

Victorian Medical Radiations

Workforce Supply and Demand Projections (2010–2030)



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Acknowledgments

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Executive summary

This report provides a high level overview of the workforce supply and demand for Victorian medical radiation services over the next 20 years. The medical radiation workforce demand estimates are mainly derived from population ratios, service utilisation and effective infrastructure methods. The projection of workforce supply is based on various data sources and applies a ‘stocks and flows’ methodology.

The supply and demand modelling is produced for three streams of medical radiations: radiation oncology, medical imaging and nuclear medicine. Within these streams, nine medical radiation professions are modelled, applying the common assumption of ‘business as usual’ during the projection period (2010–2030).

Data regarding current supply and workforce characteristics were collected from a number of sources, including surveys. These were combined with demand data to project required supply. The modelling also identifies the number of workforce entrants required each year in order to achieve the required supply.

The key outcomes of the supply and demand modelling are summarised below.

Radiation oncology

Radiation therapy technologist (current supply: 427 Full Time Equivalents (FTE))

[Projected supply gap from 2010 to 2030: 7 to 64 FTE](#)

Required annual graduates from 2014 onwards: 51 (six more than current numbers)

Radiation oncologist (current supply: 95 FTE)

[Projected supply gap from 2010 to 2030: 33 to 47 FTE](#)

Required annual new fellows from 2013 onwards: 9 (three more than current numbers)

Radiation oncology medical physicist (current supply: 54 FTE)

[Projected supply gap from 2010 to 2030: 21 to 66 FTE](#)

Required annual new fellows from 2015 onwards: 8 (six more than current numbers)

Medical imaging

Radiographer (current supply: 2,032 FTE)

[Projected supply gap from 2010 to 2030: 149 to 1,597 FTE](#)

Required annual graduates from 2014 onwards: 246 (127 more than current numbers)

Radiologist (current supply: 372 FTE)

[Projected supply gap from 2010 to 2030: 53 to 102 FTE](#)

Required annual new fellows from 2015 onwards: 33 (seven more than current numbers)

Medical physicist (medical imaging and nuclear medicine) (current supply: 34 FTE)

[Projected supply gap from 2010 to 2030: 18 to 26 FTE](#)

Required annual new fellows from 2015 onwards: 5 (three more than current numbers)

Nuclear medicine

Nuclear medicine technologist (current supply: 242 FTE)

Projected supply gap from 2010 to 2030: 12 to 199 FTE

Required annual graduates from 2014 onwards: 50 (20 more than current numbers)

Nuclear medicine physician/specialist (current supply: 68 FTE)

Projected supply gap from 2010 to 2030: 9 to 76 FTE

Required annual new fellows from 2015 onwards: 7 (four more than current numbers)

Collectively, the outcomes of the modelling suggest that there will be significant medical radiations workforce supply shortages, particularly among radiographers and nuclear medicine technologists by 2030. These projections present a substantial challenge to the Victorian government in examining and implementing best practice approaches to dealing with workforce supply and medical radiations service delivery.

Introduction

Context

There is increasing evidence, and growing concern, that current pressures on the medical radiations workforce are presenting significant challenges for service delivery that are likely to be exacerbated into the future. Ensuring a sustainable workforce in the future requires strategic investment. Currently there are significant information gaps around the characteristics, distribution and adequacy of the existing workforce supply. There is also limited analysis, modelling and forecasting of the adequacy of supply in the future, in the context of an expected growth in demand for services.

The objective of this project is to inform workforce planning and policy by creating a better understanding of the workforce delivering medical radiation services in Victoria. Projections of workforce requirements to meet demand for these services in the future, are presented in this report, to inform longer term planning.

Scope

The modelling presented in this report includes all medical physicists, medical radiation technologists and medical specialists involved in the delivery of radiation oncology, medical imaging and nuclear medicine services. The project scope does not extend to radio-pharmacists, radio-chemists, nurses, biomedical engineers and other contributors to the overall medical radiations workforce. The sonography workforce is also excluded from the scope of this review, as this professional workforce is the subject of a separate recent workforce study conducted by the Workforce, Leadership and Development Branch in the Victorian Department of Health.

Geographically, the model extends across all of Victoria (metropolitan, regional and rural). Both the private and public sectors are included. A significant proportion of services operate within the private sector, including services contracted by the public health sector.

Professions and services

The medical radiations workforce covers a number of different professions from technician roles through to medical specialists. Table 1 summarises the nine key professions involved in the delivery of medical radiation services in Victoria, including their roles and qualifications.

Table 1: Medical radiation professions and their roles in delivering health services in Victoria

Professions	Responsibilities	Accreditation body ¹	Qualifications in Australia	Services
Medical radiation technologists				
Nuclear medicine technologist	Diagnostic examinations or treatments that use injected or ingested radioactive tracers.	MRPB ANZSNM	BAppSc (MRS/NM) BMedRad Sci (NM) BMedRad (NM)	Diagnostic Therapeutic
Radiation therapist technologist	Design and deliver radiation treatment programs prescribed by radiation oncologist.	MRPB	MMedRad BAppSci (MRS/T) BMedRadSci	Therapeutic
Diagnostic radiographer	Creation of medical images using x-rays, computed tomography (CT) or magnetic resonance (MR) for clinical diagnosis, treatment, screening and/or research.	MRPB AIR	BRadMedImag MMedRad BAppSci (MRS/T) BMedRadSci MMedImagSc	Diagnostic Preventive
Medical specialists				
Radiation oncologist	Responsible for clinical care, preparation of prescriptions and supervision of radiotherapy courses for cancer patients.	MPBV RACP RANZCR	BMed FRANZCR FRCPA	Therapeutic
Diagnostic radiologist	Responsible for diagnosing injury or disease through interpretation and reporting on a range of images produced by radiographers. Also involved in conducting intervention and therapeutic procedures. (NHS 2007, RANZCR 2009).	MPBV RACP RANZCR	BMed FRANZCR FRCPA	Diagnostic Preventive
Nuclear medicine physician	Medical specialists who interpret nuclear medicine images, oversee nuclear medicine procedures, and prescribe and administer doses for therapeutic nuclear medicine purposes.	MPBV RACP RANZCR	BMed FRANZCR FRCPA	Diagnostic Therapeutic

¹ See abbreviations on page 42 for full name of accrediting bodies.

Professions	Responsibilities	Accreditation body	Qualifications in Australia	Services
Medical physicists				
Radiation oncology medical physicist (ROMP)	Specification and calibration of therapy equipment, establishment of quality assurance procedures regarding the delivery of treatment, radiation safety, quality control and regulatory compliance.	ACPSEM ANZAPNM	BAppSci (MRS/T) BMedRadSci MMedPhy	Therapeutic
Medical imaging physicist	Quality assurance of images generated through x-rays, CT or MR and balancing image quality with radiation dosage for staff and patients and associated patient management (NHS 2008).	ACPSEM ANZAPNM	BRadMedImag MMedPhy	Diagnostic
Nuclear medicine physicist	Responsible for maintenance of equipment and software performance standards, for dosimetry, managing the accuracy of dose calibrators and radiation safety (Walker 2007)	ACPSEM ANZAPNM	BMedRad Sc (NM) BMedRad (NM) MMedPhy	Diagnostic Therapeutic

Sources:

<http://www.mrpb.vic.gov.au/>

http://www.drh-careers.med.usyd.edu.au/health_courses/docs/radiath.htm

http://www.drh-careers.med.usyd.edu.au/health_courses/docs/nucmeds.htm

unless otherwise specified

Report outline

Detailed workforce supply and demand models have been developed for each workforce group within the following medical radiations service streams:

- radiation oncology
- medical imaging
- nuclear medicine

The models cover the period 2010 to 2030.

Radiation oncology modelling includes radiation therapy technologists, radiation oncologists and radiation oncology medical physicists. For the medical imaging workforce, modelling is carried out for radiographers, radiologists and medical physicists. For the stream of nuclear medicine, the workforces modelled are nuclear medicine physicians and nuclear medicine technologists.

Methodology

Data sources

Survey data

Medical radiation technologists (MRT) labour force survey

A paper-based survey was designed by the Victorian Department of Health and distributed by the Medical Radiation Practitioners Board (MRPB) along with their registration renewals in June 2008. The survey collected basic information about demographic and work characteristics. The response rate to the 2008 medical radiation technologists labour force survey was 85%.

Radiation oncology facilities and workforce survey

This survey was conducted as part of the national radiation oncology workforce planning project contracted to HealthConsult by the Commonwealth Department of Health and Ageing (DOHA) in 2009. The survey collected information regarding radiation equipment type and operating days, utilisation patterns (patients, attendance, fields and throughputs), workforce recruitment and retention. A total of 52 radiation oncology facilities participated in the survey.

Medical labour force survey (MLFS)

This is an annual survey conducted by the Victorian Department of Health in collaboration with the Medical Practitioners Board of Victoria (MPBV). In 2008, Over 80% of the registered medical practitioners in Victoria responded to the MLFS.

Australian radiologist workforce survey

The Royal Australian and New Zealand College of Radiologists (RANZCR) has conducted a biennial workforce survey since 2004. The survey collects information on demographic characteristics, work status and intention, workload, work setting, productivity and satisfaction. The overall response rate was 63.4%.

Australasian clinical medical physics and biomedical engineering workforce survey

This survey was conducted by the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM) in 2006 in Australia and New Zealand. The survey provided information regarding workforce size, practice profile, salary level and vacancies for medical physicists, by jurisdiction, in Australia. There were 56 FTE positions from Victoria included in this survey.

Victorian medical imaging workforce recruitment and retention survey

Victorian nuclear medicine workforce recruitment and retention survey

These two surveys were carried out by the Victorian Department of Human Services in 2009 as part of the medical radiations workforce study. The study aimed to develop a better understanding of the medical radiations workforce across all practice settings. Recruitment and retention issues were sought from public and private medical imaging and nuclear medicine facilities.

Victorian medical physicist workforce survey

Detailed work status, qualifications and practice profiles were collected via the medical physicist workforce survey to build up a more realistic workforce picture for this profession. This survey was also conducted by the Victorian Department of Human Services as part of the medical radiations workforce study.

Registration and licence data

Medical Radiation Practitioners Board (MRPB)

The MRPB (Victoria) collects data from registrants regarding date of birth, gender, and residential postcode. Registration data provided in November 2008 indicated there were 929 male and 1,999 female medical practitioners registered to practise in Victoria.

Victorian radiation management licensing database

The *Radiation Act 2005* requires both that all radiation sources be licensed and that all users of radiation sources be licensed. The administration of licences is managed by the Environmental Health Unit of the Victorian Department of Health. The 2009 active medical radiation source data and user licence data were used for the purposes of this modelling.

Other data sources

Other data used throughout the modeling process were:

- Australasian Medical Publishing Company (AMPCo) — The Medical Directory of Australia
- Cancer Council Victoria — *CANSTAT: Cancer in Victoria 2006*
- Department of Education and Workplace Relations (DEEWR) — Higher Education Statistics (2005–2008)
- Department of Health — Victorian Admitted Episodes dataset (VAED)
- Department of Health — Victorian Emergency Minimum Dataset (VEMD)
- Department of Health — Victorian inpatient forecasts (2009–2027)
- Department of Health — Victorian tumour stream (cancer) forecasts (2009–2027)
- Department of Health and Ageing — *Medical Training Review Panel Eleventh Report, December 2007*.
- Department of Human Services — *Victorian Radiotherapy Services Plan July 2007*.
- Department of Planning and Community Development — Victoria in Future (VIF) population projections (released September 2009)
- Medicare Australia — Medicare Benefits Schedule Statistics (2004–2008)

Supply and demand projections

The supply and demand modelling presented in this report has been carried out using the National Health Workforce Planning Tool (NHWPT). Workforce supply is based on a 'stocks and flows' model, where the projected workforce for each year is based on the previous year's workforce, adjusted for inflows and outflows. Future demand for services is forecast by considering the current level of supply of services, adjusted for any current shortfall and assumed annual rate of growth. The model is then adjusted by increasing training places from 2010 onward (undergraduate entrants or advanced trainees) until the demand is met (the model balances) by the end of the projection period (2030).

The demand estimate uses different methodologies to calculate workload for each medical radiation profession and stream. Three methods are applied in estimating medical radiations demand: population (patient) ratio, service utilisation and effective infrastructure. These methods are driven by the needs for medical radiation services, government policy, service delivery benchmarks, service utilisation patterns and population growth. Medical radiation services are highly facility dependent. Unlike other professionals, medical radiation practitioners can only deliver their professional services where the necessary infrastructure is available, namely medical radiations equipment. The supply and demand projections of the model have been formulated into three distinct outcomes; required Full Time Equivalent (FTE); status quo FTE and adjusted FTE once the balancing process completed.

Required FTE projections identify the FTE of each given workforce required in order to meet forecast service demand on an ongoing basis.

Status quo FTE presents the estimated FTE of each given workforce based on supply assumptions and the current workforce profile.

Adjusted FTE reflects the outcome of balancing demand and supply by the end of projected period and indicates the extra number of new workforce entrants required to meet demand.

Both status quo and adjusted FTE take into account entries (including local and international graduates) and exits (including retirements) from the workforce. Training requirements account for lags in the training period as well as attrition within the education and training process.

The model also provides the projected supply of newly qualified professions (graduates/interns/fellows) per year corresponding to the **status quo** and **adjusted** outcomes. The projections of workforce entries to the various professional groups have taken account of the various training requirements and attrition rate.

Modelling caveats

The model inputs for the calculation of workforce supply and demand through this modelling are primarily based on quantifiable historical trends and future projections relevant to the medical radiations service sector from a range of data sources. When using projections of annual growth in service demand, an assumption which implicitly accounts for population growth, for ageing, and for cancer incidence has been made. The modelling, however, does not take into account qualitative issues which may affect supply and demand modelling, including such issues as changing models of care or government policy. All models also assume all medical radiations equipment is in sufficient supply and in working order.

The radiation oncology workforce

Radiation oncology service and workforce demand

The Victorian Cancer Registry (VCR) records all cancer incidences in Victoria. In 2006, 25,535 Victorians were diagnosed with cancer, of which 9,935 died (30% of all deaths in Victoria).² According to the VCR, cancer diagnoses have increased at a rate of 3.4% per annum over the last decade³. This increase exceeds the rate of growth of the aged population which is estimated to be 2.0%.⁴ From VCR cancer incidence and the past per annum growth of 3.4%, it is estimated that the incidence of new cancer cases in Victoria will increase to 29,569 in 2010 and 41,363 and 57,861 in 2020 and 2030, respectively (Table 2). It is anticipated that 52% of all new oncology cases will need radiation services and that 25% of these will require re-treatment.⁵

In the recent Radiation Oncology Workforce Planning (ROWP) study, radiotherapy facility staffing models for radiation therapy technologists (RTT), radiation oncologists (RO) and radiation oncology medical physicists (ROMP) were examined. This study reveals considerable variation among jurisdictions and service sectors. Combining current practice in Victoria with ACPSEM's recommendations⁶, each linear accelerator (linac) should be staffed by 1.7 ROMPs, 3 ROs and 10 RTTs. Based on this benchmark, and in order to meet increasing demand for radiation services, Victoria would need to increase the supply of RTTs, ROs and ROMPs to 844, 253 and 143 FTE by 2030, respectively (Table 2).

2 Cancer Council Victoria 2009, *CANSTAT: Cancer in Victoria 2006*, www.cancervic.org.au

3 Cancer Council Victoria 2009, Victorian Cancer Registry, Time trends, downloaded July 2009.

4 Australian Bureau of Statistics, Estimated resident population, 1998 to 2008, population aged 65 years and over.

5 Victorian Radiotherapy Services Plan July 2007, p.7

6 Oliver, L et al, Requirements for radiation oncology physics in Australia and New Zealand (ACPSEM Position Paper). *Aust. Phys. & Eng. Sci.*, 24 (1) 1–18, 2001

Table 2: Victorian cancer incidence and radiotherapy demand projection

Projected years	Service demand		Facility	Workforce (FTE)		
	Cancer incidence	Targeted cancer patients	Linacs required	ROMP	RO	RTT
2010	29,569	19,405	43	74	125	431
2011	30,578	20,067	45	76	134	446
2012	31,622	20,752	46	78	138	461
2013	32,702	21,460	48	81	143	477
2014	33,818	22,193	49	84	148	493
2015	34,972	22,951	51	87	153	510
2016	36,166	23,734	53	90	158	527
2017	37,401	24,544	55	93	164	545
2018	38,677	25,382	56	96	169	564
2019	39,998	26,248	58	99	175	583
2020	41,363	27,144	60	103	181	603
2021	42,775	28,071	62	106	187	624
2022	44,235	29,029	65	110	194	645
2023	45,745	30,020	67	113	200	667
2024	47,306	31,045	69	117	207	690
2025	48,921	32,105	71	121	214	713
2026	50,591	33,200	74	125	221	738
2027	52,318	34,334	76	130	229	763
2028	54,104	35,506	79	134	237	789
2029	55,951	36,718	82	139	245	816
2030	57,861	37,971	84	143	253	844

The delivery of radiation therapy services is contingent on the availability of linear accelerators and the specialist workforce to operate this equipment. Benchmarking by the Collaboration for Cancer Outcomes Research and Evaluation identified that on average one linear accelerator can accommodate 450 courses of treatments per year⁷. Based on projections of cancer incidence and treatment requirements, the required number of linacs has been identified in Table 3. These projections indicate that Victoria will require 43 linacs in 2010, 60 in 2020, and 84 in 2030. Currently, there are 40 linacs licensed for treating cancer patients in Victoria⁸. Over half of the current linacs are over 10 years of age. The current development and expansion of radiotherapy service sites (Box Hill, Dandenong, Casey, Goulburn Valley and The Northern Hospitals and the Olivia Newton John Cancer Centre) is expected to increase the number of linacs operating in Victoria to 46 by 2015.

Comparing the number of linacs in Victoria (current and forecast) to existing benchmarks indicates that Victoria will require an additional 38 linacs by 2030 in order to meet the need for radiotherapy services at that time.

⁷ The Collaboration for Cancer Outcomes Research and Evaluation 2003, A Cancer Services Framework for Victoria and future directions for the Peter MacCallum Cancer Institute. July 2003.

⁸ Department of Health, Victorian radiation management licensing database

Table 3: Victorian radiotherapy facility (linacs) forecast 2015–2030

	2015	2020	2025	2030
Required linacs	51	60	71	84
Estimated supply	46	46	46	46
Shortfall	-5	-14	-25	-38

Radiation oncology workforce current supply

The ACPSEM recommends that each linac should be staffed by 1.7 ROMPs, 3 ROs and 10 RTTs⁹. Table 4 summarises the current Victorian radiation oncology workforce supply, estimated requirements, and assessed shortage as it relates to radiation therapy.

According to the National Radiation Oncology Workforce Study, there were workforce shortages for RO (6.8% vacancies) and ROMPs (6.3% vacancies). These results suggest a consistent trend of unmet workforce demand based on ACPSEM benchmarks. Table 4 shows comparisons of the current workforce with that recommended by ACPSEM benchmarking of linacs (from Table 2) and indicates a current shortfall among radiation oncologists and ROMPS.

Table 4: Current workforce and estimated FTE shortfall for radiation oncology workforce

Profession	Required FTE	Available FTE	Vacancies#	Current Shortfall (FTE)
Radiation therapy technologists	431	427	0%	NS
Radiation oncologists	125	95 †	6.80%	30
ROMPs	74	54	6.30%	20

Vacancy rate from Radiation Oncology Workforce Planning Study, HealthConsult 2009. Shortfall is the difference between required FTE (from benchmarks) and available FTE – the vacancy rate is used as a check.

† Includes advanced trainees as contributors to radiation oncology service delivery

The detailed modelling of the workforce in subsequent sections of this report will articulate the workforce requirements to meet service demand in more detail.

Radiation oncology workforce modelling

This section details the outcomes of the radiation oncology workforce supply and demand modelling for each of the following workforce groups:

- radiation therapy technologists
- radiation oncologists
- radiation oncology medical physicists

The workforce supply and demand model for radiation oncology professionals has been developed with a number of key common assumptions forming the base model. These assumptions are presented in Table 5.

⁹ Oliver, L et al, Requirements for radiation oncology physics in Australia and New Zealand (ACPSEM Position Paper). Aust. Phys. & Eng. Sci., 24 (1) 1–18, 2001

Table 5: Common assumptions for radiation oncology workforce

Radiation oncology workforce common assumptions	
•	Workforce demand growth rate is comparable to the cancer incidence and radiotherapy services growth
•	Clinical practice remains the same
•	Supply of graduates from universities is gradually increasing
•	Government policy and benchmarks remain the same
•	Radiotherapy facilities are in sufficient supply

This base model assumes that the current level of radiotherapy provision is a baseline and there is an additional demand generated by a number of factors (some of which are known, but most of which will be estimated). The annual demand growth rate implicitly accounts for population growth and ageing, cancer incidence, and also for a gap between current and targeted (best care practice) provision of radiation oncology.

The radiation therapy technologist workforce

The data inputs for the radiation therapy technologist workforce model are presented in Table 6.

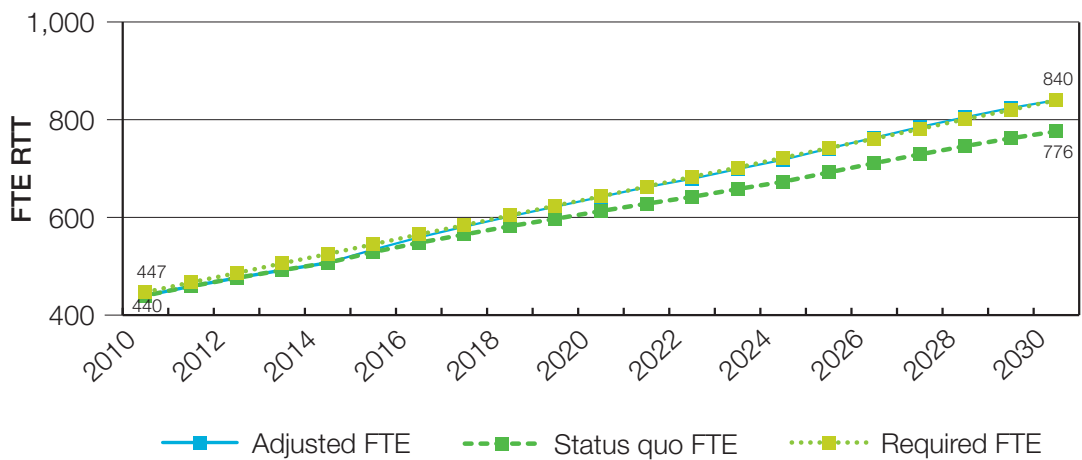
Table 6: Data inputs for the radiation therapy technologist model

Model parameter	Base case	Data source
Demand growth per annum	4.6%	See Table 2. Compound growth is 3.4% per annum; the equivalent simple growth rate for input to the modelling tool is 4.6%.
Workforce supply (base year 2009)	479 headcount (427 FTE)	Medical Radiation Practitioners Board 2009 registration data MRT labour force survey 2008
Workforce shortage (FTEs)	0	(See Table 4)
Average weekly work hours	38 male; 33 female	MRT labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow-graduates per annum	40–45–48	DEEWR enrolment data and DHS clinical internships projection [#]
Training dropout rate	20%	Based on University experience (private communication)
Workforce inflow immigration	1	Medical Radiation Practitioners Board 2008 registration data
Workforce outflow – retirement age	>65 yrs	Based on the labour force survey
Workforce outflow – average loss rate	4.6%	Medical Radiation Practitioners Board 2008 registration data
Workforce inflow – average re-entry rate	1.5%	Medical Radiation Practitioners Board 2008 registration data

[#] unpublished internal data

Figure 1 shows the outcomes of the radiation therapy technologist base model in terms of assumed workforce supply (status quo FTE), demand (required FTE) and adjusted supply meeting demand (adjusted FTE). A gap is noted between the required and status quo FTE, indicating that workforce growth continuing according to historical trends would be insufficient to meet the projected demand. The shortage of radiation therapy technologists is projected to reach 64 FTE in 2030.

Figure 1: Victorian radiation therapy technologist workforce projections 2010–2030



Comparing the status quo and adjusted training positions indicates that an additional six radiation therapy technology graduates are required per year in order to achieve a balance in the supply and demand of radiation therapy technologists by 2030 (Table 7).

After accounting for the training attrition rate, the graduate injection required equates to a total of eight additional first year training places per year from 2010 to 2017 and seven additional first year training places from 2018 to 2026.

Table 7: Radiation therapy technologist training placements required between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
Graduates (Interns)		
2010–13	40	40
2014–21	45	51
2022–29	48	54
First year training placements		
2011–17	56	64
2018–26	60	67

The radiation oncologist workforce

The workforce supply and demand model for radiation oncologists (RO) has been developed based on the same assumptions as those for radiation therapy technologists (Table 5).

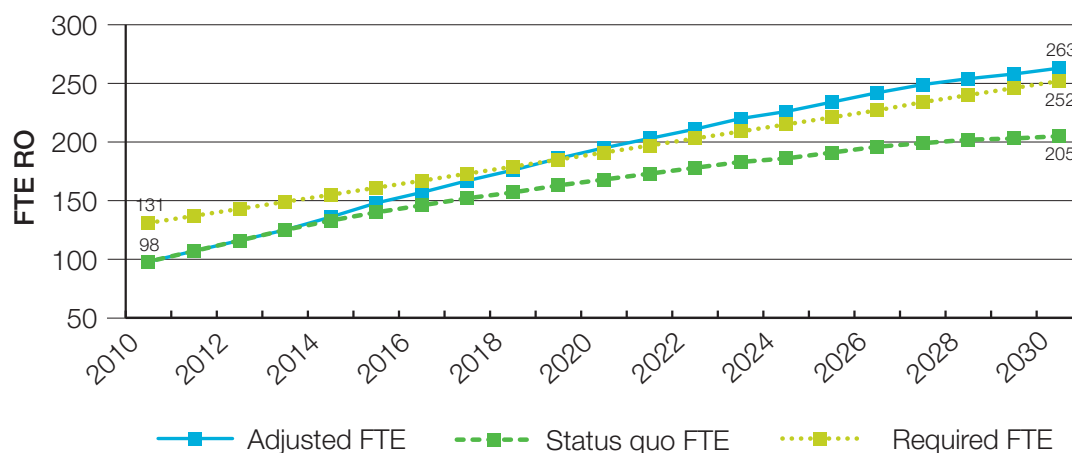
The RO model commences with a shortage of 30 FTE based on a comparison of demand for services and the total RO FTE for 2009 and ACSPEM benchmarking (Table 4). Due to the different training pathway and qualification requirements, the projections for ROs are based on new fellows and advanced trainees only. First year trainees are not included as training at this level is generalist radiology training and may include radiologists who enter subspecialties other than radiation oncology. The inputs of the model are shown in Table 8.

Table 8: Data inputs for the radiation oncologist model

Model parameter	Base case	Data source
Demand growth per annum	6.4%	See Table 2. Compound growth is 3.4% per annum; the equivalent simple growth rate for input to the modelling tool is 6.4%.
Workforce supply (base year 2009)	82 headcount 95 FTE	AMPCo data 2009 Medical labour force survey 2008
Workforce shortage (FTEs)	30 FTE	(See table 4)
Average weekly work hours	47 male; 40 female	Medical labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow RANZCR fellows per annum	6	Based on <i>Medical Training review Panel Report (MTRP) 2007</i>
Advanced training dropout rate	20%	RANZCR examination pass rate from MTRP 2007
Workforce inflow immigration	1	Medical Practitioners Board of Victoria registration data 2008
Workforce outflow – retirement age	>65 years	Medical labour force survey 2008
Workforce outflow – average loss rate	4.8%	AMPCo data 2009
Workforce inflow – average re-entry rate	1.6%	Medical labour force survey 2008

Figure 2 indicates that the gap between the status quo and required FTE remains relatively constant at about 30 FTE up until 2020. Beyond 2020, the shortage of ROs increases to 47 FTE by 2030.

Figure 2: Victorian radiation oncologist workforce projections 2010–2030



Examining the supply of ROs through education and training, Table 9 shows that nine new RANZCR fellows and 22 advanced vocational (year 4 and year 5) trainees per year are required from 2013 to 2030, in order for workforce supply to meet service demand. It is important to note that due to the complexity of the radiation oncology subspecialty training and the small size of this professional group, it is not possible to precisely balance the model at 2030. As such, with the recommended entries into the radiation oncology workforce, a surplus of 11 FTE is projected in 2030.

Table 9: Training requirements for radiation oncologists between 2010 and 2030

Projection years	Status quo supply (per year)	Adjusted supply (per year)
RANZCR fellows		
2010–12	6	6
2013–29	6	9
Advanced trainees (year4–5)*		
2010–12	15	15
2013–29	15	22

* Trainees at these levels are more likely to become qualified Radiation Oncologists upon their completion of the training program.

The radiation oncology medical physicist workforce

The projection of ROMPs is based on limited workforce supply data obtained from the facilities survey of the Radiation Oncology Study conducted by Health Consult. Currently there are 54 medical physicists in Victoria.

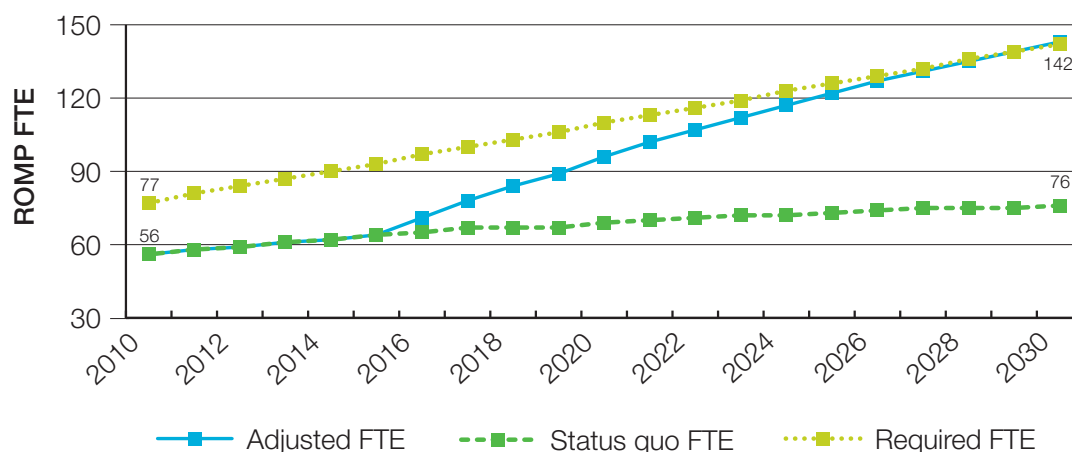
The workforce requirement for ROMPs has been developed based on the ACPSEM benchmark (1.7 ROMPs per linac; see above). In addition to previously noted common assumptions, this model also assumes that the number of medical physicists migrating from overseas to Australia will be maintained at current levels of two per year. The data inputs to the modelling are summarised in Table 10.

Table 10: Data inputs for the ROMP model

Model parameter	Base case	Data source
Demand growth per annum	6.0%	See Table 2. Compound growth is 3.4% per annum; the equivalent simple growth rate for input to the modelling tool is 6.0%.
Workforce supply (base year 2009)	54 headcount 54 FTEs	Radiation Oncology Workforce Planning Study (ROWPS) 2009
Workforce shortage (FTEs)	20	See table 4
Standard weekly work hours	38 male and female	Radiation Oncology Workforce Planning Study (ROWPS) 2009
Average weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow ACPSEM registrars per annum	2 (estimated for Victoria)	10 new registrars per annum Australia (ACPSEM)
Dropout rate from TEAP*	16%	Based on University experience (private communication)
Workforce inflow immigration	2	Radiation Oncology Workforce Planning Study (ROWPS) 2009
Workforce outflow – retirement age	>75 years	Radiation Oncology Workforce Planning Study (ROWPS) 2009
Workforce outflow – average loss rate	4.4%	Radiation Oncology Workforce Planning Study (ROWPS) 2009

* Advanced training program: Training, Education and Accreditation Program

Figure 3 shows the outcome of the supply and demand modelling for ROMPs. Comparisons between the status quo and required FTE outcomes indicate a consistently increasing shortfall of ROMPs between 2010 and 2030. A shortfall of 66 FTE is forecast by 2030, assuming no change in current patterns of workforce entries and exits.

Figure 3: Victorian ROMP workforce projections 2010–2030


The adjusted training requirement suggests that in order for the supply of the ROMP workforce to meet the demand for radiation oncology services, an additional six ACPSEM fellows per year are required from 2015 onwards (Table 11). Taking into account training attrition, this equates to a total of 10 advanced Training Education and Accreditation Program (TEAP) first year trainees per year in Victoria from 2011.

Table 11: Training requirements for ROMPs between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
ACPSEM new fellows		
2010–14	2	2
2015–29	2	8
TEAP* trainee (commencing placements)		
2010–24	3	10

* Training Education and Accreditation Program.

The medical imaging workforce

Medical imaging service and workforce demand

Medical imaging (MI) is an essential diagnostic service for all patient care. Data from Medicare Australia indicates that diagnostic medical imaging has increased at a rate of 5.6% per annum from 2003–04 to 2008–09. The increase in emergency presentations (6.2% per annum) has contributed to the increased demand for medical imaging services. According to the service growth, the workforce requirements by 2030 will be expected to double the current radiographer and radiologist supply (Table 12).

Table 12: Medical imaging workforce demand projection

Projection year	Radiographer	Radiologist	Medical imaging physicist
2009	2,098	391	34
2010	2,192	408	35
2011	2,285	425	36
2012	2,379	443	36
2013	2,472	460	37
2014	2,566	477	37
2015	2,659	494	38
2016	2,753	511	38
2017	2,846	528	39
2018	2,940	545	39
2019	3,033	562	40
2020	3,127	580	40
2021	3,220	597	41
2022	3,314	614	41
2023	3,407	631	42
2024	3,501	648	42
2025	3,594	665	42
2026	3,688	682	43
2027	3,781	699	43
2028	3,875	717	44
2029	3,968	734	44
2030	4,062	751	45

The majority of medical imaging physicists (about 60%) are also working as a nuclear medicine medical physicists. As such, it is difficult to completely separate the medical imaging physicist workforce from the nuclear medicine physicist workforce in estimating the respective workforce size.

A recent report by Round (2007)¹⁰ on the medical physics and biomedical engineering workforce identified significant shortages in the national and Victorian-specific medical imaging and nuclear medicine physicist workforce when compared to the recommendations based on population ratios. Table 13 shows that the size of these workforces in Australia and New Zealand are substantially lower than those recommended in Germany.

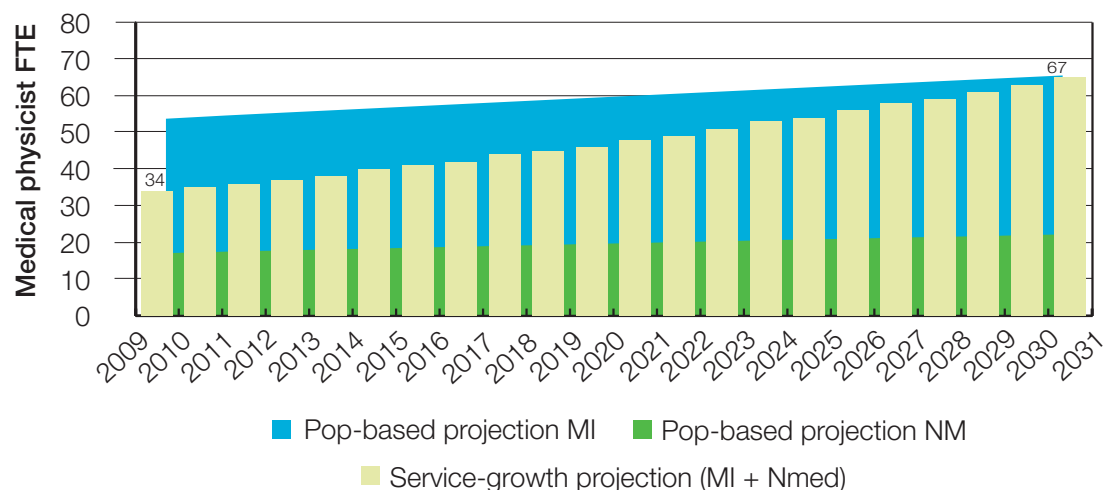
Table 13: Comparison of actual size of the medical physicist workforce in Australia and New Zealand with German recommendation

	Germany	Australian	New Zealand	Victoria
Profession	Recommended	Actual supply /1,000,000 population		
Nuclear medicine physicist	3.2	0.9	1.8	0.7
Medical imaging physicist	6.4	1.5	0.4	0.4

(Note: Recommended levels for the nuclear medicine and medical imaging physics workforces in Australia and New Zealand have not yet been developed)

In order to further examine the size of the medical physicist workforce in relation to two different estimate approaches, a comparison of population-based projections with service utilisation-based projections is presented in Figure 4. The result indicates that the service growth rate exceeds the population growth rate and that the service-related projections will catch up to the population-based projections (67) by 2030. Both approaches yield similar results by the end of projection period.

Figure 4: Victorian demand for medical physicists working in medical imaging and nuclear medicine 2010–2030



10 Round, W. H. 2007. "A survey of the Australasian clinical medical physics and biomedical engineering workforce". *Australasian Physical & Engineering Sciences in Medicine*, volume 30, number 1, pp. 13–24.

Medical imaging workforce current supply

The statewide medical radiations workforce recruitment and retention survey conducted in 2009 indicated wide-ranging shortfalls in the medical imaging workforce, based on vacancy data. Table 14 indicates that vacancies are highest among medical physicists. The current shortfall for the medical imaging workforce is estimated based on the participation and vacancy rate for available medical imaging practitioners. Although there is a large shortage in FTE (66) for radiographers, medical physicists have the highest unmet workforce demand (35% of the required workforce).

Table 14: Current workforce and estimated FTE shortfall for medical imaging workforce

Profession	Required FTE	Available FTE	Vacancies [#]	Current shortfall (FTE)
Radiographer	2,098	2,032	3.60%	66
Radiologist	391	372	5.60%	19
Medical physicist (Medical imaging and nuclear medicine)	52	34	15.00%	18

[#] Vacancy rate derived from Victorian medical imaging and nuclear medicine workforce recruitment and retention survey. FTE shortfall is calculated from the available FTE x participation rate x vacancy rate.

Medical imaging workforce modelling

This section details the outcomes of the medical imaging workforce supply and demand modelling for each of the following workforce groups:

- radiographers
- radiologists
- medical physicists (medical imaging and nuclear medicine).

The workforce supply and demand model for medical imaging professionals has been developed with a number of common assumptions forming the base model. These assumptions are presented in Table 15.

Table 15: Common assumptions for medical imaging workforce

Medical Imaging workforce common assumptions
• Workforce demand growth rate is comparable to the services utilisation trend
• Clinical practice remains the same
• Graduates supply from universities is the same or gradually increasing
• Government immigration policy remains the same
• Medical imaging facilities are in sufficient supply
• No significant changes in radiation technology.

The radiographer workforce

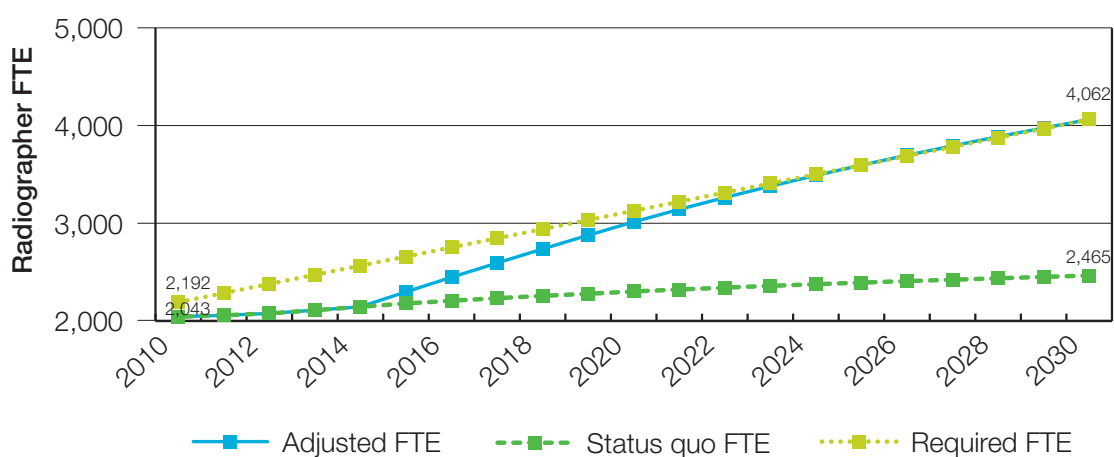
Table 16 summarises the data inputs for the development of the base case supply and demand modelling for radiographers between 2010 and 2030.

Table 16: Data inputs for the radiographer model

Model parameter	Base case	Data source
Demand growth per annum	4.6%	The demand rate required to achieve the workforce demand in Table 12.
Workforce supply (base year 2009)	2,194 headcount (2,032 FTE)	Medical Radiation Practitioner Board 2008 registration data
Workforce shortage (FTEs)	66 FTE	See Table 14 Department of Human Services medical imaging and nuclear medicine workforce recruitment and retention survey 2009
Average weekly work hours	39 male; 34 female	Medical radiation technologists labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow graduates per annum	106–119	Based on university enrolment and clinical internships
Training dropout rate	16%	Estimated base on University experience
Workforce inflow immigration	10 FTEs	Medical Radiations Practitioners Board 2008 registration data
Workforce outflow – retirement age	>65 years	Medical radiation technologists labour force survey 2008
Workforce outflow – average loss rate	4.5%	Medical radiation technologists labour force survey 2008
Workforce inflow – average re-entry rate	0.6%	Medical radiation technologists labour force survey 2008

The outcomes of the workforce supply and demand modelling for radiographers indicate that the continuation of current trends in workforce supply would lead to an increasing shortage of radiographers over the next 20 years from 66 FTE to 825 FTE in 2020 and further to 1,597 FTE in 2030 (Figure 5).

Figure 5: Victorian radiographer workforce projections 2010–2030



In order to meet the projected service demand, the adjusted training requirement indicates that an extra 127 graduates are needed each year from 2014 onwards. Taking into account the education and training attrition rate of radiographers, and the current first year enrolments, this equates to a requirement for 293 first year radiography training placements per year from 2010 (Table 17).

Table 17: Training requirements for radiographers between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
Graduates (Interns)		
2010–11	106	106
2012–13	119	119
2014–29	119	246
First year training placements		
2010–26	142	293

The radiologist workforce

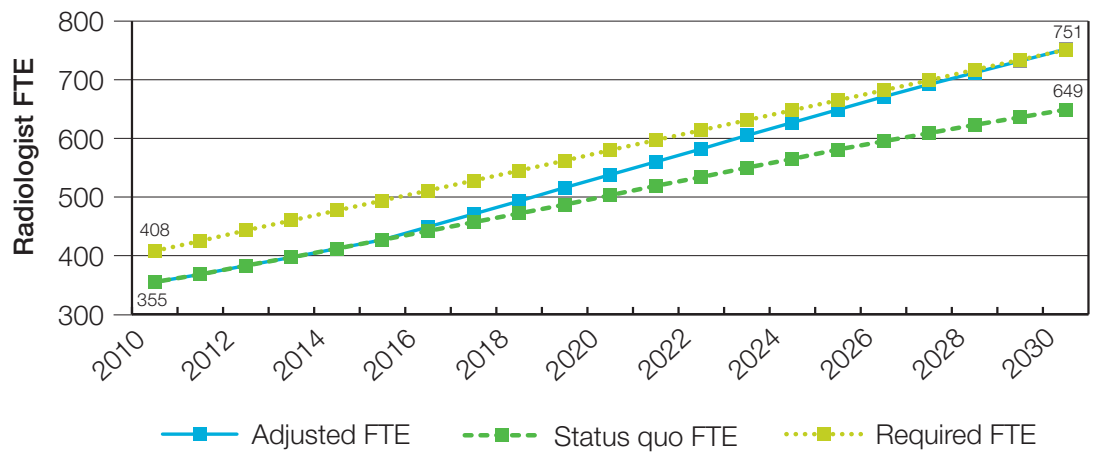
Table 18 summarises the supply and demand inputs to the radiologist workforce model. Due to the male predominance within the radiologist workforce, the retirement age for males has been extended to 75 years in this model to better reflect the work patterns of male medical specialists. As with radiation oncologists, the current modelling has only projected the number of new RANZCR fellows and advanced trainees and does not include the PGY trainees.

Table 18: Data inputs for the radiologist model

Model parameter	Base case	Data source
Demand growth per annum	4.6%	The demand rate required to achieve the workforce demand in Table 12.
Workforce supply	391 headcount (372FTE)	AMPCo 2009 data
Workforce shortage (FTEs)	19 FTE	See Table 14 Department of Human Services medical imaging and nuclear medicine workforce recruitment and retention survey 2009
Average weekly work hours	41 male; 32 female	Using age and gender specific average weekly work hours from Medical labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow RANZCR fellows per annum	26 new fellows	MTRP 2007 report
RANZCR training dropout rate (over 4 years)	16%	Estimated base on the examination pass rate MTRP 2007 report
Workforce inflow immigration	0	
Workforce outflow – retirement age	>65 years Female >75 years Male	Medical labour force survey 2008
Workforce outflow – average loss rate	13.0%	AMPCO 2009 data Medical labour force survey 2008
Workforce inflow – average re-entry rate	0%	AMPCO 2009 data Medical labour force survey 2008

The outcomes of the workforce supply and demand modelling project a steady workforce gap (13%) over the 20 year forecast period. In FTE terms, the gap is forecast to increase from 53 FTE at 2010 to 102 FTE by 2030 (Figure 6).

Figure 6: Victorian radiologist workforce projections 2010–2030



The adjusted supply indicates that an additional seven radiologist FTE per year are required to enter the workforce from 2015 onwards to meet the service demand by 2030. In terms of training posts, this equates to at least 65 advanced training placements (year 4 and 5) per year in the next five years and 82 from 2015 onwards (Table 19).

Table 19: Training requirements for radiologists between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
RANZCR fellows		
2010–14	26	26
2015–29	26	33
Advanced trainees (year4–5)		
2010–14	65	65
2015–26	82	82

* Trainees at these levels are more likely to become qualified Radiation Oncologists upon their completion of the training program.

The medical imaging and nuclear medicine physicist workforce

Medical imaging and nuclear medicine physicists are a small professional group (combined total of 34 FTE). There is limited information regarding their practice, professional training, and career pathways. The following forecast is based on various sources of data and information from the Department of Health radiation use licence database, the workforce recruitment and retention survey, and the TEAP program.

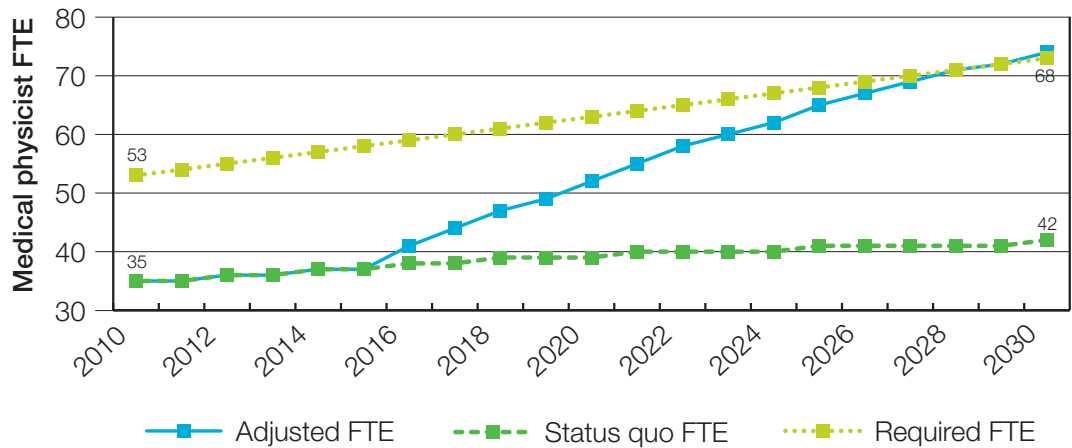
The modelling of the medical physicist workforce is based on the inputs presented in Table 20.

Table 20: Data inputs for the medical imaging and nuclear medicine physicist model

Model parameter	Base case	Data source
Demand growth per annum	2.2%	Equivalent to the demand from Table 13 (population-based benchmark)
Workforce supply (base year 2009)	34 headcount (34 FTEs)	Department of Health radiation use licence database. Department of Human Services medical imaging and nuclear medicine physicist survey 2009
Workforce shortage (FTEs)	18 FTE	See Table 14
Average weekly work hours	38 hours	Department of Human Services medical imaging and nuclear medicine physicist survey 2009
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow ACPSEM registrars per annum	2	Based on the RMIT current enrolments
Dropout rate for the TEAP (over 5 years)	16%	Estimated base on University experience
Workforce inflow immigration	0	
Workforce outflow – retirement age	>75 years male >65 years female	Similar to ROMPs Radiation Oncology Workforce Planning Study (ROWPS) 2009
Workforce outflow – average loss rate	4.0%	Similar to ROMPs Radiation Oncology Workforce Planning Study (ROWPS) 2009

Figure 7 shows the projected gap between workforce supply and demand for medical physicists between 2010 and 2030. This indicates a gap increasing to 26 FTE by 2030 compared with 18 FTE at 2010.

Figure 7: Victorian medical imaging and nuclear medicine physicist workforce projections 2010–2030



The adjusted supply projections indicate that Victoria requires five new fully qualified medical physicists for medical imaging or nuclear medicine per year from 2015 onwards, equating to six TEAP first year training placements from 2010 (Table 21). These findings are consistent with shortfalls identified when comparing Australian and Victorian ratios of medical physicists with recommended population benchmarks identified in Germany.

Table 21: Training requirements for medical imaging and nuclear medicine physicists between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
New fellows		
2010–14	2	2
2015–29	2	5
TEAP first year training placement		
2010–24	3	6

The nuclear medicine workforce

Nuclear medicine service and workforce demand

Service utilisation trends for nuclear medicine in Victoria have increased significantly over the last five years. According to Medicare Australia, the annual growth rate for nuclear medicine related diagnostic imaging (MBS Group I4) was 4.1% per annum from 2004–05 to 2008–09. The annual growth rate for bone densitometry was 10.3% per annum over the same period. The growth rate of bone densitometry has been calculated separately as it constitutes a separate cluster of Medicare Benefits Schedule (MBS) items.

The workforce requirements for nuclear medicine technologists and nuclear medicine specialists are based on the combined growth for nuclear medicine related diagnostic imaging and bone densitometry (6.2% per annum). At this rate of growth, Victoria will need 564 qualified nuclear medicine technologists and 175 nuclear medicine specialists/physicians by 2030 (Table 22).

The projected number of nuclear medicine physicists for the next 20 years is included in the medical physicist projection using the population ratio method (Figure 4).

Table 22: Nuclear medicine workforce demand projection 2010–2030

Projection year	Nuclear medicine technologist	Nuclear medicine specialist	Nuclear medicine physicist*
2010	264	78	18
2011	279	82	18
2012	294	87	18
2013	309	92	18
2014	324	97	19
2015	339	102	19
2016	354	107	19
2017	369	112	19
2018	384	117	20
2019	399	122	20
2020	414	126	20
2021	429	131	20
2022	444	136	21
2023	459	141	21
2024	474	146	21
2025	489	151	21
2026	504	156	21
2027	519	161	22
2028	534	165	22
2029	549	170	22
2030	564	175	22

* Demand for nuclear medicine physicists is estimated in conjunction with medical imaging physicists in Figure 7.

Nuclear medicine workforce current supply

Results from the statewide recruitment and retention survey of the medical radiations workforce identified a number of vacancies within the nuclear medicine workforce in 2009. These vacancies have been used to reflect current workforce shortfalls. Based on this data, there is an estimated current gap of seven and five FTE of nuclear medicine technologists and nuclear medicine physicians, respectively (Table 23).

Table 23: Current workforce and estimated FTE shortfall for nuclear medicine workforce

Profession	Required FTE	Available e FTE	Vacancies#	Current shortfall (FTE)
Nuclear medicine technologist	249	242	2.5%	7
Nuclear medicine specialist	73	68	9.0%	5

Department of Human Services nuclear medicine workforce recruitment and retention survey 2009. FTE shortfall is calculated from the available FTE x participation rate x vacancy rate.

Nuclear medicine workforce modelling

This section details the outcomes of the nuclear medicine workforce supply and demand modelling for each of the following workforce groups:

- Nuclear medicine technologists
- Nuclear medicine physician/specialists

The nuclear medicine physicist model has been incorporated with medical imaging physicists in the previous section because of the high proportion of overlap in practice streams.

The workforce supply and demand model for nuclear medicine professionals has been developed with a number of key common assumptions forming the base model. These assumptions are presented in Table 24.

Table 24: Common assumptions for nuclear medicine workforce

Nuclear Medicine workforce common assumptions
<ul style="list-style-type: none"> • Workforce demand growth rate is comparable to the services utilisation trend • Clinical practice remains the same • Supply of graduates from universities remains the same • Nuclear medicine facilities are in sufficient supply • No significant changes in nuclear medicine technology.

The nuclear medicine technologist workforce

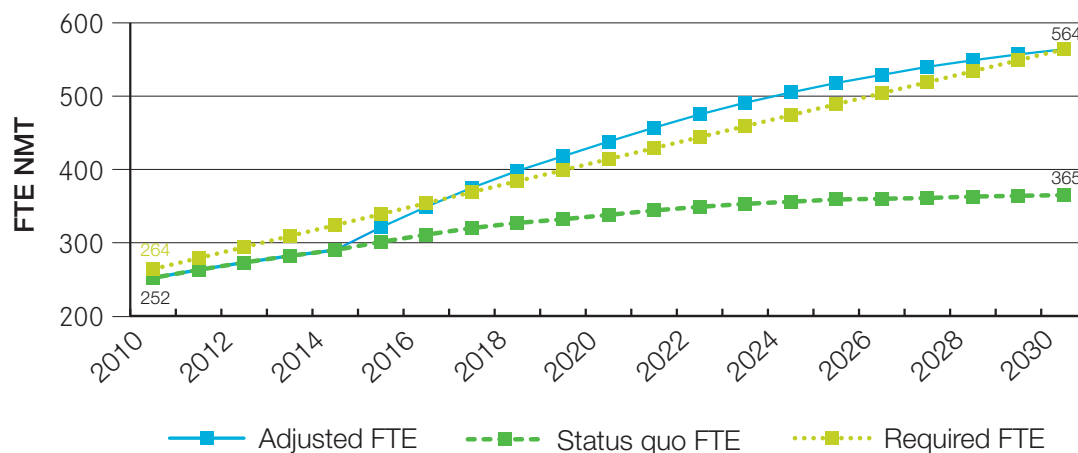
Table 25 presents the workforce inputs used in the development of the nuclear medicine supply and demand workforce model.

Table 25: Data inputs for the nuclear medicine technologist model

Model parameter	Base case	Data source
Demand growth per annum	6.2%	As per service growth in relevant MBS items, and corresponding workforce demand in Table 22
Workforce supply (base year 2009)	259 headcount (242 FTEs)	Medical Radiation Practitioners Board 2009 registration data MRT labour force survey 2008
Workforce shortage (FTEs)	7 FTE	See Table 23 Department of Human Services Medical Imaging and Nuclear Medicine Workforce Recruitment and Retention Survey 2009
Average weekly work hours	40 male; 33 female	Medical radiation technologists labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow graduates per annum	30	Department of Human Services intern appointments projection
University dropout rate (over 4 years period)	30%	Estimated based on university experience
Workforce inflow immigration	0	Medical radiation technologists labour force survey 2008
Workforce outflow – retirement age	>65 years	Medical radiation technologists labour force survey 2008
Workforce outflow – average loss rate	7.3%	Medical radiation technologists labour force survey 2008
Workforce inflow – average re-entry rate	1.5%	Medical radiation technologists labour force survey 2008

Outcomes of the supply and demand modelling indicate that a substantial gap exists between the required FTE of nuclear medicine technologists based on service demand and the status quo growth in this workforce. The gap between required and status quo FTE is projected to increase to 199 FTE by 2030 (Figure 8).

Figure 8: Victorian nuclear medicine technologist workforce projections 2010–2030



The adjusted supply indicates that 50 new graduates are required to enter the nuclear medicine technologist workforce from 2014 onwards (Table 26). This increase equates to 72 first year enrolments per year starting from 2010, when training attrition is taken into account.

Table 26: Training requirements for nuclear medicine technologists between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
Graduates (Interns)		
2010–13	30	30
2014–29	30	50
First year training placements		
2010–25	43	72

The nuclear medicine physician/specialist workforce

Nuclear medicine physicians are a relatively small professional group and, as such, information regarding training and education pathways is limited. In some cases, nuclear medicine physicians are also trained as radiologists, and go through both RANZCR and RACP training programs. For the purposes of the supply and demand modelling of this workforce, workforce supply has been identified using three main sources:

- The Department of Human Services recruitment and retention survey 2009 — this survey was used to identify the size of the current workforce and any shortfall.
- AMPCo 2009 data — to determine the age and sex profile of the workforce
- MLFS 2008 — to identify weekly work hours.

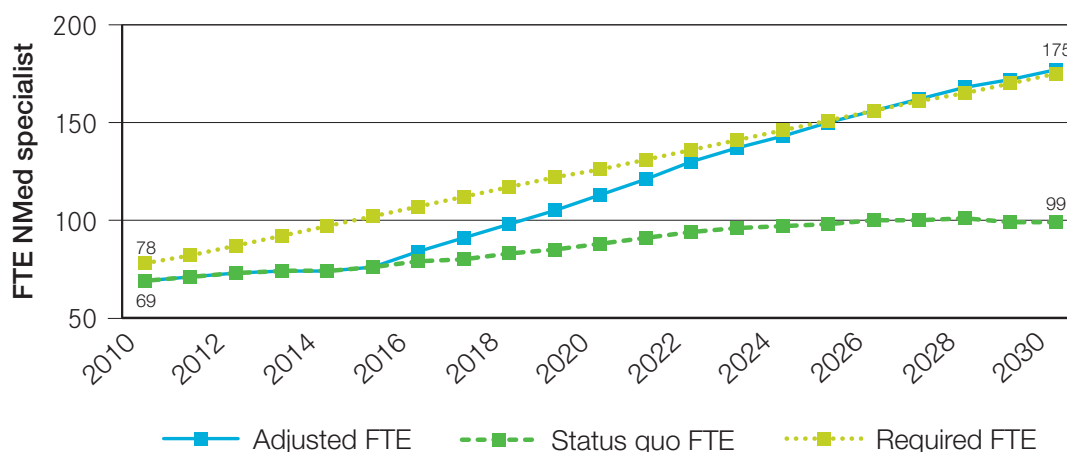
Table 27 summarises the supply and demand data input of the model. The retirement age for males has been increased to 75 years, as with radiologists and radiation oncologists, due to their documented longer working life span. The radiologist attrition rate is applied to this projection as there is a high level of overlap in qualifications and work practice between these two professions.

Table 27: Data inputs for the nuclear medicine physician/specialist model

Model parameter	Base case	Data source
Demand growth per annum	7.2%	As per service growth in relevant MBS items, and corresponding workforce demand in Table 22
Workforce supply (base year 2009)	54 headcount (68FTE)	Department of Human Services nuclear medicine workforce recruitment and retention survey 2009 AMPCo 2009 data
Workforce shortage (FTEs)	5 FTE	See Table 23 Department of Human Services nuclear medicine workforce recruitment and retention survey 2009
Average weekly work hours	52 male; 32 female	Medical labour force survey 2008
Standard weekly work hours	38 hours	Weekly work hours from professional award
Workforce inflow new fellow (per annual)	3 new fellows	RACP annual report 2007
Advanced training dropout rate (over 2 years period)	20%	Estimated base on the examination pass rate MTRP 2007 report
Workforce inflow – immigration	0	Medical labour force survey 2008
Workforce outflow – retirement age	>65 years female >75 years male	Medical labour force survey 2008
Workforce outflow – average loss rate	13.0%	AMPCo 2009 data Medical labour force survey 2008
Workforce inflow – average re-entry rate	0%	AMPCo 2009 data Medical labour force survey 2008

Figure 9 shows the projection of the status quo and required FTE for nuclear medicine physicians/specialists. Projections indicate that the gap between the status quo and the required FTE will continue to increase over the next 20 years, reaching 76 FTE by 2030.

Figure 9: Victorian nuclear medicine physician/specialist workforce projections 2010–2030



Projections of adjusted supply indicate that an additional four qualified nuclear medicine physicians/specialists are required per year from 2015, equating to 17 RACP and RANZCR advanced training posts from 2014 (Table 28).

Table 28: Training requirements for nuclear medicine physician/specialists between 2010 and 2030

Projection year	Status quo supply (per year)	Adjusted supply (per year)
New fellows		
2010–14	3	3
2015–29	3	7
Advanced vocational trainees (year4–5)*		
2010–13	8	8
2014–28	8	17

* Trainees at these levels are more likely to become qualified Radiation Oncologists upon their completion of the training program.

Conclusion

Supply and demand models have been produced for all nine medical radiation professions. This is the first time that this has been done in Victoria. The models project shortfalls of varying degrees in all professional streams. In terms of FTE, radiographers face the highest estimated shortfall of 1,597 FTE at 2030. As a percentage of the current workforce, the largest additional requirements are for ROMPs and nuclear medicine physicians/specialists.

The modeling shortfalls are based on current practice. A number of factors may impact the requirements for medical radiation professionals, such as policy around Breastscreen, availability of linacs, and alternative cancer treatments. The models presented in this report are base case forecasts and scenarios should be modelled where changes in policy or practice are known to be likely.

The list below presents the medical radiation streams and professions along with their current supply, projected gap, and requirement for new entrants in order to meet projected demand.

Radiation oncology

Radiation therapy technologist (current supply: 427 Full Time Equivalent (FTE))

[Projected supply gap from 2010 to 2030: 7 to 64 FTE](#)

Required annual graduates from 2014 onwards: 51 (six more than current numbers)

Radiation oncologist (current supply: 95 FTE)

[Projected supply gap from 2010 to 2030: 33 to 47 FTE](#)

Required annual new fellows from 2013 onwards: 9 (three more than current numbers)

Radiation oncology medical physicist (current supply: 54 FTE)

[Projected supply gap from 2010 to 2030: 21 to 66 FTE](#)

Required annual new fellows from 2015 onwards: 8 (six more than current numbers)

Medical imaging

Radiographer (current supply: 2,032 FTE)

[Projected supply gap from 2010 to 2030: 149 to 1,597 FTE](#)

Required annual graduates from 2014 onwards: 246 (127 more than current numbers)

Radiologist (current supply: 372 FTE)

[Projected supply gap from 2010 to 2030: 53 to 102 FTE](#)

Required annual new fellows from 2015 onwards: 33 (seven more than current numbers)

Medical physicist (medical imaging and nuclear medicine) (current supply: 34 FTE)

[Projected supply gap from 2010 to 2030: 18 to 26 FTE](#)

Required annual new fellows from 2015 onwards: 5 (three more than current numbers)

Nuclear medicine

Nuclear medicine technologist (current supply: 242 FTE)

[Projected supply gap from 2010 to 2030: 12 to 199 FTE](#)

Required annual graduates from 2014 onwards: 50 (20 more than current numbers)

Nuclear medicine physician/specialist (current supply: 68 FTE)

[Projected supply gap from 2010 to 2030: 9 to 76 FTE](#)

Required annual new fellows from 2015 onwards: 7 (four more than current numbers)

Collectively, the outcomes of the modelling suggest that there will be significant medical radiations workforce supply shortages.

These projections present a substantial challenge to the Victorian Government in examining and implementing best practice approaches to dealing with these shortfalls and medical radiations service delivery.

Appendix A: Summary tables for medical radiation workforce base model forecasts

A–1: Victorian radiation oncologist forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts
Status Quo assumptions	6.4%	1.0	1.0	1.0	1.0	2010	5 years	20.0%
User assumptions	6.4%	1.0	1.0	1.0	1.0	2010	5 years	20.0%

Projection Years	Base year																						
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Required FTE	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	234	240	246	252	
Status quo FTE	95	98	107	116	125	133	140	146	152	157	163	168	173	178	183	186	191	196	199	202	203	205	
Status quo FTE gap	-30	-33	-29	-26	-24	-22	-21	-21	-21	-22	-22	-23	-24	-24	-25	-26	-29	-30	-32	-35	-38	-43	-47
Adjusted FTE	95	98	107	116	125	136	148	157	167	176	186	195	203	211	220	226	234	242	249	254	258	263	
Adjusted FTE gap	-30	-33	-29	-26	-24	-19	-13	-9	-6	-3	0	4	6	6	8	10	11	13	14	15	15	12	11
Status quo graduates	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Additional graduates required	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Adjusted graduates	6	6	6	6	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
Projection year for advanced training places*	2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028																						
Adjusted year 4 and 5 trainees	15 15 22																						

* Projection year shift 1 year to cover minimum training period to gain an accreditation for RANZCR fellowship for year 4 trainees.

A-2: Victorian radiologist forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts														
Status Quo assumptions	4.6%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
User assumptions	4.6%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required FTE	408	425	443	460	477	494	511	528	545	562	580	597	614	631	648	665	682	699	717	734	751	
Status quo FTE	372	355	368	383	397	412	427	442	457	472	487	503	519	534	550	565	581	595	609	623	636	649
Status quo FTE gap	-19	-53	-57	-60	-63	-67	-69	-71	-73	-75	-76	-78	-80	-81	-83	-84	-87	-90	-94	-98	-102	
Adjusted FTE	372	355	368	383	397	412	427	449	471	493	516	538	560	582	605	627	649	671	692	712	732	752
Adjusted FTE gap	-19	-53	-57	-60	-63	-65	-67	-62	-57	-52	-47	-41	-36	-31	-26	-21	-16	-11	-8	-4	-1	1
Status quo graduates	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Additional graduates required	0	0	0	0	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Adjusted graduates	26	26	26	26	26	26	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
Projection years for advanced training places*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028			
Adjusted Year 4 and 5 trainees	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65

* Projection year shift 1 year to cover minimum training period to gain an accreditation for RANZCR fellowship for year 4 trainees.

A–3: Victorian nuclear medicine specialist/physician forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts
Status Quo assumptions	6.0%	1.00	1.00	1.00	1.00	2010	5 years	20.0%
User assumptions	7.2%	1.00	1.00	1.00	1.00	2010	5 years	20.0%

Projection Years	Base year																					
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required FTE	73	78	82	87	92	97	102	107	112	117	122	126	131	136	141	146	151	156	161	165	170	175
Status quo FTE	68	69	71	73	74	74	76	79	80	83	85	88	91	94	96	97	98	100	100	101	99	99
Status quo FTE gap	-5	-9	-12	-14	-18	-23	-26	-28	-31	-34	-37	-39	-41	-42	-45	-49	-53	-56	-60	-65	-71	-76
Adjusted FTE	68	69	71	73	74	74	76	84	91	98	105	113	121	130	137	143	150	156	162	168	172	177
Adjusted FTE gap	-5	-9	-12	-14	-18	-23	-26	-23	-21	-19	-16	-13	-10	-6	-4	-3	-1	0	1	2	1	1
Status quo graduates	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Additional graduates required	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Adjusted graduates	3	3	3	3	3	3	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Projection years for advanced training places*		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2028	
Adjusted Year 4 and 5 trainees		8	8	8	8	8	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17

* Projection year shift 1 year to cover minimum training period to gain an accreditation for RANZCR/RACP fellowship for year 4 trainees.

A-4: Victorian radiation therapy technologist forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts															
Status Quo assumptions	4.0%	1.00	1.00	1.00	1.00	2010	4 years	20.0%															
User assumptions	4.6%	1.00	1.00	1.00	1.00	2010	4 years	20.0%															
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
	<small>Base year</small>																						
Required FTE	427	447	467	486	506	525	545	565	584	604	624	643	663	683	702	722	742	761	781	801	820	840	
Status quo FTE	427	440	459	476	492	507	529	548	565	582	597	613	628	642	658	673	692	711	729	746	762	776	
Status quo FTE gap	0	-7	-7	-10	-14	-18	-17	-17	-19	-23	-27	-30	-35	-41	-45	-49	-49	-50	-52	-55	-58	-64	
Adjusted FTE	427	440	459	476	492	507	534	559	581	602	622	642	662	679	699	718	741	763	785	805	824	840	
Adjusted FTE gap	0	-7	-7	-10	-14	-18	-11	-6	-3	-2	-2	-1	-1	-3	-3	-4	-1	2	4	4	4	0	
Status quo graduates	30	40	40	40	40	45	45	45	45	45	45	45	45	48	48	48	48	48	48	48	48	48	
Additional graduates required	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Adjusted graduates	30	40	40	40	40	51	51	51	51	51	51	51	51	54	54	54	54	54	54	54	54	54	
Projection year for First Year* Undergraduates	2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025																						
Status quo placements	56 56 56 56 56 56 56 56 56 56 60 60 60 60 60 60 60 60 60 60 60 60 60																						
Net extra placements	7 7																						
Adjusted placements	64 64 64 64 64 64 64 64 64 64 67 67 67 67 67 67 67 67 67 67 67 67 67																						

* Projection year shift 4 years to cover minimum training period to gain an accreditation as a medical radiation practitioner.

A–5: Victorian radiographer forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts															
Status Quo assumptions	5.6%	1.00	1.00	1.00	1.00	2010	4 years	16.0%															
User assumptions	4.6%	1.00	1.00	1.00	1.00	2010	4 years	16.0%															
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
	<i>Base year</i>																						
Required FTE	2,098	2,192	2,285	2,379	2,472	2,566	2,659	2,753	2,846	2,940	3,033	3,127	3,220	3,314	3,407	3,501	3,594	3,688	3,781	3,875	3,968	4,062	
Status quo FTE	2,032	2,043	2,058	2,077	2,110	2,145	2,179	2,207	2,233	2,257	2,278	2,302	2,322	2,341	2,359	2,376	2,393	2,408	2,422	2,437	2,451	2,465	
Status quo FTE gap	-66	-149	-227	-302	-363	-421	-480	-546	-613	-683	-755	-825	-898	-973	-1,048	-1,125	-1,201	-1,280	-1,359	-1,438	-1,517	-1,597	
Adjusted FTE	2,032	2,043	2,058	2,077	2,110	2,145	2,298	2,447	2,593	2,737	2,877	3,014	3,142	3,263	3,379	3,489	3,595	3,696	3,792	3,886	3,975	4,062	
Adjusted FTE gap	-66	-149	-227	-302	-363	-421	-361	-306	-253	-203	-156	-113	-78	-50	-28	-12	1	8	11	11	7	1	
Status quo graduates	106	106	106	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	
Additional graduates required	0	0	0	0	0	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	
Adjusted graduates	106	106	106	119	119	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246	
Projection year for First Year* Undergraduates																							
Status quo placements																							
Net extra placements																							
Adjusted placements																							

* Projection year shift 4 years to cover minimum training period to gain an accreditation as a medical radiation practitioner.

A-6: Victorian nuclear medicine technologist forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts														
Status Quo assumptions	6.2%	1.00	1.00	1.00	1.00	2010	4 years	30.0%														
User assumptions	6.2%	1.00	1.00	1.00	1.00	2010	4 years	30.0%														
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Base year																						
Required FTE	249	264	279	294	309	324	339	354	369	384	399	414	429	444	459	474	489	504	519	534	549	564
Status quo FTE	242	252	263	273	282	290	301	311	320	327	332	338	344	349	353	356	359	360	361	363	364	365
Status quo FTE gap	-7	-12	-16	-21	-27	-34	-38	-43	-49	-57	-67	-76	-85	-95	-106	-118	-131	-144	-158	-172	-185	-199
Adjusted FTE	242	252	263	273	282	290	321	349	375	398	418	438	457	475	491	505	518	529	540	549	557	564
Adjusted FTE gap	-7	-12	-16	-21	-27	-34	-18	-5	6	14	19	24	28	31	32	31	29	25	21	15	8	0
Status quo graduates	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Additional graduates required	0	0	0	0	0	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Adjusted graduates	30	30	30	30	30	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Projection year for First Year* Undergraduates	2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026																					
Status quo placements	43 43																					
Net extra placements	29 29																					
Adjusted placements	72 72																					

* Projection year shift 4 years to cover minimum training period to gain an accreditation as a medical radiation practitioner.

A–7: Victorian radiation oncologist medical physicist (ROMP) forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts														
Status Quo assumptions	7.0%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
User assumptions	6.0%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required FTE	74	77	81	84	87	90	93	97	100	103	106	110	113	116	119	123	126	129	132	136	139	142
Status quo FTE	54	56	58	59	61	62	64	65	67	67	67	69	70	71	72	72	73	74	75	75	75	76
Status quo FTE gap	-20	-21	-23	-24	-26	-28	-29	-31	-33	-36	-39	-41	-43	-45	-48	-51	-53	-55	-57	-60	-64	-66
Adjusted FTE	54	56	58	59	61	62	64	71	78	84	89	96	102	107	112	117	122	127	131	135	139	143
Adjusted FTE gap	-20	-21	-23	-24	-26	-28	-29	-25	-22	-19	-17	-14	-11	-9	-7	-6	-4	-2	-2	-1	0	0
Status quo graduates	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Additional graduates required	0	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Adjusted graduates	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
TEAP commencing* placements																						
Status quo placements							3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Net extra placements							7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Adjusted placements							10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

* Projection year shift 5 years to cover minimum training period to gain a qualification of medical physicist.

A-8: Victorian medical physicist (nuclear medicine and medical imaging) forecasts between 2010 and 2030

Assumptions	Demand	Migration	Re-entries	Losses	Immigration	Starting	Training	Dropouts														
Status Quo assumptions	3.0%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
User assumptions	2.2%	1.00	1.00	1.00	1.00	2010	5 years	20.0%														
Projection Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Base year																						
Required FTE	52	53	53	54	55	56	56	57	58	59	59	60	61	62	62	63	64	65	65	66	67	68
Status quo FTE	34	35	35	36	36	37	37	38	38	39	39	39	40	40	40	41	41	41	41	41	41	42
Status quo FTE gap	-18	-18	-18	-18	-19	-19	-19	-19	-20	-20	-21	-21	-21	-22	-22	-23	-23	-24	-24	-25	-26	-26
Adjusted FTE	34	35	35	36	36	37	37	41	43	46	48	51	53	56	58	60	62	64	66	67	69	71
Adjusted FTE gap	-18	-18	-18	-18	-19	-19	-19	-17	-15	-12	-11	-9	-8	-6	-4	-3	-2	-1	1	1	2	3
Status quo graduates	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Additional graduates required	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Adjusted graduates	2	2	2	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TEAP commencing* placements	2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025																					
Status quo placements	3 3																					
Net extra placements	4 4																					
Adjusted placements	6 6																					

* Projection year shift 5 years to cover minimum training period to gain a qualification of medical physicist.

Abbreviations

ACPSEM	Australasian College of Physical Scientists and Engineers in Medicine
AIR	Australian Institute of Radiography
AMPCo	Australasian Medical Publishing Company
ANZAPNM	Australian and New Zealand Association of Physicians in Nuclear Medicine
ANZSNM	Australian and New Zealand Society of Nuclear Medicine
DEEWR	Commonwealth Department of Education, Employment and Workplace Relations
DOHA	Commonwealth Department of Health and Ageing
FTE	Full time equivalent
linac	linear accelerator
MBS	Medicare Benefits Schedule
MLFS	Medical Labour Force Survey
MPBV	Medical Practitioners Board of Victoria
MRPB	Medical Radiation Practitioners Board of Victoria
MRT-LFS	Medical Radiation Technologists Labour Force Survey
MTRP	Medical Training Review Panel
NHWPT	National Health Workforce Planning Tool
PGY	Postgraduate year (medicine)
RACP	Royal Australasian College of Physicians
RANZCR	The Royal Australian and New Zealand College of Radiologists
RO	Radiation oncologist
ROMP	Radiation oncology medical physicist
RTT	Radiation therapy technologist
TEAP	ACPSEM's Training Education and Accreditation Program
VAED	Victorian Admitted Episodes Dataset
VEMD	Victorian Emergency Minimum Dataset
VCR	Victorian Cancer Registry

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