

Australian Medical Workforce Advisory Committee

# **THE SPECIALIST RADIATION ONCOLOGY WORKFORCE IN AUSTRALIA**

**SUPPLY AND REQUIREMENTS**

**1997 - 2007**

**AMWAC Report 1998.2**

**February 1998**

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## **ABBREVIATIONS**

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AHMAC	Australian Health Ministers' Advisory Council
AHTAC	Australian Health Technology Advisory Committee
AIHW	Australian Institute of Health and Welfare
Aust	Australia
DHFS	Commonwealth Department of Health and Family Services
DMLA	Dual modality linear accelerator
FTE	Full Time Equivalent
LDR	Low dose rate
MBS	Medicare Benefits Scheme
MWDRC	Medical Workforce Data Review Committee
NHMRC	National Health and Medical Research Council
NSW	New South Wales
NT	Northern Territory
PDR	Pulse dose rate
Pop	Population
Qld	Queensland
RACR/FRO	Royal Australasian College of Radiologists/Faculty of Radiation Oncology
RRMAR	Rural, Remote Metropolitan Areas classification
SA	South Australia
SPLA	Single photon linear accelerator
SPR	Specialist:Population ratio
Tas	Tasmania
Terr	Territory
TRD	Temporary Resident Doctor
Vic	Victoria
WA	Western Australia

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## **TERMS OF REFERENCE OF AMWAC AND THE AMWAC RADIATION ONCOLOGY WORKFORCE WORKING PARTY**

The Australian Health Ministers' Advisory Council (AHMAC) established the Australian Medical Workforce Advisory Committee (AMWAC) to advise on national medical workforce matters, including workforce supply, distribution and future requirements. AMWAC held its first meeting in April 1995.

### AMWAC Terms of Reference

1. To provide advice to AHMAC on a range of medical workforce matters, including:
  - the structure, balance and geographic distribution of the medical workforce in Australia;
  - the present and required education and training needs as suggested by population health status and practice developments;
  - medical workforce supply and demand;
  - medical workforce financing; and
  - models for describing and predicting future medical workforce requirements.
2. To develop tools for describing and managing medical workforce supply and demand which can be used by employing and workforce controlling bodies including Governments, Learned Colleges and Tertiary Institutions.
3. To oversee the establishment and development of data collections concerned with the medical workforce and analyse and report on those data to assist workforce planning.

### AMWAC Radiation Oncology Workforce Working Party Terms of Reference

As part of the 1997-98 AMWAC work plan, AHMAC requested a report on the specialist radiation oncology workforce. An AMWAC Radiation Oncology Workforce Working Party was established as a sub-committee of AMWAC and was asked to provide a report on the optimal supply and appropriate distribution of radiation oncology specialists across Australia, including projections for future requirements.

The Working Party held its first meeting on 28 July 1997 and presented a final report to the 2 February 1998 AMWAC meeting. The report was presented to AHMAC at its 19 March 1998 meeting.

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## **INTRODUCTION, GUIDING PRINCIPLES AND METHODOLOGY**

### **Introduction**

In preparing this report, the Working Party's aim has been to facilitate an adequate supply and appropriate distribution of radiation oncology specialists across Australia by the year 2007.

Radiation oncologists are involved with the clinical care of patients with cancer, both inpatients and outpatients, as well as with the technical aspects of the prescription and supervision of a course of radiotherapy. Most radiotherapy treatments are for cancer and most services are provided on an ambulatory basis by public hospital outpatient departments. However, 25% to 30% of services are provided in private facilities. The delivery of a course of radiotherapy is highly technical and involves a team of health professionals, including, radiation oncologists, radiation therapists (radiographers) and radiation physicists.

### **Definitions**

The Working Party defined the specialty of radiation oncology as:

The specialty concerned with the treatment of cancer and other diseases with ionising radiation.

The Working Party defined a specialist radiation oncologist as:

A qualified radiation oncologist who manages patients with cancer and who conducts consultations leading to the design and administration of a course of treatment for cancer and other diseases with ionizing radiation and who is licenced by the relevant State/Territory Radiation Safety Committee to prescribe a course of treatment using irradiating apparatus or radioisotopes.

This definition includes radiation oncologists in salaried positions in public hospitals and private practice, radiation oncologists in full time or part time academic positions relating to radiation oncology and radiation oncologists who conduct medico legal consultations on radiation oncology.

The above definition does not include registrars who hold accredited training positions or service registrars who work in radiation oncology but are not in an accredited training position.

### **Guiding Principles**

In compiling this report, the Working Party adopted the following guiding principles:

- the Australian community should have available an adequate number of specialist radiation oncologists, appropriately distributed, to provide the radiation oncology services it requires;

- the community is best served when radiation oncologists have high standards of qualification and work with a high level of ongoing experience;
- the best assurance of standards is a high quality requirement for entry to practice;
- standards of practice will also be highest if radiation oncologists have available the appropriate infrastructure and associated professional staff to perform a reasonable volume of work;
- the Australian community must have access to a good standard of radiation oncology care irrespective of geography and economic status; although it is recognised that because of the substantial infrastructure requirements of providing a radiation oncology service it is impractical for these services to be located in small rural centres. Hence, it is important that mechanisms are in place to assist rural patients to access radiation oncology services;
- both public and private sectors must provide an adequate amount and quality of service; and
- it is recognised that a range of specialist staff, in addition to radiation oncologists, are involved in the delivery of radiotherapy services and that cancer management is most effective when provided by a multidisciplinary team.

### **Methodology**

The approach of the Working Party has been to analyse existing data sources and to undertake consultation with relevant persons and organisations, in order to make informed comments on the factors affecting the current and future market for radiation oncology services.

In estimating workforce numbers, establishing a profile of the workforce and assessing its adequacy, important sources of data were:

1. Royal Australasian College of Radiologists - Faculty of Radiation Oncology (RACR/FRO)

The RACR/FRO keeps a variety of data, principally on number, age, gender and location of Fellows, and data on training posts and trainees. Information supplied by the College included all radiation oncologists currently practising in Australia, both Fellows of the College and specialist radiation oncologists who are not College Fellows. It also indicated radiation oncologists practising part-time, by converting the time worked into full time equivalents (FTE). This data did not include any Fellows of the College who were practising in other specialist areas, nor did it include radiation oncologists who had retired, or were permanently not working in the field. In June 1997, the RACR/FRO undertook a survey of radiation oncologists and trainees in Australia and this data was made available to the Working Party.

## 2. Australian Institute of Health and Welfare (AIHW)

The principal AIHW data source is the annual Medical Labour Force Survey which presents national labour force statistics for registered medical practitioners, principally through a survey collected as part of the annual renewal of registration. In the Medical Labour Force Survey, a radiation oncologist was a specialist in active practice who reported being a specialist whose principal qualification was in radiation oncology. The numbers presented in this report are estimates produced from the National Medical Labour Force Survey of all medical practitioners registered in Australia in 1995. In producing these estimates, the AIHW has assumed that non-respondents to the survey had the same characteristics as respondents. Overall the 1995 survey had an 79.6% response rate.

## 3. Commonwealth Department of Health and Family Services (DHFS) Medicare provider database

Medicare provider statistics define medical practitioners according to the predominant services billed to Medicare. The Medicare statistics include all practitioners who have billed Medicare for at least one service during a financial year. The major deficiency with the use of Medicare data for workforce planning purposes is that it does not reflect public hospital work and this can sometimes provide a false impression of trends in service provision. Hence, Medicare does not provide data on practitioners who are salaried radiation oncologists in the public hospital system and who do not render services to private patients on a fee for service basis. Medicare data thus excludes services rendered free of charge to public hospital patients. Furthermore, it does not reflect services provided to Veterans' Affairs patients.

## 4. Australian Health Technology Advisory Committee (AHTAC) of the National Health and Medical Research Council (NHMRC)

In 1996 AHTAC completed a report on beam and isotope radiotherapy. This report provides a useful source of data on radiation oncology infrastructure and in particular megavoltage machines. The report provided data on both current number and likely future number of megavoltage machines. The report also contained useful data on the future incidence of cancer.

## 5. AMWAC Survey of State/Territory Health Departments

State/Territory health departments were surveyed seeking information about the current establishment of radiation oncologists and megavoltage machines in the public sector and their views on the adequacy of supply of radiation oncologists and expected future requirements. This survey had an 100% response rate.

## 6. Rural, Remote and Metropolitan Areas classification

Wherever possible, distributional data has been interpreted using the rural, remote and metropolitan areas (RRMA) classifications developed by the Commonwealth Departments of Primary Industries and Energy and Health and Family Services (DPIE & DHFS 1994). A summary of the RRMA classification is provided in Appendix A.

## 7. Australian Bureau of Statistics (ABS)

The Australian Bureau of Statistics (ABS) population data and projections are used as the sole source on population data. In making its population projections ABS uses four different series. The population projections in this report are based on Series A/B, where constant fertility and low overseas migration are assumed (ABS 1994 and ABS 1997). A summary of the population estimates used are provided in Appendix B.

### **Key Assumption**

The Working Party would like to emphasise that the projections on radiation oncologist supply and requirements are based on the assumption that there will be no significant change in existing national health structures. Overseas experience indicates that significant structural changes to the Australian health system, for example the introduction of formalised coordinated care arrangements may change medical workforce requirements in Australia (AMWAC & AIHW 1996).

## SUMMARY OF FINDINGS AND RECOMMENDATIONS

This report describes the current radiation oncology workforce, assesses the adequacy of that workforce, and projects workforce supply and requirements to the year 2007. Radiation oncologists are involved in the care of patients with cancer through the use of radiotherapy. Radiation oncology is particularly dependent on the availability of radiation oncology facilities and equipment. As a result, it is vital that workforce supply does not exceed the availability of essential equipment and facilities. In undertaking this analysis the Working Party has been guided by the findings and recommendations of the NHMRC AHTAC (1996) report *Beam and Isotope Radiotherapy* noting in particular estimates of the future incidence of cancer and future requirements for megavoltage machines.

Drawing on the NHMRC AHTAC report, the Working Party concluded that a shortfall of between 22 to 30 radiation oncologists exists (representing 14.4% to 18.6% of the workforce). AHTAC recommends that when planning new facilities a 50% referral rate of newly diagnosed cancer patients be used. In addition, AHTAC maintains that the increasing incidence of cancer can best be accommodated by using the ratio of radiation oncologists required to achieve a 50% rate of referral of newly diagnosed cancer patients. The AHMAC (1986) report maintained that the maximum number of new patient referrals that each radiation oncologist can manage is 250 per year. In 1997, the cancer incidence is estimated to be 4,147 per million population with an estimated 76,360 newly diagnosed cases of cancer. Hence to treat 50% of these new patients with radiotherapy would require 153 radiation oncologists. In 1997, there are 131 radiation oncologists (123.4 FTE). Therefore, using this methodology, it can be argued that Australia has a shortfall of between 22 to 30 radiation oncologists.

This situation has arisen for a variety of reasons, including, an increase in the incidence of cancer and in the complexity of cancer treatment, a shortage of training positions, pressures on practising radiation oncologists which make it difficult for them to give sufficient attention to training, trainees under heavy clinical pressure which can impede their completion of the training program, and lack of a suitable academic structure to enable attention to teaching.

The report also concludes that without prompt corrective action, the undersupply of radiation oncologists will escalate. The current projected level of graduate output will not be sufficient to meet expected future requirements. It is estimated that requirements will grow by a minimum of 2.1% per year. Future supply will be affected by the cohort of predominantly male radiation oncologists aged 55 years and over and the increased representation of women among radiation oncologists aged under 45 years (29%) and among radiation oncology trainees (35%).

As a result of the current shortfall in radiation oncologists and the estimated growth in service requirements it is recommended that graduate output be increased from the

recent average of 8 graduates per year to 11 graduates per year.

To achieve this increase in graduate output it is recommended that State and Territory health departments and the Royal Australasian College of Radiologists/Faculty of Radiation Oncology (RACR/FRO) coordinate the establishment of 12 new training positions with the increases to be staged over the next two years, commencing, if possible, in 1998.

In projecting future workforce requirements the Working Party assumed a growth in requirements for this workforce of 2.1% based on estimated growth in the crude incidence of cancer and a current shortfall of 22 radiation oncologists. The Working Party also assumed that the length of the RACR/FRO training program would continue to be five years and that the majority of candidates would complete the program within this time frame. In addition, the Working Party assumed that 0.5 overseas trained radiation oncologists would be added to the workforce each year and that the age, gender and workforce participation profile of the current group of radiation oncology trainees and of the current workforce provides a suitable basis on which to project future workforce requirements.

### **Description of the Current Radiation Oncology Workforce**

#### *Number of Practising Radiation Oncologists*

- The RACR/FRO data indicate that in 1997 there were 131 (123.4 FTE) radiation oncologists in Australia. Medicare data for 1994-95 and 1995-96 identified 130 practising radiation oncologists. The AIHW 1995 survey identified 132 specialists with a qualification in radiation oncology (for 122 of whom this was their main qualification) and 132 specialists practising in radiation oncology (for 127 of whom it was their main specialty of practice).
- Radiation oncology is a small specialty, representing just 0.8% of all specialists.
- Between 1988 and 1997 the number of radiation oncologists, according to the RACR/FRO records, has increased from 76 to 131 (an overall increase of 55 and an average annual increase of six). This has followed an increase in radiation oncology services in response to prior reports (eg., AHMAC 1989). Above average increases occurred in Victoria, New South Wales and Queensland while the workforce in both South Australia and Tasmania increased by one specialist and the Australian Capital Territory lost one specialist. Population growth between 1984-85 and 1995-96 was 17.4%, a per annum increase of 1.6%.

#### *Radiation Oncologists to Population*

- The records of the RACR/FRO indicate that in 1997 there are 0.71 radiation oncologists per 100,000 people (1:140,427). Victoria, Queensland, Tasmania and the Australian Capital Territory have above average ratios while Western Australia

and New South Wales are below the average with 0.51 per 100,000 population and 0.63 per 100,000 population respectively.

### *Geographic Distribution*

- RACR/FRO data indicate that 21.7% of radiation oncologists are in New South Wales, well below its share of the population (33.9%) while Victoria has 31.9% of radiation oncologists which is well above its share of the population (24.8%). Like New South Wales, Western Australia has a lower share of radiation oncologists (8%) in comparison to its share of the population (9.7%), Queensland has 22.5% of radiation oncologists and South Australia has 10%. There is no radiation oncologist in the Northern Territory.
- The AIHW 1995 survey found that 97.5% of radiation oncologists were in capital cities and other major urban centres and 1.2% were in large rural centres. This distribution pattern is consistent with the notion that the distribution of this specialty depends on the availability of megavoltage machines which are limited to locations with large populations and suitable institutional infrastructure. However, a large number of radiation oncologists are involved in providing rural services as part of a comprehensive service network with 46 rural centres receiving outreach services.

### *Age Profile*

- According to the records of the RACR/FRO, in 1997 the average age of radiation oncologists is 45.8 years. The largest ten year age group are radiation oncologists aged between 38 and 47 years (38.8%). 9.4% of radiation oncologists are aged over 58 years and 19.4% are aged under 38 years.

### *Gender Profile*

- Data from the RACR/FRO show that in 1997, 23% of radiation oncologists were women. This level of female representation is slightly below the average for all clinicians (27%), but above the average for all specialists (14.0%).
- Medicare data (1995-96) indicate that since 1984-85 the number of women radiation oncologists has increased from 10.9% to 21.5%. In addition the data reveal that in 1985-86, 57% of female radiation oncologists worked part-time compared with 19.6% of male radiation oncologists and that in 1995-96 the percentage of female and male radiation oncologists working part-time had reduced to 32% and 17.6% respectively.

### *Hours Worked*

- Radiation oncologists work on average, 50.1 hours per week and spend 42.3 hours per week on direct patient care (AIHW 1997). The majority (83.3%) of radiation oncologists work between 35 to 64 hours in total per week, 8.6% of radiation oncologists work more than 64 hours per week and 8% work less than 35 hours per week. Most radiation oncologists (78%) spend the majority of their

working week (35 to 64 hours per week) on direct patient care.

- According to the AIHW survey, 49.4% of radiation oncologists report being on call with all on-call practitioners located in a major urban centre.
- On average, female radiation oncologists work 8.3 hours less per week than do male radiation oncologists. Women in the under 35 year age group work, on average, 16.5 hours less per week than do their male colleagues and women aged between 35 to 54 years work six hours less per week (on average). However, with respect to direct patient care hours worked, the differential between males and females is considerably less in the age group 35 to 54 years (ie., a difference of four hours).

#### *Work Setting*

- Stevens and Berry (1995) in a survey of radiation oncologists found that 77% were employed as staff specialists, 10% were VMOs, 8% had some other position. With respect to their main place of work, 84% worked in a public institution and 13% worked in a private institution.
- The AIHW survey found substantial variation among States/Territories in work setting of radiation oncologists. For example, in New South Wales 86% of radiation oncologists work in an acute care public hospital while in Victoria only 52.8% work in this type of setting. In Queensland, the percentage of radiation oncologists working in private rooms is lower (22.3%) than the average for Australia (42.7%) while 33% of specialists in this State work in other settings which is well above the average for Australia (16.8%).

#### *Services Provided*

- A radiation oncologist may be involved with the care of cancer patients from soon after diagnosis to the later phase of a patient's care, when there is wide spread cancer. Radiotherapy may be used for prophylactic purposes or for cure or it may be used for palliation of metastatic disease for relief of symptoms. Referrals more commonly come from surgeons, haematologists, medical oncologists and palliative care providers and less frequently from general practitioners. The survey by Stevens and Berry (1995) of radiation oncologists revealed that three types/sites of cancer account for approximately 50% of radiation oncologists' clinical time, namely, breast cancer (24.5%), urology (14.5%) and head/neck cancers (10.5%).
- 92.6% of the Medicare services provided in 1995-96 by radiation oncologists were delivered to outpatients while 7.4% were for hospital in-patients. On average, in 1995-96 each radiation oncologist provided 4,053 Medicare services (3,811 out-of-hospital and 342 in-hospital). Between 1991-92 to 1995-96 the total number of Medicare services provided by radiation oncologists increased by 47.6% (10.2% per annum). However, while there was an increase in the total number of services

there was a decrease of 15.8% (4.2% per annum) in the number of Medicare services provided in-hospital. At the same time the number of out-of-hospital services increased by 56.9% (11.9% per annum).

- Medicare data also reveal that in 1995-96 rural patients received 27% fewer services per 100,000 population than did people located in capital cities and 42.8% fewer service than people located in other metropolitan areas.
- Data from the AHTAC report indicate that between 1988 and 1995 there was a 49.3% increase in the number of new courses of treatment ( 5.9% per annum increase), an 51.8% increase in the number of patient attendances (6.1% per annum increase). This rate of growth reflects both an increase in cancer incidence and a catch-up in the rate of referral of people with cancer for radiotherapy treatment.

### *Training Arrangements*

- The RACR/FRO training program in radiation oncology is a five year program which commences at the end of the intern year and which most trainees take six years to complete.
- As at June 1997, there were 52 accredited training posts and 5 non-accredited posts with 57 trainees in Australia.
- Between 1988 and 1997 the number of radiation oncology trainees increased from 35 to 52 (an increase of 62.9%).
- The average age of radiation oncology trainees is 31 years and 35% of trainees are women. The average age of acquisition of full membership of the FRACR is 34 years.
- Over the past eight years, on average, seven trainees have completed the training program each year; ranging from a high of 11 trainees in 1994 to a low of three trainees in 1991 and 1996. Over the next six years it is expected that annual training program completions will average eight.

## **Adequacy of the Current Radiation Oncology Workforce**

### *Radiation Oncologist:Population Ratio*

- Between 1988 and 1997, the number of radiation oncologists per head of population increased from 1:219,697 to 1:140,427 with 0.46 radiation oncologists per 100,000 in 1988 and 0.71 per 100,000 in 1997 (or 7.1 per million). This specialist population ratio falls short of the 1986 AHMAC Guidelines for Cancer Treatment Services when the incidence of cancer is factored into the calculation. Based on this internationally recognised benchmark, it is estimated that Australia

has a shortage of 22 radiation oncologists.

#### *Radiation Oncologists to New Patient Referrals*

- Since the 1986 AHMAC report, most States/Territories have been working towards a 50% treatment rate of newly diagnosed patients with cancer. The current average rate of referral for radiotherapy treatment in Australia is 38.9% with wide variations between States/Territories and between metropolitan and rural areas within States/Territories. There are several reasons for this suboptimal radiation oncology treatment rate, including, an increase in the incidence of cancer with facilities and workforce expanding at a slower rate, lack of awareness by the medical profession of the benefits of radiotherapy and barriers to access particularly for rural and isolated people.
- According to AHTAC the increasing incidence of cancer can best be accommodated by using the ratio of radiation oncologists to new referrals (p 72). The 1986 AHMAC Guidelines for Cancer Treatment Services maintains that the maximum number of new patient referrals that each radiation oncologist can manage is 250 per year. In 1997, the number of newly diagnosed cases of cancer is estimated to be 76,360. Hence, to treat 50% of these cases with radiotherapy would require 153 radiation oncologists. In 1997, there are 131 radiation oncologists (123.4 FTE). Hence, using this approach, it can be argued that Australia has a shortfall of between 22 to 29.6 radiation oncologists.

#### *Vacancies for Radiation Oncologists*

- In 1996 there were 11 vacant positions for radiation oncologists.

#### *Patient Waiting Times*

- Three States/Territories reported keeping data on waiting times with waiting times ranging from 0 days to 23 days. Currently, there is little consistency among States/Territories in the criteria used to assess patient waiting times for radiation oncology treatment and the Australian Council of Healthcare Standards/Care Evaluation Program is in the process of developing a waiting time clinical indicator.

#### *Conclusions on Adequacy of the Current Workforce*

- The Working Party concludes that there is a shortfall in the order of between 22 to 30 radiation oncologists. The impact of this shortfall on patients requiring treatment is difficult to detail, but is likely to involve a combination of waiting longer for treatment than is optimal, or not receiving radiotherapy treatment at all.
- This shortfall is likely to have arisen for a variety of reasons, including that the growth in trainee output has failed to keep pace with the growth in requirements. The Working Party believes expanding the radiation oncology training program offers the best long term solution to reducing the shortfall. In the short term, consideration could be given to the use of appropriately trained and qualified

overseas specialists.

- In terms of States and Territories, Western Australia and New South Wales have comparatively high cancer incidence rates and specialist population ratios above that of the national average. It should also be noted that the radiation oncologist workforces in Western Australia and South Australia have relatively high proportions of radiation oncologists aged 65 years and over and therefore nearing retirement and/or reducing the average hours worked.

## **Projections of Requirements and Supply**

### *Requirement Trends*

- Australia has a growing and an ageing population which is estimated to increase health service requirements by 1.6% per annum. Hospital data and ABS (National Health Survey) data indicate that people with cancer are predominantly in the older age groups; hence patient demand for radiation oncology is expected to increase with continued ageing of the population.
- Between 1998 and 2005 the crude incidence of cancer is expected to grow by 2.1% per annum.
- Medicare data indicate a 10.2% annual growth rate in the services provided by radiation oncologists over the last decade.
- The AHTAC report shows an increase of 5.9% per annum in the number of megavoltage treatments over the last decade and projects a requirement for an additional 43 to 54 machines by 2005. The AMWAC 1997 survey of State/Territory health departments suggests that department plans are consistent with this projected requirement when private providers are also considered.
- Changes in technology and options for service provision are likely to increase requirements for radiation oncologists (eg., the trend towards breast-conserving surgery followed by radiotherapy for the treatment of breast cancer).
- The Working Party considered that trends in services growth are likely to continue at a similar level to cancer incidence growth per million population as estimated by AHTAC for the years 1995 to 2005 (ie., approximately 2.1% per annum).

### *Supply Trends*

- Over the past five years, an average of seven new radiation oncologists have entered the workforce each year and in each of the next four years an average of eight new graduates in radiation oncology are likely to enter the workforce plus 0.5 overseas trained radiation oncologists.

- The average expected age of retirement of radiation oncologists is 64 years and the loss from the workforce is estimated to average two per year.

#### *Balancing Projected Supply with Projected Requirements*

- A balance in supply to match a continued growth rate in requirements of 2.1% per annum can be achieved by the year 2007 by increasing the number of new radiation oncology graduates from an average of eight per year until the year 2002 to 11 in subsequent years to 2007.
- In previous years, 52 training positions have produced, on average, eight graduates per year. Hence, if the target of 11 graduates is desired an additional twelve radiation oncology training positions would be required. The Working Party concludes that the number of training positions in radiation oncology should increase to 64 with six positions introduced in 1998 and a further six in 1999. In terms of ability to effect increases in training positions the staged scenario is preferable. It will also enable the projected trends in requirements to be monitored and the recommended increases in training positions adjusted if necessary.
- Ideally, training positions should be increased proportionately more in the comparatively poorly endowed State of New South Wales. This State with 33.9% of the Australian population has a radiation oncology specialist population ratio of 1:159,251, which is well above the Australian average of 1:140,427. Consideration also needs to be given to Western Australia, which has a comparatively high SPR (1:196,933) and a relatively high proportion of radiation oncologists aged 60 years and over. In addition, consideration needs to be given to improving the provision of radiation oncology services to underserved areas, such as, the Northern Territory.

## RECOMMENDATIONS

The following recommendations recognise that radiation oncology is a specialty which is particularly dependent on the availability of appropriate facilities and equipment. Hence, it is vital that workforce supply does not exceed the availability of essential equipment and facilities.

The Working Party recommends:

1. There be an increase in the number of funded radiation oncology training positions and trainees to overcome the current shortfall in the number of radiation oncologists and to match an expected future growth in requirements of 2.1% per year.
2. That State and Territory health departments undertake negotiations with the Royal Australasian College of Radiologists/Faculty of Radiation Oncology for the establishment of an additional 12 training positions; with the increases to be staged and distributed as shown in the following Table:

**Total and additional radiation oncology training positions, by State/Territory, 1997 to 2000**

<b>State/Territory</b>	<b>Total 1997 (current)</b>	<b>Total 2000</b>	<b>Increase in 1998</b>	<b>Increase in 1999</b>
NSW/ACT	24	28	2	2
Vic./Tas.	14	16	1	1
Queensland	6	8	1	1
South Aust.	4	6	1	1
West. Aust.	4	6	1	1
<b>AUSTRALIA</b>	<b>52</b>	<b>64</b>	<b>6</b>	<b>6</b>

3. That State/Territory health departments develop strategies for the provision of megavoltage machines and other infrastructure requirements in the light of the recommended increase in the workforce and taking account of the recommendations of the NHMRC AHTAC report on Beam and Isotope Radiotherapy (1996).
4. State/Territory health departments and the Royal Australasian College of Radiologists/Faculty of Radiation Oncology co-ordinate the establishment of the new training positions and oversee the introduction of any short term measures they may feel are necessary to meet localised service shortfalls (recognising that the increased number of graduates will not make an effective contribution to the

radiation oncology workforce until 2003).

5. That radiation oncology requirements and supply projections be monitored regularly so that they can be amended if new trends emerge, particularly if the anticipated infrastructure expansion is not met. A full review of the workforce should be conducted again in five years.
6. That this monitoring be coordinated by the Royal Australasian College of Radiologists/Faculty of Radiation Oncology and AMWAC and the results incorporated into the AMWAC annual report to AHMAC. AMWAC will provide all necessary support.

## **DESCRIPTION OF THE CURRENT RADIATION ONCOLOGY WORKFORCE**

As discussed in the Introduction, there is a variety of data sources on the numbers, attributes and distribution of radiation oncologists in Australia. While each of these data collections has some deficiency, it is possible to piece together a reasonably accurate and up-to-date profile of the workforce.

In establishing the profile of the current radiation oncology workforce the Working Party defined:

- the number of radiation oncologists;
- their distribution by State/Territory and geographic location using the RRMA classification;
- age and gender profiles of the workforce;
- the hours worked; and
- the services provided.

### **The Number of Practising Radiation Oncologists**

The data sources used are the records of the RACR/FRO, the AIHW 1995 medical labour force survey and the DHFS Medicare data base.

The RACR/FRO data indicate that in 1997 there were 131 (123.4 FTE) radiation oncologists in Australia.

Medicare data for 1994-95 and 1995-96 identified 130 practising radiation oncologists. This data refers to any specialist who bills Medicare at least once for a given item identified as provided by a radiation oncologist.

The AIHW annual Medical Labour Force Survey reports numbers based on specialists who indicate that they hold a qualification in radiation oncology and who indicate that their main, second or third specialty of practice is in radiation oncology. The 1995 survey identified 132 specialists with a qualification in radiation oncology (122 of whom indicated this was their main qualification). The survey also identified 132 specialists practising in radiation oncology (127 of whom indicated radiation oncology was their main specialty of practice). Six specialists qualified in radiation oncology reported that they were not practising in radiation oncology; their specialties of practice were nuclear medicine (two), general medicine, medical oncology, plastic surgery and occupational medicine.

The data from these three sources are summarised in Table 1.

**Table 1: Number of radiation oncologists (various sources), selected years, 1995-96 to 1997**

<b>RACR (1997)</b>	<b>Medicare (1995-96)</b>	<b>AIHW (1995)</b>
131	130	127*

\* Numbers based on specialists whose main practice is in radiation oncology

Sources: RACR, DHFS, AIHW

Medicare 1995-96 data indicate that 70.8% (92) of radiation oncologists gained their initial qualification in Australia, 15.5% (20) in the United Kingdom/Ireland, 3.8% (5) in New Zealand, 3% (4) in South Africa and 7% (9) in some another country.

### **Growth in the Radiation Oncology Workforce**

Table 2 shows the changes occurring in the radiation oncology workforce since 1984-85. The picture is one of an emerging workforce with substantial growth from a very small baseline.

Between 1988 and 1997 the number of radiation oncologists, according to the RACR/FRO records, has increased from 76 to 131 (a net increase of 55 in eight years with an average increase of seven per year and representing a compound annual increase of 7%).

Medicare data shows that the total number of radiation oncologists billing Medicare increased by 128% from 57 in 1984-85 to 130 in 1995-96 (a compound annual increase of 7.8%). Data from the AIHW survey indicates a workforce increase of 11.4% between 1994-95 and 1995-96.

Population growth between 1984-85 and 1995-96 was 17.4%, an average annual increase of 1.6%.

**Table 2: Number of radiation oncology specialists (various sources), 1984-85 to 1997**

<b>Radiation oncologists</b>	<b>1988</b>	<b>1994</b>	<b>1996</b>	<b>1997</b>	<b>% change 1988-97</b>	<b>% increase per annum</b>	
RACR/FRO	..	76	99	119	131	72.4 <sup>a</sup>	7.0
AIHW	..	..	114	127	-	-	-
	<b>1984-85</b>	<b>1988-89</b>	<b>1994-95</b>	<b>1995-96</b>			
Medicare	57	93	119	130	-	128.1 <sup>b</sup>	7.8

a - Percentage change for years 1988 to 1997; b - Percentage change for the years 1984-85 to 1995-96; .. - no data collected.

Sources: RACR, AIHW, DHFS

Some idea of the growth in the radiation oncology workforce across States and Territories over the past five years can be gained from Table 3 using Medicare data. Medicare data may not reveal the complete workforce but the inclusion criteria are constant and therefore provide an indication of the magnitude of change in the workforce. The data reveal that above average increases have occurred in New South Wales, Victoria and Queensland while the workforce in both South Australia and Tasmania increased by one specialist and the Australian Capital Territory has lost one specialist.

**Table 3: Radiation oncology specialists (Medicare), by State/Territory, 1991-92 and 1995-96**

Year	NSW	Vic	Qld	SA	WA	Tas	ACT	NT	Aust
1991-92	32	30	18	10	9	3	4	-	106
1995-96	41	39	23	11	9	4	3	-	130
% change	6.4	6.8	6.3	2.4	0.0	7.5	-6.9	-	5.2
% pop. increase	0.8	0.4	2.1	0.4	1.2	0.5	1.5	1.2	0.9

Sources: DHFS and ABS

### **Distribution of the Radiation Oncology Workforce**

Table 4 uses Medicare 1995-96 data, RACR/FRO records and AIHW 1995 survey data to examine the distribution of radiation oncologists by State/Territory.

Each data source reveals roughly similar trends. In particular the number of radiation oncologists in New South Wales and Western Australia is below the respective State's population shares, whilst in Victoria, Queensland, South Australia, Tasmania and the Australian Capital Territory the number of radiation oncologists is greater than the respective population shares. There are no specialist radiation oncologists in the Northern Territory.

RACR/FRO data (1997) indicate that 21.7% of radiation oncologists are in New South Wales, well below its share of the population (33.9%) while Victoria has 31.9% of radiation oncologists which is well above its share of the population (24.8%). Western Australia also has a lower share of radiation oncologists (8%) in comparison to its share of the population (9.7%). Queensland has 22.5% of radiation oncologists (18.3% population) and South Australia has 10% (8.1% population). The data for the other States/Territories are reasonably consistent with the data from Medicare, namely, Tasmania with 2.8%, the Australian Capital Territory with 2.2% and the Northern Territory with no radiation oncologists (Table 4).

Medicare data (1995-96) indicate that New South Wales with 33.9% of the Australian population has 31.5% of radiation oncologists, while Victoria with 24.8% of the

population has 30% of radiation oncologists. Comparative figures for the other States and Territories are Queensland 17.7% of radiation oncologists (18.3% population), South Australia 8.5% of radiation oncologists (8.1% population), Western Australia 6.9% radiation oncologists (9.7% population), Tasmania 3.1% radiation oncologists (2.4% population), the Northern Territory has no radiation oncologists (1.0% population) and the Australian Capital Territory has 2.3% of radiation oncologists (1.7% population) (Table 4).

Data from the AIHW 1995 survey (based on specialists whose main practice is radiation oncology), indicate that New South Wales has 33% of the workforce while Victoria has only 22% of the workforce which is eight percentage points lower than indicated by Medicare data and College data. However consistent with the data arising from the other two sources, Western Australia has less than its share of the workforce (7.8% of the radiation oncologists and 9.7% of the population) (Table 4).

Table 4 also uses the 1995-96 Medicare data, the 1997 RACR/FRO data, the 1995 AIHW survey data and ABS (1994) projections for 1996 (series A/B) to examine the distribution of radiation oncologists per head of population.

According to data from Medicare, per 100,000 people, there were 0.71 radiation oncologists for Australia (1:140,063 persons). Two States/Territories had specialist per 100,000 population ratios well below that for Australia as a whole, namely Western Australia and the Northern Territory. States/Territories with above average ratios were Victoria (0.86 per 100,000 population), Tasmania (0.83 per 100,000 population) and the Australian Capital Territory (0.95 per 100,000 population).

The records of the RACR/FRO indicate that in 1997 there are 0.71 radiation oncologists per 100,000 people (1:140,427). Victoria, Queensland, Tasmania and the Australian Capital Territory have above average ratios while Western Australia and New South Wales are below the average with 0.51 per 100,000 population and 0.63 per 100,000 population respectively. According to the AHMAC (1986) report, the ratio for Victoria and Tasmania of 0.83 per 100,000 is the optimal number of radiation oncologists for 1997 based on cancer incidence and population.

The AIHW data indicates that in 1995 there were 0.7 radiation oncologists per 100,000 people (1:141,914 persons) for Australia in 1995. States/Territories with below average ratios were Victoria, Western Australia and Tasmania (Table 4).

**Table 4: Radiation oncologist:population (Medicare, RACR and AIHW), by State/Territory, selected years 1995-96 to 1997**

State/ Territory	Radiation oncologists	% of total radiation oncologists	% of Australian population	Radiation oncologists SPR	Radiation oncologists per 100,000 pop.
<i>Medicare (1995-96)</i>					
NSW	41	31.5	33.9	1:150,220	0.67
Vic	39	30.0	24.8	1:116,149	0.86
Qld	23	17.7	18.3	1:144,200	0.69
SA	11	8.5	8.1	1:134,845	0.74
WA	9	6.9	9.7	1:194,100	0.52
Tas	4	3.1	2.4	1:120,325	0.83
NT	0	0.0	1.0	-	-
ACT	3	2.3	1.7	1:104,733	0.95
<b>Australia</b>	<b>130</b>	<b>100.0</b>	<b>100.0</b>	<b>1:140,063</b>	<b>0.71</b>
<i>RACR/FRO (1997)</i>					
NSW	39	29.8	33.9	1:159,251	0.63
Vic	38	29.0	24.8	1:119,984	0.83
Qld	27	20.6	18.3	1:125,115	0.80
SA	11	8.4	8.1	1:135,573	0.74
WA	9	6.9	9.7	1:196,933	0.51
Tas	4	3.0	2.4	1:121,100	0.83
NT	0	0.0	1.0	-	-
ACT	3	2.2	1.7	1:106,533	0.94
<b>Australia</b>	<b>131</b>	<b>100.0</b>	<b>100.0</b>	<b>1:140,427</b>	<b>0.71</b>
<i>AIHW (1995 - figures based on specialists whose main specialty of practice is radiation oncology)</i>					
NSW	42	33.1	33.9	1:145,438	0.69
Vic	28	22.0	24.8	1:160,743	0.62
Qld	27	21.2	18.3	1:120,581	0.83
SA	12	9.4	8.1	1:122,933	0.81
WA	10	7.8	9.7	1:172,180	0.58
Tas	3	2.4	2.4	1:159,367	0.63
NT	0	0.0	1.0	-	-
ACT	5	3.8	1.7	1:137,730	1.62
<b>Australia</b>	<b>127</b>	<b>100.0</b>	<b>100.0</b>	<b>1:141,914</b>	<b>0.70</b>

Source: DHFS, RACR/FRO, AIHW, ABS

Table 5 uses AIHW 1995 Labour Force Survey data, Medicare data (1995-96) and the RRMA classification to show the distribution of radiation oncologists by geographic location. Of the specialists whose main practice was radiation oncology, 97.5% were located in capital cities and other major urban centres and 1.2% were in large rural centres. Analysis of Medicare data showed a similar distribution pattern. This distribution pattern is consistent with the notion that the distribution of this specialty depends on the availability of megavoltage machines which are limited to locations with large populations and suitable institutional infrastructure.

**Table 5: Distribution of radiation oncologists (AIHW and Medicare), by geographic location, 1995 and 1995-96**

	Number	% of Australia	Major urban centre	Large rural centre	Other rural
Region of main job (AIHW 1995)	128	100	97.5	1.2	1.2
No. of providers (Medicare, 1995-96)	130	100	97.7	2.3	0.0

Sources: AIHW, DHFS

Table 6 uses AIHW (1995) data and the RRMA classification to examine the geographic distribution of radiation oncologists within States/Territories. This Table indicates that most radiation oncologists reside and practice in an urban area. Two States have resident radiation oncologists in non-metropolitan areas, namely Tasmania (50%) and Victoria (6.9%).

**Table 6: Distribution of radiation oncologists (AIHW data), by State/Territory and geographic location, 1995**

State/Territory	Rad. Onc. No.	% of total Radiation oncologists	Major urban centre	% by State/Terr.	Rural centre	% by State/Terr.
NSW	42	32.6	42	100.0	0	0.0
Vic	29	22.5	27	93.1	2	6.9
Qld	27	20.9	27	100.0	0	0.0
SA	12	9.3	12	100.0	0	0.0
WA	10	7.8	10	100.0	0	0.0
Tas	4	3.1	2	50.0	2	50.0
NT	0	0.0	0	0.0	0	0.0
ACT	5	3.9	5	100.0	0	0.0
<b>Australia</b>	<b>129</b>	<b>100.00</b>	<b>125</b>	<b>96.9</b>	<b>4</b>	<b>3.1</b>

Source: AIHW

Table 7 shows that a large number of radiation oncologists are involved in providing

rural outreach services with services being provided to 46 rural areas involving public sector and private sector providers. Responses to the AMWAC (1997) survey of State/Territory health departments revealed that, in addition to providing rural outreach services in Broken Hill, South Australia also provided regular telemedicine and teleconference links with the Royal Darwin Hospital, Port Lincoln and Port Augusta.

Rural outreach radiation oncology services do not involve the provision of radiation treatment. Normally, rural outreach services involve radiation oncologists consulting with newly diagnosed cancer patients to assess their need for radiation treatment and follow-up consultations with patients who have completed a course of radiation treatment. Referral for radiation treatment may be particularly demanding for rural patients because it requires attendance over a period of time in an urban centre with appropriate facilities. On average, patients who require radiation treatment receive 17 treatments which take three to four weeks and which may take up to six to seven weeks.

In their responses to the AMWAC 1997 survey, several States/Territories wrote of the need for improved support for travel and accommodation arrangements for rural residents. In New South Wales the Isolated Patients Travel and Accommodation Assistance Scheme is being reviewed with the intention of improving access for rural patients to metropolitan-based specialist medical facilities.

**Table 7: Rural outreach services provided by radiation oncologists, by State/Territory, 1997**

State/Territory	Location of provider	Location of rural service	Frequency of service
<b>New South Wales</b>	Sydney	Armidale	Fortnightly
	Sydney	Bathurst	Fortnightly
	Sydney	Bowral	3 weekly
	Sydney	Dubbo	Monthly
	Sydney	Goulburn	3 weekly
	Sydney	Griffith	2 clinics in 3 weeks
	Sydney	Orange	Fortnightly
	Sydney	Tamworth	Weekly
	Sydney	Wagga Wagga	Weekly
	Sydney <sup>a</sup>	Bathurst	Monthly
	Sydney <sup>a</sup>	Coffs Harbour	Monthly
	Sydney <sup>a</sup>	Inverell	Monthly
	Sydney <sup>a</sup>	Nowra	Fortnightly
	Sydney <sup>a</sup>	Orange	Monthly
	Sydney <sup>a</sup>	Orange	Monthly
	Sydney <sup>a</sup>	Port Macquarie	Monthly
	Gosford <sup>a</sup>	Wyong	Fortnightly
<b>Victoria</b>	Melbourne	Albury	Fortnightly
	Melbourne	Bendigo	Fortnightly
	Melbourne	Dandenong	Weekly
	Melbourne	Frankston	Twice per week
	Melbourne	Rosebud	Fortnightly
	Melbourne	Traralgon	Monthly
	Melbourne	Wangaratta	Monthly
	Geelong	Ballarat	Weekly
Geelong	Warnambool	Fortnightly	
<b>Queensland</b>	Brisbane	Bundaberg	Fortnightly
	Brisbane	Charleville	6 monthly
	Brisbane	Coffs Harbour	Monthly
	Brisbane	Gold Coast	Weekly
	Brisbane	Longreach	6 monthly
	Brisbane	Mt Isa	3 monthly
	Brisbane	Maryborough	Monthly
	Brisbane	Rockhampton	Fortnightly
	Brisbane	Toowoomba	Monthly
	Brisbane <sup>a</sup>	Lismore	Fortnightly
	Brisbane <sup>a</sup>	Grafton	Monthly
	Brisbane <sup>a</sup>	Coffs Harbour	Monthly
	Townsville	Cairns	Weekly
	Townsville	Mackay	Weekly
<b>South Australia</b>	Adelaide	Broken Hill	Bi-monthly
<b>Western Australia</b>	Perth <sup>a</sup>	Bunbury	Fortnightly
	Perth <sup>a</sup>	Busselton	Monthly
	Perth	Geraldton	2 monthly
	Perth	Kalgoorlie	3 monthly
	Perth	Northam	3 monthly
<b>Tasmania</b>	Launceston	Ulverstone/Burnie	Fortnightly
<b>ACT</b>	Canberra <sup>a</sup>	Bega	Monthly
	Canberra <sup>a</sup>	Moruya	Monthly

a - Outreach clinics provided by private clinics; b - South Australia also provides regular telemedicine and teleconference links with the Royal Darwin Hospital, Port Lincoln and Port Augusta

Source: RACR/FRO, NSW Health Department

## Age Profile

According to the records of the RACR/FRO, the average age of radiation oncologists is 44.4 years. The largest ten year age group are radiation oncologists aged between 35 and 44 years (43.5%). Only 9.2% of radiation oncologists are aged over 55 years and 9.9% are aged under 35 years.

**Table 8: Age profile of radiation oncologists (RACR), by age group and State/Territory, 1997**

State/Territory	< 35 yrs	35-44yrs	45-54 yrs	55-64 yrs	65 yrs & over	Average age (yrs)
NSW	9	13	13	1	3	43.6
Vic	2	18	14	4	0	44.8
Qld	1	15	10	1	0	43.4
SA	0	5	6	0	0	45.9
WA	1	5	2	1	0	43.4
Tas	0	0	2	1	1	50.8
ACT	0	1	2	0	0	48.0
<b>Australia</b>	<b>13</b>	<b>57</b>	<b>49</b>	<b>8</b>	<b>4</b>	<b>44.4</b>

Source: RACR /FRO

According to the AIHW (1995) survey, the average age of radiation oncologists was 46.3 years with substantial variation among State/Territories. The average age of radiation oncologists in South Australia was 56 years and in Western Australia it was 52 years. The largest age group was specialists aged 35 to 44 years (39.7%). 10.4% of radiation oncologists were aged 65 years and over. Three States had above average percentages of radiation oncologists aged 65 years and over, namely South Australia (37.9%), Western Australia (21.5%) and Victoria (13.5%) (Table 9).

**Table 9: Age profile of radiation oncologists (AIHW), by age group and State/Territory, 1995**

State/Terr.	< 35 yrs	35-44 yrs	45-54 yrs	55-64 yrs	65-74 yrs	Average age (yrs)	% aged 65 yrs & over
NSW	7	16	13	2	3	44.3	6.1
Vic	0	10	13	1	4	47.5	13.5
Qld	1	14	10	2	0	44.1	0.0
SA	0	2	5	1	5	56.0	37.9
WA	0	4	2	2	2	51.8	21.5
Tas	0	3	0	0	0	41.0	0.0
ACT	0	1	3	0	0	46.0	0.0
<b>Australia</b>	<b>9</b>	<b>50</b>	<b>46</b>	<b>9</b>	<b>13</b>	<b>46.3</b>	<b>10.4</b>
% age group	7.1	39.4	38.6	7.1	10.1	..	..

Source: AIHW

Table 10 uses Medicare data and shows that throughout Australia, 47.7% of radiation oncologists were aged 45 years and over in 1995-96 (the numbers were too small for Medicare to disclose data on those aged 55 years and over). States/Territories with an above average number of radiation oncologists aged over 45 years were South Australia (72.7%), Victoria (56.4%), Western Australia (55.6%) and Tasmania (50%).

**Table 10: Age profile of radiation oncologists (Medicare), by age group and State/Territory, 1995-96**

State/Territory	< 45 yrs %	45 yrs & over %	Unknown %	Total %
NSW/ACT	53.7	34.1	12.2	100.0
Vic	35.9	56.4	7.7	100.0
Qld	56.5	39.1	4.3	100.0
SA/NT	27.3	72.7	-	100.0
WA	44.4	55.6	-	100.0
Tas	50.0	50.0	-	100.0
<b>Australia</b>	<b>45.4</b>	<b>47.7</b>	<b>6.9</b>	<b>100.0</b>

Source: DHFS

### Gender Profile

Data from the RACR/FRO show that in 1997, 23% of radiation oncologists were women. Medicare data indicate that in 1995-96, 21.5% of radiation oncologists were women.

AIHW data indicate that in 1995, 74.7% of radiation oncologists were men and 25.3% were women.

This level of female representation is slightly below the average for all clinicians (27.2%) and well above the average for all specialists (14.0%) (AIHW, 1997).

According to RACR/FRO records Victoria (15.8%) has a lower than average representation of women while South Australia (36.4%) and Queensland (29.6%) have a higher than average representation. (Table 11).

**Table 11: Percentage of radiation oncologist who are women (RACR), by State/Territory, 1997**

NSW	Vic	Qld	SA	WA	Tas	ACT	Total
20.5	15.8	29.6	36.4	22.2	25.0	33.3	22.9

Source: RACR/FRO

Table 12 uses data from the AIHW survey (1995) to examine the age and gender profile of the radiation oncology workforce. Of note is the large representation of women in specialists aged over 65 years and in those aged under 35 years.

**Table 12: Age and gender of radiation oncologists (AIHW data), 1995**

Gender	<35 yrs	35-44 yrs	45-54 yrs	55-64 yrs	65 + yrs	Total
Male %	66.6	76.0	73.9	100.0	61.5	<b>74.8</b>
Female %	33.4	24.0	26.1	0.0	38.5	<b>25.2</b>
<b>Total</b>	<b>9</b>	<b>50</b>	<b>46</b>	<b>9</b>	<b>13</b>	<b>127</b>

Source: AIHW

Data from Medicare provide a similar picture to that obtained from the AIHW survey (Table 13).

**Table 13: Age and gender of radiation oncologists (Medicare), 1995-96**

Gender	<35 yrs	35-44 yrs	45 yrs & over	Total
Male %	70.0	75.0	82.1	<b>78.5</b>
Female %	30.0	25.0	17.9	<b>21.5</b>
<b>Total</b>	<b>10</b>	<b>44</b>	<b>67</b>	<b>130</b>

Source: DHFS

Data from the RACR/FRO indicate that a small percentage of men and women are choosing to work part-time (Table 14).

**Table 14: Total number of radiation oncologists compared with the number of full-time equivalents, by gender (RACR/FRO), 1997**

State/Territory	Males		Females		Workforce	
	Total	FTE	Total	FTE	Total	FTE
NSW	31	30.0	8	7.1	39	37.1
Vic	32	30.5	6	6.8	38	37.3
Qld	19	19.0	8	5.5	27	24.5
SA	7	6.0	4	3.1	11	9.1
WA	7	7.0	2	2.0	9	9.0
Tas	3	2.4	1	1.0	4	3.4
ACT	2	2.0	1	1.0	3	3.0
<b>Total</b>	<b>101</b>	<b>96.9</b>	<b>30</b>	<b>26.5</b>	<b>131</b>	<b>123.4</b>

Source: RACR/FRO

The AMWAC/AIHW report *Female Participation in the Australian Medical Workforce* reported that the proportion of female specialists to male specialists under the age of 40 years is much higher than for the workforce as a whole. It was estimated that these specialists will, on average, work shorter hours, contribute fewer FTEs to the workforce and retire on average at least five years earlier than male specialists. In hours, the life time contribution of female specialists was estimated to be around 75% of a male specialist across all specialties. It was concluded that shortages in some specialties could be exacerbated in the future as specialist Colleges increase the number of female trainees and that increases in the number of training placements may be needed to offset the decreased lifetime workforce contribution by female specialists (AMWAC & AIHW, 1996b).

### Hours Worked

Radiation oncologists work on average, 50.1 hours per week and spend 42.3 hours per week on direct patient care (AIHW, 1995 survey). According to the AIHW survey, 49.4% of radiation oncologists report being on call with all on-call practitioners located in a major urban centre.

Table 15 shows that the majority (83.3%) of radiation oncologists work between 35 to 64 hours in total per week. 8.6% of radiation oncologists work more than 64 hours per week and 8% work less than 35 hours per week.

Seventy eight percent of radiation oncologists work between 35 to 64 hours per week on direct patient care, 2.2% work more than 64 hours per week on direct patient care and 22.2% work less than 35 hours per week on direct patient care (Table 19).

**Table 15: Average hours worked per week by radiation oncologists (AIHW), by percentage of the workforce, 1995**

Hours	<35 hours	35-49 hours	50-64 hours	65 hours & over	Total
<i>Total hours worked</i>					
% of workforce	8.1	40.5	42.8	8.6	100.0
<i>Direct patient care hours worked</i>					
% of workforce	22.2	48.1	27.6	2.2	100.0

Source: AIHW

Data from the AIHW survey indicate that there is substantial variation between States/Territories in the hours worked by radiation oncologists with practitioners in Tasmania, New South Wales and the Australian Capital Territory working up to 20 hours more per week than the average for all practitioners (Table 16).

**Table 16: Average hours worked per week by radiation oncologists (AIHW), by State/Territory, 1995**

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT	Average
Total hours worked	52.0	45.2	47.4	47.4	45.7	69.5	51.3	0.0	49.2
Direct patient care hours worked	42.9	40.4	38.7	38.6	40.6	60.5	44.0	0.0	41.7

Source: AIHW

Table 17 indicates that radiation oncologists in rural areas work more hours per week on average than do specialists in major urban centres.

**Table 17: Average hours worked per week by radiation oncology specialists (AIHW), by geographic location, 1995**

	Major urban centre	Rural/remote area	Total
Total hours worked	49.9	55.0	50.1
Direct patient care hours worked	42.2	47.5	42.3

Source: AIHW

Data from the AIHW 1995 survey indicate that on average, female radiation oncologists work 8.3 hours less per week than do male radiation oncologists. Women in the under 35 year age group work, on average, 16.5 hours less per week than their male

colleagues and women aged between 35 to 54 years work, on average, six hours less per week. However, with respect to direct patient care hours worked, the differential between males and females is considerably less in the age group 35 to 54 years (ie., a difference of four hours) (Table 18).

**Table 18: Radiation oncology specialists average hours worked per week, by gender and age group (AIHW), 1995**

Gender	<35 yrs	35-44 yrs	45-54 yrs	55-64 yrs	65 yrs & over	Total
<i>Total hours worked</i>						
Male	56.5	50.4	53.5	49.8	40.0	51.2
Female	40.0	44.9	47.1	0.0	18.0	42.9
<b>Total</b>	<b>51.0</b>	<b>49.0</b>	<b>52.1</b>	<b>49.8</b>	<b>33.7</b>	<b>49.2</b>
<i>Direct patient care hours worked</i>						
Male	47.5	41.8	44.7	41.0	42.0	43.4
Female	30.0	37.7	41.9	0.0	15.5	36.2
<b>Total</b>	<b>41.7</b>	<b>40.8</b>	<b>44.0</b>	<b>41.0</b>	<b>33.2</b>	<b>41.7</b>

Source: AIHW

Table 19 uses Medicare data (1995-96) to examine trends in the gender distribution and full-time/part-time working status of the workforce. The data indicate that since 1984-85 the number of women radiation oncologists has increased from 10.9% to 21.5%. In addition the data reveal that in 1985-86, 57% of female radiation oncologists worked part-time compared with 19.6% of male radiation oncologists. In 1995-96 32% of female radiation oncologists were working part-time compared with 17.6% of male radiation oncologists.

**Table 19: Gender profile of the radiation oncology workforce, by full-time/part-time practice (Medicare), 1985-86 to 1995-96**

Year	% male	% part-time	% female	% part-time	% workforce part-time
1985-86	87.5	19.6	10.9	57.1	23.4
1987-88	87.5	22.6	12.5	41.7	25.0
1990-91	82.0	23.2	18.0	44.4	27.0
1993-94	80.5	22.0	19.5	40.9	25.7
1995-96	78.5	17.6	21.5	32.1	20.8

Source: DHFS

The RACR/FRO survey revealed that, on average, radiation oncologists work 52 hours per week; 38 hours in clinical activities, five hours on administration, two hours teaching, four hours on self education and two hours on research. Most of this activity occurs at their place of work with some self education done at home.

### **Work Setting**

Radiation oncology treatment in Australia is provided in a variety of institutional settings, including:

- departments of radiation oncology in public teaching hospitals which have varying levels of integration with other cancer treatment services;
- a public teaching hospital devoted exclusively to the provision of cancer treatment services;
- private radiation oncology facilities in a private hospital providing integrated cancer services; and
- free standing private radiation oncology facilities (AHTAC, 1996).

A survey of radiation oncologists by Stevens and Berry in 1995 asked respondents about their current practice and found that 84 (77%) were employed as staff specialists, 11 (10%) were VMOs, nine (8%) had some other position, and five (5%) did not answer this question. 67 (61%) of survey respondents worked in only one institution, 31 (28%) worked in two institutions and seven (6%) worked in three institutions. With respect to their main place of work, 94 (84%) worked in a public institution and 14 (13%) worked in a private institution. In terms of their second place of work, seven specialists worked in a public institution and 24 worked in a private institution. Of radiation oncologists working in a third institution, four worked in a public institution and three worked in a private institution.

The AIHW survey indicates that in 1995, 59% of radiation oncologists had their main job in an acute care public hospital, 33.9% had their main job in private rooms and the remaining 7% had their main job in some other setting. When asked about the setting of all jobs, a similar pattern emerged with respect to public acute care hospitals and private rooms. However, 5.5% of radiation oncologists indicated they also worked in an acute care private hospital and 16.8% indicated they work in some other work setting.

Table 20 uses AIHW data to report the work setting of radiation oncologists by State/Territory. This data indicate that there is substantial variation among States/Territories in work setting of radiation oncologists. For example, in New South Wales, 86% of radiation oncologists work in an acute care public hospital while in Victoria only 52.8% work in this type of setting. In Queensland, the percentage of radiation oncologists working in private rooms is lower (22.3%) than the average for Australia (42.7%) while 33% of specialists in this State work in other settings which is well above the average for Australia (16.8%).

**Table 20: Work setting of radiation oncologists (AIHW), main job and all jobs, by State/Territory, 1995**

State/Territory	Private rooms	Acute care public hospital	Acute care private hospital	Other work settings	Total
<i>Work setting of main job</i>					
NSW	13	25	-	4	42
Vic	13	15	-	0	28
Qld	6	16	-	5	27
SA	5	7	-	0	12
WA	4	6	-	0	10
Tas	2	2	-	0	3
ACT	0	5	-	0	5
NT	0	0	-	0	0
<b>Australia</b>	<b>43</b>	<b>75</b>	<b>-</b>	<b>9</b>	<b>127</b>
<i>Work settings of all jobs (% of total)</i>					
NSW	49.7	86.1	8.4	24.7	-
Vic	47.2	52.8	5.1	0.0	-
Qld	22.3	63.0	0.0	33.7	-
SA	56.4	69.1	0.0	0.0	-
WA	40.1	79.9	20.1	20.1	-
Tas	100.0	50.0	0.0	0.0	-
ACT	0.0	100.0	0.0	0.0	-
NT	0.0	0.0	0.0	0.0	-
<b>Australia</b>	<b>42.7</b>	<b>71.3</b>	<b>5.5</b>	<b>16.8</b>	<b>-</b>

Source: AIHW

### Services Provided

Radiation oncologists are involved with the clinical care of patients with cancer, both inpatients and outpatients, as well as with the technical aspects of the prescription and supervision of a course of radiotherapy. Most radiotherapy treatments are for cancer and most services are provided on an ambulatory basis by public hospital outpatient departments. However, 25% to 30% of services are provided in private facilities.

The options for treating cancer include surgery, radiotherapy and chemotherapy. Modern management involves the appropriate integration of all these modalities according to the type of cancer, the extent of disease and the condition of the patient. A

radiation oncologist may be involved with the care of cancer patients from soon after diagnosis or in the later phase of a patient's care, when there is wide spread cancer. Radiation oncologists consult with patients about the treatment options for cancer. If radiotherapy is to be used, the radiation oncologist designs, prescribes and supervises the course of treatment. Radiotherapy may be used for cure or it may be used for palliation of metastatic disease for relief of symptoms. The delivery of a course of radiotherapy is highly technical and involves a team of health professionals, including, radiation oncologists, radiation therapists (radiographers) and radiation physicists.

Referrals more commonly come from surgeons, haematologists, medical oncologists and palliative care providers and less frequently from general practitioners.

Stevens and Berry (1995) found that 36% of radiation oncologists supervised the administration of cytotoxic chemotherapy. Table 21 summarises the percentage of clinical time radiation oncologists spend on treating people with different types/sites of cancer and the percentage who attend regular multi-disciplinary meetings as part of the associated treatment program. Three types/sites of cancer account for approximately 50% of radiation oncologists' clinical time, namely, breast cancer (24.5%), urology (14.5%) and head/neck cancers (10.5%).

**Table 21: Percentage of total clinical time spent on selected activities and percentage of radiation oncologists who attend regular multidisciplinary meetings, 1997**

Type/site of cancer	Mean percentage of clinical time	Percentage attending multidisciplinary meetings
Breast	24.5	53.0
Urology	14.5	32.0
Head/neck	10.5	44.0
Thoracic	9.2	29.0
Gastro intestinal tract	8.2	21.0
Palliative care	6.3	13.0
Gynaecology	5.3	28.0
Haematology	4.9	21.0
Central nervous system	4.5	15.0
Skin/melanoma	4.3	17.0
Musculoskeletal	1.8	10.0
Paediatrics	1.6	13.0
Other	2.8	6.0

Source: Stevens and Berry (1995)

Currently, there is no national data system, similar to that for acute care hospital inpatient casemix, which reports trends in ambulatory service provision. As a result the Working Party has been restricted to examining data on the number of radiation oncology services provided using Medicare data and data on the number of new courses of radiotherapy treatment and patient attendances reported in the AHTAC report. Medicare data does not include data on radiation oncologists who are salaried in the public hospital system and who do not render services to private patients on a fee for service basis. Medicare data thus excludes services rendered free of charge to public hospital patients and services provided to Veterans' Affairs patients.

### *Medicare Services*

Table 22 reveals that 92.6% of the Medicare services provided in 1995-96 by radiation oncologists were outpatient services while 7.4% were hospital inpatient services. On average, in 1995-96 each radiation oncologist provided 4,053 Medicare services (3,811 out-of-hospital and 342 in-hospital).

Between 1991-92 to 1995-96, the total number of Medicare services provided by radiation oncologists increased by 47.6% (10.2% compound annual increase) with some of this change associated with an increase in the number of providers (a compound annual increase of 5.8%) and some associated with an increase in the number of services per provider (a compound annual increase of 4.2%). However, while there was an increase in the total number of services there was a decrease of 15.8% (4.2% compound annual decrease) in the number of Medicare services provided in-hospital. At the same time the number of out-of-hospital services increased by 56.9% (11.9% compound annual increase) (Table 22).

**Table 22: Radiation oncology specialists, Medicare Benefits Schedule item trends, 1991-92 to 1995-96**

<b>Location of service</b>	<b>1991-92</b>	<b>1992-93</b>	<b>1993-94</b>	<b>1994-95</b>	<b>1995-96</b>	<b>% increase*</b>
<i>In-hospital services</i>						
- Number of providers	98	99	104	110	117	4.5
- Services provided	47,509	45,641	41,395	37,075	40,026	-4.2
<i>Out of hospital services</i>						
- Number of providers	107	103	113	121	132	5.4
- Services provided	320,479	339,542	390,864	452,982	503,028	11.9
<i>Total services</i>						
- Number of providers	107	104	113	122	134	5.8
- Services provided	367,988	385,183	432,259	490,057	543,054	10.2
- Services per provider	3,439	3,704	3,825	4,017	4,053	4.2

\* - compound annual increase

Source: DHFS

Table 23 examines trends in the provision of radiation oncology services by five Medicare Benefits Schedule (MBS) item subgroups, namely, superficial (MBS items 15000 to 15012), orthovoltage (MBS items 15100 to 15115), megavoltage (MBS items 15203 to 15214), brachytherapy (MBS items 15303 to 15357) and computerised planning (MBS items 15500 to 15536).

Between 1985-86 and 1995-96, there was a 154% increase in the provision of Medicare radiation oncology services, representing a compound annual increase of 8.9%. Among the five radiation oncology subgroups of MBS items, the largest compound annual increases occurred in computerised planning (9%) and megavoltage (8.4%). The only subgroup in which a decrease occurred was orthovoltage, which decreased by 51.6% (a per annum decrease of 3.9%) (Table 23).

**Table 23: Radiation oncology Medicare Benefits Schedule services provided, 1985-86, 1992-93 and 1995-96**

MBS item	1985-86	1992-93	1995-96	% Change 1985-86 to 1995-96	Per annum increase %
Subgroup 1: Superficial <sup>a</sup>	10,338	12,524	10,688	3.39	0.01
Subgroup 2: Orthovoltage <sup>b</sup>	5,092	2,989	2,467	-51.6	-3.90
Subgroup 3: Megavoltage <sup>c</sup>	136,904	262,759	365,694	167.1	8.42
Subgroup 4: Brachytherapy <sup>d</sup>	309	343	426	37.9	1.87
Subgroup 5: Computerised Planning <sup>e</sup>	..	24,377	35,408	45.3*	9.02
All other items <sup>f</sup>	60,144	82,945	124,443	106.9	10.7
<b>Total items</b>	<b>214,106</b>	<b>385,913</b>	<b>544,036</b>	<b>154.0</b>	<b>8.85</b>

Notes: a - MBS items 15000 to 15012; b - MBS items 15100 to 15115; c - MBS items 15203 to 15214; d - MBS items 15303 to 15357; e - MBS items 15500 to 15536; f - MBS items 1 to 13,939 and 16000 to 73806.

Source: DHFS

Table 24 indicates that, on average, 2,302 major radiation oncology MBS services were provided per 100,000 population in 1995-96. States/Territories with an above average number of services were Tasmania, the Australian Capital Territory, Victoria, South Australia and New South Wales, while the remaining States/Territories had a below average number of Medicare services. These differences in level of MBS service provision may reflect differences in the billing practices within each State/Territory.

**Table 24: Number of major radiation oncology Medicare Benefits Schedule items per 100,000 population provided by radiation oncologists, by State/Territory, 1995-96**

NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Total
2,551.2	2,319.5	1,646.8	2,725.4	2,178.4	3,109.7	0.0	2,828.8	2,302.0

Source: DHFS and ABS

Table 25 examines trends in the provision of Medicare services by geographic location. These data indicate that between 1990-91 and 1995-96 there was an overall increase in the population of 5.8%, an increase of 40.8% in the number of patients per 100,000 population receiving services from radiation oncologists and an increase of 43.8% in the number of services provided per 100,000. During this same period of time the number of providers per 100,000 population increased by 22.9% and the number of services per provider increased by 17% with little change in the number of services per patient.

The data presented in Table 25 also reveal that in 1995-96, rural patients received 27% fewer services per 100,000 population than did people located in capital cities and 42.8% fewer services per 100,000 population than people located in other metropolitan areas.

**Table 25: Medicare services provided by radiation oncologists, by geographic location, 1995-96**

Location of service	1990-91	1993-94	1995-96	% change since 1990-91
<i>Capital city</i>				
- Population	10,985,449	11,271,987	11,594,374	5.5
- Patients per 100,000 pop.	302	358	414	37.0
- Services per 100,000 pop.	2185	2592	3,099	41.8
- Services per patient	7.23	7.25	7.48	3.5
<i>Other metropolitan</i>				
- Population	1,262,397	1,328,421	1,375,839	9.0
- Patients per 100,000 pop.	369	456	491	32.9
- Services per 100,000 pop.	3,316	3,415	3,928	18.5
- Services per patient	8.98	7.49	8.01	-10.9
<i>Rural</i>				
- Population	5,036,190	5,237,993	5,318,885	5.6
- Patients per 100,000 pop.	208	308	324	55.7
- Services per 100,000 pop.	1,353	2,009	2,247	66.1
- Services per patient	6.51	6.52	6.94	6.7
<b>Total</b>				
- Population	17,284,036	17,838,401	18,289,098	5.8
- Providers per 100,000	0.60	0.63	0.73	22.9
- Patients per 100,000 pop.	280	350	394	40.8
- Services per 100,000 pop.	2,025	2,482	2,913	43.8
- Services per patient	7.24	7.08	7.40	2.2
- Services per provider	3,399	3,918	3,976	17.0

Source: DHFS

### *Megavoltage Machines and Megavoltage Treatments*

Table 26, indicates that in 1996 there were 87 megavoltage machines throughout Australia, with 1.4 radiation oncologists per megavoltage machine. Victoria, with 1.7 radiation oncologists to one megavoltage machine is above the average for Australia as a whole, namely 1.4:1 and Western Australia is well below the average with 1.1:1. The RACR/FRO advised the Working Party that the optimal ratio of radiation oncologists to megavoltage machines is 1.6:1.

**Table 26: Radiation oncologists per megavoltage machine, by State/Territory (AHTAC), 1996**

State/Territory	Radiation oncologists	Megavoltage machines	Ratio RO: 1 Megavoltage machine
NSW/ACT	38	31	1.2
Vic	35	21	1.7
Qld	24	16	1.5
SA	10	8	1.3
WA	9	8	1.1
Tas	3	3	1.0
<b>Australia</b>	<b>119</b>	<b>87</b>	<b>1.4</b>

Source: Data derived from the NHMRC AHTAC report, 1996 (p 46)

Table 27 indicates considerable variation between States/Territories in the rate of growth in the number of megavoltage machines during the last eight years. The end result of this differential pattern of change is that in 1996 the number of machines per million population is reasonably consistent across States/Territories apart for the Northern Territory, which has no machines and Tasmania which is more generously endowed with three machines. New South Wales and the Australian Capital Territory have 31 machines, Victoria 21, Queensland 16 and both South Australia and Western Australia 8 (AHTAC 1996).

**Table 27: Growth in the number of megavoltage machines, by State/Territory, 1996**

State	1988	1990	1992	1994	1996	% change 1988 to 1996	Compound annual increase %
NSW/ACT	21	19	22	26	31	47.6	5.7
Vic	8	9	11	16	21	162.5	14.8
Qld	6	8	10	12	16	233.3	15.0
SA	4	6	8	8	8	100.0	10.4
WA	5	6	7	7	8	60.0	6.9
Tas	2	2	2	2	3	50.0	6.0
<b>Australia</b>	<b>46</b>	<b>50</b>	<b>60</b>	<b>71</b>	<b>87</b>	<b>89.1</b>	<b>9.5</b>

Source: AMWAC using data derived from the NHMRC AHTAC report, 1996 (p 46)

Table 28 draws on the AHTAC report to examine trends in the provision of megavoltage treatments. These data indicate that between 1988 and 1995 there was a 49.3% increase in the number of new courses of treatment (a per annum increase of 5.9%), a 51.8% increase in the number of patient attendances (a per annum increase of 6.1%), a decrease of 15% in the number of courses per machine (a per annum decrease of 2.3%) and little change in the number of attendances per course of treatment and in the number of fields per patient attendance.

**Table 28: Summary of statistics of megavoltage treatments in Australia , 1988 to 1995**

Service indicators	1988	1990	1992	1994	1995	% change 1988-1995
Number of new courses	23,379	27,955	30,194	33,340	34,915	5.9
Number of attendances	408,678	445,129	501,806	557,509	620,460	6.1
Number of fields	1,101,982	1,114,087	1,248,928	1,515,607	1,625,383	5.7
Number of courses per machine	508	560	503	470	431	-2.3
Number of attendances per course	17.5	15.9	16.6	16.7	17.7	0.2
Number of fields per attendance	2.7	2.5	2.5	2.7	2.6	-0.5

Source: AMWAC using data derived from the NHMRC AHTAC report, 1996 (p 46)

The AHTAC (1996) report notes that differences between States/Territories exist in the limitation of cancer treatment services to selected institutions. For example, public radiation oncology facilities are confined to a single facility in the Australian Capital

Territory, while in Tasmania services are provided at two hospitals. In South Australia, services are provided in one teaching hospital and one private facility. In New South Wales, services are provided independently in nine teaching hospitals and four private facilities. In Victoria, services are provided at two major centres, four other teaching hospitals and two private facilities. Queensland has three public and two private radiation oncology facilities. Western Australia has one public sector facility and two private facilities. Furthermore, the report notes that some radiation oncology facilities are free-standing and some are integrated with other services with a trend towards consultations being undertaken in outreach clinics. Table 29 provides a summary of the distribution of radiotherapy equipment in use in Australia as at June 30, 1996.

**Table 29: Summary of radiotherapy equipment in use in Australia (RACR), 1996**

Type of radiotherapy equipment	NSW/ACT	Vic	Qld	SA	WA	Tas	Total
Superficial/Orthovoltage	12	5	3	2	3	2	<b>27</b>
Cobalt-60 units	1	1	0	1	0	0	<b>3</b>
Linear accelerators							
- <i>SPLA</i>	15	8	8	4	4	1	40
- <i>DMLA</i>	15	12	8	3	4	2	44
Simulators	14	8	7	1	4	2	<b>36</b>
- ( <i>with CT</i> )	(4)	(3)	(1)	(0)	(2)	(0)	(10)
Computerised planning systems	17	15	7	3	4	2	<b>48</b>
- ( <i>+ CT interfacing</i> )	(12)	(11)	(5)	(2)	(4)	(2)	(36)
Brachytherapy	10	7	4	1	1	2	<b>25</b>
- <i>Manual after loading</i>	0	0	0	0	1	2	3
- <i>LDR</i>	3	4	2	1	0	0	10
- <i>HDR</i>	5	2	2	0	0	0	9
- <i>PDR</i>	2	1	0	0	0	0	3
On-line portal imaging	6	5	0	1	1	0	<b>13</b>

Notes: SPLA - single photon linear accelerator, DMLA - dual modality linear accelerator, LDR - low dose radiotherapy, PDR - pulsed dose radiotherapy.

Source: NHMRC AHTAC report, 1996 (p 45)

### Training Arrangements

Responsibility for specialist radiation oncology training lies with the Royal Australasian College of Radiology. The College will accredit for training purposes any radiation oncology department which treats as a minimum 800 to 1000 patients per annum and complies with other requirements such as provision of a suitably equipped library and a hospital setting which includes access to pathology, radiology and major surgery.

The FRACR training program in radiation oncology is a five year program which commences at the end of the intern year and which most trainees take approximately six years to complete. The training program aims for competence in radiation oncology and also an understanding of the role of a number of cancer associated areas such as surgery, chemotherapy, palliative care and haematology.

Trainees must pass two examinations. The Part 1 examination may be taken during the trainees' first year, but normally this is deferred until the second year, which is the usual entry point to the training program. The Part 1 examination is usually taken in the August of that year or the following February. The Part 2 examination cannot be attempted until at least three years have elapsed from passing Part 1 and is usually taken in the fifth and final year of training.

The first year of training is usually spent in a general medical/surgical rotation with the restriction that no more than three months can be spent in several areas including medical oncology or clinical haematology. The organisation of training of radiation oncologists varies between States, but in New South Wales there is a monthly day release course organised for Part II candidates rotating through all departments, including private practices. The College also organises a long weekend pre-part II examination course. The course is held each year, rotating between Brisbane, Sydney and Melbourne, and is well attended.

The recent increase in female graduates in medicine has resulted in the College recognising part-time or shared training positions, although at present only one or two of these exist.

There are no rural departments of radiation oncology. However, there are departments in non-capital city centres of Geelong, Newcastle, Wollongong, Launceston and Townsville. Most of the exposure of trainees to rural practice occurs when they attend outreach country clinics.

As at June 1997, there were 52 accredited training posts and five non-accredited posts with 57 trainees in Australia (Table 30). One of these trainees was a United Kingdom trained doctor.

**Table 30: Radiation oncology training positions (RACR), by hospital and by State/Territory, 1997**

State	Area/hospital	Accredited training posts
<i>New South Wales/ACT</i>		24
	Liverpool	2
	Newcastle Mater	2
	Prince of Wales	5
	Royal North Shore	2
	Royal Prince Alfred	3
	St George	2
	St Vincents	3
	Westmead	4
	Wollongong	
	Canberra	1
<i>Victoria/Tasmania</i>		14
	Alfred	2
	Geelong	1
	Peter MacCallum Institute	11
<i>Queensland</i>		6
	Queensland Radium Institute, Brisbane	6
<i>South Australia</i>		4
	Royal Adelaide	4
<i>Western Australia</i>		4
	Sir Charles Gardiner	4
<b>Total</b>		<b>52</b>

Source: RACR/FRO

Table 31 indicates that between 1988 and 1997, the number of radiation oncology trainees increased from 35 to 52 (an overall increase of 48.6 representing a 5.4% average annual increase) with a large proportion of the growth in New South Wales.

Table 31 also shows that the distribution of the radiation oncology trainees by State/Territory is not altogether consistent with the distribution of the population. New South Wales/Australian Capital Territory have a proportion of trainees higher than that of the general population, although it should be remembered that New South Wales currently has a comparatively lower number of specialist radiation oncologists compared to population (Table 4). Queensland, Western Australia and South Australia have trainee proportions lower than their respective population shares. There are no training posts or trainees in Tasmania or the Northern Territory.

**Table 31: Radiation oncology trainees in accredited posts (RACR), by State/Territory, 1989 to 1997**

Year	NSW/ACT	Vic	Qld	SA	WA	Aust
1988	14	10	5	3	3	35
1990	19	4	3	3	3	32
1992	22	10	5	4	3	44
1994	21	9	5	4	2	41
1995	23	10	5	4	3	45
1997	24	14	6	4	4	52
% increase 1988 -1996	71.4	40.0	20.0	33.3	33.3	48.5
% 1997 trainees	46.2	26.9	11.5	7.7	7.7	100.0
% population <sup>a</sup>	35.5	25.0	18.2	8.1	9.6	100.0

a - population is an estimate for 1995-96

Source: RACR and ABS

Table 32 outlines the age, gender and training status of the 52 RACR/FRO 1997 trainees by State/Territory. The average age of radiation oncology trainees is 31 years, 35% of trainees are women. The RACR/FRO estimates that the attrition rate among trainees is 13.9%.

**Table 32: Age, gender and training status of trainee radiation oncologists (RACR), by State/Territory, 1997**

	NSW/ACT	Vic	Qld	SA	WA	Australia
Average age	30	30	32	31	30	31
% Female	37.9	35.7	16.7	25.0	50.0	35.1
Year of training						
- 1st year	4	4	2	1	2	13
- 2nd year	7	2	3	0	0	12
- 3rd year	8	2	0	1	1	12
- 4th year	4	4	1	2	0	11
- 5th year	1	2	0	0	1	4

Source: RACR/FRO

The average age of acquisition of the FRACR is 34 years. There is some expectation that this age may tend to rise, especially with the advent of graduate-entry medical courses; although it will be some ten years before this possibility would start to have any effect.

Table 33 shows that over the past seven years, on average, seven trainees have completed the training program each year; ranging from a high of 11 trainees in 1994 to a low of three trainees in 1991 and 1996. Over the next three years it is expected that annual training program completions will average ten.

**Table 33: Radiation oncology trainees training program completions (RACR), 1992 to 2002**

Year	NSW/ACT	Vic	Qld	SA	WA	Total
1990	3	2	2	0	1	8
1991	0	3	0	0	0	3
1992	2	0	2	1	0	5
1993	5	2	0	0	1	8
1994	2	6	2	1	0	11
1995	4	2	1	1	0	8
1996	2	0	0	1	0	3
1997	4	2	2	1	0	9
1998 <sup>a</sup>	4	4	2	1	0	11
1999 <sup>a</sup>	5	2	1	1	1	10
2000 <sup>a</sup>	4	2	2	1	1	10

a - expected completions

Source: RACR/FRO

As indicated in Table 33, between 1990 and 1997 a total of 55 trainees graduated and were awarded the FRACR.

As the RACR is a combined Australian and New Zealand College, and hence the FRACR may also be obtained in New Zealand, there may be some radiation oncologists trained in New Zealand who also enter the workforce in Australia. The RACR/FRO reports that between 1990 and 1997, five overseas trained doctors (not from New Zealand) were granted the FRACR and a further four overseas trained doctors were added to the workforce and currently practice in Australia without the FRACR. Seven of the trainees who obtained the FRACR are working overseas. Hence, the additions to the workforce during this time were 57 (ie., 55-7+9) with an average of 6.3 per year.

The AIHW 1995 survey found that radiation oncology trainees worked on average 48 hours per week (43.6 hours on direct patient care). Male radiation oncology trainees averaged 49.7 hours of work per week and female trainees 42.1 hours of work per week (Table 34).

**Table 34: Radiation oncology specialists-in-training (AIHW), average hours worked by sex and age, 1995**

Gender	25-34 years	35-44 years	Average hours
Total hours worked			
Male	50.2	43.0	49.7
Female	42.5	40.0	42.1
<b>Total</b>	<b>48.4</b>	<b>42.0</b>	<b>48.0</b>
-----			
Direct patient care hours			
Male	45.7	41.5	45.2
Female	38.0	40.0	38.3
<b>Total</b>	<b>43.9</b>	<b>41.0</b>	<b>43.6</b>

Source: AIHW

### **The Main Characteristics of the Radiation Oncology Workforce**

Radiation oncology is a small specialty, representing just 0.8% of all specialists. The Working Party estimates that there are currently 131 practising radiation oncologists in Australia. This is equivalent to 0.71 radiation oncologists per 100,000 population or an SPR of 1:140,427.

97.5% of the workforce is located in a capital city or metropolitan area, which is consistent with the need for considerable infrastructure to provide radiation oncology services. There is however, some maldistribution between States/Territories with the number of radiation oncologists in New South Wales and Western Australia below their respective population shares and the Northern Territory has no radiation oncologists or infrastructure to support them.

Nationally, the age profile of the workforce is fairly even, although Victoria, South Australia and Western Australia have an above average proportion of their workforce in the older age category.

Approximately 23% of the workforce are female and 35% of trainee radiation oncologists are female.

It is estimated that radiation oncologists work an average 50.1 hours per week. The main work setting is in a public hospital (59% of the workforce), although for a significant number (33.9%) the main setting is private rooms.

Most radiotherapy treatments administered by radiation oncologists are for cancer, with the main cancers currently treated being breast, urology and head/neck.

## **ADEQUACY OF THE CURRENT RADIATION ONCOLOGY WORKFORCE**

There are a number of indicators of the adequacy of a medical workforce. No single measure can provide a definitive assessment; however, by examining each of the following it is possible to gain an indication of whether the workforce is adequately meeting current demand or if there is a significant shortfall or oversupply. The indicators chosen by the Working Party were:

- radiation oncologist:population ratio
- radiation oncologists to new patient referrals
- vacancies for radiation oncologists
- State/Territory health department assessment

### **Radiation Oncologist:Population Ratio**

The Working Party considered that the main value of the radiation oncology SPRs lies in their use as tools of comparison between States/Territories and for comparisons over time. Table 4 calculated SPRs using RACR/FRO, Medicare and AIHW data. The RACR/FRO data are used in this section to provide some comparisons over time.

Table 35 indicates that between 1988 and 1997, the number of radiation oncologists per head of population increased from 1:219,697 to 1:140,427 with 0.46 radiation oncologists per 100,000 in 1988 and 0.71 per 100,000 in 1997 (4.6 per million in 1988 to 7.1 per million in 1997).

In 1997, the radiation oncologist to population ratio of 7.1 per million falls short of the 1986 AHMAC Guidelines for Cancer Treatment Services when the incidence of cancer is also factored into the equation. In 1986, the incidence of cancer per million population was 3,500 and the AHMAC guidelines recommended that there should be seven radiation oncologists per million of population (1:142,857). In 1997, the incidence of cancer is estimated by AHTAC to be 4,147 per million population; an increase of 18.5%. Hence if all other treatment considerations remain as they were in 1986, then it can be argued that in 1997 the optimal ratio of radiation oncologists per million population is 8.3 (or 1:126,445). According to this internationally recognised benchmark, Australia (with 131 radiation oncologists -123.4 FTE- and an estimated population of 18,396,000 in 1997) has a shortage of radiation oncologists of between 22 to 30 (14.4% to 19.4% of the workforce).

**Table 35: Radiation oncology specialist:population ratio (RACR), by selected years, 1988 to 1997**

Year	Radiation oncologists	Population ('000)	Population per radiation oncologist	Radiation oncologists per 100,000 population
1988	76	16,697.0	1:219,697	0.46
1990	78	17,169.6	1:220,123	0.45
1992	88	17,573.1	1:199,694	0.50
1994	99	17,840.8	1:180,210	0.55
1995	108	18,023.1	1:166,881	0.60
1996	119	18,208.2	1:153,010	0.65
1997	131	18,396.0	1:140,427	0.71

Note: 1996 population is an estimate.

Source: RACR/FRO and ABS

Table 36 also shows that the number of radiation oncologists per head of population has increased over the last four years (from 1:164,992 to 1:138,638) and that this trend is evident across all States/Territories except Western Australia, the Northern Territory and the Australian Capital Territory. The data also indicate that Western Australia continues to have SPRs above that for Australia as a whole, the Northern Territory does not have a radiation oncology service and the Australian Capital Territory which had four radiation oncologists in 1991-92 had three in 1995-96.

**Table 36: Radiation oncology specialist:population ratio (Medicare), by State/Territory, 1984-85 and 1995-96**

Year	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Aust
<b>1991-92</b>									
Radiation oncologists	32	30	18	10	9	3	0	4	106
Pop. (>000)	5,898.7	4,420.4	2,961.0	1,446.3	1,636.1	466.8	165.5	289.3	17,065.1
SPR 1:	186,209	148,367	168,489	145,760	184,156	156,567	-	73,625	164,992
No./100,000	0.5	0.7	0.6	0.7	0.5	0.6	-	1.4	0.6
<b>1995-96</b>									
Radiation oncologists	41	39	23	11	9	4	0	3	130
Pop. (>000)	6,190.2	4,541.0	3,354.7	1,479.2	1,762.7	473.7	177.1	307.5	18,023.0
SPR 1:	150,980	116,436	145,857	134,437	195,856	118,350	-	102,500	138,638
No./100,000	0.7	0.9	0.7	0.7	0.5	0.8	-	1.0	0.7

Note: 1995-96 population is an estimate; Source: DHFS and ABS

## **Radiation Oncologists to New Patient Referrals**

AHTAC (1996) recommended that when planning radiation oncology facilities, a referral rate for radiotherapy treatment of between 50% to 55% of patients newly diagnosed with cancer should be anticipated. This rate of referral is based on data from the United States, the United Kingdom, Canada and the Netherlands. Furthermore, it is consistent with the AHMAC (1989) report which recommended that a referral rate of 45% to 55% be used for future planning of services and since then most States/Territories have been working towards a 50% treatment rate of newly diagnosed patients with cancer (AHTAC 1996: 49).

According to the AHTAC report, the current average rate of referral for radiotherapy treatment is suboptimal at 38.9% (Table 37). The report notes that there are wide variations between States/Territories and between metropolitan and rural areas within States/Territories. The AHTAC report concludes that among the reasons for the suboptimal radiation oncology treatment rate of patients with cancer are a lack of ready access to treatment, with a shortage of radiotherapy facilities in most States and lack of awareness among the medical profession and the general community as to the role of radiotherapy in treating cancer.

Denham (1995) concluded that access difficulties for rural patients contribute to low referral rates for treatment with radiotherapy. Similarly, a submission to the AHTAC Committee from Western Australia acknowledged that treatment decisions are affected by access to radiotherapy, with country women with breast cancer more likely to decide on mastectomy as the primary treatment rather than conservative surgery supplemented by radiotherapy (AHTAC 1996).

The Working Party considered that it is the right of all Australians to receive equitable health care regardless of where they live and that they should not be denied radiotherapy because they live in an isolated area. It is important that support be provided for rural/isolated patients and their close family members in order for them to access services (ie., travel and accommodation costs). The Working Party also noted the emotional and financial costs associated with accessing cancer treatment services such as loss of earnings, family accommodation and living expenses.

The AHTAC report claimed that there may be delays before radiotherapy treatment can be given to patients because facilities are unable to expand rapidly enough to meet rising demand and a shortage of staff to deliver treatment. The shortage of radiation oncologists is compounded by the lack of an academic base in the specialty and resultant inadequate undergraduate teaching and a lack of radiation oncologist trainees (AHTAC 1996).

Table 37 indicates that radiotherapy treatment rates have been increasing, from 31.6% of newly diagnosed patients in 1988 to 38.9% in 1995. Based on the 50% referral rate benchmark, Table 36 indicates that 7,936 newly diagnosed cancer patients failed to receive radiotherapy treatment in 1995. According to AHTAC the increasing incidence

of cancer can best be accommodated by using the ratio of radiation oncologists to new referrals (p 72). The Faculty of Radiation Oncology considers that the maximum number of new patient referrals that each radiation oncologist can manage is 250 per year. In 1997, the cancer incidence is estimated to be 4,147 per million population with an estimated 76,360 newly diagnosed cases of cancer. Hence, to treat 50% of these new patients with radiotherapy would require 153 radiation oncologists. In 1997, there are 131 radiation oncologists (123.4 FTE). Therefore, using this methodology, it can be argued that Australia has a shortfall of between 22 to 30 radiation oncologists.

**Table 37: Patient radiation oncology treatment statistics, 1988 to 1995**

<b>Treatment statistic</b>	<b>1988</b>	<b>1990</b>	<b>1992</b>	<b>1994</b>	<b>1995</b>
Population (millions)	16.532	17.076	17.498	17.843	18.028
Cancer incidence per million	3,440	3,586	3,738	3,897	3,979
Newly diagnosed cancers	56,870	61,235	65,408	69,534	71,734
Courses of treatment	23,379	27,995	30,194	33,340	34,915
Re-treatment rate (%)	23.0	26.2	26.3	20.2	20.0
Newly diagnosed patients treated with RT	18,002	20,660	22,252	26,605	27,932
Newly diagnosed cancer patients treated with RT (%)	31.6	33.7	34.0	38.3	38.9
Newly diagnosed patients not treated with RT (50% treat. rate)	10,433	9,957	10,452	8,162	7,936
55 per cent treatment rate	13,276	13,019	13,722	11,639	11,522

Source: RACR surveys from 1988 to 1995 in NHMRC AHTAC report, 1996 (p 48)

Table 38 shows the age standardised incidence of cancer per 100,000 population and the distribution of radiation oncologists per 100,000 population. States/Territories with above average cancer incidence rates for males in 1994 were Tasmania, Western Australia, South Australia, New South Wales and Victoria. States/Territories with above average cancer incidence rates for females in 1994 were Tasmania, Victoria, the Australian Capital Territory and South Australia. Table 38 also indicates that while Western Australia and New South Wales have comparatively high cancer incidence rates, the ratio of radiation oncologists per 100,000 is comparatively low.

**Table 38: Age standardised cancer incidence per 100,000 population and radiation oncologist per 100,000 population, by State/Territory, 1994**

	NSW	Vic	Qld*	SA	WA	Tas	NT	ACT	Aust
Cancer incidence <sup>a</sup>									
- male	516.9	511.3	413.5	520.8	565.8	583.7	273.2	468.0	503.2
- female	330.7	348.9	295.4	335.8	332.6	353.1	230.8	346.1	330.1
Radiation oncologists <sup>b</sup>									
No./100,000	41	39	23	11	9	4	0	3	130
	0.6	0.8	0.8	0.7	0.5	0.8	-	1.0	0.7

\* 1990 cancer incidence data because this was the latest year for which this data were available

Source: (a) AIHW; (b) RACR/FRO

### **Vacancies for Radiation Oncologists**

The RACR/FRO (1996) survey of Departments of Radiation Oncology found that there were 11 vacant positions for radiation oncologists. There were no TRDs filling radiation oncology specialist vacancies in 1997.

### **Patient Waiting Times**

The AMWAC (1997) survey of State/Territory health departments requested information as to whether departments collected data about waiting times and if so to describe how the information was collected and the length of time that patients wait for radiotherapy services.

Four States/Territories reported keeping data on waiting times with waiting times ranging from 0 days to 23 days. One respondent noted that delay for treatment was directly related to the staffing levels which are available. However, there is little consistency among States/Territories in the criteria being used to assess patient waiting times for radiotherapy treatment and the Australian Council of Healthcare Standards/Care Evaluation Program is in the process of developing a waiting time clinical indicator (ACHS 1997).

### **Radiation Oncologists' Workload**

The Stevens and Berry 1995 survey of radiation oncologists found that 40% of radiation oncologists were satisfied with the proportion of time they spend on various work activities and 59.6% were not satisfied.

### **Conclusions on Adequacy of the Current Radiation Oncology Workforce**

Assessing the adequacy of any medical workforce is difficult. In assessing the adequacy of the current specialist radiation oncology workforce, the Working Party examined a number of indicators, three of which highlighted the likelihood that the current supply is not adequately meeting demand. In addition, two approaches have indicated a similar level of shortfall. Accordingly, the Working Party has concluded that there is shortfall in the order of between 22 to 30 radiation oncologists.

The impact of this shortfall on patients requiring treatment is difficult to detail, but is likely to involve a combination of waiting longer for treatment than is optimal, or not receiving treatment at all. The difficulty for the Working Party is that there is little information available on waiting times, although it is acknowledged that the current work by the Australian Council of Healthcare Standards should alleviate this problem in due course.

Despite the provision of rural outreach services to 46 centres, the rural population is receiving comparatively fewer radiation oncology treatments than the metropolitan population.

In terms of States and Territories, Western Australia and New South Wales have comparatively high cancer incidence rates and specialist population ratios above that of the national average. It should also be noted that the radiation oncologist workforces in Western Australia and South Australia have relatively high proportions of radiation oncologists aged 65 years and over and therefore nearing retirement and/or reducing the average hours worked.

The shortfall of radiation oncologists is likely to have arisen for a variety of reasons, including that the growth in trainee output has failed to keep pace with the growth in requirements. The Working Party believes expanding the training program offers the best long term solution to reducing the shortfall. In the short term, consideration could be given to the use of appropriately trained and qualified overseas specialists. It needs to be recognised that boosting the output of the training program does take time, will require a funding commitment from government, and sufficient practising radiation oncologists with the time to take on additional training commitments.

Finally, it needs to be stressed that the findings of the Working Party are consistent with three other comparatively recent studies in this area, making this the fourth report to highlight that there is a current shortage of specialist radiation oncologists (MWDRC 1993 and 1994 and AHTAC 1996).

## PROJECTIONS OF REQUIREMENTS

### Population

Australia has a growing and an ageing population. The 1995-96 population was estimated at 18.29 million (ABS 1997). The ABS estimates that the population will reach 19.17 million by 2001 and 20.09 million by 2006 (ABS 1994) with a projected 1.2% growth per annum.

ABS estimates that the median age of the total population will rise from 33.1 years in 1993 to between 39.4 and 41.8 years in 2041. As a proportion of the total population, those aged 65 and over represented 11.7% (2.1 million) in 1993, and will increase to 12.78% (around 2.56 million) in 2006 (ABS 1994).

The effects of ageing on demand for health services is estimated at 0.4% with a combined effect of population growth and ageing on demand for services of 1.6%.

### Incidence of Cancer

Hospital data and ABS (National Health Survey) data indicate that people with cancer are predominantly in the older age groups; hence patient demand for radiation oncology is expected to increase with continued ageing of the population. Table 39 shows that the ageing of the Australian population is likely to impact significantly on requirements for the radiation oncology workforce.

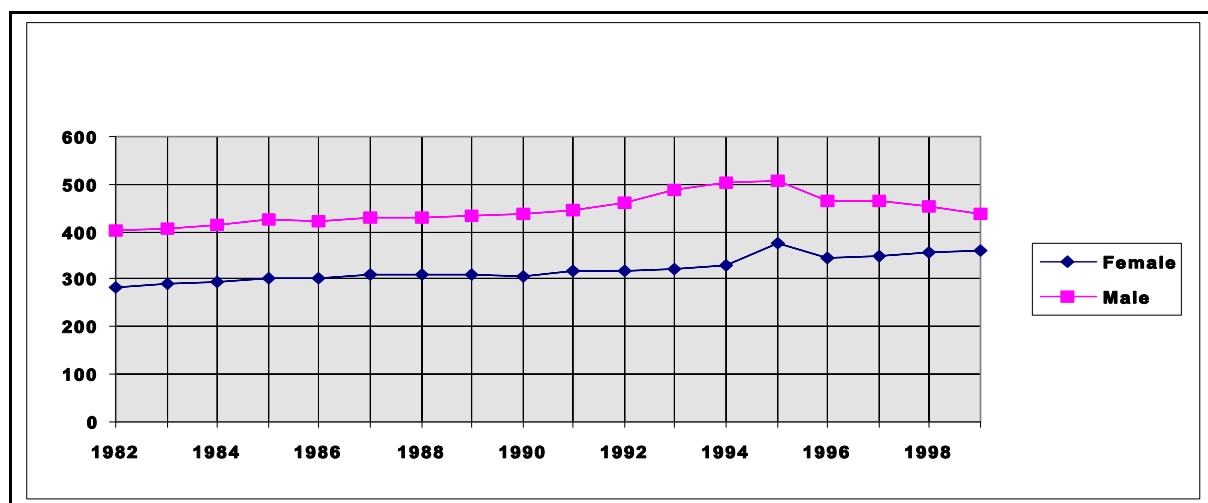
**Table 39: Persons reporting illness because of cancer (recent illness and long term condition), by age group, rate per 1,000 population, 1995**

	< 5 yrs	5-14 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	65-74 yrs	75 + yrs	Total
Recent illness	0.1	1.0	1.3	2.4	5.9	10.1	19.4	32.9	41.6	8.8
Long term condition	0.3	1.3	3.2	7.2	14.7	22.9	36.6	63.4	69.6	17.8

Source: ABS (1995)

Figure 1 indicates that between 1982 and 1994 the age adjusted incidence of cancer for Australian males increased by 25.2%, representing a compound annual increase of 1.9%, while for females there was a 16.7% increase (1.3% compound annual increase). Figure 1 also shows that the projected growth in the incidence of cancer is estimated to decline from 1995 to 1999, with an overall growth between 1982 and 1999 of 0.5% for males and 1.5% for females. The AIHW considers that the recent decline in the incidence of all cancers is associated with a change in the incidence of cancer of the prostate. Between 1989 and 1993, the incidence of this cancer increased markedly due to improved screening techniques. However, over the next five years the incidence of prostate cancer is expected to decline.

**Figure 1: Trends in the age adjusted incidence of cancer, per 100,000 population (AIHW), 1982 to 1994 with projections to 1999**



Source: AIHW (1998) Cancer Incidence in Australia 1991-1994 with projections to 1999, Canberra

Table 40 shows that the crude incidence of cancer per million population is expected to increase by an average yearly increase of 2.1% from 1998 to 2005, with below average increases in Victoria and the Australian Capital Territory and above average increases in New South Wales, Queensland, Western Australia and Tasmania (AHTAC 1996). The Northern Territory was not included in the AHTAC analysis of cancer incidence trends because the cancer incidence in the Northern Territory for 1988 was only 1,406 per million, or a total of 219 new cancers (AHTAC 1996: 110). The report goes on to say that while this may represent under-reporting, particularly in Aboriginal communities, the proportion of the population over 65 years was only 2.7% in 1991.

**Table 40: Estimated trends in the incidence of cancer per million population, 1988 to 2005**

State/Terr	1982	1986	1990	1994	1998	2002	2005	% change
NSW	3,053	3,344	3,663	4,011	4,393	4,812	5,150	2.3
Vic	3,278	3,479	3,692	3,919	4,159	4,414	4,615	1.5
Qld	3,083	3,389	3,727	4,098	4,505	4,954	5,319	2.4
SA	3,406	3,687	3,990	4,319	4,675	5,060	5,369	2.0
WA	2,666	2,931	3,222	3,543	3,896	4,283	4,599	2.4
Tas	3,075	3,375	3,703	4,064	4,460	4,890	5,234	2.3
ACT	1,956	2,080	2,213	2,354	2,505	2,702	2,794	1.6
<b>Australia</b>	<b>3,037</b>	<b>3,300</b>	<b>3,586</b>	<b>3,897</b>	<b>4,235</b>	<b>4,601</b>	<b>4,898</b>	<b>2.1</b>

\* Estimated average annual increase, 1982-2005 (extrapolation)

Source: AMWAC using data derived from the NHMRC AHTAC report (1996: Appendix 4)

Table 41 uses data from the AHTAC report which indicate that between 1988 and 1995, the number of newly diagnosed cases of cancer increased by 3.4% per annum, the number of newly diagnosed cancer patients treated with radiotherapy increased by 6.5% per annum and the number of newly diagnosed cancer patients not treated with radiotherapy (based on a 50% gold standard referral rate) reduced by 3.8%.

**Table 41: Trends in patient cancer treatment statistics, 1988 to 1995**

Treatment	1988	1990	1992	1994	1995	% change*
Newly diagnosed cancers	56,870	61,235	65,408	69,534	71,734	3.4
Newly diagnosed patients treated with RT	18,002	20,660	22,252	26,605	27,932	6.5
Newly diagnosed cancer patients not treated with RT (50% referral rate)	10,433	9,957	10,452	8,162	7,936	-3.8

\* Compound annual increase

Source: AMWAC using data derived from the NHMRC AHTAC report (1996: Table 6.5, p 48)

### Trends in Radiation Oncology Service Provision

The trends in the services provided by radiation oncologists are summarised in Table 42. These data indicate that between 1985-86 and 1995-96 there was a 10.2% annual increase in the number of Medicare services provided by radiation oncologists and a 5.9% annual increase in the number of new courses of megavoltage treatments.

**Table 42: Trends in services provided by radiation oncologists, selected years**

Indicator	% Compound annual increase
Total MBS items (1985-86 to 1995-96)	10.2
Number of new courses of megavoltage treatments (1988 to 1995)	5.9

Sources: DHFS and AMWAC using data derived from the NHMRC AHTAC report (1996: Table 6.5)

### Projected Megavoltage Machine Requirements

The AHTAC report projected megavoltage machine requirements for Australia and individual States/Territories for 1995, 2000 and 2005. This estimation was based on the knowledge that the number of newly diagnosed cancer patients who can be treated per machine is static, while the number of newly diagnosed cancer patients needing treatment will increase due to increases in cancer incidence and in the population. Table 43 indicates that between 1996 and 2005, the AHTAC report recommends that the number of megavoltage machines based on two rates referral of patients newly diagnosed with cancer. Using a 50% referral rate, AHTAC projects an increase in the number of megavoltage machines from the 1996 level of 87 to 127 (an overall increase of 45.9% representing an average annual increase of 5.1%). Using a 55% referral rate, AHTAC projects an increase of 87 to 140 machines (an overall increase of 60.9%

representing an average annual increase of 6.8%). These projections for megavoltage machines take into account estimated growth in population and cancer incidence.

Based on the above projections of requirements for megavoltage machines, Australia needs a minimum of 40 additional machines by 2005, with each machine requiring an adequate supply of radiation oncologists. The current ratio of specialist to megavoltage machines is 1.4:1 which means, using this methodology, that by 2005 Australia requires a minimum of 56 additional radiation oncologists.

**Table 43: Current and projected megavoltage machines, by State/Territory, 1996 to 2005**

State/Territory	1996 current <sup>a</sup>	2000 projected <sup>b</sup>	2005 projected <sup>b</sup>
NSW	29	38-42	45-49
Victoria	21	26-28	29-31
Queensland	16	22-24	27-29
South Australia	8	10-11	12-13
Western Australia	8	10-11	12-13
Tasmania	3	3	3-4
Northern Territory	0	0	0
ACT	2	2	2
<b>Australia</b>	<b>87</b>	<b>108-119</b>	<b>127-140</b>

a - referral rate for megavoltage treatment of newly diagnosed cancer patients in 1995 was 38.9%

b - projections based on 50% and 55% referral rate for megavoltage treatment of newly diagnosed cancer patients

Source: AMWAC using data derived from the NHMRC AHTAC report (1996: Appendix 4, p 119)

The AMWAC 1997 survey of State/Territory health departments found that the supply of megavoltage machines had increased by three machines between 1996 and 1997 and that plans for the future supply of machines is reasonably consistent with the AHTAC recommendations, although two States were unable to provide complete data for the year 2001 and most States did not provide data for the year 2007 (Table 44).

Comments from the various States/Territories indicated that the figures pertaining to future plans for the provision of megavoltage machines were conservative estimates and subject to change should there be changes in cancer incidence, referral rates, population distribution etc. The response from the Territory Health Services indicated that there were no plans to establish a radiation oncology unit in the Northern Territory because the population is too small for such a service to be cost-effective. Northern Territory clients requiring radiation oncology treatment are transported to Adelaide.

**Table 44: Current number of megavoltage machines and future plans, by State/Territory, 1997 to 2001**

State/Territory	1997 current	2001 projected
NSW	32 <sup>a</sup>	39 <sup>a</sup>
Victoria	19	..*
Queensland	15 <sup>b</sup>	19 <sup>c</sup>
South Australia	8	10
Western Australia	8	9
Tasmania	4	4
Northern Territory	0	0
ACT	2	3
<b>Australia</b>	<b>90</b>	<b>103<sup>d</sup></b>

..\* data not supplied as radiation oncology services currently under review; a - Includes machines in both the public and private sector; b - includes 10 public and 5 private sector machines; c- assumes a minimum of 5 private sector machines as private sector data for 2001 was not supplied; d - assumes a minimum of 19 machines for Victoria and a minimum of 5 private sector machines in Queensland.

Source: AMWAC 1997 survey of State/Territory Health Departments

### **Changes in Technology and Options for Service Provision**

The AHTAC report concluded that recent changes in the diagnosis and treatment of cancer are likely to increase referral rates to radiation oncologists. Among these changes in practice are an increased use of breast-conserving surgery followed by radiotherapy for the management of early stage breast cancer, the use of radiotherapy, with or without chemotherapy, for treatment of advanced laryngeal cancer, the increasing incidence of prostate cancer, and the use of post-operative radiotherapy with or without chemotherapy in rectal cancer (AHTAC 1996).

## **PROJECTIONS OF SUPPLY**

### **Entry Into the Workforce**

Over the past five years, an average of seven new graduates have entered the workforce each year and this number is expected to increase to ten over the next five years. The Working Party estimates that, on average, in each of the next four years ten new radiation oncologists will enter the workforce (Table 33).

### **Retirements**

The RACR/FRO survey (1997) found that the age of radiation oncologists ranged from 30 to 69 years indicating that most radiation oncologists have retired by the age of 70 years. The average expected age of retirement is 64 years. It would seem that the use of 60 to 70 years would be appropriate as a retirement age for projection purposes.

RACR/FRO and AIHW data indicate that the average age of radiation oncologists is between 45 and 48 years.

AIHW 1995 data indicate there are 22 radiation oncologists aged 55 years and over; equivalent to 17.2% of the workforce. If all of these radiation oncologists retired over the next ten years this would represent an average loss of two radiation oncologists per year (see Table 9).

### **Female Participation in the Workforce**

The representation of women in the workforce is approximately 23% (RACR/FRO 23%; AIHW 25.3%; Medicare 21.5%). It is expected that the proportion of women in the workforce will increase, as the number of female trainees continues to increase (currently 35.1% of trainees are female) and the predominantly male cohort of radiation oncologists aged 55 years and over proceeds through to retirement.

Generally, female specialists have a lifelong working contribution which is 75% of the male contribution (AMWAC & AIHW 1996b).

### **Overseas Trained Doctors**

Radiation oncologists entering the Australian workforce through the Australian Medical Council specialist pathway are expected to be small and to have a minimal effect on overall workforce supply. According to the RACR/FRO, between 1990 and 1997, five overseas trained doctors were granted the FRACR and a further four overseas trained doctors were added to the workforce and are currently practice in Australia without the FRACR.

There may also be a small number of radiation oncologists who emigrate, but overall the Working Party felt there would be a net gain of approximately 0.5 overseas trained doctors per year.

### **Provision of Services in Rural and Remote Areas**

The AIHW 1995 survey estimates that 5% of specialist radiation oncologists reported providing resident services in rural areas. Medicare 1995-96 data indicate that the rural population was receiving a lower provision of services than the metropolitan population (Table 25). However, these data also show that the provision of radiation oncology services outside capital cities and major urban areas is increasing. The Medicare data takes into account specialist outreach services and rural people travelling to metropolitan centres for treatment.

In some States, rural outreach services are provided as part of a comprehensive service network involving metropolitan based tertiary referral hospitals and major non-metropolitan base hospitals. The Working Party found that 46 rural communities were receiving regular rural outreach services from urban based radiation oncologists in 1997. In their response to the AMWAC 1997 survey, the New South Wales Health Department stated that, as part of the Department's Optimising Cancer Management Initiative a cancer care (service delivery) model for New South Wales was being developed within a service networking arrangement which links, for the purposes of ensuring accessibility, quality and efficiency, various levels of expertise within the system.

Rural outreach services are currently held in country hospitals of widely varying bed-size and infrastructure support. The minimum size of a country town would be a population of approximately 20,000 and a base hospital of 50 to 100 beds. Normally the visiting radiation oncologist sees newly referred cancer patients and patients following a course of radiotherapy treatment (provided in an urban centre) in the outpatient department of the rural hospital. This requires assistance from nursing and administrative staff to run the clinic and funding for the travel costs for the radiation oncologist. This results in considerable cost savings for patients and relatives and provides consultation in cases where the patient may be otherwise too ill to travel. The travel costs for the radiation oncologist are often reimbursed.

The RACR/FRO has recommendations of the minimum equipment needs for a Department of Radiation Oncology (Appendix C). These recommendations apply to capital city or large population centres with access to a catchment population of 350,000 to 400,000. Based on a cancer incidence of 4,000 per million of population this will yield 1,400 to 1,600 newly diagnosed patients per annum of whom 50-55% (700 to 850) will receive radiotherapy. Together with 20-25% retreatments this will fully occupy two linear accelerators.

The Working Party believes that in most situations, it is not possible to provide resident radiation oncology services in rural areas because of the infrastructure required to support a radiation oncology service. However, rural outreach consultations are one way of increasing access to services for rural people. Essentially, this will be in the medium sized and smaller rural and remote communities. It will continue to be important for general practitioners in these areas to obtain and maintain basic diagnostic and cancer management skills.

### **Substitution**

Medicare data show that only 4.1% of MBS radiation oncology services are provided by providers other than radiation oncologists. The Working Party was advised that before ionising radiation can be used for therapeutic purposes, it is necessary for the medical practitioner to have a license for the radiotherapy equipment and a license to administer radiation to patients from the Radiation Safety Committee of the respective State/Territory health department. Radiation oncologists are the only medical practitioners who can obtain a license to use radiation for treatment purposes. The only exception to this are some dermatologists who use radiation for skin tumours and some specialist physicians and diagnostic radiologists trained in nuclear medicine who have licenses for unsealed radioactive sources for therapeutic purposes. The use of radiation by these other groups is uncommon. There is thus very little substitution of other specialist groups using radiotherapy.

## BALANCING SUPPLY AGAINST REQUIREMENTS

### Requirement Trends

Over the next ten years, the Australian population is expected to increase at an annual rate of 1.2% per annum. Trends in the age adjusted incidence of cancer per 100,000 population indicate an annual increase of 1.6% while the crude incidence of cancer per million population is extrapolated by AHTAC (1996) to increase by 2.1% per annum between 1995 and the year 2005.

Between 1996 and 2005, the AHTAC report recommends that the number of megavoltage machines should increase from 87 to 127 based on a 50% referral rate of patients newly diagnosed with cancer, an average annual increase of 5.1%.

The productivity of radiation oncologists as measured in hours worked will vary from time to time and by age group, as not all specialists work a uniform full time working week, so it is appropriate to measure services provided in hours instead of by head count. In 1997 the 131 (123.4 FTEs) radiation oncologists worked, on average, 50.1 hours per week and provided an estimated total of 6,566 hours of services per week. The Working Party concluded that in 1997 there was a shortfall in requirements of between 22 to 30 radiation oncologists.

Assuming a shortage of 22 radiation oncologists, Table 45 shows workforce requirements by hours worked per week under three different growth assumptions, starting from the 1997 requirement level; and ranging between growth in requirements of 1.6% per year to 3.3% per year.

**Table 45: Projected requirements for radiation oncology services, by hours worked per week, 1997, 2002 and 2007**

Year	Population growth/ ageing trend (1.6% per year)	Cancer incidence (2.1% per year)	Population growth plus crude cancer incidence growth (3.3% per year)
1997	7,665	7,665	7,665
2002	8,298	8,504	9,016
2007	8,983	9,435	10,605

Source: AMWAC and van Konkelenberg

The Working Party considered that trends in services growth are likely to continue at a similar level to cancer incidence growth per million population as estimated by AHTAC for the years 1995 to 2005 (ie., approximately 2.1% per annum).

## **Supply Trends**

The supply of radiation oncologists was projected using the standard AMWAC projection methodology, based on hours worked per week.

The supply of radiation oncologists was projected by ageing the 1997 supply through each year of age, subtracting retirements (average of two per year), and adding an average eight new graduates per year to 2002 and 11 graduates in subsequent years to the year 2007 plus 0.5 overseas trained doctors per year.

The number of radiation oncologists was converted to hours per week by applying the average number of hours worked to head counts in each major age cohort. These projections show that, based on an estimated growth trend of 2.1%, supply will need to increase from the estimated 1997 level of 6,563 hours per week to an estimated 9,440 hours per week in 2007.

## **Projected Balance**

A balance in supply to match a continued growth rate in requirements of 2.1% per annum can be achieved by the year 2007 by increasing the number of new radiation oncology graduates from an average of eight per year until the year 2002 to 11 in subsequent years to 2007.

The results of this projection work show that output of the radiation oncology training program should increase to 11 graduates per year from 2003.

In previous years, 52 training positions have produced, on average, 8 graduates per year. Hence, if the target of 11 graduates is desired an additional twelve radiation oncology training positions would be required. This is a reasonably large increase in training positions for a training program already under pressure due to the current shortage of radiation oncologists and consequently the number of specialists available to supervise trainees.

The Working Party concludes that the number of training positions in radiation oncology should increase to 64 with six positions introduced in 1998 and a further six in 1999. In terms of ability to effect increases in training positions, the staged scenario is preferable. It will also enable the projected trends in requirements to be monitored and the recommended increases in training positions adjusted if necessary. The conservative increase in new positions and the staged increase in new positions will mean that in 2007, the projected shortfall in hours worked will be 1.5% not 0.2% as shown in Table 46.

**Table 46: Radiation oncology graduate output needed to move projected supply into balance with projected requirements (2.1% growth per year), by hours worked per week, 1997 to 2007**

Year	Number of graduates	Projected supply (FTEs)	Projected requirements (FTEs)	Balance (shortage)	% shortage
1997	9	6,563	7,665	(1,103)	16.8
1998	11	6,709	7,829	(1,121)	16.7
1999	10	6,969	7,994	(1,025)	14.7
2000	10	7,248	8,162	(914)	12.6
2001	8	7,553	8,333	(780)	10.3
2002	8	7,812	8,508	(697)	8.9
2003	11	8,067	8,687	(620)	7.7
2004	11	8,403	8,869	(466)	5.5
2005	11	8,743	9,055	(312)	3.6
2006	11	9,083	9,246	(162)	1.8
2007	11	9,442	9,440	(2)	0.2

Source: AMWAC and van Konkelenberg

Ideally, training positions should be increased proportionately more in the comparatively poorly endowed State of New South Wales. This State with 33.9% of the Australian population has a radiation oncology specialist population ratio of 1:159,251, which is well above the Australian average of 1:140,427. Consideration also needs to be given to Western Australia, which has a comparatively high SPR (1:196,933) and a relatively high proportion of radiation oncologists aged 60 years and over. In addition, consideration needs to be given to improving the provision of radiation oncology services to underserved areas, such as the Northern Territory. The response to the AMWAC survey from the Territory Health Services indicated that clients requiring radiation oncology treatment are transported to Adelaide, while the South Australian Health Commission wrote that service enhancement is proposed through the provision of regular telemedicine and teleconferencing links between Adelaide and the Royal Darwin Hospital.

The Working Party understands that training positions in radiation oncology require appropriate and substantial infrastructure including sufficient specialists to provide supervision. Taking these and the above factors into consideration, the Working Party concludes that four of the new twelve training positions should be in New South Wales and that the other new positions should be evenly distributed among the remaining four States with training programs (Table 47).

**Table 47: Recommended distribution of new radiation oncology training positions and comparison with projected population shares, by State/Territory, 1997, 2000 and 2005**

State/Terr.	1997 positions	2000 positions	Projected 2005 pop. share (%)	1997 share of positions (%)	2000 share of positions (%)
NSW/ACT	24	28	35.1	46.2	43.7
Vic/Tas	14	16	26.6	26.9	25.0
Qld	6	8	19.5	11.5	12.5
SA/NT	4	6	8.8	7.7	9.4
WA	4	6	10.0	7.7	9.4
Australia	52	64	100.0	100.0	100.0

Source: ABS, AMWAC

The recommendations of the Working Party are based on a conservative estimate of future workforce requirements and an optimistic assessment of the number of graduates the RACR/FRO training program is able to produce. Therefore, it is important that workforce participation and attrition assumptions be monitored and the projections amended if new trends emerge.

## RECOMMENDATIONS

The following recommendations recognise that radiation oncology is a specialty which is particularly dependent on the availability of appropriate facilities and equipment. Hence, it is vital that workforce supply does not exceed the availability of essential equipment and facilities.

The Working Party recommends:

1. There be an increase in the number of funded radiation oncology training positions and trainees to overcome the current shortfall in the number of radiation oncologists and to match an expected future growth in requirements of 2.1% per year.
2. That State and Territory health departments undertake negotiations with the Royal Australasian College of Radiologists/Faculty of Radiation Oncology for the establishment of an additional 12 training positions; with the increases to be staged and distributed as shown in the following Table:

**Table 48: Total and additional radiation oncology training positions, by State/Territory, 1997 to 2000**

State/Territory	Total 1997 (current)	Total 2000	Increase in 1998	Increase in 1999
NSW/ACT	24	28	2	2
Vic./Tas.	14	16	1	1
Queensland	6	8	1	1
South Aust.	4	6	1	1
West. Aust.	4	6	1	1
<b>AUSTRALIA</b>	<b>52</b>	<b>64</b>	<b>6</b>	<b>6</b>

3. That State/Territory health departments develop strategies for the provision of megavoltage machines and other infrastructure requirements in the light of the recommended increase in the workforce and taking account of the recommendations of the NHMRC AHTAC report on Beam and Isotope Radiotherapy (1996).
4. State/Territory health departments and the Royal Australasian College of Radiologists/Faculty of Radiation Oncology co-ordinate the establishment of the new training positions and oversee the introduction of any short term measures they may feel are necessary to meet localised service shortfalls (recognising that the increased number of graduates will not make an effective contribution to the

radiation oncology workforce until 2003).

5. That radiation oncology requirements and supply projections be monitored regularly so that they can be amended if new trends emerge, particularly if the anticipated infrastructure expansion is not met. A full review of the workforce should be conducted again in five years.
6. That this monitoring be coordinated by the Royal Australasian College of Radiologists/Faculty of Radiation Oncology and AMWAC and the results incorporated into the AMWAC annual report to AHMAC. AMWAC will provide all necessary support.

## APPENDIX A: RURAL, REMOTE AND METROPOLITAN AREAS CLASSIFICATION

The Commonwealth Departments of Health and Family Services and Primary Industries and Energy, Rural, Remote and Metropolitan Areas classification, has been used to classify the geographic location of the job of responding medical practitioners in the following seven categories. The data used in determining these categories are based on the 1991 population census.

### Metropolitan areas:

1. *Capital cities* consist of the State and Territory capital cities of Sydney, Melbourne, Brisbane, Perth, Adelaide, Hobart, Darwin and Canberra.
2. *Other metropolitan centres* consist of one or more statistical subdivisions which have an urban centre of population of 100,000 or more in size. These centres are: Newcastle, Wollongong, Queanbeyan (part of Canberra-Queanbeyan), Geelong, Gold Coast-Tweed Heads, Townsville-Thuringowa.

### Rural zones:

3. *Large rural centres* are statistical local areas where most of the population reside in urban centres of population of 25,000 to 99,999. These centres are: Albury-Wodonga, Dubbo, Lismore, Orange, Port Macquarie, Tamworth, Wagga Wagga (NSW); Ballarat, Bendigo, Shepparton-Mooroopna (Vic); Bundaberg, Cairns, Mackay, Maroochydore-Mooloolaba, Rockhampton, Toowoomba (Qld), Whyalla (SA); and Launceston (Tas).
4. *Small rural centres* are statistical local areas in rural zones containing urban centres of population between 10,000 and 24,999. These centres are: Armidale, Ballina, Bathurst, Broken Hill, Casino, Coffs Harbour, Forster-Tuncurry, Goulburn, Grafton, Griffith, Lithgow, Moree Plains, Muswellbrook, Nowra-Bombaderry, Singleton, Taree (NSW); Bairnsdale, Colac, Echuca-Moama, Horsham, Mildura, Moe-Yallourn, Morwell, Ocean Grove-Barwon Heads, Portland, Sale, Traralgon, Wangaratta, Warrnambool (Vic); Caloundra, Gladstone, Gympie, Hervey Bay, Maryborough, Tewantin-Noosa, Warwick (Qld); Mount Gambier, Murray Bridge, Port Augusta, Port Lincoln, Port Pirie (SA); Albany, Bunbury, Geraldton, Mandurah (WA); Burnie-Somerset, Devonport (Tas).
5. *Other rural areas* are the remaining statistical areas within the rural zone. Examples are Cowra Shire, Temora Shire, Guyra Shire (NSW); Ararat Shire, Cobram Shire (Vic); Cardwell Shire, Whitsunday Shire (Qld); Barossa, Pinnaroo (SA); Moora Shire, York Shire (WA); George Town, Ross (Tas); Coomalie, Litchfield (NT).

**Remote zones:**

These are generally less densely populated than rural statistical local areas and hundreds of kilometres from a major urban centre.

6. *Remote centres* are statistical local areas in the remote zone containing urban centres of population of 5,000 or more. These centres are: Blackwater, Bowen, Emerald, Mareeba, Moranbah, Mount Isa, Roma (Qld); Broome, Carnarvon, East Pilbara, Esperance, Kalgoorlie/Boulder, Port Hedland, Karratha (WA); Alice Springs, Katherine (NT).
7. *Other remote areas* are the remaining areas within the remote zone. Examples are: Balranald, Bourke, Cobar, Lord Howe Island (NSW); French Island, Orbost, Walpeup (Vic); Aurukun, Longreach, Quilpie (Qld); Coober Pedy, Murat Bay, Roxby Downs (SA); Coolgardie, Exmouth, Laverton, Shark Bay (WA); King Island, Strahan (Tas); Daly, Jabiru, Nhulunbuy (NT).

## APPENDIX B: AUSTRALIAN POPULATION, 1984 TO 2007

**Table B1: Australian population, by State/Territory, 1984 to 2007**

State/ Terr.	1984	1985	1986	1987	1988	1989	1990	1991	1992
NSW	5431800	5496500	5572300	5661800	5746300	5797900	5862500	5928800	5979500
Vic	4097600	4140400	4183400	4234400	4295100	4349700	4400700	4435700	4459400
Qld	2547100	2597100	2649700	2706600	2785700	2871000	2928700	2995100	3071800
SA	1365300	1376800	1388200	1401400	1416600	1431800	1438900	1451900	1460400
WA	1403000	1436900	1479500	1520300	1571400	1614800	1624400	1646900	1666700
Tas	440100	444600	447700	447900	449400	453600	464400	468400	470800
NT	145300	152400	155900	156800	156600	156500	165000	166500	168600
ACT	247100	255900	262500	269800	275800	281700	285000	291300	295900
<b>Australia</b>	<b>15677300</b>	<b>15900600</b>	<b>16139000</b>	<b>16398900</b>	<b>16697000</b>	<b>16957100</b>	<b>17169600</b>	<b>17384600</b>	<b>17573100</b>
Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
NSW	6008600	6057900	6108400	6159000	6210800	6263900	6318100	6373600	6428000
Vic	4462100	4476200	4500800	4529800	4559400	4589600	4620300	4651600	4681900
Qld	3112600	3189600	3255700	3316600	3378100	3440200	3502900	3566200	3629200
SA	1461700	1468000	1475200	1483300	1491300	1499200	1507000	1514700	1522000
WA	1677600	1699000	1721800	1746900	1772400	1798300	1824700	1851400	1878000
Tas	471700	475000	478100	481300	484400	487500	490500	493500	496400
NT	168300	171200	174100	177100	180000	183000	186000	189100	192100
ACT	298900	303900	309000	314200	319600	325000	330600	336300	341900
<b>Australia</b>	<b>17661500</b>	<b>17840800</b>	<b>18023100</b>	<b>18208200</b>	<b>18396000</b>	<b>18586700</b>	<b>18780100</b>	<b>18976400</b>	<b>19169500</b>
Year	2002	2003	2004	2005	2006	2007			
NSW	6481300	6533600	6584800	6635000	6684200	6732200			
Vic	4711400	4740000	4767700	4794300	4820000	4844600			
Qld	3691900	3754400	3816700	3878600	3940100	4001200			
SA	1529100	1535800	1542300	1548500	1554400	1560000			
WA	1904600	1931100	1957500	1983800	2010000	2036000			
Tas	499100	501800	504400	506900	509400	511700			
NT	195100	198100	201000	204000	206900	209800			
ACT	347700	353400	359200	364900	370700	376300			
<b>Australia</b>	<b>19360200</b>	<b>19548200</b>	<b>19733600</b>	<b>19916000</b>	<b>20095700</b>	<b>20271800</b>			

Source: ABS

## **APPENDIX C:       MINIMUM REQUIREMENTS FOR A DEPARTMENT OF RADIATION ONCOLOGY**

The RACR/FRO recognises that radiation oncology units will vary in size with the needs based on the cancer incidence and population of the States in which they are located. It is recommended that the basic minimum requirements in equipment for a Radiation Oncology Centre should be:

- Two megavoltage machines. This can be either two dual modality linear accelerators or one dual modality and one single energy machine. Phased development should commence with installation of a dual modality linear accelerator. In a three machine department there should be two dual modality linear accelerators (DMLA) and one single photon linear accelerator (SPLA). In a department with four or more machines the ratio of megavoltage machines should be one DMLA to one SPLA.
- Planning simulator.
- CT interfacing computer planning facility.
- Facilities for construction of custom made blocks and patient immobilisation devices.
- Dosimetry equipment for machine quality control.
- Computerised database system for evaluation of treatment outcome.
- Access to remote automatic after loading brachytherapy facilities.

To ensure that radiation oncology continues to develop, it is important that larger units are created for professional development, postgraduate activity and clinical review, including attendance at meetings, participation in teaching of undergraduate and postgraduate students, therapeutic radiographers and nurses plus participation in ongoing clinical studies.

Recommendations for additional equipment such as, on-line portal imaging, multi-leaf collimators etc., cannot be given at the present time as these items are currently in a development and evaluation phase.

The recommendations should be reviewed in three years time.

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