use in understanding the health system, acute and long-term care, institutional elements, community, environmental and occupational health, health promotion and disease prevention, health staffing issues, alternate forms of care and future trends.

Medical Sciences

These courses give students an understanding of the structure, function and disease patterns of the human body. The courses should include anatomy, physiology, pathology and biochemistry.

Physical Sciences

These courses provide students with an understanding of general and radiation physics necessary for application to the various forms of ionizing and non ionizing radiation

Radiobiology

This course gives students an understanding of cell biology in humans and the effects of ionizing radiation on the human body.

Mathematics/Statistics

Mathematics forms the basis for an appreciation of scientific principles. A basic understanding of statistics and statistical analysis enables the student to understand and analyze data produced.

Management

This course provides the student with an understanding of management and organizational theory, and an opportunity to develop his knowledge and skills in the management process.

Research Methodology

This course gives the student an opportunity to understand and use the elements involved in the research process.

Nursing/Patient Management

This course provides the student with an understanding of the concepts of patient care including the patient's physical and psychological needs as well as cross-infection prevention techniques. The student will be able to undertake a number of routine and emergency procedures in a variety of circumstances.

Applied Ethics

This course fosters abilities and values required for ethical conduct at work including the need for confidentiality. The student develops skills in logical analysis, a working knowledge of moral principles and theories, and the ability to diagnose and resolve moral disagreements commonly found in the workplace.

General Education Courses

These courses are included with the aim of achieving the following objectives:

- a) To make the student an effective communicator
- b) To enable the student to develop outside interests
- c) To enable the student to reflect on and to take his place in society

A list of courses may include:

Behavioral Sciences (e.g. Psychology, Sociology)

These courses will provide an understanding of human development and behavior.

Communication skills

These skills will enable the student to interact/function effectively in various situations.

Computer Science

This course will provide the student with an understanding of the principles in the operation of the computer and its associated technology. The course will also provide the necessary skills to effectively apply the technology.

Elective Courses

These courses/activities will provide the student with an opportunity to pursue a particular interest at the institution. These courses may not necessarily be related to radiographic technology, e.g. computer languages, economics, philosophy, health and fitness courses, activities in the national society/students' union but must be weighted such that they form a very minor course requirement. (This list is by no means exhaustive and can be modified to suit the local conditions).

8. CERTIFICATION

It is essential that, on completion of the programme, students receive some form of certification that will ensure professional recognition not only from their own profession but also from allied professions. The programme, therefore, should be established under the auspices of an institution that may grant such an award or, if established separately, care must be taken to ensure the graduates have recognized professional standing. Integral to this is the requirement that the programme has validation or accreditation with the professional agency if there is to be no external examination.

9. MAINTENANCE OF STANDARDS

Internal

The education institute must have its own on-going, defined programme of evaluation of the educational process and a mechanism for correction/ adaptation where this proves necessary. This should include a review on at least an annual basis of examination/assessment results, examiners' comments (internal and external where appropriate), and reports from clinical placements and other interested parties.

The person/team responsible for the programme must propose a course of corrective action if and when required and subsequently report on its effectiveness at a pre-determined interval.

External

It is expected that countries will have their own systems of periodic review in which the national association and any accrediting body will be involved. Where only one training program exists within a country, it is recommended that an external evaluation programme with other countries having similar programmes be instituted. Consideration could be given to the use of accreditors from other countries when assessing international standards of education.

Program Accreditation/Validation

Accreditation is an external audit for educational programmes and is a mechanism by which recognition is granted to educational programmes that meet or exceed established standards.

Accredited programs should incorporate these key dimensions:

- Responsive to the needs of the profession to allow development and expansion of professional roles
- Stated outcomes should acknowledge clinical capabilities of graduates
- Assessment strategies should allow clinical competence to be demonstrated in addition to academic knowledge through the use of role play, OSCE, image interpretation and critique, clinical competency tasks, volume and variety of experiences, clinical practical ability assessment (use clinical portfolio to provide evidence)

A partnership approach gives a breadth of expertise to the process

Quality Assurance systems that measure satisfaction/relevance/employment, etc., through a system of Performance Indicators can be done by the programme itself without having to involve an external agency, if such an agency does not exist.

10. LIFE-LONG LEARNING

The education programme that has been described gives a sound foundation in the broad aspects of medical radiation technology. This must be viewed as a starting point from which depth of knowledge in specialist areas must be acquired. The need for specialist education has become more urgent with the proliferation of new technologies

and information in radiation medicine and post qualification courses should be established. Technologists must have the opportunity to keep abreast of the ever-changing technology.

Serious consideration should be given to promoting higher education for teaching personnel.

A continuing education programme should provide for better avenues for an appropriate career structure in the profession.

Professional development and continuing education programs should be structured to stimulate critical thinking and enhance the ability to retain and use the knowledge acquired.

Graduates must be encouraged to use the internet to locate Distance Education Courses for which they could enroll. Many Associations affiliated with the ISRRT have information on their respective web sites that are linked to the ISRRT website at www.isrrt.org

Workshops and Seminars can be organized by local associations and by educational institutions and schools for graduate technologists.

Graduates and students should be encouraged to attend conferences and Congresses of their profession. The scientific sessions and technical exhibitions provide the opportunity to keep up-to-date with technological advances.

11. INTERFACE WITH LEGISLATION, REGULATORY FRAMEWORKS AND KEY STAKEHOLDERS

In some countries MRTs are governed by legislative acts that determine the education program for radiographers within the country. It is important that institutions providing education for MRTs establish a working relationship with all stakeholders, including governments, to be an integral part of the establishment and updating of the educational curricula for MRTs.

Role of Legislation

- Purpose of legislation is to protect the public and also the practitioner
- It establishes authority and recognizes the professions
- It provides a lever for ensuring uniformity/transferability through standardization
- It is important that professionals have input into development of legislation involving the professional education and practice.

- Essential to have checks and balances in place
- Legislation must allow a certain amount of interpretation but should be as precise as possible so that its meaning is clear
- It should not stifle development by being too slow to amend to reflect wider changes
- Establish and maintain minimum standards

APPENDIX A

List of English sites on which education parameters/programmes are detailed for perusal and guidance

American Society of Radiologic Technology: www.asrt.org

The College of Radiographers: www.SOR.org

British Columbia Institute of Technology: www.bcit.ca

APPENDIX B:

ROLE OF THE MEDICAL RADIATION TECHNOLOGIST (MRT) (RADIOGRAPHER)

1.0 INTRODUCTION

This document has been produced by the ISRRT in consultation with all member countries with the following aims:

1. To help identify and clarify the role of the medical radiation technologist (MRT)
2. To clarify the responsibilities resting upon the MRT as a member of the health care team.
3. To facilitate the formulation of professional education programmes.

In this document, unless the context otherwise requires, all references in the masculine gender includes the feminine. MRT refers to Medical Radiation Technologists, Medical Radiological Technologists, Radiographers, Radiological Technologists, Imaging Technologists, **Radiation therapist, Sonographer, Nuclear Medicine Technologist**, and others who have successfully completed a nationally recognized education programme in the profession. It is recognized that different countries use different terminology.

The following detailed statements define the role of the MRT both overall and in the particular disciplines (Diagnostic Radiography, Radiation Therapy, Nuclear Medicine, Medical Ultrasound, Digital Imaging and Magnetic Resonance Imaging).

It is clear that a large number of factors affect the role which individual MRT's are asked to fulfill. These factors include the stage of technological development reached, local traditions, the size of the institution, the variety of work done by the health care team and the quality and availability of other staff. It, therefore, must be recognized that there will be variation both within and between countries as to what is acceptable practice.

2.0 RESPONSIBILITIES OF THE MRT

The MRT is the expert in integrating seven areas of key importance in the imaging or radiation therapy departments. The seven areas include patient care, use of technology, optimization of dose, clinical responsibility, organization, quality assurance and education and training. The role of the MRT in each of these areas is outlined:

2.1 PATIENT CARE

The MRT has both a direct and a supervisory role with regard to the welfare of the patient in his or her care. This is a prime responsibility of the MRT. The welfare of the patient will depend upon:

- a) recognition by the MRT of relevant physical and psychological factors which may affect the patient, together with an understanding of the patient's social and cultural needs and a reporting of these when necessary.
- b) the MRT making appropriate arrangements for the patient's general safety and comfort.
- c) the MRT ensuring that all required information is present and correct, and that correct identification procedures are carried through.
- d) the patient giving informed consent to the required procedure.

- e) the MRT fulfilling the requirement to use all appropriate facilities and methods to prevent cross-infection.
- f) all ethical considerations being met.

2.2 USE OF TECHNOLOGY

The MRT tends to specialize according to whether patients require diagnostic imaging using either ionizing or non-ionizing radiation, or treatment using ionizing radiation. The MRT is the only expert in the production of diagnostic images or in the delivery of such treatment.

2.3 OPTIMIZATION OF DOSE

ICRP 36 states that MRTs are in a key position regarding radiation protection of the patient and will, by their “skill and care determine, within wide limits, the amount of radiation administered”. The MRT must therefore:

- a) be able to interpret and apply all relevant laws, rules, regulations and recommendations relating to the application of ionizing radiation to patients and staff
- b) understand both the somatic and the genetic hazards which are consequent upon the medical and research uses of ionizing radiations, and to be able to explain these in appropriate terms to inquiries
- c) by their attitude, authority and maintenance of current knowledge, help in the control of use of radiation for medical purposes.
- d) the MRT should be prepared to act as ‘Radiation Protection Supervisor’.

2.4 CLINICAL RESPONSIBILITY

The MRT’s prime expertise and responsibility is to undertake the whole range of techniques in diagnostic imaging and/or radiotherapy, and to subsequently assess the quality of his own work. The MRT must be professionally accountable for his actions, make judgments as to his professional limitations and maintain confidentiality of information.

2.5 ORGANIZATION/MANAGEMENT

Depending upon the level in the organization to which an MRT is appointed, he has the responsibility for proper and efficient organization of his work, use of resources and the application of departmental policies for the area for which he is responsible.

2.6 QUALITY ASSURANCE

All areas of the MRT’s responsibility require quality assurance procedures. In all specializations, he MUST be a full member of the team that develops, maintains and monitors the quality standards of the department. If no program is in place, then the MRT has the responsibility to initiate one, and to ensure its implementation.

2.7 EDUCATION AND TRAINING

As a professional practitioner the MRT has the duty to update and maintain his practice in line with developments and to apply proven research results that benefit patients.

The MRT working in the clinical situation must be involved with the clinical education of the MRT student. The MRTs' qualifications, abilities and role enable him to advise, instruct and supervise other staff in appropriate circumstances. In addition, he may be required to participate in the theoretical training of the students other professionals and the general public.

The above section refers in general terms to the responsibilities of all MRTs in whatever specialty they may practice. The following sections give more specific advice as to the role in particular areas.

3.0 THE ROLE OF THE MRT IN A RADIODIAGNOSTIC DEPARTMENT

In the modern diagnostic department, imaging modalities commonly include general radiographic and fluoroscopic examinations, digital imaging, ultrasound, nuclear medicine and magnetic resonance imaging.

3.1 PATIENT CARE

The MRT will undertake imaging procedures only if he has ascertained that:

- a) the patient has been properly identified
- b) no previously performed imaging procedure has already provided the information requested.
- c) a relevant clinical history has been obtained from the patient prior to the x-ray examination, and that an appropriate examination has been requested OR if not, that referral to an appropriate member of the medical staff occurs
- d) no concurrent treatment or investigation will prevent a good result
- e) any preparatory instructions or pre-medication and/or contrast media order have been administered correctly
- f) appropriate after care is carried out
- g) recommended procedures to protect the unborn child are applied
- h) all precautions are taken to prevent cross-infection
- i) all ethical guidelines are followed.

3.2 PATIENT POSITIONING

It is the responsibility of the MRT to position the patient and film and direct the X-ray beam in such a way that the final image is optimum. The following aspects must be considered:

- a) the patient's comfort
- b) immobilization
- c) departmental protocols and necessary modifications
- d) radiation protection for all present

3.3 EXPOSURE FACTORS

It is the responsibility of the MRT to select suitable combination of exposure factors and image recording materials to produce the correct radiographic densities and image detail (sharpness), allowing for the patient's condition. The following aspects must be considered:

- a) the penetrating power of the beam
- b) correct usage of any automatic exposure device or MA-time-distance combinations
- c) the focus size selected and the tube rating
- d) the use of all possible and appropriate equipment to limit primary and secondary radiation
- e) the image recording systems selected, and the processing required

3.4 RADIATION PROTECTION AND OPTIMIZATION OF DOSE

The MRT has a major responsibility relating to somatic and genetic hazards arising from ionizing radiation.

The following aspects must be considered:

- a) the equipment is fit for its purpose
- b) there is proper filtration of the primary beam
- c) there is proper selection and use of accessories which control the radiation during each exposure
- d) appropriate gonad protection is used
- e) recommended procedures to protect the unborn child are applied
- f) the MRT reacts appropriately to "incidents" involving the use of ionizing radiation
- g) any regulations or local rules are obeyed
- h) the MRT keeps up to date with current requirements

3.5 IMAGE RECORDING

It is the responsibility of the MRT to maintain and control all the steps involved in the production and storage of a permanent and/or visible image. He should be able to judge subsequently whether the image is of sufficient standard for a report to be given. The MRT is responsible for the following aspects:

- a) the processing equipment and chemicals are in good order and safe to use
- b) image quality is optimum for its purpose
- c) identification is correct, complete and permanent (this is a medico-legal requirement)
- d) documentation is completed before the image is presented to the appropriate member of the medical staff

The MRT may have to include in his responsibilities the need to describe radiographic appearances to clinicians and the requirement to notify when non-routine appearances are seen.

3.6 EQUIPMENT

The MRT must be able to use and care for equipment in such a way that:

- a) there is minimum possible hazard to patient, staff or to any other person
- b) there is no unnecessary irradiation of the patient, staff or any other person
- c) any error in the final radiographic image is not due to incorrect use of equipment
- d) the equipment is used safely and correctly
- e) the performance of the equipment is constantly monitored.

In order to fulfill these functions, the MRT must be able to:

- a) check that the equipment provided is in satisfactory working order
- b) carry out whatever checks and tests are required to monitor the performance of the equipment

The MRT is responsible for:

- a) ensuring that all testing equipment required to carry out function tests is available to the departments and is in good working order
- b) reporting any defects in equipment or its function and ensuring that the necessary repairs are requested from the appropriate person
- c) ensuring that the equipment and its environment does not present a health hazard
- d) selecting from the range of equipment and accessories provided, those items which will help produce the best radiographic image, taking into account department protocols.

3.7 RESPONSIBILITIES IN DIGITAL IMAGING

The MRT is responsible for:

- a) applying a detailed knowledge of cross-sectional anatomy in order to be able to correlate the position of the patient with the required three-dimensional information
- b) selecting programmes
- c) giving advice as to the likely quality of the image using the parameters selected, e.g. use of compensating filters, selection of exposure factors or pulse sequences, use of accessory equipment, etc.
- d) recording, adapting and reconstructing data to obtain optimum image quality

- e) the storage and retrieval of information
- f) assessing the resultant images for suitability for interpretation and diagnosis.

3.8 EXAMINATIONS REQUIRING A MULTIDISCIPLINARY APPROACH

It is the responsibility of the MRT to cooperate with the radiologist or trained clinician with procedures such as:

- a) fluoroscopy and image intensification
- b) complex radiological examination such as angiography and treatment procedures
- c) radiographic examinations carried out external to the main department such as the operating room or cardiac laboratory.
- d) other imaging modalities

The MRT's responsibilities in these situations may include the coordination of the examination, in addition to the following:

- a) preparation and use of equipment
- b) patient care and positioning
- c) the selection of exposure factors
- d) optimization of dose
- e) documentation of the procedure and image recording

4.0 ADAPTATIONS TO THE DESCRIPTION OF THE ROLE OF THE MRT WHEN EMPLOYED IN THE MEDICAL ULTRASOUND DEPARTMENT

4.1 INTRODUCTION

Medical Ultrasound is a specialty utilizing non-ionizing radiation. It is more operator dependent than any other imaging modality and is thus very demanding on the understanding and evaluative skills of whoever operates the equipment. In addition to the previously itemized role, the sonographer requires a complete understanding of the relevant anatomy, physiology and pathology, as well as the physics of the instrumentation.

4.2 PATIENT POSITIONING

The part to be examined should be demonstrated by means of either standard scanning techniques or any acceptable modification.

Immediate improvisation from standard procedures due to information obtained from the on-line image is an essential skill.

4.3 EQUIPMENT SETTING

It is the responsibility of the MRT to select the optimum factors in order to obtain an image suitable for its purpose. This will include:

- a) choice of transducer

- b) gain settings and other related factors
- c) selection of the recording system

4.4 IMAGE RECORDING

It is the responsibility of the MRT to maintain and control all the steps involved in the production and storage of a permanent and/or visible image. He must be able to exercise judgment as to whether the image is of sufficient standard for a report to be given either by the MRT or another appropriate professional.

4.5 OPTIMIZATION OF DOSE

The exposure of patients to ultrasound energy must, at all times, be kept to a minimum consistent with the production of a satisfactory result.

4.6 CLINICAL RESPONSIBILITY

The MRT must be able to:

- a) differentiate between artifacts, pseudo echoes and genuine appearances
- b) recognize anatomical and pathological structures
- c) recognize electronic equipment limitations.

Where relevant education and training has occurred and where authorization has been given, an MRT may give a description of appearances and/or a verbal or written report as required.

5.0 ADAPTATIONS TO THE ROLE OF THE MRT IN MAGNETIC RESONANCE IMAGING/SPECTROSCOPY (MRI & MRS)

5.1 PATIENT CARE

The MRT must:

- a) carefully prepare the patient in order to reduce anxiety and minimize the incidence of refusal due to claustrophobia
- b) screen the patient prior to the examination for metallic and other items sensitive to magnetic fields in order to prevent accidents and the appearance of artifacts on images.

5.2 EQUIPMENT

The MRT must have an understanding of the basic physical principles and, through competence in the operation of the equipment, be able to select

- a) pulse sequences

- b) tissue variables, T1, T2, proton density and flow
- c) signal acquisition
- d) and use accessory equipment

5.3 SAFETY

The MRT must be aware of the extraordinary hazards of strong magnetic fields which affect a variety of equipment in common use. He must always assess both people and equipment entering the area and take appropriate action.

6.0 THE ROLE OF THE MRT IN A NUCLEAR MEDICINE DEPARTMENT

6.1 PATIENT CARE

The MRT will only undertake imaging or treatment procedures after it has been ascertained that:

- a) the patient has been properly identified
- b) all work and patient areas are in a state suitable for patient treatment
- c) the patient is not taking any drugs which will prevent accurate results
- d) the patient has not previously undergone any test or treatment which will prevent an accurate result
- e) any preparatory drugs have been taken or administered correctly
- f) any necessary preparation has been completed
- g) a pregnancy check has been completed for appropriate patients, and that if positive, appropriate action has been taken
- h) patients have been counseled regarding any precautions they need to observe in their normal lives because of the radioactive nature of the pharmaceutical administered (this refers in particular to nursing mothers)

6.2 RADIO PHARMACY

The MRT should be able to prepare simple and complex radiopharmaceuticals. This includes:

- a) setting up the radionuclide generators
- b) eluting a generator and measuring the activity of the elute
- c) calculating the correct volume and activity
- d) aseptically labeling the radionuclide in a form suitable for clinical use

The MRT should be able to carry out “in vitro” measurements on specimens from patients who have received diagnostic or therapeutic doses. This includes:

- a) using equipment correctly, checking daily with the standard
- b) counting and recording the background activity
- c) using the recorded data and carrying out the required calculations
- d) ensuring that data identification is correct, complete and permanent

6.3 ADMINISTRATION OF RADIOPHARMACEUTICALS

The MRT will:

- a) assist and/or perform intravenous or oral administration of radionuclide to patients
- b) ensure that the dose to be administered is correct (radiopharmaceutical and radioactivity)
- c) keep an accurate dosage record to include the time administered

6.4 EQUIPMENT

The MRT is responsible for:

- a) selecting, from the range of equipment and accessories provided, those which are most appropriate for the examination requested
- b) checking that the equipment provided is in satisfactory working order
- c) in the event of the equipment developing a recognizable fault, the MRT is responsible for reporting its presence, requesting the necessary repairs, completing the appropriate documentation and any other appropriate action.

6.5 PATIENT POSITIONING

It is the prime responsibility of the MRT to:

- a) ensure correct positioning of the patient in all aspects to produce the optimum image
- b) to mark the image in such a way that anatomical topography of apparent, but no part of the image should be altered or obscured by markers in any way which might lead to incorrect diagnosis.

6.6 OPERATING PARAMETERS

It is the responsibility of the MRT to select the optimum factors to include:

- a) selection of accurate energy windows for the radionuclide being used
- b) selection of suitable collimation
- c) selection of the recording systems

6.7 IMAGE RECORDING

The MRT is responsible for:

- a) ensuring that any required data analysis has been completed using appropriate programmes
- b) that the relevant image data has been recorded and stored appropriately and can be retrieved

6.8 RADIATION PROTECTION AND OPTIMIZATION OF DOSE

The MRT has the major responsibility relating to hazard from ionizing radiation. Additional and specific hazards exist because of the use of unsealed radioactive sources. The MRT must:

- a) keep records that include details of reception, storage, administration and disposal of radioactive materials
- b) ensure that the storage and shielding of the radioactive materials is according to the national and local rules
- c) prevent radioactive contamination of persons, equipment, and the environment
- d) take appropriate action following radioactive contamination following set departmental codes of practice
- e) carry out correct reporting procedure following a radioactive contamination
- f) check that the administration of a therapeutic dose is carried out with the minimum radiation hazard to patient and staff
- g) supply adequate instructions for the protection of staff and other persons coming into contact with patients who have received large amounts of diagnostic or therapeutic radiopharmaceuticals
- h) organize the disposal of radioactive waste from patients, as required by the local regulations of the department and/or country
- i) be prepared to act as a radiation protection supervisor

6.9 QUALITY ASSURANCE

Quality Assurance plays a vital role in a Nuclear Medicine Department. The equipment is very sensitive and regular checks are required to ensure that it is performing within parameters. Accurate calibration of instruments is of the utmost importance. Many tests are concerned with counting and statistical variations. The points mentioned provide a comprehensive list of the activities the MRT is expected to perform.

To carry out the programme of quality assurance it is necessary for the MRT to have an understanding and experience of all tests and test equipment involved so that he may:

- a) ensure that all testing equipment is available when required and is in good working order
- b) use the test equipment appropriately

- c) monitor the environment, (to include patient and staff areas) regularly
- d) recognize a fault when it occurs and prevent the use of inaccurate data
- e) ensure the imaging equipment is functioning to agreed standards before undertaking an investigation.

7.0 THE ROLE OF THE MRT IN A RADIATION THERAPY DEPARTMENT

The MRT prepares, checks and administers treatment in accordance with the prescription of the radiation oncologist. The MRT's responsibilities also include localization, radiographic recording and marking of treatment areas and the production of moulds. In addition, the MRT has an important role in the guidance and counseling of patients and their families. This section includes both teletherapy and brachytherapy, although separate paragraphs will be used where appropriate.

7.1 PATIENT CARE

The MRT will undertake treatment of a patient only if he has ascertained that:

- a) the patient has been properly identified
- b) counseling of the patient, their partners and family has occurred
- c) organizing and ensuring that the patient has received all necessary prior treatments (e.g. dental), and advice (e.g. diet)

The MRT is responsible for:

- a) the patient's physical and psychological comfort throughout the treatment
- b) ensuring effective communication with the patient and family at all times
- c) continuous observation of the patient during treatment
- d) advising the patient about the treatment and its side effects, in conjunction with other professionals
- e) monitoring the reaction of the patient to treatments, recognizing significant changes and taking appropriate action. This may be in cooperation with a medical officer.

7.2 TREATMENT PLANNING

The MRT must be (responsible for and) able to:

- a) interpret and check the prescription and planning instructions of the radiation oncologist
- b) aid in the localization by means of fluoroscopy and/or CT scanning, and perhaps MRI, and the checking by means of simulation the treatment area(s) and/or source configurations
- c) produce a treatment. This may be in cooperation with other professionals

- d) aid in the design and production of customized immobilization and protective devices (moulds, compensating filters, etc.)

7.3 EQUIPMENT

The MRT must be able to use and care for the equipment, including sealed radioactive sources and after-loading equipment so that:

- a) there is no hazard to patients, staff or to any other person
- b) there is no unnecessary irradiation of the patient, staff or any other person
- c) any malfunctions or damage incurred to the equipment is reported immediately and recorded
- d) it is used safely and correctly and its performance is constantly monitored

In order to fulfill these functions the MRT must be able to:

- a) ensure that appropriate calibrations and checks have been carried out
- b) ensure that the testing equipment is available and in good working order
- c) carry out checks of performance of equipment according to department protocols, record the results, and where these do not meet departmental requirements, report them to the appropriate personnel
- d) maintain accurate and comprehensive records regarding equipment performance (including repairs and modifications)
- e) ensure that the equipment and its environment are kept clean and in order so that there is no hazard
- f) continuously monitor the performance of the equipment during treatment
- g) prepare radioactive sources and the programming of after-loading devices
- h) prepare and care for radioactive sources during their application in the special situation of the operating theatre. This may include surgical sterile procedures.

7.4 PATIENT POSITIONING

The MRT must interpret, check and implement the setup procedure prescribed by the simulation and treatment planning department with regard to:

- a) the position of the patient
- b) the direction of the radiation beam(s)
- c) the choice and use of necessary equipment
- d) the daily total dose and fraction(s) used
- e) the energy and types of radiation

- f) the treatment parameters and the necessity for the use of accessory equipment
- g) proper immobilization of the patient

7.5 TREATMENT RECORDING

The MRT must record treatment according to protocols, consideration being given to the following:

- a) verification
- b) registration - the result of verification
- c) use of portal (transmission) imaging
- d) use of “in vivo” dosimetry

7.6 RADIATION PROTECTION AND OPTIMIZATION OF DOSE

The MRT has a major responsibility relating to somatic and genetic hazard from ionizing radiation. The following aspects must be considered:

- a) accurate application of the prescribed treatment techniques
- b) application of department protocols
- c) an understanding of the most recent regulations on radiation protection and their application
- d) appropriate reaction to possible accidental exposures in relation to the use of radiation

7.7 TREATMENTS REQUIRING A MULTIDISCIPLINARY APPROACH

It is the responsibility of the MRT to cooperate with the radiation oncologist, trained clinician or diagnostic imaging department. Examples are procedures such as the placing of applicators within the patient (intracavity, interstitial and intraluminal) and localization and simulation using CT, MRI and/or other modalities.

8.0 THE ROLE OF THE MRT IN ORGANIZATION ASPECTS (MANAGEMENT)

The scope and area of responsibility of the MRT in organization will vary with the level of seniority to which he is appointed. As the level of seniority rises, it is expected that the organizational element of his role will increase.

Elements which need to be considered include:

- a) the MRT has to ensure the highest possible standard of service to patients at all levels and ensure that standards are maintained and improved
- b) set objectives and goals for the department or area
- c) communicate with, organize and motivate department staff

- d) participate in the selection and appointment of staff where appropriate
- e) ensure that good quality 24 hour service is maintained where appropriate
- f) ensure that the required statistical information is kept and is available in order to enable the provision of an efficient service
- g) ensure compliance with all legislation relating to the MRT and that local application is updated
- h) provide advice on the subject of an MRT's expertise to management and others and to cooperate with them on items of common interest
- i) to be a member of the planning team in any departmental developments that include equipment, protocols and utilization of resources
- j) to ensure that stocks and supplies are kept at an optimal level within the agreed departmental budget and are fit for the purpose for which they are to be used
- k) to communicate and cooperate on subjects of common interest with professionals within and outside the hospital
- l) to communicate with manufacturers' representatives on the current status of equipment and to ensure that its design and function meets future needs
- m) to ensure that national, hospital and departmental policies are carried out
- n) to ensure that staff are developed to their full potential
- o) to assist in the formulation of the education of student MRTs and to contribute to their teaching and training
- p) to contribute to the development of the profession

Development of this Document

A workshop to determine the feasibility of establishing international recommendations for Education systems was held in Lexington, Massachusetts, USA on October 24, 25 and 26, 2003. The main purpose of the meeting was to compare the various systems that are used throughout the world to see if common elements could be identified that would be applicable to an international recommendation for education systems and, if so, should the ISRRT proceed to develop such a document. All member societies were invited to participate and those who were unable to be represented were invited to send written submissions.

A total of 23 persons attended the workshop representing Australia, Canada, Denmark, Ireland, Japan, the United Kingdom and the United States of America. Also participating by invitation were representatives from the Joint Review Committee on Education in Radiologic Technology in the US (the US accrediting authority) and the American Registry of Radiologic Technologists (the registration body in the US). The ISRRT was represented by the Secretary General, Treasurer and the Director of Education. Each day of the three day meeting was divided into four sessions, with the final session of the meeting being devoted to summing up recommendations as to future activities.

This was an extremely productive meeting and all participants contributed significantly to the workshop. Those present gave their full support to the production of a document outlining international requirements. This document is a result of that decision, the discussions that took place at the workshop, and the follow-up review process of which all participants had the opportunity to review the document and comment.

The following individuals participated in the original meeting on behalf of their Associations:

AIR	Jo Smylie Pam Rowntree	IIR	Mary Coffey
ARRT	Shirley Pinette	JART	Kumagai Kazumasa Sakugawa Tetsu Kitamura Yoshiaki
ASRT	Lynn May Greg Morrison Eileen Maloney	JRCERT	Joanne Greathouse
CAMRT	Richard Lauzon Dorothy Gallagher Roberta McCammond	SOR	Hazel Harries-Jones Audrey Paterson Ethna Glean
FRD	Christian Hansen Johnny Jensen Claus Bruun Rasmussen	ISRRT	Terry West Sandy Yule Shirley Hundvik

A special thank you is expressed to all who participated and particularly to those individuals who contributed to the lengthy review process.