Australian Health Technology
Advisory Committee

Report of the working party on beam and isotope radiotherapy

CONSULTATION DRAFT—SEPTEMBER 1996

National Health and Medical Research Council

This document has been prepared by a working party of the Australian Health Technology Advisory Committee (AHTAC). AHTAC evaluates health technologies and specialised services looking at safety, efficacy, effectiveness, cost, equity, access and social impact.

AHTAC is a standing committee of the National Health Advisory Committee, an advisory arm of the National Health and Medical Research Council (NHMRC).

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Submissions commenting on the draft report are invited from a wide range of interested individuals, organisations, State and Federal governments and professional bodies. These comments are used to finalise a document which is based on the best available evidence, and is relevant and useful to the target group.

This document consolidates the work to date of the AHTAC working party on beam and isotope radiotherapy. It is a *working document* which is now subject to a consultative process.

NHMRC considers full public participation in the development of advice, recommendations and guidelines is more likely to result in information which is relevant and useful to the Australian community. Accordingly, readers with an interest in this issue are encouraged to contribute to the further development of the document by making submissions to:

The Secretary
Australian Health Technology Advisory Committee
Mail Drop 107
GPO Box 9848
CANBERRA ACT 2601.

Submissions may be formal or in the form of a letter. Submissions should include details of any research or evidence which supports the views put forward in the submission.

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Summary

This report is intended to be a major resource document for the development of radiation oncology services in Australia to the year 2005. The role of radiation oncology in the management of patients with cancer using either external beam treatment or brachytherapy has been examined.

The Working Party reviewed previous reports on radiotherapy published since the early 1980s and used this information, together with more recent evidence and information from consultations with expert groups, to assess both the current status of radiotherapy in Australia and future needs. Recommendations on the appropriate expansion of the specialty have been carefully considered and form the basis of this report.

There is continuing debate about the adequacy of current services provided and the place of radiotherapy in cancer treatment. The Working Party found that radiotherapy is an effective and cost-effective curative and palliative treatment for a number of cancer types, either used alone or in combination with surgery or chemotherapy. The demand for services will continue to grow because of the ageing population and the increasing incidence of cancer. However, radiotherapy appears to be under-used in Australia. The main issues contributing to this are:

- rates of radiotherapy treatment which are well below overseas standards, caused by:
  - a lack of understanding about the effectiveness of radiotherapy compared with other treatments;
  - insufficient medical education about radiotherapy at undergraduate and postgraduate levels; and
  - lack of knowledge about the cost effectiveness of radiotherapy;
- inadequate staffing levels in all States and insufficient facilities in some areas; and
- problems with access to services for patients living outside metropolitan areas.

For many reasons there are calls for changes in the way in which cancer services are organised and delivered to patients. The integration of radiotherapy services with other treatment modalities to enable coordinated management of cancer patients is considered a necessary development for best practice and service provision. Ideally, these multidisciplinary centres would conduct research and quality assurance programs to provide Australian data on which to more accurately assess the role of radiotherapy in this country, as well as promoting best practice guidelines to reduce variability in practice.

To improve access to services but maintain high quality treatment, these centres could also be the central units of a network, and provide support, quality assurance activities and continuing education for affiliated public and private centres.

Even with such a network, the nature of radiotherapy treatment means that many consumers and their carers will still require practical assistance, and State and Territory governments should ensure that their travel and accommodation schemes are adequately addressing these needs. People with cancer are equal partners in decision making about treatment. They need appropriate and adequate information about cancer and treatments as well as adequate structures for the continuity of aftercare.

Given the increase in radiotherapy services and the role of the treatment in cancer management, the lack of solid scientific evidence upon which to compare outcomes and costs and evaluate practice is unsatisfactory. The Working Party identified the need for more research in many of the aspects of radiotherapy which were considered. While there are considerable observational data, there is a paucity of data from randomised controlled trials. Issues of rigorous data and the lack of an academic base for the speciality have contributed to uncertainty about the place of radiotherapy in cancer management. The pressure on services tends to exacerbate this problem, as the priorities of treatment delivery do not allow adequate time for audit and research.

The Working Party has satisfied itself that radiotherapy in Australia maintains a high standard of safety, and considers that its applications are appropriate. It believes that patient outcomes are as efficacious with radiotherapy as other modalities in the treatment of a number of cancers, and has made recommendations for further studies. Outcome data should contribute to more definitive cost-effectiveness evidence. As radiotherapy and other modalities for the treatment of cancer evolve, the collection, analysis, interpretation and dissemination of evidence should be an integral component of service provision.

Radiotherapy is a rapidly changing area, and it can be expected that a number of current and future developments will alter the nature and structure of services and should improve both treatment delivery and outcomes. This will further increase demand for radiotherapy services, making it even more important to address and resolve as soon as possible current problems such as low referral rates and staff shortages. New clinical techniques should be evaluated rigorously before they become widely used, so that it is clear which are beneficial. This will allow future decisions on provision and development of services to be based on rigorous assessment of authenticated data.

Findings and recommendations

Effectiveness of radiotherapy

As a treatment for cancer

- Radiotherapy has advanced significantly over recent decades, and offers clear benefits to patients in terms of organ preservation, quality of life, effective palliation of symptoms and survival rates in a number of forms of malignant disease.

Quality of the evidence

- There is a lack of rigorous evidence about patient outcomes in the treatment of cancer, following radiotherapy, surgery, chemotherapy or combinations of these treatments.

Recommendation:

- **In cancers for which there is insufficient evidence about treatment outcomes, further controlled trials should be undertaken to identify the optimal treatment strategies, and to address the lack of evidence from randomised controlled trials.**

Radiotherapy in the treatment of specific cancers

Lung cancer

- Radiotherapy has an important role in the palliative treatment of lung cancer and a small but significant role in curative therapy.

Breast cancer

- Radiotherapy after breast-conserving surgery significantly reduces the risk of local recurrence. Omission of radiotherapy, even in carefully selected cases, leads to an increased risk of local recurrence. It is noted that this is the subject of ongoing randomised controlled trials.
- There is no consensus regarding the use of radiotherapy after mastectomy for early breast cancer. Further clinical trials are required to determine the indications for its use.

Prostate cancer

- Radiotherapy is no less effective than radical surgery for early prostate cancer and may produce lower morbidity. However, the impact of both these modalities on survival when compared with expectant management is not yet clear and will remain unclear until the results of current randomised controlled trials are available.

Rectal cancer

- Radiotherapy is effective as an adjuvant to surgery in the treatment of primary rectal cancer. It has an important role in the management of local recurrence and in the palliation of unresectable tumours.
- When surgery, radiation therapy and chemotherapy are combined to treat primary rectal cancer there may be a benefit in terms of survival.

Cervical cancer

- Radical radiotherapy and radical surgery produce the same survival outcomes when used to treat early stage cervical cancer.
- Radical radiotherapy alone is an effective treatment for more advanced disease (stage IIB or above).

Hodgkin's disease

- Radiotherapy is effective in treating non-bulky early stage Hodgkin's disease.
- Radiotherapy is effective in conjunction with chemotherapy for bulky stage Hodgkin's disease.

Palliation of metastatic disease

- Radiotherapy is highly effective for palliation of symptoms of localised metastatic disease of the bone.
- Radiotherapy is effective palliation, either alone or in combination with surgery, in the treatment of metastatic cancer to the brain.

Consumer issues

Access to services

- Access is mediated by the availability and regulatory framework of patient assistance schemes. The restrictions and inflexibility of the regulations of Patient Accommodation and Travel Schemes (PATS) indicate that the overall funding base is inadequate and they are understood to comprise a form of rationing to curb budgetary expenditure on the schemes.
- Existing PATS do not meet the requirements of access and equity of people living in rural and remote areas. The current level of subsidy is inadequate when the total financial burden of the patient and the immediate family is considered.
- The availability and magnitude of subsidies varies considerably between States/Territories.
- The Victorian and Queensland decision to redefine isolation for subsidy purposes from 200 km to 100 km is one step toward redressing inequalities of access but such restrictions still mediate against equitable access to treatment for low income or dependent people in both rural and metropolitan areas.
- Newer treatment modalities can sometimes require longer courses of outpatient rather than inpatient treatment. Therefore, daily or weekly travel, accommodation, meals and loss of earnings result in substantial out-of-pocket costs to patients and carers, especially as most PATS are based on a single treatment and not repeated visits.
- Education about the benefits of radiotherapy to patients and issues concerning equal opportunity to access this treatment should be targeted to rural practitioners.

Recommendations:

- **PATS should be revised to provide increased financial assistance, including assistance to carers travelling with a patient. The schemes should include provision for patients requiring longer courses of treatment. Distance criteria should be reviewed in all States/Territories so that optimal treatment choices are not compromised because of lack of access.**
- **Easy to read pamphlets containing entitlements, eligibility and details about accessing the schemes should be produced by State and Territory health authorities and should be available in doctors' rooms, hospitals and health centres where cancer patients are treated.**

Quality of life

- Quality of life issues are being increasingly recognised as highly significant indicators in the assessment of outcome of treatment.

Education and information

- While there is consumer information available for cancer patients about treatment options including radiotherapy, there are still gaps in this information.
- Decision making about treatment can be adversely affected if the referring doctor and the patient have a limited understanding of treatment options.

Recommendations:

- **Consumer information should be developed which specifically focuses on treatment options available to patients to assist their decision making.**
- **Plain English consumer education booklets about care after treatment should be developed and provided to all patients undergoing radiotherapy.**
- **Primary care guidelines in a multidisciplinary framework should be developed for post-radiotherapy management, particularly for GPs and district nurses.**

Costs and cost effectiveness of radiotherapy

- The costs and cost effectiveness of radiotherapy, surgery and chemotherapy in the treatment of cancer are not well documented.
- Costing methodologies vary significantly from study to study, and it is therefore not possible to accurately compare the cost of radiotherapy with other modalities.
- Costs of treatment vary considerably with site and stage of cancer. The available data on costs cover a limited proportion of available treatments.
- The evidence that is available, including some from Australian studies, indicates that radiotherapy compares favourably with surgery and chemotherapy in terms of cost effectiveness. However, this is not based on randomised controlled trials.

Recommendation:

- **There is an urgent need for research into the costs and cost effectiveness of radiotherapy, chemotherapy and surgery, alone or in combination, in the treatment of particular cancers.**

Current radiotherapy services in Australia

- Despite an increase in numbers of linear accelerators and radiotherapy centres since 198 the expansion has not kept pace with increasing need for services and treatment rates in Australia are still suboptimal.
- It is recognised that current service provision is inadequate, with large numbers of newly diagnosed patients each year not receiving radiation treatment. The reasons for this are complex and vary within Australia, but include referral rates which are lower than overseas standards, staff shortages and, in some States, insufficient radiotherapy facilities.

Referral rates

- Referral rates in Australia are lower than in some comparable countries. In the absence of evidence on appropriate referral rates for particular cancers, the Working Party recommends that a referral rate of 50 to 55 per cent should be considered for Australia.
- The further patients live away from metropolitan areas, the less likely they are to be referred for radiotherapy.
- Overall referral rates for people in rural areas are lower than those for people who live in metropolitan areas.

Recommendations:

- **When planning facilities a referral rate of 50 to 55 per cent should be anticipated.**
- **Radiotherapy should receive a higher profile in medical education.**
- **Inadequate staffing levels should be addressed.**
- **Traditional referral practices should be moderated in favour of multidisciplinary clinics where possible.**
- **Particular attention should be paid to improving the referral rates to radiotherapy of people living in rural and remote areas.**

Treatment delay

- There is little objective evidence available about treatment delay periods in Australia, and about the effect of treatment delay on outcome.

Recommendations:

- **A study should be undertaken to determine whether there are significant treatment delays for radiotherapy in Australia.**
- **A study should be undertaken to determine the effect of treatment delays on the outcome of treatment.**
- **If significant delays exist, further studies should be undertaken to identify the most cost-effective ways to reduce them.**

Radiotherapy practice

- Cancer management is believed to be more effective when given by a multidisciplinary team, with one member of the team acting as a point of reference for the patient.
- There is growing use of evidence-based clinical practice guidelines to promote best practice in many areas of medicine. Guidelines aim to achieve better health outcomes by improving the practice of health professionals and by better informing consumers about treatment options.

Recommendations:

- **Evidence-based best-practice guidelines for the use of radiotherapy in the management of cancer should be developed for each cancer.**
- **Further studies should be undertaken in Australia to compare outcomes of various treatment options.**

Recommended model of service delivery

- The Working Party recognises the advantages in terms of research, clinical education and quality assurance if public and private radiotherapy facilities have affiliations with universities or teaching hospitals, and considers that there should not be any small, independent centres.

Recommendations:

- **The Working Party considers that patients may be best served by a network of facilities which provide care in a multidisciplinary, multimodality setting. A network of different types of centres would allow some decentralisation of services and provide logistically more convenient care, without sacrificing the quality of services.**
- **Strong linkages between the public and private sectors should be established and supported to facilitate quality assurance activities and educational opportunities.**
- **Minimum requirements for radiotherapy facilities should be revised regularly to include new types of equipment which have been shown to be effective and which are practical to recommend for widespread use.**
- **Current radiotherapy facilities should be expanded progressively to allow for the continuing growth in need for radiotherapy services.**

Workforce and training

Radiation oncologists

- The shortage of radiation oncologists results in high individual workloads, detracting from the quality of training that can be delivered.
- The shortage of radiation oncology trainees also results in high individual workloads, placing the trainees under high clinical pressure, and reducing the productivity and attractiveness of training posts.
- The limited academic base of radiation oncology in Australia hampers teaching at both the undergraduate and postgraduate levels.
- The relative ignorance of the medical profession concerning radiotherapy results in a significant number of potential trainees being either unaware of the discipline, or preferentially attracted elsewhere.

Recommendations:

- **The way in which cancer management is taught in undergraduate and postgraduate medical education should be reviewed. In particular, medical schools should be asked to address the issue of undergraduate education about cancer when reviewing their curricula.**
- **Increased radiation oncologist positions and trainee positions should be established as a matter of urgency, in line with Medical Workforce Data Review Committee findings.**

Radiation therapists

- Currently the number of radiation therapists (formerly therapy radiographers) in Australia is considered to be adequate, although the distribution of radiation therapists varies around the country and this may result in local shortages or oversupply.
- The growing complexity of radiotherapy technology and more complex quality assurance and safety standards are adding to the time needed for radiation therapists to deliver treatment. Minimum standards for numbers of radiation therapists may need to be increased, so that quality assurance and safety standards are not compromised in the face of increasing pressure to maintain current patient throughput levels.

Medical physicists

- There are no national standards for training, accreditation or employment of medical physicists.
- No formally designated medical physics training positions exist within Australian teaching hospitals.
- The practical competency standards governing the employment of medical physicists are inadequate.
- Although the Working Party is not in a position to independently verify the legitimacy of ACPSEM recommended staffing levels, their consistency with recommended levels overseas gives them credence. This suggests that an increase in medical physics training positions is required.

Recommendations:

- **The staffing requirements of medical physicists in radiation oncology, including the required number of training positions, should be independently reviewed.**
- **There should be a national minimum qualification standard for medical physicists working in radiation oncology.**
- **A national accreditation system for the medical physics profession should be introduced.**
- **Medical physics training positions should be introduced to enable an approved practical training program to be carried out under the accreditation system.**

Radiation oncology nurses

- Education for oncology nurses is generally provided as in-service by hospitals with an emphasis on chemotherapy nursing. District and community based nurses are responsible for much of the aftercare of radiotherapy patients, particularly the elderly.
- There is insufficient recognition of the important role played by radiation oncology nurses in the treatment of cancer patients.

Recommendations:

- **Oncology education for nurses should include all treatment modalities. Nurses working with oncology patients need accessible and flexible study options in oncology nursing that include consumer perspectives, treatment options and aftercare management.**
- **There should be increased recognition of oncology nurses, including a widely accepted definition of their role and a national program for professional development.**

Funding arrangements for the oncology workforce

Recommendation:

- **There should be greater coordination between State and Commonwealth bodies in determining the funds available for training.**

Future developments in radiotherapy

- Technical and clinical advances over past decades have established the place of radiotherapy in cancer management. Future developments in the field are likely to further improve the effectiveness and efficiency of the technique.
- Technical advances include: multileaf collimators and independent jaws; on-line portal imaging; record and verify systems; 3D planning systems; and the use of CT scans as simulators.
- New clinical techniques include: treatments given in multiple daily fractions; 3D conformal radiotherapy; high dose rate brachytherapy; stereotactic radiosurgery, intra-operative radiotherapy; and combined hyperthermia and radiotherapy.

Recommendation:

- **New technical and clinical developments should be evaluated rigorously before they become widely used.**

1. Introduction

Radiation oncology is the branch of clinical medicine concerned with the application of ionising radiation in the treatment of disease, and now is devoted almost entirely to the treatment of cancer. Radiation oncology is also known as radiation therapy or radiotherapy. It is one of the three main treatments for cancer, with surgery and chemotherapy.

Radiotherapy has been used in the curative and palliative treatment of cancer for many decades. Demand for the provision of radiotherapy services continues to grow. The provision of services needs to be kept under review because, unlike some other expensive therapies and interventions, the expansion of radiotherapy services requires dedicated facilities and early decisions to make capital investment, as well as consideration of appropriate infrastructure and staffing requirements.

The need for review is underlined by the ageing Australian population and an annual two per cent increase in the incidence of cancer. The number of newly diagnosed cancer patients is likely to increase from 72,000 in 1995 to 99,000 in 2005. This has significant implications for the provision of radiotherapy services, including both the installation of new machines and the upgrading and replacement of existing facilities.

While radiation oncology services continue to expand, debate persists about the adequacy of the service and its place in the health care system. Between 1982 and 1995 a total of 42 reports and inquiries on radiation oncology services in Australia was published, including a number at both State and Federal level. There has been general concern that little action has resulted from these reports, especially as many recommendations are common to a number of them. Similar recommendations have been made for radiotherapy services in countries of comparable sophistication and population size, such as the Netherlands (Health Council of the Netherlands, 1993).

The Australian Health Technology Advisory Committee (AHTAC) has undertaken the assessment of radiation oncology services in view of the importance of this technology and the continuing debate. AHTAC, a standing committee of the National Health and Medical Research Council (NHMRC), evaluates health technologies and highly specialised services.

To assist AHTAC, a Working Party on beam and isotope radiotherapy was established in 1993. The Working Party was comprised of members with expertise in radiation oncology, surgery, medical oncology, medical physics and biomedical engineering, health economics and consumer issues. The membership of the Working Party and its terms of reference are set out in Appendix 1. The Working Party had a brief to consult widely in the development of its report and has received input from a number of interested groups.

The Working Party examined data on existing practices and information on new developments in radiotherapy treatment in order to assess its safety, efficacy, effectiveness, cost, equity, accessibility and social impact in the context of the Australian health care system. Patient outcomes following radiotherapy were compared with those of alternative treatments. Estimates of cost effectiveness and the implications of equipment distribution and availability were also considered.

The outcomes of radiotherapy have been assessed for curative, palliative and adjunctive roles. Measures of outcome include survival rates, side effects, relapse rates and data on relief of symptoms. Consideration of impact on quality of life has also been included where data were available.

Radiation oncology units are highly specialised, need extensive infrastructure and require a large population base to ensure the quality of the services they provide. These services cannot be provided in the less populated areas of Australia. There is a need to ensure that adequate mechanisms exist to support those patients living away from major population centres, and these aspects were also considered.

The task of the Working Party was considered in the context of significant national initiatives in the health area, including the following.

- The Australian Health Ministers' Advisory Council (AHMAC) in its Sunshine Statement of February 1993 (AHMAC 1993) agreed to achieve optimal individual and population health within available resources through a focus on improving health outcomes. An outcome was defined as a change in the health of an individual, a group of people or population which is attributable to an intervention or series of interventions.
- The report *Better Health Outcomes for Australians* (DHSH 1994), which resulted from the Sunshine Statement, set out national health goals and targets as a first step in the development of a national approach to improving health outcomes. Cancer was one of the initial target areas.
- In 1995 the Better Health Outcomes Overseeing Committee (BHOOC) was established to monitor and report on the progress of goals and targets identified in *Better Health Outcomes*. BHOOC focuses on practices across the health continuum, from prevention and early intervention through to the development of best clinical practice and measurement of the impact that interventions or changed health practice has on the health status of population groups. BHOOC plans to develop principles for linking health outcomes and financing arrangements within the health sector as a whole.
- The NHMRC Quality of Care and Health Outcomes Committee (QCHOC) was established to develop a national program to encourage the development of clinical practice guidelines and outcome measures for selected conditions. The main purpose of these guidelines is to achieve better health outcomes by improving the practice of health professionals and by better informing consumers about treatment options. QCHOC has recently released *Guidelines for the Development and Implementation of Clinical*

Practice Guidelines (QCHOÇ 1995a) as well as guidelines for both clinicians (QCHOC 1995b) and consumers (QCHOC 1995c) about the management of early breast cancer. The chapter in the latter for radiotherapy of early breast cancer is of particular relevance to the Working Party.

- The Australian Health Outcomes Clearing House at the Australian Institute of Health and Welfare (AIHW) was established to provide a focus for activity in measures of health and health outcomes in Australia.
- The *Report on the Management and Treatment of Breast Cancer in Australia* by the House of Representatives Standing Committee on Community Affairs, released in February 1995, made a specific recommendation that the AHTAC *address immediately the distribution of radiotherapy units and the required number of radiation oncologists and technical staff* (House of Representatives Standing Committee on Community Affairs 1995). Other recommendations concerning radiotherapy relate to the education of general practitioners and medical undergraduates about radiotherapy.
- National programs for the early detection of breast cancer and the prevention of cervical cancer have been in operation since 1991. These programs may increase the identification of both these cancers in the short term, and therefore the demand for treatment services including radiotherapy.
- AHTAC is conducting reviews of colorectal and prostate cancer screening, magnetic resonance imaging (MRI) and diagnostic ultrasound. The impact of radiotherapy treatment options are important issues for both colorectal and prostate cancer, and the development and application of MRI and diagnostic ultrasound have implications for the diagnosis and staging of cancers.

Methods

Definitions

For the purposes of the report, the term 'beam and isotope radiotherapy' includes mega-voltage external beam radiotherapy and brachytherapy. Radiosurgery is not included in the discussion, although it is referred to in the chapter on new developments. There has been no consideration of treatment with radiopharmaceuticals (unsealed sources).

Quality of life was understood by the Working Party to include both subjective and objective measures and to have particular meaning for cancer patients. A statement about quality of life is included in the report.

A glossary of terms relating to cancer treatment is in Appendix 5.

Consultations

In the course of the study, formal consultations were held with the Faculty of Radiation Oncology of the Royal Australasian College of Radiology (RACR), Australian Institute of Radiography (AIR), the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM) and the College of Nursing Australia (CNA).

Informal consultations were held with a number of other organisations and individuals.

Public consultation

The draft report was released for public consultation in September 1996. It is expected that a revised draft will be considered by NHMRC in November 1996.

Previous reports and inquiries

The Working Party reviewed the 42 previous reports and inquiries into radiotherapy services in Australia. A summary of these reports is set out in Appendix 2.

In addition, the reports of the Medical Workforce Data Review Committee (DHSH 1995) and the House of Representatives Standing Committee on Community Affairs (1995) were important sources of information.

Data sources

Data used in this report have been obtained from literature searches based on Medline and other data bases, ACPSEM, AIHW and Australian Bureau of Statistics (ABS) and summaries from previous Australian inquiries into radiotherapy services. The RACR provided extensive information including survey results.

A number of overseas organisations were contacted in an attempt to obtain data on referral rates for radiotherapy.

State health authorities provided information about provision of radiotherapy services and about patient assistance schemes for rural and remote patients who must travel to receive radiotherapy treatment. These schemes were analysed to assess their ability to overcome the geographic and financial barriers these patients face.

Consumer representation was sought through the Consumers' Health Forum of Australia to facilitate the incorporation of consumer perspectives on radiotherapy services. Consideration of consumer issues focused particularly on defining barriers to accessing radiotherapy treatment, particularly because of the centralisation of treatment centres in metropolitan areas.

2. Cancer and its major treatments

A profile of cancer

The term cancer is used to describe a number of diseases characterised by the proliferation and spread of abnormal cells. These cells cannot be regulated by normal cellular mechanisms, and grow in an uncoordinated fashion. Cancerous cells may invade normal tissues or metastasise (spread) to distant organs, and each cancer has its own pattern of local behaviour, metastasis and response to preventive measures and therapy. Some cancers have common causes or risk factors, but most are believed to be initiated by a unique set of factors (DHSH 1994). The incidence of a number of cancers continues to increase and, while the overall cancer death rate has begun to fall, the death rate from many of the most common cancers is either stable or still increasing.

In 1994, cancer was the leading cause of death in Australia, accounting for 33,658 deaths or 26.6 per cent of the 126,683 registered deaths from all causes (ABS 1995). The standardised death rate for malignant neoplasms in 1994 was 189 deaths per 100,000 of the population. Cancers were the leading cause of death for both males (19,285 deaths) and females (14,373 deaths) (ABS 1995).

Ischaemic heart disease was the second leading cause of death in 1994, responsible for 30,573 or 24.1 per cent of deaths from all causes (ABS 1995).

The most common primary site of malignant neoplasms was the digestive organs and peritoneum (including the colon, stomach and pancreas). These cancers caused 9,511 deaths, which is a rate of 53 deaths per 100,000 of the population (ABS 1995).

In males, the lung (including trachea and bronchus) was the most common primary cancer site. Lung cancer caused 4,810 deaths in 1994, representing a standardised rate of 54 deaths per 100,000 population. The breast remained the most common primary site of malignant neoplasms for females, accounting for 2,655 deaths in 1994, which is a standardised death rate of 30 deaths per 100,000 population (ABS 1995).

Treatments for cancer

The aims of cancer treatment are to cure the disease, prolong useful life and improve the quality of survival (palliation). Treatment involves surgery, radiotherapy, chemotherapy, hormone therapy or a combination of these. There can be no single approach to cancer management because each type is detected and treated differently depending on the tissue involved and the extent of disease at the stage of presentation. While some cancers can be cured, others can continue or recur and require repeated treatments over time.

Surgery

In most cancers which involve solid tumours, removing the tumour surgically is the mainstay of curative treatment. For many years, this involved the removal of the tumour and all surrounding tissue in an attempt to cure the disease. However, the trend in recent years has been towards less radical surgery, with radiotherapy and chemotherapy used post-operatively to treat local or distant areas to which the tumour may have spread. For example, most surgery for breast cancer now involves either less radical but total mastectomy or breast-conserving lumpectomy, reinforced by radiotherapy and/or chemotherapy. Surgery may also be used secondarily when the bulk of the tumour has been reduced by prior radiotherapy or chemotherapy and in palliative treatment. The major problems associated with cancer surgery are the risks implicit in the conduct of surgery and anaesthesia and the mutilating effects of excision, although these can be overcome by modern reconstructive techniques.

Chemotherapy and hormone therapy

This includes all treatments for cancer other than radiotherapy and surgery. These treatments may be targeted specifically at the cancer primarily in a curative sense, or used palliatively, and include chemotherapy (cancer-killing chemicals), hormones and gene therapy. These treatments differ from both radiotherapy and surgery in that they are usually given systemically and thus are capable of controlling widespread disease. They may be given as adjuvant therapy after surgery or radiotherapy to eradicate hidden residual disease and lessen the risk of recurrence. In neo-adjuvant therapy, medical therapy is given before local treatment to try to reduce the size of the primary cancer and allow less radical surgery or radiotherapy.

There are at least 40 cancer-killing drugs available for prescription which are usually given in combinations of between two and six drugs, in repeated short courses. Chemotherapy can be used in the adjuvant therapy of common cancers such as breast and colon cancers, in the palliation of symptoms in advanced disease and as a curative strategy in some of the less common cancers.

The main disadvantage of chemotherapy continues to be the balance between benefit and risk in terms of side effects on normal tissue. Recently, the introduction of new agents which have the capacity to minimise the toxic effects of chemotherapy have allowed the administration of doses of chemotherapeutic drugs that would not have been tolerated previously, thus increasing the chances of cure.

Hormone therapy has a major role in the treatment and palliation of hormone-dependent tumours such as breast and prostatic cancers. Gene therapy has potential for the management of genetically determined disease but its precise role in the management of cancer remains to be defined.

Radiotherapy

Radiotherapy, like surgery, is used for the local control of malignant disease for intended cure and in palliation. Radiotherapy may be used singly as the primary curative method, or as adjuvant therapy with surgery (either before or after an operation), or with chemotherapy, or both. In addition, radiation serves to palliate the symptoms of locally advanced or metastatic disease and improve quality of life. The treatment is based on the fact that doses of radiation destroy cells. Limiting the dose as much as possible to the tumour and its potential extensions minimises the damage to normal tissues, although some injury to such tissues and some systemic effects are inevitable results of radiotherapy.

There are two main forms of radiotherapy: external irradiation (external beam radiotherapy); and intracavitary and interstitial irradiation (brachytherapy).

External beam radiotherapy

External beam radiotherapy delivers treatment from outside the body. This involves the use of high energy X-rays and electron beams produced from a linear accelerator, gamma rays from decay of cobalt-60 in a cobalt unit, or less penetrating X-ray beams similar to those produced by diagnostic X-ray equipment.

These types of irradiating apparatus produce treatment beams of different characteristics and allow the radiation oncologist to vary the treatment prescribed according to the particular tumour being treated and its position within the body.

Superficial units generate X-rays of 50 kV to 150 kV which deliver 100 per cent of the dose to the skin surface and have only limited penetration, so that at a depth of 0.5 cm the given dose has been reduced to approximately 80 per cent. These units are therefore most commonly used for treatment of superficial tumours, such as basal cell and squamous cell carcinomas and Kaposi's sarcoma.

Orthovoltage units generate X-rays of 250 kV to 400 kV. They also deliver 100 per cent of the dose to the skin surface, but penetrate more deeply, so that it is not until a depth of 3 cm that the given dose has been reduced to approximately 80 per cent. In addition to treating more deeply infiltrating skin cancers, orthovoltage units have been used for treating cancers which are close to the body's surface, such as bone metastases in ribs.

Megavoltage units are linear accelerators or cobalt-60 units which produce X-rays, electron beams and gamma rays in excess of 1 million volts (1000 kV or 1 MV). The notation MeV refers to million electron volts as distinct from MV which is million X-ray volts or gamma ray energy.

Cobalt-60 units contain a radioactive cobalt-60 source produced in a nuclear reactor. On decay this gives two gamma rays with an average energy of 1.22 MV. The major advantage of cobalt is the greater penetration of the treatment beam and the skin sparing effect. One hundred per cent of the dose is at 0.5 cm below the skin surface and 80 per cent of the dose reaches 4.5 cm.

Linear accelerators can produce both X-rays of 4 to 25 MV and electron beams of 6 to 25 MeV, depending on the specifications of the unit. The X-ray beams are more deeply penetrating than cobalt gamma rays and the 80 per cent dose ranges varies from 7 cm for 6 MV to 10 cm for 25 MV. In addition, the beam edges are more sharply defined than either orthovoltage or cobalt beams, meaning that the treatment can be more focused and the adjacent tissue receive less of the dose. The X-ray beams also have a skin sparing effect which increases with the beam energy up to a limit. Electron beams also have a skin sparing effect and a rapid fall off in penetration which varies with the electron energy used. In many ways electron beams are similar to both superficial and orthovoltage beams but, because of their skin sparing and greater energy selection and more rapid fall off in dose, they are the preferred treatment in many sites.

A ***single photon*** linear accelerator (SPLA) has a maximum X-ray energy of less than 10 MV. This includes single X-ray energy machines or machines with two X-ray energies with or without a range of electrons.

A ***dual modality*** linear accelerator (DMLA) is defined as having two X-ray energies, with the highest energy being 10 MV or above and, in addition, a range of electrons up to 15 MeV minimum.

Brachytherapy

Brachytherapy uses sealed radioactive sources inserted into tumours or cavities to deliver a high dose of irradiation locally without excessive exposure of the surrounding normal tissues. It may be used either as sole treatment, or more often as a means of delivering a *boost* dose to the main tumour volume, in conjunction with external beam radiotherapy.

Radioactive isotopes such as caesium-137, iodine-125, iodine-131, iridium-192, tantalum-182 and gold-198 are used. Applicators are inserted into the desired position under general anaesthetic in theatre, with later afterloading of the radionuclide when the patient has returned to the ward (Brady et al. 1993). Automated remote afterloading is now the recommended means of delivering brachytherapy (AIHW 1989). It allows the transfer of the radionuclide into the applicators from a shielded machine outside the treatment room, with return of the sources into the machine whenever nursing procedures or visits from relatives take place (Mazeron & Boisserie 1993). This avoids the inadvertent exposure of visitors and staff.

Brachytherapy is given in three main ways.

- Low dose rate (LDR) treatments using caesium-137 are the current benchmark for gynaecological applications, as this is the method for which the largest experience is available.
- Brachytherapy using iridium-192 can be given over a much shorter time with high dose rate (HDR) treatments (several minutes compared with several days for LDR treatments). Intraluminal HDR brachytherapy (into body lumens such as bronchus and oesophagus) can give effective palliation of obstruction or bleeding after a single treatment. It can be done as a day-only procedure, rather than as management by a fractionated course of external treatment from a linear accelerator.
- Pulsed dose rate (PDR) brachytherapy is a more recent development which mimics the well established low dose rate treatment. A *pulse of treatment* is given for 10 to 15 minutes each hour, and between pulses the sources are retracted into the machine and the patient is free to move around and have visitors.

The development of radiotherapy over this century is discussed in the next chapter, and current and future developments in technical and clinical aspects of the specialty are presented in Chapter 9.

3. Historical development of radiotherapy

Radiation oncology would not exist today without the discovery of X-rays by Roentgen in 1895, of radioactivity by Becquerel in 1896 and of radium by Marie Curie in 1898. The X-ray tube was initially used to obtain images of bones for diagnosis and later to treat superficial cancers. In the early 1900s sufficient quantities of radium became available for therapeutic use and it too was used to treat superficial cancers.

External beam radiotherpy

The use of X-rays to treat cancer was inhibited by the unstable output of the early apparatus and the limited tissue penetration of the radiation produced. This improved in 1914 with the introduction of the Coolidge vacuum tube, which resulted in stable and later more penetrating X-ray beams. With gradual improvements orthovoltage therapy (deep X-ray) was developed and by the 1930s X-ray machines were capable of delivering beams of up to 250 kV (Prosnitz et al. 1983). Substantial cure rates were obtained for superficial cancers such as those of the skin and lip. Bleeding from ulcerated tumours and bone pain from secondary tumours in the ribs and spine could be palliated effectively. However, adverse skin reactions severely limited the delivery of an effective dose at depth and the control of deep seated tumours was obtained less often.

The first megavoltage machine was installed at St Bartholomew's Hospital, London in 1936. Following the development of the nuclear reactor in the 1940s and the production of radioactive isotopes, the first cobalt-60 machine developed for radiotherapy treatment was used in 1951. The gamma rays produced had a mean energy of 1.22 MV and together with a skin sparing effect considerably improved the usefulness of external beam radiotherapy. After the development of the magnetron during World War II, linear accelerators evolved rapidly during the 1950s and 1960s. X-ray and electron energies up to 20 MV became available and further extended the application of radiotherapy.

The introduction of planning simulators in the 1970s allowed more accurate localisation of tumour volumes which previously were outlined using anatomical bony landmarks. Computerised planning techniques and the later addition of CT profiles further assisted in the delineation of tumour extent. Computerisation of treatment delivery and some recent technological and clinical advances in radiotherapy are outlined later in this report. Many of the advances in radiotherapy have been due to developments in radiobiology which have provided a scientific basis for the clinical improvements in patient outcomes.

There have been a number of important advances in the clinical and technical aspects of radiation oncology over the past decade, and these are discussed fully in reviews by Lichter and Lawrence (1995) and Mameghan (1992).

Brachytherapy

The isolation of radium in usable amounts did not occur until the early 1900s, but the technique was quickly adapted to treat superficial cancers. Radium was held in place in wax casts or lead cut-outs which were moulded to the surface to be treated. It was not until radium was packed into cylinders or needles that brachytherapy (previously called curietherapy or endocurietherapy) began to be used for accessible and deeper seated tumours. Intracavitary (into body cavities) and interstitial (into tumour masses or body tissues) methods became popular and cancers such as those of the cervix, uterus, tonsil or neck nodes were treated, often in conjunction with external beam radiotherapy. Radium was not an ideal radionuclide as it was quite bulky, had a half-life of 1620 years, emitted rays of effective energy of 1.2 MeV and decayed to form radon (a gas). This presented considerable problems with shielding. However, the use of brachytherapy was well developed before World War II, largely because of the limitations of the available external beam treatments.

After World War II the popularity of brachytherapy decreased with the introduction of mega-voltage equipment. However, developments in nuclear reactor technology produced new radioactive isotopes that had the desired energy, specific activity and half-life for repeated use and emitted no gas on decay. In 1961 afterloading techniques were introduced by Henschke in New York. Automated remote afterloading became commercially available in 1979 and is now the recommended means of delivering brachytherapy (NHTAP 1989).

There has been recent resurgence in the use and application of brachytherapy in clinical radiotherapy (Nag et al. 1995), with the availability of high dose rate sources and computer technology. These allow treatment to be given over a much shorter time period and also allow for variation in tumour outlines and the position of the applicator in the tumour. For a number of less common cancers, brachytherapy is well established as the definitive or boost treatment and most studies in these areas aim to define best practice rather than prove overall benefit. This is true for gynaecological malignancies such as cervical and endometrial carcinomas, but also for skin carcinomas, head and neck cancers, some orbital tumours and anal cancer.

Development of radiation oncology in Australia

By the early 1900s most capital city hospitals in Australia had obtained X-ray tubes for diagnosis. The effect of X-rays on tumour growth was observed and mainly used by dermatologists to treat superficial skin cancers (Ryan et al. 1996).

By the end of the 1920s there had been considerable improvements in X-ray equipment used for radiotherapy. For example, in 1928 St Vincent's Hospital in Sydney was supplied with a Victor Deep Therapy unit and in 1934 a separate department of radiotherapy was established.

The Mater Hospital in Brisbane began operation of a radiotherapy department in December 1926. During this time intracavitary radium was used in the treatment of cancers of the cervix and endometrium.

In 1927 the Commonwealth Government bought a substantial quantity of radium for distribution to hospitals in all States of Australia. It also established a Cancer Research Committee which met annually between 1930 and 1939 to discuss the latest developments in the use of radium and X-rays in the treatment of cancer. With this yearly conference and the creation of radium registrar positions in Sydney, Melbourne and Adelaide, expertise in cancer treatment developed. Due to the high skin dose and limited penetration with the X-ray machines then available for external beam radiotherapy, brachytherapy became a well established treatment.

The Australian and New Zealand Association of Radiologists was formed in 1935. It later became the Australasian College of Radiology and finally the Royal Australasian College of Radiologists. The Radiation Oncology Standing Committee was formed in 1978 and became the Faculty of Radiation Oncology of the RACR in 1994.

By the 1940s most radiotherapy centres had superficial and orthovoltage X-ray units of up to 400 MV and also had a supply of radium and radon for intracavitary and interstitial use. During World War II there were significant developments in the field of radioactivity leading to the isolation and subsequent production of a number of radioactive isotopes. Cobalt units were also introduced in various States at around the same time as linear accelerators. Patients were first treated by linear accelerators in Australia at the Queensland Radium Institute in November 1956 and in January 1957 at the Peter MacCallum Cancer Institute in Melbourne. Adelaide followed in 1957, Perth in 1962, Sydney in 1963 and Hobart in 1969.

Further growth of radiotherapy services in Australia has occurred more slowly. There are now 33 public and private radiation oncology facilities around the country, with variation among the States and Territories in the numbers and types of services offered. The development of radiotherapy services has not always been well coordinated, and has depended to some extent on the support of individual activities. This has been in part due to the perceived high establishment costs, debate about the best modes of treatment for cancer and a pervading yet unfounded belief that cancer is incurable. Some of the units have been publicly subsidised by community organisations.

Review of previous reports

In order to provide appropriate background and focus for the present study, the reports of the previous inquiries were reviewed where they were available. The inquiries into radiotherapy services in Australia held between 1982 and 1995 are listed in Appendix 2, along with summaries of their reports.

Table 3.1 lists the recurring recommendations of these reports. In general, the inquiries found that radiotherapy was under-utilised as a treatment for cancer in Australia, and that units in most States required more equipment and staff. There was a need for more megavoltage machines and associated equipment, more radiation oncology traineeships, more radiation therapist (formerly therapy radiographer) positions and more medical physicists. The phasing out of cobalt units for megavoltage machines was recommended in most of the reports reviewed. Another issue commonly raised was the need for radiotherapy services to be integrated better with other cancer treatment services, preferably in a comprehensive cancer care centre.

Table 3.1

Recurring recommendations in the inquiries into radiotherapy services in Australia

- Radiation oncology facilities in each State should be organised around a comprehensive cancer centre model to ensure concentration of expertise, maintenance of high quality services and efficient use of capital resources.
- Radiation oncology facilities should comply with AHMAC guidelines for minimum standards.
- Projections of future radiotherapy equipment and workforce should be periodically reviewed to take account of changes in radiotherapy treatment patterns (including referrals and retreatments), technological advances and cancer incidence patterns.
- Future projections should be based on 45–55% referral rate for radiotherapy services since the current 38% referral rate is below standards in other countries such as the UK, USA and Canada.
- Cobalt units should be phased out with future megavoltage machines being linear accelerators.
- More megavoltage machines and associated equipment are required to counteract the existing shortfall and accommodate future increases arising from population ageing, increased cancer incidence and population growth.
- The number of radiation oncology traineeships should be increased to overcome existing staff shortfalls and to ensure the effective operation of recommended additional equipment.
- The number of radiation therapist training positions should be increased to counteract the shortfall arising from insufficient Australian training positions and the worldwide shortage of radiation therapists.
- The number of medical physicist positions should be increased to accommodate projected increases in equipment availability.
- Radiotherapy data collection should be improved to enable better analysis of equipment/staffing requirements and provide assessment of the comparative cost effectiveness of radiotherapy.
- Transport and accommodation needs of radiotherapy patients and their families should be addressed.

Source: see Appendix 2

The 1989 AHMAC report on radiation oncology (AHMAC 1989) concluded that major deficiencies existed in the provision of radiotherapy services in Australia and recommended that a planned program of increasing equipment be undertaken immediately by Governments at both state and federal level. While there have been improvements since then, the report's recommendations were made without access to accurate estimates of cancer incidence, and the appropriate levels of equipment and staffing were underestimated significantly. The incidence of cancer has continued to increase and the Australian population has continued to age, placing further demand on services. As cancer treatment technologies develop and the demand for services grows, there are calls for changes in the way in which cancer services are organised and delivered to patients.

In view of the substantial number of reports on radiotherapy issued since 1982, the Working Party acknowledges that governments and health care organisations recognise major problems with the provision of adequate resources for this technology.

4. Effectiveness of radiotherapy

Radiation treatment of cancer is a vast topic. There are many types of disease, their different stages require varied approaches and there are numerous complex issues related to the technical aspects of treatment, use of resources and measurement of outcomes. Rather than attempt to address all these issues, the Working Party decided to begin this chapter with a brief review of the overall effectiveness of radiotherapy, followed by a more detailed analysis of the use and effectiveness of radiotherapy which is based on reviews of the treatment of selected cancers.

Consideration of the effectiveness of radiotherapy must be interpreted in terms of the quality of evidence upon which it is based. The overall clinical objective is to identify the optimal treatment strategies for selected cancers. However, there is insufficient rigorous evidence comparing patient outcomes following surgery, chemotherapy, radiotherapy, or combinations of these modalities. Consequently, the place of radiotherapy in the optimal management of cancers has not been clearly defined and this has impeded the full acceptance of radiotherapy as a branch of oncology rather than a technical tool in cancer management.

There is a paucity of randomised controlled evidence in this area. The randomised controlled trials that have been done tend to compare techniques of delivery or dose sizes within radiotherapy practice rather than compare the effectiveness of different modalities. This is principally because cancer treatment usually involves a combination of different treatments, but also because radiotherapy has become so established in the treatment of a number of cancers that randomised trials would be considered to be unethical. However, despite these difficulties, any controversy about the use of any modality as a definitive treatment should be resolved by a randomised controlled trial.

Recommendation:

- **In cancers for which there is insufficient evidence about treatment outcomes, further controlled trials should be undertaken to identify the optimal treatment strategies, and to address the lack of evidence from randomised controlled trials.**

Measures of benefit for radiotherapy

Radiotherapy may be used singly as the primary curative method, or as adjuvant therapy with surgery or chemotherapy or both. Radiation is also used to palliate the symptoms of locally advanced or metastatic disease and to improve quality of life.

As a single method of treatment undertaken with curative intent, radiotherapy is a local or regional form of therapy that is often an alternative to surgery (Prosnitz et al. 1983). If the probability of cure is equivalent for the two methods, the choice between them will often depend on referral practices, availability and relative risk of morbidity. In the case of larger

tumours, surgery usually has a higher likelihood of tumour cure. However, primary radiotherapy is often employed in neoplasms that are technically unresectable or require surgery that is excessively mutilating.

Radiotherapy is frequently combined with surgery in more advanced tumours. The rationale is to enhance the chance of cure and improve functional results by resecting clinically apparent disease and delivering moderate radiation doses to potential residual microscopic tumours in the primary site or regional areas or both. Radiotherapy is also used as an adjunct to chemotherapy.

Over recent decades, there have been impressive technological and clinical advances in radiotherapy and these have increased the benefits of the treatment for patients. Indicators of these benefits include higher survival figures, organ preservation techniques, palliation of symptoms and improvement in quality of life.

Survival

Morgan (1993) has summarised the significant improvements in survival achieved for a number malignancies primarily treated with radiotherapy.

Table 4.1
Improvement in five-year survival with radiotherapy treatment

Cancer	Orthovoltage X-rays	Megavoltage X-rays	
	1950s (%)	1970s (%)	1990s (%)
Hodgkin's disease	30–35	70–75	70–85
Carcinoma of cervix	35–45	55–65	55–85
Carcinoma of bladder	0–5	25–35	25–45
Seminoma of testis	65–70	90–95	95–98
Carcinoma of tonsil	25–30	40–50	40–65

Source: Morgan 1993

Organ preservation

Radiotherapy is used for this purpose for carcinoma of the vocal cord, conservative management of breast cancer, carcinoma of the anus and in the treatment of subclinical disease without mutilating surgery, for example radical neck dissection (Morgan 1993).

Palliation of symptoms

Radiotherapy has a major role in the palliation of symptoms of a number of cancers, particularly the palliation of symptoms of metastases in the bone and the brain.

Quality of life

Treatment with radiotherapy can improve quality of life in a number of ways in selected cases:

- relieve pain;
- avoid recurrence of the cancer;
- avoid the need for laryngectomy, colostomy, ileostomy or other more extensive and mutilating surgery, and avoid amputation in some cases; and
- halt or delay progression of the illness.

Radiotherapy has advanced significantly over recent decades, and offers clear benefits to patients in terms of organ preservation, quality of life, effective palliation of symptoms and survival rates in a number of forms of malignant disease.

The role of radiotherapy in the treatment of selected cancer sites

The use and effectiveness of radiotherapy have been assessed in the treatment of the following cancers:

- lung
- breast
- prostate
- rectum
- cervix
- Hodgkin's disease
- bone/brain metastases

These cancers were chosen either because they have a relatively high incidence in the Australian population or because radiotherapy has a significant role in their treatment. For example, cancer of the breast is common and is an example of a cancer where the treatment modality depends on the stage of the disease and there are alternative treatments. Hodgkin's disease is not common, but is important to evaluate because it often begins in early adulthood and radiotherapy offers a possible cure.

Lung cancer

Lung cancer is the third most common malignant neoplasm in Australia, with an age-standardised incidence of 29.2 per 100,000 population (Jelfs et al. 1996). However, lung cancer is the leading cause of cancer mortality with a death rate of 38 per 100,000 population in 1994 (ABS 1995). It is the most common cause of cancer death in males, causing 4,810 deaths in 1994 (a death rate of 54 per 100,000 males). For women, death rates have increased from 14.5 per 100,000 females in 1984 (Abraham et al. 1995) to 21 per 100,000 females in 1994 (ABS 1995). In 1994, 1887 women died from lung cancer. Most lung cancer deaths occur after 55 years of age.

Non-small cell lung cancer (NSCLC)

The treatment of NSCLC makes up between 10 and 20 per cent of the workload in many radiation oncology units (Hamilton et al. 1992, Maher et al. 1993). The prognosis for patients with NSCLC is poor , although early stage disease is curable by surgical resection or radical radiotherapy. Two-year results from the CHART (Continuous Hyperfractionated Accelerated Radiation Therapy) trial show that small frequent doses of radiation can improve both tumour control and survival in patients with NSCLC (Saunders et al. In press).

Use as palliative therapy

Several reports have established the efficacy of relieving the symptoms of NSCLC with external beam radiotherapy. (Awan et al. 1990, MRC 1991). Both intrathoracic and extrathoracic symptoms such as haemoptysis, cough, dyspnoea and chest pain are effectively palliated. Radiotherapy is also effective in reducing the pain and suffering associated with skeletal, hepatic and brain metastases as well as having a useful role in the alleviation of superior vena cava syndrome and spinal cord compression. Many patients with spinal cord compression resulting from metastatic lung cancer may be effectively managed by radiotherapy alone, without surgical decompression (Awan 1990).

Traditionally a two-week course of treatment has been used to give an acceptable level of palliation. Recent trials have suggested that fewer larger fractions over a shorter period may be just as effective (MRC 1991). However, while a short high dose treatment may be appropriate for a patient with a very short life expectancy, such treatment is often not appropriate management for a patient with a good performance status or exhibiting a long natural history. In these circumstances the cost savings of a short course of treatment are frequently offset by a poorer level of palliation and the subsequent need to retreat (MRC 1991).

Use as an adjunctive therapy

Comparisons between surgery and radiation therapy for early stage lung cancer are difficult because of a difference in staging techniques (Bezjak & Payne 1993). On the basis of the available evidence, the giving of adjuvant radiotherapy after curative resection for NSCLC does not have an impact on the survival of the patient (Shaw 1992). However, when the curative resection results in a small amount of gross residuum that the surgeon is unable to remove, radiation may play a significant role in locoregional control (Bezjak & Payne 1993). The practice of pre-operative radiation has no overall survival benefit (Damstrup & Skovgaard Poulsen 1994).

Combined approaches such as chemotherapy and radiotherapy for inoperable or locally advanced disease may produce better results than the single modality approach. Some of the studies have indicated a modest increase in survival after combined chemotherapy and radiotherapy for NSCLC (Damstrup & Skovgaard Poulsen 1994, Mirimanoff 1994, Schaake-Koning et al. 1992, NSCLC Collaborative Group 1995).

Brachytherapy

Since the 1960s Halaris has accumulated extensive experience in the use of brachytherapy, including its use in the treatment of inoperable lung cancer and residual disease at the time of surgery (Halaris et al 1988). HDR intraluminal brachytherapy has been developed in the last decade primarily to provide palliation of symptoms (Chang et al. 1994), prevention of atelectasis and control of haemoptysis, particularly in frail elderly patients, where a single HDR treatment is preferable to a two-week course of external beam treatment. As up to 50 per cent of patients treated radically with external beam radiotherapy for NSCLC fail in the primary site, the use of a supplementary intraluminal dose by HDR brachytherapy is currently being investigated.

Small cell lung cancer (SCLC)

SCLC represents approximately 25 per cent of all lung cancers and is usually treated with combination chemotherapy with or without radiotherapy. The studies reviewed report an improvement in local control in patients receiving chemotherapy and radiation treatment as opposed to those receiving chemotherapy alone, with corresponding significant improvements in survival (Pignon et al. 1992).

Radiotherapy has an important role in the palliative treatment of lung cancer and a small but significant role in curative therapy.

Breast cancer

The age-standardised incidence of cancer of the breast is 65.5 per 100,000 females (Jelfs et al. 1996). The incidence rises with age and the disease is most common in older women. Breast cancer is the second most common cancer in women after non-melanocytic skin cancers and is the most common cause of cancer death in women. In 1993 it accounted for 19 per cent of all female cancer deaths (Abraham et al. 1995). The mortality rate is 30 per 100,000 females, with 2,655 deaths in 1994. In 1994 there were also 17 male deaths from breast cancer (ABS 1995).

Breast cancer is treated with combinations of surgery, radiotherapy and chemotherapy. Radiotherapy is used commonly after breast-conserving surgery and less commonly after total mastectomy, but its role in treating breast cancer is not yet clearly defined and this is the subject of a number of current studies.

The Working Party noted that the treatment of early breast cancer has recently been evaluated by the NHMRC Standing Committee on Quality of Care and Health Outcomes (QCHOC) in its clinical practice guidelines for the management of early breast cancer (QCHOC 1995b), and drew on the findings of this report for the summary below.

Radiotherapy after breast-conserving surgery

QCHOC found that the overall risk of local recurrence with radiotherapy after breast-conserving surgery for early breast cancer is between one and two per cent per year. The indications for boost irradiation are not well defined. However, failure to boost in patients with a positive margin of resection has been associated with a 30 per cent recurrence rate.

Studies involving the omission of radiotherapy after breast-conserving surgery showed a statistically significant difference in favour of giving radiotherapy to reduce the risk of local recurrence and consequent mastectomy. The recurrence rate without radiotherapy was nearly 10 per cent within two years and up to 40 per cent at eight years.

The QCHOC guidelines concluded that there is good evidence from randomised controlled trials that radiotherapy after breast-conserving surgery significantly reduces the risk of local recurrence, and that the omission of radiotherapy even in carefully selected cases leads to an increased risk of local recurrence.

Although adjuvant radiotherapy is frequently omitted in elderly women, there appears to be no objective evidence to show that this does not incur an increased risk of local recurrence. However, there is one reported study with a very short follow-up which suggests that the benefits of adjuvant radiotherapy are greater in women aged 55 years or less (Veronisi et al. 1993). The decision to omit radiotherapy following conservative surgery involves careful weighing of the benefits of avoiding the side effects and inconvenience of radiotherapy against risks of local recurrence and the possible need for later mastectomy.

The QCHOC guidelines also stated that women who have radiotherapy to the conserved breast may experience discomfort in the breast in the longer term, particularly in the first two years. They are extremely unlikely to be able to breastfeed from the affected breast. The end cosmetic result can depend on a number of factors, including the dose of radiation, the boost technique and the extent of surgery.

Radiotherapy post mastectomy

Post-mastectomy radiotherapy to the chest wall and draining lymph nodes is controversial for both early breast cancer (QCHOC 1995b) and locally advanced breast cancer (Recht & Houlihan 1995).

Various criteria have been proposed to justify radiotherapy as a means of preventing local recurrence. The decision to give post-mastectomy radiotherapy in individual cases is usually based on one or more of the following (QCHOC 1995b):

- the number of nodes involved
- the existence of extracapsular spread

- the size of the tumour (≥ 8 cm)
- the involvement of margins.

Among women with tumours larger than 5 cm in diameter or with four or more positive lymph nodes, the incidence of local recurrence is greatly diminished if mastectomy is followed by irradiation. It is possible that irradiation after mastectomy also increases the survival of post menopausal women (Recht & Houlihan 1995).

Overall, the routine addition of radiotherapy to surgery causes no significant change in mortality in the first 10 years, but an excess late mortality. This late mortality may have been due to older techniques of radiotherapy following radical mastectomy during which large doses were delivered to substantial volumes of the heart. In recent trials, the excess in cardiac deaths is offset by a reduction in breast cancer deaths, probably because of improvements in radiotherapy techniques (QCHOC 1995b).

The QCHOC study concluded that there is no consensus regarding the use of radiotherapy after mastectomy for early breast cancer and recommended further clinical trials to determine the indications for its use.

Ductal carcinoma in situ (DCIS)

DCIS is a variant of breast cancer that requires special consideration. With DCIS, the risk of local recurrence is related to the cytonuclear grade, as high grade DCIS is more likely to recur than low grade DCIS. The role of adjuvant radiation treatment following complete local excision for DCIS is uncertain. Several prospective, randomised clinical trials are being conducted and further results are anticipated over the next few years (QCHOC 1995b).

Radiotherapy after axillary dissection

Axillary lymph node status is the most powerful single variable in the estimation of prognosis for primary breast cancer. The benefits of axillary dissection in eradicating nodal disease are uncertain. However a recent review by Recht has shown that either surgery alone or radiotherapy alone may result in a one to two per cent recurrence rate (Recht & Houlihan 1995). When dissection of the axillary contents has been carried out, the risk of arm lymphoedema is increased substantially by the addition of radiation treatment (QCHOC 1995b).

Adjuvant chemotherapy

There is strong evidence that systematic adjuvant therapy with anti-oestrogen tamoxifen, multi-agent chemotherapy or ovarian ablation (in women aged 50 or less), can reduce annual risk of recurrence and death after treatment for stage I or II breast cancer (QCHOC 1995b).

Radiotherapy after breast-conserving surgery significantly reduces the risk of local recurrence. Omission of radiotherapy, even in carefully selected cases, leads to an increased risk of local recurrence. It is noted that this is the subject of ongoing randomised controlled trials.

There is no consensus regarding the use of radiotherapy after mastectomy for early breast cancer. Further clinical trials are required to determine the indications for its use.

Prostate cancer

Prostate cancer is the most commonly occurring cancer among males, with an age-standardised incidence rate of 50.4 per 100,000 males (Jelfs et al. 1996). Prostate cancer is the second highest cause of cancer death in men in Australia, with 2590 deaths in 1994. (ABS 1995). The risk of cancer of the prostate increases with age, with 95 per cent being detected in men who are 60 years of age or older (Abraham et al. 1995).

Prostate cancer tends to progress very slowly so that not all men with the disease will die from it. In fact, many elderly patients with cancer of the prostate die from another cause and may not know that they have this cancer (Johansson et al. 1992). Australian data show that the incidence of prostate cancer is rising (Abraham et al. 1995). This reported increase may be in part attributable to increased detection as a result of the growing use of Prostate Specific Antigen testing (McCredie 1995).

There is considerable controversy about the treatment of prostate cancer. The options are 'watchful waiting' (which reserves treatment for symptoms or complications), radical surgery or radiotherapy. As with other cancers the literature confirms the lack of controlled clinical trials comparing the effects of intervention in the form of surgery or radiotherapy either with each other or with expectant management.

The watchful waiting strategy is based on the average 10-year observed time from diagnosis to the need for palliative treatment. A pooled analysis (Chodak et al. 1994) has shown that observation plus delayed hormone therapy gave an 87 per cent 10-year disease-specific survival with low grade tumours. Advocates of early treatment in the form of radical surgery or radiotherapy argue that delayed treatment may miss an important opportunity to provide cure.

Radical prostatectomy is advocated strongly in both the USA and Australia, although there are no adequate Australian studies to justify the argument. None of the available studies from the USA can be regarded as definitive trials comparing outcomes in men treated by radical prostatectomy with those treated on an expectant basis, although this issue is now being addressed by the Prostate Cancer Intervention Versus Observation Trial (PIVOT) (Wilt & Brawer 1995), the Scandinavian Prostate Cancer Group (Norlen 1994) and a UK study (Barry et al. 1995) which will compare radical prostatectomy, radiotherapy and expectant management. The results of these trials will be critical in establishing a proper basis for treatment decisions for localised prostate cancer.

Review of a number of large uncontrolled case series has shown a 91 per cent 10-year disease-specific survival following radical surgery for apparent organ-confined tumours (Wasson et al. 1993). In that review, radical surgery for early stage prostate cancer showed a surgical mortality of 1.1 per cent and a significant morbidity with a complete incontinence rate of 7 per cent, impotence in at least 32 per cent and urethral stricture in 12 per cent. Radiotherapy is now undergoing extensive study due to its apparent lower morbidity and survival rates which seem comparable to those of surgery, with an 86 per cent 10-year disease-specific survival rate (Bagshaw et al. 1994). The review by Wasson et al. (1993) showed a mortality rate of 0.2 per cent, a complete incontinence rate of 1.2 per cent and a stricture rate of 4.5 per cent. Radiotherapy does cause significant early bowel and urinary symptoms but these subside with time.

When radiotherapy is used with curative intent, there is evidence that conformal treatment, which delivers a higher dose of radiotherapy locally to the prostate, produces better local control and fewer side effects than does standard therapy. However, this technique has not been widely used in Australia.

Brachytherapy

A variety of brachytherapy techniques have been used for prostate cancer treatment. Variability in patient selection, technique and the lack of randomised controlled trials incorporating brachytherapy means that it is too early to determine the role of this treatment for prostate cancer and at which stages its use is appropriate (Mazeron & Boisserie 1993).

Advanced prostate cancer

In the treatment of advanced prostate cancer, surgery has little role. External beam radiotherapy has an effect in palliation of symptoms, although there is no evidence of increased survival (Steinberg et al. 1990). However, external beam is a safe and effective modality for the palliation of pain in patients with metastatic disease from prostate cancer (Bagshaw et al. 1992).

Radiotherapy is no less effective than radical surgery for early prostate cancer and may produce lower morbidity. However, the impact of both these modalities on survival when compared with expectant management is not yet clear and will remain unclear until the results of current randomised controlled trials are available.

Rectal cancer

The incidence of rectal cancer is 13.5 per 100,000 population (Jelfs et al. 1996). Approximately 85 per cent of colorectal cancer occurs in those aged 55 and over (Abraham et al. 1995). Rectal cancer caused 1,099 deaths in 1994. The mortality rate is 6 per 100,000 population, or 8 per 100,000 males and 5 per 100,000 females (ABS 1995).

Surgical resection is the primary treatment for rectal carcinoma, either in the form of abdominoperineal resection or increasingly by anterior resection with maintenance of continuity of the bowel. However, local recurrence rates following surgery alone are high,

ranging between 20 and 70 per cent depending on the stage of disease (Willett et al. 1992). Due to the well established palliative effect of the irradiation of locally recurrent disease, pre-operative and post-operative radiation therapy or a combination of both (the sandwich technique) is being evaluated. There have been no definitive controlled trials using this technique, but a report including results from a single surgeon (thus eliminating one of the biases of other studies) suggests benefits from the sandwich technique in terms of both locoregional control (3 per cent recurrence at five years) and survival (86 per cent at five years) (Botti et al. 1994). Controversy remains as to the best timing of such therapy, and the optimal dose to be delivered has yet to be defined (Myerson et al. 1995).

Pre-operative treatment has the potential to influence resectability of the tumour, to provide optimal response of fully oxygenated tissue cells unaffected by surgery and to minimise the spread of viable tumour cells at the time of surgery (Cummings 1992). Most controlled studies have shown significant decreases in local recurrences which is a valuable response in itself, but have not demonstrated a reproducible statistically significant change in five-year survival rates (Marsh et al. 1994).

Patients who have undergone apparently complete tumour resection and have been found to have tumour extending into perirectal tissues or regional lymph node metastases are those usually selected for post-operative adjuvant radiotherapy (Cummings 1992). Post-operatively delivered radiotherapy has given only small reductions in local recurrence rates. These rates are inferior to those achieved with pre-operative radiotherapy for rectal cancer. Survival rates appear to be unaffected (Treuniet-Donker et al. 1991).

In patients with inoperable tumours, high dose radiotherapy showed conversion of an inoperable tumour into an operable tumour in 80 per cent of patients in one study, with complete eradication of cancer on histological grounds in at least half of the patients. Those who remained inoperable or who had residual tumour in the operative specimen were incurable. Radiotherapy therefore gave a high probability of cure to approximately 40 per cent of patients with what were considered to be inoperable cancers (Krook et al. 1991). The results of this study await confirmation by other groups.

As with other forms of tumour, there may be an advantage in combining chemotherapy with radiotherapy. Most studies have focussed on high dose post-operative radiotherapy with chemotherapy being delivered before, during or after post-operative irradiation. Combined modality treatment of this type for patients with deeply invasive rectal cancer or cancer involving the regional nodes improves the rate of local control and has demonstrated a 29 per cent reduction in death rate (Krook et al. 1991).

Brachytherapy

Brachytherapy does not have an established role in the treatment of primary rectal cancer but does offer reasonable local control with acceptable morbidity in locally advanced or recurrent unresectable rectal cancer (Minsky et al. 1991). However, intracavitary irradiation combined with localised pre-operative external beam radiotherapy may provide an alternative to external beam therapy alone (Gerard et al. 1994).

Complications of treatment

Acute effects following adjuvant radiotherapy given pre-operatively, post-operatively or both, such as enteritis, diarrhoea and nausea are relatively well known (Frykholm et al. 1993). The addition of chemotherapy to the treatment regimen has raised concern about tissue toxicity (Forman 1994). Although infrequent, long-term radiation effects can be severe, including radiation enteritis and bowel obstruction, because tumouricidal doses of radiation are necessary. However there is evidence that careful attention to the technical details of radiation therapy can reduce acute and chronic radiation side effects (Frykholm et al. 1993).

Radiotherapy is effective as an adjuvant to surgery in the treatment of primary rectal cancer. It has an important role in the management of local recurrence and in the palliation of unresectable tumours.

When surgery, radiation therapy and chemotherapy are combined to treat primary rectal cancer there may be a benefit in terms of survival.

Cervical cancer

The incidence of cervical cancer is 10.2 per 100,000 females (Jelfs et al. 1996). Cervical cancer risk increases with age; in 1988 the median age at diagnosis was 46 years (Jelfs 1995). Cervical cancer has a mortality rate of 4 per 100,000 females, causing 336 deaths in 1994 (ABS 1995).

Clinical staging has been unified by the International Federation of Gynaecology and Obstetrics (FIGO) and the International Union against Cancer (IUCC), but does not by itself determine treatment. According to FIGO data, outcome was relatively constant between 1950 and 1980, with five-year survival rates of approximately 80 per cent for stage I, 60 per cent for stage II, 30 per cent for stage III and 10 per cent for stage IV (Petterson et al. 1988). Prognostic factors that determine outcome are stage, tumour bulk, lymph node involvement and for radiotherapy, prolongation of treatment time.

The two forms of radical treatment for cervical cancer are surgery and radiotherapy. Irradiation has been used since the 1920s and radical hysterectomy was first described by Werthiem in 1895. For early stage disease there is little difference in outcome with either radical surgery or radical radiotherapy but, in stage IIB and above, radical surgery as the sole treatment has little application.

Radical radiotherapy

Radiotherapy as a radical treatment uses a combination of external beam and intracavitary (brachytherapy) treatments, except for small tumours and disease in situ where the likelihood of nodal spread is less than two per cent and brachytherapy alone may be used. The aim of treatment is to achieve a high dose to the cervix with brachytherapy and to use external beam irradiation to treat the pelvis and pelvic nodes, while limiting the rectal and bladder dose with appropriate shielding. External beam radiotherapy usually precedes intracavitary insertions where fractionation into two or more insertions is better than a single insertion. The presence

of involved pelvic or para-aortic nodes is one of the reasons for treatment failure. Para-aortic nodes are pathologically involved in 10 per cent of stage I patients, 20 per cent of stage II patients and 30 per cent of stage III patients. In randomised studies by the Radiation Therapy Oncology Group (RTOG) and European Organisation for Research and Treatment of Cancer (EORTC) the use of extended field external beam radiotherapy to treat both the pelvic and para-aortic nodes has resulted in statistically significant improvements in overall survival rates. The benefit is greatest for women with stage IIB or stage III disease who have the highest likelihood of spread (Rotman et al. 1995).

Low dose rate (LDR) brachytherapy is a well established treatment which has been used since the 1920s. Although a randomised comparison between LDR and high dose rate (HDR) methods has not been carried out, there is no difference in control rates or complication rates between the two. LDR involves two insertions about 10 days apart and HDR requires three or four insertions integrated with external beam irradiation (Atterbury 1993).

In major institutions, the five-year survival and severe complication rates by clinical stage for radical radiotherapy alone are: stage IB, 85 and 4 per cent; IIA, 75 and 6 per cent; IIB, 65 and 10 per cent; and III, 40 and 12 per cent (Crook & Esche 1990).

Radical hysterectomy

Radical hysterectomy is an alternative treatment for early tumours (IB and IIA less than 3 cm) in pre-menopausal women of thin build and good health. Cure rates are similar to those found with radiotherapy. The operative mortality is 0.5 to 1 per cent and the overall rate of serious or fatal complications is 2 to 8 per cent. There is no evidence of a curative role for either pre- or post-operative radiotherapy, but pelvic irradiation for high-risk patients after hysterectomy may improve locoregional control. Likewise, there is no evidence that surgery following radical radiotherapy for bulky primary tumours increases survival, but local control is likely to be improved. Recurrent tumours after radical hysterectomy may be amenable to further radical surgery including pelvic exenteration or to radical radiotherapy. Either treatment can result in five-year survival rates of 30 to 40 per cent (Crook & Esche 1990).

Chemotherapy

Chemotherapy has no defined role in curative management of carcinoma of the cervix but short-term palliation of symptoms in recurrent disease is often seen.

Radical radiotherapy and radical surgery produce the same survival outcomes when used to treat early stage cervical cancer.

Radical radiotherapy alone is an effective treatment for more advanced disease (stage IIB or above).

Hodgkin's disease

The incidence of Hodgkin's disease is 1.9 per 100,000 population (Jelfs et al. 1996). Hodgkin's disease is more common in males than in females and shows two peaks in incidence, one in young adults and the other in the elderly (Jelfs et al. 1996). The disease has a mortality rate of 0.3 per 100,000 population, with 48 males and 27 females dying from Hodgkin's disease in 1994 (Jelfs et al. 1996, ABS 1995).

Hodgkin's disease is a malignant neoplasm of the lymphatic system of the body, usually characterised by painless and progressive enlargement of lymphoid tissue. The aetiology of Hodgkin's disease is unknown, but it may be caused by viral infections, environmental exposures and/or genetic predisposing factors.

Radiation therapy alone, chemotherapy alone, and radiotherapy in combination with chemotherapy are effective modalities in the treatment of the various stages of Hodgkin's disease (Straus 1993). Accurate staging of the extent of the disease is essential for treatment to be successful (Weinshel & Peterson 1993).

Radiotherapy is the treatment of choice for early stage non-bulky disease (Biti et al. 1992, Barton, M et al. 1995, Hoppe et al. 1994). It provides a 14-year freedom from progression rate of 93 per cent and a survival rate of 75 to 82 per cent. For bulky disease, radiotherapy is used in conjunction with combination chemotherapy (Urba & Longo 1992). For patients with advanced disease, combination chemotherapy is the treatment of choice. The addition of radiotherapy may prolong duration of remission in several sub-groups, including those patients with bulky disease (Prosnitz et al. 1988, Fabian et al. 1994).

As patients now survive for many years after treatment, late unwanted side effects attain greater significance, especially if quality of life is affected. Late side effects are well understood and include second cancers and cardiac and thyroid disease (Boivin et al. 1992, Morgan et al. 1985, Zinzani et al. 1991). Special attention to choice of treatment and treatment protocols are reducing long-term complications.

Radiotherapy is effective in treating non-bulky early stage Hodgkin's disease.

Radiotherapy is effective in conjunction with chemotherapy for bulky stage Hodgkin's disease.

Palliation of metastatic disease

In Australia, palliation of symptoms of cancer in either metastatic, recurrent, locally advanced or inoperable disease may account for up to 60 per cent of the workload of a radiation oncology department.

The development of a bone metastasis is a common event for the cancer patient. The incidence of bone involvement ranges from 23 to 84 per cent among various forms of cancer (Tong et al. 1982). The most common primary lesions which give rise to metastases of the bone are carcinomas of the prostate, breast or lung (Mauch 1982).

Metastases to the brain occur in 15 to 20 per cent of patients with cancer. Of those with such metastases, approximately 40 per cent have a solitary brain metastasis (Epstein et al. 1993). The most common primary lesions that give rise to metastases of the brain are carcinomas of the lung or the breast (Ultmann & Phillips 1987).

Treatment of metastatic cancer to the bone

Localised radiation therapy is a highly effective modality in the treatment of bone pain, offering partial or complete relief in 73 to 96 per cent of patients treated (Mauch 1982). The probability of relief appears slightly better with metastatic breast cancer than with carcinoma of the kidney or prostate which require higher total doses. Patients can often be treated on an outpatient basis with megavoltage treatment. This treatment is usually well tolerated, with little morbidity.

There is some controversy regarding the total dose and number of treatments required to treat bone metastases. Although disputed (Blitzer 1985, Ciezki & Macklis 1995), studies have shown that low-dose short schedules are as effective as more protracted programs (Needham et al. 1994, Tong et al. 1982, Price et al. 1986). There are some data on retreatment rates and symptom control information for the shorter treatment schedules (Mithal et al. 1994), which show that patients can be retreated with a similar response to initial treatment, but this needs to be confirmed with prospective randomised studies.

The course of therapy may vary with the patient's location, performance status and predicted life expectancy. For a patient with bone metastases and a reasonably good life expectancy, a high dose fractionated course of treatment to delay or prevent onset of symptoms may be justified. The use of a single fraction may be more appropriate in a patient living hundreds of kilometres distant from a treatment centre.

For patients with extensive metastases, alternative approaches such as systemic therapy with endocrine therapy and/or chemotherapy may be used as well as radiotherapy, as the sequential treatments to multiple sites will involve frequent attendances at hospital (Ciezki & Macklis 1995, Mithal et al. 1994). Hemi-body irradiation has been used to control pain in selected patients with extensive metastases. A further alternative approach to the relief of multifocal pain is to administer a radionuclide which concentrates at sites of increased bone turnover. Strontium-89 is now being evaluated (Robinson et al. 1995). In considering extensive use of radiation therapy, its impact on the ability to give effective doses of chemotherapy also needs to be considered in appropriate patients.

Radiotherapy is highly effective for palliation of symptoms of localised metastatic disease of the bone.

Recommendation:

- **A study should be undertaken to determine best practice guidelines for the treatment by radiotherapy of metastatic cancer to the bone.**

Treatment of metastatic cancer to the brain

The treatment of most patients with brain metastases is palliative and quality of life considerations assume paramount importance. In general, radiotherapy with concomitant steroid therapy is the principal and often the sole treatment for most patients (Ciezki & Macklis 1995, Weissman et al. 1991).

The optimal therapy for a patient with brain metastases depends on the tumour type and clinical setting (Bourne 1991). Generally, these cancers are treated with radiation, surgery, chemotherapy, or a combination of these.

Whole brain irradiation therapy is the current standard treatment for brain metastases resulting in an increase in the median length of survival of three to six months. Studies have also shown that short treatment schedules provide as good palliation as long radiation schedules (Haie-Meder et al. 1993, Kurtz et al. 1981).

Surgery plays a primary role for a selected group of patients with solitary surgically accessible brain metastases, and is restricted to younger patients with limited systemic disease and good performance status. Although surgery plus radiotherapy has been found to be superior to radiotherapy alone in the treatment of single brain metastases (Patchell et al. 1991) radiotherapy alone remains the treatment of choice for most patients. This is because only about 40 per cent of brain metastases are single and potentially resectable. In addition, nearly half of patients with single metastases are not candidates for surgery because of the inaccessibility of the tumour, the presence of systemic disease or other factors (Ciezki & Macklis 1995, Patchell et al. 1991). Stereotactic radiosurgery, a new technique in which brain tumours can be irradiated, is now being used to treat this condition. It is described in Chapter 9. There is a need for rigorous studies in this area as there is still controversy about the existing evidence.

Radiotherapy is effective palliation, either alone or in combination with surgery, in the treatment of metastatic cancer to the brain.

Recommendations:

- **A study should be undertaken to determine best practice guidelines for the treatment by radiotherapy of metastatic cancer to the brain.**
- **A study should be undertaken to determine the effectiveness in a controlled clinical trial environment of radiosurgery in the treatment of brain metastases.**

5. Costs and cost effectiveness of radiotherapy services

In Australia, as in other comparable countries, there has been a lack of coordination in the development of radiotherapy services. First, in contrast with the adoption of new pharmaceuticals or new procedures, there are high initial cost commitments in establishing facilities. Second, in common with other treatment modalities, there is a lack of data about whether these costs are justifiable in the long term. Australian information on the costs and cost effectiveness of radiotherapy is very limited. The data are difficult to obtain because of the way that costs are collected and reimbursed in this country, especially as some costs are borne by the Commonwealth Government, some by state governments, and other costs are privately borne. Also, there is a lack of rigorous scientific clinical evidence upon which to base studies of cost effectiveness.

The available Australian and overseas evidence on costs and cost effectiveness is summarised below. These studies vary widely, with some including total hospital costs and others assigning costs to patient benefit or life years gained. Others have compared a range of common medical interventions but it is not possible to identify comprehensive comparative cost studies with consistent identified methodologies.

A review of the evidence indicates the difficulty of conducting comparative cost studies: they experience the problems inherent to clinical studies, such as heterogeneous patient groups and varying clinical practice, and have additional problems such as varying costing methodologies and the need to address quality of life issues.

Costs of services

Goddard and Drummond (1988) have reported on a review of UK studies to establish the costs of radiotherapy, and attempted to account for their apparent inconsistencies. The authors noted that despite the widespread use of radiotherapy treatment for cancer, there is little evidence on the costs of the treatment in the UK or elsewhere.

The review found that evaluation of the little information that does exist was made difficult by two factors in particular. First, the costings refer to different units of 'output' such as fractions, attendances at outpatient departments, courses of treatment or weeks of treatment, and this makes the comparison more difficult. Second, the costing methodologies vary enormously between studies, with some taking into account capital costs of machinery, maintenance, space for machinery, and other overheads, and some simply dividing annual departmental running costs by the total number of patients or attendances. Evaluation is made more difficult when the elements that have been included or excluded are not specified. This is particularly the case when charges for services are used as measures of costs, as it is often unclear if an element for overheads and capital is included in such figures.

After reconciling some of these differences, the authors found that some of the substantial discrepancies that remained might be attributable to different medical approaches to the delivery of radiotherapy treatment to cancer patients. They concluded that immediate research was needed: empirical studies to confirm the estimated costs of treatment and comparative studies of the effectiveness of different approaches to the use of the technique.

Baseline costs—Australian data

In Australia there has been little analysis of radiotherapy costs but baseline costs and capital component costs for private patients treated in the public or private sectors are available from Medicare and other Department of Health and Family Services statistics.

Table 5.1 shows the cost to Medicare of radiotherapy services for the period 1990–91 to 1994–95. As significant proportions of expenditure on radiotherapy services are not funded under Medicare, this table should be regarded as indicative only of the growth of Medicare costs, and does not include services to public inpatients or outpatients.

Table 5.1
Medicare costs for private patients, 1990–1995

Year	Cost to Medicare	% annual increase
1990/1991	$15,093,453	
1991/1992	$18,217,371	20.7
1992/1993	$19,683,948	8.1
1993/1994	$22,676,702	15.2
1994/1995	$26,427,309	16.5

Source: Department of Health and Family Services

In 1988, after negotiation with the Royal Australian College of Radiologists (RACR), the Australian Medical Association (AMA) and the Australian Association of Private Radiation Oncology Practices (AAPROP), the Commonwealth introduced a funding arrangement whereby the capital costs of major items of radiation oncology equipment were reimbursed. This arrangement superceded the inclusion of a capital component of the schedule fee for the relevant radiation oncology items in the Medicare Benefits Schedule (MBS).

For private providers, the reimbursement is 100 per cent of the notional capital cost of each machine, as determined by the Department. The payment takes place on a capital component per attendance basis up to the determined capital cost of the machine, at which point reimbursement for capital costs ceases. Grant instalments are based on utilisation statistics from MBS claims, for each uniquely identified piece of equipment.

For public providers, grant payments are determined through item utilisation for privately referred patients only in each identified facility. Equipment is not identified uniquely with the exception of dual modality linear accelerators which are grouped under a separate equipment category number and the capital component payments are not limited to a capital balance. Public providers are required to place their capital component payments into a trust fund, to be used only for the replacement or refurbishment of funded radiotherapy equipment.

Table 5.2 shows the amount expended on capital benefits from 1992–93 to 1994–95.

Table 5.2
Radiation oncology—capital component scheme

Year	Cost
1992–93	$11,544,394
1993–94	$13,530,620
1994–95	$16,727,840

Source: Dept Health and Family Services

Casemix payment

Casemix is a classification scheme that enables the numbers and types of patients treated in a hospital to be related to the resources required by a hospital. When the Medicare agreements were updated in 1993, it was agreed that the Commonwealth and States and Territories should work towards the establishment of a nationally consistent casemix-based management and information system which could serve as the foundation for alternative hospital-based funding.

In Australia, Australian National Diagnosis Related Groups (AN-DRGs) is the best known casemix classification system, although it is not the only one. AN-DRGs are based on major diagnostic categories which are further broken down according to whether a significant procedure was done or not. Most categories have an associated list of procedures as well as medical conditions. These may be divided according to the patient's age and subsequently according to the presence or absence of complications of comorbidities.

AN-DRG cost weights for radiotherapy

AN-DRG cost weights provide users with an estimate of differences in resource consumption that, on average, can be expected between DRG classes. AN-DRG cost weights are derived by:

- calculating the average resource use across all AN-DRGs; and
- using this as a common base to compile a relative value scale, with cost weight figures expressed as relative values against an overall cost weight average of 1.00.

In a casemix funding system, cost weights can be used to determine the level of payment associated with each DRG class.

Calculations for AN-DRG Version 3 cost weights were released nationally in August 1995. They revealed the following cost weights and total average costs for the two specific radiotherapy AN-DRGs:

a) Public hospitals with more than 50 beds

	cost weight	total cost
AN-DRG 781 Radiotherapy: age > 49	1.93	$4,742
AN-DRG 782 Radiotherapy: age < 50	1.21	$2,976

b) Private hospitals with more than 50 beds

AN-DRG 781 Radiotherapy: age > 49	2.59	$4,272
AN-DRG 782 Radiotherapy: age < 50	1.25	$2,089

The accuracy of DRG costing depends on accurate procedure coding to a precise classification system. However, because radiotherapy treatment is used for a wide range of illnesses, patients receiving radiotherapy may appear in DRGs other than 781 and 782. In addition, the majority of radiotherapy services are provided on an outpatient basis, so that these DRG costs are of limited use. As ambulatory DRGs are developed, these data should provide a more accurate estimate of total radiotherapy costs.

Out-of-pocket costs to patients

When considering the costs of radiotherapy, it is essential to include not just the costs to the health sector but also those carried by the patients and their carers. Patients may have to make gap payments if their practitioner charges above the scheduled fee. In terms of non-medical costs, patients often bear the cost of their travel, which can be substantial if they require a number of treatment visits. If they are accompanied by a friend or relative, there are additional costs associated with time lost from work for these people. These non-medical expenses can include out-of-pocket expenses for travel, accommodation, food and telephone as well as wages lost because of treatment time. Some overseas studies have attempted to identify and value such travel and time costs (Lansky et al. 1979, Houts et al. 1984, Junor et al. 1992). Two of these studies relate to treatment with chemotherapy, and the third to radiotherapy treatment. It is expected that the out-of-pocket expenses would be similar.

Lansky and colleagues (1979) reported on a study of non-medical costs of childhood cancer in Kansas, USA. They commented that the financial burden of cancer treatment was a major source of anxiety for families of paediatric cancer patients. Parents of these patients reported that non-medical, out-of-pocket costs were the most troublesome because, unlike medical bills, non-medical bills had to be paid immediately and were rarely reimbursed. The authors collected data on transportation, food, lodging, clothing and family care among other items. Factors influencing non-medical costs were found to include level of care, the patient's

performance status, distance from the cancer treatment centre and family size. When loss of pay resulting from one or both parents accompanying the child to the hospital was combined with non-medical costs, the results indicated a serious strain on the family budget. They found that over 50 per cent of the families studied were paying over 25 per cent of the family's weekly income for non-medical expenses associated with the child's illness and its treatment.

Houts et al. (1984) extended this study of non-medical costs to a group of adult cancer patients receiving outpatient chemotherapy in Pennsylvania USA. Results showed that approximately 45 per cent of costs to patients were out-of-pocket expenses. Patients living at a greater distance from treatment centres had higher out-of-pocket costs and younger patients reported more wages lost. Fourteen per cent of the patients were estimated to be spending more than 50 per cent of their weekly incomes on non-medical expenses, and these patients were found largely in the lower income categories.

The results of these studies were similar. In both studies transportation and food were among the largest out-of-pocket expenses, distance was associated with increased costs, and non-medical costs took a substantial proportion of weekly income for a significant number of patients.

Junor et al. (1992) undertook a survey of all patients receiving outpatient radiotherapy in the west of Scotland on a single day in 1990 to identify the methods of transport used, the time taken and the problems encountered by the patients attending outpatient radiotherapy. The authors found that some patients were having to travel very long distances with travelling times of up to two hours and a maximum time away from home of seven hours. Also it was noted that 50 per cent of the patients arranged their own transport for treatment, mostly by car driven by themselves or a relative, with only a few using public transport.

In Australia subsidies are available in some cases to assist with travel and accommodation costs. These are discussed in the chapter on consumer issues.

Voluntary and support groups

The Working Party recognises that the contribution of voluntary and support groups to cancer care has an economic component. The role of these groups is discussed further in the chapter on consumer issues.

Cancer is a disease which gives rise to substantial medical and out-of-pocket expenses for patients and their immediate families.

No Australian studies have provided information on out-of-pocket expenses for radiotherapy patients, although there is extensive anecdotal evidence.

Cost effectiveness

The cost effectiveness of some commonly used medical interventions is listed in Table 5.3. Smith et al. (1993) emphasised the importance of recognising that the available studies reported in this table were performed using a variety of methods and that differences in the data and models could lead to considerable variations in the estimates of cost effectiveness.

Mason et al. (1993) similarly warned decision makers of some of the pitfalls found in cost-effectiveness league tables and suggested that meaningful comparisons may be made between health care technologies by considering the context of the setting of the study in which they were undertaken, rather than comparing the study with the situation of the current application. Care also needs to be taken that quality of life issues are addressed.

However, both authors commented that in the absence of systematic comparisons such assessments are likely to take place informally, probably leading to a worse risk-benefit trade off than the formalised use of league tables.

Table 5.3
Cost effectiveness of commonly used medical interventions

Medical intervention	Cost per life year*
Liver transplantation	237,000
Screening mammography, women less than 50 years old	232,000
Cholestyramine for high cholesterol	178,000
Routine use of non-ionic radiography contrast medium	72,000–243,000
Coronary artery bypass, two-vessel disease plus angina	106,000
Captopril for hypertension	82,600
Zidovudine for HIV	8,200–88,500
Renal dialysis, in-centre benefit, men	42,000–80,300
Screening mammography, women more than 50 years old	20,000–50,000
Hydrochlorothiazide for hypertension	23,500
Coronary artery bypass, left main disease plus angina	17,400
Smoking cessation counselling, men	1,300

* Data as reported in the medical literature, adjusted to 1992 US dollars.
Source: Smith et al. 1993

Economic evaluation and radiotherapy treatment

In 1985 Rees (1985) compiled a list of approximate costs of certain procedures and treatments. He provided estimated total hospital costs of a sample of treatments (Table 5.4). Hospital transport costs were not included and the author noted that these could add substantially to the costs of palliative outpatient radiotherapy and chemotherapy.

Table 5.4
Estimates of total hospital costs of a sample of treatments

Treatment	Total hospital costs (pounds)
Mastectomy	900
Wertheim's hysterectomy	1,500
Laryngectomy	2,000
Abdominoperineal resection	2,000
Hip replacement	2,300
Radiotherapy	
- palliative for carcinoma of bronchus (outpatient, two weeks)	300
- potentially curative for carcinoma of larynx (outpatient, six weeks)	1,000
- potentially curative for carcinoma of larynx (total duration six weeks, inpatient two weeks)	2,400
Palliative outpatient chemotherapy with vincristine, dexorubicin, and cyclophosphamide for advanced breast carcinoma (six months)	1,100
Potentially curative chemotherapy with cisplatin, etoposide, and bleomycin for metastatic testicular teratoma (4 courses)	3,100

Source: Rees 1985

Rees also estimated the notional patient benefit year cost for a variety of treatments for cancer (see Table 5.5). Rees noted that cure is almost always relatively cheap but palliation can be very expensive. This does not take into account quality of life issues which are discussed later in the report. In this study, the relative cost of external beam therapy was less than half that observed for either of the two surgical treatment methods.

The author commented that, where equivalent outcomes were expected for the treatment methods, health agencies might consider payment of the least expensive method. There has been no equivalent significant review on this topic since 1985.

Table 5.5
Estimates of notional patient benefit year (NPBY) cost for a sample of treatments for cancer

Treatment	NPBY cost (pounds)
Potentially curative	
- surgery and radiotherapy for stage 1 seminoma	80
- cytotoxic chemotherapy for metastatic teratoma	110
- outpatient radiotherapy for glottic laryngeal carcinoma	120
- abdominoperineal resection for rectal carcinoma	500
Palliative	
- tamoxifen for advanced breast carcinoma	380
- outpatient radiotherapy (10 fractions, response rate 75%, mean duration 4 months)	1200
- MRC phase III study of cisplatin and methotrexate in T4b bladder carcinoma	16,000
- chemotherapy for metastatic non-small cell bronchogenic carcinoma with cylophosphamide, doxorubicin, and etoposide	18,000
- chemotherapy for advanced previously treated non-small cell bronchogenic carcinoma with vindisine, etoposide and cisplatin	112,000
Hip replacement	270

Note: These calculations apply to 1985 and are included for comparative purposes
Source: Rees 1985

More recently Glazebrook (1992) estimated the dollar cost for survivors of cancer treated by radiotherapy in Canada, and compared this cost with other medical costs in the treatment of liver failure, hypertension, heart transplant, AIDS, and chemotherapy for testicular cancer. Glazebrook also compared the cost per year of life gained from various treatments, such as neonatal, renal dialysis and myocardial infarction, with that of curative radiotherapy.

Morgan (1993) has summarised the results (Table5.6). Glazebrook (1992) concluded that radiotherapy is cheaper than the various listed medical and surgical procedures in terms of cost per procedure or cost per year of life gained.

Table 5.6
Relative cost per procedure and cost per year of life gained compared with the cost of radiotherapy and cost per radiotherapy person-year gained

Treatment	Cost per procedure	Cost per year life gained ($CAN)
Radical course of radiotherapy	1.0	1.0
Chemotherapy for testicular cancer	1.65	
Treatment of severe hypertension (40 yr male)	3.78	
Treatment of mild hypertension (40 yr male)	7.67	
Treatment of AIDS (final 400 days)	12.99	
Heart transplant	33.50	
Neonatal care <1 Kg birth weight		14.19
Coronary bypass		10.13
Renal dialysis		101.88
Myocardial infarction		258.77

Source : Morgan 1993

In a costing study performed at Westmead Hospital, Rosenthal et al. (1992) found that the median overall cost per patient of treating small cell lung cancer (SCLC) was $A14,413 for all patients. For limited and extensive disease the median cost was $A18,234 and $A13,177 respectively. The costs associated with the treatment were hospitalisation (42 per cent), chemotherapy (18 per cent), radiotherapy (11 per cent), investigations (seven per cent) and follow-up (eight per cent). The cost contribution for radiotherapy increased to 19 per cent for patients with limited disease. Rosenthal et al. (1992) state that the cost of radiotherapy is predominantly determined by the number of fractions and fields. Because of the high infrastructure costs within such units, a reduction in the number of fractions given and a shorter treatment time may reduce apparent costs substantially for this particular disease but will not reduce the total cost of radiotherapy to the institution. However, reducing the number of fractions and hence the cost of treatment may well reduce the effectiveness of the radiotherapy and result in an inferior outcome. Therefore, cost considerations alone should not determine the appropriate use of radiotherapy as the effectiveness of the 'cheaper' option may be equivalent to not giving any treatment at all.

Barton and colleagues (1995) examined the long-term cost effectiveness of radiotherapy in the treatment of cancer at the Department of Radiation Oncology, Westmead Hospital, from its inception in 1980 to December 1993. The cost of radiotherapy was found to be $A7,363 per life year gained. Though the cost derived was an average across different cancer sites there was no evidence to suggest that the case mix at Westmead was any different to other Australian centres. The authors commented that, although no direct comparisons with other modalities were made in the study, the cost of radiotherapy compared favourably with the costs of other medical interventions and cancer interventions in Australia, and that the relative costs of radiotherapy in Australia appeared to be comparable with international experience.

In 1989 Walker et al. (1989) reported on a cost comparison at Westmead Hospital between two treatment modalities used with curative intent for carcinoma of the oesophagus for 144 patients. The authors compared 42 patients who underwent radical oesophagectomy with 50 patients who underwent radical radiotherapy. The median survival of both groups was identical (12 months). The remaining patients underwent a variety of palliative procedures and were not considered further for the purposes of this study. Components of management were identified and costed on the basis of direct resource use by the hospital. Surgically treated patients cost $A13,638 in 1987 dollars on average, whereas those treated by radiotherapy cost $A3,533. The major factors accounting for this cost difference were necessary peri-operative intensive management in the surgical group, peri-operative complications and the subsequent prolonged hospitalisation of a proportion of patients. The cost of management of the complications of radiation therapy were included but were not a major factor in overall costs for the irradiated group. The authors concluded that this cost differential should influence the continuation of existing strategies in which radical surgery, rather than irradiation, is the selected routine curative approach for oesophageal cancer, particularly in the absence of evidence of higher survival.

Sperduto et al. (1994) reported on the relative cost effectiveness for alternative treatments for locoregional prostate cancer. Patient data were examined on a computerised registry of the Upper Midwest Oncology Registry System. Stage, age, treatment and other data were recorded. Between 1974 and 1988, 7,867 patients with locoregional prostate cancer were enrolled in the registry. All patients had a minimum of five years follow-up. Four alternative treatments were identified; orchiectomy (516 patients), transurethral resection of the prostate (2,280 patients), radiation therapy (2,341 patients) and radical prostatectomy (1,043 patients). The median ages for the treatment groups were 74, 73, 69 and 66 years respectively. The results appear in Table 5.7.

Table 5.7
Relative cost effectiveness for alternative treatments for locoregional prostate cancer

Treatment	Effectiveness 10 yr survival x 10 (yrs)	Cost ($)	Average cost effectiveness ($/yr)	Marginal cost effectiveness ($/yr)
Orchiectomy	2.46	2,400	976	N/A
TURP	3.03	7,970	2,630	9,771
Radiation	5.19	9,800	1,888	847
Prostatectomy	5.69	18,140	3,188	16,680

Source: Sperduto et al. 1994

The authors concluded that:

- radiation therapy and prostatectomy have similar effectiveness at ten years;
- the costs of radiation therapy are 54 per cent of the costs of prostatectomy;
- per year of survival, the costs of radiation therapy are 59 per cent of the costs of prostatectomy;
- the marginal cost effectiveness of prostatectomy compared with radiation therapy shows that the six-month advantage in survival is at a cost of $16,680 per year.

While the results of this study infer that radiation treatment for prostate cancer is more cost effective than surgery, other reviews have not been as conclusive. The difficulty in comparing costs of different modalities and the lack of long-term randomised controlled data means that there is still much debate about the best treatment for this cancer. This uncertainty exists for the treatment of many cancer sites and illustrates how practice can become based more on tradition and teaching than on rigorous scientific evidence.

The costs and cost effectiveness of radiotherapy, surgery and chemotherapy in the treatment of cancer are not well documented.

Costing methodologies vary significantly from study to study, and it is therefore not possible to accurately compare the cost of radiotherapy with other modalities.

Costs of treatment vary considerably with site and stage of cancer. The available data on costs cover a limited proportion of available treatments.

The evidence that is available, including some from Australian studies, indicate that radiotherapy compares favourably with surgery and chemotherapy in terms of cost effectiveness. However, this is not based on randomised controlled trials.

Recommendation:

- **There is an urgent need for research into the costs and cost effectiveness of radiotherapy, chemotherapy and surgery, alone or in combination, in the treatment of particular cancers.**

6. Radiotherapy in Australia—current services and future needs

This chapter reviews current practice in radiation oncology and examines projected requirements for the expansion of facilities to the year 2005. It discusses the issues contributing to the apparent under-use of radiotherapy in Australia, and also examines growing influences on service provision such as the promotion of multidisciplinary treatment and best-practice guidelines. A model of service delivery is recommended.

Current practice and services

While the integration of all treatment types in a comprehensive cancer care centre continues to be recommended as best practice for cancer management, in reality this is only available to a small proportion of patients. In Australia, radiation oncology treatment 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 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.

As well as institutional variations there are differences between States in the limitation of cancer treatment services to selected institutions. Currently, public radiation oncology facilities are confined to a single facility in the ACT while in Tasmania services are provided at two hospitals under the auspices of a single organisation. 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 two public and two private radiation oncology facilities. Western Australia has one public sector facility and two private facilities. This may change with current restructuring of the public hospital system in the States.

There are variations in the level of integration of services between States and between public and private sectors. Some of the radiation oncology facilities are 'free standing', some are integrated with other services. In addition, consultations are increasingly being undertaken in outreach clinics.

Balance between public and private provision

For its report to AHMAC in 1989, the Working Party on Radiation Oncology conducted a survey which showed that approximately 20 per cent of new courses of treatment were administered to patients in the five private facilities. AHMAC noted that the case mix of patients in private facilities was in general similar to that in public facilities (AHMAC 1989).

There are no data to suggest any differences in access to treatment between Medicare patients and those who are privately insured, or that privately insured patients receive preferential treatment in either hospital based or private practice units. Private facilities are recognised as having a significant role in the provision of cancer treatment services and in the recent increase in the numbers of patients being treated. Over 25 per cent of patients are now treated in private radiation facilities (RACR 1994).

Demographic analysis of services

A demographic analysis of services gives a picture of radiotherapy services in Australia which shows current levels of practice and the variation between States. Such an analysis includes size, capacity to treat, physical location and distribution of services. The Faculty of Radiation Oncology of the Royal Australasian College of Radiologists undertakes regular surveys of radiation oncology facilities in Australia. The results of the four most recent surveys are displayed in Tables 6.1 and 6.2. The surveys also cover radiation oncology workload statistics, presented in Tables 6.3 and 6.4.

The information from the surveys from 1988 to 1994 indicates whether the problems with provision of resources for radiation therapy services which have been identified by inquiries for the past 20 years have been addressed and remedied to any extent. As discussed in Chapter 3, the 1989 AHMAC report on radiation oncology (AHMAC 1989) concluded that major deficiencies existed in the provision of radiotherapy services in Australia and recommended that a planned program of increasing equipment be undertaken immediately by Governments at both state and federal level.

Table 6.1
Summary of radiotherapy equipment in use in Australia at 30 June 1994

Type of radiotherapy equipment	State						
	NSW/ ACT	VIC	TAS	SA	WA	QLD	Total
Superficial/ Orthovoltage	8	5	3	3	4	3	26
Cobalt-60 units	2	1	0	1	1	0	5
Linear accelerators	13	8	1	4	4	7	37
SPLA	11	7	1	3	2	5	29
DMLA							
Simulators	12	7	2	1	4	5	31
Computerised planning systems	20	9	2	3	3	4	41
(+ CT interfacing)	(15)	(6)	(2)	(3)	(3)	(3)	(32)
Brachytherapy systems	10	3	1	1	1	3	19
Manual afterloading			1		1	1	3
Automatic afterloading							
LDR	4	2		1		1	8
HDR	5					1	6
PDR	1	1					2
On-line portal imaging	4	3		1	1		9

Notes: SPLA=Single photon linear accelerator
DMLA=Dual modality linear accelerator
LDR=low dose radiotherapy
HDR=high dose radiotherapy
PDR=pulsed dose radiotherapy

Source: Survey, Faculty of Radiation Oncology, RACR

Table 6.2
Summary of number of megavoltage machines (and number per million population) in Australia by State, 1988–1994

State	1988	1990	1992	1994
New South Wales/ACT	21 (3.5)	19 (3.1)	22 (3.5)	26 (4.1)
Victoria	8 (1.9)	9 (2.0)	11 (2.5)	16 (3.6)
Queensland	6 (2.2)	8 (2.8)	10 (3.3)	12 (3.8)
Western Australia	5 (3.2)	6 (3.7)	7 (4.2)	7 (4.1)
South Australia	4 (2.8)	6 (4.2)	8 (5.5)	8 (4.3)
Tasmania	2 (4.4)	2 (4.3)	2 (4.3)	2 (4.2)
Australia	46 (2.9)	50 (2.9)	60 (3.4)	71 (3.9)

Source: Faculty of Radiation Oncology, RACR

Table 6.3
Summary of statistics of megavoltage treatments in Australia, 1988–1994

Workload indicators	Year			
	1988	1990	1992	1994
Number of new courses	23,379	27,955	30,194	33,340
Number of attendances	408,678	445,129	501,806	557,509
Number of fields	1,101,982	1,114,087	1,248,928	1,515,607
Number of courses per machine	508	560	503	470
Number of attendances per course	17.5	15.9	16.6	16.7
Number of fields per attendance	2.7	2.5	2.5	2.7

Source: Survey, Faculty of Radiation Oncology, RACR

Table 6.4
Radiotherapy treatments 1 July 1993–30 June 1994

	NSW	VIC	TAS	SA	WA	QLD	Total
Megavoltage treatments (Linac-Cobalt)							
Courses	11,612	8,452	1,048	3,196	2,959	6,073	33,340
Attendances	197,499	119,924	17,667	60,373	56,505	105,541	557,509
Fields	533,069	332,335	47,177	166,802	51,732	294,492	1,515,607
Superficial -Orthovoltage							
Courses	923	1,125	294	296	309	103	3,050
Attendances	6,349	6,775	1,354	1,546	1,905	496	18,425
Fields	9,075	9,998	1,685	2,104	3,130	746	26,738
Gynaecology Insertions	449	224	7	28	21	202	931
Brachytherapy	79	90	1	17	3	58	248
Stereotactic Radiosurgery (patients treated)	57	Nil	Nil	6	13	Nil	76
Pterygium (patients treated)	379	535	122	734	53	32	1,855
Total body irradiation	31	22	Nil	12	8	16	89
Other treatments							
I-125 Eye plaques					40		
Intra-operative radiotherapy					4		
P-32 instillations					16		60

Source: RACR Survey 1994

Since the 1989 AHMAC report there has been an improvement in radiation oncology facilities and the profile of the specialty has also improved. RACR survey data show that between 1988 and 1994 there was an increase in the numbers of megavoltage machines, an increase in departments of radiation oncology and a significant increase in the total number of patients receiving radiotherapy. The greatest expansion of facilities occurred in NSW and Victoria. The number of linear accelerators currently in operation in each State is largely in line with both the AHMAC Working Party and State Government recommendations for equipment levels by 1995. However, it is now apparent that the AHMAC recommendations were made without access to accurate estimates of cancer incidence and, as a result, the appropriate levels of equipment and staffing were underestimated significantly. Although the increase in machine numbers has led to a modest increase in the proportion of newly diagnosed cancer patients receiving radiotherapy there has been a significant increase in cancer incidence and hence new cases of cancer over this period, and the proportion of patients treated remains at 38 per cent. In addition, the numbers of machines in most States still fall short of RACR

projected requirements which are based on a 50 per cent referral rate to radiotherapy.

Despite an increase in numbers of linear accelerators and radiotherapy centres since 1989, the expansion has not kept pace with increasing need for services and treatment rates in Australia are still suboptimal.

Issues affecting current practice

It is recognised that current service provision is inadequate, with large numbers of newly diagnosed patients each year not receiving radiation treatment (see treatment statistics in Table 6.5). In most States a shortage of radiotherapy facilities contributes to the problem. However there are a number of other issues that affect practice and services. Firstly, it appears that referral rates for radiotherapy are too low. Referral rates are affected by ease of access to treatment and by continuing ignorance about the role of radiotherapy in treating cancer. Secondly, after referral there may be delays before radiotherapy can be given. These are mostly because the largely uncoordinated development of services has left most facilities unable to expand to meet the rising demand for radiotherapy treatment, and there are insufficient numbers of staff to deliver treatment. For patients in rural areas, there is the additional problem of access to services.

Table 6.5
Patient treatment statistics, 1988–1994

	1988	1990	1992	1994
Population (millions)	16.532	17.076	17.498	18.102
Cancer incidence per million	3440	3586	3738	3897
Newly diagnosed cancers	56870	61235	65408	70543
Courses of treatment	23379	27995	30194	33340
Re-treatment rate	23%	26.2%	26.3%	20.2%
Newly diagnosed pts treated with RT	18002	20660	22252	26605
% newly diagnosed cancer pts treated	31.6%	33.7%	34.0%	37.7%
Newly diagnosed pts not treated with RT—				
50% treatment rate	10433	9957	10452	8666
55% treatment rate	13276	13019	13722	12194

Source: RACR surveys from 1988 to 1994

Referral practices

The percentage of patients in Australia with cancer who currently receive radiotherapy at some point in their management varies between States and between metropolitan and rural areas within States. The average for Australia is 37.7 per cent, which is low by international standards. Data from the USA, UK, Canada and the Netherlands are remarkably consistent and show referral rates ranging from 45 to 53 per cent (Wigg 1988, Health Council of the Netherlands 1993). There have been no studies showing that outcomes are better in countries with higher rates of treatment with radiotherapy; in fact, because those not treated with radiotherapy are not studied no comparison of outcomes can be made. However, the AHMAC report in 1989 concluded that *there is no reason to suppose that treatment methods should vary across countries*, and that *on international figures, significant numbers of cancer sufferers who could benefit from radiotherapy treatment are not receiving treatment* (AHMAC 1989). In 1995, Denham concluded that the very low rates of referral to radiotherapy for cancer patients in rural areas were a major factor in Australia's suboptimal treatment rate (Denham 1995). The AHMAC report recommended a referral rate of 45 to 55 per cent for future planning of services, and these parameters have been adopted by all subsequent inquiries into radiotherapy. Most States are working towards 50 per cent treatment rates.

The overseas and Australian data were collected before recent changes in practice which are likely to have increased referral rates. Such changes include:

- 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 the 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.

Based on the available data and these changes in practice, the Working Party believes that a referral rate of 50 to 55 per cent should be used for future planning.

The reasons for the relatively low referral rates in Australia are complex but include (Lovell Report 1985, Denham 1995):

- lack of ready access to treatment;
- insufficient education of the medical profession about the benefits of radiotherapy, compounded by the lack of an academic base in the specialty and resultant inadequate undergraduate teaching;
- lack of radiation oncologists, trainees and radiographers to see and treat additional patients;
- the influence of powerful peers;
- traditions in treatment options;
- the perceived 'ownership' of patients by professionals;

- the fact that treatment decisions are usually made on a one-to-one basis between the patient and physician; and
- the exclusion of private practitioners from public hospitals in some States.

The literature on different cancer sites suggests that the whole range of available treatments should be considered for many types of cancer, and that multimodal treatments are best practice in the treatment of some cancers. However, these options may not be offered routinely to all for whom such alternatives are appropriate. There are indications that, despite our sophisticated health care system, there remains an element of chance in the type of service provided to an individual with cancer. After diagnosis, the most common scenario is a one-to-one consultation between doctor and patient during which treatment decisions are made. The Working Party considers that a more appropriate practice would be to have these decisions made by the patient together with a multidisciplinary team. This is consistent with *Better Health Outcomes for Australians* strategy (DHSH 1994), and is discussed in more detail below.

Further, there are indications that many doctors are not aware of best practice in cancer treatment and that there is insufficient education of the medical profession about the benefits of radiotherapy. This is discussed in more detail in Chapter 8 on workforce requirements.

Referral rates in Australia are lower than in some comparable countries. In the absence of evidence on appropriate referral rates for particular cancers, the Working Party recommends that a referral rate of 50 to 55 per cent should be considered for Australia.

Recommendations:

- **When planning facilities, a referral rate of 50 to 55 per cent should be anticipated.**
- **Radiotherapy should receive a higher profile in medical education (specific education recommendations are in Chapter 8).**
- **Inadequate staffing levels should be addressed (specific workforce recommendations are in Chapter 8).**
- **Traditional referral practices should be moderated in favour of multidisciplinary management.**

Differential access to services

While the RACR surveys show variation between States, there are also treatment differences within States depending on the geographic distribution of the population and the location of services, both of which affect access. The Working Party has noted that the further patients are away from metropolitan areas, the less likely they are to be referred for radiotherapy. Indeed some patients are not given the option of radiotherapy at all. Overall referral rates for people in rural and remote areas are lower than for people in metropolitan areas (Denham 1995).

The Lovell report in 1985 identified distance from a treatment centre as the major reason for lower usage of radiotherapy services. This means that people in rural and remote areas diagnosed with cancer are not receiving radiotherapy services at the same rate as their counterparts in metropolitan areas. There seems to have been little change to these patterns since 1985, as the findings were confirmed by Denham in 1995.

This means that rural people may not be offered radiotherapy services, or if offered services, may choose not to undergo this mode of treatment at a distant centre. While this suggests that rural people think differently about their mortality than city people, this view was not supported by a survey conducted by Keleher and Ellis (1995). Although not conducted specifically on cancer patients, this study indicates that rural people regard the specialist treatment services available in the cities very highly and will tolerate associated (short-term) financial and emotional burdens to secure the best treatment available to them. However a problem specific to radiotherapy treatment is that it must be given in fractionated courses over six to eight weeks, making it just too difficult for some people to undertake. The issue of access to services is discussed further and recommendations given in Chapter 7.

The further patients live away from metropolitan areas, the less likely they are to be referred for radiotherapy.

Overall referral rates for people in rural areas are lower than those for people who live in metropolitan areas.

Recommendation:

- **Particular attention should be paid to improving the referral rates to radiotherapy of people living in rural and remote areas.**

Treatment delay

The Faculty of Radiation Oncology, RACR defines the treatment delay period as the interval between the decision to treat with radiotherapy and the first treatment. The Faculty agrees that the following treatment delay periods are reasonable and reflect current waiting periods (Mackillop 1994), although these vary widely throughout Australia.

- Emergency treatment (spinal cord compression) — 24 hours
- Palliation of severe symptoms (severe pain, haemoptysis) — 48 hours
- Other radical treatment or non-urgent palliation — 10 working days

As discussed above, treatment delays for radiotherapy are a consequence of insufficient numbers of machines and inadequate numbers of radiotherapy staff, among other reasons. Treatment delays cause dilemmas, especially when urgent cases which are almost always palliative are treated first, delaying the treatment of patients with potentially curable cancers. In a small minority, delays are dictated by the patient's condition or preference. There is anecdotal evidence to suggest that patients may be deterred by the length of time they have to wait for radiotherapy treatment and may choose an alternative.

There is little objective evidence available about treatment delay periods in Australia or about the effect of treatment delays on outcome. However, it seems reasonable to assume that treatment delay is deleterious because, as the patient waits for treatment, the cancer continues to grow. Delays may change a potentially curable cancer into one in which the chances of a cure have been significantly compromised. In Canada, Mackillop et al. (1996) used a mathematical model and radiobiological principles to demonstrate that delays in starting radiotherapy treatment may be associated with significant decreases in local control, and recommended that waiting times for radiotherapy should be *as short as reasonably achievable*. The Working Party recognises that further research is needed to determine the effect of treatment delays on outcomes, whether significant treatment delays exist and, if so, consider cost-effective ways to reduce them. A study at Westmead Hospital in Sydney found that investing in new equipment and increasing staffing would be more cost-effective in the long term than more intensive use of existing facilities, for any unit with a workload over 98,525 fields per year (Smith et al. 1993).

Recommendations:

- **A study should be undertaken to determine whether there are significant treatment delays for radiotherapy in Australia.**
- **A study should be undertaken to determine the effect of treatment delays on the outcome of treatment.**
- **If significant delays exist, further studies should be undertaken to identify the most cost-effective ways to reduce them.**

Influences on radiotherapy practice and services

Multimodality and multidisciplinary relations

Oncology services include cancer surgery, radiation oncology and medical oncology. Many patients require combined modality treatment and for some time the integration of these services in specialised cancer treatment centres or by multidisciplinary teams has been advocated. The care of the cancer patient necessitates access to a wide range of medical specialists and the expertise of a diversity of other professions including specialist nurses, radiographers and counsellors. A comprehensive service requires the development of special groups with expertise in treating cancer in special anatomical sites such as the breast, colon, lung, lymph glands, urological sites, and head and neck. Full facilities for supportive care, pharmacy services, pain relief, rehabilitation and psychiatric assistance are also needed both within the hospital and in the community.

The definition of multidisciplinary in this report therefore includes not only the different groups of medical specialists involved in the treatment of cancer, but also all other health professionals such as nurses, physiotherapists, occupational therapists, social workers, dietitians and psychologists (Royal College of Nursing 1995).

The Better Health Outcomes for Australians report (DHSH 1994) recommends that *hospitals and State and Territory Health Departments should work towards the organisation of cancer services along multidisciplinary, disease-focused lines rather than in terms of medical speciality or other means, and should monitor the cost-effectiveness of these changes*. Networking with other hospitals and treatment services to improve cancer treatment outside major centres is integral to this strategy. In many areas of Australia, the lack of an integrated service has led to situations where the modality used to treat a particular type of cancer depends on the point of the patient's entry into the system (Denham 1995).

There is good evidence that the survival of cancer patients is usually better if they are treated by a specialist who also treats a large number of similar patients, and who has access to the full range of treatment options in a multidisciplinary setting (Sainsbury et al. 1995). However, there must be consideration of the patient's ability and willingness to travel long distances to obtain treatment in such a setting.

The House of Representatives Standing Committee on Community Affairs in its Report on the Management and Treatment of Breast Cancer (1995) concluded that a multidisciplinary approach benefits the patient and creates a working environment for medical and paramedical staff in which they can provide an optimal level of management and treatment. This Committee also recognised the problem of access to services, and the considerable difficulties for patients from rural and remote areas in accessing treatment based on the multidisciplinary model.

The importance of the patient having a particular person as a point of reference within the multidisciplinary team is a theme that has recurred throughout the Working Party's consultations. Although not attempting to prescribe who should fill this role, the Working Party considers it vital that a patient has a key person to whom they can refer during and after treatment.

Cancer management is believed to be more effective when given by a multidisciplinary team, with one member of the team acting as a point of reference for the patient.

Promoting best practice

Best-practice guidelines

Evidence based clinical practice guidelines for the use of radiotherapy for treating different cancers could assist in changing clinical practice so that it is based more on research, as guideline development involves analysing and rating the existing evidence and making recommendations based on the analysis. Guidelines can also identify areas where further research is needed.

In Australia there is an increasing focus on the development and implementation of these guidelines in all areas of medicine. In response to a National Health Strategy recommendation (Harvey 1991) identifying the need for a national program of guidelines development and for the development of health outcome measures, the NHMRC produced *Guidelines for the Development and Implementation of Clinical Practice Guidelines* (QCHOC 1995a).

In this report, the Quality of Care and Health Outcomes Committee (QCHOC) proposed that the primary purpose of guidelines is to achieve better health outcomes by improving the practice of health professionals and by better informing consumers about treatment options. Guidelines are seen as having a role in professional and consumer education and in quality assurance, and they may also assist in the resolution of legal disputes and ethical dilemmas (QCHOC 1995a).

The QCHOC report discusses the evidence that guidelines are an effective means of improving health outcomes, and proposes some general principles for clinical guideline development. These principles state that guideline development and evaluation should be outcome focused and that clinical guidelines should be based on the best available evidence. Guideline development should be a multidisciplinary process. Guidelines should be adaptable to local conditions, include a consideration of resources and be subject to evaluation and regular updating (QCHOC 1995a).

As noted earlier in this report, this guideline development methodology is currently being piloted for the treatment of breast cancer. A first edition of *Clinical Practice Guidelines for the Management of Early Breast Cancer* was released in October 1995 and the AHTAC Working Party has drawn on this work (QCHOC 1995b).

The Australian Cancer Network also supports a best-practice guideline approach. It proposes a broad structure aiming to follow practices which deliver the best outcomes, which change effectively when necessary and which continually improve. In a multidisciplinary setting, elements included would be (ACN, personal communication):

- the development of a partnership between patient and practitioner;
- relationships between treating practitioners at a level recognising and enhancing their individual competence and skills;
- a shared vision in which there is participation underpinned by consultation, agreed plans of action and integrated change where necessary;
- acknowledgment of 'leadership' within a flat structure when 'group' care is contemplated;
- provision to patients of clearly stated options and an opportunity to discuss these before commencing treatment; and
- training and certification of each member of a multidisciplinary clinical group by their own Learned College. Each should also be awarded credentials by their caring facility.

Patterns of Care Study

In the US, the approach to best practice has been through the Patterns of Care Study (PCS) of the American College of Radiology, started in 1973. This study has sought to establish national benchmarks for the practice of radiotherapy to treat prevalent cancers for which radiation plays an important part in cure. Over the years the sites chosen for study have included the cervix, uterine corpus, breast, bladder, prostate, testes, larynx, anterior tongue, nasopharynx, and Hodgkin's disease.

The PCS was based on the theory that differences in clinical practice exist and that these differences have a significant impact on the outcome of treatment. The PCS convened committees of experienced radiation oncologists, other oncology specialists and physicists, each of which developed a consensus of current management guidelines for one of the ten disease sites. The PCS is a model based on structure, process and outcome (Kramer et al. 1983). Structure encompasses the materials that are used to provide care. These include the qualifications of the staff, their organisation, physical facilities and equipment. Process represents the techniques of information gathering based on history, examination and diagnostic tests and the subsequent delivery of appropriate therapy. Outcome assessment includes the changes in health status that can be related to the care delivered by the radiation oncology team.

Each consensus was expressed in the form of a decision tree. The tree graphically displayed the sequence of decisions leading to one of several treatment options. The development of current management guidelines reflects an ongoing process of increasing knowledge, developing technology and improving evaluation.

The various Patterns of Care Studies have been referenced in the Working Party's deliberations on the selected cancers reported on in the appendices. The Working Party notes that the Australasian Radiation Oncology Lymphoma Group (a special interest group of the Faculty of Radiation Oncology of the RACR) has completed a Hodgkin's Disease outcome study showing that, while there are variations between centres, these are only minor and that the overall outcome data are not different from those obtained in Europe or America (Barton, M et al. 1995). While the PCS approach has been used in Australia to study lymphoma, it is not known whether the method could be applied to all cancer sites. While the Working Party acknowledges the important contribution of the Patterns of Care Study, it is not considered necessary to repeat this study in Australia. Rather, gaps in knowledge should be identified as the subjects for further research.

Recommendations

- **Evidence-based best-practice guidelines for the use of radiotherapy in the management of cancer should be developed for each cancer.**
- **Further studies should be undertaken in Australia to compare outcomes of various treatment options.**

Quality assurance

While there is no formal national policy on quality assurance, numerous quality assurance procedures are routinely carried out in radiotherapy facilities. These include regular physics assessment of beam output data, record and verify procedures in patient treatment, regular port films during treatment plus informal chart review by medical staff throughout the treatment course.

Recommended model for service delivery

In considering the optimal model for delivery of radiotherapy services, an attempt has been made to balance two vital needs of patients: quality and access. The Working Party recognises that it is not feasible to deliver radiotherapy treatment beyond specialist centres, but that assessment for treatment could be more widely disseminated, to determine preferred treatment patterns. This would be in the best interests of many people who develop cancer. Combined multimodality clinics should be in both metropolitan and regional areas, with an emphasis on the needs of rural people in the area who are less likely to be referred to city specialists.

The Working Party considers that patients may be best served by a network of facilities which provide care in a multidisciplinary, multimodality setting. A network of different types of centre would allow some decentralisation of services and provide logistically more convenient care, without sacrificing the quality of services. The Working Party recognises the advantages in terms of research, clinical education and quality assurance if public and private radiotherapy facilities have affiliations with universities or teaching hospitals, and considers that there should not be any small, independent centres.

Major centres

These centres should be large enough to have an active interdisciplinary multimodality approach, state-of-the-art equipment and important clinical research tools. They should conduct basic research and undertake or participate in clinical research, especially randomised controlled trials. There should be an emphasis on undergraduate and postgraduate medical education, and a program of professional development which includes attendance at scientific meetings. There should be an active quality assurance program which collects treatment and follow-up data.

Other public and private facilities

These smaller metropolitan and regional centres should be staffed by at least three radiation oncologists. They should have as a minimum the equipment listed below. These smaller centres should be formally connected to the larger metropolitan centres for quality assurance activities and to ensure that staff education continues.

Recommended equipment requirements for radiation oncology facilities

- Two megavoltage machines. These can be either two dual modality linear accelerators (DMLA) or one dual modality and one single energy machine (SPLA). Phased development should begin with installation of a dual modality linear accelerator. In a three machine department there should be two DMLA and one 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 afterloading brachytherapy facilities.

Recommendations for additional equipment such as on-line portal imaging cannot be given currently because they are in the development and evaluation phase. However, there are continual advances in equipment technology which will make radiotherapy treatment faster, safer and more cost efficient. After three years, these minimum requirements should be revised to include new types of equipment that have been shown to be effective and that are practical to recommend for widespread use.

Recommendations:

- The Working Party considers that patients may be best served by a network of facilities which provide care in a multidisciplinary, multimodality setting. A network of different types of centres would allow some decentralisation of services and provide logistically more convenient care, without sacrificing the quality of services.
- Strong linkages between the public and private sectors should be established and supported, to facilitate quality assurance activities and educational opportunities.
- Minimum requirements for radiotherapy facilities should be revised regularly to include new types of equipment which have been shown to be effective and which are practical to recommend for widespread use.

Projections for future provision

It is clear from previous reports considered by the Working Party that radiotherapy services in Australia must expand, not only to compensate for the current shortfall in staff and facilities, but to keep pace with the growing demand for services. The objectives of expansion include the ability to treat increasing numbers of radiotherapy patients, to reduce waiting times for radiotherapy and to improve the accessibility of radiotherapy services.

Projections for provision to the year 2005 were provided by most State health authorities and by the RACR and are presented below.

Table 6.6
Current and projected megavoltage machine numbers for States and Australia

	1994*	1994 projection (a)	Projection to 2000 (a)	Projection to 2005 (a)	Projection to 2000, State Health depts.
NSW	24	31–35	38–42	45–49	39 including ACT(b)
Victoria	16	23–25	26–28	29–31	
Queensland	12	18–19	22–24	27–29	16–17(c)
West. Australia	7	8–9	10–11	12–13	+1.6 more than current(d)
South Australia	8	8–9	10–11	12–13	
Tasmania	2	3	3	3–4	4(e)
ACT	2	2	2	2	
Australia	71	97–101	108–119	127–140	

* Most recent figures available from RACR

Sources: (a) RACR Submission to the Working Party for the year 2005 (1995)
(b) Strategic Plan for Radiotherapy Services in NSW 1995-2000 (1995)
(c) Health Services Plan for Radiation Oncology for Queensland (Queensland Health 1994)
(d) Report and future requirements for major radiation oncology equipment in W.Australia (1993)
(e) Reports of WP Holman clinics for Hobart and Launceston (1994)

The projections were calculated within the following planning parameters:

- population projections for the year 2000 were used in conjunction with cancer incidence data (data for each State listed in Appendix 3);
- 47–55 per cent referral rates;
- assumption that 20–25 per cent of cases require re-treatment;
- 17–19 attendances per course;
- eight hours per day operation;
- the number of attendances for megavoltage treatment per machine is set at 8,280 per annum;
- no allowance for cross border patient transfer was made.

It can be seen from Table 6.6 that the current numbers of machines, especially in the larger states, are well below requirements according to RACR estimates of population growth and cancer incidence. The table also shows the differences in machine requirements projected by the RACR and by State Health Departments, which reflect the differing perceptions of specialists and health planners about the degree of expansion required.

Unless an active program of increasing facilities is embarked upon now, the current remaining shortage of machines will worsen and projections for the next 10 years will not be met, as demand for services will continue to grow. Coupled with the shortage of radiation oncologists and other staff, this is likely to place further strain on services and increase treatment delay times.

Recommendation:

- **Current radiotherapy facilities should be expanded progressively to allow for the continuing growth in need for radiotherapy services.**

7. Consumer issues

Cancer patients have special needs during treatment and aftercare because of the nature of the disease and the usual extended duration of treatment. In terms of radiotherapy, access to treatment is one of the most important issues, and forms the basis of this chapter. Quality of life is also discussed, as well as the needs of carers, and the importance of voluntary groups and patient education programs in supporting cancer patients.

Access

Access to radiotherapy treatment services in Australia is a key issue. For the purposes of this report, access is defined as having geographic, financial, psychological and social dimensions.

In geographic terms, there are particular challenges inherent in the planning of comprehensive and accessible radiotherapy services. Historically, the demographics of Australia's population has led to the concentration of radiotherapy services in the largest cities. The distribution of physical facilities is not likely to change significantly in the foreseeable future because high quality, effective, efficient radiotherapy units must be established on a large population base. As discussed in Chapter 6 on service delivery, small independent regional radiotherapy centres are not appropriate or practical because initial capital costs are high and there is a chance that quality of treatment will be compromised if patient numbers are too small.

Financial aspects of access will be addressed in the following section on Patient Accommodation and Travel Schemes (PATS). Social and psychological issues are incorporated in the section on patient education.

The principles of equal access for all Australians to publicly funded health and medical services are compromised by both the distribution of and the referral patterns to radiotherapy services. As discussed earlier in this report, referral rates to radiotherapy treatment in Australia are below international standards. There are also different rates of treatment within Australia, because of the difficulties rural people face in accessing services. Most country areas are serviced by clinics attended by staff from treatment centres, although this is not comprehensive and varies from state to state. Planning should be directed towards maximising opportunities for timely access to radiotherapy treatment.

Because most radiotherapy treatment is provided on an outpatient basis, metropolitan people receiving treatment can visit the centre daily while living at home even though they may need the assistance of family or friends with transport and social support. People living in rural or isolated areas who decide to have radiotherapy treatment for what is usually a life threatening illness have the additional burden of finding affordable accommodation nearer to the treatment centre.

In a submission to the House of Representatives Subcommittee on the Management and Treatment of Breast Cancer, the Royal Australasian College of Surgeons expressed concern over access to radiotherapy for women with breast cancer. Access difficulties are caused by: distance from centralised city treatment centres; long absences from families and personal support systems; and the effect of choice of initial treatment option, where women may choose mastectomy closer to home even if breast preservation is possible. Extrapolation of this situation to people with other forms of cancer can be made. The submission to the Working Party from WA 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.

Patient Accommodation and Travel Schemes (PATS)

These schemes are designed to assist rural and isolated people who need specialist treatment that is not available locally. The Working Party was given information on PATS by all States and both Territories. Most states supplied the information usually received by a prospective referring medical practitioner or a person requiring treatment. Only Western Australia provided information about the use of the scheme, grouped by region and total expenditure. No comprehensive evaluations of the success of the program in access and equity terms were given, although Western Australia, Queensland and New South Wales provided comments. However a number of difficulties with the schemes were identified. The reimbursements are mostly based on a single visit, and are not applicable to lengthy city visits. In addition, some of the discretion arrangements for funding of partners appear to be inadequate and to contain anomalies.

The South Australia Health Commission (SAHC) provided a copy of the Directory of Accommodation for Rural Families of Hospital Patients prepared by the South Australian Rural Advisory Council. This is a comprehensive document that includes information on childcare, carparking, welfare and SAHC in relation to the Patient Accommodation and Travel Scheme. Such a document could be usefully replicated by every State/Territory. The South Australian scheme includes special arrangements for radiotherapy patients in terms of reimbursement of entitlements.

A few hospitals have made accommodation available for rural people in what were previously nurses' quarters, and some hostels under the auspices of voluntary agencies have also been made available. As radiotherapy is increasingly administered on an outpatient basis, States should be increasing their responsibility towards rural people and their families. Because of the reliance in some states on privately run facilities for accommodation, overall there are significant out-of-pocket expenses for rural patients and their families.

Assistance available

The schemes vary considerably between States. All require a $30–75 contribution from the patient for the return journey, as well as for the attendant if this is deemed applicable by the referring doctor.

The most economical means of transport is specified in most States, although the referring doctor can indicate where medical need necessitates air travel. In Queensland and the Northern Territory the most economical means of travel must be used within the state, and this seems to preclude air travel as an option within those states. In Western Australia, Northern Territory and Tasmania economy air travel for one return journey is available for interstate services.

An attendant is automatic for patients under 17 years in some states and 18 years in others. Tasmania and Australian Capital Territory allow an annual maximum assistance of $2,000 while other states do not specify a limit.

The benefit in any State/Territory is $30–35 per person per night for commercial accommodation and $10 per person per night for private accommodation, with some restrictions. Tasmania and Australian Capital Territory have maximum annual amounts for accommodation. Tasmania also requires non-card holders to pay for the first two nights of the accommodation. The Northern Territory allows only seven nights of benefit for all cases except maternity cases, and this seems to disadvantage outpatient radiotherapy cases particularly as there is no treatment centre in the Northern Territory.

Definitions of isolation

All States except Victoria and Queensland limit eligibility for assistance to those living beyond a 200 km radius of the treatment centre. Victoria and Queensland have recently reduced the definition of isolation from a 200 km to a 100 km radius. Substantial numbers of people seeking radiotherapy treatment live in densely populated cities within the 100 km radius. The travel time involved can still constitute isolation from a treatment centre.

Administration and referral of the Patient Accommodation and Travel Schemes

All States/Territories have devolved responsibility for administration of the scheme to their regions. Supplementary information provided indicates that when regions are experiencing budgetary restraints, patient travel assistance may be an easy service to cut. One hospital in far north Queensland, for example, will not fly any patient for treatment but instead will subsidise the cost of a bus fare.

Regions have administrative responsibility but referring hospitals appear to bear some of the administrative costs. The scheme in Tasmania is not means tested, and in the other States eligibility is assessed by a social worker.

Implications for access and equity

Two states have reviewed their schemes in the last three years. Victoria's scheme is currently under review. In Queensland the review found many inconsistencies between interpretations of the available assistance and the actual assistance provided. In New South Wales it is acknowledged that existing guidelines disadvantage radiotherapy outpatients who may not live in isolated areas (ie more than 200 kms from the treatment centre) but who may be required to attend treatment on a daily basis for perhaps six to seven weeks. This finding can reasonably be extrapolated across Australia and is of concern in terms of access and equity of service provision and of choice of treatment for cancer patients.

All States require that the application for assistance be completed by a general practitioner. This is no doubt an administrative burden on GPs, but it also constitutes a form of gatekeeping to the system. Some schemes discriminate against people who require repeated visits. As changes to treatment modalities occur, patient assistance schemes must be sufficiently flexible to ensure that access to recommended treatments is not limited by the potential for financial hardship incurred by travel and accommodation expenses. Further, Regional Directors of Health, to whom budgeting responsibility for PATS is devolved, must also have flexible budgetary discretion to safeguard access arrangements.

The restrictions on PATS indicate that the overall funding base is inadequate. Many of the regulations are inflexible, intended to curb budgetary expenditure on the scheme.

Carers

The needs of carers of radiotherapy patients should not be overlooked because of an emphasis on the complex issues surrounding the delivery of the service. The majority of carers in our society are women. However, both men and women caring for a cancer patient undergoing radiotherapy treatment will have particular needs and those living in rural or remote areas have particular problems to overcome. An awareness among service providers of the support and information needs of carers can enhance the quality of care available to the person requiring treatment. Improved information booklets about Patient Accommodation and Travel Schemes, support groups, voluntary and formal organisations concerned with cancer, should be made available both at the referral point and the treatment service.

Access is mediated by the availability and regulatory framework of patient assistance schemes. The restrictions and inflexibility of the regulations of PATS indicate that the overall funding base is inadequate and they are understood to comprise a form of rationing to curb budgetary expenditure on the schemes.

Existing PATS do not meet the requirements of access and equity of people living in rural and remote areas. The current level of subsidy is inadequate when the total financial burden of the patient and the immediate family is considered.

The availability and magnitude of subsidies varies considerably between States/Territories.

The Victorian and Queensland decision to redefine isolation for subsidy purposes from 200 km to 100 km is one step toward redressing inequalities of access but such restrictions still mediate against equitable access to treatment for low income or dependent people from rural or metropolitan areas.

Newer treatment modalities can sometimes require longer courses of outpatient rather than inpatient treatment. Therefore, daily or weekly travel, accommodation, meals and loss of earnings result in substantial out-of-pocket costs to patients and carers, especially as most PATS are based on a single treatment and not repeated visits.

Education about the benefits of radiotherapy to patients and issues concerning equal opportunity to access this treatment should be targeted to rural practitioners.

Recommendations:

- PATS should be revised to provide increased financial assistance, including assistance to carers travelling with a patient. The schemes should include provision for patients requiring longer courses of treatment. Distance criteria should be reviewed in all States/Territories so that optimal treatment choices are not compromised because of lack of access.
- Easy to read pamphlets containing entitlements, eligibility and details about accessing the schemes should be produced by State and Territory health authorities and should be available in doctors' rooms, hospitals and health centres where cancer patients are treated.

Quality of life

Quality of life has both objective and subjective dimensions. Both patients and their docto will have views on quality of life issues in relation to technological interventions. Any discussion about the quality of life should not be confused with judgements about the value life or social utility of another's life (Beauchamp 1989, McCormick 1990).

There is evidence of increasing consideration of the outcomes and effectiveness of medical technology—not just physiological but also social and functional outcomes. Medical care is thought to be effective in quality of life terms when that care is able to maintain a symptom free state in people, allow them to maintain employment or assist them to endure the ending life. For those with chronic, disabling conditions, technological interventions can improve th quality of life in terms of increasing comfort or functional capacity (Sax 1990). However, Sax also discusses the perhaps unrealistic societal expectations of medicine that technological intervention should cure, not merely palliate.

Quality of life in relation to cancer treatment by radiotherapy cannot be easily defined. Ethic justifications for treatment require that the best interests of the patient should be maintained, and that the benefits of the treatment should outweigh the costs. Treatment should be given i the knowledge that it is better for the patient *in terms of cure, relief or comfort* than the alternative (Sax 1990).

Cancer patients should be well informed about the treatment they are to have. Open, honest relationships about the intent of any treatment and its possible outcomes form the basis of the rules of informed consent (Beauchamp 1990). Instruments that attempt an objective measurement of quality of life are available and are regarded as integral to evaluations of the effectiveness of clinical treatments (Gough 1994). However, given that quality of life definitions are also subjective, a climate of information sharing can assist with the quality of how people *live, how they die, and how they live while dying* (McCormick 1989).

Quality of life issues are being increasingly recognised as highly significant indicators in the assessment of outcome of treatment.

Voluntary and support groups

The proliferation of voluntary and support groups for people living with cancer is an important development in Australia. The groups are community based and most gather and disseminate information to enable people to make informed decisions about their illness and treatment. They provide psychological and practical support as well as fund-raising for cancer services and research. Their importance for the promotion of self-help and understanding cannot be underestimated.