RECOMMENDATIONS FOR ACCREDITATION AND CERTIFICATION IN MEDICAL PHYSICS EDUCATION AND CLINICAL TRAINING PROGRAMMES FOR THE RCA REGION

I.D. McLean[1], B.J. Healy[2], K. Adhikari[3], N. Jamal[4], M. B. Kakakhel[5], A. Krisanachinda[6], J.C.L. Lee[7], K. H. Ng[8], S.A. Pawiro[9], K.A. Quadir[10], B. San Juan[11], B.J. Thomas[12], W.A.K. Wan Abdullah[13]

[1]The Canberra Hospital, Canberra, Australia, [2]Icon Group, Brisbane, Australia, [3]NAMS, Bir Hospital, Kathmandu, Nepal, [4]Planning and International Relation Division, Malaysia Nuclear Agency, Bangi, Malaysia, [5]Department of Physics and Applied Mathematics, Pakistan Institute of Engineering and Applied Sciences, Islamabad, Pakistan, [6]Department of Radiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, [7]Department of Radiotherapy, National Cancer Centre, Singapore, [8]Department of Biomedical Imaging, University of Malaya, Kuala Lumpur, Malaysia, [9]Department of Physics, Universitas Indonesia, Depok, Indonesia, [10]Bangladesh Atomic Energy Commission, Dhaka, Bangladesh, [11]Ministry of Health, Manila, Philippines, [12]Queensland University of Technology, Brisbane, Australia, [13]Universiti Sains Malaysia, Kota Bharu, Malaysia

Abstract— **In a regional environment of expansion of radiation medicine services, often associated with cancer treatment, it is critical that the medical physicist is equipped to play their critical role. This requires the successful implementation of education and clinical training for medical physicists to lift the quantity and quality of medical physicists. This in turn demands formal national governance structures consisting of accredited centres providing education and training and a nationally recognised process of certification of medical physicists against agreed international standards of best practice. Recommendations on accreditation and certification for the East Asia and Pacific region have recently been developed through an IAEA/RCA regional project. These advocate a three-layered approach with a multi-disciplinary national body responsible for national registration, a predominantly profession-based body to steer professional standard processes, and a specialised accreditation and certification board responsible for professional standards and their assessment. Accordingly, accreditation should be awarded to academic institutions and clinical training centres who have been assessed as being consistent with agreed educational standards. Similarly, certification should only be awarded to residents assessed, typically through written, oral and practical examination, as competent in the needed knowledge and skills for a clinically qualified medial physicist. The spirit of such recommendations is importantly one of promoting encouragement and improvement.**

Keywords— **medical physics, education, training, accreditation, certification**

I. Introduction

The Regional Cooperative Agreement (RCA) is an intergovernmental agreement between Government Parties of the East Asia and Pacific region, under the auspices of the International Atomic Energy Agency (IAEA). The aim of the RCA is to promote and coordinate cooperative research, development and training projects in nuclear science and technology through their members' appropriate national institutions (www.rcaro.org). Each Government Party appoints a National Project Coordinator (NPC) to collaboratively manage a specified regional project with the proposing Government Party appointing a Lead Country Coordinator (LCC). The list of RCA Government Parties can be found here www.rcaro.org/states. One area of training that the RCA has been supporting for some time is in medical physics, particularly encouraging sustainability through locally based education and training.

The IAEA/RCA regional project RAS6077 on "Strengthening the Effectiveness and Extent of Medical Physics Education and Training" is a multi-faceted project which attempts to address through one of its outputs issues of professional standards and recognition of the work of medical physicists. Two technical meetings were implemented to develop recommendations on accreditation of relevant education and training institutions and certification for medical physicists in the East Asia and Pacific region. This paper presents those recommendations which have been endorsed by the RAS6077 national project coordinators at their concluding meeting in 2017. These recommendations are addressed to professionals and administrators involved in the development, implementation and management of medical physics education and training programmes in the Asia Pacific region as well as informing those that utilise medical physics services in the diagnosis and treatment of cancer and other diseases. It is recognised that such recommendations may also have relevance outside of this region.

II. Background to accreditation and certification

The role of the medical physicist in radiation medicine is critical to the safe, effective and economic delivery of medical services that typically include radiation oncology, diagnostic radiology and nuclear medicine. The roles of a medical physicist as described recently [1] apply generally to the Asia Pacific region with lessons learnt from previous practice in radiation oncology [2] and in diagnostic radiology [3]. Furthermore, the region is undergoing increasing expansion in radiation medicine in both the complexity of technical innovation and in its general application to the population, due to the increasing living standards, aging population and expectation of medical services in the region. Medical physicists are uniquely placed to address needs in increasingly technical sophistication of service delivery as well as basic safety requirements, including shielding and occupational and patient safety. Unfortunately, medical physics workforce needs are not always met in the East Asia and Pacific region [4, 5], and expansion in radiation medicine services will place further stress on the current medical physics workforce.

The IAEA Basic Safety Standards [6] has defined the Medical Physicist as "a health professional, with specialist education and training in the concepts and techniques of applying physics in medicine, and competent to practise independently in one or more of the subfields (specialties) of medical physics". The IAEA [1] has also stated that a clinically qualified medical physicist (CQMP) must have:

- A university degree in physics, engineering or equivalent physical science;
- Appropriate academic qualifications in medical physics (or equivalent) at the postgraduate level;
- At least two years (full time equivalent) structured clinical in-service training undertaken in a hospital.

A CQMP is therefore one who has successfully completed an appropriate academic postgraduate medical physics degree and has successfully undergone an appropriate clinical residency training programme in a chosen speciality or subfield of medical physics.

In order to ensure that the above process has produced a CQMP with the level of expertise needed to practise independently in one or more specialisation of medical physics, the CQMP needs to be certified by an appropriate professional certification body. In a similar way the integrity of both the postgraduate education and the clinical training programmes need to be assured through the accreditation of these programmes, by an appropriate accreditation body. There have been commendable efforts by many East Asia and Pacific countries in establishing medical physics education and training, but more effort is required in fully implementing the international recommendations on accreditation and certification throughout the East Asia and Pacific region. Regional cooperative initiatives rather than individual national initiatives may be required to create self-sustaining education and training programmes.

The above certification and accreditation bodies may exist separately or as one board. This may vary from country to country. In any case the board(s) must be independent and duly appointed for their purpose. For simplicity in this document we shall refer to a joint accreditation and certification board (ACB) which might need to be expanded appropriately for multiple specialities. Such a board, although independent, is closely associated with the appropriate national or regional professional body and will be largely composed of appropriate professionals from the professional body, ideally represented by the official professional society for medical physics. The ACB will be responsible for setting the professional standards and criteria for accreditation and certification, as well as maintaining strict standards in the conduct of the accreditation and certification processes. The ACB is made up of at least two senior Clinically Qualified Medical Physicists (CQMP). In the absence of an ACB, the National Steering Committee (NSC) will assume this responsibility and make the arrangements for the appointment of suitable external examiners. Three independent ACBs (Radiation Oncology, Diagnostic Radiology, and Nuclear Medicine) can be set up. Alternatively, a single board having expertise in all sub specialities can be constituted. The ACB functions in some capacities in a similar way to a national steering committee mentioned in the IAEA clinical training guides TCS 37, 47 and 50 although the national steering committee as described applies only to clinical training and the processes necessary to maintain its integrity and standards

A formal health care industry recognition of CQMP by the appropriate National Responsible Authority (NRA) is a realistic expectation since the medical physicist profession has been recognised by the International Labour Organization (ILO). The NRA would most likely be an arm of government. In order for the certification process to be effective within the health care industry, the process needs to be recognised by an appropriate NRA that is able to grant registration for a CQMP. Ideally this would be done directly by a suitable government body (such as the Ministry of Education, or Ministry of Health), since registration of professions is usually a function of government. However, in some cases another professional body (for example from the medical profession or a university) may be required as an intermediary to allow government recognition. A simplified generic outline of the association of bodies and process in medical physics accreditation and certification is given in Fig. 1. Note that the IAEA TCS publications on medical physics clinical training [7-9] refer to a National Steering Committee (NSC) for oversight of the programme. The NSC would typically appoint a training coordinator with needed support mechanisms for successful administrative and training outcomes. However in some countries this role is taken by the medical physics Professional Body. Note the ACB is independent of the national steering committee, even if composed of national steering committee members. A professional body acting as the national steering committee must be legitimately operating in the country having complied with the relevant government requirements. If there are two or more competing professional bodies in the country the NRA would need to recognise only one and this would likely be the professional body which has the largest membership. Also, the role of the NRA is simply recognition of the process which in turn enables the national level of the registration process.

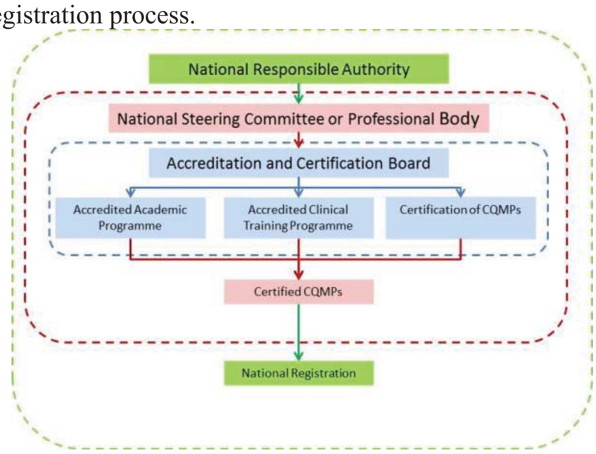

Fig. 1 Outline of generic relationships between the accreditation and certification board (ACB), national steering committee (NSC) and national responsible authority (NRA)

In order to maintain and enhance their professional competence, and their ability to work independently, CQMPs should undertake a continuing professional development (CPD) programme which ideally would be determined and overseen by the ACB (Fig. 2). Such a programme should include attendance at national and/or international conferences, publications in refereed journals and courses on topics related to their field of specialization.

While the outline processes for CQMP certification and associated accreditations is designed to ensure the quality of medical physicists practicing in a country, attention also needs to be given to the competitiveness of the provision of medical physicists in an environment of unparalleled expansion in the development of radiation medicine in the Asian region [10-12]. The need for workforce expansion should clearly be balanced against the need for competently trained personnel in the name of efficacy of patient services and patient safety. Added to this imperative is the management of a transition to higher qualifications inherent in a new and evolving certification process, where established persons, currently performing medical physics roles need to be carefully considered.

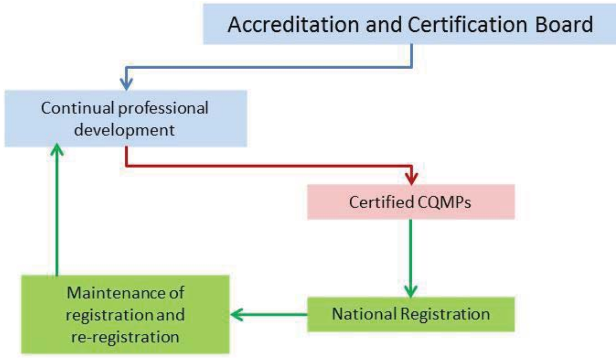

Fig. 2 Abridged outline of generic relationships involved in the maintenance of national registration through the use of continual professional development (CPD) ideally under the oversight of the accreditation and certification board (ACB). Note that a national registration process by an NRA is required before registration and or re-registration occurs. This process also allows the enforcement of a CPD requirement for the lifelong learning of the CQMP

When the NRA assumes a major role in the registration process of CQMPs in the regulated health care industry, it is also assumed that there is an adequate number of CQMP to satisfy the manpower requirements of the country or the region. Essentially what this means at the time of writing, is that there is a need for an increase in CQMPs by a factor ranging from 2 to 10 in many of the Asian countries in the RAS6077 technical cooperation project. While many of the factors needed for such an expansion in CQMP numbers are beyond the control of the profession, accreditation and certification processes need to be carefully designed nationally and perhaps regionally in such a way so as not to obstruct expansion in the profession. Further consideration needs to be given to upgrade paths to allow existing personnel and migrating personnel to have a manageable path to be recognised as CQMPs as appropriate. Having ACBs across the Asian region adopting a common set of accreditation and certification criteria will also benefit from mutual training support, shared resources and cross-border recognition of CQMP.

III. RECOMMENDATIONS FOR ACCREDITATION OF MEDICAL PHYSICS ACADEMIC PROGRAMMES

Accreditation is the formal process by which an independent recognized body (professional and/or governmental) evaluates and recognizes that an academic programme or a clinical site meets pre-determined requirements or criteria. It is highly desirable that both the postgraduate academic programme and the clinical residency be formally accredited by a professional body authorized by the government or by a relevant government office. It is emphasized that a system of accreditation does not constitute a permanent status, and should be renewed periodically [1].

A compulsory component of a physicist's education and training to become a clinically qualified medical physicist specialist, certified in a particular specialty area, is the acquisition of an appropriate postgraduate degree in medical physics. The professional body and the universities collaborate to enable universities to provide this essential component.

While the accreditation of medical physics postgraduate programmes can be viewed as a voluntary process, for example for research focussed institutions, the emerging trend is for accreditation of medical physics postgraduate programmes to be mandated, especially when linked to a certification process by a professional body. A typical accreditation process for a postgraduate programme is given in Fig. 3 which illustrates that accreditation readiness can be achieved through self-assessment first be carried out internally within the university department before submission to the ACB. The assessment of the ACB is made against a number of criteria as seen below.

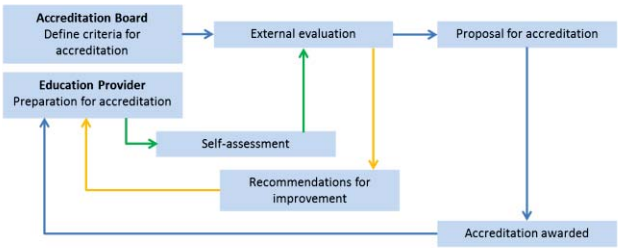

Fig. 3 Accreditation process flow chart

There are four assessment criteria for accreditation of medical physics postgraduate programmes, namely, admission criteria, faculty members, facilities and teaching modules.

Admission Criteria

The 3 to 4 year undergraduate degree of students entering a post-graduate medical physics academic programme should be in Physics or an equivalent relevant physical or engineering science. Because there are significant differences in the level and composition of tertiary education worldwide, it is often necessary for qualifications authorities to determine the local degree equivalence prior to student registration. For admission to the medical physics programme, it will in addition be necessary to examine the academic transcript of the degree and it is recommended that:

- At least 2 years of undergraduate level mathematics were completed successfully including:
    - Applied Linear Algebra
    - Advanced Calculus
    - Complex Variables
    - Differential Equations
    - Numerical methods;
- The following physics topics should be covered during undergraduate study. If not, they should be completed prior to entry into the postgraduate medical physics programme:
    - Electricity and Magnetism
    - Atomic Physics/Nuclear Physics
    - Quantum Mechanics
    - Classical Mechanics
    - Solid State Physics
    - Modern Physics and Relativity
    - Thermodynamics/Statistical Physics
    - Signal Processing/Fourier Transform
    - Physics of Fluids and Gases
    - Optics
    - Computational Physics/Computer Programming;
- The admission requirements for other individuals, who have already completed a graduate or post-graduate degree in any other field, should be the same.

Faculty Members

The academic faculty should include at least one instructor holding a PhD, in at least a physics related discipline, preferably with clinical experience in medical physics. The lack of faculty with a PhD will most likely limit the ability of the institution to offer the course at a post-graduate level.

The structure must therefore include a formal link with a clinical department, utilising medical physics services for radiation oncology, diagnostic radiology and nuclear medicine in a hospital setting. Such links should include both teaching and practical contributions. The university should recognise this input with an appropriate appointment for the staff involved. Costs incurred by the clinical department should be considered by the university.

Facilities

The university should have access to clinical equipment utilised in clinical radiation oncology, diagnostic radiology and nuclear medicine for practical experience. Such equipment is listed below.

Radiation oncology services should have:

- A teletherapy unit;
- A treatment planning system;
- A simulator (conventional and/or computed tomography (CT));
- Dosimetry and quality control equipment, including a 3D water phantom;
- A Brachytherapy facility;
- Access to medical imaging services.

Diagnostic radiology services should have:

- General X ray units;
- Fluoroscopy X ray units;
- Computed Tomography (CT);
- Mammography unit;
- Dental units;
- Ultrasound units;
- Dosimetry equipment and quality control tools;
- In addition, it would be advantageous to have access to dual energy X ray absorptiometry (DXA) unit, a solid state dosimetry system (TLD or OSL) and a magnetic resonance imaging (MRI) unit.

Nuclear medicine services should have:

- A gamma camera, single photon emission computed tomography (SPECT) or SPECT/CT system;
- Dose calibrator, probes and counters;
- Phantoms and calibration sources;
- Survey meters and contamination probes;
- Radionuclide therapy services;
- Internal dosimetry;
- In addition, it would be advantageous to have access to positron emission tomography (PET) or PET/CT.

Teaching Modules

Suitable measures need to be in place to maintain and develop quality and excellence in teaching and learning. Suitable methods of assessing and monitoring student progress need to be evident.

The academic modules contained within the medical physics programme should aim at preparing a student to conduct research and to apply critical and innovative thinking to problem solving. At least a small research project should be included.

A suggested core syllabus for an academic programme is given in Table 1. It is important that the modules have the necessary depth, breadth and balance in its requirements on intellectual effort. While it is not required that the units of study have the names shown in Table 1 the substance of the units are considered compulsory although there is some scope for flexibility in extending the syllabus to adapt the course to match local interest and expertise. Detail of typical core modules are found in IAEA TCS 56 [13], AAPM Report No.197 [14], ACPSEM [15], IPEM [16], and IOMP [17] academic programme guidelines. Practical sessions or laboratory work are possible in all modules, bearing in mind that one practical session could cover multiple modules. Examples of practical sessions or laboratory work are given IAEA TCS 56 [13]. A typical structure for a medical physics postgraduate programme, outlining core modules, contact hours and laboratory hours is given in Table 1.

Table 1 An example of a medical physics academic programme structure [13]

Module	**Weighting**	**Contact Hours**	**Lab Hours**
Anatomy and Physiology as applied to Medical Physics	5%	30	
Radiation Physics; Radiation Dosimetry	10%	40	10
Radiation Protection; Radiobiology	15%	50	
Professional and Scientific Development	10%	40	
Medical Imaging Fundamentals; Physics of Nuclear Medicine; Physics of Diagnostic and Interventional Radiology	20%	80	40
Physics of Radiation Oncology	15%	60	40
Advanced Subject or Additional Topics	5%	20	10
Research Project	20%	10,000 words	
Total	**100%**	**320**	**100**

IV. Accreditation of medical physics clinical training centres

As mentioned previously, it is highly desirable that the clinical residency programme as well as the postgraduate academic programme be formally accredited by a professional body authorized by the government or by a relevant government office.

The purpose of the clinical training is to provide medical physicists with relevant knowledge and appropriate problem-solving skills as part of the medical physics training programme in the selected speciality. The academic knowledge necessary for certification will be primarily acquired through the postgraduate educational component, however it is necessarily and extensively supplemented with knowledge acquisition throughout the training period.

Accreditation of a hospital facility for a medical physics clinical training programme in one of the specialties of medical physics is recognition that such a programme conforms to the guidelines such as IAEA TCS 37 [7], 47 [8] & 50 [9], AAPM [18], ACPSEM [19, 20], including general standards, physical and human resources and training activities. Hospital facility accreditation ensures their suitability in preparing medical physicists with the necessary depth and breadth of knowledge and clinical opportunities. Where an entire programme is not available in a single facility, accreditation may be granted to a training "network" provided the network can demonstrate a satisfactory method by which the required in-service clinical training can be achieved. Those who complete such a programme should be qualified for professional practice in one or more of the specialties of medical physics.

In reviewing a hospital facility for accreditation purposes, the ACB will consider general standards, physical resources, human resources and training activity as listed below.

General standards

- The resident must have the opportunity to be involved in a full range of (diagnostic radiology, nuclear medicine or radiation oncology, depending on speciality offered) medical physics services, consistent with national expectations. It is the responsibility of the hospital facility to arrange appropriate rotation of the resident to other clinical centres to fulfil these requirements, if considered necessary by the ACB;
- Appropriate arrangements should be made for university study as part of the course if applicable;
- Links are needed to appropriate universities for research as available;
- The performance of previous residents (where applicable) should be considered;
- The level of quality control practiced by the hospital facility as is evident from records of work undertaken should be reviewed;
- It should be noted whether the hospital facility is situated in a teaching hospital, or in a network with formal links to a teaching hospital.

Physical resources

- Adequacy of resources for the training of residents needs to be assessed, including access to major treatment or diagnostic equipment modalities (see Section 2.1.1), hardware such as physical phantoms, radiation detectors, test equipment, computing facilities, etc. and recommended text books and journals;
- The facilities available need to be reviewed including office space, equipment, libraries, internet access, e-resources, physics laboratories, workshops etc.;
- Facilities available for video conference and training need to be reviewed including access to audio visual facilities to permit the preparation of audio-visual aids for lectures, demonstrations and teaching.

Human resources

- The number of clinical medical physics staff in the hospital facility, their professional qualifications and experience needs to be reviewed. A minimum of 1 (full-time equivalent) clinically qualified senior medical physicist (or other medical physicists approved by the ACB) is recommended to be employed in the department for each resident. However local expertise might be supplemented by external online supervision if available and appropriate;
- If the full range of necessary skills in supervision is not present in the one hospital facility, a plan of how this required supervision expertise will be realised through a network of physicists should be available;
- A suitably qualified clinical supervisor is required (preferably not the hospital facility Head of Medical Physics in larger hospital facilities), responsible for overseeing the training programmes of residents in the hospital facility. Where more than two residents are employed, additional suitably qualified clinical supervisors should be appointed. The clinical supervisors must be senior medical physicists (or other medical physicists approved by the ACB).

Training activities

- The training programme must meet the recommendations made by the ACB;
- The hospital facility must ensure that the resident is given adequate time and training under supervision in all areas of the medical physics speciality such that the resident gains the required knowledge and competencies;
- The hospital facility must ensure records of supervision and a training evidence portfolio and logbook are kept by residents in the hospital facility. They are to be available for inspection by the ACB at any time;
- The clinical supervisor must meet regularly with residents and at these meetings progress must be reviewed in accordance with the appropriate clinical training guide (e.g. IAEA TCS 37[7], 47 [8], and 50 [9]). Formal documented performance evaluations are recommended to be performed as per hospital policy in conjunction with bi-annual external reviews by the National Programme Coordinator (NPC). The NPC is responsible for coordination of the clinical training programme nationally (the NPC role is defined in the IAEA TCS 37 publication [7]).

V. Recommendations for certification of medical physicists

The criterion for entry into a clinical training programme is a postgraduate degree in medical physics from an accredited institution. The clinical training programme involves a modular/competency framework based on a nationally adopted Clinical Training Guide (CTG). For step-by-step details on the conduct of a clinical training programme, which is beyond the scope of this document, the IAEA TCS 37 [7], 47 [8] and 50 [9] publications can be referred to for guidance.

For certification of medical physicists, a process of assessment needs to be in place (see Fig. 4). The assessment involves continuous monitoring of the progress of the resident by the clinical supervisor and formal external assessment by qualified examiners that report to and are directed by the ACB. The form of examination typically includes written, oral and if possible a practical component. As mentioned previously, in the absence of an ACB in the country, the NSC has the responsibility to appoint external examiners for the written examination and oral/practical examination.

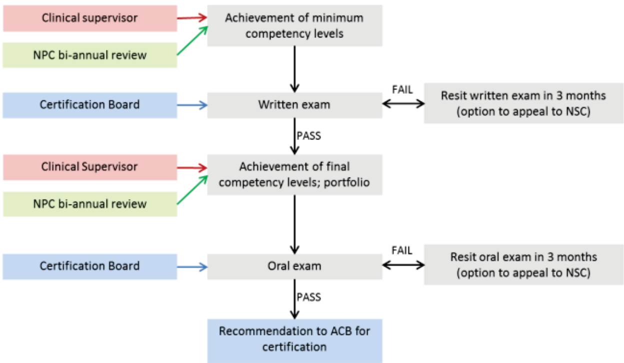

Fig. 4 Certification process flow chart

The length of clinical training programme is two years in one of three sub-specialities including core modules (with competency levels as directed by the Professional Body or NSC) and non-core modules. The CTG is the list of all modules and sub-modules along with the desired competency levels. The CTG is set by the NSC by adapting available international CTGs (e.g. IAEA [7-9], ACPSEM, AAPM [18]) while keeping in view the local needs. The roles and composition of the NSC are defined by the IAEA TCS 37 publication [7].

A portfolio is required to be maintained by the medical physics resident. The portfolio provides residents with an opportunity to demonstrate the breadth and depth of their knowledge on certain topics. The portfolio incorporates the follow documents:

- Curriculum vitae;
- Progress reports "Summary of Competency Achievement" demonstrating the level of competency achieved in each sub-module;
- Samples of work prepared by the resident from at least five of the modules of the CTG. The samples of work could be departmental reports, e.g. commissioning and clinical implementation of new equipment or treatment technique, assignments on key competencies, a research paper published in a peer-reviewed journal/ national or international conference or in-house presentations delivered covering key aspects of the core modules.

The clinical supervisor will examine the portfolio at regular (at least 6 monthly) intervals and provide feedback to the resident.

There will be bi-annual reviews by the NPC of the resident's progress. As part of the review the NPC will meet the resident and the clinical supervisor (individually) to monitor the smooth progress of the resident. The NPC will also review the resident's portfolio and rate the portfolio as satisfactory or unsatisfactory. An example of a review template is given as in Appendix II.

The resident is required to present once (oral or poster) at a national/international conference. The presentation must be completed before the oral examination.

Furthermore, the resident is required to maintain a logbook to record all activities in the clinical training programme for self-tracking and record purposes.

Written Examination

The written examination takes place after the achievement of a minimum level of competency in all of the core modules. The written examination is to be set and marked by examiners from the ACB or as appointed by the Professional Body or the NSC. A suggested written examination procedure is given as follows:

The written examination will consist of two parts. Part I: General Medical Physics (90 minutes for 45 multiple choice questions). Part II: Core modules (90 minutes for 45 multiple choice questions). The multiple choice questions will comprise five options with one correct answer. For successful completion of the written examination, the resident should score 60% or more in each part.

The written examination evaluation is sent to the NPC by the examiners. In case of a non-satisfactory examination report, a repeat examination (Part I or Part II or both) will be conducted with at least 3 months gap after the initial examination. Consideration needs to be given by the NSC as to the maximum number of fails each resident can make in the written examination before they are removed from the residency programme.

Oral Examination

The oral examination takes place after all elements of the clinical training programme have been completed. The oral examination will be conducted by at least two external examiners from the ACB or as appointed by Professional Body or the NSC. The questions are to be devised from the core modules, clinical scenarios and the submitted portfolio. The resident's clinical supervisor could participate in the oral examination as an observer. The recommended duration of the examination is between

90 – 150 minutes. Each of the set questions will receive a mark in the range 0 – 10. In order to pass the examination, the candidate must score 60% or more over in all questions asked and must score 50% or more in each module/scenario/portfolio. Consideration needs to be given by the NSC as to the maximum number of fails each resident can make in the written examination and/or practical examination before they are removed from the residency programme.

Practical Examination (If Feasible)

The practical examination takes place after all elements of the clinical training programme have been completed. The practical examination will be conducted by at least two external examiners from the ACB or as appointed by the Professional Body or the NSC. The clinical scenario given in the practical examination is to be devised from the core modules. The resident's clinical supervisor could participate in the practical examination as an observer. The duration of the examination is 2 – 3 hours.

Recommendation for Certification

After the accomplishment of the oral examination and practical examination if applicable, the result is sent by the examiners to the Accreditation and Certification Board (ACB)/NSC through the National Project Coordinator.

Appeal Process

An appeal process needs to be established by the Professional Body or the NSC. After the resident is notified of the result of written examination or oral/practical examination, he/she can file an appeal within two weeks to the NSC. The NSC would appoint suitable senior persons independent of the examination process and independent of the resident's hospital to conduct the appeal.

VI. Conclusions

The experience of RCA regional projects in medical physics has been that academic and clinical training programs in all medical physics specialties can be successfully run utilizing the above guidelines. Experience also reinforces the understanding that each Government Party is unique in its circumstance relating to the involvement of medical physicists in radiation medicine and the available educational and training opportunities. It is therefore suggested that the above recommendations be applied appropriately to create new or strengthen existing education and training processes needed to equip an increasing number of qualified clinical medical physicists to address needs in the region.

Acknowledgment

The authors acknowledge the financial support of the IAEA and RCA in facilitating the meetings through which this work was produced.

References

1. INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists, IAEA Human Health Series No. 25. IAEA, Vienna
2. INTERNATIONAL ATOMIC ENERGY AGENCY (2000) Lessons Learned from Accidental Exposures in Radiotherapy, Safety Reports Series No. 17. IAEA, Vienna
3. MATHEWS J D, et al. (2013) Cancer risk in 680,000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. BMJ 346 f2360.
4. KRON T, HEALY B, NG K H (2016) Surveying trends in radiation oncology medical physics in the Asia Pacific Region. Phys Med 32 883-888.
5. PAWIRO S A, et al (2017) Current Status of Medical Physics Recognition in SEAFOMP Countries. Medical Physics International 5:11-15
6. INTERNATIONAL ATOMIC ENERGY AGENCY (2014) Radiation protection and safety of radiation sources: International basic safety standards: General Safety Requirements Part 3, No. GSR Part 3. IAEA, Vienna
7. INTERNATIONAL ATOMIC ENERGY AGENCY (2009) Clinical Training of Medical Physicists Specializing in Radiation Oncology, Training Course Series No. 37. IAEA, Vienna
8. INTERNATIONAL ATOMIC ENERGY AGENCY (2010) Clinical Training of Medical Physicists Specializing in Diagnostic Radiology, Training Course Series No. 47. IAEA, Vienna
9. INTERNATIONAL ATOMIC ENERGY AGENCY (2010) Clinical Training of Medical Physicists Specializing in Nuclear Medicine, Training Course Series No. 50. IAEA, Vienna
10. KRON T, et al. (2012) Medical physics aspects of cancer care in the Asia Pacific region: 2011 survey results. Biomed Imaging Interv J 8:e10.
11. KRON T, et al. (2008) Medical physics aspects of cancer care in the Asia Pacific region. Biomed Imaging Interv J 4:e33.
12. KRON T, et al. (2015) Medical physics aspects of cancer care in the Asia Pacific region: 2014 survey results. Australas Phys Eng Sci Med 38:493-501
13. INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Postgraduate Medical Physics Academic Programmes, Training Course Series No. 56. IAEA, Vienna
14. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE (2009) Academic Program Recommendations for Graduate Degrees in Medical Physics, Report No. 197. AAPM, Maryland
15. AUSTRALASIAN COLLEGE OF PHYSICAL SCIENTISTS AND ENGINEERS IN MEDICINE (2013) Accreditation of University Postgraduate Courses in Medical Physics for the Purposes of the ACPSEM Training, Education and Assessment Program, at https://www.acpsem.org.au/documents/item/37
16. INSTITUTE OF PHYSICS AND ENGINEERING IN MEDICINE (2010) Training Prospectus for Medical Physicists and Clinical Engineers in Health Care, Version 5. IPEM, York
17. INTERNATIONAL ORGANIZATION FOR MEDICAL PHYSICS (2013) Model Curriculum for Postgraduate (MSc-level) Education Programme on Medical Physics, Medical Physics International 1:15-21

18. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE (2013) Essentials and Guidelines for Medical Physics Residency Training Programs, Report No. 249. AAPM, Maryland
19. AUSTRALASIAN COLLEGE OF PHYSICAL SCIENTISTS AND ENGINEERS IN MEDICINE (2018) Policy for Accreditation of Clinical Departments for the Diagnostic Imaging Medical Physics Training Program, at https://www.acpsem.org.au/documents/item/137
20. AUSTRALASIAN COLLEGE OF PHYSICAL SCIENTISTS AND ENGINEERS IN MEDICINE (2014) Policy for Accreditation of Clinical Medical Physics Departments for the Radiation Oncology Medical Physics Training Education and Assessment Program, at https://www.acpsem.org.au/documents/item/57

Contacts of the corresponding author:

Author: Ian Donald McLean
Institute: The Canberra Hospital
Street: Yamba Drive
City: Canberra
Country: Australia
Email: donald.mclean@act.gov.au

Conflict of Interest Statement.
No conflict of interest was found with author or organization that has either had influence on the content of the manuscript or who could potentially benefit from the publication of the manuscript.