The Allen Consulting Group

Projecting the radiation oncology workforce

Input to the Tripartite National Strategic Plan For Radiation Oncology in Australia

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Executive summary

The Royal Australian and New Zealand College of Radiologists (RANZCR) is currently leading a project, with the Australian Institute of Radiography (AIR) and the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM), to prepare a Radiation Oncology National Strategic Plan. This plan will include analysis of the workforce. Specifically it will consider the supply of, and demand for, the different skilled professionals needed to meet Australia's needs in the provision of radiation oncology services.

The Allen Consulting Group was commissioned to develop a model to assist in the analysis of the medical radiation workforce covering the next ten years. The model covers three professional groups:

- Radiation Oncologists;
- Radiation Therapists; and
- Radiation Oncology Medical Physicists (ROMPs).

Previous studies have been conducted on this workforce. In particular, in 2009 Health Consult prepared a Radiation Oncology Workforce Planning Report for the Department of Health and Ageing that contained workforce projections in 2014 and 2019 for the above occupations. This analysis goes beyond those previously conducted. It is based on updated data sources where possible and makes more variables available for analysis.

In order to estimate potential workforce shortfalls for each occupation into the future, demand for, and supply of, full-time equivalent (FTE) professionals has been estimated over the period 2012 to 2022.

The demand side of the model estimates the future demand for medical radiation services, based on the increasing incidence of cancer, and allows the user to alter the utilisation rate to be achieved in 2017 and 2022. The supply side estimates future supply based on current entry and exit trends.

Assuming the achievement of a utilisation rate of 52.3 per cent in 2022, significant workforce shortfalls would occur by 2022. These are summarised in the table below. This scenario would have significant implications for the funding of additional linear accelerators and clinical training positions.

Table ES 1.1
WORKFORCE SHORTFALLS IN 2022

Occupation	Supply	Demand	Shortfall
Radiation Oncologists	499	535	36
Radiation Therapists	2135	2673	538
ROMPs	327	535	208

This table presents the shortfalls under one scenario only. Using the model, RANZCR may choose to undertake analysis based on any utilisation rate.

Chapter 1

Introduction

Providing a skilled workforce to meet the growing needs of the medical radiation sector has been a matter of concern to Australian health authorities for more than a decade. The Baume report (2002) was a catalyst for action, on the part of government and the professions, for widespread reform of the sector.

More recently a number of studies and reports have been commissioned in relation to this workforce, including the following.

- A report by HealthConsult (2009) commissioned by the Commonwealth Department of Health and Ageing (DoHA) to consider workforce planning issues in more depth.
- A Victorian study of workforce supply and demand (Zhang 2010).
- A 2009 study of the medical oncology workforce by Koczwara (2009), subsequently reported by Blinman (2012).
- The Radiation Oncology Reform Implementation Committee (RORIC) Workforce Reform Framework (2011).
- Two studies by RANZCR (2011a&b) accompanied by a paper by Leung and Vukolova (2011).

1.1 This project

RANZCR is currently leading a project, with AIR and ACPSEM, to prepare a Radiation Oncology National Strategic Plan. This plan will include analysis of the workforce. Specifically, it will address the supply of, and demand for, the different skilled professionals needed to meet Australia's needs in this area. The Allen Consulting Group was commissioned to assist in the analysis of the medical radiation workforce covering the next ten years, including the development of a workforce model.

For this project, it was agreed that the three organisations (RANZCR, ACPSEM and AIR) would provide data on the existing workforce and on the 'pipeline' of future professionals in their areas.

1.2 The medical radiation workforce

Projections of the medical radiation workforce rely on assumptions regarding supply and demand.

Demand

A number of factors influence the medical radiation workforce demand. These include:

- incidence of cancer;
- availability of linear accelerators (linacs);

- availability of clinical training positions;
- actual and optimal utilisation rates; and
- relevant state/territory and Commonwealth government policies.
- Demand projections in the model factor in the increasing incidence of cancer and the utilisation rate. The utilisation rate is the proportion of new cancer patients who receive radiotherapy.

Supply

Factors which influence the supply of this workforce include:

- the supply of newly qualified personnel;
- participation rates;
- flexible work arrangements;
- work practices, including use of time for different purposes;
- retirements from the existing workforce; and
- relevant government policies.

The model calculates the supply of FTE professionals from which it is possible to derive headcount numbers. Advice on how to calculate headcounts from FTEs is given in Section 2.62.6.

1.3 Overview of the model

The model covers three professional groups.

- Radiation Oncologists: medical specialists who have specific postgraduate training in management of patients with cancer, in particular, involving the use of radiation therapy (also called radiotherapy) as one aspect of their cancer treatment. They also have expertise in the treatment of non-malignant conditions with radiation therapy (RANZCR 2012d).
- Radiation Therapists: members of the professional team that manages the cancer patient's treatment. In conjunction with the Radiation Oncologists they are responsible for the design, accurate calculation and delivery of a prescribed radiation dose over a course of treatment to the patient (AIR 2012b).
- Radiation Oncology Medical Physicists (ROMPs): are physicists who establish, implement and monitor processes which allow optimal treatment using radiation, taking account of the protection and safety of patients and others involved in the treatment process (HealthConsult 2009).

The base year for the model is 2011. Projections start from 2012 and extend through to 2022. Three main scenarios have been developed in the model in order to estimate potential workforce shortfalls into the future.[1]

[1] The core assumptions underlying calculation of supply and demand are similar to those used in Stuckless et al 2012.

- Demand — estimates the future demand for medical radiation services, based on the increasing incidence of cancer, and allows the user to alter the utilisation rate to be achieved in 2017 and 2022.
- Baseline supply — estimates future supply based on current entry and exit trends.
- Adjusted supply — based on baseline supply, but allows the user to alter entry variables to estimate ways to close the gap between the baseline and the demand supply scenarios.

The data sources and assumptions underlying the model are discussed in detail in Chapter 3.

1.4 This report

The rest of this report is structured so that the results of the modelling are presented first, with the details of the inputs and assumptions described later.

- Chapter 2 describes the results of the modelling.
- Chapter 3 provides details of the inputs and assumptions underlying calculations of supply and demand.
- Chapter 4 compares our results with a previous report on workforce projections for the occupations of interest.
- Chapter 5 presents the results of some sensitivity analyses.
- Appendix A contains detailed analysis on the need for additional linacs.

Chapter 2

Predicted workforce shortfalls

This chapter describes some of the results of the model for each occupation. The results of the baseline supply model are described, as well as demand and shortfall results under different scenarios. Three different demand scenarios were tested.

- Target utilisation: where the utilisation rate to be achieved is set to 45.2 per cent in 2017 and 52.3 per cent in 2022. A utilisation rate of 52.3 per cent is estimated to be the optimal rate (Delaney et al 2003), and 45.2 per cent was taken as the mid-point between the target rate and the current rate of 38.1 per cent.
- Halfway between target and current utilisation: where the utilisation rate to be achieved is set to 41.7 per cent in 2017 and 45.2 per cent in 2022.
- Current underutilisation: where the utilisation rate to be achieved is set to 38.1 per cent over the whole period. The current average utilisation rate is 38.1 per cent (HealthConsult 2009).

Using the adjusted supply scenario, the effect of increasing the intake of trainees (by per cent) on the gap between supply and demand has been estimated.

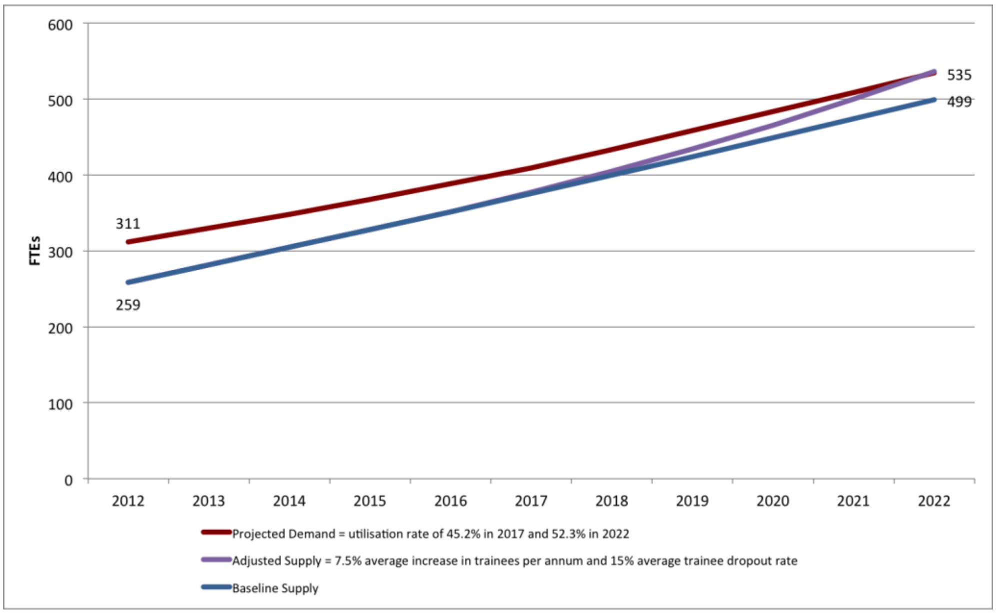
2.1 Radiation Oncologists

Starting from a base supply of 235.8 FTE professionals in 2011, the Radiation Oncologist baseline supply model, which assumes current entry and attrition trends continue, projects a supply of 376 FTE professionals in 2017 and 499 FTE professionals in 2022. The precise difference between supply and demand depends, in large part, upon the utilisation rate that will be achieved in 2017 and 2022.

Target utilisation

In 2017, with a utilisation rate of 45.2 per cent, 410 FTEs would be required, resulting in a shortfall of 34 FTEs. If the target utilisation rate of 52.3 per cent is to be achieved by 2022, the model projects that 535 FTEs would be required in 2022, resulting in a workforce shortfall of 36 FTEs (see Figure 2.1).

Figure 2.1
RADIATION ONCOLOGIST WORKFORCE – TARGET UTILISATION SCENARIO



Source: ACG 2012.

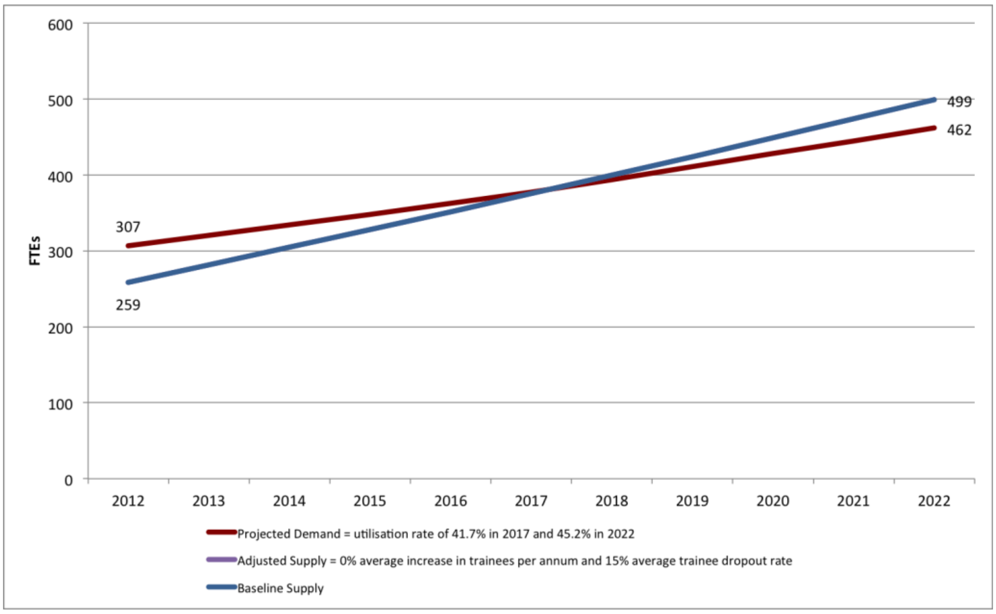
In order for supply to meet target utilisation in 2022, the intake of trainees over the years 2012 to 2017 needs to increase, on average, by around 7.5 per cent each year (resulting in an inflow of 31 FTE trainees into the occupation in 2022, assuming the dropout rate from the trainee program remains at 15 per cent). Historical data indicates that the intake of trainees has been increasing at a rate of only 2 per cent per annum over the last 10 years.

Halfway utilisation

Halfway utilisation was estimated to be the achievement of 41.7 per cent utilisation in 2017 and 45.2 per cent in 2022. The model projects that in 2017, 378 FTEs would be required (shortfall of 2), and 462 in 2022 (surplus of 37) (see Figure 2.2). The current intake of trainees is sufficient to meet demand over the next 10 years under this scenario.

Figure 2.2

RADIATION ONCOLOGIST WORKFORCE – HALFWAY UTILISATION SCENARIO



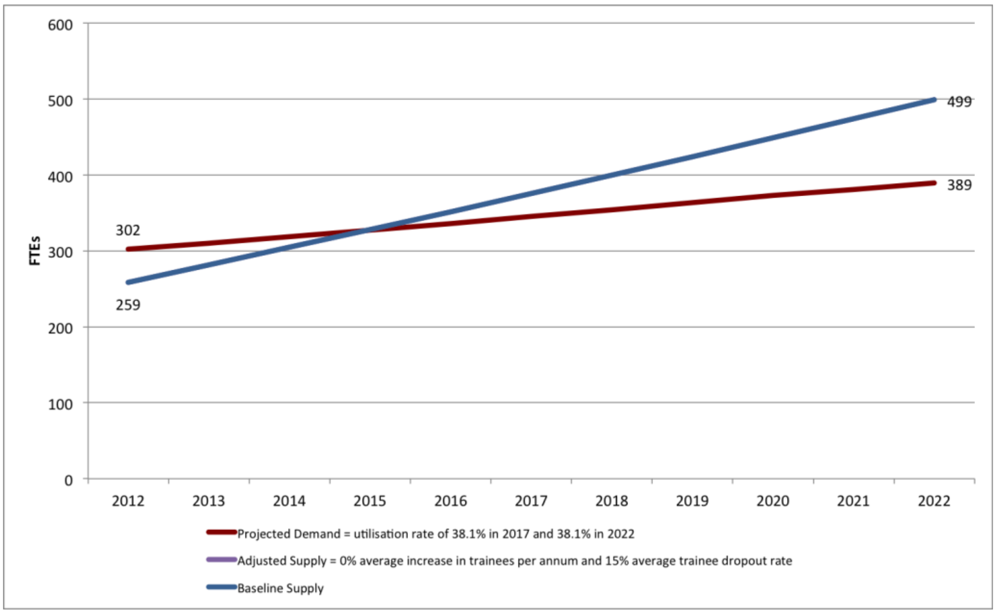
Source: ACG 2012.

Current underutilisation

If the current utilisation rate was maintained over the entire projected period at 38.1 per cent, then the demand requirements would be commensurately lower, with 345 FTE professionals required in 2017 and 389 in 2022 (see Figure 2.3). Given the baseline supply projections, this amounts to a surplus of 31 FTEs in 2017 and a potential surplus of 110 FTEs in 2022.

Figure 2.3

RADIATION ONCOLOGIST WORKFORCE – CURRENT UNDERUTILISATION SCENARIO



Source: ACG 2012.

2.2 Radiation Therapists

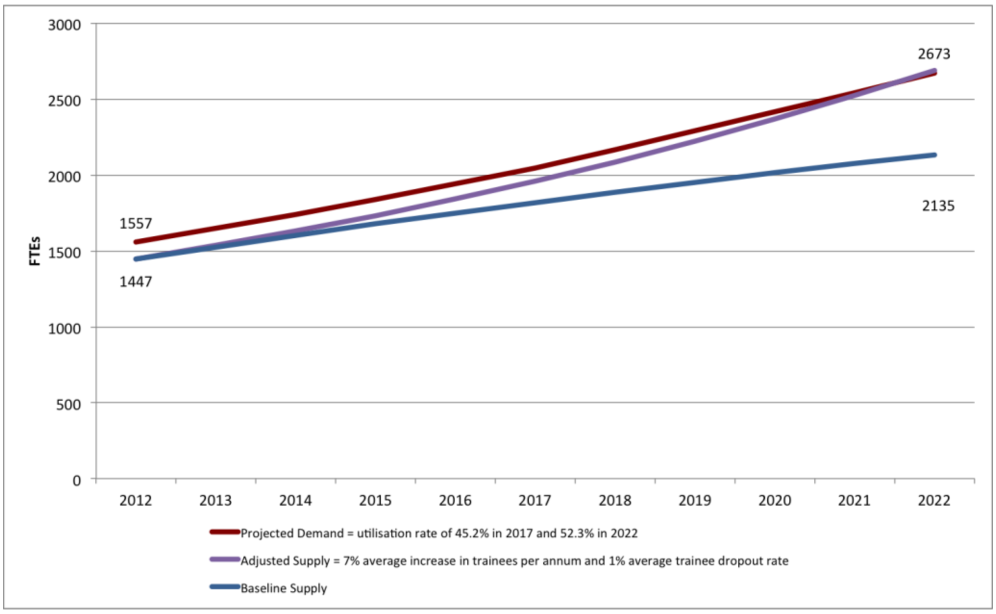
Starting from a base supply of 1364.4 FTE professionals in 2011, the Radiation Therapist baseline supply model projects a supply of 1726 FTE professionals in 2017 and 1947 in 2022.

Target utilisation

In 2017, with a utilisation rate of 45.2 per cent, 2047 FTEs would be required, resulting in a shortfall of 228 FTEs. If the target utilisation rate of 52.3 per cent is to be achieved by 2022, the model projects that 2673 FTEs would be required in 2022, resulting in a workforce shortfall of 538 FTEs (see Figure 2.4).

Figure 2.4

RADIATION THERAPIST WORKFORCE – TARGET UTILISATION SCENARIO



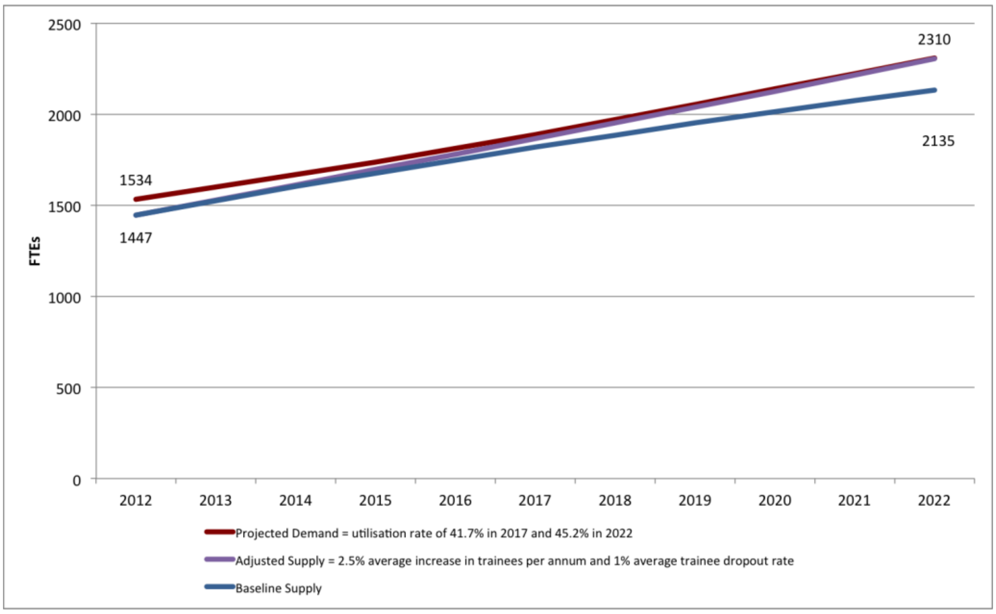
Source: ACG 2012.

In order for supply to meet target utilisation in 2022, the intake of trainees over the years 2012 to 2021 needs to increase, on average, by around 7 per cent each year (resulting in an inflow of 292 FTE trainees into the occupation in 2022, assuming the dropout rate from the clinical trainee program remains at 1 per cent).

Halfway utilisation

Halfway utilisation was estimated to be the achievement of 41.7 per cent utilisation in 2017 and 45.2 per cent in 2022. The model projects that in 2017, 1889 FTEs would be required (shortfall of 69), and 2310 in 2022 (shortfall of 175) (see Figure 2.5).

Figure 2.5
RADIATION THERAPIST WORKFORCE – HALFWAY UTILISATION SCENARIO



Source: ACG 2012.

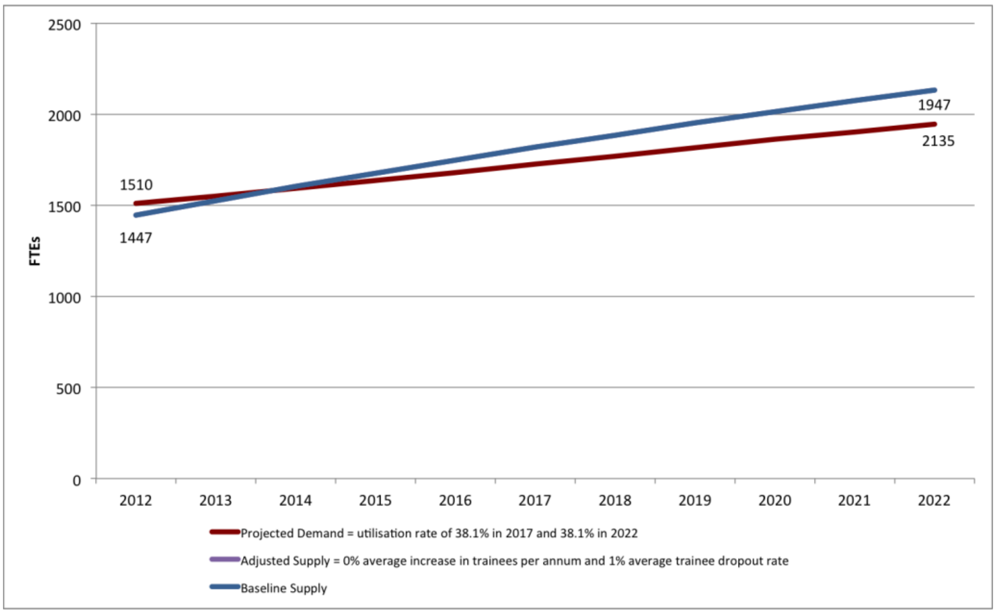
In order for supply to meet halfway utilisation in 2022, the intake of trainees over the years 2012 to 2021 needs to increase, on average, by around 2.5 per cent each year (resulting in an inflow of 190 FTE trainees into the occupation in 2022, assuming the dropout rate from the trainee program remains at 1 per cent).

Current underutilisation

If the current utilisation rate was maintained over the entire projected period at 38.1 per cent, then the demand requirements would be lower, with 1726 FTE professionals required in 2017 and 1947 in 2022, with surpluses of 94 and 188 FTEs respectively (see Figure 2.6). This suggests that current intake into the trainee program would be sufficient to meet demand by 2022 in this scenario.

Figure 2.6

RADIATION THERAPIST WORKFORCE – CURRENT UNDERUTILISATION SCENARIO



Source: ACG 2012.

2.3 Radiation Oncology Medical Physicists

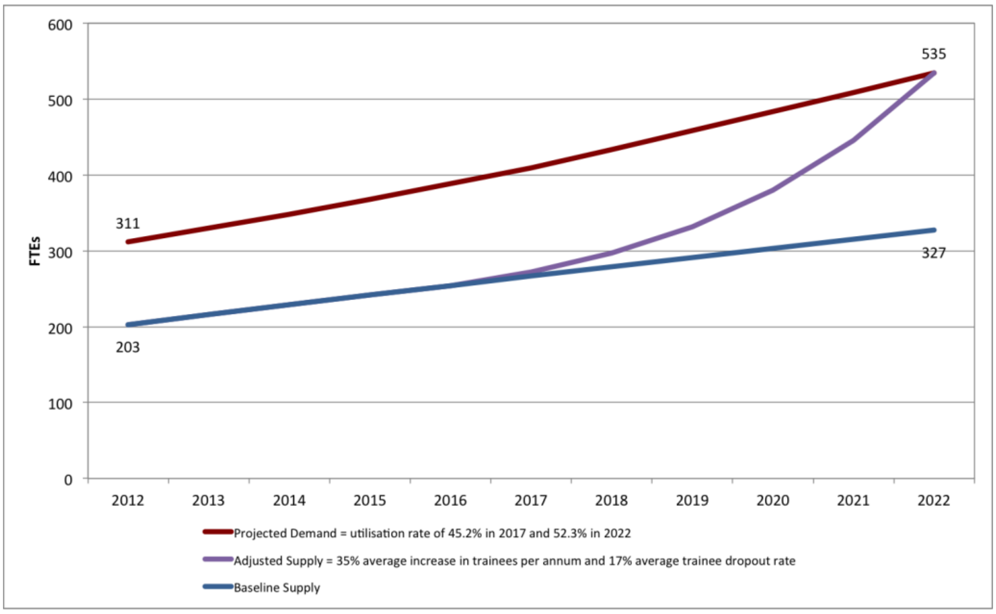
Starting from a base supply of 189.2 FTE professionals in 2011, the ROMP baseline supply model projects a supply of 267 FTE professionals in 2017 and 327 in 2022.

Target utilisation

In 2017, with a utilisation rate of 45.2 per cent, 410 FTEs would be required, resulting in a shortfall of 143 FTEs. If the target utilisation rate of 52.3 per cent is to be achieved by 2022, the model projects that 535 FTEs would be required in 2022, resulting in a workforce shortfall of 208 FTEs (see Figure 2.7).

Figure 2.7

ROMP WORKFORCE – TARGET UTILISATION SCENARIO



Source: ACG 2012.

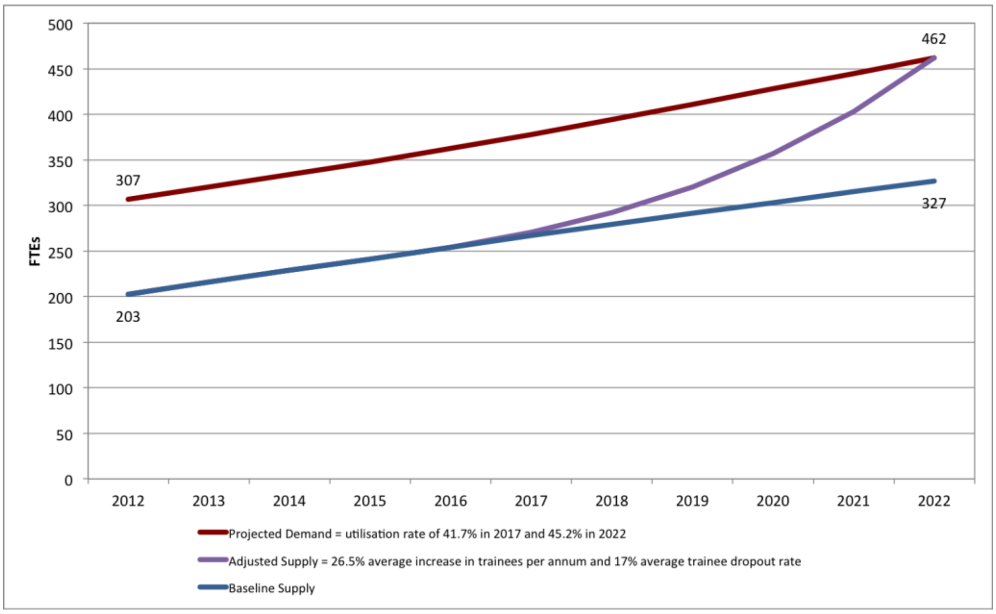
In order for supply to meet target utilisation in 2022, the intake of trainees over the years 2012 to 2017 needs to increase, on average, by around 35 per cent each year (resulting in an inflow of 94 FTE trainees into the occupation in 2022, assuming the dropout rate from the trainee program remains at 17 per cent). Historical data indicates that the intake of trainees has been increasing at a rate of only 6 per cent per annum over the last seven years.

Halfway utilisation

Halfway utilisation was estimated to be the achievement of a 45.2 per cent utilisation rate in 2022, and 41.7 per cent in 2017. The model projects that in 2017 378 FTEs would be required (shortfall of 111), and 462 in 2022 (shortfall of 135) (see Figure 2.8).

Figure 2.8

ROMP WORKFORCE – HALFWAY UTILISATION SCENARIO



Source: ACG 2012.

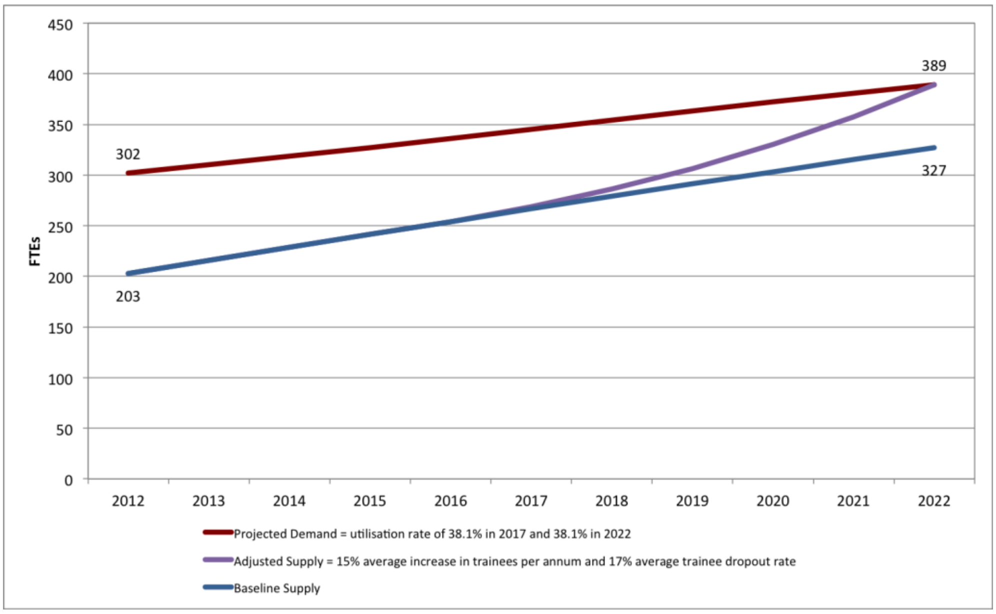
In order for supply to meet halfway utilisation in 2022, the intake of trainees over the years 2012 to 2017 needs to increase, on average, by around 27 per cent each year (resulting in an inflow of 64 FTE trainees into the occupation in 2022, assuming the dropout rate from the clinical trainee program remains at 17 per cent).

Current underutilisation

If the current utilisation rate was maintained over the entire projected period at 38.1 per cent, then the demand requirements would be lower, with 345 FTE professionals required in 2017 and 389 in 2022 (see Figure 2.9). However, this still amounts to a shortfall of 78 FTEs in 2017 and 62 in 2022. This suggests that intake into the training program needs to increase by around 15 per cent each year over the years 2012 to 2017, resulting in an inflow of 36 FTE trainees into the occupation in 2022.

Figure 2.9

ROMP WORKFORCE – CURRENT UNDERUTILISATION SCENARIO



Source: ACG 2012.

2.4 Linacs needed

In 2011 there were 168 linacs nationally (RANZCR 2012a). The number of linacs is sensitive to the demand scenarios described above. The table below summarises the differences in workforce and linac requirements under each scenario.

The industry-accepted useful life of a linear accelerator is 10 years (Zhang 2010). The number of linacs needed does not take into account machine retirements.

Table 2.1

LINACS REQUIRED

Demand scenario	2017	2022
Target utilisation		
Linacs	205	267
Radiation Oncologists	410	535
Radiation Therapists	2047	2673
ROMPs	410	535
Halfway utilisation		
Linacs	189	231
Radiation Oncologists	378	462
Radiation Therapists	1889	2310
ROMPs	378	462
Current underutilisation		
Linacs	173	195
Radiation Oncologists	345	389
Radiation Therapists	1726	1947
ROMPs	345	389

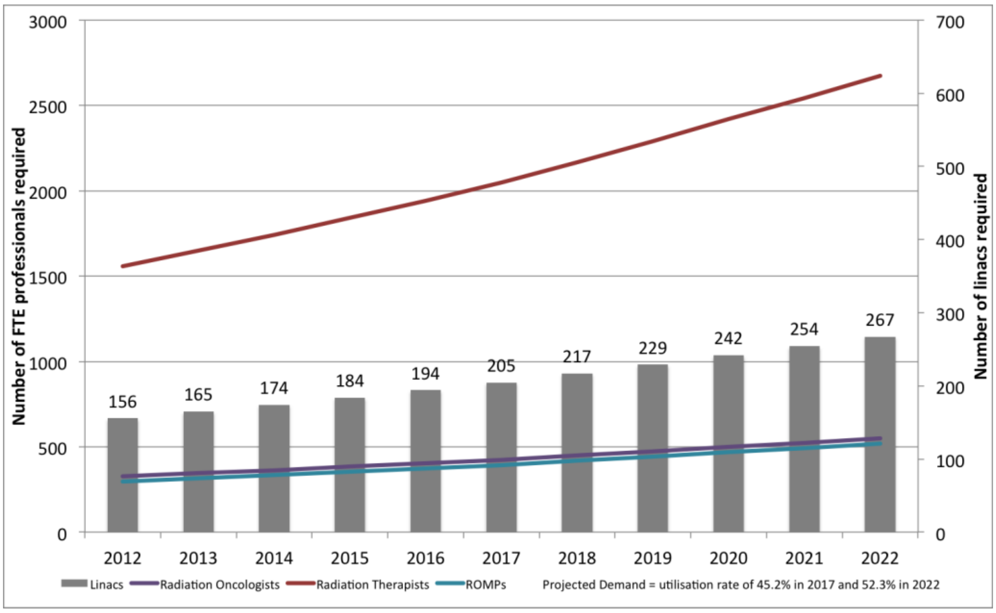
The sections below show the number of linacs needed in the target utilisation, halfway utilisation and current underutilisation demand scenarios.

Target utilisation

Figure 2.10 shows the number of linacs and staff in each occupation needed over the next 10 years in order to achieve a target utilisation rate of 52.3 per cent in 2022. By 2022, 267 linacs will be required to meet increasing demand.

Figure 2.10

LINACS NEEDED WITH TARGET UTILISATION



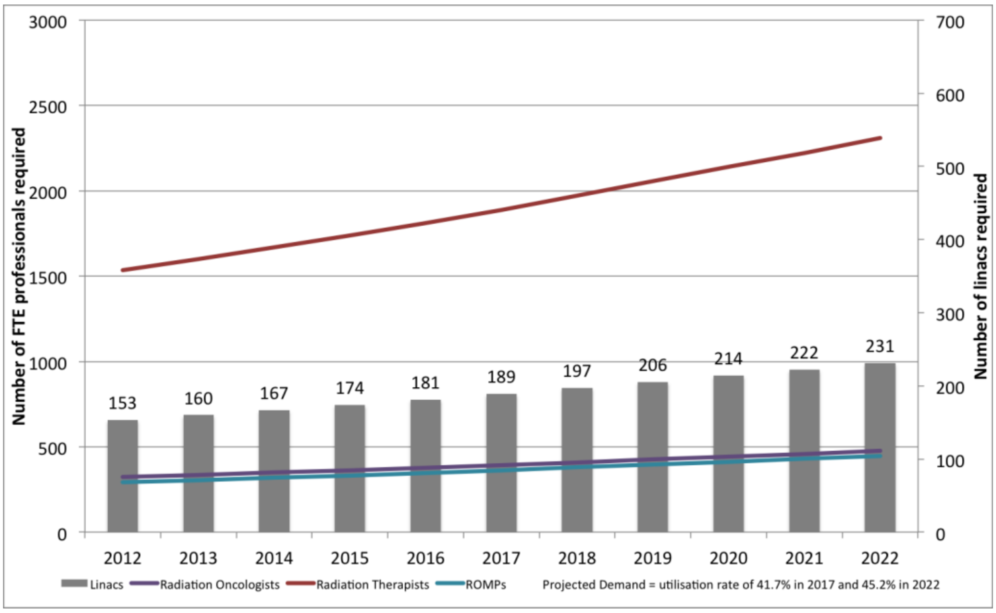
Source: ACG 2012.

Halfway utilisation

If a utilisation rate of 45.2 per cent is to be achieved by 2022 then 231 linacs will be required, as shown in Figure 2.11.

Figure 2.11

LINACS NEEDED WITH HALFWAY UTILISATION

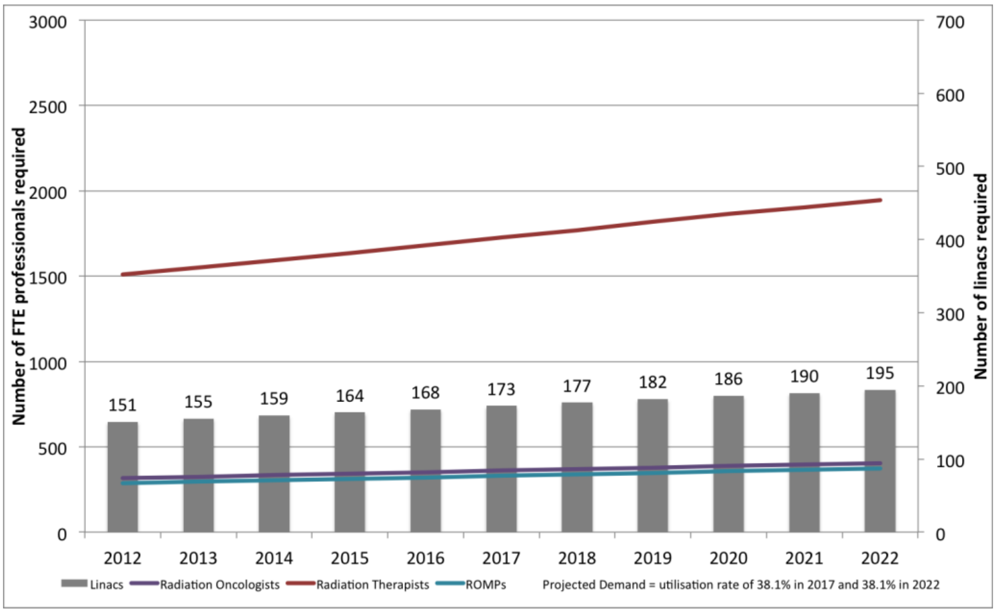


Source: ACG 2012.

Current underutilisation

Even under the current underutilisation scenario where the utilisation rate is held constant, the increasing number of patients requiring radiotherapy treatment over the next 10 years is forecast to require 27 more linacs — 195 required in 2022 (Figure 2.12).

Figure 2.12
LINACS NEEDED WITH CURRENT UNDERUTILISATION



Source: ACG 2012.

Additional projections of linac requirements were undertaken in a separate modelling exercise to the preceding workforce analysis. A separate model was developed to allow for a comparison between potential linac availability and requirements. Appendix A presents the results of this analysis.

2.5 Jurisdiction level data

The model provides numbers by state and territory. However, the results should be interpreted with caution. In many cases, the national assumptions have been applied to each jurisdiction, because data was not available by state/territory. This can have significant effects on the small numbers in some jurisdictions. In addition, we are dealing with a national labour market and there is potential for a shortage in one jurisdiction to be filled in part by movement from another jurisdiction experiencing a surplus.

2.6 Converting FTEs to headcount numbers

The model outputs professional FTEs. However, headcount numbers can be calculated by the user if necessary. The equation is:

$$\text{Headcount} = (\text{FTEs}/\text{average hours worked per week}) \times \text{standard hours}$$

According to the FairWork Ombudsman, standard full-time weekly hours in Australia are 38. The below table contains average hours worked per week for each occupation.

Table 2.2

AVERAGE HOURS WORKED PER WEEK

Occupation	Average hours	Data source
Radiation Oncologists	44.3	Leung and Vukolova 2011
Radiation Therapists	32.6	AIR 2012a
ROMPs	40.0	HealthConsult 2009

In the case of Radiation Oncologists, average hours worked significantly exceed standard hours, and converting FTEs to headcounts may not be appropriate. In the case of Radiation Therapists, there would be a significant difference between headcount and FTE numbers.

Chapter 3

Data sources and assumptions of the model

This chapter describes how we have estimated demand for, and supply of, FTE professionals for each occupation. This includes a description of the methodology for calculating demand and supply, and the inputs and assumptions used in the calculations.

3.1 Cancer incidence and radiation utilisation rate

The incidence of new cases of cancer has been reported by the Australian Institute of Health and Welfare (AIHW) (2010). In 2007, the age-standardised cancer incidence rate stood at 485 cases per 100,000 people, which was significantly higher than the rate of 383 cases per 100,000 people in 1982 (excluding basal and squamous cell carcinomas of the skin).

For use in the model, AIHW (2012) projected cancer incidence data was used (all cancers excluding basal and squamous cell carcinomas of the skin). The projections extend from 2011 to 2020. These were the base for forecasts of incidence in 2021 and 2022. This resulted in 156,721 new cancer cases in 2022. In the absence of detailed and consolidated state and territory data for the projected period, jurisdiction level data was obtained by apportioning the national data by the distribution of incidence by state/territory reported in AIHW's Cancer in Australia 2010 report.

The radiation therapy utilisation rate is defined as the number of new cases in a year treated by radiotherapy divided by the number of new cases of cancer in that year (Barton and Delaney 2011). This only includes notifiable cancers (Delaney et al 2003).[2] The recommended overall optimal radiotherapy utilisation rate for new cancer cases was estimated to be 52.3 per cent (Delaney et al 2003). The current rate for Australia is estimated to be 38.1 per cent, with significant variation amongst jurisdictions (HealthConsult 2009).

3.2 Demand

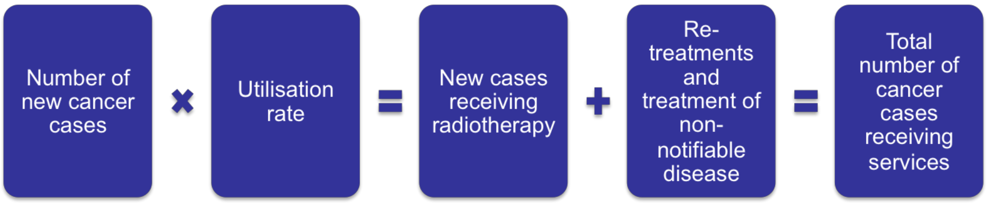
Estimates of demand for FTE professionals are calculated from the increasing incidence of cancer over time and possible increases in the utilisation rate.

Firstly, for each year of the projected period, the utilisation rate is applied to the projected incidence of new cancer cases to obtain the number of new cases to receive radiotherapy. This result is increased by 25 per cent to account for re-treatments, and by 10 per cent to account for treatment of non-notifiable disease (CCORE 2003). In this way the total number of cases requiring services is obtained. An overview of the steps for calculating the cancer population is shown in the figure below.

[2] Notifiable cancers are cancers for which statutory requirements exist to notify a state cancer registry. Statutory notification excludes non-melanomatous skin cancers and benign tumours.

Figure 3.1

METHOD FOR DETERMINING THE CANCER POPULATION



Source: ACG 2012.

The number of linacs required to service these patients is then determined. For each year, the number of patients requiring radiotherapy is divided by 414, which is the industry accepted standard average number of courses of treatment each linac can accommodate per year (ROJIG 2002).

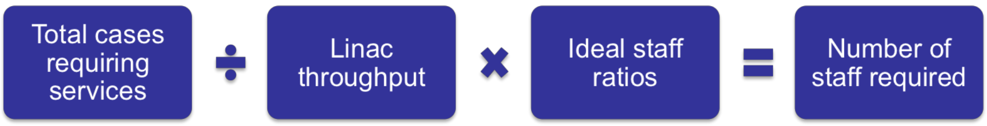
Average linac throughput of 414 courses per year is based on an eight-hour working day for 240 days per year. Many linacs operate for extended hours or on weekends, but may have other periods of unavailability. However, it is acknowledged that attendances and throughputs may vary.

The number of FTE professionals required in future years is calculated by multiplying the required number of linacs by the staff to linac planning ratio for each occupation (Oliver et al in Zhang 2010 and RANZCR 2012e). Apart from the staff ratios, the demand equation is applied consistently across all three occupations.

The figure below shows flow through the demand model.

Figure 3.2

OVERVIEW OF THE DEMAND EQUATION



Source: ACG 2012.

Utilisation rate

The user of the model has the ability to alter the utilisation rate to be achieved in 2017 and in 2022. The model then calculates the increase required each year to obtain these rates, starting from the utilisation rate in 2011. It should be noted that this rate is sourced from the latest published information on utilisation, which is based on 2008 data (HealthConsult 2009).

The default demand scenario assumes that the target utilisation rate of 52.3 per cent is to be achieved in 2022, and the half-way point between 38.1 per cent and 52.3 per cent of 45.2 per cent is to be achieved in 2017. The rate entered by the user in 2017 and 2022 applies across all jurisdictions.

The table below shows the inputs and assumptions underlying projected demand and the associated data sources.

Table 3.1

DATA INPUTS AND ASSUMPTIONS FOR CALCULATING DEMAND

Model parameter	Base case	Data source	Notes on jurisdiction level data
Number of new cancer cases	156,721 (2022)	AIHW 2012	Australia total distributed by historical proportion
Increase for re-treatments	25%	CCORE 2003	Assumed the same across jurisdictions
Increase for treatment of non-malignant disease	10%	CCORE 2003	Assumed the same across jurisdictions
Utilisation rate in 2011	38.1%	HealthConsult 2009	Data provided at jurisdiction level[3]
Target utilisation rate	52.3%	Delaney *et al* 2003	Assumed consistent across jurisdictions
Average number of courses per linac per year	414	ROJIG 2002	Assumed consistent across jurisdictions
Planning ratio for radiation oncologists per linac	2	RANZCR 2012e	Assumed the same across jurisdictions
Planning ratio for radiation therapists per linac	10	Zhang 2010	Assumed the same across jurisdictions
Planning ratio for ROMPs per linac	2	RANZCR 2012e	Assumed the same across jurisdictions

For example, to calculate demand for Radiation Oncologists in 2022 under the target utilisation scenario the following equation was used:

Demand in 2022 = ((156,721 $\times$ 0.523) + ((156,721 $\times$ 0.523) $\times$ 0.25) + ((156,721 $\times$ 0.523) $\times$ 0.10))) $\div$ 414 $\times$ 2

3.3 Baseline supply scenario

The baseline supply scenario projects the supply of professional FTEs into the future assuming that current entrant and attrition trends continue. The projections build on the base year's supply of professional FTEs, with inflows into the occupation due to trainees, immigration and re-entry added each year, and outflows due to retirement[4] and other factors such as emigration and career change removed each year.

The inflow due to trainees is the intake of trainees each year minus the average loss rate from the trainee program. The entry and attrition inputs have been determined based on historical data sources. They are held constant across future years, but the calculations are conducted year on year.

3 HealthConsult (2009) did not collect information on utilisation in the NT. As such, a recent and verified utilisation rate for the NT was unavailable at the time of writing.

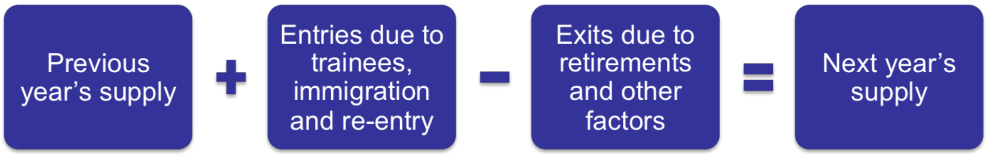
4 Because consistent historical age profile data and retirement ages for every occupation were not available simple retirement rates have been calculated and assumed across future years.

In all occupations, the base year is 2011. The number of qualified FTEs was provided by RANZCR (2012a) from the 2011 Facilities Survey. We received workforce data from AIR and ACPSEM, however the raw numbers were not used in base year estimates because of lower response rates in the surveys and to keep the base year consistent between occupations.

The figure below shows an overview of how baseline supply was calculated.

Figure 3.3

OVERVIEW OF METHODOLOGY FOR CALCULATING SUPPLY



Source: ACG 2012.

The inputs and assumptions vary between each occupation and are detailed in the sections below.

Assumptions and inputs underlying the Radiation Oncologist model

The assumptions and inputs underlying the Radiation Oncologist baseline supply model are shown in the table below.

Table 3.2

DATA INPUTS TO THE RADIATION ONCOLOGIST MODEL

Model parameter	Base case	Data source	Notes on jurisdiction level data
2011 workforce supply (FTEs)	235.8	RANZCR 2012a	Raw data provided at jurisdiction level
Intake of trainees	24 p.a.	RANZCR 2012c, historical 5 year average	Total for Australia distributed amongst states by historical proportion of trainee distribution
Length of training program[5]	5 years	RANZCR 2011c	Assumed the same across jurisdictions
Training dropout rate	15% p.a.	RANZCR 2012c, historical 10 year average	Assumed the same across jurisdictions
Workforce inflow – immigration	1% p.a.	HealthConsult 2009	Assumed the same across jurisdictions
Workforce inflow – re-entry	3% p.a.	HealthConsult 2009	Assumed the same across jurisdictions
Workforce outflow – retirement	2% p.a.	HealthConsult 2009	Assumed the same across jurisdictions
Workforce outflow – other factors	1% p.a.	HealthConsult 2009	Assumed the same across jurisdictions

Note: State figures have been assumed consistent across jurisdictions where there is an absence of quality, current information.

[5] It should be noted, that the prescribed length of the training program is a minimum and trainees often take longer (Morgan et al 2000).

The equation below demonstrates how supply was calculated in 2012 for Radiation Oncologists.

Supply in 2012 = 235.8 + (24 $\times$ 0.85) + (235.8 $\times$ 0.01) + (235.8 $\times$ 0.03) − (235.8 $\times$ 0.02) − (235.8 $\times$ 0.01)

For Radiation Oncologists, trainees refer to those undergoing the five-year Radiation Oncology Training Program (RANZCR 2011). Historical trainee data for Radiation Oncologists was received from RANZCR at the national level. These were distributed by state/territory according to the historical distribution of trainees.

Inflow and outflow rates for Radiation Oncologists were calculated based on numbers in the HealthConsult report. This was conducted because updated data were not available. The predicted numbers of inflows and outflows each future year due to the reasons outlined in the table above (which were based on historical data sources) were divided by the number of people in the workforce in 2008 (the base year for HealthConsult's analysis).

Assumptions and inputs underlying the Radiation Therapist model

The assumptions and inputs underlying the Radiation Therapist baseline supply model are shown in the table below.

Table 3.3

DATA INPUTS TO THE RADIATION THERAPIST MODEL

Model parameter	Base case	Data source	Notes on jurisdiction level data
2011 workforce supply (FTEs)	1364.4	RANZCR 2012a	Raw data provided at jurisdiction level
Intake into NPDP	150 p.a.	AIR 2012a	Raw data provided at jurisdiction level
Length of NPDP	1 year	AIR 2011	Assumed the same across jurisdictions
NPDP training dropout rate	1% p.a.	AIR 2012c	Assumed the same across jurisdictions
Workforce inflow – immigration	1% p.a.	AIR 2012a and HealthConsult 2009	Assumed the same across jurisdictions
Workforce inflow – re-entry	0% p.a.	AIR 2012a and HealthConsult 2009	Assumed the same across jurisdictions
Workforce outflow – retirement	1% p.a.	AIR 2012a and HealthConsult 2009	Assumed the same across jurisdictions
Workforce outflow – other factors	4% p.a.	AIR 2012a and HealthConsult 2009	Assumed the same across jurisdictions
Average hours worked/week	32.6	AIR 2012a	Assumed the same across jurisdictions

Note: State figures have been assumed consistent across jurisdictions where there is an absence of quality, current information.

For Radiation Therapists, trainees are those undertaking the National Professional Development Programme (NPDP), which takes one year to complete following completion of an appropriate degree qualification (AIR 2011). The current number of people undertaking an NPDP was provided by AIR (2012a) by jurisdiction.[6] The dropout rate from the program was based on discussions with AIR, informed by their knowledge of trends in historical training data.

In the case of Radiation Therapists, the number of trainees flowing into the occupation is converted to FTEs given the significantly lower average number of hours worked per week in this occupation.[7]

Inflow and outflow rates were calculated based on both HealthConsult (2009) and the results of a recent workforce survey conducted by AIR (2012a). The rates based on HealthConsult were conducted in the same way as for Radiation Oncologists. The rates based on AIR (2012a) were calculated by taking the number of people who were indicated as entering or leaving the workforce for different reasons over the past year as a proportion of the number of people in the workforce in 2011. The rates from both sources were averaged to overcome any anomalies in the recent data.

Assumptions and inputs underlying the ROMP model

The assumptions and inputs underlying the ROMP baseline supply model are shown in the table below.

Table 3.4

DATA INPUTS TO THE ROMP MODEL

Model parameter	Base case	Data source	Notes on jurisdiction level data
2011 workforce supply (FTEs)	189.2	RANZCR 2012	Raw data provided at jurisdiction level
TEAP enrolments	19 p.a.	ACPSEM 2012a, historical 5 year average	Raw data provided at jurisdiction level
Length of TEAP	5 years	ACPSEM 2012a	Assumed the same across jurisdictions
Training dropout rate	17% p.a.	ACPSEM 2012a, historical 10 year average	Assumed the same across jurisdictions
Workforce inflow – immigration	5% p.a.	HealthConsult 2009 and ACPSEM 2012b	Assumed the same across jurisdictions
Workforce inflow – re-entry	0% p.a.	HealthConsult 2009 and ACPSEM 2012b	Assumed the same across jurisdictions
Workforce outflow – retirement	1% p.a.	HealthConsult 2009 and ACPSEM 2012b	Assumed the same across jurisdictions
Workforce outflow – other factors	4% p.a.	HealthConsult 2009 and ACPSEM 2012b	Assumed the same across jurisdictions

Note: State figures have been assumed consistent across jurisdictions where there is an absence of quality, current information.

6 The intake into NPDP is heavily influenced by university graduate numbers, which vary by year. However, historical data on the intake of students into the NPDP was not available; therefore it was not possible to reflect a mean of the variation of NPDP intake over time.

7 Whilst it is acknowledged that the average hours worked by Radiation Therapists may vary by jurisdiction, the data was not available for input into the model. As such, altering the definition of standard full-time hours by state/territory was not necessary and the FairWork Ombudsman's definition was applied consistently across each jurisdiction.

For ROMPs, trainees are those enrolled in the Training Education and Accreditation Program (TEAP), which usually takes five years to complete (ACPSEM 2012). Historical trainee data for ROMPs was received from ACPSEM at the jurisdiction level. However, the dropout rate was available only at the national level.

Inflow and outflow rates were calculated based on both HealthConsult (2009) and the results of a recent workforce survey conducted by ACPSEM (2012b). The rates based on HealthConsult were conducted in the same way as for Radiation Oncologists and Radiation Therapists. The rates based on ACPSEM (2012b) were calculated by taking the number of people who were indicated as entering or leaving the workforce for different reasons over the past year as a proportion of the number of people in the workforce in January 2012. The rates from both sources were averaged to overcome any anomalies in the recent data.

3.4 Adjusted supply scenario

The foundation of the adjusted supply scenario is the baseline supply scenario. This scenario uses the same inputs and equation, but allows the user to increase the intake of trainees in each occupation per year (by per cent) and change the trainee dropout rate via the control panel in order to fill the gap between supply and demand. All other inflows and outflows are held constant.

Because of the length of the training programs of the occupations of interest, increasing the intake of trainees in a year is not felt in terms of the workforce supply until five years later for Radiation Oncologists and ROMPs, and one year later for Radiation Therapists.

3.5 Future data collections

As indicated by the inputs and assumptions tables above, in order to update the model in future years, there needs to be ongoing data collection of a number of variables.

Of particular relevance to future workforce surveys, there needs to be consistent collection of data on the number of people entering and leaving the workforce for each occupation each year and their reasons for doing so. Of the current workforce in each year, it is necessary to determine:

- how many trainees enter the workforce;
- how many people enter the workforce from overseas;
- how many people re-enter the workforce;
- how many people leave due to retirement; and
- how many people leave due to other reasons, such as going overseas or for a career change.

Chapter 4

Comparison with HealthConsult 2009

In 2009, HealthConsult prepared a Radiation Oncology Workforce Planning Report for the Department of Health and Ageing. It contained workforce projections of supply and demand based on a modelling exercise. There are several differences between the ACG models and the HealthConsult models in terms of inputs, calculations and outputs.

4.1 Inputs and calculations

The HealthConsult models predicted supply and demand at two points in time – 2014 and 2019 – rather than in a year-on-year time series. As such, their methods of determining inputs and calculations for both supply and demand were different to the ACG model.

HealthConsult's methods are documented in their 2009 report, however the key differences to the ACG model are summarised below.

Supply

The supply-side model of the HealthConsult projections was conceptually similar to the ACG model. However, all inputs to the HealthConsult models are net entry and attrition numbers at two points in time.

With respect to trainees, both models incorporate the number exiting the training program and entering the workforce. However, with respect to Radiation Oncologists and ROMPs, HealthConsult assumed that the intake of registrars would be equal to the amount entering the workforce, whereas the ACG model has assumed an attrition rate from the clinical training programs based on available data. With respect to Radiation Therapists, HealthConsult used student numbers to estimate the number of qualified professionals entering the workforce rather than the number of clinical trainee placements.

Because the ACG model is year-on-year and over a longer time period, ACG used *rates* of other inflows and outflows that depend on the workforce figure in the preceding year. Although the rates differ between occupations, the calculations in our models are the same. HealthConsult took a slightly different approach for each occupation, as detailed in their report.

Demand

HealthConsult's demand equation differs from the one used in the ACG model. The most significant difference is that HealthConsult calculated demand on top of the net supply in 2014 and 2019 that their supply-side model produced. In the current model demand is calculated independently of supply.

The HealthConsult models account for the increase required for best practice and increase in cancer incidence, although these are calculated differently to the ACG model. In HealthConsult's work, the increase required for best practice increase is the difference between the optimal utilisation rate and the current utilisation rate, divided by the current utilisation rate, which is then multiplied by *current staff numbers*. The same approach is taken for 2014 and 2019. This differs to the ACG model where the increase required to reach 52.3 per cent utilisation is applied incrementally to the cancer population.

With respect to cancer incidence, HealthConsult assumed a 2.5 per cent increase in new cases per year over the projected period, based on an older AIHW release of cancer incidence (2005). This was added on top of the best practice increase in staff numbers. The ACG model uses actual numbers of projected cancer incidence, which estimates, on average, a 2.6 per cent increase in cancer incidence per annum (AIHW 2012).

Although allowance has been made in their model, HealthConsult's base demand projections do not include changes required to staff facilities at recommended benchmark levels. As explained in Chapter 3, this is central to the ACG model.

4.2 Outputs

Outputs of HealthConsult's analysis are headcount numbers and hours, rather than FTEs. However, HealthConsult's results can be compared to ACG's by converting the HealthConsult results to FTEs using average hours worked for each occupation as documented in the HealthConsult report and assuming standard full-time hours in Australia are 38 per week (FairWork Ombudsman 2010). In conducting this comparison we have assumed a 52.3 per cent utilisation rate to be achieved in the relevant years to be consistent with HealthConsult.

The results of the comparison between supply, demand and the shortfall between them are shown in the table below. For all occupations, the current model estimates a lower supply than HealthConsult. The current model estimates lower demand for Radiation Oncologists and Radiation Therapists, but similar demand for ROMPs.

Table 4.1

COMPARISON OF RESULTS

FTEs		2014			2019		
		Health Consult	ACG	*Difference*	Health Consult	ACG	*Difference*
Radiation Oncologists	Supply	522	305	*-217*	599	424	*-175*
	Demand	654	438	*-216*	738	499	*-239*
	Shortfall	132	133	*1*	139	74	*-65*
Radiation Therapists	Supply	1738	1604	*-134*	2057	1952	*-105*
	Demand	2318	2188	*-130*	2619	2494	*-125*
	Shortfall	580	584	*4*	562	542	*-20*
ROMPs	Supply	336	229	*-107*	417	291	*-126*
	Demand	445	438	*-7*	499	499	*0*
	Shortfall	109	209	*100*	82	208	*126*

Source: HealthConsult 2009, ACG 2012.

Chapter 5

Sensitivity analysis

A number of variables are central to both the supply side and demand side models. We have tested two of these in sensitivity analysis: cancer incidence and linac throughput. The results are detailed below.

5.1 Cancer incidence

The cancer incidence figures used in the model were calculated from AIHW (2012) data. While the inputs to the model are predicted *numbers* of cancer patients, the forecasts predict an average growth in cancer incidence of around 2.6 per cent per annum over the next 10 years. We tested the sensitivity of cancer incidence by using impact of increasing and decreasing growth in cancer incidence by using the AIHW 95 per cent prediction intervals (around 3.5 per cent lower or higher than the reported predicted incidence).

The results of altering cancer incidence are shown in the table below. Under all scenarios the utilisation rate is set to 52.3 per cent. Reducing or increasing cancer incidence affects the workforce results by around 4 per cent.

Table 5.1

PROJECTED DEMAND IN 2022 UNDER THREE CANCER INCIDENCE SCENARIOS

	Reduced incidence	Base incidence	Increased incidence
Radiation Oncologists	514	535	555
Radiation Therapists	2571	2673	2777
ROMPs	514	535	555

Source: ACG 2012.

5.2 Linac throughput

The model assumes an average of 414 courses of treatment per linac each year (ROJIG 2002). However, since there is some variability in expected throughput of courses per linac per annum (e.g. 450 in Zhang 2010), we have tested the impact of varying the average number of courses plus or minus 40 on workforce demand (52.3 per cent utilisation rate).

Reducing throughput by 40 increases demand by 11 per cent, while increasing throughput reduces demand by 9 per cent. The results are shown in the table below.

Table 5.2

PROJECTED DEMAND IN 2022 UNDER THREE LINAC THROUGHPUT SCENARIOS

	Reduced throughput	Base throughput	Increased throughput
Radiation Oncologists	592	535	487
Radiation Therapists	2959	2673	2437
ROMPs	592	535	487

Source: ACG 2012.

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Appendix A

Additional linac analysis

As mentioned in Chapter 2, further analysis on future linac requirements was undertaken separately from the workforce analysis. A separate model was developed to allow for a comparison between potential linac availability and requirements. The inputs, assumptions and results of this additional modelling exercise are presented below.

A.1 Inputs and assumptions

The number of linacs that will be available and the number that will be required over the years 2012 to 2022 were projected. A separate model was developed to allow different types of scenario testing, especially at the jurisdiction level, compared with those provided for in the workforce model.

Linacs required

Requirements for linacs over the years 2012 to 2022 was calculated in the same way as described in Chapter 3. In this model, the user can alter the utilisation rate to be achieved in 2022. The model calculates the increases required in the intermediate years to meet the target utilisation rate defined by the user. The calculations of increases start from 2011.

Unlike the workforce model, the user can alter the utilisation rate by state in the linac model. The most recent utilisation rate was used as the base value for each state (HealthConsult 2009).

The throughput input is applied across jurisdictions. Without complete jurisdiction level data on the average number of course a linac can treat per year, base linac throughput of 414 was applied across all jurisdictions (as the industry accepted standard). However, it is acknowledged that this does vary by jurisdiction.

Linacs available

Each year of projections of the number of linacs that will be available adds the average number of linacs installed per year over the last five years, and removes those that should be retired.

Data on the current stock of linacs by state was obtained from the 2011 Facilities Survey and this was supplemented by additional data gathered through consultations with individual centres. In 2011, there were 168 linacs nationally (Table A.1). The data was broken down into year of installation.

The Facilities Survey provides a snapshot of the current stock of linacs, from which it is not possible to calculate the average age that linacs are retired. However, the data shows that 15 per cent of current linacs were installed in 2002 or earlier.

In the Radiation Oncology Inquiry, Baume (2002) recommended that linacs aged over 12 years should be replaced. The Radiation Oncology Health Program Grants guidelines indicate that the notional life of a linac in Australia is 10 years (Department of Health 2010).

Research conducted in the UK also assumes a ten-year useful life (Dunscombe et al 1999), while evidence from the US indicates the useful life is shorter than ten years (Maine Department of Health and Human Services 2011).

On the basis of the above, the useful life of a linac was assumed to be 10 years in our calculations. Although there is a case for replacing them earlier, 10 years was determined as a reasonable assumption for our analysis.

The first year of projections (2012) removes all linacs in the current stock that were installed in 2002 or prior (15 per cent of current stock), as it is assumed they will not be in service in the projected period. Subsequent years of the projections removes the linacs that were installed in the year that was 10 years prior.

The average number of installations per year, over the years 2007 to 2011 years, was calculated. Each year of projections adds this number to the previous year's stock.

Table A.1

ASSUMPTIONS

Jurisdiction	Number of linacs in 2011	Number of linacs installed prior to 2002 (inclusive)	Average number of linacs installed per year between 2007 and 2011	Utilisation rate in 2011
NSW	54	6	6	34.5%
Vic.	44	5	4	40.7%
Qld	33	9	4	35.8%
SA	13	3	1	38.0%
WA	13	3	2	49.6%
Tas.	5	1	1	36.7%
NT	2	0	0	NA[8]
ACT[9]	4	1	0	68.4%
NSW & ACT[7]	*58*	*7*	*6*	*35.5%*
Australia	168	26	19	38.1%

Source: 2011 Facilities Survey, HealthConsult 2009, stakeholder consultation.[10]

[8] A recent and verified utilisation rate for the NT was unavailable at the time of writing. HealthConsult (2009) did not collect information on utilisation in the NT. Older sources (e.g. CCORE 2004) indicate that the rate was low, however recent anecdotal evidence indicates utilisation in the NT has improved substantially. Therefore, it was not deemed possible to calculate an accurate utilisation rate for the NT for use in the model.

[9] A combined NSW and ACT utilisation rate is shown because the utilisation rate in the ACT may be inflated as patients from NSW are serviced in the ACT.

[10] Advice from the Commonwealth Department of Health and Ageing indicates that the current number of linacs may differ in some jurisdictions from the 2011 figures shown.

Although the current number of linacs was supplied by state, the number of linacs projected to be available is not presented by jurisdiction. The results are not presented at the jurisdiction level because several comprise they are small numbers, and as such, are particularly sensitive to small changes in the assumptions.

A.2 Linacs required over time in Australia

Projected linac availability over the next 10 years, at the national level, was compared with requirements in the utilisation scenarios described in this report (target, halfway and current).

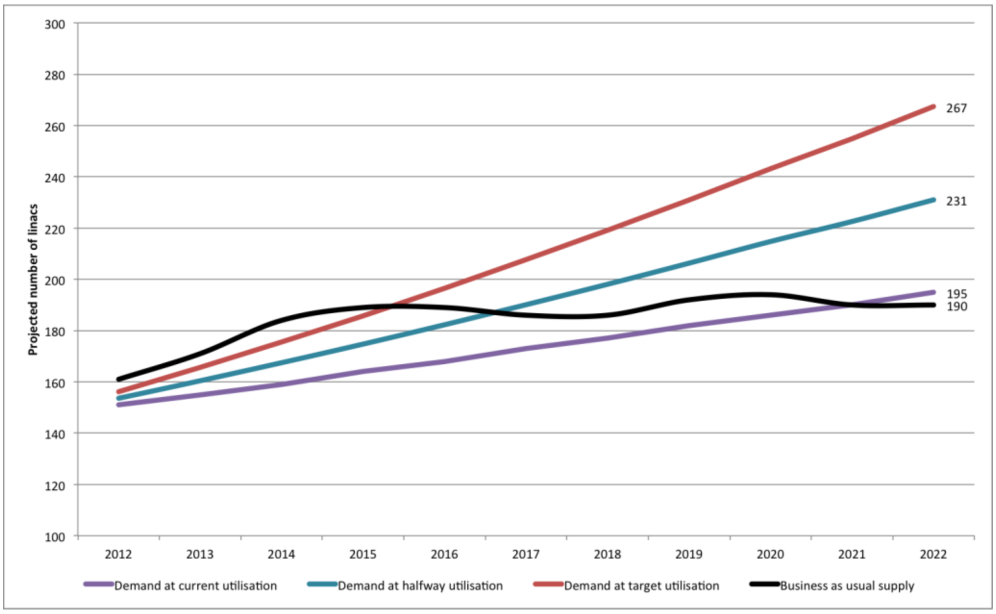
At current levels of utilisation and current throughput (414), the gap between availability of, and requirements for, linacs would grow from a surplus of 10 nationally, to a shortage of five in 2022. This equates to 1,950 cases unable to be treated.

With the achievement of target utilisation in 2022, the gap between availability and requirements would grow from a surplus of five to a shortage of 77 nationally in 2022. This equates to 32,000 cases unable to be treated.

Figure A.1 shows the discrepancy between linac availability and requirements over the next 10 years.

Figure A.1

PROJECTED LINAC REQUIREMENTS AT CURRENT THROUGHPUT LEVELS



Source: ACG 2012.

A.3 Linac requirements in 2022 by jurisdiction

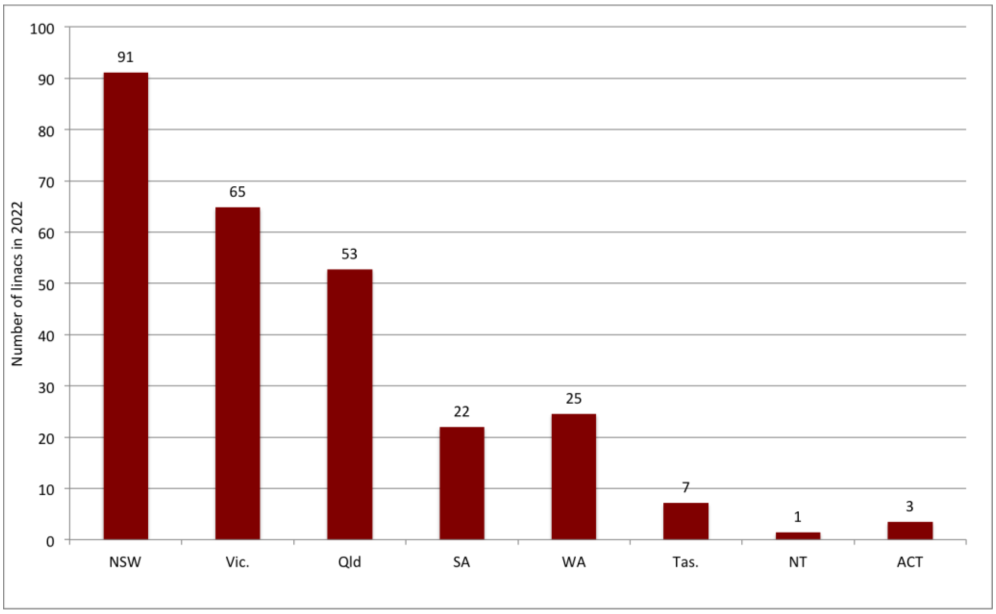
Two demand scenarios were tested, and the results in 2022 examined. The first was target utilisation, which is the achievement of a utilisation rate of 52.3 per cent in 2022. This goal was applied across all jurisdictions. Then the current rates of utilisation in each jurisdiction were modelled as being unchanged constant across the whole period.[11] An intermediate level was not modelled because the utilisation rates vary significantly between jurisdictions.

Target utilisation

With the achievement of target utilisation at current levels of throughput (414), 267 linacs will be required nationally. The breakdown by jurisdiction is provided in Figure A.2.

Figure A.2

NUMBER OF LINACS REQUIRED IN 2022: TARGET UTILISATION AND CURRENT THROUGHPUT



Source: ACG 2012.

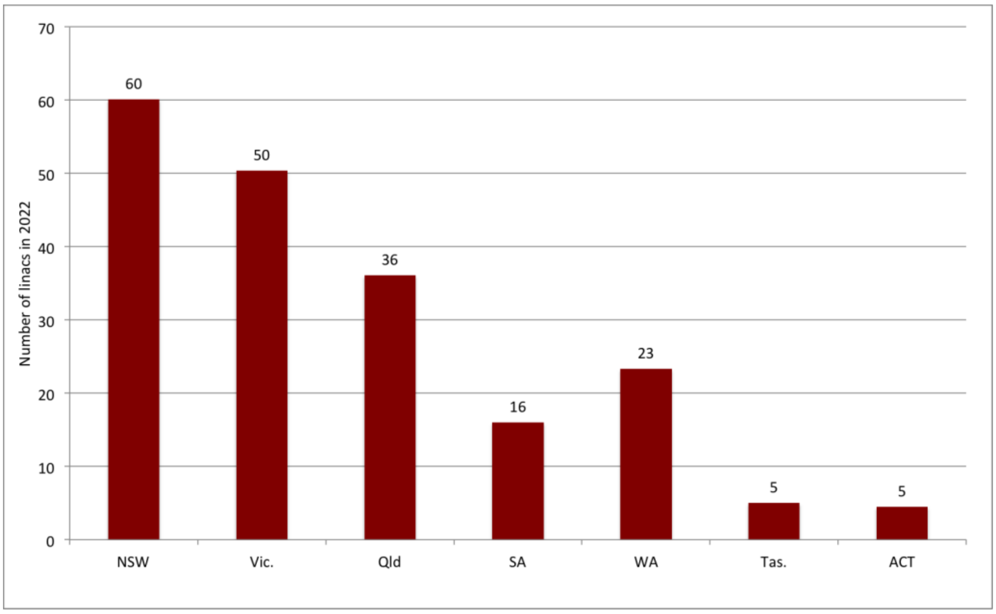
Current utilisation

At current levels of utilisation and current levels of linac throughput, 195 linacs will be required nationally in 2022. The breakdown by jurisdiction is provided in Figure A.3.

[11] The NT was excluded from the analysis using current utilisation rates because a recent and verified utilisation rate was unavailable.

Figure A.3

NUMBER OF LINACS REQUIRED IN 2022: CURRENT UTILISATION AND CURRENT THROUGHPUT



Source: ACG 2012.