JOURNAL OF PHYSICAL AND CHEMICAL SCIENCES

Journal homepage: https://scienceq.org/journals/jpcs.php

Research Article Open Access

Education and Training in Radiation Protection and Mutual Recognition of Qualification in Australia, Canada, News Zealand, Germany and UK

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Received: January 22, 2020, Accepted: March 12, 2020, Published: April 14, 2020.

ABSTRACT

Radiation therapy plays an important role in the management of various cancers. However, it is equally important to keep radiation levels as low as reasonably achievable to protect radiation staff and general public from harmful effects of radiation. This requires implementation of good radiation protection practices at all times which in turn requires good training and knowledge in radiation protection issues. Radiation is used in various sectors such as nuclear, medical and research and the expertise in radiation protection is on decline. Thus maintaining excellent radiation protection practices and competencies is essential in ensuring safe use of ionizing radiation. More over there is lack of mutual recognition of qualified experts across many countries of the world. This paper discovers education and training approaches employed for Radiation protection training for qualified experts (Radiation protection experts, Radiation Protection officers, Radiation protection supervisors and Radiation protection advisors) in Australia, New Zealand, Canada, UK and Germany with respect to medical sector especially radiation oncology and radiotherapy. This study also assesses whether mutual recognition of training across these countries exist or not. The study also assesses what is equivalent to what and who can do what. This will assist in harmonizing and standardization of training in these countries as well as will help in establishing infrastructure for mutual recognition of training for Radiation Protection Experts. This in turn will guarantee fast movement of skilled workers. The process of harmonization of radiation protection training has already started in Europe and by expanding this process to Australia, Canada and New Zealand will eventually help in developing a compatible system of radiation protection training and expertise across these countries which in turn will help in establishing international standardization of radiation protection training. Moreover, it will help tackle decline in radiation protection expertise and will ensure availability of excellent radiation protection knowledge and skills which can meet demands of the future. This is unique research in the sense that it has not been carried out in Canada, Australia and New Zealand.

Keyword: *Radiation Protection, Education and Training, Standardization, Radiation safety experts, Radiotherapy*.

INTRODUCTION

Radiation Therapy plays an important role in the management of various cancers. However, it is equally important to keep radiation level and exposure as low as reasonably achievable to protect radiation staff and general public from harmful effects of radiation. Radiation is used in various sectors and the expertise in radiation protection is on decline. Furthermore, the researcher also has qualifications in Radiation protection and wanted to explore working opportunities abroad. However, researcher was not sure about the Education and Training requirements of these countries. All this prompted the researcher to carry out a short E-study in 2016 to discover education and training approaches employed for Radiation protection training for Radiation officers in Australia, Canada, New Zealand and Germany against UK standard. The study also assesses whether mutual recognition of training exists across these above mentioned countries especially recognition of UK and EU qualifications in Canada, Australia and New Zealand. This will eventually assist in harmonizing and standardization of training in these countries and will help improve the standard of mutual recognition of radiation protection qualifications

Objectives of the study

The aim of this work was to evaluate a) Education and Training (E&T) requirements for Radiation protection professionals in Australia, Canada, New Zealand and Germany against UK standard to see if mutual recognition of Qualified radiation protection experts is possible which is 2nd objective of this study, b) Mutual recognition of E&T and of qualified experts in above mentioned countries, c) to identify institutes that provide E&T ans well as registration d) who can do what.

Objectives of the study are shown in fig.1

Fig.1 Objectives and Focus of E-survey

METHODS

In order to achieve the goals of this study, an E- Survey was designed. (See Appendix A). This was a quality enhancement and evaluation study which did not require any REB approval.

Questionnaire was emailed to selected academic institutes, Radiation protection governing bodies and hospitals across

Australia (AU), Canada (CA), New Zealand (NZ), and Germany (DE). The results from these countries were compared with Education & Training (E&T) requirements in United Kingdom, UK. All participants voluntarily answered questionnaire and had access to principal investigator's email to ask any questions.

Participants' responses to 9 questions on Survey questionnaire were scored and graded. One point was given for a correct response while no points were awarded for no answers or incorrect answers.

This resulted in a minimum score of zero and a maximum score of 9 points. If a participant achieved >= 5 out of 9 he/ she was considered having good knowledge. However, those that scored < 5 out of 9 points were regarded as having poor knowledge.

E- questionnaire Design: The E questionnaire was designed in MS Word format and contained 9 questions. The questionnaire was likely to take about 10-15 minutes to complete depending upon the knowledge of the respondent. This survey mostly contained open ended questions. E- Survey was designed after doing a brief background research on radiation protection surveys. One particular Early survey highlighted importance of moving towards mutual recognition of Qualified experts in EU countries and two other studies highlighted the gap in knowledge of professionals who deal with radiation in medical sector [1-3].

Target Population: This study was intended for those working in Radiation protection and

radiation related fields such as Radiotherapy, Radiation Oncology and Medical physics (Medical Sector).

E- survey Distribution and collection:

E- survey was first implanted in the end of 2016 for a short period of three months and preliminary results were presented in 2017. To improve the survey response, it was again implanted in 2018 and 2019 for 4 weeks. It was distributed by email and responses were collected by email. Completion of the survey was voluntary and anonymous as no personal information was collected from the respondents and no personal information of respondents was disclosed in the study results.

Statistical Analysis: The results of this study were examined by using descriptive statistics.

Superiority of one strategy was determined if considered important by majority of respondents. i.e. by determining percentage of responses for a particular category.

Appendices

Five Appendices (A-E) are provided in this research paper. Appendix A consists of a sample of questions that were directed towards targeted audience. List of organizations that responded to E-survey is given in Appendix B. Appendix C gives further information about the links provided by respondents in answer to Question 8. Appendix D shows Glossary and Appendix E abbreviations.

E & T in UK

This Section will explain the E & T (Education and training) requirements for various categories of radiation protection Experts (RPEs) in UK. The results from other countries will be compared to E & T in UK to determine existence of mutual recognition. Health and Safety Executive (HSE) enforces two main radiation regulations:

- IRR99 – covers all uses of radiation
- IR(ME)R 2000 – covers medical uses of radiation.

IRR99 is now replaced by IRR17 [4]. It requires employers to apply ALARP (As low as reasonably Practical) concept and implements Basic safety standards Directive (96/29/2013/59/Euro atom). In UK qualified Expert (QE) under IRR99 regulations is Radiation Protection Advisor (RPA) for occupation exposures and Radioactive waste advisor (RWA) for public exposures [5]. RPS (Radiation Protection Supervisor): is expected to get Appropriate training. RPS is a requirement of IRR99. Appointed in department to support compliance with regulations. RPA (Radiation Protection Advisor): need to submit a portfolio of evidence covering education, competence and experience to RPA 2000 (an assessing body) to show they meet regulatory requirements for core competencies e.g. knowledge of basic syllabus, IRR99 (also IRR17), operational Radiation protection methods and ability to provide adequate advice [6-7]. The new Euro-atom basic safety standard Directive i.e. EU BSS 2013, requires Radiation Protection Experts (RPEs).

RESULTS

Overall Assessment:

Thirty-eight professionals/institutes were contacted but only 13 responses were received, an overall response rate of 34.2%. Table 1 shows characteristics of E-survey.

Table 1: Characteristics of E-survey

Countries	Institutes Contacted	Responses Received (n)	% out of 13
Australia (AU)	8	5	38.46
New Zealand (NZ)	17	4	30.76
Canada (CA)	7	2	15.38
Germany (DE)	6	2	15.38

Socio-Demographic Profile of Respondents Socio-demographic profile of respondents is shown in Fig 2-3 and Table 2. 38.4% of respondents were females and 61.5% were males. Appendix B shows names of different organizations whose professionals were contacted to participate in this E-Survey. In Australia out of 8, only 5 responded. In Germany 6 organizations/personnel were contacted but only 2 filled the survey questionnaire. Seventeen institutes/ organizations were contacted in New Zealand. However Only four institutes responded to the questionnaire. Two responses were received from Canada.

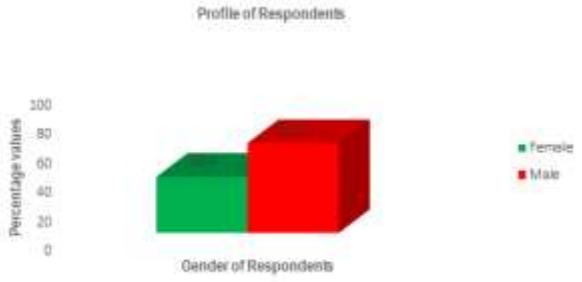
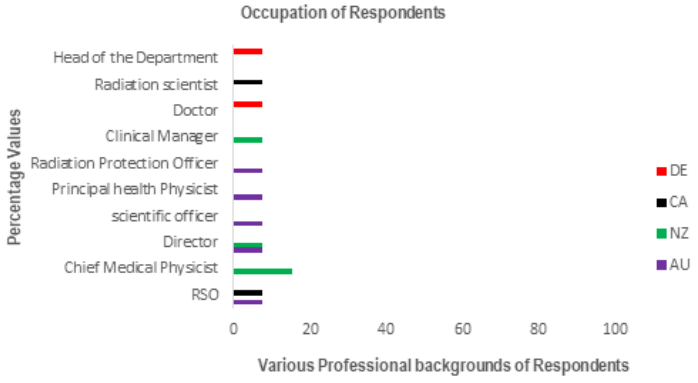


Fig 2. Profile of Respondents: Gender



Note: Two respondents from New Zealand were Chief Medical Physicists (15.4%)

Fig 3. Profile of Respondents: Occupation

Table2: Socio-Demographic Profile of respondents

Characteristics of the Respondents	Percentage Value % n=13
Gender	
Female	38.4 (5)
Male	61.5 (8)
Occupation	
Radiation safety Officer (RSO)	15.4 (2)
Chief Medical Physicist	15.4 (2)
Director	15.4 (2)
Scientific officer	7.7 (1)
Principal Health Physicist	7.7 (1)
Radiation Protection Officer	7.7 (1)
Clinical Manager	7.7 (1)
Doctor	7.7 (1)
Radiation scientist	7.7 (1)
Head of the Department	7.7 (1)
Departments/Organizations	
Radiation/Health Protection Branch/Department of Health & Human Services (AUVIC 1)	7.7 (1)
Medical Imaging Section /ARPANSA, VIC, AU (AUVIC 2)	7.7 (1)
Radiation Health Branch/ Department of Health, Radiological Council (AUWA)	7.7 (1)
Radiation Protection Unit/ Department of Health & Human Services, Tasmania (AUTAS)	7.7 (1)
Radiation Health, Radiation Protection Branch/Environmental Protection Authority, EPA (AUSA)	7.7 (1)
Blood & Cancer Centre/Wellington Hospital, New Zealand (NZWH)	7.7 (1)
Ministry of Health, New Zealand (NZMOH)	7.7 (1)
Medical Physics &Bioengineering / Christchurch Hospital (NZCCH)	7.7 (1)
Medical Physics/Waikato DHB (NZ WDHB)	7.7 (1)
Radiation Safety Institute of Canada, Toronto (CAT)	7.7 (1)
Vancouver Coastal Hospital Authority, Canada (VCH)	7.7 (1)
Technical and Social Safety State Office for Consumer Protection Saxony-Anhalt, Germany (DEU)	7.7 (1)
Radiation Protection, Radiological Monitoring Lower Saxony Ministry of Environment, Energy and Climate Protection, Germany (DET)	7.7 (1)

Knowledge of Radiation Protection Regulations among participants

84.6% (11) of participants showed good knowledge and 15.4% (2) showed poor knowledge of radiation protection regulations concerning Education and training of Radiation experts.

Q.1: Categories of Radiation Experts

Results for Q1 are shown in Fig 4. and 5. Different levels and categories of Radiation experts exist in these countries. Classification of RPEs also exists with regards to area of work such as medical sector, nuclear sector and Industrial sector.

69.3% Respondents said that they have radiation safety roles where as 30.7% said No. Respondent from Radiation safety office wellington and one respondent from Victoria, Australia said that codes refer to RSOs and QEs. Respondent from DHB Canterbury /Christchurch hospital said that they have Radiation advisory officer. In Germany both Respondents (15.4%) said that radiation protection staff is called Strahlenschutzbeauftragte (SS).

Given below is the short description of each country that was surveyed in this project. This information is deduced from the answers given by respondents on the questionnaire.

Australia: In Australia variations exist in different jurisdictions or states. There are 7 jurisdictions in Australia.

and it is a federal state. In Victoria, Radiation experts are not the same as in UK. ARPANSA Codes refer to Radiation Safety officers (RSO) but there are no formal requirements for these in Victoria. There is no formal accreditation like RPA in the UK. In Victoria RSO is considered somewhat between RPS and RPA in UK. Another respondent from Victoria from ARPANSA gave definition of Qualified Expert according to RPS14 [8].

In hospitals in Western Australia Radiation officer is usually a Medical Physicist with other duties. The position of radiation safety officer is not standalone. In Tasmania they have Radiation safety officers. The respondent further described Radiation safety officer as "a radiation safety officer is a person authorised on a licence whose role is to assist the licence holder and other authorised users with managing radiation safety." In South Australia any employer of Radiation workers must appoint a radiation safety officer.

New Zealand:

One respondent from WDHB said Medical physicists perform Radiation safety duties and the other respondent from Wellington hospital said that there are no dedicated roles and medical physicists perform radiation safety tasks.

Another Two respondents from New Zealand said there are Radiation safety roles (Respondents from Ministry of health and Christchurch hospital). Respondent from Christchurch hospital said generally radiation safety tasks are picked up by Radiation oncology medical physicist but district health board (DHB) is an exception as it employs Radiation advisory officer.

Respondent from Ministry of Health said that newly published codes of practice have a definition for Radiation safety officers and Qualified Experts, but no specific requirements are set out in their legislation. The definitions of Radiation safety officer (RSO) and Qualified Expert (QE) provided by this respondent are given as follows:

A RSO is a person who is competent in radiation protection and safety, who is designated by the managing entity (a company) to oversee the application of regulatory requirements for occupational and public radiation protection and safety.

The Codes also define a 'qualified expert' as an individual who is recognised as having expertise in a relevant field of specialisation such as medical physics or radiation safety.

The main Act in New Zealand is Radiation Safety Act 2016 [9]. This Act is supported by Radiation safety regulations and apply to those who deal with ionizing radiation sources.

It seems that generally there are no dedicated radiation safety roles in Hospitals of New Zealand but new codes recognize RSO and QEs. Moreover, DHBs are exceptions where radiation advisory officer positions exist.

Canada: One (7.7%) respondent from Radiation Safety Institute said there are RSOs in Canada. Other respondent from Vancouver Coastal Hospital said Medical Physicists or Radiation technologists with additional training perform radiation safety tasks.

Germany: There Radiation officers (ROs) in Germany but they are called Strahlenschutzbeauftragte (SS). RPE/RPS exist in form of recognized surveyors. Radiation Officer (RO), RPS, RPA,

Radiation Protection Expert (RPE) are not completely compatible with the corresponding persons responsible in German.

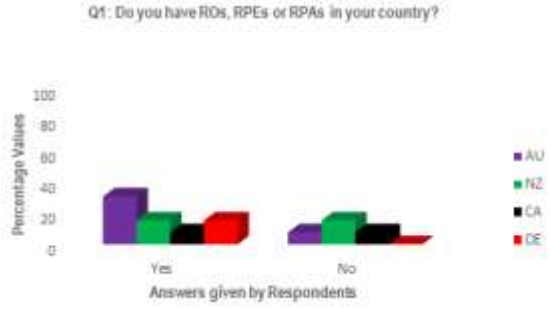


Fig 4. Distribution of percentages for Yes and No answers for Q.1

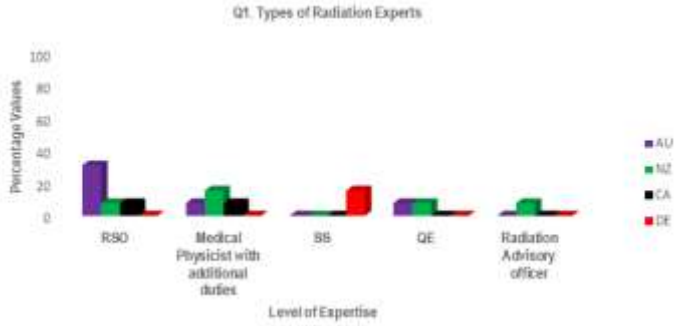


Fig 5. Level of Expertise

Q2 & Q7: Conditions to become ROs, and Certification and Registration of Radiation Officers.

Results for Q.2 and Q7 are shown in Table 3 and 4 below. One respondent from ARPANSA, Victoria Australia quoted from section 3.1.24 of RPS 14 that the Code talks about a Qualified Expert who is present for discussion and advice, and for calibration, dosimetry and quality assurance purposes in radiation therapy (Radiation Protection Series No. 14). However, the code does not talk about RSO. The three safety guides mention RSO role. In south Australia EPA issues licence to use radiation but eventually it is up to employer to decide suitability of qualifications of job applicants. In New Zealand MOH issues use licence.

Table 3: Answers to Q.2. and Q.7.

Note IN Table AU= Australia, AUVIC= Victoria, Australia, AUWA, Western Australia, TAS, Tasmania, SA= South Australia, NZ= New Zealand, WH= Wellington Hospital, MOH=Ministry of Health, CH=Christchurch Hospital, WDHB= Waikato District health board, CA= Canada, T= CAT= Toronto, Canada, VCH= Vancouver Coastal Hospital, Canada, DE= Germany, DEU= Technical & social safety, Saxony, Germany, DET= Ministry of Environment, Germany

Countries	Q.2. Conditions to become a Radiation Officer, Expert or Advisor in Your Country. Q7. Are qualified radiation protection experts registered or certified in your country?
UK	University degree, hospital placement and/or training. Yes
AUVIC	Various companies offer industry focused training courses. There are no formal requirements for RSOs. They would need to be suitably qualified and experienced, but there is no formal accreditation, like the RPA in the UK. There is an accreditation body ARPAB which accredits people in a similar way to RPA2000 in the UK, however there is no requirement to consult an ARPAB accredited person. RPS14 does not talk about a radiation safety officer. However, associated 3 safety guides for Radiation protection examine the role of RSO and QE and state a medical physicist would fulfil the requirements of a QE. The general understanding is persons of other qualifications are not prohibited to meet requirements of a QE (Answers from 2 respondents)
AUWA	One needs to get a licence for WA to work in radiation area. Recognized training courses from providers listed on Radiological council website. No information about certification and registration. (It is assumed one needs to be registered as a Medical physicist as there are no RO dedicated roles in WA).
AUTAS	A person's qualifications and experience for a RSO role are considered on a case-by-case basis. No info about certification or registration requirements was given.
AUSA	One must have detailed knowledge of principles, practices of all aspects of radiation protection applicable to the activities carried out by the employer. One would be required to apply through the South Australian Environment Protection Authority for either a licence to operate ionising radiation apparatus or a licence to handle radioactive substances in South Australia. In the end individual employers determine suitability of qualifications and experience. No info provided about certification or registration.
NZWH	Medical physics degree and training. ACEPSEM & ARAB offer registration. This is voluntary not regulatory registration.
NZMOH	MOH holds a register of Use licensees. Use & source licences are issued by MOH. Use licences have sub divisions: Medical & non-medical. Licences are issued for 1, 2 and 3 years.
NZCH	Master's degree in Medical Physics & 3 years structured training placement. Certification from ACPSEM or an acceptable International equivalent.
NZW	Medical Physics degree & professional experience plus ACPSEM Accreditation or equivalent such as IPEM, ABR, CCPM. No system of registration or certification for radiation officers.
CA	A degree in medical Physics or Health Physics. Certification is provided from CRPA.
CAVGH	For a Medical Physicist – Master's degree + 2 years clinical Experience and certification by the CCPM, For a radiation technologist – radiation technologist degree, work experience as technologist + additional internal certification
DE	It is required to gain expertise of radiation protection by an appropriate seminar. No register of RPEs. Qualifications are recognized by the competent Government department.

Table 4: Summary of answers to Q7

Countries	*Organizations that offer Registration and / or Certification*
Australia	ARPAB
New Zealand	ACEPSEM, ARAB
Canada	CRPA, CCPM
Germany	None

Note: ACPSEM= The Australasian college of Physical sciences and Engineering in Medicine, ARPAB= Australian Radiation Protection Accreditation Board, CRPA= Canadian Radiation Protection Association, CCPM= Canadian College of Physicists in Medicine.

Education & Training (E&T)

The questions 3 to 5 are related to education and training systems in these countries. Results are shown in Tables 5-7 and in Fig.6

53.8% (7) of respondents said Universities provide E&T, 46.2 % (6) mentioned hospitals, 15.4% (2) said training centres, 7.7% (1) replied companies and clinical centres, 30.8% (4) stated ACPSEM and AHPRA registration and 7.7% (1) responded certification from federal organizations is required. 23.1% (3) gave no answers. ACPSEM oversees education and training for Medical Physicists in Australia and New Zealand who usually work as Radiation safety officers. One respondent from Germany said Companies and clinical centres provide E&T for SS. Respondent (7.7%) from Ministry of Health, New Zealand said Training centre provide E&T for Radiation safety officers. 23.1% (3) of respondents gave no answers.

It seems in most countries/ regions that were investigated during this survey, university degree in physics or medical physics are needed prior to work as RPE or QE in medical sector. In New Zealand Medical physicists generally perform duties of Radiation officers and therefore master's degree in medical physics is generally required which can be obtained from universities. Most hospitals in New Zealand are accredited to provide training in Radiation Oncology Medical physics. Respondents from Victoria and South Australia provided links to ACPSEM and health.vic.gov website. These links show medical physics degrees are prerequisite for obtaining licence to use radiation. Hence universities are main sources for getting medical physics or physics degrees.

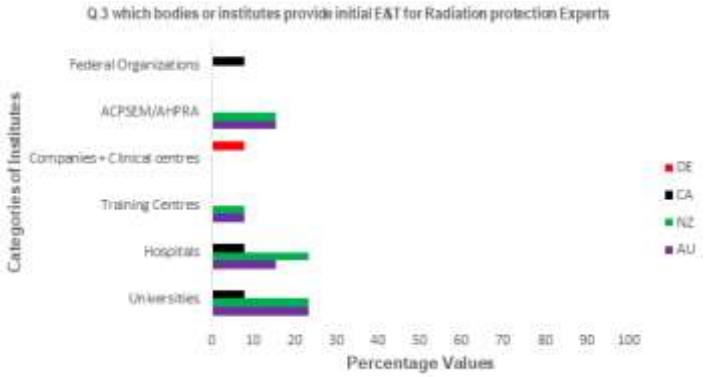


Fig 6. Initial Training and Education for Radiation Protection Experts

Table 5: Answer to Q.3

Countries	Q.3. Which Institutes provide initial E&T for radiation protection Experts
UK	Universities and Training centres
AUVIC	One respondent said Universities & other provided following link in response to Q3. https://www2.health.vic.gov.au/public-health/radiation This website shown Prerequisites for sector specific Radiation Use licences which are given below: - (i) **ROMP:** a medical physics degree (Bachelor's degree majoring in physics or medical physics) + evidence of training relevant to type of radiation sources they intend to use or accreditation with ACPSEM. (ii) **Diagnostic Radiographers:** registration with AHPRA. (iii) **Nuclear Radiation Technologist**: AHPRA registration and a short course in CT or bone mineral densitometers. (iv) **Education & Research:** a course in Radiation Safety and evidence of training/knowledge/experience and training in use of sources. (v) **Radiation Therapist:** must hold registration with AHPRA. (vi) **RO:** Registration with AHPRA or Royal Australian & New Zealand College of Radiologists Thus authors have assumed universities and hospitals/training centres and/or ACPSEM or AHPRA accreditation as answer to Q3. See Appendix C for details.
AUWA	No answer
AUTAS	No answer
AUSA	A link to ACEPEM was given if one wants to work as Medical physicist. Hence it is assumed university+ hospital + ACPSEM is involved in providing E&T (ACPSEM provides registration).
NZWH	Medical Physicist training is overseen by ACPSEM & includes an MSC Medical physics plus 2 years clinical training in an accredited hospital with assessment and examination. The training includes Radiation protection.
NZMOH	Training Centre
NZCH	Universities provide academic qualifications & hospitals provide training
NZW	TEAP Programme: University of Canterbury + ACPSEM + Hospital placement
CA	Universities
CAVGH	Clinical training by the hospital, certification by a federal organization.
DE	One respondent provided a link in the response. However, link did not work. The other respondent said companies + Training centres provide E&T for SS.

Note: AU= Australia, AUVIC= Victoria, Australia, AUWA, Western Australia, TAS, Tasmania, SA= South Australia, NZ= New Zealand, WH= Wellington Hospital, MOH=Ministry of Health, CH=Christchurch Hospital, WDHB= Waikato District health board, CA= Canada, T= CAT= Toronto, Canada, VCH= Vancouver Coastal, Hospital, Canada, DE= Germany, DEU= Technical & social safety, Saxony, Germany, DET= Ministry of Environment, Germany, ACPSEM= The Australasian college of Physical sciences and Engineering in Medicine, AHPRA= Australian Health practitioner Regulation Agency. RO: Radiation Oncologists, ROMP: Radiation Oncology Medical Physicist.

Q. 4: Does training require any practical work?

Practical work is required in UK.

53.8% (7) said yes. 7.7% (1) of respondents said practical work requirements are decided on case by case basis (Tasmania). 15.4% (2) said it depends on hiring company/employer (respondent from Toronto, Canada and Western Australia). One responded (7.7%) from Ministry of Health, NZ gave no answer. One respondent further added that no specific training is available for RPEs in New Zealand and Australia.

Table 6: Answers to Q.4

Note: AU= Australia, AUVIC= Victoria, Australia, AUWA, Western Australia, TAS, Tasmania, SA= South Australia, NZ= New Zealand, WH= Wellington Hospital, MOH=Ministry of Health, CH=Christchurch Hospital, WDHB= Waikato District health board, CA= Canada, T= CAT= Toronto, Canada, VCH= Vancouver Coastal Hospital, Canada, DE= Germany, DEU= Technical & social safety, Saxony, Germany, DET= Ministry of Environment, Germany, ACPSEM= The Australasian college of Physical sciences and Engineering in Medicine

Countries	Q.4. Does training demand practical work?
UK	Yes
AUVIC	From link it seems practical work experience is required. Answer from both respondents is thus yes.
AUWA	Obtain licence to work in WA in radiation area. Contact Employer to check requirements for RSO roles.
AUTAS	A person's qualifications and experience to be a radiation safety officer are considered on a case-by-case basis.
AUSA	A link was given (from link it seems if one can register as a Medical physicist then they can also work as ROs) Hence answer is assumed yes.
NZWH	Same training as of a Medical Physicist (Yes)
NZMOH	No answer
NZCH	Yes- IPEM, ACPSEM Training accepted for Medical physicists. There is no specific training for RPEs in New Zealand and Australia
NZW	Yes
CA	Depends on hiring company
CAVGH	No answer given but Judging from answer to Q.2 it seems practical work is required
DE	Yes in most cases. Both respondents said yes.

Q.5. Is Professional experience in industry essential to become Radiation officer?

Results are shown in Table 6.

Professional experience is required in UK. 23.1% (3) respondents said yes.

53.8% (7) gave other responses (i.e. No or there are No specific requirements or decision made on case by case basis or depends on job/ employer or same as medical physicist's requirements). 23.1% (3) respondents gave no answers. One respondent from Germany said in-house training and practical experience is provided.

Table 7: Answers to Q. 5

Countries	Q. 5: Is professional Experience essential to become a Radiation officer
UK	Yes
AUVIC	There are no specific requirements. However most employers would look for someone with experience (Both respondents).
AUWA	No answer
AUTAS	On case by case basis
AUSA	No answer
NZWH	same as Medical physicist E&T
NZMOH	No answer
NZCH	Yes
NZW	Yes
CA	Depends on Job
CAVGH	Yes
DE	No, but it is useful sometimes (Both respondents)

Note: AU= Australia, AUVIC= Victoria, Australia, AUWA, Western Australia, TAS, Tasmania, SA= South Australia, NZ= New Zealand, WH= Wellington Hospital, MOH=Ministry of Health, CH=Christchurch Hospital, WDHB= Waikato District health board, CA= Canada, T= CAT= Toronto, Canada, VCH= Vancouver Coastal Hospital, Canada, DE= Germany, DEU= Technical & social safety, Saxony, Germany, DET= Ministry of Environment, Germany, ACPSEM= The Australasian college of Physical sciences and Engineering in Medicine.

Mutual Recognition of Qualifications

Results for Q6 are shown in Fig.7. 46.2% (6) of respondents said UK E&T is recognized. 23.1% (3) said it depends on job or employer. Both Respondents from Germany (15.4%) said UK qualifications and attendance of a seminar in German law are required. 15.4% (2) respondents said UK E&T not formally recognized.

One (7.7%) respondent from Victoria, Australia said UK qualifications are not formally recognized but are good evidence of someone's ability and expertise in Radiation protection. The other respondent (7.7%) said it depends on employer. Similarly, one respondent (7.7%) from Tasmania said UK qualifications are not formally recognized by them but federal government has processes to recognize UK E&T. Respondent (7.7%) from South Australia said one needs to obtain Licence from Environment Protection Agency (EPA) and even after that it depends on individual employer to determine if you hold necessary or required qualifications for their purpose. Respondent from Western Australia said UK E &T is accepted.

All four Respondents from New Zealand said they accept UK E&T. One respondents (7.7%) from Canada said UK qualifications are accepted i.e. Master of Science degree in Medical Physics plus an International equivalent of training i.e. IPEM, UK, ABR, CCMP) are accepted. The other said it depends on job and employer.

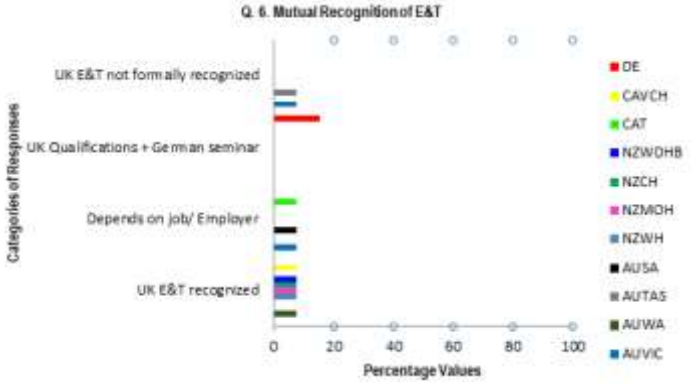


Fig 7. Mutual Recognition of E&T

Education and training Institutes:

Q.8. Which institutes to get in touch to obtain education and training to become an RSO and RPE?

ANSTO provides training courses recognized by most states and territory regulators. Three (23.1%) Respondents from New Zealand mentioned ACPSEM, one (7.7%) mentioned University of Canterbury, as their answers. One respondent (7.7%) from New Zealand Christchurch hospital said all major hospitals are accredited to provide training in Radiation Oncology Medical physics. Respondent from MOH did not answer the question.

One respondent (7.7%) from Victoria Australia, provided link to Health.vic. However, no information about training centres or courses is listed there. On the Health.vic website there is a link to ARPANSA website. The other respondent from Victoria mentioned ACPSEM and also provided link to Radiation safety training courses website. One respondent (7.7%) from WA listed radiological council website. The website lists some training courses. See Appendix C for information regarding links given in answers. The respondent from Canada said someone with Medical physics degree is qualified for most RSO positions. Radiation safety institute of Canada provides RSO Courses which are recognized by CNSC and CAMRT. CRPA (Radiation Protection Association) website lists number of Radiation safety courses such as Courses provided by British Columbia Institute of Technology. (Radiation safety officer Practice course, Radiation safety officer administration). Respondent from Vancouver coastal hospital said they offer in house training for their employees. The link provided by German respondents did not work.

Results: Other findings of the study

(i) Results obtained from this E-Questionnaire are based on the opinions and answers of respondents representing 10 disciplines/occupational categories in Radiation protection and oncology.
(ii) No respondent offered training placements.
(iii) One respondent from VCH mentioned that Slight growth, more in the US is in demand in Radiation protection. In Canada it will depend on attrition.

DISCUSSION

The present study is different from other similar studies as it has tried to uncover the current status of RPEs in four big countries (Australia, New Zealand, Canada, Germany) in three continents (Australia, Europe, North America) and to find out whether mutual recognition of foreign RPEs happens in these countries or not. The study is also different because it differentiates the status and requirements of RPEs between various states of Australia, New Zealand and Germany

This study was aimed at radiation protection of ionizing radiation in medical sector. The response rate initially was very discouraging (only 7). However, it improved slightly (13) after re-contacting the organizations and asking them the questions again. Disappointing results (only 4) in the beginning were also reported by NRG- Radiation and Environment while carrying out a survey in EU countries regarding the status of radiation protection Experts despite establishing a network of national correspondents [1]. However, the authors reported improved response rates after sending three reminders and generating an appeal during an Art meeting.

The findings of the current study show that E& T from UK and other countries are not universally accepted in Australia, Canada, New Zealand and Germany. Considerable regional differences exist when it comes to accepting E & T from UK and from these countries. However generally E & T from UK or equivalent international E& T of radiation protection staff is considered good evidence of knowledge, skill and professional competence and can usually lead to obtaining radiation use licenses in these countries. In some region's education and Training from UK and from these countries is well accepted. In Vancouver, Canada for instance outside qualifications are accepted.

The present study revealed the radiation regulations in Australia, New Zealand and Germany. One respondent from Germany mentioned The German radiation laws and regulations consists of Radiation Protection Ordinance, Atomic energy Act and X-ray regulations. This seems correct information. According to IRPA, in accordance with Atomic Energy Act, two regulations have come into existence in Germany namely Radiation Protection Ordinance and the X-Ray Ordinance [10]. The two ordinances also mention Radiation Protection supervisor (German: Strahlenschutzverantwortlicher). There are also radiation protection commissioners in Germany, and they are called German: Strahlenschutzbeauftragter.

The radiation protection commissioners provide advice to Radiation Protection supervisors and are responsible for area of radiation protection described in their duties [10]. Generally, they can be considered as Radiation Protection Experts (RPEs). The responses from Germany lacked information on conditions to become a Radiation officer (i.e. Q.2). According to IRPA guidance on certification of a radiation protection expert, several Radiation Protection commissioners do not essentially have academic qualifications. The mandatory qualification in radiation consists of obtaining education appropriate for a particular area of radiation application, practical experience and by attending and contributing to courses recognized by competent agency [10]. There are numerous (about 60) courses covering different levels of educations and practical experiences. Every 5 years the mandatory qualifications need to be updated by either attending a course or attaining higher education [10].

The present study showed the definitions of RSO and QE in Australian and New Zealand Legislations. It also showed mutual recognition of UK qualification and RPEs in the targeted countries. Requirements for RPEs varies from state to state. Generally, in New Zealand hospitals, Medical Physicists perform duties of radiation safety as there are no dedicated roles of Radiation safety officers. However, there are some exceptions.

The main act in Victoria, Australia that governs radiation is Radiation Act 2005. This legislation is run by Department of Health and Human services [11]. There is the Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008) which is also called 'the Code or RPS14'[(8)]. The Code is a regulatory document that discusses the working procedures of radiotherapy, diagnostic and interventional radiology and nuclear medicine relevant to radiation protection (Radiation Protection Series No. 14).

In Australia RSOs are not mentioned in ARPANSA's Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (RPS 14). However, the three associated safety guides for Radiation Protection in Diagnostic and Interventional, Nuclear Medicine and for Radiotherapy discuss the role of RSO and QE (RPS 14,1. RPS 14.2, RPS 14.3) [12-14].

The definition of "qualified expert" in RPS14 is "a person who is qualified in the application of the physics of therapeutic of diagnostic uses of ionizing radiation and who has been recognised by the relevant regulatory authority as being able to perform the dosimetric calculations, radiation measurements and monitoring relevant to the person's area of expertise" [8].

The definition of QE in Safety guide:

"The Qualified expert will have suitable qualifications and experience in radiotherapy physics. A medical Physicist with specialist experience in radiotherapy- a Radiation Oncology Medical Physicist (ROMP) would satisfy these requirements." (Safety guide for Radiation protection in radiotherapy, RPS 14.3, section 3.5) [14].

As far as training is concerned Universities, hospitals and training centres provide required education, practical work and professional experience to carry out RPE duties. Radiological council website lists a number of training courses and examinations for fulfilling the prerequisite for licensing in western Australia. New Zealand accepts international E&T from Institute of Physics and Engineering in Medicine, (IPEM), UK, American board of Radiology (ABR), and Canadian College of physicists in Medicine (CCPM). Mutual recognition of qualifications occurs in Victoria, Australia. According to Health. Vic website (https://www2.health.vic.gov.au/public-health/radiation/licensing/use-licences-employees/general-information), "A person who is registered in an equivalent occupation in another state or territory or New Zealand may be entitled to apply to the department under the Commonwealth Mutual Recognition Act 1992 for a licence to use radiation sources in Victoria related to their occupations" [11].

In Vancouver, Canada Medical physicists and Radiation technologists with additional qualifications perform Radiation safety duties. There are Radiation safety officers in Toronto,

Canada. In Vancouver, outside qualifications are accepted, especially if there is a Canadian Connection or CAMPEP accreditation. They would have to see if the degree obtained and school attended by international applicant have equivalent levels in Canada. VGH said certification and registration is provided by CRPA (Canadian College of Physicists in Medicine). CRPA also provides various Industry related and International radiation safety training Physics such as ALARA Training course [15].

Many studies stress the importance of radiation safety [16-18]. One study in Nigeria showed lack of good radiation practices despite reasonable radiation protection knowledge among radiation experts [18]. SRA and EC Radiation protection guidelines No. 175 emphasize on education and training of staff and researchers to make sure protection of patients, staff and public from unwanted radiation exposures [17,19].

SRA further acknowledges the necessity to establish a European certification system for education and training of health professionals in radiation protection so that safety of European citizens can be ensured. Harmonization of practice via education and training can ensure compliance with safety procedures with respect to radiation protection. These concepts are in line with the aims and objectives of the current study. The current study takes this concept of harmonizing of practices and standardization of E& T in Europe one step ahead i.e. it includes other major developed countries.

By extending the concept of European certification to include Australia, New Zealand and Canada will more likely to ensure radiation protection of staff, patients and public across a larger platform. This can be achieved via harmonization of practice across all these countries which in turn can be achieved via education and training of health professionals' especially radiation protection staff. The current study thus proposes development of Same metric system to gauge the knowledge, competence and experience of professionals in ionizing radiation protection. This will also facilitate movement of health professionals in the field of radiation protection across these countries.

In order to translate state of the art research into clinical practice it is vital to provide parallel education and training courses covering outcomes of new and ongoing research projects as well as education and training of new technology in ionizing radiation fields. This study also identified that Radiation safety office in New Zealand provides License to Use radiation application form to applicants. It was disappointing to learn that director of Radiation Safety Office failed to process an already accepted application of Radiation Use licence for no good reason. This kind of irregularities and non-transparency in application processing needs to be eliminated as it results in discouraging qualified radiation personnel for applying for the licence and also creates unnecessary problems in obtaining radiation use licence. There is no independent complaints authority to go to should the radiation safety office fails to justify its decision.

Limitations of the Study

This study was implemented over a short period of time. The results reported here are accurate but limited by small number of responses. However even this has resulted in the generation of important data that provides direction for future studies. Co-operation from national bodies and hospital staff needs to be improved so that better participation in filling surveys/questionnaires can occur which in turn can result in more accurate results. The author of this study believes that this research paper has achieved its objectives and has provided useful and correct information regarding radiation protection experts and their current status in targeted countries.

CONCLUSION

This study provided an overview of current state of radiation protection experts in Germany, Canada, Australia and New Zealand in comparison to UK. It took lot of effort to obtain relevant information from various professionals in these countries. One of the reasons for not answering the E-survey could be the difficulty to find the relevant person in the institute to answer the questionnaire. This study and its accompanying E-survey is an uncomplicated and straightforward means for collecting opinions of the professionals about E&T requirements of radiation Protection Experts in their countries.

In a fairly brief period, this study has made available the data required to understand varying E&T requirements regarding Radiation protection Experts in these countries, to identify institutes and bodies who provide E&T in radiation protection, to learn which institutes to get in touch in order to obtain registration, to encourage and implement mutual recognition of E&T from other countries, to identify areas for improvement in E&T and to inspire standardization of E&T of Radiation protection Experts in these countries which in turn is likely to improve mobilization of Radiation Protection Experts. This study also identified knowledge of radiation protection laws and regulations among participants.

The E-survey manifested differences in E&T. There is no automatic Mutual recognition process in place. Most countries however accept E&T from UK if documentary evidence is provided such as New Zealand and Western Australia). In Tasmania, South Australia (states of Australia) and Canada, recognition is carried out on individual basis and depends on employer. In Germany UK qualifications can be accepted but require additional qualifications in German law by seminar. There are variations in RPEs in these countries based on area of work and level of expertise. Responses of participants have shown that academic education is required to work as RPE and in some countries a medical physicist with additional duties works as RPE or RO. Thus university courses are available to become medical physicist and also there are other training centre that provide RPS or RSO trainings. In house and practical experience is offered to employees who want to become RSOs.

In some countries/ states training centres need to be formally recognized by authorities. Practical work is expected to be part of training programme in Victoria, (Australia), Germany, UK, Wellington, Christchurch, NZ (40%). Specifics of Professional experience are not always specified. However professional experience is considered useful in view of 20% of respondents (Germany, Victoria) and most employers look for it. Certification of Radiation experts is available in UK and Canada. In Germany Sachverständige (RPE/RPS) are recognized by competent government department. In New Zealand, a register of licensee (holders of licence to Use radiation) is kept by Radiation safety Office of Ministry of Health. Irregularities in Radiation Use license applications in New Zealand must be removed.

Footnotes

Acknowledgement:

Author would like to thank you all respondents of this E-survey. Special thanks to Director Medical Imaging of ARPANSA, Victoria, Australia.

Funding:

No funding or financial support was taken to carry out this research Project.

Competing Interests:

The author declares that there is no conflict of Interest or competing Interests.

Ethical Approval:

This is a quality improvement study to gauge the current status of Radiation protection and did not require any Ethical approval. No patients were approached. No medical or personal data of participants collected. By answering the questionnaires, the professionals agreed to give their informed consent.

Recommendations

Recommendations derived from the analysis of the Survey results are given below:

1. There is still work needs to be done to establish mutual recognition of E&T among these countries.
2. Standardization of qualifications will improve mobility of the radiation protection experts and availability of expert.
3. Training placements and educational courses need to be offered by institutes, hospitals and private companies to improve radiation officer's education and skills as well as E & T of staff working in health departments and licensing departments is indicated.
4. Authorities or governing bodies need to recognize Training centres.
5. Education and training of researchers is also recommended.
6. A transparent system of acknowledging UK or other international equivalent qualifications need to be implemented when it comes to accepting and issuing radiation Use licenses and any complaints from applicants should be justly handled. This is to prevent discouraging talented radiation protection professionals who are seeking Use licenses to work in Radiation protection fields.
7. An independent body should be established to hear complaints regarding unjust decisions given by radiation safety office and similar bodies with respect to radiation use licence or with respect to registration as a radiation protection expert or as Medical Physicist.

Additional Information

The preliminary results of this study were presented in ARPS conference on Radiation Protection in Wollongong, Australia in 2017.

REFERANCES

1. NRG- Radiation and Protection, Netherlands., "Radiation Protection 133. The status of Radiation Protection Expert in EU member states and applicant countries. Study on Education and Training in Radiation Protection", 2003, No. 133.
2. Yarar Y., and Kara O., "Final results of a survey on the awareness of the Radiation Protection in Medical Sector in Turkey", euronuclear.org. Available at: https://www.euronuclear.org/events/etrap/etrap2017/pdf/Posters/ETRAP2017-A0058-fullpaper.pdf
3. Yurt, A., Cavuşoğlu, B., and Günay, T., "Evaluation of awareness on radiation protection and knowledge about radiological examinations in healthcare professionals who use ionized radiation at work", Molecular imaging and radionuclide therapy, 2014, Vol. 23 No.2, pp 48-53.
4. HSE., "Working with ionising radiation. Ionising Radiations Regulations 2017. Approved code of practice and guidance", 2018, TSO, Norwich Available online at: www.hse.gov.uk/pubns/priced/l121.pdf
5. The society of Radiographers., "The Ionising Radiations regulations 1999 (1RR99): Guidance booklet", 2012. Available at: https://www.sor.org/learning/document-library/ionising-radiations-regulations-1999-irr99-guidance-booklet-0
6. Stewart, J., "Transposition of RPE & RPO requirements of 2013/59/EURTAOM in the UK", HERCA Task Force on E & T ENTRAP III & 7.
7. RPA 2000.org.uk. Available at: http://www.rpa2000.org.uk/rpa-certification-scheme/ [Accessed 2/08/2017]
8. Australian Radiation Protection and Nuclear Safety Agency., "Code of Practice for Radiation Protection in the Medical Applications of Ionizing Radiation (2008), Radiation Protection Series Publication No. 14, 2008", Published by the Chief Executive Officer of ARPANSAAvailable at: https://www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps14.pdf (Accessed: 17/01/2019)
9. Radiation Safety Act 2016, Published under the authority of the New Zealand Government—2016. Available at: http://www.legislation.govt.nz/act/public/2016/0006/latest/DLM6339517.html (Accessed 18/01/2019)
10. International Radiation Protection Association, "IRPA guidance on certification of a Radiation Protection Expert", 2016. Available online at: http://www.irpa.net/docs/IRPA%20Guidance%20on%20Certification%20of%20a%20RP%20Expert%20(2016).pdf (Accessed 18/01/2019)
11. Health. Vic. Victoria State Government., "Mandatory radiation safety requirements for use licence holders (Use Licence Condition U1638), Radiation Act 2005", Health. Vic. Victoria State Government. Available at: https://www2.health.vic.gov.au/public-health/radiation. Accessed 17/01/2019
12. Radiation Protection Series No. 14.1, Safety guide for Radiation protection in Diagnostic and Interventional Radiology (2008) Published by the Chief Executive Officer of ARPANSA in August 2008Available at: https://www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps14_1.pdf (Accessed 18/01/2019)
13. Radiation Protection Series No. 14.2, Safety Guide for Radiation Protection in Nuclear Medicine (2008), Published by the Chief Executive Officer of ARPANSA in August 2008Available at: https://www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps14_2.pdf (Accessed 18/01/2019)
14. Radiation Protection Series No. 14.3, "Safety Guide for Radiation Protection in Radiotherapy", Published by the Chief Executive Officer of ARPANSA in August 2008.Available at: https://www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps14_3.pdf (Accessed 18/01/2019)

15. Canadian Radiation Protection Association. Available at: http://crpa-acrp.org/home/?page_id=11243(Accessed 22/01/2019).
16. Holmberg, O., Malone, J., Rehani, M., Mclean, D., and Czarwinskil, R., "Current issues and actions in radiation protection of patients", European Journal of Radiology, 2010, Vol. 76, pp. 15-19
17. European Association of Nuclear Medicine (EANM)., European Federation of Organizations for Medical Physics (EFOMP)., European Federation of Radiographer societies (EFRS)., European society of Radiology (ESR)., European society for Radiotherapy and Oncology (ESTRO)., "Common strategic research agenda for radiation protection in medicine", Insights Imaging, 2017, Vol.8, pp 183-197
18. Awosan, K., Ibrahim, M., Saidu, S., Maaji, S., Danfulani, M., Yunusa, E., et al., "Knowledge of Radiation Hazards, Radiation Protection Practices and Clinical Profile of Health Workers in a Teaching Hospital in Northern Nigeria", Journal of Clinical and Diagnostic Research, 2016, Vol. 10, pp. LC07-12.
19. Director-General for Energy., (European Commission)., "European Commission C Radiation Protection No. 175. Guidelines on radiation protection education and training of medical professionals in the European Union", 2014.

Citation: Auj- E Taqaddas. (2020). Education and Training in Radiation Protection and Mutual Recognition of Qualification in Australia, Canada, News Zealand, Germany and UK. J. of Physical and Chemical Sciences. V7I3:01. DOI: 10.5281/zenodo.3750487.

Supplementary Data

Supplementary data related to this article can be found below:

Appendix A

	Survey sample questionnaire
Q.1	Do you have Radiation officers and Radiation Protection Experts or advisors in your country? If yes what type of experts i.e. Radiation protection supervisor or advisor?
Q.2	What are the conditions to become a Radiation officer (radiation protection supervisor), and Radiation protection Expert or Advisor or qualified Radiation Expert in your country?
Q.3	Please advise which bodies or institutes provide initial training and education for Radiation protection Experts (Radiation protection supervisor and radiation protection advisor) in your country or hospital or region e.g. government and local

	authorities, universities, special training centres, in-house training, others?
Q.4	Does training require any practical work?
Q.5	Is professional experience or experience of working in industry essential to become a radiation officer or Radiation protection expert?
Q.6	Do you accept Radiation protection supervisor and Radiation protection advisor or Expert qualifications from UK or European countries?
Q.7	Are qualified radiation protection experts such as RPO or supervisors registered or certified in your country?
Q.8	Which institutes to get in touch to obtain education and training to become a RSO and RPE?
Q.9	Do you offer any training placements

Appendix B

List of some of the institutes contacted
ARPANSA
Department of Health human services, Australia
District health boards in New Zealand – 16 DHBs
Environment Protection Agency, EPA, SA
Ministry of Health, New Zealand
Radiation safety institute of Canada
Radiological council, Western Australia, ARPS, Australia
ANSTO- Australia
CCNC, CAMRT, VGH- Canada

Appendix C

	Links provided in Q8. by respondents
Health. Vic Website	https://www2.health.vic.gov.au/public-health/radiation
ARPANSA	https://www.arpansa.gov.au/

	https://www.arpansa.gov.au/our-services/training/radiation-safety-training
ANSTO	**https://www.ansto.gov.au/business/products-and-services/radiation-services#training**
Radiological council website	**http://www.radiologicalcouncil.wa.gov.au/**

Under the Radiation Safety training courses, no courses are listed. It states: *Currently there are no radiation safety courses approved in the ACT, no* Approved radiation safety courses have been posted on Victorian Health Website, no radiation safety courses posted on DHHS website, no radiation safety courses posted on the EPA website. The website advises to contact these authorities directly. Contact information is given for each authority.

However, ARPANSA has launched a module titled: Radiation Protection of the Patient (RPOP) on its website to enhance knowledge about radiation safety features of medical imaging. The website also runs a Practical Reference Dosimetry Course for external beam radiotherapy.

Radiological council website lists a number of training courses and examinations for fulfilling the prerequisite for licensing in western Australia. Some of them are listed below

Radiation safety courses
Cone beam CT for dental practitioners
Laser safety
Unsealed radioisotopes

List of some of the course providers
Radiation safety services
DENTSPLY Pty Ltd
Curtain university

Appendix D

Glossary

Use Licence: Use licences authorise the holder to use specified types of radiation sources for a specified purpose (Health. Vic)

Qualified Expert:

"The Responsible Person must ensure that: (a) a qualified expert is available: (i) for consultation on optimisation, dosimetry and quality assurance; and (ii) to give advice on matters relating to radiation protection in medical exposure, and (b) for radiotherapy, the calibration, dosimetry and quality assurance requirements of this Code are conducted by, or under the supervision of, a qualified expert" (RPS14)

RSO: is a radiation safety officer. An RSO will have sufficient professional and/or technical training to oversee and provide advice on radiation safety within the practice. (RPS14.3)

RPS safety guides: The ARPANSA code (RPS 14) is supported by three safety guides, RPS 14.1. RPS 14.2, RPS 14.3

RPA2000 = company that certifies competence in radiation protection practice

Appendix E

Abbreviations

ABR = American board of Radiology

ACPSEM = The Australasian College of Physical Scientists and Engineers in Medicine,

ARPAB = Australian Radiation Protection Accreditation Board (ARPAB)

AUSA = South Australia

AUTAS = Tasmania Australia

AUVIC= Australia Victoria,

AUWA = Western Australia,

CA = Canada,

CCPM = Canadian College of physicists in Medicine organization,

CRPA = Canadian radiation protection association,

DE = Germany,

IPEM = Institute of Physics and Engineering in Medicine

NZ = News Zealand

NZCH = Christchurch Hospital,

NZMOH = Ministry of health

NZWH = Wellington hospital,

NZWDHB = Waikato hospital District health Board

QE = Qualified Expert

RO = Radiation officer,

RPA = Radiation Protection Advisor,

RPS14 = Radiation Protection Series Publication-14