AUSTRALIAN INSTITUTE OF HEALTH:
PREVENTION PROGRAM EVALUATION SERIES NO 1

# Breast cancer screening in Australia: future directions

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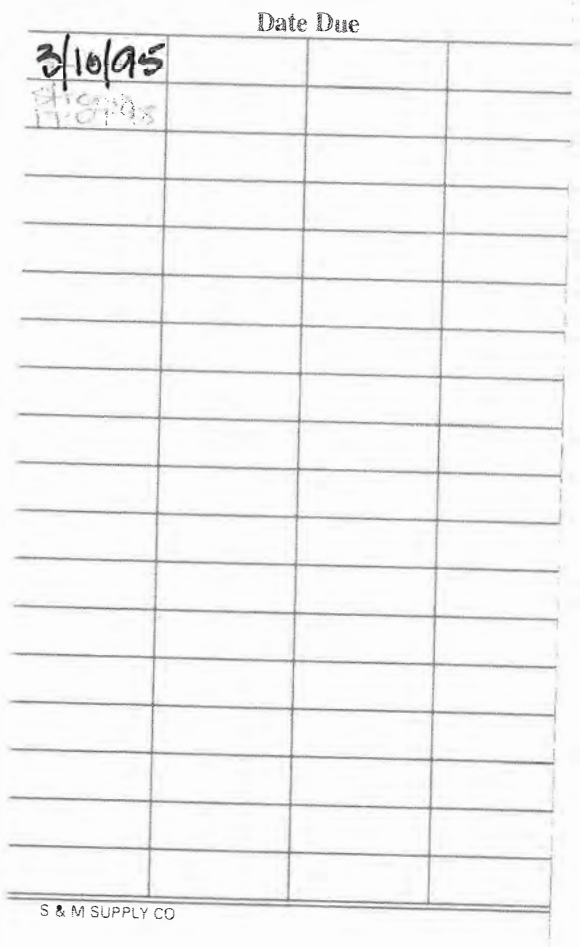

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Australian Health Ministers' Advisory Council
Breast Cancer Screening Evaluation Steering Committee

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Canberra

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14 May 1990

Dr WT McCoy
Chairperson
Australian Health Ministers' Advisory Council
C/- Department of Community Services and Health
GPO Box 9848
CANBERRA ACT 2601

Dear Dr McCoy

**BREAST CANCER SCREENING EVALUATION STEERING COMMITTEE**

In February 1988 AHMAC created the Steering Committee to oversee and direct the National Evaluation of Breast Cancer Screening Pilot Projects and to advise AHMAC on breast cancer screening programmes. I have pleasure in conveying the report of the Committee to you.

It is envisaged that the Australian Institute of Health will publish a number of technical reports associated with the evaluation later in 1990.

Yours sincerely

A. J. McMichael

Professor A J McMichael
Chairman

# Contents

# 1 Preface

This report of the Australian Health Ministers' Advisory Council's Breast Cancer Screening Evaluation Steering Committee is the principal outcome of the national evaluation of breast cancer screening pilot projects. The terms of reference of the Committee are overleaf. The main purpose of this report is to make detailed recommendations about the policy aspects of developing a national breast cancer screening program for Australia. The contents of the report should also be useful to groups involved in breast cancer screening and, more generally, groups involved in public health, preventive medicine and women's health.

The recommendations of the report are presented in chapter 4. The substance of the report is structured as four main chapters:

6 **Screening for breast cancer**
This chapter examines in detail the various methods which have been proposed for breast cancer screening, and assesses the likely impact that breast cancer screening would have on death from breast cancer in Australia. It also examines the cost–effectiveness of breast cancer and whether high quality breast cancer screening can be performed in Australia and is acceptable to Australian women.

7 **Components of a successful screening program**
This chapter examines the benefits and potential adverse effects of mammographic screening. It also discusses the requirement for a screening program to meet women's needs, and the potential involvement of general practitioners in a screening program.

8 **A breast cancer screening program for Australia**
This chapter discusses in detail proposed screening policy, organisational arrangements, funding and implementation of a national mammography screening program.

9 **Cost of a national screening mammography program**
This chapter presents estimates of the cost of a national screening program, during both the implementation phase and steady–state operation.

The numbering of the recommendations in the text is not self explanatory. The recommendations in chapter 4 have been placed in a logical order and numbered in sequence. This numbering has been used in the text, although in the text the recommendations do not appear in this order. This system has been used to facilitate cross referencing between the text and chapter 4.

The information used in this report has been gained from the following sources:

- Australian mammography screening pilot projects;
- International and Australian published research on breast cancer screening;
- Study tour by the head of the Screening Evaluation Coordination Unit of national breast cancer screening programs in Sweden, Finland, Britain and the Netherlands.

The views of a wide range of interested organisations within Australia were also sought.

To evaluate the pilot projects, standard data sets were developed in consultation with the projects, which were then requested to submit data in accordance with the data sets. In the time available, not all projects have been able to provide all the data requested. This has resulted in missing data in some tables. Nevertheless, the data provided are sufficient to draw a number of major conclusions. An important area in which data are lacking is the proportion of women who would attend screening if there were an intensive recruitment campaign using electronic media. This information, which would have significant planning and resource implications, may only be gained once large scale screening has commenced.

In relation to outstanding data, pilot projects will be asked to submit these data to the Screening Evaluation Coordination Unit at the Australian Institute of Health by 30 June 1990. It is intended to use these data (and data previously supplied but not included in this report) to prepare several technical reports and refereed publications in collaboration with pilot projects.

As part of the Steering Committee's consideration of possible methods of breast cancer screening, the Health Technology Unit at the Australian Institute of Health was requested to convene a working party to examine this issue as well as update advice on technological aspects of mammography technology. The material in section 6.5.4 which examines the possible alternative technologically based methods of breast cancer screening was prepared by the Working Party. The report of the Working Party was published in March 1990 and is available from the Australian Institute of Health (Australian Institute of Health 1990).

# 2 Terms of reference

The Breast Cancer Screening Evaluation Steering Committee was given the following terms of reference by the Australian Health Ministers' Advisory Council:

1 to ensure the adequate conduct of and give direction to the Screening Evaluation Coordination Unit of the Australian Institute of Health;

2 to advise the Australian Health Ministers' Advisory Council on the various policy aspects of developing national strategies for extensive screening programs.

# 3 Committee membership

Professor Tony McMichael (Chair)
Professor of Occupational and Environmental Health
Department of Community Medicine
University of Adelaide

Dr Susan Britton — Until November 1988
Medical Coordinator
South Australian Health Commission

Ms Kay Collett (Coopted) — From March 1989
Radiographer
Royal North Shore Hospital

Ms Carla Cranny
Western Sydney Area Health Service
NSW Department of Health

Dr John Donovan — From March 1989
Principal Medical Services Advisor
Australian Institute of Health

Ms Jane Hall
Health Services Researcher
Department of Community Medicine
University of Sydney

Professor William Hare — Until September 1988
Radiologist
University of Melbourne

Mr Roy Harvey — Until November 1988
Head
Health Services Division
Australian Institute of Health

Dr Paul McCann
Director
Medical Services
Royal Hobart Hospital

Dr Cathy Mead — From March 1989
Medical Services Adviser
Commonwealth Department of Community Services and Health

Dr Ian Ring
Medical Director
Epidemiology and Prevention Unit
Queensland Department of Health

Mr Ian Russell
Surgeon
Amalgamated Melbourne and Essendon Hospitals

Dr Peter Wilson — From November 1988
Radiologist

Professor Martin Tattersall
Department of Cancer Medicine
University of Sydney

From December 1989

Secretary/Convenor
Dr Michael Fett
Head
Screening Evaluation Coordination Unit
Australian Institute of Health

# 4 Recommendations

1 Properly conducted mammography screening programs are effective in reducing breast cancer mortality. There are no universally accepted benchmarks in economic evaluation for the trade-off between years of life saved and cost. If a cost per life year gained of approximately $6,600–$11,000 is considered acceptable value for money, then mammography screening outlined in this report can be recommended for adoption. Having considered both the scientific and economic evidence, the committee recommends that mammography screening be introduced into Australia and be made available to all eligible women (sections 6.5–6.9).

2 Breast cancer screening should employ screen-film mammography alone as the principal screening method for reducing breast cancer mortality. Screening programs should consider providing instruction in breast self-examination, while recognising that an important goal of such instruction is to reinforce the message that a negative mammographic screen does not preclude the development of breast cancer prior to the next screen. This recommendation is not an endorsement of breast self-examination per se as a screening method for breast cancer (section 6.5.2–6.5.5).

3 To maximise the benefits and minimise any adverse effects to women, a national mammography program should possess the following features:

- a national mammography screening policy;
- mammographic screening provided as an integrated, systematic and coordinated program;
- national and State–Territory level coordination mechanisms;
- appropriate treatment services;
- provision of adequate resources;
- specialised training for radiographers, radiologists, surgeons and pathologists;
- an appropriate balance of incentives for service providers to maximise quality of service;
- quantitative performance criteria;
- ongoing monitoring and evaluation of the screening program;
- standardised accreditation procedures;
- ongoing research and program review (section 7.1).

4 A national mammography screening program should select women on the basis of age alone. There are two broad options: to make mammography available to women aged 40 years and above or to make mammography available only to women aged 50 years and above. There is an international consensus that mammographic screening is effective for women aged 50 years and above, while there is not yet a consensus in relation to women aged 40–49 years. It is the committee's view that mammographic screening should be made available and publicised for women aged 40 years and above, but that recruitment strategies should be targeted at women aged 50–69 years at this time. The recommended age range for screening should be reviewed as new data become available (section 8.4.1).

5 Screening should be made available as widely as possible to all eligible women in the target group with the intent of rescreening them every two years. The recommended screening interval should be reviewed as new data become available (section 8.4.2).

6 All women should be initially screened with two-view mammography. At subsequent screens, one-view may be used if previous mammograms indicated that two-views were not required at subsequent screens. Research is required which would examine the relative cost-effectiveness of two view versus one view screening mammography (section 8.4.3).

7 On the balance of current evidence, all mammography films should be read independently by two readers, with the two reports being combined into a single recommendation. Both readers must be specially trained in screening mammography. At least one of the readers should be a radiologist. In the case of radiologists, this training is in addition to FRACR training.

Research is required which would examine whether non-radiologist film readers can be trained in screening mammography film reading to the same level of proficiency as radiologists and whether such training would be cost-effective. Research is also required into the relative merits of one and two film readers per film (section 8.4.4).

8 A national mammography screening program should seek to maximise attendance at the program by providing adequate resources for recruitment as well as by maximising the visibility and accessibility of the program to all eligible women. Close attention should be given to equity of access.

The results of screening should be provided promptly and directly to the woman in a way which is sensitive to the anxiety provoked by a positive result.

The screening program should provide screening in a way which is acceptable to women by offering:

- a non-threatening, comfortable environment;
- comprehensive and easily understood information about screening;
- emotional support;
- involvement by women in decisions about their management, particularly in relation to further assessment and treatment (section 7.2.1 and 7.2.2).

9 Education programs and material about screening mammography which are targeted at the medical profession, and in particular at general practitioners, should be developed, widely promoted and disseminated among the profession (section 7.3).

10 A woman's general practitioner should be kept informed of the results of screening and any further work-up required, unless directed otherwise by the woman (section 7.3).

11 Formal research should be conducted into the comparative effectiveness and cost-effectiveness of mammary serum antigen and mammography in screening for breast cancer (section 6.5.4).

12 In Australia, with a federal system and shared responsibilities for different aspects of health services, the support and quality assurance functions should be shared between national bodies and State and Territory bodies (section 8.2).

13 In view of the fact that a national mammographic screening program would be the first of its type in Australia, and that large scale financing is involved, a national breast cancer screening advisory committee and a national breast cancer screening coordination unit should be established. While a number of governmental and non-governmental bodies would be responsible for various components of the screening program, these two national screening bodies should act as the final common path, coordinating all the elements of the screening program. Once the national mammography program is implemented, the need for these two bodies should be reviewed (section 8.2.1).

14 Each State and Territory should give consideration to establishing a breast cancer screening coordination unit to perform the functions outlined in section 8.2.2. States and Territories should consider the need for additional organisational mechanisms, eg State-Territory steering or advisory committees and regional or local planning bodies (section 8.2.2).

15 Screening and assessment should be carried out in dedicated screening units and assessment centres. Assessment centres and their affiliated screening units should be responsible for all procedures provided as part of the national screening program up to and including cytological or histological diagnosis of breast cancer. Individual screening units should not operate independently, but should operate in close association with a designated assessment centre. It is highly desirable that each assessment centre and its affiliated screening units has a well defined geographic catchment area, to assess the population coverage of screening. Assessment centres and affiliated screening units may have catchment areas which overlap with other assessment centres and their screening units, or may have catchment areas which do not overlap, for example in rural areas (section 8.3.2).

16 To ensure that all screening mammography conducted in Australia is of high quality, mammography screening and assessment of women with suspicious mammograms should only be performed by facilities which are accredited for mammographic screening. All such screening units and assessment centres should be required to meet initial and ongoing accreditation standards. If accreditation procedures are in place for any categories of staff, accredited assessment centres and their affiliated screening units should be restricted to selecting staff only from those who are accredited (section 7.1).

17 Women with histologically or cytologically confirmed breast cancer should be given the option of referral to a treatment clinic specialising in the treatment of screen-detected breast cancer or returning to their general practitioner for referral (section 8.3.3).

18 Comparable data returns should be used by all accredited assessment centres and their affiliated screening units to facilitate uniform monitoring/evaluation and the use of uniform computer software. The State-Territory coordinating units should be the central repository for data collected from the accredited assessment centres and their affiliated screening units on each woman screened and followed up. The national breast cancer screening coordination unit should maintain a national data base incorporating summary data collected by each State-Territory coordinating unit (section 7.1).

19 Screening units and assessment centres could be established within either the public sector or private sector at the discretion of the States-Territories. Both public and private sector assessment centres and screening units should meet the same accreditation procedures and technical selection criteria, and should be required to provide the same uniform data returns (preferably utilising the same computer software) to the State-Territory and national coordinating units as in recommendation 18 (section 8.7).

20 A national screening mammography program for Australia should be implemented in a systematic manner over the next five years up to mid 1995. Each State-Territory should implement the mammography screening program according to a specified plan. Central activities such as recruitment, coordination, policy, monitoring and quality assurance should be established in the first year of the program. All assessment centres should be established progressively in the first three years and the screening units should be established progressively over five years. Decisions on the locations of assessment centres and screening units, and the mix of mobile and fixed screening units should be made in the context of the development of State-Territory plans for mammography screening (section 8.7.2).

21 One radiology registrar position should be created within each mainland State. The position should be located within one of the mammography screening pilot projects and be occupied on rotation for six to 12 week periods by senior radiology registrars (section 8.7.3).

22 In view of the comparatively small differences between the projected radiographer workforce and the projected requirements for radiographers in the context of a national mammography screening program, as well as the inadequate information available on the radiologist workforce, the national and State-Territory coordination units should monitor in an ongoing way the supply and demand for radiographers and radiologists. The coordination unit should initiate appropriate action required to ensure that sufficient radiographers and radiologists are available to adequately staff the national mammography screening program (section 8.7.3).

23 The national mammography screening program should be jointly funded by the Commonwealth and State-Territory governments (section 8.6.1).

24 The Commonwealth-State-Territory cost sharing arrangements should be developed in such a way that funds are dedicated to the national mammography screening program and jointly pooled, so that changes in budgetary allocations do not distort resource allocation between key components of the screening program. Involvement of the proposed State-Territory breast cancer screening coordination units in the funding process is an important means of achieving this (section 8.6.1).

25 The Commonwealth-State-Territory cost sharing arrangements (along with accreditation and quality assurance) should promote the achievement of:

- high recruitment rates of women in the target age group;
- a high quality and well integrated screening and assessment service;
- incentives for assessment centres and their affiliated screening units to maximise the number of cancers detected, while encouraging optimal use of assessment procedures;
- the efficient use and distribution of available funds between all stages of the screening process (recruitment/recall, screen taking/reading, assessment, notification, counselling, training, monitoring/evaluation and coordination);
- adherence to the national screening guidelines;
- flexibility in the way individual States and Territories choose to organise the provision of screening and assessment services, including the public-private mix of services and fixed/mobile screening units, subject to meeting the national guidelines; and
- a funding mechanism which could be applied equally to the private or public sector and which recognises the unique capital requirements of the implementation phase (section 8.6).

26 Funding of mammography screening and assessment through to histologically or cytologically confirmed diagnosis of breast cancer should be independent of Medicare rebate fee-for-service schedules (section 8.6.1).

27 Payment from the national mammography screening program funds should only be made to assessment centres and screening units (whether public or private) which are accredited, which achieve satisfactory performance in relation to specified performance criteria and which provide comparable data returns to the State-Territory coordination units (section 8.6.2).

28 It is vital that cost to women should not be a barrier to their participation in the screening program. An essential component of any funding arrangement is that mammography screening be available free of charge for women in the target age group who would not attend if there was a charge (section 7.2.1).

29 Medicare funding of diagnostic mammography and associated procedures should be monitored during implementation of the national mammography screening program. It would be preferable to avoid a situation where the two systems of funding mammography and associated procedures created incentives which were not conducive to achieving the goals of the screening program and to the establishment and recognition of assessment centres of excellence (section 8.6.2).

# 5 Background to the national evaluation of breast cancer screening

This report is an important outcome of the National Breast Cancer Screening Evaluation. The Evaluation was established as a joint initiative of Commonwealth, State and Territory health authorities under the auspices of the Australian Health Ministers' Conference (AHMC). It followed the recommendations of an Australian Health Ministers' Advisory Committee (AHMAC) Sub-committee on Breast and Cervix Cancer Screening, which reported in November 1987. At that time, small scale breast cancer screening services were being established in Australia. This resulted from the findings of overseas studies that breast cancer screening, in particular high quality mammography, can substantially reduce the risk of death from breast cancer among women screened. This reduction in risk becomes apparent after a period of about five years.

Health Insurance Commission data show that there has been strong growth in demand for mammography services in Australia over recent years and mammography is now available in both the private and public sectors. Most of the public sector screening services have been established as pilot projects with a view to ensuring that the results obtained in other countries will be reproduced in Australia.

The pilot projects have also comprised a source of experience and data to assist planning of a national mammography screening program. In 1987, the Commonwealth committed $2.6 million over three years for a national evaluation of the feasibility and cost-effectiveness of a national screening mammography program. Specifically, the evaluation was to assess the possibility of providing a high quality service which is acceptable and accessible to women, and which represents value for money. Further Commonwealth funding of $500,000 for evaluation and $2.8 million for mobile mammography vans was allocated in 1989-90.

A Screening Evaluation Coordination Unit was established at the Australian Institute of Health to oversee the national evaluation and to assist the Breast Cancer Screening Evaluation Steering Committee in providing a report to AHMAC by mid-1990. In the lead up to the March 1990 federal election, the Australian Labor Party promised that, if re-elected, it would introduce a National Early Breast Cancer Detection Program offering mammographic screening to women aged 40 years and above. The committee's findings are independent of this political commitment. The committee's report was submitted for consideration by AHMAC at its meeting on 1 June 1990.

# 6 Screening for breast cancer

## 6.1 What is screening?

Screening is the performance of tests on apparently well people in order to detect a medical condition at an earlier stage than would otherwise be the case. Screening is only beneficial if treatment of the screen detected condition results in a better long term outcome (in terms of reduced morbidity or mortality) than treatment of the same condition presenting clinically.

For a screening test to be acceptable it should fulfil the following criteria, which have been developed for the World Health Organisation (Wilson and Junger 1968):

- the condition sought should be an important health problem;
- the natural history of the disease should be well understood;
- there should be a recognisable early stage;
- treatment of the disease at an early stage should be of more benefit than treatment started at a later stage;
- there should be a suitable test;
- the test should be acceptable to the population;
- there should be adequate facilities for the diagnosis and treatment of abnormalities detected;
- for diseases of insidious onset, screening should be repeated at intervals determined by the natural history of the disease;
- the chance of physical or psychological harm to those screened should be less than the chance of benefit; and
- the cost of a screening program should be balanced against the benefit it provides.

This report addresses these issues in relation to breast cancer screening, as well as practical issues relevant to implementation in Australia.

## 6.2 Why screen for breast cancer?

Cancer of the breast is the most common cancer among Australian women. In 1982, the most recent year for which national cancer incidence data are available, there were 5,049 cases of breast cancer reported in Australian women. This makes breast cancer more than twice as common as the next most common cancer among Australian women, cancer of the colon. The incidence of breast cancer rises rapidly with age from the early 20s to 50 years of age and, after a brief plateau, rises again into old age. Based on these data, the lifetime risk of a woman developing the disease is one in 16.

Breast cancer is also the most common cause of death from cancer in Australian women. In 1987, the most recent year for which cancer mortality data are available, there were 2,258 deaths recorded from breast cancer in women. This represents about 18.5% of all female deaths due to cancer for that year. The next most common cancer, cancer of the colon, caused about 12.9% of female deaths due to cancer.

From the 1987 mortality data, the likelihood of a woman dying from breast cancer before the age of 75 is one in 44.

## 6.3 Prospects for primary prevention

It would clearly be preferable to prevent breast cancer from occurring in the first place, rather than subject women to a screening test in order to detect breast cancers already present. On present evidence, the only well established and potentially modifiable risk factors are obesity, nulliparity, and a first full-term pregnancy at a comparatively late age. It has been estimated that if all women were to reduce their body weight to at or below their ideal weight and to have at least one full term pregnancy before 25 years of age, about 35% of breast cancers could be prevented completely. (Adapted from the Report to the Minister for Health for Western Australia from the Working Party on Screening Mammography, 1987.) However, expectations of such significant modifications of these risk factors are unrealistic.

The next means of reducing breast cancer mortality is to detect breast cancer sufficiently early in its natural history when treatment has a more favourable impact on long term survival from the disease. Such an approach to disease control is known as secondary prevention. It is in this context that studies of the impact of breast cancer screening on mortality from breast cancer have been conducted.

## 6.4 Important considerations in screening for breast cancer

In deciding whether to introduce breast cancer screening in Australia, it is important to assess in detail three issues.

1 Is breast cancer screening effective? The goal of breast cancer screening is to reduce breast cancer mortality among women. Without evidence of clinical effectiveness it is not possible to justify the introduction of screening.

2 Does breast cancer screening represent value for money? If breast cancer screening is clinically effective, it is necessary to examine whether such screening contributes more per dollar spent to the improvement of health than other competing uses for the health resources. This can be expressed as comparative cost per life year gained, or preferably, as comparative cost per quality adjusted life year (QALY) gained.

3 Is breast cancer screening appropriate for Australia? If breast cancer screening is considered effective and value for money in Australia, it is necessary to establish that it is feasible and practicable to establish breast cancer screening in this country. This assessment requires examination of a number of practical issues such as the acceptability of such a program to Australian women, how such a program would be organised and implemented, whether high quality can be maintained in a large scale screening program and whether adequate staffing is available.

This report summarises the steering committee's consideration of these three fundamental issues.

## 6.5 How to screen for breast cancer

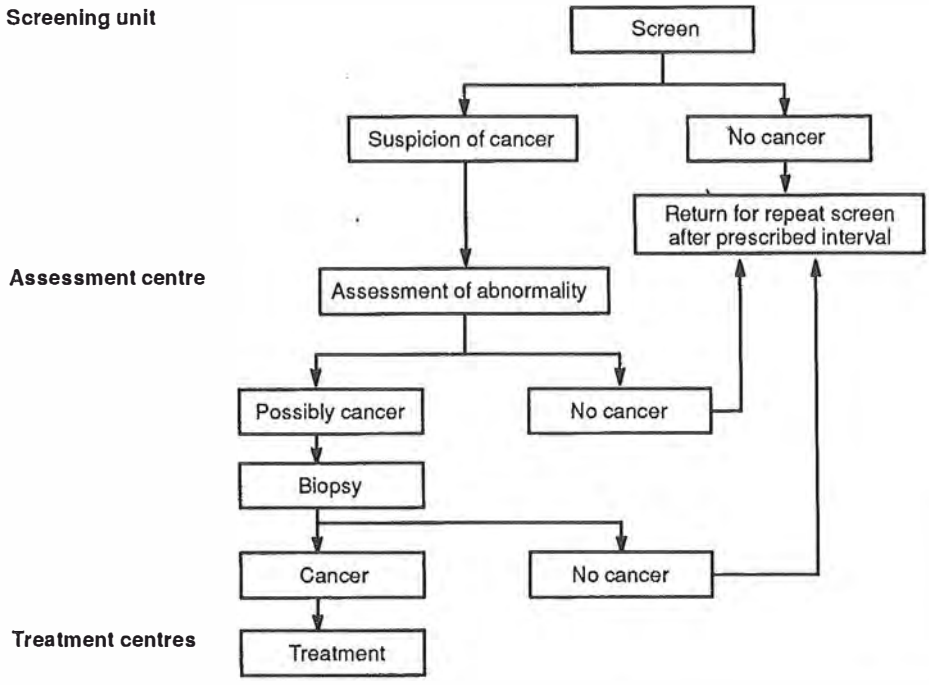
Various methods have been considered for screening women for breast cancer. They are:

- breast self-examination (BSE);
- physical examination (PE);
- mammography;
- a variety of other methods: ultrasound, transillumination light scanning, thermography, computerised tomography, magnetic resonance imaging and immunological techniques.

The potential impact of each of these methods on breast cancer mortality is examined below.

All breast cancer screening methods involve progression through a sequence of stages from the initial screen to the final confirmation of cancer by biopsy. This is followed by treatment. The stages are shown in figure 6.1.

**Figure 6.1: Screening procedure for breast cancer**




### 6.5.1 Breast self–examination

Breast self–examination is a method of screening for breast cancer which involves tuition of women in examination of their own breasts for abnormalities. Instruction can be provided in special classes by health professionals, by media such as video or printed instructions or during routine health care visits. The woman is then able to check her breasts regularly and thoroughly for symptoms or signs of breast cancer. It is reasoned that women will then be able to detect breast cancer earlier than otherwise, enhancing the probability of cure.

A combined analysis of the studies of BSE (Hill et al 1988) suggests that BSE is effective in detecting cancers at an earlier stage than when the cancers are clinically apparent. One might therefore expect subsequent improvements in survival and reductions in mortality from breast cancer. At this stage, no mortality data are available from prospective randomised trials of BSE. However, BSE can never detect impalpable breast cancers. (The detection of impalpable cancers by mammography is thought to have been an important contributor to the observed reductions in breast cancer mortality in studies of mammography.) Therefore, while BSE may have a role in breast cancer screening programs in detecting cancers which arise in an interval between screens, at this stage it cannot be recommended as the sole screening method. Furthermore, BSE may have adverse consequences such as higher biopsy rates for benign breast disease, especially in younger women.

However, clinical considerations provide justification for BSE instruction generally and as part of an organised breast cancer screening program: BSE may lead to the earlier detection of some palpable breast cancers which may thereby require less extensive surgery, even if there is no impact on mortality. In the context of a screening program, BSE instruction has the additional benefit of reinforcing the message that mammography screening does not provide protection from the development of breast cancer nor a 100% guarantee of early detection and that any lumps or significant symptoms which arise between formal screenings should be brought to the attention of the woman's medical advisor immediately.

### 6.5.2 Mammography

In mammography, a woman's breasts are individually briefly compressed between two flat plastic surfaces, during which an x-ray of the breast is taken. One or two views (using different orientations) of each breast are taken. Mammography requires purpose built machines which are used only for mammography. Two types of technology are available for screening mammography: screen-film mammography and xeromammography. Both screen-film mammography and xeromammography are examples of transmission radiography, in which X-rays are transmitted through the breast, creating specific X-ray absorption patterns. The techniques differ in the methods used to capture these patterns in a visible image.

In screen-film mammography a fluorescent screen converts X-rays transmitted through the breast into visible light, which exposes the X-ray film. In xeromammography, an electrostatic recording system is used, with a charged photoconductive plate in place of X-ray film, yielding a latent image that is visualised with toner and transferred to paper. Generally, screen-film mammography has been the more popular technique, largely because xeromammography gives a higher radiation dose in small and average size breasts. Production of xeromammography systems has been suspended.

The first evidence on the effectiveness of mammography in reducing the risk of death from breast cancer in women came from a randomised, controlled trial known as the Health Insurance Plan of New York study (HIP) (Shapiro et al 1982; Shapiro et al 1988). Women offered screening were aged 40–64 years at entry into the study and were offered four annual screens comprising physical examination and mammography. At 10 years after commencement, the breast cancer mortality in the study group was 29% lower than in the comparison group, which is statistically significant. Lower breast cancer mortality in the study group was observed within four years of commencement of the study and the mortality reduction in the study group has persisted for 18 years, although it declined to 23%.

The analysis of the HIP study reported here is based on breast cancer mortality among women diagnosed with breast cancer within seven years of entry into the study. This period was chosen as by this time the incidence of breast cancer in the control group was equal to that in the study group. This ensured that the observed beneficial effect of screening on breast cancer mortality was not due to overdiagnosis. Overdiagnosis would lead to favourable outcomes in women with screen detected lesions diagnosed as breast cancers but which would never have become clinical cancers.

A similar reduction in breast cancer mortality was observed in a Swedish randomised, controlled trial of mammography, known as the Two Counties or WE study, commencing in 1976 (Tabar et al 1985; Tabar et al 1989). In this study, breast cancer screening was by mammography alone. Women offered screening were aged 40 years and over at entry into the study. The average screening interval for women aged 40–49 years was 24 months. The average screening interval for women aged 50 years or more was 33 months. Lower breast cancer mortality in the study group was observed within five years of commencement of the study. The most recent results, at eight years of follow-up, show a 32% lower breast cancer mortality in the study group

relative to the control group. This difference is statistically highly significant. There was no difference between the study and the control groups in mortality from causes other than breast cancer, indicating that the apparently beneficial effect of mammography was not due to misclassification of cause of death.

Statistically significant reductions in breast cancer mortality as a result of mammographic screening have also been observed in three case control studies in Nijmegen (Verbeek et al 1984; Verbeek et al 1989) and Utrecht (Collette et al 1984; Ward et al 1984) in the Netherlands and Florence in Italy (Palli et al 1986)) (table 6.1). Overdiagnosis as an explanation of these findings has been excluded in the Nijmegen study (Peeters et al 1986). Comparable data are not available for the other two studies. Due to possible biases in case control studies of screening, the magnitude of the reduction in breast cancer mortality found in these studies may be overestimated.

**Table 6.1: Breast cancer mortality in case control studies**

| *Study* | *Age range* | *Screening interval* | *No screens offered* | *Relative risk* | *95% CI* |
|---|---|---|---|---|---|
| Nijmegen(1) | (a)35-65, (b)40+ | 2y | 1-5 | (c)0.51 | 0.26-0.99 |
| Utrecht(2) | 50-64 | 1-4y | 2-5 | (d)0.50 | 0.13-0.70 |
| Florence(3) | 40-70 | 2-5y | 1-6 | (e)0.53 | 0.29-0.95 |

(a) During period 1975-1977.

(b) During period 1978+.

(c) During period 1975-1982.

(d) Six year period of observation from commencement of screening; adjusted for differences in survival periods for cases and controls.

(e) Between seven and fourteen years after commencement of screening.

Sources: (1) Verbeek et al (1984)
(2) Waard et al (1984); Collette et al (1984)
(3) Palli et al (1986)

As a result of these studies, the United Kingdom, Sweden, Finland and Iceland embarked on implementing national breast cancer screening programs using mammography as the sole screening method.

Subsequently, the results of the US Breast Cancer Detection Demonstration Project (BCDDP) were published (Morrison et al 1988). The BCDDP was a program of five annual screening examinations conducted at 29 centres in the United States. Screening comprised physical examination, mammography and, initially, thermography. Thermography was later discontinued due to its low sensitivity. Data have been published which compare the breast cancer mortality of white women aged 35-74 years at the time of their first screen with mortality expected without screening. The nine year cumulative mortality from breast cancer among women offered screening who did not have breast cancer at the start of observation was only 80% of that expected in unscreened women. This mortality reduction was observed even though only about 50% of women offered screening attended all screening cycles.

The recently published results of two other trials of breast cancer screening have been interpreted by some commentators as casting doubt on the effectiveness of mammography. The first of these, the UK trial of breast cancer screening (UK Trial of Early Detection of Breast Cancer Group, 1988), was a non-randomised, controlled trial of breast cancer screening for women aged 45-64 years at entry. Breast cancer screening comprised physical examination and mammography in years one, three, five and seven, and physical examination only in years two, four and six. At six years

after entry into the study, the breast cancer mortality in the screened group was 20% lower than in the comparison group, a result which is consistent with other studies but does not quite reach statistical significance (p = 0.06). One arm of this study conducted in Edinburgh was a randomised controlled trial of screening with physical examination and mammography. These data have been published separately (Roberts et al 1990). At seven years after entry into the study, the breast cancer mortality reduction achieved was 17% (relative risk 0.83, 95% CI 0.58–1.18). This was not statistically significant, even when corrected for socioeconomic status. However, the statistical power of the study was low due to relatively small sample sizes. Furthermore, the level of mammography in the control group was unknown and may have diluted the apparent effectiveness of screening in the study. The results of the Edinburgh study differ little from those of the UK trial, which is not surprising given that Edinburgh was one of the two cities in the UK trial in which comprehensive breast cancer screening was offered.

The second study which has cast doubt on the effectiveness of mammographic screening is the randomised, controlled trial conducted in the Swedish city of Malmo (Andersson et al 1988). Here, women aged 45 years and over were offered five mammographic screens at intervals of 18–24 months. After nine years of follow-up, breast cancer mortality in the study group was only 4% below that in the comparison group, a result which does not approach statistical significance.

Closer examination of both the UK and the Malmo trials, however, reveal that their data are consistent with a protective effect from mammographic screening, although of a lesser magnitude than expected in the period of observation than was found in the HIP and Two Counties trials. In relation to the UK trial, table 6.2 shows that there is no significant breast cancer mortality reduction in years one to five from entry into the study. However, in years six to seven the mortality from breast cancer among women offered screening is statistically significantly lower than among women in the comparison group. This is consistent with the delayed mortality reductions observed in the HIP and Two Counties studies, in which breast cancer mortality reductions were not observed until four and five years of follow-up respectively.

In the UK trial, screening was alternately by physical examination only and physical examination plus mammography. In the screening rounds which included mammography the cancer detection rate was two and a half times higher than in the physical examination-only rounds. Thus, it seems reasonable to attribute the majority of the mortality reduction observed in years six to seven to mammography.

In the Malmo trial, the data show an excess of breast cancer deaths among the study group in the first five years of the study and a deficit of breast cancer deaths among the study group in the following four years (table 6.3). As with the other cohort studies, it is in this latter period that an effect of mammographic screening on breast cancer mortality would be expected. When the results are presented for the full period of follow-up, the excess of deaths in the first five year period nullifies the mortality reduction found in the second five year period.

**Table 6.2: Breast cancer mortality among women offered screening in UK trial**

| | Years since entry | | |
|---|---|---|---|
| | *1-3* | *4-5* | *6-7* |
| Relative risk | 1.10 | 0.97 | 0.54 |
| 95% CI | 0.71–1.71 | 0.68–1.38 | (a)0.36–0.81 |

(a) $p < 0.01$.

Source: UK Trial of Early Detection of Breast Cancer Group (1988)

**Table 6.3: Breast cancer mortality in the Malmo trial by years since entry**

| | Years since entry | | |
|---|---|---|---|
| | *1-5* | *6-9* | *1-9* |
| Relative risk | 1.54 | 0.76 | 0.96 |
| 95% CI | 0.80-2.96 | 0.49-1.19 | 0.68-1.35 |

Source: Andersson et al (1988)

Taken individually, the various trials of breast cancer screening appear to give different estimates of the mortality effect of breast cancer screening. However, a statistical method known as meta-analysis allows the combination of results from a number of studies to give an overall estimate of effect, taking into account all available data. This method has the benefit of overcoming the problem of low-power in some studies due to small sample sizes. Therefore meta-analysis can provide a more accurate, average estimate of the effect of screening. When data from the randomised, controlled trials, (HIP, WE, Malmo, and Edinburgh studies), are analysed as a whole, a 22% reduction in deaths from breast cancer is found (95% CI 0.10– 0.33) (P Glaziou, personal communication). If the analysis is restricted to the more recent prospective trials in which mammography was the primary method of screening, (WE, Malmo, Edinburgh and the rest of the UK trial), a 19% reduction in breast cancer deaths is found (95% CI 0.06– 0.30) (Source: Screening Evaluation Coordination Unit).

A further adjustment can be made to these average estimates to take into account non-compliance by women randomised to receive breast cancer screening but who did not attend (Newcombe 1988). This gives an estimate of the effect of screening if all women allocated to have screening had actually attended screening. Such a combined analysis shows that 30% to 35% of deaths (including WE, Malmo, Edinburgh plus the rest of the UK trial, and HIP, WE, Malmo plus Edinburgh data respectively) from breast cancer would be prevented if all eligible women attend screening. Thus the data from all studies taken together demonstrate the effectiveness of breast cancer screening using mammography alone and in combination with physical examination.

Following the publication of the UK and Malmo results, the countries which had already embarked upon the introduction of national mammography programs continued with their programs and the Netherlands also decided to introduce a national program. In Sweden in particular, the publication of the Malmo study caused vigorous debate, the outcome of which was continuation of the national screening program. The US National Cancer Institute also continued to promote screening mammography, and was joined by ten other US medical groups in August 1989 in urging women 40 years and older to seek regular screening mammograms and clinical breast exams. In August 1989, a symposium of the Nordic Cancer Union (Anonymous 1989) concluded that 'screening for breast cancer by mammography alone or mammography plus physical examination can reduce mortality from the disease'. These actions reflected an international consensus that the balance of evidence still indicated that mammography screening can reduce breast cancer mortality.

New data on the effectiveness of screening mammography should continue to be reviewed, along with data on other potential methods of breast cancer screening. Periodic meta-analyses of all available data should also be performed.

An understandable concern in relation to any radiological procedure is the possible risk of cancer caused by radiation. A recent paper (Feig and Ehrlich 1990) examined this issue in detail and concluded that the possible years of life lost from possible radiation induced breast cancers are negligible compared with estimates of life expectancy gained from screening. To minimise this potential radiation risk, radiation dose should be monitored as part of ongoing quality assurance.

### 6.5.3 Physical examination

No adequately controlled trials have been conducted to specifically assess the effectiveness of screening by physical examination in reducing deaths from breast cancer. However, indirect evidence on the effectiveness of physical examination comes from the HIP and UK studies mentioned above. In neither of these studies was physical examination the sole screening method. In the HIP study it is not possible to infer the relative effectiveness of physical examination and mammography.

In the UK trial, omitting the first screening round (because it is atypical), the cancer detection rate was much higher in screening rounds using mammography plus physical examination (3.3 cancers detected per 1,000 women screened) than in screening rounds using physical examination alone (1.3 cancers detected per 1,000 women screened) (UK Trial of Early Detection of Breast Cancer Group 1988). Since mammography found more tumours, especially impalpable tumours, the majority of the benefit observed in the UK trial is likely to be due to mammography rather than physical examination.

Thus, physical examination alone has not been shown to reduce mortality from breast cancer, although the results of the HIP study are consistent with physical examination contributing to reduced breast cancer mortality. Nevertheless, the UK trial results strongly suggest that physical examination offers little in addition to modern mammography.

### 6.5.4 Other screening methods

A number of other technologies have been considered for use in the diagnosis of breast cancer. These include ultrasound, transillumination light scanning, thermography, computed tomography, magnetic resonance imaging and immunological techniques.

**Ultrasound** has an important function in the evaluation of established breast abnormalities, primarily in the differentiation of cystic from solid breast lesions. However, it has severe limitations as a screening method. It is significantly less sensitive in detecting impalpable cancers than mammography, it cannot reliably distinguish between benign and malignant solid masses, and it cannot accurately detect cancer not detected by mammography or physical examination. Thus the available data fail to support the use of ultrasound as a screening method (Kopans 1987). Moreover, there are practical difficulties: a large number of images would be required for complete examination of large breasts and the procedure is time consuming.

**Transillumination light screening** uses far-red and near-infrared light transmissions to scan breast tissues. The basic premise for its use is that cancer tissue absorbs more light at these wavelengths than normal tissue because of its increased blood supply, and can therefore be distinguished on the light scan.

Although early results with this technique were favourable, later studies indicated that its sensitivity was well below that of mammography. It performs particularly poorly in the detection of cancers smaller than 1 cm in diameter (Kopans 1987).

The US National Center for Health Services Research and Health Care Technology Assessment undertook an assessment of transillumination light scanning in 1988. The Center reported that the National Cancer Institute, American Cancer Society

and American College of Radiology considered that it should not be regarded as a substitute for mammography, and was still in the investigational phase. (US Center for Health Services Research and Health Care Technology Assessment 1988).

**Thermography** is a technique for imaging temperature differences on the surface of the body. It has been investigated as a means of diagnosing breast cancer but results have been poor (50% sensitivity and 70% specificity). In addition, there are practical problems associated with the need for stabilising surface body temperature before measurement (Health and Public Policy Committee 1985; Mushlin 1985).

There is currently little interest in the use of **computerised tomography** as a screening tool for breast cancer. Its high cost and relatively high radiation dose in comparison with mammography make it unsuitable for this application.

**Magnetic resonance imaging** has been shown to be less accurate than mammography in the detection of breast cancer (Turner et al 1988). In particular, it is unable to detect early disease (Kopans 1987). Its high cost and long examination times would make it unsuitable for use as a screening tool.

**Immunological techniques** based on monoclonal antibodies (MCAs) are being investigated for use in the detection, targeting and identification of breast and other cancers. Many MCAs reactive with breast cancer have been described but most of them also react with normal tissue or, to a lesser extent, with other tumours, with resultant low specificity. These MCAs are not reacting with tumour specific antigens but with normal tissue antigens which are expressed in greater quantity on malignant cells. It is the level of antigen present which indicates the presence or otherwise of the tumour.

MCAs have been investigated for use in serum testing, immunohistologic testing and radioimmuno detection techniques. Of these, only serum testing techniques would have potential for screening asymptomatic women for breast cancer.

In serum testing, the MCA is used to determine the level in the serum of a particular antigen associated with breast cancer, and a certain level is chosen as the criterion for a positive result. Many MCA antigen combinations have been investigated, but in most cases they gave poor results in the detection of early cancer. More promising results have been obtained for a test involving the use of an MCA called 3E1-2 to detect the serum level of mammary serum antigen (MSA). Using a level of 300 units or greater as the criterion for a positive result, the test was able to detect the presence of breast cancer in 69-72% of Stage I and 78-82% of Stage II cases (Stacker et al 1988; Tjandra et al 1988). There was a false positive rate of 2% in tests on serum samples from apparently normal individuals, and 18% for patients with benign breast disease (Stacker et al 1988).

In a study by Hare et al (1988) the MSA test was compared with two-view xeromammography in a study of 97 symptomatic patients (37 with Stage I or II breast cancer and 60 with benign breast disease). The MSA test gave superior results in the detection of breast cancer in this study. The MSA test had a sensitivity of 76% for the detection of Stage I and II breast cancers, while the mammographic technique had a sensitivity of 54%. The mammography results in this study were particularly poor, indicating that the xeromammography used had a sensitivity well below that of modern screen-film techniques. The study had the limitation that only symptomatic women were studied, and gives no information on the usefulness of the test as a screening technique for use with asymptomatic women. This would require further research.

It is possible that second generation MCAs will have greater sensitivity and specificity, with improved prospects for application in breast cancer screening. At the present time, the value of MCA serum tests in screening programs to detect preclinical breast cancer and involving large numbers of asymptomatic women has not been determined.

### 6.5.5 Conclusion

Of all of the methods of breast cancer screening which have been examined, mammography is the only method which has been shown unequivocally to reduce the risk of death from breast cancer screening. Screen-film mammography is the preferred technology for mammographic screening.

#### Recommendation 2

**Breast cancer screening should employ screen-film mammography alone as the principal screening method for reducing breast cancer mortality. Screening programs should consider providing instruction in breast self-examination, while recognising that an important goal of such instruction is to reinforce the message that a negative mammographic screen does not preclude the development of breast cancer prior to the next screen. This recommendation is not an endorsement of breast self-examination per se as a screening method for breast cancer.**

#### Recommendation 11

**Formal research should be conducted into the comparative effectiveness and cost-effectiveness of mammary serum antigen and mammography in screening for breast cancer.**

## 6.6 Potential impact on breast cancer mortality

As discussed in section 6.5.2, results from several screening trials can be combined by meta-analysis to give an overall estimate of the expected reduction in breast cancer deaths due to screening. The following section is based on a meta-analysis of the prospective controlled trials in which mammography was the primary method of screening, (WE, Malmo and the UK trials). The UK trial is included here although it included physical examination as physical examination is likely to have made only a minimal contribution to the mortality reduction observed. The HIP trial has been omitted as out-dated mammography technology was used and an unknown but possibly substantial part of the mortality deficit observed may have been due to physical examination.

When using data from the prospective controlled trials of mammography to estimate the potential impact on breast cancer mortality of a mammography screening program, three issues need to be considered.

Firstly, the mortality reductions reported include deaths from breast cancer found at the commencement of screening, when a high proportion of advanced breast cancers would be detected by the screening program. These cancers have higher mortality. This would contribute to the delay of four to five years before breast cancer mortality declines. In an ongoing screening program, this initial delay in mortality reduction would be greatly reduced. As a result, the steady state impact of mammographic screening on mortality is best assessed in terms of the mortality reduction observed beyond the initial five year period, when most deaths are not from pre-existing advanced cancers. Such data are presented in table 6.4. Table 6.4 shows that in the first five years, higher breast cancer mortality was observed among the group offered screening in two of the studies and lower breast cancer mortality was observed in the third. None of the differences was statistically significant, and the combined analysis shows a statistically non-significant 8% decrease in breast cancer mortality in the first five years. It can be seen that after five years of screening, the breast cancer mortality reduction in women offered screening should be of the order of 34%. This reduction is statistically significant.

**Table 6.4: Relative risk of breast cancer mortality by period from screening commencement (95% confidence interval)**

| | Period since commencement(a) | |
|---|---|---|
| *Study (age range at commencement)* | *1-5 years* | *6-10 years* |
| WE (40-69y) | 0.76 (0.54, 1.05) | 0.71 (0.48, 1.04) |
| UK (45-64y) | 1.10 (0.84, 1.43) | 0.58 (0.39, 0.86) |
| Malmo (45-69y) | 1.54 (0.83, 2.83) | 0.76 (0.49, 1.16) |
| Total | 0.92 (0.76, 1.13) | 0.66 (0.52, 0.83) |

(a) Six to seven year follow-up only for UK trial.
Source: Screening Evaluation Coordination Unit, Australian Institute of Health

Secondly, the results reported in table 6.4 relate to all women offered screening. However, this includes women who, while offered screening, did not attend and therefore would not have benefited. To estimate the impact of mammographic screening on women who do attend, the estimates in table 6.4 need to be adjusted for attendance rates. The breast cancer mortality reductions after adjustment for the time of screening and participation rates are shown in table 6.5. It can be seen that after a five year delay, women who participate regularly in screening can anticipate a reduction in the risk of death from breast cancer of around 58%.

**Table 6.5: Relative risk of breast cancer mortality by period from screening commencement adjusted for screening participation (95% confidence interval)**

| | Period since commencement(a) | |
|---|---|---|
| *Study* | *1-5 years* | *6-10 years* |
| WE | 0.76 (0.52, 1.14) | 0.50 (0.36, 1.70) |
| UK | 1.03 (0.78, 1.35) | 0.26 (0.21, 0.41) |
| Malmo | 1.83 (0.95, 3.52) | 0.63 (0.41, 0.99) |
| Total | 0.99 (0.81, 1.22) | 0.42 (0.34, 0.52) |

(a) Six to seven year follow-up only for UK trial.
Source: Screening Evaluation Coordination Unit, Australian Institute of Health using method of Newcombe (1988)

Thirdly, only women from a specific age range are offered screening. Breast cancer occurs and causes death outside these age ranges. In addition, not all eligible women will attend screening. Both these factors need to be considered when assessing the likely impact of breast cancer screening on the total number of deaths from breast cancer in the population. The effect on total breast cancer mortality in the population has been assessed here by using a computer model (Knox 1988) which uses data from the HIP and WE studies. Table 6.6 shows the annual reduction in the total number of deaths from breast cancer which would be anticipated if screening was offered every two years to all Australian women aged 40-69 years, based on a participation rate by these women of an optimistic 100%, and, more realistically, 70% and 55%.

**Table 6.6: Estimated annual reduction in the number of deaths from breast cancer among Australian women(a) due to a mammographic screening program, by participation rate, using a computer model**

| *Participation rate %* | *Premature deaths averted* | *% reduction* |
|---|---|---|
| 100 | 526 | 23 |
| 70 | 366 | 16 |
| 55 | 297 | 13 |

(a) Using 1988 Australian mortality data, in the steady state.

These data can be summarised as follows: based on data from the WE, Malmo and UK trials, individual women participating regularly in mammographic screening of high quality can anticipate an approximately 60% reduction in the risk of death from breast cancer while they participate in the program. This reduction in risk follows a delay of about five years from commencement of screening. Overall, if 100% of eligible women were to participate in mammographic screening, computer modelling based on HIP and WE data suggests that there would be an approximately 23% reduction in the number of deaths from breast cancer. While women benefit immediately from the treatment of screen detected cancer, the reduction in deaths does not become statistically apparent until around five years after the first screen. With a fully operational screening program and a participation rate among eligible women of 70%, computer modelling predicts that the reduction in mortality from breast cancer among all Australian women (not only those who attend screening) would be around 16% (approximately 370 premature deaths averted per annum using 1988 figures). These figures are substantially lower than the risk reduction for individual women because they take into account cancers which occur among women who do not participate in the screening program, either because they choose not to be screened or because they are outside the age range. However, a substantial proportion of the cancer deaths not averted would tend to occur among women aged 75 years and above, when the remaining lifespan in the absence of breast cancer is less and other causes of death become more significant.

## 6.7 Is breast cancer screening value for money?

The question of whether breast cancer screening represents value for money cannot be answered in absolute terms. It is necessary to examine whether such screening contributes more per dollar spent to the improvement of health than other competing uses for health resources. This comparison must also have regard to what would happen in the 'base case' without a screening program. The base case is necessary because costs and benefits of the new project are always incremental to what would have happened had the project not gone ahead. The value for money analysis, therefore, focuses on **net economic costs** and **net economic benefits**, that is, what are the net effects of detecting and treating breast cancer by an organised, national, population-based screening program compared with what is happening at the moment.

This analysis can be expressed as estimates of comparative net cost per life year gained, or, where quality of life is an important consideration as it is in breast cancer treatment, as comparative net cost per quality adjusted life year (QALY) gained. Original research on quality of life implications of breast cancer screening was conducted as part of the economic evaluation of the mammography pilot projects, but the final results were not available in time for inclusion in this report. Interim results from this research are presented in section 6.7.3 and will be presented more fully in a technical report.

In order to summarise the costs and benefits of breast cancer screening in a way that is readily comparable with other possible uses of health service resources, comparative estimates of economic cost per life year or per QALY gained are given in tables 6.7 and 6.8. While comparison with Australian studies employing consistent methodologies is clearly preferable, there are very few Australian studies available which have calculated cost per life year or cost per QALY results (or from which cost per life year or cost per QALY results can be derived) for health care, cure or promotion programs. The studies which are available are presented in table 6.7.

**Table 6.7: Comparative Australian cost–utility/cost–effectiveness results(a)**

| *Program (reference)* | *Adjusted cost per life year or per QALY at 1988–89 prices* |
|---|---|
| **Care/cure programs:** | |
| AIDS treatment with zidovudine (Cooper and Elias 1990) | (b)$130,000 per life year |
| Hospital dialysis (Doessel DP 1978) | (c)$47,789 per QALY |
| **Breast cancer screening provided by a national coordinated program** | **$6,600–$11,000 per life year** |
| Neonatal intensive care, babies < 801g (John et al 1983; Yu et al 1981) | (d)$3,600–$4,600 per life year |
| Kidney transplant (Doessel P 1978) | (c)$4,596 per life year |
| Neonatal intensive care, babies 1,000–1,500g (John et al 1983; Yu et al 1981) | (d)$1,200–$3,000 per life year |
| **Health promotion programs:** | |
| Non–drug blood pressure reduction clinic (Viney et al 1990) | (e)$5,000 per life year |
| Sydney Quit Smoking Campaign (Dwyer et al 1986) | (f)$16 per life year |

(a) Many of these cost per life year results were not derived by the authors but have been calculated by the Australian Institute of Health based on the cost data in the articles to give some illustrative Australian results. The definition of costs is not consistent across all studies and the life years saved estimates are very approximate. The results should be interpreted with appropriate caution as providing order–of–magnitude estimates only. Cost data for years prior to 1988–89 have been inflated using the health expenditure index. A 5% discount rate has been applied to life years (except for the Doessel study where the author used 4%).

(b) The Cooper and Elias (1990) study estimates the extra cost of treating Australian patients with ARC and AIDS with zidovudine as $120,000 per patient, with a resultant increase in life span of 11 months. This gives a cost per life year of $130,000. The cost per quality adjusted life year would be lower as zidovudine significantly improves quality of life, but as no measures are yet available on the extent of the quality improvement, a cost per QALY cannot be calculated. Recent evidence also suggests that if zidovudine is given early on in the treatment process, life prolongation benefits would be greater.

(c) The Doessel kidney dialysis and kidney transplantation study provides cost per QALY estimates but is based on 1968–69 costs to service provider data. The dollars per life year figures were inflated to 1988–89 prices using the GDP price inflator for the years 1968–69 to 1970–71 and the health price inflator for the period 1970–71 to 1988–89. The original 1968–69 prices were $706 per life year for kidney transplantations and $4,184 per life year for hospital dialysis. The AIH applied a quality adjustment factor of 0.57 to the kidney dialysis life years saved (Torrance 1987). The author used a discount rate of 4%.

(d) The authors provided cost to service provider estimates during neonatal intensive care which have been inflated to 1988–89 prices using the health expenditure index. Infants are assumed to have an average life expectancy of 75 years which has been discounted at 5%. It is doubtful whether the costs accurately reflect all the resource costs to parents and the health sector (costs incurred after initial intensive care episode not included, for example), but give a useful order of magnitude estimate.

(e) The Viney study analysed the blood pressure reductions that occurred in a group of Tasmanian volunteers who sought advice from a Hobart clinic on lowering blood pressure by non pharmacological means in the latter part of 1988. Blood pressure reduction was measured 12 weeks after entry into study. The economic effects for two groups were analysed separately. For the medicated hypertensives, the benefits were the reduction in cost of anti–hypertensive medication. For the non medicated group, the benefits were the calculated years of life gained because blood pressure had fallen. Costs included travel and time costs of patients. The costs of the clinic were allocated between the medicated and non medicated group according to the number in each group who completed four visits. A discount rate of 5% was used. The best case and worst case assumptions gave $4,940 and $5,365 per life year saved respectively.

(f) The Sydney 'Quit for Life' mass media based campaign ran in 1983. Based on surveys on the population in Sydney and other Australian cities, it was estimated that the 'Quit for Life' campaign led to a 2.8% fall 12 months after the campaign in the numbers smoking in Sydney over and above the decline in the rest of Australia. The 95% confidence interval was 0.9% to 5.1%. The expenditure was $620,000 and the result was 83,000 fewer smokers in 1984, giving a cost per quitter of $7. Cost per life year saved was calculated using American data which indicates that a smoker who quits adds an average 0.8 discounted life years to his/her life. The discount rate used was 5%.

To assist in the consideration of possible alternative uses for the funds, overseas results have also been provided in table 6.8. Care should be taken in making judgements based on inter-country comparisons as there are often important differences between countries in their health service systems, in treatment patterns and in associated health service costs. The different cost per life year results for similar programs in tables 6.7 and 6.8 illustrates this. The evaluation studies cited use similar but not identical methodologies.

In examining the comparative results presented in tables 6.7 and 6.8 it is important to bear in mind that there is no unique decision rule in cost-effectiveness and cost-utility evaluation. What is acceptable expenditure in a well-endowed health care setting may not be so in a more financially constrained situation. Besides, the allocation of considerations other than those of an economic nature are important in decisions on health expenditure between care, cure and health promotion programs. Moreover, other interventions which are currently not funded may, if evaluated, cost less per life year saved than breast cancer screening.

**Table 6.8: Comparative overseas cost-utility results for selected programs(a)**

| *Program (reference)* | *Reported cost/QALY(c) gained in US$ (year)* | *Adjusted(b) cost/QALY(c) gained in $A 1988-89* |
|---|---|---|
| PKU screening (Bush et al 1973) | < 0 (1970) | |
| Post-partum and anti-D injection (Torrance and Zipursky 1977) | < 0 (1977) | |
| Ante-partum and anti-D injection (Torrance and Zipursky 1984) | 1,200 (1983) | 2,173 |
| Coronary artery bypass surgery for left main coronary artery disease (Weinstein 1981) | 3,500 (1981) | 7,564 |
| Neonatal intensive care, 1,000-1,499g (Boyle et al 1983) | 2,800 (1978) | 8,159 |
| T4 (thyroid) screening (Epstein et al 1981) | 3,600 (1977) | 11,463 |
| Treatment of severe hypertension (diastolic ≥ 105mm Hg) in males age 40 (Stason and Weinstein 1977) | 4,850 (1976) | 16,773 |
| Treatment of mild hypertension (diastolic 95-104mm Hg) in males age 40 (Stason and Weinstein 1977) | 9,880 (1976) | 34,087 |
| Estrogen therapy for postmenopausal symptoms in women without a prior hysterectomy (Weinstein 1980) | 18,160 (1979) | 48,396 |
| Neonatal intensive care, 500-999g (Boyle et al 1983) | 19,600 (1978) | 57,112 |
| Coronary artery bypass surgery for single vessel disease with moderately severe angina (Weinstein 1981) | 30,000 (1981) | 64,883 |
| School tuberculin testing program (Bush et al 1972) | 13,000 (1968) | 68,415 |
| Continuous ambulatory peritoneal dialysis (Churchill et al 1984) | 35,100 (1980) | 83,957 |
| Hospital hemodialysis (Churchill et al 1984) | 40,200 | 96,156 |

(a) These studies use similar, but not identical, methods. Generally, costs are net health care costs: however, discount rates and preference weights are not completely consistent. Differences in methods should be considered when comparing the relative cost-utility. For details, see original sources.

(b) Adjusted to 1988-89 Australian dollars using the purchasing power parity method (rather than the exchange rate) and health expenditure indexes.

(c) QALY denotes quality-adjusted life-years.

Source: Table taken from Torrance and Zipursky (1984). Adjustment to 1988-89 Australian dollars calculated by Australian Institute of Health

This being said, it nevertheless seems reasonable to take as a guide to what an acceptable cost-effectiveness benchmark might be, the results of a range of programs where resources are currently being committed. The data in tables 6.7 and 6.8 illustrate that there are likely to be quite a number of health programs currently being funded in Australia that are less cost-effective than the mammography screening program recommended in this report. However, if a gross economic cost per life year saved of $10,671 for the national program ($6,584 in net economic terms when the 'base case' is included) is considered acceptable value for money, then national population-based mammography screening on the basis described in this report can be recommended for implementation on economic grounds.

**Recommendation 1**

**Properly conducted mammography screening programs are effective in reducing breast cancer mortality. There are no universally accepted benchmarks in economic evaluation for the trade-off between years of life saved and cost. If an economic cost per life year gained of approximately $6,600–$11,000 is considered acceptable value for money, then mammography screening outlined in this report can be recommended for adoption. Having considered both the scientific and economic evidence, the committee recommends that mammography screening be introduced into Australia and be made available to all eligible women.**

### 6.7.1 Calculation of the cost per life year estimate

The key steps and assumptions involved in the calculation of the economic cost per life year estimates for the recommended national screening program are summarised in table 6.9.

Costs of screening to service providers for the national screening program are based on cost data received from the Australian pilot projects. The estimates include the costs of recruitment, screen taking and reading, work-up/diagnosis (including biopsy), notification and counselling. The costs are based on a Year One estimate of $120 per women screened, falling to $80 per screen in steady-state operation (see chapter 9 for pilot project cost details).

The cost estimates do not include differences in treatment costs that may arise because cancers are detected and treated earlier under a national screening program. Preliminary treatment cost estimates for screen detected and non-screen detected cancers from one pilot project are presented in section 6.7.4. The research on comparative treatment costs undertaken as part of the national evaluation will be included in the technical report.

The life years saved were estimated using the 1988 Australian population structure and a computer model based on data from the HIP and the Swedish Two Counties trial (Knox 1988). The Knox model does not differentiate between the effectiveness of screening by age group and may, therefore, give optimistic forecasts of likely mortality reductions. A Netherlands computer simulation model (Miscan) is also being used to develop life year saved estimates to compare with the Knox model, and the preliminary results indicate lower life year saved estimates. An analysis of the results of the two models and a more detailed consideration of the life year saved estimates will be presented in the technical reports. The sensitivity analysis of the life years saved estimate given in table 6.11 illustrates that it is an important determinant of the cost per life year results. A discount rate of 5% was applied in the calculation of the net present value of both costs and benefits.

**Table 6.9: Economic cost of the recommended national screening program(a)**

| | *National mammography screening program(b)* | *De facto screening scenario(c)* | *Net economic cost* |
|---|---|---|---|
| | (A) | (B) | (C) = (A) - (B) |
| Present value of costs to service providers | $982.4m | $612.0m | $370.4m |
| Present value of time and travel costs to women | $392.2m | $223.8m | $168.4m |
| Present value of costs to women and service providers | $1,374.6m | $835.8m | $538.8m |
| Present value of total life years saved | (d)128,812 | (d)46,977 | 81,835 |
| **Cost per life year saved in the Australian evaluation** | (e)**$10,671** | **$17,748** | **(f)$6,584** |
| Cost per life year UK evaluation(g) | (h)$7,751 | | |
| Cost per life year Netherlands evaluation(i) | | | (h)$7,319 |

(a) All cost and outcome estimates are for the period 1990–2020 using a 5% discount rate.

(b) The national program is costed on the basis of a two year screening interval for women aged 40 years and above (assuming a 70% participation rate for women aged 40–69 years, 15% for women aged 70–79 years and 0% for women aged 80 years and above). A five year phase-in of capacity is assumed.

(c) The de facto screening scenario shown in table 6.9 assumes that 50% of the current Medicare Schedule item no 2734 (radiographic examination of both breasts and report) in the 30–69 age group is de facto screening. A declining growth rate is applied (commencing at the recent rate over the last year adjusted down for the growth rate in diagnostic mammography) with the number of de facto screens being capped at no more than 30% of the Australian female population in the 30–69 age group. The figure of 30% is based on the Australian experience in relation to cervical cancer screening, where the current opportunistic system results in some 40% of eligible women being screened. Women are assumed to present for a mammogram every two years.

The costs of de facto screening are estimated conservatively at $61.20 per screen (the current 85% Medicare rebate on item no 2734) plus $221 for each follow-up/assessment, assuming a 15% recall rate. The estimate of $221 is a weighted average cost reflecting the cost of one general practitioner visit plus the likelihood of having various follow-up procedures (such as further mammography, clinical examination, ultrasound, a fine needle biopsy or an open biopsy). The costs of the various follow-up procedures are based on the pilot project cost data, not on Medicare. The time and travel costs to women are estimated on the same basis as for the national screening program.

(d) Estimated using the Knox computer model (Knox 1988). No benefit is attributed to de facto screening of the 30–39 age group. De facto screening of women 40+ is assumed to be 75% as effective as a national program in year one, rising to 90% as effective after five years of a de facto program. These assumptions probably favour the likely benefits of a de facto program, given the large variability in quality control that is likely to exist.

(e) Does not include an adjustment for potential treatment cost savings.

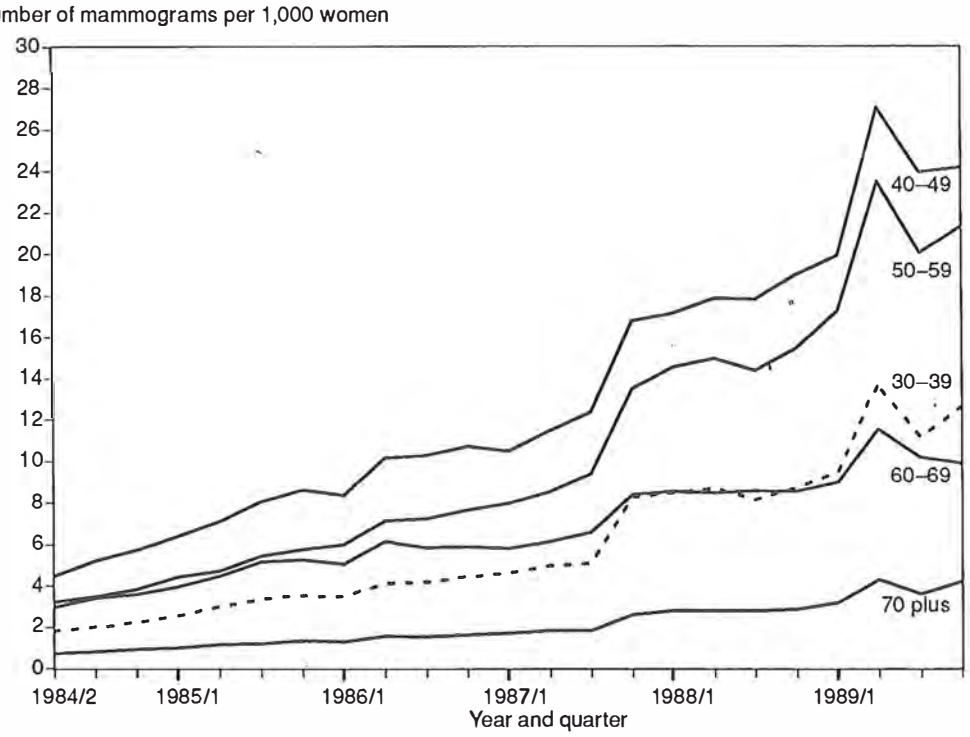
(f) Calculated by dividing $538.8m by 81,835.

(g) The United Kingdom evaluation was for screening of women aged 50–64 years with single view mammography at a three year interval. The program was costed over a 15 year period at a 5% discount rate and includes costs to service providers and women but no allowance for treatment cost savings (Report 1986).

(h) Adjusted to 1988–89 Australian dollars using the purchasing power parity method (rather than the exchange rate) and health expenditure indexes.

(i) The Netherlands evaluation was for screening offered every two years to women aged 50–70. The program was costed over the period 1988–2015 at a 5% discount rate and includes costs to service providers and women. The evaluation includes cost savings due to a decrease in the need for treatment of advanced disease and a decrease in the demand for mammograms outside the screening program (van der Maas et al 1989).

**Figure 6.2: Number of two breast mammograms per 1,000 Australian women by age group and by year and quarter.**




Source: Medicare claims data provided by Commonwealth Department of Community Services and Health

The estimate of time and travel costs to women for participation in the national program include both an initial visit for screening and one follow-up visit for those recalled for further assessment. The estimate is based on survey data from several of the fixed site pilot projects indicating a cost to women of $30 per visit and assumes the screening is provided free of charge. Research conducted by the pilot projects offering a mobile screening van suggests that this financial cost to women could be reduced considerably (to $5–$6 per screen) by the widespread provision of mobile vans. No provision has been included for psychological costs (pain, anxiety) or benefits (reassurance). Further consideration of this issue may be presented in the technical report.

To determine the net or incremental costs of a national screening program, the issue of what is the most appropriate baseline scenario needs to be carefully considered. While 'no screening' is one possible specification of the base case, it is not an accurate description of what is happening in Australia at the moment. Some screening– or more accurately, case finding– is taking place in Australia.

Medicare currently provides for mammography where 'there is reason to suspect the presence of malignancy in the breasts because of the past occurrence of breast malignancy in the patient or members of the patient's family or because symptoms or indications of malignancy were found on an examination of the patient by a medical practitioner' (Commonwealth Department of Community Services and Health 1988). Medicare benefits paid for mammography have increased dramatically, however, showing a fourfold increase over the last four years (see figure 6.2). Services are also provided on a user-pays non-insured basis in a number of private clinics. There is

little doubt that much of the increase in mammography is de facto mammography screening. While the costs and anticipated outcomes resulting from both a no screening and a de facto screening version of the base case are given in table 6.9 to assist consideration of this issue, the committee's view is that the appropriate baseline case is the likely situation based on current practice, rather than a hypothetical 'no screening' option.

### 6.7.2 Sensitivity analysis of the cost per life year results

The gross cost-effectiveness estimate of $10,671 for the national program given in table 6.9 will vary according to the estimate of life years saved, the screening policy adopted (especially in terms of age range and screening interval), utilisation of screening facilities by Australian women, and the cost structure of screening/assessment units. The cost of associated infrastructure for coordination, evaluation and training at the Commonwealth-State-Territory level have not been included in the economic evaluation, but some very preliminary cost estimates are given in section 9.2.

An indication of the relative cost-effectiveness of screening at different ages is shown in table 8.6 of section 8.4.1, of different intervals in table 8.9 of section 8.4.2 and of different cost structures in table 6.10. All these tables show the net present value of costs and life years saved for 30 years of steady-state operation with a five year phase-in period of a national screening program.

Data in all tables are based on a number of assumptions and should therefore be interpreted as providing only an indication of the relationships between age group, screening interval, cost structure and relative cost-effectiveness. Base case costs have not been deducted from the project cost estimates and the participation rates have been held constant at 70% for the 40-69 year age group, 15% for the 70-79 year age group and 0% for women aged 80 years and above.

Table 6.10 has been calculated by holding the number of women screened constant and varying the cost per screen to give an indication of how total costs and the average cost-effectiveness of the national program is likely to vary. The variations in the cost per screen could be due, for example, to organisational differences between screening units in approaches to staff, capital or recall policy.

The sensitivity analysis in table 6.10 indicates that the gross program cost-effectiveness estimate of $10,671 is a reasonably robust figure in relation to cost variations, with a cost per screen increase of 50% still yielding an average cost per life year result of $14,116 (or a net result of $12,007 per life year when the base case is included).

**Table 6.10: Relative cost-effectiveness of a 30 year screening program for different cost structures**

| *Steady state cost per woman screened to service providers* | *Net present value of costs to service providers and women (5% discount)* | *Average cost per life year saved* |
|---|---|---|
| $ | $m | $ |
| 120 | 1,818.4 | 14,116 |
| 110 | 1,701.2 | 13,207 |
| 100 | 1,587.3 | 12,323 |
| 90 | 1,478.0 | 11,474 |
| 80 | 1,374.6 | 10,671 |
| 70 | 1,278.2 | 9,923 |

**Table 6.11: Relative cost-effectiveness of a 30 year screening program for different estimates of life years saved**

| *Variation in net present value of life years saved* (%) | *Net present value of life saved (5% discount rate)* | *Gross cost per life year estimate* $ | *Net cost per life year estimate* $ |
|---|---|---|---|
| Base assumption (table 6.9) | 128,812 | 10,671 | 6,584 |
| - 10 | 115,931 | 11,857 | 7,315 |
| - 20 | 103,050 | 13,339 | 8,230 |
| - 30 | 90,168 | 15,245 | 9,406 |
| - 40 | 77,287 | 17,786 | 10,973 |
| - 50 | 64,406 | 21,343 | 13,168 |
| + 10 | 141,693 | 9,701 | 5,985 |
| + 20 | 154,574 | 8,893 | 5,487 |
| + 30 | 167,456 | 8,208 | 5,064 |

Table 6.10 can also be used to gain an indication of the impact of varying utilisation rates on the cost per screen results. On current cost structures, a cost per screen of $120 equates to a utilisation rate of 55%, $110 to 60%, $90 to 70%, $80 to 80% and $70 to 90%. If the national screening program is to achieve the cost-effectiveness results of which it is capable (and operate within its financial budget) careful attention will need to be given to matching the demand for and supply of screening and assessment facilities.

An indication of the relative cost-effectiveness of screening for different estimates of life years saved is given in table 6.11. The table has been calculated by simple arithmetic increases/decreases to the net present value of the life years saved estimate, holding the costs of the national program and base case constant (as set out in table 6.9). The table illustrates that the cost per life year saved results are more sensitive to variation in the estimate of benefit than they are to the estimate of cost. More detailed consideration of the life year saved estimates will be presented in the technical reports, incorporating the results of both the Knox and Miscan models, together with appropriate adjustments for the quality of life.

### 6.7.3 Interim quality of life results

Quality of life after breast cancer treatment is an important consideration to Australian women and in economic evaluation. This issue was examined by researchers at the Westmead Hospital Department of Community Medicine. One hundred women (approximately half of whom had had breast cancer) were presented with a range of possible 'case histories' of women following initial treatment for breast cancer. These case histories varied in terms of long term physical health (good/poor) and long term mental health (good/poor). The 100 women were asked to rate the quality of life of the case histories using a time trade-off method in which time spent in one health state is compared with time spent in another.

Table 6.12 shows that even with good physical and mental health following initial treatment of breast cancer, as might occur with a small screen detected or small clinically detected breast cancer, women rate the quality of the remaining life years as only being worth 0.7-0.8 of life years without having had a breast cancer. With poor health, the value of the remaining life years is even less. The table also shows that the quality weights vary according to life expectancy in full health, complicating the use of the weights in economic evaluation. A simple adjustment factor should not be used and further work is required before these interim results can be meaningfully applied to the estimate of life years saved.

**Table 6.12: Healthy year equivalents of various health states following initial treatment for breast cancer**

| *Case history* | *Healthy year equivalents (years)* | | |
|---|---|---|---|
| Full health | 30 | 20 | 10 |
| Good physical and mental health | 24 | 15 | 7 |
| Good physical health, poor mental health | 10 | 8 | 3 |
| Poor physical and mental health | 8 | 6 | 3 |

Source: Westmead Hospital Department of Community Medicine

The significance of these observations is that the benefits in terms of additional years of life which result from breast cancer screening should be adjusted to take account of the quality of these extra years. Quality of life should also be considered in relation to the earlier diagnosis which can result from screening (ie anxiety is experienced earlier) offset by the potential for better health following diagnosis if a cancer is screen detected (ie minimises likelihood of severe morbidity and early death associated with late detection).

### 6.7.4 Interim treatment cost results

An important issue in assessing the economic cost of a screening mammography program is whether treatment of screen detected cancers is less costly than treatment of clinically presenting cancers. This issue was investigated by two pilot projects as part of the national evaluation. Interim results from the NSW Breast X-ray Service and Westmead Hospital Department of Community Medicine are presented here. These data have not been incorporated into the economic costings elsewhere in this report due to the preliminary nature of the data.

Treatment will be less costly if initial treatment of screen detected cases is less costly than initial treatment of symptomatically detected cases or if the incidence of the development of metastatic disease is lower in screen detected cases. Table 6.13 presents the average costs of initial treatment for both a screen detected and a clinically presenting case. These data are based on a review of initial treatment costs of 54 cases of screen detected breast cancer and of 50 cases of clinically presenting breast cancer, all treated by the same treatment team at the Royal Prince Alfred Hospital in Sydney.

For the patients studied, conservative surgery was less costly than mastectomy. Conservative surgery was estimated to cost around $1,600 per case with an average hospital stay of 3.5 days whereas mastectomy was estimated to cost around $3,900 with an average length of stay of 11.3 days. However, table 6.14 illustrates that fewer screen detected cases than clinically presenting cases were actually treated by conservative surgery. (This may change in subsequent screening rounds.) As a result, the average surgical costs per patient were similar in both screened and non screened cases. Treatment savings of around $1,000 per case are attributable largely to less frequent use of radiotherapy, adjuvant chemotherapy and hormone therapy in screen detected cases.

**Table 6.13: Costs per breast cancer of treatment in the twelve months following diagnosis by method of detection**

| | *Screen detected* | *Not screen detected* |
|---|---|---|
| Surgery | 3,330 | 3,650 |
| Chemo/hormone therapy | 51 | 381 |
| Radiotherapy | 322 | 688 |
| Total | $3,703 | $4,719 |

Source: Sydney Breast X-ray Service and Westmead Hospital Department of Community Medicine

**Table 6.14 Proportions of women with breast cancer who received various treatment modalities by method of detection**

| | *Screen detected (%)* | *Not screen detected (%)* |
|---|---|---|
| Mastectomy | 63 | 44 |
| Radiotherapy | 22 | 31 |
| Iridium implant | 4 | 18 |
| Chemotherapy | 4 | 18 |
| Hormone therapy | 31 | 49 |

Source: Sydney Breast X-ray Service and Westmead Hospital Department of Community Medicine

Treatment of metastatic breast cancer was estimated to cost between $9,000 and $12,000 per case. This is a conservative estimate as nursing home and hospice costs were not included. If detection by screening and consequent earlier treatment results in a lower incidence of metastatic disease then there will be further cost savings. It is not possible to calculate the magnitude of these potential savings as data on the incidence of metastatic disease in screen detected and non-screen detected cases are not yet available.

Overall, there is a potential for cost savings from earlier treatment of breast cancer. Whether these are realised depends on appropriate treatment policies being adopted by clinicians and the effectiveness of earlier treatment in preventing metastatic disease. The significance of treatment policies adopted by individual clinicians as a determinant of cost can be guaged from the paper by Hill et al (1990), where large variations were observed in the types of procedures used to treat women with breast cancer at the same clinical stage.

## 6.8 Can high quality breast cancer screening be performed in Australia?

The performance of a screening program can be gauged by quantitative performance measures such as the recruitment rate, cancer detection rate, benign to malignant ratio, etc. The design features of the Australian pilot projects are shown table 6.15. The performance of the Australian pilot projects in relation to acceptable performance criteria is shown in table 6.16. The performance of several overseas screening programs is shown in table 6.17.

In general, the pilot projects which have provided data are achieving or are close to achieving the performance standards specified in table 7.2, and are comparable in performance with the overseas programs shown in table 6.17. Significant exceptions are as follows.

- Projects I, II, III, VI,VII and X had higher than recommended rates of recall for assessment. Except for Project VI, these projects do not have design features which distinguish them from other projects. It seems likely that the high recall rates are due to clinical policies about recall criteria which tend to result in high numbers of women being recalled.
- The high recall rates of Projects III and VI resulted in low positive predictive value of positive screens.
- Project VI had an unacceptably high 'recall' rate of 30% of women screened. This is because, in this project, any necessary assessment was performed at the time of screening. This arrangement increased the propensity of film readers to request additional views in doubtful cases. However, as further investigation was carried out at the time of screening, women did not have the inconvenience of having to return to the clinic, and had the benefit of knowing the results of assessment of suspicious screens without any delay.

- Projects II, VI and VII had lower than recommended cancer detection rates, prevalence/incidence ratios and PPVs of a positive screen. This may be because from 44% to 58% of the women screened in these projects were aged 40–49 years. In this age group, first round cancer detection rates are typically less than half those in women aged 50–69 years.
- Projects VIII and IX had higher than recommended biopsy rates. These rates would appear to be justifiable on the basis of the high cancer detection rates of these projects.
- Projects II and VII had higher than recommended benign to malignant biopsy ratios and low positive predictive values of both positive screens and biopsies. This may be due to more difficult evaluation of screens for women aged 40–49 years, poor quality films or inappropriate calling of films.

Thus, the majority of the Australian pilot projects were able to achieve the performance levels required to achieve the mortality reductions which have been observed in studies in other countries. It is noteworthy that the acceptable values in table 6.15 were developed for the UK mammography screening program where screening is confined to women aged 50-64 years. A number of these parameters are known to vary with age at screening. It would be desirable to develop acceptable values for each ten year age group: 40–49 years, 50-59 years, 60–69 years, and 70 years and above.

**Table 6.15: Design features of Australian mammography screening projects**

| | Project | I | II | III | IV | V | VI | VII | VIII | IX | X |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Location | | | | | | | | | | |
| | M = metropolitan | | | | | | | | | | |
| | R = rural | M | R | M | M | M | M | R | M | R | M |
| 2 | Type of screening unit | | | | | | | | | | |
| | F = fixed | | | | | | | | | | |
| | M = mobile | M | M | F | F | F | F | F | F | M | (a)F |
| 3 | Age range (years) | 45-69 | 40 & over | ≥40 | 50-69 | (b)50-69 | ≥40 | ≥40 | 45-69 | 45-69 | 50-64 |
| 4 | Screening interval | 3 | 40–49 1y | 12-18 mths | 2 | 2 | 40–49 1y | (c)40–50 18 mths | (c)2y | (c)2y | 2y |
| | | | 50 & over 2y | | | | (d)≥50 2y | (c)>50 2y | | | |
| 5 | Number of views for first screen | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 6 | Number of views for rescreens | (e) | (e) | 2 | (e) | 1 or 2 | 1 or 2 | (e) | (e) | (e) | 2 |
| 7 | Physical examination | No | No | No | No | Only if symptoms | Yes | No | No | No | No |
| 8 | Screening of symptomatic women | No | Yes | Yes | Yes | Yes | (f)No | No | Yes | Yes | No |
| 9 | Qualifications and number of film-readers per film | | | | | | | | | | |
| | R = radiologist | R x 2 | R x 2 | R x 1 | R x 2 | R x 1 | R x 1 | R x 1 | R x 2 | R x 2 | R x 2 |
| | D = non radiologist doctor | | | D x 1 | | D x 1 | D x 1 | | | | |
| 10 | Recall policy (excluding technical recalls) | | | | | | | | | | |
| | S = screens suspicious of cancer | | | | | | | | | | |
| | A = all abnormal screens including benign changes | A | A | S | S | A | (g)A | A | A | A | S |
| 11 | Principal place of assessment | | | | | | | | | | |
| | S = at screening unit | | | | | | | | | | |
| | A = at affiliated clinic | | | | | | | | | | |
| | P = referral to usual care | S | S | A | S | S | S | R | R | R | S |
| 12 | Other features | | | | Counsellor on site | | Counsellor on site | | Linked to breast cancer registry | Linked to breast cancer registry | Central coordinating unit |

(a) Three half time screening units at three locations.

(b) Also women 40–49 years with a personal or family history of breast cancer.

(c) One year if positive family history.

(d) One year if positive family history or dense breasts.

(e) Rescreening not yet decided.

(f) A diagnostic clinic is provided for symptomatic women.

(g) Additional assessment occurs at first visit if suspicious areas are seen, so women are not actually recalled to the clinic.

**Table 6.16: Screening performance of Australian mammography screening projects – first round screening**

| *Outcome objective:* | | *% of films which are technically inadequate* | *Rate of recall for assessment (% of screened women)* | *Rate of biopsy (% of screened women)* | *Benign to malignant open biopsy ratio* | *Cancer detection rate(a) (per 1,000 women screened)* | *Rate of detection of cancers ≤ 1cm(a) (per 1,000 women screened)* | *Prevalence/ incidence(b) cancers* | *PPV of positive screen(c) (%)* | *PPV of biopsy(d) (%)* |
|---|---|---|---|---|---|---|---|---|---|---|
| *Acceptable value for initial screening round(e):* | | *< 3% of screens* | *< 10% of screens* | *< 2% of screens* | *< 3:1* | *> 5 per 1,000 women screened* | *> 1.5 per 1,000 women screened* | *> 3* | *> 5%* | *> 25%* |
| Pilot project screening dates | | | | | | | | | | |
| 3.88–9.89 | I | 3.3 | 11.2 | 1.4 | 0.9:1 | 7.4 | 3.8 | 4.5 | 6.0 | 53 |
| 1.89–3.90 | II | 1.7 | 11.7 | 1.8 | 3.6:1 | 3.9 | na | 2.6 | 3.9 | 22 |
| 11.88–3.90 | III | 0.1 | 12.9 | 1.3 | 1.2:1 | 5.8 | 3.5 | 3.8 | 4.5 | 45 |
| 11.88–6.89 | IV | 1.4 | 7.3 | 1.7 | 0.6:1 | 10.2 | 2.2 | 5.9 | 16.2 | 61 |
| 11.88–12.89 | (f)V | 0.0 | 7.1 | 1.5 | 1.5:1 | 6.0 | 2.0 | 3.4 | 7.9 | 37 |
| 7.87–2.90 | VI | (g)na | (h)35.1 | 1.1 | 1.5:1 | 4.2 | 0.6 | 2.8 | (i)1.2 | 40 |
| 2.89–3.90 | VII | na | 8.6 | 1.8 | 5.3:1 | 2.8 | 0.9 | 1.9 | 3.3 | 16 |
| 3.89–4.90 | VIII | (g)na | (j)6.7 | (k)2.5 | (k)4.0:1 | (k)7.0 | na | (k)4.2 | 10.2 | 20 |
| 2.90–4.90 | IX | 1.3 | 5.7 | na | na | na | na | na | na | na |
| 1.89–12.89 | X | 1.4 | 11.3 | 2.4 | 1.6:1 | 9.2 | 3.9 | 5.6 | 8.1 | 38 |

(a) Excluding lobular in situ carcinomas.

(b) Age specific incidence rates according to age range of target population are used. They are not fully age standardised.

(c) Positive predictive value of a positive screen, ie % of positive screens which are confirmed as cancer.

(d) Positive predictive value of a biopsy, ie % of women biopsied who are confirmed as having cancer.

(e) From table 7.2. Several values were developed specifically for screening of women aged 50–64 years. Different acceptable values may apply for women aged less than 50 years. Pilot projects I, II, III, VI, VII, VIII and IX screened women aged less than 50 years.

(f) First and subsequent round data combined. (61% of the screens were first round screens.) The first round cancer detection rate was 8.9/1,000.

(g) Films are checked by radiographer and redone immediately if inadequate. No count is kept of these.

(h) Additional views and procedures are all done at the first visit, so women do not actually have to return to the clinic for assessment.

(i) Women who have additional views at the first visit are regarded as having a positive screen.

(j) Women receiving further views at radiographer's discretion at initial screening are excluded.

(k) Based on data for first 1,000 women screened to 20.7.89 only.

## Table 6.17: Screening performance in various overseas screening programs

| Outcome objectives: | Rate of recall for assessment (% of screened women) | Rate of biopsy (% of screened women) | Benign to malignant ratio | Cancer detection rate (R1-/1,000 wo; R2+/1,000 wo yrs) | Prevalence/ incidence cancers | Interval cancer rate (1st 12 months after screen (/1,000 wo sc eened) | PPV(a) of positive screen (%) | PPV(a) of biopsy (%) | Sensitivity (%) | Specificity (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sweden** | | | | | | | | | | |
| WE:study gp=94,000 | | | | | | | | | | |
| Controls-67,000 | | | | | | | | | | |
| Ostegotlund | R1-5.7 | R1-1.1 | R1-0:7.1 | R1-6.9 | 6.9/1.9=3.6 | R1-0.28 | R1-12 | R1-58 | 95 | R1-95 |
| | R2-2.3 | R2-0.5 | R2-0.3:1 | R2-1.6 | | | R2-7 | R2-75 | | R2-98 |
| Kopperberg | R1-5.2 | R1-0.9 | R1-0.8:1 | R1-5.3 | 5.3/1.9=2.8 | 0.36 | R1-10 | R1-55 | | |
| | R2-3.0 | R2-0.5 | R2-0.5:1 | | | | | R2-67 | | |
| | R3-2.5 | R3-0.4 | R3-0.9:1 | | | | | R3-53 | | |
| **Malmo** | R1-3.4 | R1-1.2 | R1-0.6:1 | R1-7.5 | 7.5/2.7=2.8 | Int 1-1.2 (21 mths) | R1-22 | R1-61 | 91.5 | 97.4 |
| Study gp=21,000 | R2-3.8 | R2-1.5 | R2-2.0:1 | R2-2.2 | | Int 2-0.7 (21 mths) | | R2-33′ | | |
| Controls=21,000 | R3-3.1 | R3-0.6 | R3-0.7:1 | R3-2.0 | | | | R3-58 | | |
| Stockholm | R1-5.1 | R1-1.2 | R1-0.5:1 | R1-4.0 | 4.0/1.7=2.4 | Int 1-0.5 | R1-8 | | 87 | 95.3 |
| Study gp=40,000 | | | | | | | | | | |
| Controls=20,000 | | | | | | | | | | |
| **UK** | | | | | | | | | | |
| UK Trial: mamm gp=46,000 | | | | | | | | | | |
| BSE gp=64,000 | | | | | | | | | | |
| Controls=127,000 | | | | | | | | | | |
| Edinburgh | | | | R1-6.2 | 6.2/1.9=3.2 | | | | 91-97 | |
| | | | | R3,5,7-3.1-3.3 | | | | | | |
| Guildford | | | R1-0.4:1 | R1-4.8 | | | | | | |
| **The Netherlands** | | | | | | | | | | |
| Nijmegan | < 50 yrs: | | | < 50 yrs: | | Int 1-1.2 (2 yrs) | R1-30 | < 50 yrs: | 80% | 99.8 |
| Target population=23,000 | R1-1.1 | | | R1-2.3 | | Int 2-1.7 (2 yrs) | R2-39 | R1-32 | | |
| Cases=46 | R2-0.8 | | | R2-1.8 | | | R3-40 | R3-36 | < 50 yrs: | |
| Controls=230 | R6-0.4 | | | R6-2.4 | | | R4-39 | R4-33 | 59-48 | |
| | | | | | | | R5-54 | R5-59 | 50-64 yrs: | |
| | 50-64 yrs: | | | 50-64 yrs: | | | | R6-86 | 75-71 | |
| | R1-1.5 | | | R1-5.6 | | | | > 50 yrs: | > 65 yrs: | |
| | R2-0.9 | | | R2-4.4 | | | | R1-58 | 83-71 | |
| | R3-0.7 | | | R6-6.4 | | | | R2-66 | | |
| | | | | | | | | R3-71 | | |
| | ≥ 65 yrs: | | | ≥ 65 yrs: | | | | R4-75 | | |
| | R2-2.0 | | | R2-9.5 | | | | R5-90 | | |
| | R6-1.3 | | | R6-9.4 | | | | | | |
| Utrecht | R1-1.8 | | R1-1.5:1 | R1-7.3 | | Int 1-0.2 | | R1-40 | 94 | 99 |
| Target population=21,000 | (b)(2.2) | | R2 to 4-1:1 | R2-1.3 | | | | R2 to 4-48 | | |
| Cases=46 | R2 to 4-0.3 | | | R3-1.5 | | | | | | |
| Controls=138 | (b)(0.9) | | | R4-2.0 | | | | | | |

R1 = round 1, R2 = round 2, etc. (a) PPV = positive predictive value. (b) Includes early rescreens.

## 6.9 Is breast cancer screening acceptable to Australian women?

The acceptability of breast cancer screening to Australian women can be judged in a number of ways from the experience of the Australian pilot projects and associated surveys of women. Firstly, the pilot projects have been patronised by women. Table 6.18 shows the number of women screened during the period of operation for nine of the pilot projects. While the annualised throughput rates for some projects are low compared with the 6,000 to 9,000 screens per year used for planning purposes in this report, they do indicate a community demand for mammography. The initial, lower throughput rates can be attributed to limited screening capacity in the initial start-up phase and to limited opportunities for extensive mass media recruitment and community and professional education due to the restricted target populations of the pilot screening programs. In projects which have screened over two years, it can be seen that screening rates are higher in the second twelve months.

Table 6.19 shows the proportion by age of women from the target population who attended for screening. The comparatively low proportions of women recruited from the target populations of the projects, given a screening interval of two years, are attributable to long lead times, suboptimal throughput (as discussed above) and the choice of target populations which were too large to screen in the given time. The proportions in table 6.19 should not be interpreted as indicating the proportions of women seeking mammography. Recruitment data from the pilot projects are presented more fully in section 7.2.

All program projections in this report have been based on screening 70% of women aged 40–69 years, 15% of women aged 70–79 years and 0% of women aged 80 years and above. While these recruitment rates have not been achieved in the pilot projects to date, this approach is supported by the comparatively low recruitment rates achieved among women aged 70 years and above relative to women aged 40–69 years and the reduced benefit of screening for aged women.

**Table 6.18: Annual screening rates of pilot projects**

| Project | Screening period | Total number of women screened | No of women screened annually | |
|---|---|---|---|---|
| | | | 1st 12 mths | 2nd 12 mths |
| I | 1.88–12.89 | 9,193 | 3,882 | 5,311 |
| II | 1.89–12.89 | 5,451 | 4,058 | (a)5,572 |
| III | 11.88–3.89 | 1,720 | (b)1,208 | (a)1,500 |
| IV | 11.88–6.89 | 4,498 | (a)6,747 | |
| V | 11.88–12.89 | 8,674 | (a)7,435 | |
| VI | 10.88–6.89 | 2,794 | (a)3,725 | |
| VII | 2.89–3.90 | 3,528 | (a)2,668 | (a)3,246 |
| VIII | 3.89–4.90 | 6,590 | (a)5,649 | |
| IX | 2.90–4.90 | 1,100 | (a)4,400 | |
| X(c) | 1.89–12.89 | 5,965 | 5,965 | |

(a) Annualised rate.

(b) For 1.89 to 12.89.

(c) Throughput for three half-time screening units.

**Table 6.19: Percentage of target population screened by project and age group(a)**

| Project | Months of screening data by age | Age range of target population (years) | Age sub-groups | No of women in target population | No of women in target population screened | % of target population screened |
|---|---|---|---|---|---|---|
| I | 18 | 45-69 | 45-49 | 9,225 | 1,412 | 15.3 |
| | | | 50-59 | 17,323 | 2,239 | 12.9 |
| | | | 60-69 | 16,244 | 1,907 | 11.7 |
| | | | Total | 42,792 | 5,558 | 13.0 |
| II | 12 | 40-69 | 40-49 | na | 1,697 | na |
| | | | 50-59 | na | 1,307 | na |
| | | | 60-69 | na | 844 | na |
| III | 13 | 40 & over | 40-49 | 18,116 | 105 | 0.6 |
| | | | 50-59 | 14,967 | 47 | 0.3 |
| | | | 60-69 | 15,412 | 21 | 0.1 |
| | | | 70 & over | 18,212 | 4 | 0.02 |
| | | | Total | 66,707 | 177 | 0.27 |
| V(b) | 14 | 50-69 | 50-59 | 20,624 | 923 | 4.5 |
| | | | 60-69 | 21,670 | 738 | 3.4 |
| | | | Total | 42,294 | 1,661 | 3.9 |
| VI(b) | 9 | 50-69 | [40-49 | 22,982 | 553 | 2.4] |
| | | | 50-59 | 20,624 | 371 | 1.8 |
| | | | 60-69 | 21,670 | 215 | 1.0 |
| | | | [70 & over | 25,825 | 58 | 0.2] |
| | | | Total 50-69 | 42,294 | 586 | 1.4 |
| | | | [Total ≥ 40 | 91,101 | 1,197 | 1.3] |
| V & VI(b) | 8 | 50-69 | 50-59 | 20,624 | 842 | 4.1 |
| | | | 60-69 | 21,670 | 612 | 2.8 |
| | | | Total | 42,294 | 1,454 | 3.4 |
| VII | 11 | 40 & over | 40-49 | 8,104 | 1,190 | 14.1 |
| | | | 50-59 | 5,951 | 768 | 12.9 |
| | | | 60-69 | 4,700 | 379 | 8.1 |
| | | | 70 & over | 4,610 | 109 | 2.4 |
| | | | Total | 23,365 | 2,446 | 10.5 |
| VIII | 3 | 45-69 | 45-49 | 4,794 | 408 | 8.5 |
| | | | 50-59 | 8,048 | 764 | 9.5 |
| | | | 60-69 | 6,450 | 462 | 7.2 |
| | | | Total | 19,292 | 1,634 | 8.5 |

(a) Data on attendance by age group are available for limited periods and projects only.

(b) Community recruitment activities and target population for projects V and VI were shared. However, project VI also offered screening to women 40-49 years and 70 years and over. Both individual project data and combined data for 11.88 to 6.89 are given, based on the original target population.

A test of heterogeneity shows that the proportions of women from each age group attending screening differs significantly with age for all the projects (chi square = 1,414, df = 3, $p < 0.005$). The proportion of women attending screening consistently decreases with increasing age. Women aged 40–49 years are most readily recruited, suggesting that particular emphasis in recruitment activities will need to be given to women aged 50–69 years.

Surveys of women in pilot project target populations provide further evidence of the acceptability of mammography to women, even in the context of the limited publicity provided by current pilot projects. In three different community surveys, 68% and 81% of women indicated they believed that mammography is worthwhile, and 47%, 55% and 64% intended to have a mammogram. These data are presented more fully in section 7.2.

# 7 Components of a successful screening program

For a national screening program to be successful, careful consideration should be given to the following goals:

- to use resources allocated to maximise the benefits of screening and minimise the adverse effects to women;
- to provide a service which is acceptable to women and meets women's needs.

## 7.1 Maximising benefit and minimising adverse effects

The need to maximise the benefit and minimise any adverse effects of a mammographic screening program applies to all components of the screening program. The issues of acceptability to women and meeting women's needs are clearly important elements of this issue. They are considered separately below.

Since screening tests are not always accurate indicators of whether a woman does or does not have cancer, the women screened fall into four groups according to whether they do or do not have cancer and whether the screening tests are positive or negative. For screened women these four groups are thus:

- true positives: women whom the screen correctly indicates to have breast cancer;
- false positives: women who do not have breast cancer but who have a positive screening test;
- true negatives: women who do not have the disease and have a negative screen; and
- false negatives: women who prove to have breast cancer but are mistakenly cleared by the screen.

A summary of the benefits and adverse effects for each of these four groups of women and the likely proportions of screened women who will fall into each group are given in table 7.1. A fifth group consists of women who are invited to screening but do not attend.

The mortality savings from each screening round accrues to less than 1% of women screened, the true positive group. The numerically more significant benefit is the value of any reassurance women gain in receiving a negative result from the screening process. This accrues to women in the true negative group.

The second numerically significant group is the false positive group. In the Australian pilot projects around 6–13% of women screened were in this category in the first round of screening, although this should decline to between 5–10% as clinical experience increases. For these women there are some important costs, including anxiety about the possibility of cancer and diagnostic procedures which may lead to a temporary but significant reduction in their quality of life lasting for a few days. Excessive anxiety could be ameliorated by counselling. As the screening program approaches 'steady-state' operation, however, (by round three or four) it is to be hoped that the false positive rate will drop below 5% of all women screened, the rates now being achieved in Sweden and the Netherlands.

**Table 7.1: Benefits and adverse effects anticipated among a group of 10,000 women attending for their first screen**

| *Group* | *Expected number* | *Benefits* | *Adverse effects* |
|---|---|---|---|
| True positive | 50–80 (< 1%) | Mortality reduction, less invasive treatment | Anxiety |
| False positive | 420–950 (4–10%) | Reassurance after investigation | Anxiety, negative investigations |
| True negative | 9,000–9,500 (90–95%) | Reassurance | Inconvenience of screening, transient anxiety about screening |
| False negative | Up to 4 (< 0.04%) | Nil | False reassurance, possible delay in treatment |

There is no benefit for women in the false negative group, which fortunately is likely to be very small. The size of this group is indicated by the number of interval cancers occurring within one year of screening. Apart from the adverse effect of false reassurance, the false negative result may delay treatment (the opposite to the desired benefit of screening). Available evidence indicates, however, that the stage distribution of interval cancers is the same as that for women not offered screening, suggesting that any delay involved is not giving rise to more advanced cancers in this group (Holmberg et al 1986).

Clearly, a screening program should seek to maximise the detection of cancers and maximise the number of women receiving appropriate reassurance (ie maximise the numbers of true positives and the true negatives). The program should also seek to minimise the number of women who have a positive screen but who do not have cancer (false positives) and the number of women who have cancer but who have a negative screening result (false negatives). In addition, in order to maximise the impact on breast cancer mortality, the treatment provided to women with screen detected cancer should be optimal.

In order to achieve these objectives, an Australian mammography screening program should have the following components.

- **A national mammography screening policy:** this policy should cover matters of special importance to the successful conduct of screening. This policy should cover the following aspects as a minimum:
  - quality assurance and monitoring procedures;
  - performance criteria;
  - provision of information and support to women;
  - training for all personnel;
  - principals of organisation;
  - age range of women to be screened;
  - interval between screens;
  - number of views per breast;
  - qualifications and number of film readers;
  - funding mechanisms.

  The policy should be kept under review and modified as required in the light of new data. The current recommendations in relation to screening policy are presented in this section and in section 8.

- **Specialised training for medical practitioners and radiographers:** radiographers, radiologists, surgeons and pathologists involved in screening mammography and the treatment of disease so detected should be specially trained in relevant aspects of screening, assessment and treatment, and in the psychosocial impact of screening and how to meet the needs of women who are screened.
- **Provision of adequate resources:** the program should be funded at a level sufficient to ensure the recruitment of all eligible women who wish to be screened and the provision of high quality screening, assessment and treatment in accordance with the national mammographic screening policy. Funding should not be open ended, but must be sufficient for all components of the screening program to function effectively.
- **Quantitative performance criteria and mechanisms to monitor performance:** the performance of individual screening programs should be monitored in terms of defined performance criteria. Table 7.2 lists the principal performance criteria for which data should be supplied by every assessment centre and affiliated screening centre. Criteria are also required for the specifications and performance of mammography machines and film processors.
- **An appropriate balance of incentives for service providers:** incentives for service providers should encourage them to work towards the acceptable values for the outcome objectives, or at least not provide incentives to work to the detriment of the objectives. This needs to be taken into account in the design of funding mechanisms, the organisation of assessment and screening centres and the nature and operation of monitoring, evaluation and accreditation procedures.

**Table 7.2: Principal outcome objectives and standards for screening by mammography**

| *Objective* | *Measurement* | *Acceptable value(a)* |
|---|---|---|
| Maximise proportion of women attending | Proportion of women from target population attending | > 50 – > 70% |
| Minimise retake films | Proportion of films which are retakes | < 3% |
| Minimise proportion of screened women referred for assessment | Proportion of screened women referred for assessment | 1st round: ≤ 10%<br>Subsequent: ≤ 5% |
| Minimise number of invasive procedures | Benign to malignant biopsy ratio | 1st round: ≤ 2<br>Subsequent: ≤ 1 |
| Maximise number of cancers detected | Proportion of women screened found to have cancer | 1st round: > 5/1,000<br>Subsequent: > 2/1,000 |
| | (1st round cancer detection rate)/(cancer incidence rate) | > 3 |
| Maximise number of small cancers detected | Proportion of women screened found to have cancers < 10mm diameter on pathology | > 1.5/1,000 |
| Minimise number of missed cancers | Proportion of women who develop breast cancer in 12 mths following screening | < 0.6/1,000 |

(a) Adapted from the recommendations developed for the UK national screening mammography program. The UK program is targeted at women aged 50–64 years. The acceptable values may need to be modified to be applicable to a wider age range.

- **Standardised accreditation procedures:** initial and periodic accreditation is required of both individual medical practitioners and radiographers participating in screening as well as assessment and screening centres. This accreditation should be based on explicit criteria which cover the initial training of staff, post-training throughput required of each staff member, participation in centrally coordinated activities such as recruitment, monitoring and evaluation, and screening performance in relation to the quantitative performance criteria. Mechanisms are required for providing initial accreditation, re-accreditation at periodic intervals and, if necessary, the withdrawal or suspension of accreditation. Mechanisms are also required for discouraging screening by non-accredited facilities. This could be achieved by directing funding and recruitment strategies only to accredited units.
- **Appropriate treatment services:** clearly, mammographic screening can only achieve mortality reductions to the extent that the treatment of women with screen detected cancer is able to do so. Currently there is little experience in the treatment of the small and in situ lesions found by mammographic screening. This is particularly problematic for ductal carcinoma in situ, where mastectomy rather than lumpectomy is frequently used to treat disease of which only 1% will become invasive per year. This is an important area for future clinical research. For screening and subsequent treatment to achieve its potential whilst reducing unnecessary surgery, the treatment services should be organised to maximise the level of expertise and relevant experience which is available to women with screen detected cancers.
- **Mammographic screening as an integrated, systematic and coordinated program:** screening should be undertaken in the context of a systematic, organised screening program, in order to achieve the objectives listed above. In broad terms, screening can be provided as an organised, systematic program, or be provided on a laissez faire or spontaneous basis by existing health care services. Systematic screening programs include:
  - systematic and coordinated methods of recruiting women to attend for screening and of notifying them of their results;
  - centrally coordinated measures to ensure that screening is of high technical quality;
  - mechanisms to ensure women receive appropriate assessment, counselling and treatment when necessary;
  - ongoing evaluation and monitoring of the program in relation to achieving improvements in mortality and morbidity, in relation to attendance and acceptability to women, and in relation to its cost-effectiveness.

  For mammographic screening, it is also important that screening and assessment, including open biopsy, be provided as an integrated service. Such integration maximises the skills of medical practitioners involved by providing them with feedback on the accuracy of their decision to intervene at each point on the screening pathway. An integrated service also provides a framework for maintaining and refining the quality of all components of screening and assessment, because the process can be viewed as a whole and its performance measured by the performance measures presented above.

  Past experience with cervix cancer screening illustrates the advantages and disadvantages of systematic versus spontaneous screening. Data are available for cervix cancer screening programs which compare the effectiveness of systematic and spontaneous screening. Greater reductions in incidence and mortality of cervix cancer have been found in two regions in Scotland with organised screening programs than in the remainder of Scotland, with no organised screening programs (MacGregor and Teper 1978). Similarly, in

Denmark the introduction of organised screening programs in some counties resulted in cervix cancer mortality in those counties dropping by 32%, even though there was little change in the number of smears taken (Lynge, Madsen and Engholm 1989).

The lesser effectiveness of spontaneous screening is attributable to deficiencies at all stages along the path from recruitment to treatment. These deficiencies arise from a lack of clear objectives inherent in spontaneous screening, a lack of coordination within and between the components of the screening pathway and lack of coordinated quality control and monitoring. In contrast, a systematic screening program avoids these deficiencies. It also provides a framework in which a national screening policy can be applied and various activities such as training and accreditation can be coordinated.

- **Ongoing research and program review:** data from pilot projects and research in Australia and other countries should be kept under review with a view to adjusting the national mammography screening policy as required. There should also be the capacity to conduct research studies within the screening program.

### Recommendation 3

**To maximise the benefits and minimise any adverse effects to women, a national mammography program should possess the following features:**

- **quality assurance and monitoring procedures;**
- **a national mammography screening policy;**
- **mammographic screening provided as an integrated, systematic and coordinated program**
- **national and State-Territory level coordination mechanisms;**
- **appropriate treatment services;**
- **provision of adequate resources;**
- **specialised training for radiographers, radiologists, surgeons and pathologists;**
- **an appropriate balance of incentives for service providers to maximise quality of service;**
- **quantitative performance criteria;**
- **ongoing monitoring and evaluation of the screening program;**
- **standardised accreditation procedures;**
- **ongoing research and program review.**

### Recommendation 16

**To ensure that all screening mammography conducted in Australia is of high quality, mammography screening and assessment of women with suspicious mammograms should only be performed by facilities which are accredited for mammographic screening. All such screening units and assessment centres should be required to meet initial and ongoing accreditation standards. If accreditation procedures are in place for any categories of staff, accredited assessment centres and their affiliated screening units should be restricted to selecting staff only from those who are accredited.**

### Recommendation 18

**Comparable data returns should be used by all accredited assessment centres and their affiliated screening units to facilitate uniform monitoring/evaluation and the use of uniform computer software. The State-Territory coordinating units should be the central repository for data collected from the accredited assessment centres and their affiliated screening units on each woman screened and followed up. The national breast cancer screening coordination unit should maintain a national data base incorporating summary data collected by each State-Territory coordinating unit.**

## 7.2 Acceptability to women and meeting women's needs

The results of surveys among women attending for screening and among women in pilot project target populations suggest that there are a range of issues which influence women's willingness to attend for screening. The relative importance of these issues can be gauged from the data presented in table 7.3 (acceptability) and table 7.4 (perceived barriers). These and other data indicate that the provision of a mammographic screening service which is acceptable to women and meets their needs requires attention being given to the following issues.

### 7.2.1 Recruitment of women to attend for screening

**Accessibility:** the screening program should be accessible to women. The program should be geographically accessible in terms of minimising the difficulty of women in travelling to screening. This could take the form of mobile screening vans being located in areas of maximal accessibility to public transport (eg shopping centres for urban women, the local town for rural women). The hours of operation of screening clinics should accommodate the preferences of working women.

The cost of attending for screening should not be a deterrent. Thus screening and any subsequent procedures should be available free of charge to women who would not otherwise attend. Table 7.3 indicates, however, that a significant proportion of women (50-70%) report they are willing to make a payment towards the cost of a screening service.

**Visibility:** to maximise the opportunity for women to attend for screening, the screening program should be brought to the attention of women through organised recruitment activities, and, in the case of mobile vans, by placing the vans at points of maximum visibility (eg shopping centres, public transport junctions).

**Equity:** to ensure that all eligible women have similar opportunities to attend for screening, recruitment activities should be directed at all segments of the target population, defined in terms of geographic location within the target area, socioeconomic status, language background and age. Participation rates by women in terms of these characteristics should be monitored, and recruitment activities targeted at groups with lower attendance. In addition, as mentioned above, funding and charging policies should ensure that cost to women does not become a barrier to attendance. Emphasis needs to be given to the recruitment of groups likely to be underscreened, particularly older women, women of low socioeconomic status, rural women, Aboriginal women, and women of non-English speaking background.

**Table 7.3: Acceptability of mammography screening to Australian women**

(%)

| *Pilot project* | *I* | *II* | *III* | *IV* | *V–VI* | *VIII–IX* | *X* |
|---|---|---|---|---|---|---|---|
| *Number in sample* | *na* | *n = 185* | *n = 100* | *n = 668* | *n = 625* | *n = 363* | *n = 269* |
| *Type of survey* | | *Community* | *Client* | *Community* | *Community* | *Community* | *Client* |
| **A Reported 'psychological' costs/benefits** | | | | | | | |
| 1 Expect mammogram to be painful or cause discomfort | | | | | | 39 | 41 |
| 2 (a) Experienced discomfort or worse | | | | | 62 | 51 | 46 |
| (b) Experienced severe pain | | | | | | 5 | 9 |
| 3 Reported embarrassment during mammogram | | | | | | | 10 |
| 4 Anxiety experienced: | | | | | | | |
| (a) before mammogram | | | | 35 | | | 45 |
| (b) after mammogram | | | | | | | 11 |
| (c) waiting for results | | | | | | | 23 |
| 5 Concern about too much radiation to women | | 4 | | | | | |
| 6 Expect mammography to be accurate | | | | 65 | | | 46 |
| 7 Would gain reassurance from mammography screening | | 40 | 63 | 53 | | | |
| **B Attitudes to mammography screening** | | | | | | | |
| 1 Believe breast cancer screening is worthwhile | | | | 81 | 68 | | |
| 2 Believe benefits outweigh costs | | | | | | | 99 |
| 3 Intention to have mammogram | | 55 | | 64 | 47 | | |
| 4 Believe early detection is very worthwhile | | 44 | 84 | 85 | | | |
| **C Financial costs to women** | | | | | | | |
| 1 Not prepared to pay for screening | | | | | 15 | | 17 |
| 2 Prepared to pay up to $30 for screen | | | | | 63 | | 49 |
| 3 Prepared to pay $30–$50 | | | 69 | | | | 26 |
| 4 Prepared to pay > $50 | | | | | | | 8 |
| **D Satisfaction with pilot screening services** | | | | | | | |
| 1 High degree of satisfaction | 85 | | | 91 | | 99 | |
| 2 Will recommend service to friends | | | | 99 | 92 | 97 | |
| 3 Adequate location of service | | | | 86 | | 94 | |
| 4 Service facilities comfortable | | | | 88 | | 98 | 78 |
| 5 Staff perceived as technically competent | | | | 89 | | 99 | 98 |

(a) These data should be interpreted with caution. The studies on which they are based used similar but not identical methods or questions.

(b) Section (A) concerns data relating to perceived 'psychological costs' of mammography screening to women, including degree of anxiety, pain, embarrassment expected/incurred, level of reassurance provided by a negative result, and expectation of accurate results. Women's perceptions of the relative costs/benefits of screening are likely to influence their attendance and re-attendance behaviour.

(c) Section (C) provides information on women's willingness to pay for a screening mammogram, with no expectation of a rebate. It does not refer to costs incurred by clients getting to and from the service (see financial costs to women table, economics section).

(d) Section (D) is based on client surveys of degree of satisfaction with specific pilot screening services.

**Table 7.4: Perceived barriers to mammography screening among Australian women**

| | | | | (%) | | |
|---|---|---|---|---|---|---|
| *Pilot project* | | *II* | *IV* | *V–VI* | *VIII–IX* | *X* |
| *Number in sample* | | *n = 235* | *n = 668* | *n = 625* | *n = 363* | *n = 269* |
| *Type of survey* | | *Community* | *Community* | *Community* | *Community* | *Client* |
| **A** | **Features of the service** | | | | | |
| 1 | Geographical location | | | 28 | | |
| 2 | Hours of service | | | 18 | | |
| 3 | Waiting time at service | 15 | | | | (a)13 |
| 4 | Type of service (eg fixed vs mobile) | | | 48 | | |
| 5 | Having to pay for a mammogram | | | 17 | | |
| 6 | Comfort of service facilities | | | | | (a)22 |
| 7 | Perceived pain of mammogram | 12 | | 12 | 3 | |
| 8 | Level of radiation dose | 5 | 24 | 18 | 30 | |
| 9 | Embarrassment/lack of privacy | 14 | 70 | 10 | | |
| 10 | Need for GP referral | | | | 3 | |
| 11 | Potential harm of test | | | 10 | | |
| **B** | **Features of service personnel** | | | | | |
| 1 | Staff competence/interpersonal skills | | | | 1 | (a)2 |
| 2 | Concern that male doctor/nurse is present | 14 | | | | |
| **C** | **Features of the client** | | | | | |
| 1 | Not knowing enough about mammograms | (b)33 | | 25 | | |
| 2 | Fear of result | | | 21 | 30 | |
| 3 | Anxiety caused by mammogram | | | 15 | | |
| 4 | Not relevant/doubts about efficacy | | | 15 | | |
| 5 | Too busy/no time | 15%, (b)34% | | | | |

Note: These data should be interpreted with caution. The studies on which they are based used similar, but not identical methods and questions. All pilot projects however sought to gain information from women in the target range concerning those aspects which would be a potential barrier to their attendance for mammography screening.

(a) This survey was client based and respondents noted those aspects which could be 'improved'. These features were not a complete barrier to attendance.

(b) These figures relate to reasons for non-attendance on a 'specific day' (ie last shopping day near the mammography service).

**Table 7.5: Proportion of target population screened by individual pilot projects**

| Project | Screening period (inclusive) | Months of screening | Age range of target population (years) | No of women in target population | Total no of women screened (all ages) | No of women from target population screened | % of target population screened | No of women screened annually (No women/year) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 1st 12mths | 2nd 12mths |
| I | 1.88–12.89 | 24 | 45–69 | 42,792 | 9,193 | 8,062 | 18.8 | 3,882 | 5,311 |
| II | 1.89–12.89 | 15 | 40 & over | (a)85,000 | 5,451 | 5,451 | (a)6.4 | 4,058 | (b)5,572 |
| III | 11.88–3.89 | 16 | 40 & over | 66,707 | 1,720 | 264 | 0.4 | (c)1,208 | (b)1,500 |
| IV | 11.88–6.89 | 8 | 50–69 | 39,404 | 4,498 | 3,716 | 9.4 | (b)6,747 | |
| V(d) | 11.88–12.89 | 14 | 50–69 | 45,320 | (e)8,674 | (e)3,028 | na | (b)7,435 | |
| VI(d) | 11.88–3.90 | 17 | 50–69 | 45,320 | 10,149 | na | na | (b)7,848 | (b)6,903 |
| | | | (40 & over | 91,101) | | | | | |
| V & VI(d) | 11.88–12.89 | 14 | 50–69 | 45,320 | 17,673 | (f)3,444 | (f)7.6 | 5,595 | |
| | | | | (g)38,522 | | | (g)15.8 | | |
| VII | 2.89–3.90 | 14 | 40 & over | 23,365 | 3,528 | 3,528 | 15.1 | (b)2,668 | (b)3,246 |
| VIII | 3.89–4.90 | 14 | 45–69 | 19,110 | 6,590 | na | na | (b)5,649 | |
| IX | 2.90–4.90 | 3 | 45–69 | 13,071 | 1,100 | na | na | (b)4,400 | |
| X | 1.89–12.89 | 12 | 50–64 | 96,740 | 5,965 | 5,553 | 5.7 | 5,965 | |

(a) Approximately 85,000 women. Smaller target populations chosen for evaluation of recruitment strategies.

(b) Annualised screening rates.

(c) For 1.89–12.89.

(d) Community recruitment activities and target population for projects V and VI were shared. Project VI also offered screening to women 40 years and over.

(e) Includes women attending for rescreening (approximately 39%) as well as initial screens.

(f) Based on women not previously screened who attended for an initial screen.

(g) Adjusted to include screening in private sector and exclude 15% of women in target population who had been screened prior to mammography screening pilot project.

**Table 7.6: Recruitment strategies used by pilot projects**

| | Project | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Recruitment strategy* | I | II | III | IV | V & VI | VII | VIII | IX | X |
| Community based promotions(a) | X | X | X | X | X | X | X | X | X |
| Mass media(b) | X | X | X | X | X | X | X | X | X |
| Involvement of general practitioners | X | X | X | X | X | | X | X | X |
| Information brochures, letter box drops | X | | | X | X | | X | | X |
| Personal letters to women | X | | | X | (c)X | | X | X | X |
| Promotion in other health facilities(d) | X | | X | X | X | | X | X | X |

(a) Shopping centres, schools, local councils, women's groups, public lectures etc.

(b) Included print and electronic media.

(c) Reminder letters for rescreening only.

(d) Family planning clinics, health centres, displays in hospitals, etc.

Pilot project data on the proportion of women from the target population who have attended for screening are shown in table 7.5. Similar data are also presented in section 6.9. The throughput rate of number of women screened in the first year of operation ranges from 1,208 to 7,435 women per year. These data suggest that the throughput range of 6,000 to 9,000 women per screening unit per year, which has been used elsewhere in this report for planning purposes, is reasonable. For those projects which provided second year data, the throughput rate was higher in the second year of screening. This may have been due to more efficient screening operations or more successful recruitment activities. Some screening clinics were fully booked, indicating the principal determinant of throughput in these pilot projects was screening capacity. In others which were not fully utilised, the determinant of throughput was the demand for screening by women.

Target populations were selected to evaluate recruitment strategies. It can be seen from table 7.5 that the proportion of women screened was very low. This is because the target populations selected were, in general, too large for evaluation purposes. For example, to assess whether 70% of women would attend for screening at a unit which can screen 9,000 women per year with a two year screening interval, a maximum target population size of only 26,000 women is required. To examine whether more than 70% of women can be recruited, a smaller target population is required.

Table 7.6 presents the range of recruitment activities used by the pilot projects. As pilot projects combined several recruitment strategies, it is not possible to discern any relationship between the individual methods used by projects and the number of women screened per year by individual projects shown in table 7.5.

Two pilot projects have provided data which assess the effectiveness of different methods of recruitment. Illustrative data are presented in tables 7.7 and 7.8. The data presented in table 7.7 were derived from randomised controlled trials of several recruitment methods in a metropolitan area utilising a mobile screening van. From these data, the following conclusions can be drawn.

- With three visits of a mobile screening van, non-personalised community promotions (excluding electronic media) and a small amount of recruitment by personalised invitations, 45% of eligible women can be recruited.
- Personalised invitations from general practitioners or electoral records are an effective method of recruitment, more so if an appointment time is offered. With two van visits, non-personalised community promotions and personalised invitations with appointment times, 63% of eligible women can be recruited.
- Although invitation letters from general practitioners and electoral records were both effective, these data provide little information on the relative effectiveness.

Project II evaluated recruitment methods in rural communities using a quasi-experimental methodology. From table 7.8 the following conclusions can be drawn.

- The addition of community based recruitment to minimal mass media recruitment substantially increased participation rates from around 30% to 46% and 59% in two towns.
- General practitioner recruitment was even more effective than community based recruitment (including a media component). General practitioner recruitment alone was able to achieve participation rates of around 60%.

These studies were undertaken in country towns. The applicability of these conclusions to urban populations requires further research.

An important conclusion from the data in both tables 7.7 and 7.8 is that, with the addition of electronic mass media promotion to the recruitment methods tested and more intensive print mass media promotion, a participation rate of 70% is realistic. 70% has been used for planning purposes elsewhere in this report.

A limitation in the evaluation of methods of recruitment has been the limited use of electronic mass media campaigns. Intensive electronic mass media campaigns have not been conducted because of concern that such campaigns would create a level of demand that could not be met by the pilot projects. A national screening program could readily employ electronic and print mass media promotion as a major recruitment strategy.

This report does not make specific recommendations about methods of recruitment which should be used. It is important that scientifically rigorous research on recruitment continue and that this information plus information generated by the ongoing monitoring and evaluation of screening programs be used by local managers to adjust their own recruitment activities. To this end, it is important that information on the effectiveness of different recruitment methods be disseminated freely. In a national screening mammography program it will be essential to evaluate methods of encouraging attendance in an ongoing manner and adjust recruitment campaigns as appropriate.

### 7.2.2 Screening and assessment

#### Non-threatening, comfortable environment

To encourage attendance by women, as well as to minimise any anxiety they may feel, the screening clinics should be predominantly staffed by women and should provide a comfortable, relaxing environment.

### Information to women

When women attend, they should be given comprehensive information about screening. This information should be provided in a form which can be readily assimilated and in appropriate languages as required. Women should be informed of the results of their screen and assessment in a timely fashion and in a manner which minimises anxiety and maximises cooperation with any additional investigation or treatment that may be required.

### Emotional support

Given the anxiety that can accompany mammographic screening, it is important that staff have an appropriate manner and are sensitive to the emotional state of women they are screening. Staff should provide information, comfort and support as required. In addition, appropriate counselling resources should be available and staff should be able to recognise when counselling is required.

### Involvement in decision-making

Women should be informed of and involved in decisions about treatment options.

These proposed design features are supported by the results of surveys of both women who attended and those in the target populations of pilot projects. Almost all women mentioned at least one perceived barrier to mammographic screening. Among the most frequently mentioned barriers are 'embarrassment', 'preference for a female radiographer', concern about possible 'discomfort or pain' and 'fear of radiation dose'. Lack of knowledge about mammography and concern about the result are also significant barriers.

**Table 7.7: Participation rates in pilot project I with various recruitment activities**

| | % of study group attending | | |
|---|---|---|---|
| *Intervention* | *(a)Participation prior to intervention* | *Participation following intervention* | *Notional total attendance* |
| A Personalised invitation from woman's GP | (b)27 | | |
| 1 Letter with appointment time (n = 162) | | 28 | |
| Subsequent reminder letter (without appointment time) | | 8 | |
| Total | | 36 | 63 |
| 2 Letter without appointment (n = 126) | | 18 | |
| Reminder letter (without appointment time) | | 10 | |
| Total | | 28 | 55 |
| 3 No letter sent (n = 152) | | 6 | 33 |
| B Personalised invitation from electoral records | (c)36 | 21 | 57 |
| 1 Invitation (n = 163) | | | |
| 2 No invitation (n = 80) | | 6 | 42 |
| C Additional | (d)45 | | |

(a) All study groups were previously exposed to non-personalised community promotions (excluding electronic media).

(b) Attendance after one visit to area by screening van.

(c) Same study group as (A) with two visits to area by screening van.

(d) Total attendance by study group after three van visits and, on a small subset, personalised invitations from either electoral records or general practitioner (ie include preceding study groups).

Source: Department of Public Health, University of Sydney

**Table 7.8: Participation rates in pilot project II with various recruitment activities(a)**

| *Study group pairs of country towns* | *Intervention and % of study group attending* | | | |
|---|---|---|---|---|
| Pair 1 | (b)Media | 32 | (b)Media & (c)community | 46 |
| Pair 2 | (b)Media | 29 | (b)Media & (c)community | 59 |
| Pair 3 | (d)Community | 47 | (e)General practitioner | 64 |
| Pair 4 | (d)Community | 53 | (e)General practitioner | 59 |

(a) Analysis compared attendance rates within each pair. Attendance rates were significantly different within pairs 1, 2 and 3.

(b) Minimal mass media, comprising newspaper advertisements, pamphlets for women and information to general practitioners.

(c) Community based recruitment, comprising promotion of an information video, administration of an appointment system and other community activities by a community committee.

(d) Community based as above, but also including media if chosen by the committee.

(e) General practitioner recruitment, comprising general practitioners requesting women to register to receive a reminder letter to attend for screening when the screening bus next visited the town. Of women who registered, 80% subsequently attended for screening.

Source: Discipline of Behavioural Science in Medicine, University of Newcastle

### Recommendation 8

**A national mammography screening program should seek to maximise attendance at the program by providing adequate resources for recruitment as well as by maximising the visibility and accessibility of the program to all eligible women. Close attention should be given to equity of access.**

**The results of screening should be provided promptly and directly to the woman in a way which is sensitive to the anxiety provoked by a positive result.**

**The screening program should provide screening in a way which is acceptable to women by offering:**

- **a non-threatening, comfortable environment;**
- **comprehensive and easily understood information about screening;**
- **emotional support;**
- **involvement by women in decisions about their management, particularly in relation to further assessment and treatment.**

### Recommendation 28

**It is vital that cost to women should not be a barrier to their participation in the screening program. An essential component of any funding arrangement is that mammography screening be available free of charge for women in the target age group who would not attend if there was a charge.**

An important element of the information provided to women should be their individual likelihood of being recalled, of having cancer found, of having a cancer missed, etc. Figure 7.1 demonstrates the numbers of women who will reach the various end-points of the screening pathway for 10,000 women being screened for the first time, based on the acceptable values in table 7.2. Figure 7.2 presents analogous data for women presenting for routine rescreening, after their first screen.

The recall rate is lower for routine rescreening than for initial screens because suspicious areas on rescreening mammograms can be compared with previous mammograms for any change. If no change had occurred, recall would not be required. The cancer detection rate is lower on routine rescreens at the recommended screening interval than on initial screens because the initial screen leads to the detection of cancers which have been present but unnoticed for many years. The initial screen and subsequent clinical management removes these long-standing cancers, so they are not present at routine rescreens. If rescreening is delayed beyond the recommended screening interval, the number of long-standing cancers and the cancer detection rate increase, as does the number of interval cancers.

**Figure 7.1: Initial screening – estimated number of women reaching various end points of screening for every 10,000 women screened**

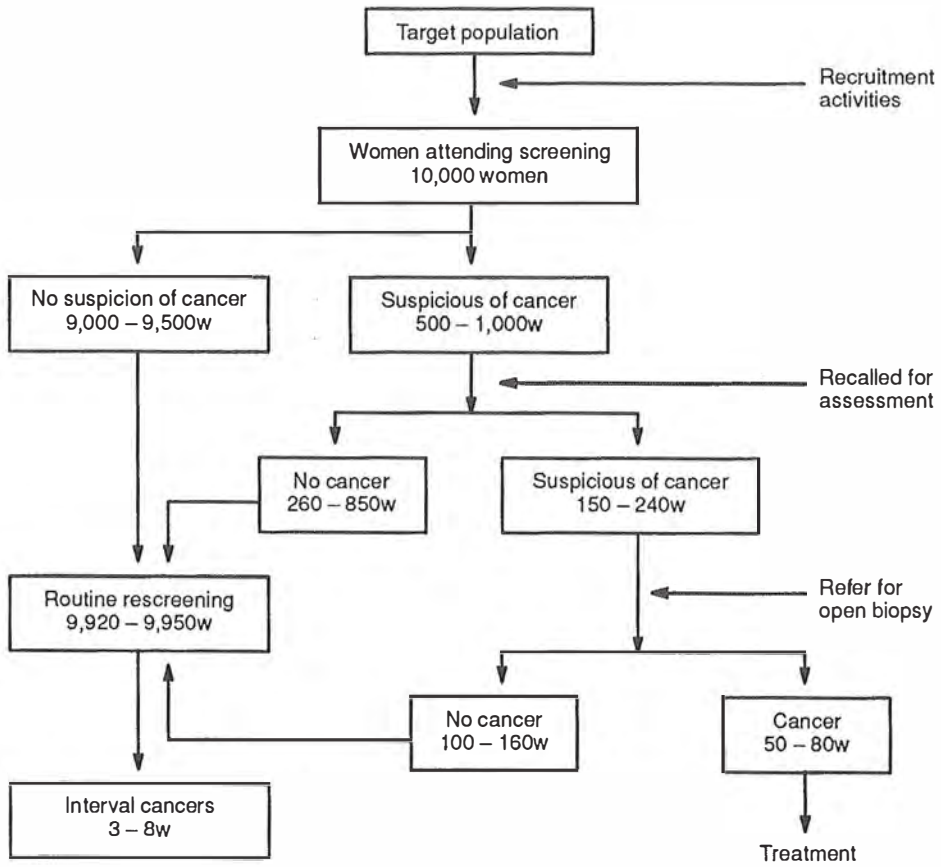
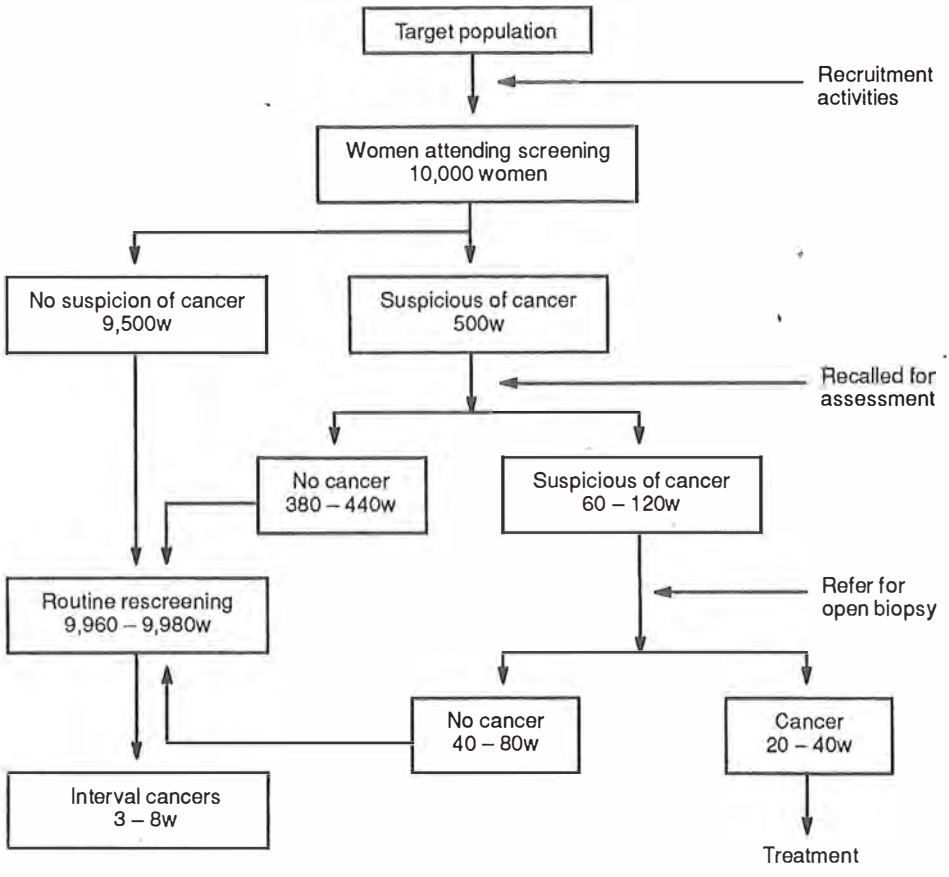


**Figure 7.2: Routine rescreening – estimated number of women reaching various end points of screening for every 10,000 women presenting for routing rescreening.**




## 7.3 Involvement of general practitioners

The involvement of general practitioners in a mammographic screening program is highly desirable because they have an important role to play in providing women with information about mammography, encouraging them to attend, and counselling women with positive results. The significance of general practitioners in recruitment of women to screening is clearly demonstrated in section 7.2.1. General practitioners are also in a unique position to increase community awareness and acceptance of mammography screening. Data from surveys of general practitioners both in and outside pilot project target populations indicate the need to educate them about mammography (table 7.9). To maximise the potential for general practitioners to contribute positively to mammographic screening, it will be necessary for information to be provided to them which will help them in their clinical decision-making and in advising their patients.

The involvement of general practitioners in screening programs would be facilitated by:

- the involvement of the Royal Australasian College of General Practitioners and the Australian Medical Association in the establishment of the screening program;
- the development and dissemination of educational material about mammography targeted at general practitioners, including Family Medicine Program trainees;
- screening and assessment centres informing general practitioners about activities and initiatives;
- screening and assessment centres informing general practitioners nominated by women screened, about their screening and assessment results, and involving general practitioners in treatment referral decisions and any other issues relevant to each woman's total health care;
- keeping general practitioners informed about State–Territory screening activities, the performance of screening programs in their area, results from surveys concerning women's needs and preferences and about advances in mammography screening.

### Recommendation 9

**Education programs and material about screening mammography which are targeted at the medical profession, and in particular at general practitioners, should be developed and widely promoted and disseminated among the profession.**

### Recommendation 10

**A woman's general practitioner should be kept informed of the results of screening and any further work-up required, unless directed otherwise by the woman.**

**Table 7.9: Level of GP support for mammography screening (knowledge, attitudes and referral behaviour)(a)**

| *Pilot project:* | *I* | *III* | *VIII-IX* |
|---|---|---|---|
| *Number in sample:* | *n = 200* | *n = 104* | *n = 59* |
| *Type of survey:* | *GPs in & outside target population* | *GPs in target population* | *GPs in target population* |
| *% of GPs who:* | % | % | % |
| **A Knowledge of mammography screening** | | | |
| A1 Know that breast cancer increases with age | 25 | | |
| A2 Know that evidence for mortality reduction weakest for women under 50 years | 29 | | |
| A3 Believe mammography is important for target age women | 75 | | |
| A4 Believe clinical examination is important for target age women | 95 | | |
| **B Attitudes to mammography screening** | | | |
| B1 Support mammography screening | 87 | | |
| B2 Believe benefits to outweigh the costs | | | 58 |
| B3 Believe screening mammography saves women's lives | | | 92 |
| **C Referral to mammography screening** | | | |
| C1 Would recommend mammography to patients | 84 | (b)66 | 78 |

(a) General practitioners in only two capital cities were surveyed (no rural data) and in areas where public mammography screening was available.

(b) These data concern referral to a specific clinic – not referral in general to mammography screening.

# 8 A breast cancer screening program for Australia

## 8.1 Functions

A mammography screening program can be divided into those functions which directly provide services to women and those which support the program and are required for quality assurance.

### 8.1.1 Services to women

In providing services to women, the principal functions are as follows.

#### Recruitment

Recruitment covers all activities involved in making women aware of the screening program and inviting them to participate.

#### Screening

Screening comprises film taking, film reporting, counselling, notifying women and their nominated doctor of the results and referring women with abnormal screens to assessment centres.

#### Assessment

Assessment comprises the investigation of women with abnormal mammograms to arrive at either a benign diagnosis or referral of women to open biopsy or definitive treatment, counselling and notifying women and their general practitioners of the results.

#### Open biopsy

Open biopsy comprises surgical removal of a breast tumor for definitive histopathological diagnosis.

#### Treatment of breast cancer

This refers to the various treatment modalities for cancers detected through the screening program.

### 8.1.2 Support and quality assurance

To ensure that the service elements of the program achieve their objectives, several support and quality assurance functions are required.

#### Coordination

Coordination ensures that all components of the screening program are properly established, that there is appropriate communication between these components and that resources are distributed so as to maximise effectiveness of the program.

#### Policy

The development and review of policy is required to ensure that the guidelines, within which screening programs operate, provide a framework for maximising the quality, acceptability, equity and cost-effectiveness of the screening program.

#### Funding

Mechanisms are required for funding the screening program which support (or are at least neutral towards) its principal objectives.

#### Training

Screening mammography and associated diagnostic procedures require specialised training for radiographers, radiologists, pathologists and surgeons.

### Technology assessment
Formal technology assessment is required for mammography machines, associated diagnostic equipment and possibly for film processors.

### Research
Ongoing research is desirable in order to develop improved ways of providing screening and to identify potential alternative methods for reducing breast cancer mortality.

### Monitoring and evaluation
An important mechanism for ensuring that high quality services are provided is ongoing monitoring and evaluation of the following aspects of screening:

- the technical performance of mammography machines and processing machines;
- screening performance and effectiveness in relation to the achievement of improvements in mortality and morbidity;
- women's satisfaction with services;
- cost.

### Accreditation
Accreditation of providers of screening services is required to ensure that high quality services are provided. Accreditation should ensure that in order to receive public funding, service providers should meet both initial accreditation and ongoing accreditation standards. Initial accreditation standards should relate to issues such as qualifications and training of individuals and equipment available in screening facilities. Ongoing accreditation should relate to issues such as throughput and achievement of monitoring and evaluation performance standards.

## 8.2 Provision of support and quality assurance functions
To ensure that mammography screening services are available to all women in the target group and that the support and quality assurance functions are implemented, responsibility for the operation of a national screening mammography program should lie with governments.

### Recommendation 12
**In Australia, with a federal system and shared responsibilities for different aspects of health services, the support and quality assurance functions should be shared between national bodies and State and Territory bodies.**

### 8.2.1 National responsibilities
To ensure that all elements of the screening program are implemented in accordance with the national policy, it is essential that implementation be nationally coordinated.

The following functions should be performed at the national level:

- reviewing and updating the agreed national screening policy in the light of new evidence;
- ensuring the national mammography screening program is implemented;
- developing and implementing funding mechanisms;
- coordinating the development and implementation of quality assurance and monitoring standards;
- coordinating the development and implementation of accreditation standards;

- developing and implementing mechanisms for monitoring and evaluation data collection;
- assessing workforce requirements in relation to demand and recommending necessary action;
- coordinating the training of medical personnel and radiographers;
- contracting out technology assessment functions. (This may be organised at a State-Territory level.);
- compiling and disseminating national data on the performance of screening programs;
- ensuring that mechanisms are present within each State and Territory for reviewing the performance of screening programs and implementing modifications and adjustments as required; and
- ensuring that all aspects of the national program are kept under review and that the program is adjusted as appropriate to maintain and enhance its clinical effectiveness and cost-effectiveness.

At the national level, there are several existing organisations that would or could be involved in implementing and operating the national mammography screening program.

- Australian Health Ministers' Advisory Council;
- The National Health and Medical Research Council;
- Commonwealth Department of Community Services and Health;
- The Health Insurance Commission;
- Australian Institute of Health;
- Australian Radiation Laboratory.

Each organisation has a potential contribution to make to the national program but is not, of itself, suited to assuming responsibility for all aspects of implementing and maintaining a national screening program. It is envisaged that, during the implementation phase, responsibilities could be distributed as follows:

- AHMAC would be responsible for ensuring that national screening policies and requirements are implemented in the States and Territories;
- DCSH would be responsible for administering the Commonwealth's financial involvement;
- HIC could have a role in the individualised recruitment of women to screening, depending on privacy considerations;
- AIH could be responsible for national evaluation and monitoring;
- NHMRC could have a role in the development of accreditation standards and screening policy guidelines;
- ARL could have a role in quality assurance.

Even with this division of responsibilities, there are some functions which do not fall easily within the ambit of existing organisations (eg accreditation). There remains a need for appropriate administrative infrastructure to ensure that all aspects of the program are implemented in a coordinated manner. To achieve this critically important function, it is proposed that a national breast cancer screening advisory committee and a national breast cancer screening coordination unit be established. These bodies would have responsibility for coordinating the implementation and conduct of a national breast cancer screening program.

The unit should have expertise in epidemiology, economics, social/behavioural science and program development and implementation. The membership of the committee should include:

- representation of the State-Territory mammography screening programs;
- Commonwealth Department of Community Services and Health representation;
- Australian Institute of Health representation;
- expertise in epidemiology, economics, radiology, surgery, health promotion and women's health.

To contain the size of the committee, it may be necessary to limit the number of State-Territory representatives and to coopt members with expertise when required.

The national breast cancer screening unit could be cojointly located at the Commonwealth Department of Community Services and Health and the Australian Institute of Health as a collaborative exercise. The departmental component would have primary responsibility for intergovernmental negotiations, finance and policy. The Institute component would have primary responsibility for monitoring and evaluation. Clear reporting lines for the committee and the unit should be defined once the location and roles of these bodies are developed.

### Recommendation 13

**In view of the fact that a national mammographic screening program would be the first of its type in Australia, and that large scale financing is involved, a national breast cancer screening advisory committee and a national breast cancer screening coordination unit should be established. While a number of governmental and non-governmental bodies would be responsible for various components of the screening program, these two national screening bodies should act as the final common path, coordinating all the elements of the screening program. Once the national mammography program is implemented, the need for these two bodies should be reviewed.**

### 8.2.2 State–Territory responsibilities

States and Territories should be responsible for the following:

- implementing screening programs in accordance with the national screening policy;
- coordinating training to meet the needs of screening programs;
- developing and implementing quality assurance and monitoring mechanisms in cooperation with the national advisory committee and the national coordination unit (which set the standards);
- implementing measures to ensure that an adequate workforce is available for the screening program;
- compiling and disseminating data on the performance of screening programs within the State or Territory;
- reviewing the performance of screening programs and implementing modifications and adjustments as required; and
- ensuring appropriate treatment services are available for screen detected lesions.

To ensure that all the central functions to be performed by States-Territories are performed in a coordinated manner, they should be undertaken or coordinated by a single body within each State-Territory. Such a body, possibly in the form of a unit, should have responsibility for:

- the recruitment of women for screening;
- establishing screening and assessment facilities;
- quality assurance and monitoring;
- coordinating training and the provision of workforce;
- coordinating the administration of accreditation mechanisms in cooperation with the national advisory committee and the national coordination unit (which sets the standards);
- reviewing the performance of screening programs, and recommending and implementing modifications as required;
- identifying additional requirements; and
- providing input into program funding decisions.

**Recommendation 14**
**Each State and Territory should give consideration to establishing a breast cancer screening coordination unit to perform the functions outlined in section 8.2.2. States and Territories should consider the need for additional organisational mechanisms, eg State–Territory steering or advisory committees and regional or local planning bodies.**

## 8.3 Provision of services to women

The provision of mammographic screening services to women involves the recruitment of women to screening, the assessment of women with abnormal screens and the provision of treatment where appropriate.

### 8.3.1 Recruitment

Recruitment activities will comprise a combination of public information and education campaigns, professional education and possibly individualised invitations to women. These activities could be conducted at various levels, including nationally, State–Territory, health region and individual screening facilities. Since States–Territories will have prime responsibility for implementing services and many major health education programs are organised at a State–Territory level, it is appropriate for recruitment to be organised at the State–Territory level.

It is envisaged that the national coordination role would involve ensuring that educational materials reflect national screening guidelines and that experience with different recruitment strategies is made available to all States–Territories. States–Territories would devolve some recruitment activities to individual screening facilities.

The potential role of the Medicare register in individualised call/recall of women to screening was noted by the committee, but important considerations of privacy were still under review by the Commonwealth Privacy Commissioner/DCSH at the time of this report. The future role of the Medicare register is an issue that the Commonwealth–States–Territories may wish to further explore during implementation of the screening program, having regard to the experience of any State–Territory registers that may be established.

### 8.3.2 Screening and assessment

It is proposed that screening and assessment services in a defined geographic area would be provided by an assessment centre and its affiliated screening units. Screening and assessment should be carried out in dedicated screening units and assessment centres. Women requiring biopsy should be given the option of referral to a treatment clinic specialising in the treatment of screen detected breast cancer or return to their general practitioner for referral.

Individual screening units should not operate independently, but should operate in close association with a designated assessment centre. It is highly desirable that each assessment centre and its affiliated screening units has a well defined geographic catchment area, to assist in the evaluation of the performance of the screening activity. Each assessment centre and its affiliated screening units may be solely responsible for providing mammographic screening and assessment services to women in a prescribed geographic region, particularly in rural areas. Alternatively, assessment centres and affiliated screening units may have catchment areas which overlap with other assessment centres and their screening units.

The screening unit would be responsible for:

- taking the mammograms;
- providing women with information about mammography screening in a form which can be easily understood (information to be prepared by national–State–Territory coordination units); and
- counselling women as required.

The assessment centre would be responsible for:

- providing assessment services and referral for open biopsy and treatment;
- counselling women as required;
- collecting quality assurance information and providing this to the State–Territory screening coordination unit (ie screening units would provide these data via their designated assessment unit).

Either the assessment centre or the screening unit would be responsible for:

- reporting on mammograms;
- processing mammograms;
- notifying women and nominated general practitioners of the results of the screening mammogram;
- liaising with the woman's general practitioner about referral options and total patient care; and
- arranging referral of women with abnormal mammograms to the assessment centre.

At least one assessment centre in each State and its affiliated screening units should be designated as a centre of excellence, with special responsibilities in the areas of teaching, research, quality assurance and evaluation. It is likely that the current pilot projects would become these centres of excellence.

### Recommendation 15

**Screening and assessment should be carried out in dedicated screening units and assessment centres. Assessment centres and their affiliated screening units should be responsible for all procedures provided as part of the national screening program up to and including cytological or histological diagnosis of breast cancer. Individual screening units should not operate independently, but should operate in close association with a designated assessment centre. It is highly desirable that each assessment centre and its affiliated screening units has a well defined geographic catchment area, to assess the population coverage of screening. Assessment centres and affiliated screening units may have catchment areas which overlap with other assessment centres and their screening units, or may have catchment areas which do not overlap, for example in rural areas.**

### 8.3.3 Treatment services

Women should be given the option of attending accredited treatment centres. Accreditation would be based on the range of expertise and facilities available. Such accreditation would not be mandatory for providers of treatment services but would provide a standard to which treatment providers should aim. This approach is recommended as a means of improving the standard of breast cancer treatment, developing expertise in the treatment of screen detected cancers and providing a network of treatment centres which can contribute cases to multi-centre clinical trials.

**Recommendation 17**

**Women with histologically or cytologically confirmed breast cancer should be given the option of referral to a treatment clinic specialising in the treatment of screen-detected breast cancer or returning to their general practitioner for referral.**

The organisational units involved in providing mammographic screening services to women and the functions performed by these units are summarised in figure 8.1.

## 8.4 National screening policy

In the implementation of a national mammography screening program several technical aspects of screening have significant implications for the effectiveness of the program and for its resource requirements. These are:

- the criteria for the selection of women for screening
- the interval between screens
- mammography and film processing equipment
- the number of mammographic views per breast
- the number and qualifications of film readers

### 8.4.1 Selection of women for screening

Possible criteria for the selection of women to be screened are the known breast cancer risk factors and age of the woman.

#### Selection on the basis of risk factors

Whether or not the identification of a high risk group is useful in a screening program depends on how well the indicators of risk used discriminate between those who will subsequently develop breast cancer and those who will not. The identification of a high risk group could be used to determine who should be screened and who need not be screened or to distinguish between those who should be offered more or less frequent screening.

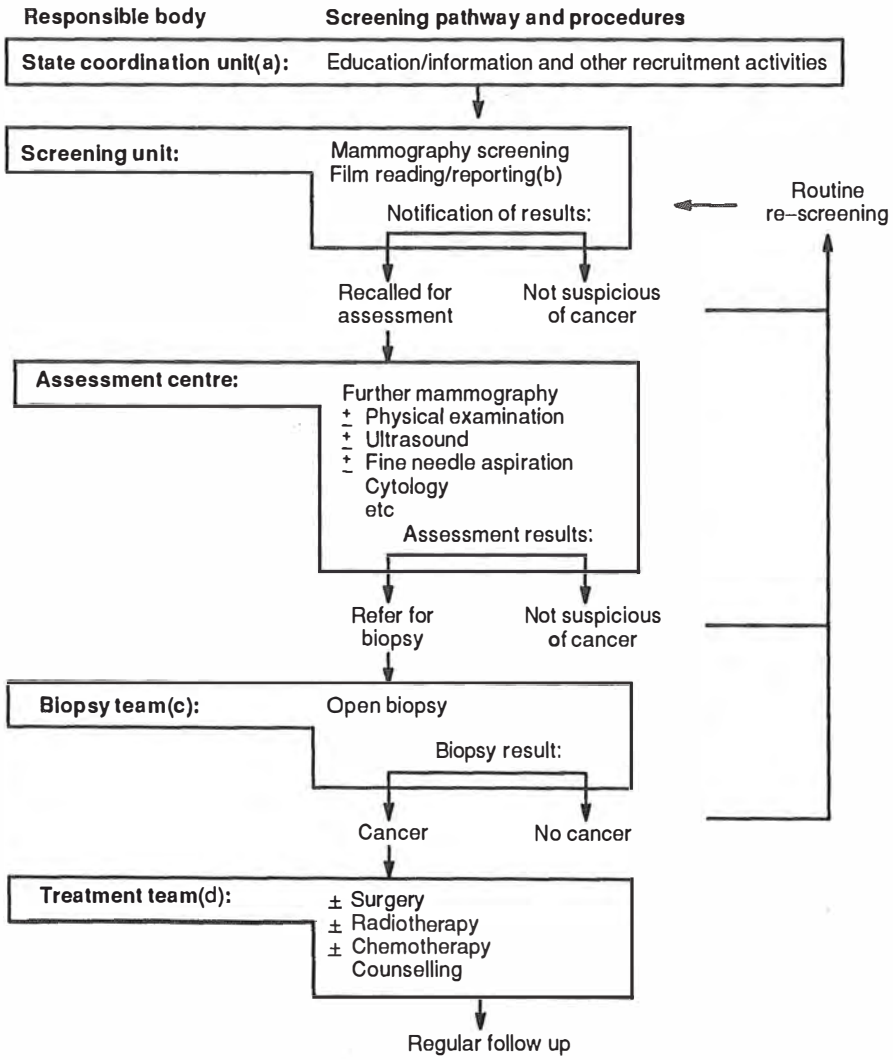
A 7-10 year follow-up study (Whitehead et al 1985) showed that a risk function based on mammographic pattern, past history of breast disease, age at first live birth, family history of breast cancer, duration of menstruation, body height and body weight did not discriminate well between those who subsequently developed breast cancer and those who did not. The two distributions overlap almost completely indicating little opportunity for selecting high risk women. Based on this work, reducing the number of women to be screened by only 13% would result in 6% of the breast cancers being missed. (Adapted from the Report to the Minister for Health for Western Australia from the Working Party on Screening Mammography, 1987). Thus, risk factors do not discriminate sufficiently between women who should and should not be screened.

#### Selection on the basis of age

Age is an important determinant of the risk of breast cancer, as shown in table 8.1. Therefore age is a potential criterion for the selection of women for screening.

The studies of mammography conducted to date have been designed to examine the effectiveness of breast cancer screening for the age ranges chosen as a whole, not effectiveness for age sub-groups. Consequently they lack the statistical power required to adequately address this issue. Nevertheless, useful indications can be gained from these studies.

**Figure 8.1: The mammography screening pathway and the organisational units responsible for each screening component**




(a) Additional functions of State coordination unit are presented in section 8.2.2
(b) Film reading/reporting may be carried out by the screening unit or the assessment centre, depending on local requirements. It is vital that the film reader receives routine feedback on the results of the assessment.
(c) The biopsy team may be an element of the assessment centre or may be part of the treatment team, depending on local requirements.
(d) The treatment team may be a specialised breast cancer unit or usual medical care.

**Table 8.1: Breast cancer incidence in Australian women by age group, 1982**

| *Age group (years)* | *Annual incidence/100,000* |
|---|---|
| 30-34 | 23.7 |
| 35-39 | 50.0 |
| 40-44 | 96.7 |
| 45-49 | 138.0 |
| 50-54 | 138.3 |
| 55-59 | 159.3 |
| 60-64 | 191.9 |
| 65-69 | 213.2 |
| 70-74 | 205.9 |
| 75-79 | 241.0 |
| 80+ | 238.2 |

Source: Giles et al (1987)

Only two studies examined women aged less that 40 years (35 years and over in the Nijmegen study and the BCDDP), suggesting a consensus on the inapplicability of mass breast cancer screening for women aged less than 40 years. This presumably relates to the comparative rarity of the disease in women under 40 years (see table 8.1).

In the HIP study, at 14 years of follow-up breast cancer mortality was reduced in all age sub-groups (table 8.2). None of the relative risks is statistically significant. However, there is no statistically significant heterogeneity among the relative risks, suggesting that the effectiveness of breast cancer screening does not vary greatly by age. The only appreciable variation with age is the interval between commencement of screening and the appearance of a difference in breast cancer mortality. In women aged 40–49 years at entry, the interval was six to eight years while in women aged 50 years and over at entry, the interval was three to five years (Shapiro et al 1988). The delayed appearance of the mortality differential in younger women can be attributed to the longer mean survival time for breast cancer in younger women.

The most recent data from the Swedish WE trial also show minimal variation with age of the breast cancer mortality reduction (table 8.3) (Tabar et al 1989). Again, there is no statistically significant heterogeneity among the relative risks for different age sub-groups. Thus, these data support the conclusions from the HIP study, in which the effectiveness of breast cancer screening was found to not vary substantially by age. The interval to appearance of the mortality differential was also greater in younger women: in women aged 40–49 years, the interval was seven years and in women aged 50–69 years, the interval was four years (Tabar and Dean 1987). The smaller mortality reduction in the 40–49 year age group is consistent with the later appearance of a mortality reduction in this group.

**Table 8.2: Mortality reduction by age at entry in the HIP Study at 14 years of follow-up**

| *Age at entry (years) (a)* | *Relative risk* | *95% CI* |
|---|---|---|
| 40-44 | 0.69 | 0.41-1.12 |
| 45-49 | 0.86 | 0.54-1.35 |
| 50-54 | 0.78 | 0.50-1.17 |
| 55-59 | 0.81 | 0.51-1.28 |
| 60-64 | 0.73 | 0.41-1.24 |
| Total | 0.78 | 0.63-0.96 |

(a) Breast cancers diagnosed within seven years of entry.
Source: Habbema et al 1986

**Table 8.3: Mortality reduction by age at entry in the Swedish Two Counties Study at eight years of follow-up**

| *Age at entry (years)* | *Relative risk* | *95% CI* | *P* |
|---|---|---|---|
| 40-49 | 0.92 | 0.52-1.60 | 0.8 |
| 50-59 | 0.60 | 0.40-0.90 | 0.01 |
| 60-69 | 0.65 | 0.44-0.95 | 0.03 |
| 70-74 | 0.77 | 0.47-1.27 | 0.3 |
| Total | 0.68 | | 0.002 |

Test of heterogeneity $x^2_3 = 2.19$, Pr [X > 2.19] = 0.53.
Source: Tabar et al 1989

In the BCDDP, breast cancer mortality was less than that expected across all age groups as well (table 8.4; Morrison et al 1988).

In the Malmo trial, data on age group are presented for women aged less than 55 years and 55 years and over at entry. All the beneficial effect observed in the period of follow-up for which data are available (nine years) is confined to women aged 55 years and over (Andersson et al 1988).

In the Florence case control study, breast cancer mortality reductions were observed in both age groups 40-49 years and 50-70 years at time of diagnosis (Palli et al 1986), although the reductions were smaller in the 40-49 years group. In the Nijmegen case control study, there was no mortality reduction among women aged 34-49 years at first invitation, but the confidence interval is very wide and it is not possible to draw conclusions (RR 1.23, 95% CI 0.31-4.81) (Verbeek et al 1985). Data on age specific mortality reductions have not been published for the UK study and no data for women under 50 years are available for the Utrecht study.

All current studies have an upper age limit for entry of women into the study (cohort studies) or age at diagnosis (case control studies). There are no data on the effectiveness of screening mammography for women entering screening at 75 years and over.

These studies may be summarised as follows: all studies suggest that mammographic screening with and without physical examination is effective in reducing breast cancer mortality for women aged 50-69 years. The HIP study strongly suggests that breast cancer screening of women aged 40-49 years can reduce breast cancer mortality, and similar or consistent results have been obtained for screening mammography in several other studies. Several studies show no effect of mammography screening for women aged 40-49 years. Due to the equivocal data, an international consensus has not yet emerged on the effectiveness of mammographic screening for women aged 40-49 years. This appears to be reflected in the age ranges adopted in national programs, as shown in table 8.5. On the basis of these data, a Nordic Cancer Union Workshop (Anonymous 1989) concluded that the benefit among women aged 40-49 years is less clear than among women aged 50 years and above, and that the screening of women aged 40-49 years should be conducted in the context of controlled trials or with continuous monitoring of the program that will permit evaluation of the results. Such monitoring is recommended in this report.

**Table 8.4: Nine year cumulative mortality from breast cancer among BCDDP participants.**

| *Age at entry (years)* | *Observed/expected* |
|---|---|
| 35-49 | 0.89 |
| 50-59 | 0.76 |
| 60-74 | 0.74 |

**Table 8.5: Screening policies of national breast cancer screening programs**

| *Country* | *Method* | *Age range (years)* | *Interval* |
|---|---|---|---|
| Finland | Mammography | 50-69 | 2y |
| Sweden | Mammography | 40-74 | 40-54y: 18 mths |
| | | | 55y: 2y |
| Netherlands | Mammography | 50-70 | 50-64y: 2y |
| | | | 65-70y: 3y |
| UK | Mammography | 50-64 | 3y |

An indication of the relative cost-effectiveness of screening different age groups is given in table 8.6. Data are presented on the assumption that mammography is equally effective at all ages and that mammography is 80% as effective in the 40-49 year and 70-79 year age groups as in the 50-69 year age group. While the average cost per life year saved of screening the 40-49 year age group is higher than screening the 50-79 year age group, it is still less than many health programs currently being funded in Australia. It should be noted, however, that the marginal cost-effectiveness of including the 40-49 year age group (ie, the difference between a 40-79 year and a 50-79 year policy) is $13,648 per life year assuming that mammography is equally effective at all ages, rising to $17,175 per life year for the differential effectiveness assumption.

In addition to these cost-effectiveness considerations, there are also important practical and ethical issues to be taken into account, including acceptability to women and the scientific community. The introduction of a mammography screening program which excluded women aged 40-49 years would undoubtedly encounter the practical difficulty that women in this age group would obtain mammography outside the screening program. Table 8.7 illustrates that the current mammography rate is high in this age group and much of this is likely to be de facto screening. Since such mammography would lack many of the features required of a national screening mammography program, it would be less effective, possibly at greater cost (the average cost-effectiveness of a de facto screening program is $17,748 per life year– refer table 6.9). Such screening would also undermine the conduct of a national screening program.

**Table 8.6: Relative cost-effectiveness of a 30 year national screening program at different age groups for a two year interval(a)**

| *Age group screened (years)* | *Net present value of costs to service providers and women(b) ($m)* | *Net present value of life years saved(b) (life years saved per annum in brackets)* | *Average cost per life saved ($)* |
|---|---|---|---|
| *Assuming that mammography is equally effective at all ages* | | | |
| 40-49 (only) | 543.2 | (2,967) 40,221 | 13,506 |
| 50-79 | 831.4 | (6,566) 89,010 | 9,340 |
| 40-79 | 1,374.6 | (9,502) 128,812 | 10,671 |
| *Assuming that mammography is 80% as effective in 40-49 year and 70-79 year age groups as in the 50-69 year age group* | | | |
| 40-49 (only) | 543.2 | (2,374) 37,063 | 14,656 |
| 50-79 | 831.4 | (6,539) 88,644 | 9,379 |
| 40-79 | 1,374.6 | (8,919) 120,271 | 11,429 |

(a) Assumes 70% participation of women aged 40-69, 15% participation for women aged 70-79 and 0% for women aged 80 years and above. Section 6.7 contains a description of other cost and outcome assumptions.

(b) 5% discount rate.

**Table 8.7: Number of two breast mammograms funded by Medicare in the second quarter of 1988 per 1,000 women**

| *Age group (years)* | *Mammograms/1,000 women* |
|---|---|
| 0–39 | 2.8 |
| 40–49 | 17.9 |
| 50–69 | 11.9 |
| 70+ | 2.8 |

Source: Commonwealth Department of Community Services and Health

While data are not available which examine whether mammography is effective for women entering screening at age 75 years and above, the risk of breast cancer does not diminish with age and the early detection of breast cancer by screening in older women may improve survival and result in less invasive treatment.

On balance, it is the committee's judgement that screening should be vigorously promoted among women aged 50–69 years, and be made available and publicised for women 40–49 years and 70 years and over, but not be vigorously promoted for these latter two age groups until additional relevant data are available.

### Recommendation 4

**A national mammography screening program should select women on the basis of age alone. There are two broad options: to make mammography available to women aged 40 years and above or to make mammography available only to women aged 50 years and above. There is an international consensus that mammographic screening is effective for women aged 50 years and above, while there is not yet a consensus in relation to women aged 40–49 years. It is the committee's view that mammographic screening should be made available and publicised for women aged 40 years and above, but that recruitment strategies should be targeted at women aged 50 years and above at this time. The recommended age range for screening should be reviewed as new data become available.**

## 8.4.2 Screening interval

Data from both the prospective trials (table 8.8) and the case-control studies, in which screening intervals ranged from one to three years (table 6.1) show no clear relationship between screening interval and reduction in breast cancer mortality. One would expect a shorter screening interval to produce a greater reduction in mortality. The increase in interval cancer rates observed in the WE trial as the screening interval increased supports this suggestion (Tabar et al 1987). The absence of such a relationship between studies is likely to be due to variations among the studies in factors such as the breast cancer incidence rate before screening, participation by women, the sensitivity of the breast cancer screening methods used, the number of screens administered to each woman and the efficacy of subsequent treatment. In addition, there may be insufficient variation in the screening intervals applied in the studies for a detectable difference in mortality to occur.

On the basis of these data alone, it is not possible to identify a preferred screening interval. A study is currently underway in the UK which will address this issue. The screening intervals chosen by the national screening programs currently in operation or being established are shown in table 8.5. A screening interval of two years would be sufficient to obtain the mortality reductions observed in the trials of screening mammography and is compatible with the screening intervals chosen in several of the national breast cancer screening programs.

**Table 8.8: Screening parameters for prospective trials of breast cancer screening**

| *Study* | *Recommended interval (monthly)* | *Regimen* | *Relative risk* | *P* |
|---|---|---|---|---|
| HIP | 12 | Mammo + clin 40-64y 4 screens | 0.71 at 10y | 0.01-0.05 |
| WE | 24<br>36 | Mammo, 40-49y<br>Mammo, 50+y Ongoing | 0.68 at 8y | 0.002 |
| UK | 12<br>24 | Clin, 45-64y<br>Clin + mammo, 45-64y 7 screens | 0.80 at 6y | 0.06 |
| Malmo | 18-24 | Mammo, 45+y 5 screens | 0.96 at 8y | > 0.05 |
| BCDDP | 12 | Clin + mammo (+ thermogr) 35-74y 5 screens | 0.80 at 9y | na |

Source: Andersson et al 1988; Shapiro et al 1982; Shapiro et al 1988; Tabar et al 1985; Tabar et al 1989; UK Trial of Early Detection of Breast Cancer Group 1988; Morrison et al 1988

An indication of the cost-effectiveness of screening at different intervals for a national screening program is given in table 8.9. Average cost per life estimates are given and marginal cost per life year estimates of moving between policies can easily be calculated from the data in the table. There is a clear difference in cost-effectiveness between two yearly and three yearly screening (or combinations thereof). However, two yearly screening is considered by the committee to be the best compromise to balance considerations of cost-effectiveness, simplicity for recruitment/education strategies, and acceptability to women and to the medical community. While further savings in life years are likely with a shorter interval (of say one year), it would be difficult to justify the increased financial cost to service providers (by an additional $85 million per year for annual screening in steady-state operation).

### Recommendation 5

**Screening should be made available as widely as possible to all eligible women in the target group with the intent of rescreening them every two years. The recommended screening interval should be reviewed as new data become available.**

**Table 8.9: Relative cost-effectiveness of screening at different intervals for women aged 40 years and above(a)**

| *Screening interval* | *Net present value of costs to service providers and women(b) ($m)* | *Net present value of life years saved(b)* | *Average cost per life saved ($)* |
|---|---|---|---|
| 1y | 2,749.2 | 188,974 | 14,548 |
| 2y | 1,374.6 | 128,812 | 10,671 |
| 3y | 916.4 | 113,628 | 8,065 |
| 40-49y: 1y 50+y: 2y | 1,917.8 | 148,427 | 12,921 |
| 40-49y: 2y 50+y: 3y | 1,097.5 | 118,956 | 9,226 |

(a) Assumes 70% participation of women aged 40-69, 15% participation for women 70-79 and 0% for women 80 years and over. Section 6.7 contains a description of other cost and outcome assumptions.
(b) 5% discount rate.

### 8.4.3 Number of mammographic views

One or two mammographic views may be taken of each breast during screening. There are conflicting reports on the relative merits of one and two views. The Swedish two-county study obtained excellent results using single view mammography. However, the use of two views at the initial screen for women 40-54 years and at subsequent screens if needed was subsequently recommended by the Swedish National Board of Health and Welfare to increase the sensitivity of mammography (National Board of Health and Welfare 1986). Some studies comparing single and two view mammography show no benefit of two views over one view, whereas others detect more breast cancers with two-view mammography, especially those smaller than 10mm (Andersson 1981).

In the Royal Women's Hospital pilot project in Brisbane, it was observed that the recall rate dropped from 11% with one view to 4% when two views were introduced. At a screening rate of 9,000 women per year, this is equivalent to 630 less women being called back for follow-up procedures. This reduction in recall rate may more than offset the cost of the additional view, and also greatly reduces anxiety among the women who no longer need to be recalled. At a weighted average cost of $200 per follow-up, the 7% fall in recall would equate to $126,000 per assessment centre per year. As all Australian pilot projects use two-view mammography, it is difficult to construct more precise cost-effectiveness data on the issue of two view versus one view. A recent meeting of clinical staff from the Australian pilot projects concluded that two views were preferable for the initial screen, with one or two views being required for subsequent screens depending on the difficulty of interpretation of the breast type.

It should be noted that all cost estimates in this report are based on two view mammography. While no data are available on the relative cost of one view versus two view mammography, it seems likely that one view mammography at subsequent screens might have substantial impact on the cost of screening by increasing the throughput of screening units and decreasing the time required to report each set of films. Further research on this issue is required.

#### Recommendation 6

**All women should be initially screened with two view mammography. At subsequent screens, one view may be used if previous mammograms indicated that two views were not required at subsequent screens. Research is required which would examine the relative cost-effectiveness of two view versus one view screening mammography.**

### 8.4.4 Film reporting

In the area of film reporting, issues with significant resource implications are the number of film readers and their qualifications. While not based on research, there is an international consensus and a majority view among Australian pilot projects that each film should be reported independently by two readers. This is thought to ensure high sensitivity of film reporting.

In the national screening programs in other countries, it is intended that all film reporting be undertaken by radiologists. Similarly, the majority of film readers in the Australian pilot projects are radiologists, although four Australian pilot projects employ non-radiologist film readers who are medical practitioners with satisfactory results. Non-radiologist film readers have also worked successfully in the UK trial and in the Utrecht (Netherlands) project. Non-radiologists have also been successfully trained to interpret mammograms in a health maintenance organisation and in hospital radiology departments in the United States (Hillman et al 1987, Alcorn et al 1971, Dowdy et al 1970). There seems to be no reason why non-radiologists cannot be trained to read mammograms, especially if they are radiographers or medical practitioners. Indeed, not all radiologists have training in

screening mammography. Radiologists need to be specially trained in screening mammography. However, at this time, the only practicable option is for at least one of the two film readers to be a qualified radiologist. The issues of number of readers per film and the role of radiologist and non-radiologist film readers in mammography screening should be the subject of further research.

### Recommendation 7

**On the balance of current opinion, all mammography films should be read independently by two readers, with the two reports being combined into a single recommendation. At least one of the readers should be a radiologist. Both readers must be specially trained in screening mammography. In the case of radiologists, this training is in addition to FRACR training.**

**Research is required which would examine whether non-radiologist film readers can be trained in screening mammography film reading to the same level of proficiency as radiologists and whether such training would be cost-effective. Research is also required into the relative merits of one and two film readers per film.**

## 8.5 Resource requirements

### 8.5.1 Coverage by current pilot projects

Current pilot projects are capable of meeting between seven and 10% of anticipated demand nationally. The coverage of pilot projects varies by State (see table 8.10).

### 8.5.2 Projected requirement for screening units and assessment centres

Table 8.11 shows the projected requirements in 1995 for screening units and assessment centres. The geographic distribution required for assessment centres and screening units would be assessed as part of the development of State-Territory plans. The projected number of screening units and assessment centres is based on assumptions about throughput for a single screening unit (6,000-9,000 women per annum) or assessment centre (3,600 per annum). It would be possible for screening units and assessment centres to have larger capacities (eg in major metropolitan centres) with concomitant reductions in numbers of units required and also with possible economies of scale.

**Table 8.10: Projected coverage by current pilot projects of 1995 population(a)**

| *State-Territory* | *Coverage (%)* |
|---|---|
| New South Wales | 5-7 |
| Victoria | 2-3 |
| Queensland | 9-15 |
| West Australia | 11-16 |
| South Australia | 19-28 |
| Tasmania | 0 |
| Australian Capital Territory | 0 |
| Northern Territory | 0 |
| Australia | 7-10 |

(a) Assuming two years screening interval, 70% participation by women aged 40-69 years, 15% participation by women aged 70-79 years, 0% participation by women aged 80 years and above and screening unit throughput of 6,000-9,000 women per year, using ABS Australian population projection series C.

**Table 8.11: Projected requirements for screening and assessment units in 1995**

| State-Territory ('000)(a) | Number of screens/ year | Current screening units | Current assessment centres | Projected screening units(b) | Projected assessment centres(b) |
|---|---|---|---|---|---|
| NSW | 366 | 3 | 3 | 41-61 | 5-9 |
| Victoria | 270 | 1 | 1 | 30-45 | 3-7 |
| Queensland | 178 | 3 | 2 | 20-30 | 2-4 |
| WA | 101 | 2 | 0 | 11-17 | 1-3 |
| SA | 90 | 3 | 1 | 10-15 | 1-2 |
| Tasmania | 28 | 0 | 0 | 3-5 | 1 |
| ACT | 16 | 0 | 0 | 2-3 | 1 |
| NT | 8 | 0 | 0 | 1 | 1 |
| Australia | 1057 | 12 | 7 | 117-176 | 13-26 |

(a) Using ABS Australian population projection series C and screening women aged 40 years of age and above every two years with the following participation rates: 40-69 years– 70%; 70-79 years– 15%; 80 years and above– 0%.

(b) From table 8.14.

State-Territory plans would also address the issue of the mix of fixed and mobile screening units. Experience both in Australia and in other countries provides only very general indicators of the relative desirability of fixed versus mobile units. Mobile units offer greater flexibility than fixed units and have an important recruitment effect by reducing time and travel costs to women. However, they also have disadvantages: Firstly, screening time is lost while a mobile unit is being relocated. This is relevant in urban areas where fixed units are a viable alternative. Secondly, staff acceptance may be lower for a mobile unit than a fixed unit. Consideration will need to be given to compensating staff for disruption, additional travelling and possibly time away from home resulting from working in a mobile unit.

Sufficient cost and outcome data from pilot projects was not available at the time of this report to adequately assess the cost-effectiveness of mobile versus fixed units. Initial data summarised in table 9.3 suggest mobile vans may be more expensive to operate than fixed site clinics on a per woman screened basis. As further cost data from other mobile vans becomes available, this issue should be further examined.

Fixed units appear to be preferred in areas of high population density, such as inner areas of major capital cities, while mobile units are preferred in areas of low population density. In the latter areas it may be difficult to keep a fixed unit fully booked. However, this preference is not universal. The Central Sydney Program operated a successful mobile unit in central Sydney where the van itself was a promotional attraction, while the St Andrews unit operated a hospital based fixed unit in Rockhampton. Thus no firm recommendation can be given in relation to fixed versus mobile units, and such decisions will need to be taken by local planners.

One approach to this problem in the context of developing a screening program would be to commence screening in urban areas with mobile units. These units would be moved between a variety of locations to test the relative acceptability to women of these locations. Fixed units could then be established at the preferred locations. The mobile units would then be used to provide screening in areas of low population density where fixed units would be much less appropriate.

### 8.5.3 Staffing requirements

The numbers of radiographers and radiologists required by a national program are shown in table 8.12.

**Table 8.12: Projected requirements for radiographers and radiologists in June 1995 for a national mammography screening program(a)(b)**

| | *Radiographers (FTEs)* | *Radiologists (FTEs)* |
|---|---|---|
| Screening(c) | 198-297 | 20 |
| Assessment(d) | 11-22 | 11-22 |
| Total | 209-319 | 31-43 |

(a) Screening women aged 40 years of age and above every two years with the following participation rates: 40-69 years– 70%; 70-79 years– 15%; 80 years and above– 0%.

(b) The screening and assessment units' full time operation will be for five days per week for 50 weeks of the year. All full time staff work a 35 hour week for 46 weeks of the year.
Full time equivalence is based on working a 40 hour week for 52 weeks of the year. Thus one FTE radiographer or radiologist under the above assumptions is equivalent to 1.292 actual radiologists or radiographers.

(c) **Screening units**
**Radiographers**
Two FTE radiographers per unit.
One radiographer can take between 12 and 18 screens per day (giving rise to a screening unit throughput of 6,000 to 9,000 screens per year).
**Radiologists**
Two radiologists read each film set.
One radiologist can read 50 film sets per hour.

(d) **Assessment centre**
Between 5% and 10% of screens are recalled to the assessment unit.
One assessment centre can conduct 16 assessments per day (giving rise to an annual throughput of 4,000).
Each assessment centre will have one fte radiologist and one fte radiographer.

## 8.6 Funding mechanisms for a national program

The following outline presents the key features of a proposed funding mechanism for a national breast cancer screening program in Australia. It draws on a consultancy report by Dr JRG Butler of the National Centre for Epidemiology and Population Health at the Australian National University prepared for the Screening Evaluation Coordination Unit.

In considering possible Commonwealth-State-Territory funding arrangements and associated payment mechanisms the committee's conclusions were based on the premise that these arrangements (along with accreditation and quality assurance) will promote the achievement of:

### Recommendation 25

- **high recruitment rates of women in the target age group;**
- **a high quality and well integrated screening and assessment service;**
- **incentives for assessment centres and their affiliated screening units to maximise the number of cancers detected, while encouraging optimal use of assessment procedures;**
- **the efficient use and distribution of available funds between all stages of the screening process (recruitment/recall, screen taking/reading, assessment, notification, counselling, training, monitoring/evaluation and coordination);**
- **adherence to the national screening guidelines;**

- **flexibility in the way individual States and Territories choose to organise the provision of screening and assessment services, including the public/private mix of services and fixed/mobile screening units, subject to meeting the national guidelines; and**
- **a funding mechanism which could be applied equally to the private or public sector and which recognises the unique capital requirements of the implementation phase.**

### 8.6.1 Commonwealth–State–Territory aspects

Constitutionally, the provision of health services is a State–Territory responsibility. However, the Commonwealth is heavily involved in the financing of both hospital and medical insurance through its hospital funding grants to the states for public hospitals, and its Medicare medical insurance system. Assuming that the Commonwealth does not wish to become involved directly in the provision of mammographic screening services, it appears to have three main options with respect to the financing of such services:

1 allow screening mammography as an item in the Medicare Benefits Schedule;

2 finance dedicated State–owned and/or private screening clinics directly, using one or a combination of a number of possible payment schemes for such clinics; and

3 provide specific purpose grants to the States–Territories, allowing the States–Territories to organise their own screening programs in accordance with their own policies.

Option one is administratively the simplest option, with implementation requiring only a minor change to the Medicare Benefits Schedule. All of the additional assessment and diagnostic procedures which may be required following a suspicious mammogram are currently covered by Medicare. This option is a form of payment based solely upon an input into the screening program (ie, a mammogram) and not upon the primary output of such a program (ie, a histologically confirmed carcinoma of the breast). Although such funding is consistent with maximising the detection rate (assuming high quality), it fails to effectively target the appropriate categories of women and has the potential to maximise cost. It also provides no economic incentive to establish some of the administrative infrastructure necessary to ensure that all potential mortality gains to be reaped from the screening program are actually attained.

Option two would involve the Commonwealth in calling for expressions of interest from State–Territory and/or private organisations interested in operating one or more breast cancer screening and assessment units. This option would ensure the development of a national screening program; it would enable the establishment of a centralised data base to monitor the performance of the program (since payment can be made conditional upon the submission of returns on each women screened); and it would ensure that Commonwealth funds committed to the program were actually expended on breast cancer screening. Its major disadvantage is that it is likely to be seen by the States–Territories as an encroachment upon their constitutional responsibility for health service provision.

Option three would be in conformity with the Commonwealth's general approach to providing funds for specific State–Territory programs. Although specific purpose grants do not, of course, give the States–Territories the same flexibility as general revenue grants, they can still allow for considerable State–Territory flexibility in the organisational and budgetary features of the programs which they are designed to support. A disadvantage of this approach is that, while conditions can be attached to such grants, they may be difficult to enforce. The breast cancer screening program may lose some of its national cohesion as a result.

Funding arrangements which seem to capture the advantages of both the second and third options without suffering from their defects are therefore proposed. Funding of mammography screening and assessment through to open biopsy and final diagnosis could occur in the following context:

- the establishment within each State and Territory of a breast cancer screening coordination unit which is responsible for making recommendations to the relevant State-Territory government on the selection of all breast cancer screening units and assessment centres within that State-Territory, as proposed in section 8.2.2;
- the breast cancer screening coordination unit in each State-Territory to be responsible for authorising payment of all assessment centres and screening units;
- joint Commonwealth-State-Territory funding of the breast cancer screening coordination unit in each State-Territory;

This system allows each State-Territory considerable flexibility in the design of its screening program (eg, with respect to the public/private mix of clinics, the combination of fixed site/mobile screening mammography units etc), subject to the minimum technical selection criteria being met. It would also put in place the elements essential to ensure national cohesion in the screening program.

### Recommendation 23

**The national mammography screening program should be jointly funded by the Commonwealth and State-Territory governments.**

### Recommendation 24

**The Commonwealth-State-Territory cost sharing arrangements should be developed in such a way that funds are dedicated to the national mammography screening program and jointly pooled, so that changes in budgetary allocations do not distort resource allocation between key components of the screening program. Involvement of the proposed State-Territory breast cancer coordinating units in the funding process is an important means of achieving this.**

### Recommendation 26

**Funding of mammography screening and assessment through to histologically or cytologically confirmed diagnosis of breast cancer should be independent of Medicare rebate fee-for-service schedules.**

## 8.6.2 The payment scheme for funding screening and assessment

In designing a payment mechanism for any health care program, it is important to focus on the primary objectives of the program to know whether particular payment mechanisms are conducive to their attainment. For a breast cancer screening program, a primary objective is the detection of breast cancer in women who presently have no symptoms. Clearly the purpose of cancer detection is to ultimately reduce breast cancer mortality and morbidity, but the attainment of this goal involves additional services to screening (ie, treatment).

Taking histologically confirmed carcinomas of the breast as the primary output of the screening and assessment centres, strict adherence to the desirable concept of paying for outputs and not inputs would dictate a payment scheme which funded the centres according to the number of cases detected. While this would undoubtedly provide a strong economic incentive for the efficient detection of cases, it also has the characteristic that the centres would carry all the financial risk of not detecting any cases, or at least detecting cases at a rate which was less than that which formed the basis of the calculation of the payment rate. While it may be appropriate not to pay

centres if cases are not detected because of incompetence, the problem is that it is possible that a centre will, by chance, screen a population of women in which the incidence of the disease is less than that which has been used in calculating the payment rate. The financial risk associated with this occurring is borne wholly by the centres if payment is based solely on the number of detected cases.

Given that the Commonwealth Government and State-Territory governments wish to encourage both consumers and producers to participate in the screening program, the prospect of service providers carrying all the financial risk may discourage a number of them from becoming involved. Also, if governments want the program to proceed, they can be expected to carry some of this financial risk themselves.

In view of these considerations, one desirable funding mechanism would have the following features:

- screening units and assessment centres would be paid using a two tier pricing structure;
- the first tier payment would be an amount per woman screened, set at a level designed to cover the cost of the initial screening mammogram;
- the second tier payment would be an amount per histologically confirmed case detected, set at a level designed to cover the cost of follow-up to various stages of various proportions of women and allowing for a predetermined malignant/benign biopsy ratio for cases taken through to open biopsy;
- for payment at the first tier to be authorised by the State-Territory breast cancer screening coordination unit, a standard form would need to be submitted by the assessment centre providing the required information about each woman who has been screened;
- for payment at the second tier to be made, a standard form for each patient followed-up would need to be submitted to the breast cancer screening coordination unit together with the pathology slides for cases claimed to be histologically confirmed (and therefore attracting the second tier payment);
- all or at least a substantial, specifically chosen, sample of pathology slides so submitted would be passed to a pathology audit panel for verification; and
- the results of the review by the pathology audit panel would be returned to the breast cancer screening coordination unit and also to the assessment centre.

This proposed payment scheme is based on the assumption that the screening units and assessment centres are responsible for all services provided as part of the screening program up to and including open biopsy. This would facilitate the development of a well integrated screening system. The units and centres would be required to organise radiologists, pathologists, surgeons and all other staff as required to carry out the relevant screening and follow-up procedures. Payment of all these personnel would be between the centre and the staff concerned. If accreditation procedures are in place for any categories of staff, centres may be restricted to selecting staff only from those who are accredited.

This payment scheme envisages assessment centres and subsidiary screening units as having dedicated funding. An assessment centre's revenue would comprise payments authorised by the breast cancer screening coordination unit under the two tier arrangement proposed above. The centre would, in turn, be required to organise and pay for the services it needs to carry out a high quality coordinated screening program.

This arrangement has many desirable features. It also has several shortcomings.

- Provision would need to be made for the comparatively high costs incurred in the set-up phase. (This also applies to fee-for-service.)
- Assessment centres and screening units would be financially vulnerable to statistical fluctuations in the cancer detection rate among women presenting for regular screening.
- A higher cancer detection rate can be expected among women presenting for their first screen. This provides unintended (but possibly desirable) incentives to screen unscreened women. However, it also makes the income from screening and assessment dependent upon the ratio of new to previous screenees.
- Since breast cancer incidence increases with age, income will be related to the age distribution of women screened. This may be influenced by the age profile of the target population and by the propensity of women of different ages to attend for screening.
- The scheme may cut across accepted practice of the medical profession and may be unacceptable on ethical grounds.
- The scheme would rely heavily on pathology in establishing the veracity of claims for payment. This may not be possible.
- The scheme may be too administratively costly to operate.

Given the ethical, technical and administrative complexity of the issues involved, it is not possible to recommend in detail a funding mechanism which meets all of the competing requirements. Nevertheless, the method of payment should have the following characteristics.

### Recommendation 27

**Payment from the national mammography screening program funds should only be made to assessment centres and screening units (whether public or private) which are accredited, which achieve satisfactory performance in relation to specified performance criteria and which provide comparable data returns to the State-Territory coordination units.**

It would be highly desirable for any funding mechanism which is a serious candidate for implementation to be pilot tested.

The question of whether some providers should be permitted to charge a fee in situations where a choice of screening services exists is a matter that requires further consideration. The charging of a fee may have the potential to substantially reduce the cost of the screening program to government. Table 7.3 in section 7.2 indicates that there are a significant number of women who report they are willing to make a payment towards the cost of screening. However, it is essential that cost of attending should not be a barrier to participation, particularly for Aboriginal women, women of low socioeconomic status, rural women and women of non-English speaking background. Free services should be available to all women who would not attend for screening if they had to pay. The extent to which user charges are employed in some parts of the national screening system could be left to the States-Territories to determine in conjunction with their positions on the public-private mix of services which they wish to obtain within their jurisdictions.

### Recommendation 28

**It is vital that cost to women should not be a barrier to their participation in the screening program. An essential component of any funding arrangement is that mammography screening be available free of charge for women in the target age group who would not attend if there was a charge.**

A significant issue in relation to the funding arrangements proposed for screening mammography is the role of the current Medicare rebate and funding for diagnostic mammography. Clearly an important role for diagnostic mammography will still exist, particularly for women outside the target age group, yet it is vital that de facto screening not continue under Medicare. This would compromise the achievement of a high quality screening service. However, this may be an issue only for the early phases of the screening program. To the extent that the program is successful, and the participation rate in screening is high, the number of symptomatic cases relative to asymptomatic cases should fall through time for the target age group. An appropriate first step, therefore, would be to monitor use of the Medicare mammography item during implementation of the national screening program and to assess to what extent it reflects diagnostic as opposed to de facto screening.

**Recommendation 29**

**Medicare funding of mammography and associated procedures should be monitored during implementation of the national mammography screening program. It would be preferable to avoid a situation where the two systems of funding mammography and associated procedures created incentives which were not conducive to achieving the goals of the screening program and the establishment and recognition of assessment centres of excellence.**

## 8.7 Implementation of a national screening mammography program

### 8.7.1 Approach to implementation

There are two broad options for the rate of implementation of a national mammography program. In the first (as in the UK), the mammography program is set up very rapidly (eg three to four years). In a context in which there are pressures for a spontaneous approach to providing screening, these pressures can be mitigated by a commitment to the rapid expansion of a national program. While it is recognised that rapid expansion is likely to produce inferior quality mammography in the first few years, it is said that when the program is in place these problems can be rectified.

The second method of expansion is for the orderly implementation of the screening program with the gradual introduction of screening facilities over seven years (as in the Netherlands).

This approach has a number of advantages:

- it allows the central accreditation, quality assurance and monitoring mechanisms to be established prior to the widespread introduction of services;
- it allows the orderly training of staff to a high degree of technical expertise prior to assuming responsibility for screening;
- it minimises peaks in expenditure on equipment and facilities in the early years;
- it allows the level of service provision to be adjusted in the light of actual demand;
- it minimises the transient increase in demand for breast cancer assessment and treatment services.

In Australia, the current pilot projects, which can be viewed as the first wave of implementation of screening services, have been in operation for between 12 months and two years. The introduction of the remainder of the services over the next five years (ie up to mid 1995) would be a highly desirable rate of implementation.

The following principles should be observed in the implementation of the program:

- central activities such as policy development, coordination, accreditation, training, monitoring, evaluation, funding and developing resources for recruiting women to screening should be implemented in the very early stages of the screening program;

- States and Territories should implement screening services according to a plan developed in conjunction with the National Breast Cancer Screening Advisory Committee and Coordination Unit; and
- in each area to be served by a breast cancer screening service, assessment centres should be established prior to the establishment of screening units so that initially each assessment centre receives women from a small number of screening units, with a subsequent increase in the number of screening units per assessment centre. This does not mean that the establishment of screening units should not commence until all assessment units are in place, only that the progressive establishment of assessment centres should precede the progressive establishment of screening units.

### 8.7.2 Timetable for introduction of a national program

In the first year, all screening coordination units and other central activities should be established. Assessment centres and screening units should be established progressively over the five year implementation period. The numbers of screening units and assessment centres which will need to become operational in each year of the program to achieve the five year implementation period are shown in table 8.13, along with the basis of calculation. Assessment centres will need to be established in advance of screening units, such that all assessment centres are operational within the first three years. This is reflected in the table. Table 8.14 shows the number of screening units and assessment centres which will be required to become operational in each State-Territory in each year. It may not be possible for some States-Territories to achieve this rate of implementation due to lesser prior experience with mammography screening, but it should be taken as a guide. It is also important to ensure that installed capacity is efficiently utilised. Thus, the rate and pattern of introduction of screening facilities should take account of levels of participation by women.

**Table 8.13: Projected requirements for screening and assessment units during expansion of program - screening women aged 40 years of age and above every two years with the following participation rates: 40-69 years—70%; 70-79 years—15%; 80 years and over—0%.**

| | *1989-90 Current* | *1990-91* | *191-92* | *192-93* | *193-94* | *194-95* |
|---|---|---|---|---|---|---|
| Projected no of women in 40-79y age group ('000)(a) | 3,073.6 | 3,152.2 | 3,230.8 | 3,309.3 | 3,387.9 | 3,466.4 |
| Projected demand for screening per year ('000) | 939.6 | 962.5 | 986.2 | 1,009.9 | 1,033.6 | 1,057.4 |
| Screening capacity over 2y interval (as % of projected demand)(b) | (c)8-(d)11 | 20 | 40 | 60 | 80 | 100 |
| Projected no of screens per year ('000) | (c)75-(d)103 | 192.5 | 394.5 | 605.9 | 826.9 | 1,057.4 |
| No of screening units required(e) | (f)[12] | 21-32 | 44-66 | 67-101 | 92-138 | 117-176 |
| No of assessment units required(g) | (h)[9] | 4-9 | 9-18 | 13-26 | 13-26 | 13-26 |

(a) The model for introduction of the screening program assumes a constant rate of expansion of screening capacity with phasing-in of assessment units prior to screening centres.
(b) Current capacity based on screening unit throughput of 9,000 screens per year.
(c) Current capacity based on screening unit throughput of 6,000 screens per year.
(d) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.
(e) Current number of screening units operating.
(f) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate. Numbers based on phasing in assessment units over three years.
(g) Current number of assessment units operating.
Source: Projections of the population of Australia, States and Territories 1987 to 2031, ABS 3222.0

**Table 8.14: Projected requirements for screening and assessment units during program expansion by State-Territory - screening women aged 40 years of age and above every two years with the following participation rates: 40-69 years—70%; 70-79 years—15%; 80 years and above—0%.**

| *Year* | *1990-91* | *1991-92* | *1992-93* | *1993-94* | *1994-95* |
|---|---|---|---|---|---|
| Projected screening capacity (% of projected demand) | 20 | 40 | 60 | 80 | 100 |
| **NSW** | | | | | |
| Screening units(a) | 7-11 | 15-23 | 23-35 | 32-48 | 41-61 |
| Assessment units(b) | 2-3 | 3-6 | 5-9 | 5-9 | 5-9 |
| **Vic** | | | | | |
| Screening units | 6-8 | 11-17 | 17-26 | 24-35 | 30-45 |
| Assessment units | 1-2 | 2-5 | 3-7 | 3-7 | 3-7 |
| **Qld** | | | | | |
| Screening units | 4-5 | 7-11 | 11-17 | 15-23 | 20-30 |
| Assessment units | 1-1 | 1-3 | 2-4 | 2-4 | 2-4 |
| **SA** | | | | | |
| Screening units | 2-3 | 4-6 | 6-9 | 8-12 | 10-15 |
| Assessment units | 1 | 1 | 1-2 | 1-2 | 1-2 |
| **WA** | | | | | |
| Screening units | 2-3 | 4-6 | 6-9 | 9-13 | 11-17 |
| Assessment units | 1 | 1-2 | 1-3 | 1-3 | 1-3 |
| **Tas(c)** | | | | | |
| Screening units | 1 | 1-2 | 2-3 | 2-4 | 3-5 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **NT(c)** | | | | | |
| Screening units | 1 | 1 | 1 | 1 | 1 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **ACT(c)** | | | | | |
| Screening units | 1 | 1 | 1-2 | 1-2 | 2-3 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **Total Australia(d)** | | | | | |
| Screening units | 21-32 | 44-66 | 67-101 | 92-138 | 117-176 |
| Assessment units | 4-9 | 9-18 | 13-26 | 13-26 | 13-26 |

(a) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.

(b) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate.

(c) Due to small numbers of eligible women in the State, screening units and assessment units may not need to operate full-time. In this case, the same unit may provide screening and assessment.

(d) Totals may not add due to rounding error and due to the requirement for at least one screening unit and one assessment unit in Tasmania, the Northern Territory and the Australian Capital Territory.

### Recommendation 20

**A national screening mammography program for Australia should be implemented in a systematic manner over the next five years up to mid 1995. Each State-Territory should implement the mammography screening program according to a specified plan. Central activities such as recruitment, coordination, policy, monitoring and quality assurance should be established in the first year of the program. All assessment centres should be established progressively in the first three years and the screening units should be established progressively over five years. Decisions on the locations of assessment centres and screening units, and the mix of mobile and fixed screening units should be made in the context of the development of State-Territory plans for mammography screening.**

## 8.7.3 Workforce requirements and availability

### Radiographers

The requirements and projected workforce for radiographers are shown in table 8.13. It is apparent that, with the assumptions used, the projected workforce of radiographers is slightly less than the maximum projected demand. Thus, it is likely that the current and projected workforce of radiographers will be adequate to meet the demands of a national screening mammography program. This latter assumption is disputed by some commentators. However, it is likely that there will be State-Territory and regional variations in the relationship between radiographer requirements and availability that may result in local shortages greater than those shown in table 8.15.

### Radiologists

The data available do not enable projections to be made for the radiologist workforce. It is equally difficult to establish the degree to which there is a shortfall of radiologists overall, rather than the shortage currently experienced in the public sector.

However, the availability of radiologists should not be a problem: the number of radiologists required by a mammography screening program (expressed as FTEs) is not large (see section 8.5.3), and radiologists currently providing mammography in the private sector could be drawn into the screening program.

**Table 8.15 Projected national radiographer workforce requirements and availability for 1990-91 to 1994-5 in full time equivalents - screening women aged 40 years of age and above every two years with the following participation rates: 40-69 years—70%; 70-79 years—15%; 80 years and above—0%.**

| | *1990-91* | *1991-92* | *1992-93* | *1993-94* | *1994-95* |
|---|---|---|---|---|---|
| Requirements (except screening program)(a) | 3,093 | 3,138 | 3,182 | 3,227 | 3,271 |
| Screening program requirements(b) | 38-58 | 78-119 | 120-183 | 163-249 | 209-319 |
| Maximum requirement including screening program | 3,151 | 3,257 | 3,365 | 3,476 | 3,590 |
| Workforce(c) | 3,161 | 3,276 | 3,391 | 3,506 | 3,621 |

(a) The projected FTE requirements for radiographers other than that for the screening program are calculated by taking the current FTE radiographer workforce and projecting its growth at the same rate as the projected growth of the Australian population (ABS Population Projection Series C). This implicitly assumes that the current radiographer workforce is sufficient to meet the requirements of the current population and that future growth in demand for radiographers (other than for mammography screening) will be due to the growth in the population.

(b) Based on assumptions used in table 8.12.

(c) The estimated size of the workforce is based on current size and current trends in enrollments in training courses.

There is a need, however, for radiologists to receive additional training in mammography and screening. Such training should be available at the pre-diploma stage for radiology registrars and available for qualified radiologists. This has been raised with the Australian Health Ministers' Advisory Council previously.

### Recommendation 21

**One radiology registrar position should be created within each mainland State. The position should be located within one of the mammography screening pilot projects and be occupied on rotation for six to 12 week periods by senior radiology registrars.**

### Conclusion

Based on available information and projected workforce requirements, at this stage there is no need for special measures to expand the workforce of radiographers and radiologists to meet the extra demands that would be imposed by a national screening mammography program commencing in 1990. Nevertheless, there is a need to train radiologists and radiographers in screening mammography, with emphasis on those who would be participating directly in the national mammography screening program. Also, close attention needs to be given to monitoring the radiographer and radiologist supply and demand.

### Recommendation 22

**In view of the comparatively small differences between the projected radiographer workforce and the projected requirements for radiographers in the context of a national mammography screening program, as well as the inadequate information available on the radiologist workforce, the national and State-Territory coordination units should monitor in an ongoing way the supply and demand for radiographers and radiologists. The coordination unit should initiate appropriate action required to ensure that sufficient radiographers and radiologists are available to adequately staff the national mammography screening program.**

## 8.7.4 Establishment of central units and screening services

The establishment of State-Territory coordination units and screening services should be the responsibility of State-Territory governments.

Central units should be established within government organisations or appropriate philanthropic institutions (eg cancer societies). It is envisaged that most current pilot projects would continue as assessment centres and affiliated screening units. There are several options for establishing new assessment centres and screening units.

- Program planners could identify the desired locations of assessment centres and screening units, and either:
  - approach potential service providers in the area to establish the services;
  - establish the services *de novo;*
  - call for submissions from potential service providers.
- Program planners could call for submissions from potential service providers and identify possible locations of assessment centres and screening units in relation to these submissions.

It is likely that several of these options will need to be used throughout the implementation period to ensure comprehensive coverage by the program.

Clearly, with mobile units there is no need to specify the precise location of screening units. Indeed, planners may wish to initially provide screening through mobile units to establish levels of demand and preferred locations prior to deciding upon the number and distribution of fixed and mobile screening units.

In rural areas, special provision may need to be made for assessment centres, eg mobile assessment teams which use diagnostic mammography equipment mounted in mobile screening vans. An important national coordination role is ensuring the dissemination of this kind of experience.

The uncontrolled proliferation of screening services by independent operators should be restrained by controlling funding and limiting accreditation. (It is noteworthy that in the Netherlands, independent mammography screening has been outlawed by legislation.)

### 8.7.5 Roles of the public and private sectors

All of the activities identified above as national and State–Territory responsibilities should be undertaken in the public or not–for–profit sector. This could be done either by departments of State, statutory authorities or, for some of the activities, philanthropic organisations such as cancer societies.

However, the assessment centres and screening units could operate in either the public or private sector. The keys to obtaining optimal performance from a screening program are training, quality assurance and monitoring, accreditation and the funding mechanisms, not whether the service is located in the public or private sector.

Since no particular benefits arise from a screening program being located wholly in the public or private sectors, there is no reason to recommend that a screening program be located wholly either in the public or private sectors. The expertise and facilities which would be required by a screening program currently reside in both the public and private sectors and it is likely that a screening program would involve both sectors. Such an approach also has the advantage that it maximises the use of currently deployed resources.

#### Recommendation 19

**Screening units and assessment centres could be established within either the public sector or private sector at the discretion of the States–Territories. Both public sector and private sector assessment centres and screening units should meet the same accreditation procedures and technical selection criteria and should be required to provide the same uniform data returns (preferably utilising the same computer software) to the State–Territory and national coordinating units as in recommendation 18.**

# 9 Cost of a national mammography screening program

Table 9.1 summarises the likely financial cost to governments (on an annualised basis) of introducing the recommended national screening program, assuming a five year implementation period. The estimates envisage coordination/evaluation costs of approximately $4 to $5 million a year on a program costing approximately $90 million a year in steady-state operation (June 1990 prices).

## 9.1 Screening and assessment costs

Table 9.2 summarises the estimated annualised costs for the major screening/assessment element of the program. The cost per screen estimates are based on cost data for the first 12–18 months of operation from the Australian pilot projects summarised in table 9.3. In accordance with overseas experience, the cost per screen estimates are projected to fall as the program passes from its early start-up stage (with high recall rates, high cancer detection rates and low utilisation rates) through to steady-state operation. The likelihood of this trend is also confirmed by the lower cost per screen results for projects V and VI (see table 9.3) where the screening facilities have been operating for three to four years. The estimate of $80 per screen in year five (June 1990 prices) is regarded as a sustainable steady-state cost per screen estimate (as it assumes an average utilisation rate of facilities of 80% and is based on current cost structures which should fall as organisational efficiencies and economies of scale are experienced).

The early data indicate that staffing costs are likely to be the major cost factor in an ongoing screening program. Careful consideration will need to be given to issues related to the most effective utilisation of key staffing resources, particularly of radiologists. Issues include the most appropriate qualifications for those managing the screening and assessment units, and the use of non-radiologist screen readers.

**Table 9.1: Projected costs(a) to governments over five years of screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years—15%; 80 years and over—0%.**

| | $m | | | | |
|---|---|---|---|---|---|
| | *1990–91* | *1991–92* | *1992–93* | *1993–94* | *1994–95* |
| National coordination and evaluation(b) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| State–Territory coordination units(b) | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Assessment/screening units(c) | 23.1 | 43.4 | 60.6 | 74.4 | 84.6 |
| Other (eg computers, training)(d) | 3.0 | 3.0 | 1.1 | 1.1 | 1.1 |
| Total | 30.7 | 51.0 | 66.3 | 80.1 | 90.3 |

(a) Costs are expressed in 1990 prices with no discounting.

(b) Preliminary estimates based on the costs associated with operating the Screening Evaluation Coordination Unit at the Australian Institute of Health and additional activities required to implement national program.

(c) See table 9.2 for derivation of these estimates.

(d) Preliminary estimates based on development in first two years of central computerised facilities in all States and Territories, with computerised facilities being progressively installed in screening units and assessment centres as they are established.

**Table 9.2: Estimated costs(a) of screening and assessment with screening of women aged 40 years and over every two years with the following participation rates:40–69 years—70%; 70–79 years—15%; 80 years and above—0%**

| | *1990–91* | *1991–92* | *1992–93* | *1993–94* | *1994–95* |
|---|---|---|---|---|---|
| Projected demand for screening(b) (in '000 of women) | 962.5 | 986.2 | 1,009.9 | 1,033.6 | 1,057.4 |
| Projected implementation of screening capacity (as a % of projected demand) | 20% | 40% | 60% | 80% | 100% |
| Projected number of screens ('000 per year) | 192.5 | 394.5 | 605.9 | 826.9 | 1,057.4 |
| Estimated cost per screen(c) | $120 | $110 | $100 | $90 | $80 |
| Projected annual cost ($ million) | $23.1 | $43.4 | $60.6 | $74.4 | $84.6 |

(a) Cost estimates are expressed in 1990 prices with no discounting.
(b) Based on the projected number of women in the 40–79 age group (taken from the Series C ABS population projections).
(c) Cost of screening includes costs of recruitment, screen taking and reading, follow-up/diagnosis, notification and counselling. Treatment cost savings (because cancers are detected earlier) training and coordination/evaluation costs at the Commonwealth–State level and costs to women are not included in this table. The cost per screen is assumed to fall from 1990–91 through to 1994–95 as the national program moves from start-up to steady-state operation. The estimates are based on the cost data from the Australian pilot projects presented in table 9.3.

**Table 9.3: Pilot project data on cost per screen disaggregated by screening pathway and expenditure category**

| | **Pilot projects** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | | V | | VI | | VIII | | X | |
| | *Mobile van* | | *Fixed clinic* | | *Fixed clinic* | | *Fixed unit* | | *Fixed unit* | |
| | $ | % | $ | % | $ | % | $ | % | $ | % |
| **Screening pathway** | | | | | | | | | | |
| Recruitment/other | 22 | 18 | 16 | 17 | 10 | 12 | 28 | 24 | 8 | 8 |
| Screen taking/reading | 63 | 53 | 54 | 57 | 47 | 55 | 63 | 54 | 50 | 51 |
| Assessment | | | | | | | | | | |
| – work-up | 25 | 21 | 14 | 15 | 22 | 25 | 10 | 8 | 25 | 26 |
| – surgical biopsy | 9 | 8 | 10 | 11 | 7 | 8 | 17 | 14 | 15 | 15 |
| **Total** | **119** | **100** | **94** | **100** | **86** | **100** | **(a)118** | **100** | **98** | **100** |
| **Expenditure category** | | | | | | | | | | |
| Staff | 80 | 67 | 67 | 71 | 58 | 67 | 70 | 59 | 65 | 66 |
| Capital | 17 | 14 | 11 | 12 | 12 | 14 | 21 | 18 | 18 | 19 |
| Consumables/admin | 11 | 9 | 12 | 13 | 12 | 14 | 13 | 11 | 13 | 13 |
| Other | 10 | 10 | 4 | 4 | 4 | 5 | 14 | 12 | 2 | 2 |
| **Total** | **119** | **100** | **94** | **100** | **86** | **100** | **(a)118** | **100** | **98** | **100** |

(a) Preliminary estimate.

It is important to note that the capital costs incorporated into tables 9.1 to 9.3 have been annualised using a 5% discount rate and assumptions as to the effective life of the various assets (eg 10 years for the mammography unit, eight years for a mobile van, 25 years for buildings, five years for x-ray reading equipment etc). If governments were to purchase all of the appropriate equipment/buildings necessary for a national program involving 13-26 assessment centres and 117-176 screening units etc, then the up-front cash requirements in years one to five would be quite different to the cost estimates presented in tables 9.1 and 9.2. This brings into question issues related to the current stock of screening assets already in the public hospitals and private clinics, the respective roles of the public and private sectors, and the method of funding the national mammography program. The annualised approach to the calculation of the program's capital cost implies that the up-front cost of capital items is reimbursed to service providers over the useful life of the asset.

## 9.2 Evaluation and coordination costs

These estimates are only provisional and may be modified after more detailed planning. $4.6 million per annum is likely to be required to fund the central support and quality assurance function, with $9.3 million required over five years for computers and training. These funds are required to ensure that the national program is implemented as intended and achieves its objectives. The significance of these functions for the program's success is outlined in sections 7.1, 8.1 and 8.2.

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# Appendix 1

## Projected resource and facility requirements for various screening policies

This appendix presents projections of the resource and facility requirements which are estimated to be required to implement and operate a national mammography screening program. The appendix comprises two sets of tables. Each set covers the following areas:

- projected requirements for screening and assessment units during expansion of the program (table 1);
- projected requirements for screening and assessment units during expansion of the program by State-Territory (table 2);
- projected requirements for radiographers and radiologists in June 1995 for a national mammography screening program (table 3);
- projected national radiographer workforce requirements and availability for 1990-91 to 1994-95 (table 4);
- projected costs to governments over five years (table 5);
- estimated costs of screening and assessment (table 6).

Each set of tables is based on one of the following sets of assumptions:

**Set 1**

Screening women aged 40 years of age and above every two years with the following participation rates:

| | |
|---|---|
| 40-69 years | 70% |
| 70-79 years | 15% |
| 80 years and above | 0% |

**Set 2**

Screening women aged 40 years of age and above every two years with the following participation rates:

| | |
|---|---|
| 40-49 years | 40% |
| 50-69 years | 70% |
| 70-79 years | 15% |
| 80 years and above | 0% |

## Set 1

**Screening women aged 40 years of age and above every two years with the following participation rates:**

| | |
|---|---|
| **40–69 years** | **70%** |
| **70–79 years** | **15%** |
| **80 years and above** | **0%** |

**Table 1:** **Projected requirements for screening and assessment units during expansion of program – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *1989-90* *Current* | *1990-91* | *1991-92* | *1992-93* | *1993-94* | *1994-95* |
|---|---|---|---|---|---|---|
| Projected no of women in 40–79y age group ('000)(a) | 3,073.6 | 3,152.2 | 3,230.8 | 3,309.3 | 3,387.9 | 3,466.4 |
| Projected demand for screening per year ('000) | 939.6 | 962.5 | 986.2 | 1,009.9 | 1,033.6 | 1,057.4 |
| Screening capacity over 2y interval (as % of projected demand)(b) | (c)8–(d)11 | 20 | 40 | 60 | 80 | 100 |
| Projected no of screens per year ('000) | (c)75–(d)103 | 192.5 | 394.5 | 605.9 | 826.9 | 1,057.4 |
| No of screening units required(e) | (f)[12] | 21–32 | 44–66 | 67–101 | 92–138 | 117–176 |
| No of assessment units required(g) | (h)[9] | 4–9 | 9–18 | 13–26 | 13–26 | 13–26 |

(a) Source; Projections of the population of Australia, States and Territories 1987 to 2031, ABS 3222.0.

(b) The model for introduction of the screening program assumes a constant rate of expansion of screening capacity with phasing-in of assessment units prior to screening centres.

(c) Current capacity based on screening unit throughput of 9,000 screens per year.

(d) Current capacity based on screening unit throughput of 6,000 screens per year.

(e) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.

(f) Current number of screening units operating.

(g) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate. Numbers based on phasing in assessment units over three years.

(h) Current number of assessment units operating.

**Table 2: Projected requirements for screening and assessment units during program expansion by State-Territory – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| *Year* | *1990–91* | *1991–92* | *1992–93* | *1993–94* | *1994–95* |
|---|---|---|---|---|---|
| Projected screening capacity (% of projected demand) | 20 | 40 | 60 | 80 | 100 |
| **NSW** | | | | | |
| Screening units(a) | 7–11 | 15–23 | 23–35 | 32–48 | 41–61 |
| Assessment units(b) | 2–3 | 3–6 | 5–9 | 5–9 | 5–9 |
| **Vic** | | | | | |
| Screening units | 6–8 | 11–17 | 17–26 | 24–35 | 30–45 |
| Assessment units | 1–2 | 2–5 | 3–7 | 3–7 | 3–7 |
| **Qld** | | | | | |
| Screening units | 4–5 | 7–11 | 11–17 | 15–23 | 20–30 |
| Assessment units | 1–1 | 1–3 | 2–4 | 2–4 | 2–4 |
| **SA** | | | | | |
| Screening units | 2–3 | 4–6 | 6–9 | 8–12 | 10–15 |
| Assessment units | 1 | 1 | 1–2 | 1–2 | 1–2 |
| **WA** | | | | | |
| Screening units | 2–3 | 4–6 | 6–9 | 9–13 | 11–17 |
| Assessment units | 1 | 1–2 | 1–3 | 1–3 | 1–3 |
| **Tas** | | | | | |
| Screening units | 1 | 1–2 | 2–3 | 2–4 | 3–5 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **NT(c)** | | | | | |
| Screening units | 1 | 1 | 1 | 1 | 1 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **ACT(c)** | | | | | |
| Screening units | 1 | 1 | 1–2 | 1–2 | 2–3 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **Total Australia(d)** | | | | | |
| Screening units | 21–32 | 44–66 | 67–101 | 92–138 | 117–176 |
| Assessment units | 4–9 | 9–18 | 13–26 | 13–26 | 13–26 |

(a) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.

(b) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate.

(c) Due to small numbers of eligible women in the State, screening units and assessment units may not need to operate full-time. In this case, the same unit may provide screening and assessment.

(d) Totals may not add due to rounding error and due to the requirement for at least one screening unit and one assessment unit in Tasmania, the Northern Territory and the Australian Capital Territory.

**Table 3: Projected requirements for radiographers and radiologists in June 1995 for a national mammography screening program(a) – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *Radiographers (FTEs)* | *Radiologists (FTEs)* |
|---|---|---|
| Screening(b) | 198-297 | 20 |
| Assessment(c) | 11-22 | 11-22 |
| Total | 209-319 | 31-43 |

(a) The screening and assessment unit's full time operation will be for five days per week for 50 weeks of the year. All full time staff work a 35 hour week for 46 weeks of the year.

Full time equivalence is based on working a 40 hour week for 52 weeks of the year. Thus one FTE radiographer or radiologist under the above assumptions is equivalent to 1.292 actual radiologists or radiographers.

**(b) Screening units**

**Radiographers**

Two FTE radiographers per unit.

One radiographer can take between 12 and 18 screens per day (giving rise to a screening unit throughput of 6,000 to 9,000 screens per year).

**Radiologists**

Two radiologists read each film set.

One radiologist can read 50 film sets per hour.

**(c) Assessment centre**

Between 5% and 10% of screens are recalled to the assessment unit.

One assessment centre can conduct 16 assessments per day (giving rise to an annual throughput of 4,000).

Each assessment centre will have 1 FTE radiologist and 1 FTE radiographer.

**Table 4: Projected national radiographer workforce requirements and availability for 1990-91 to 1994-95 in full time equivalents – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *90-91* | *91-92* | *92-93* | *93-94* | *94-95* |
|---|---|---|---|---|---|
| Requirements (except screening program)(a) | 3,093 | 3,138 | 3,182 | 3,227 | 3,271 |
| Screening program requirements(b) | 38-58 | 78-119 | 120-183 | 163-249 | 209-319 |
| Maximum requirement including screening program | 3,151 | 3,257 | 3,365 | 3,476 | 3,590 |
| Workforce(c) | 3,161 | 3,276 | 3,391 | 3,506 | 3,621 |

(a) The projected FTE requirements for radiographers other than that for the screening program are calculated by taking the current FTE radiographer workforce and projecting its growth at the same rate as the projected growth of the Aust alian population (ABS Population Projection Series C). This implicitly assumes that the current radiographer workforce is sufficient to meet the requirements of the current population and that future growth in demand for adiographers (other than for mammography screening) will be due to the growth in the population.

(b) Based on assumptions used in table 3.

(c) The estimated size of the workforce is based on current size and current trends in enrolments in training courses.

**Table 5: Projected costs(a) to governments over five years – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years— 15%; 80 years and above— 0%.**

| | $m | | | | |
|---|---|---|---|---|---|
| | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
| National coordination and evaluation(b) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| State-Territory coordination units(b) | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Assessment/screening units(c) | 23.1 | 43.4 | 60.6 | 74.4 | 84.6 |
| Other (eg computers, training)(d) | 3.0 | 3.0 | 1.1 | 1.1 | 1.1 |
| Total | 30.7 | 51.0 | 66.3 | 80.1 | 90.3 |

(a) Costs are expressed in 1990 prices with no discounting.

(b) Preliminary estimates based on the costs associated with operating the Screening Evaluation Coordination Unit at the Australian Institute of Health and additional activities required to implement national program.

(c) See table 6 for derivation of these estimates.

(d) Preliminary estimates based on development in first two years of central computerised facilities in all States and Territories, with computerised facilities being progressively installed in screening units and assessment centres as they are established.

**Table 6: Estimated costs(a) of screening and assessment – screening women aged 40 years of age and above every two years with the following participation rates: 40–69 years—70%; 70–79 years— 15%; 80 years and above— 0%.**

| | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
|---|---|---|---|---|---|
| Projected demand for screening(b) (in '000 of women) | 962.5 | 986.2 | 1,009.9 | 1,033.6 | 1,057.4 |
| Projected implementation of screening capacity (as a % of projected demand) | 20% | 40% | 60% | 80% | 100% |
| Projected number of screens ('000 per year) | 192.5 | 394.5 | 605.9 | 826.9 | 1,057.4 |
| Estimated cost per screen(c) | $120 | $110 | $100 | $90 | $80 |
| Projected annual cost ($million) | $23.1 | $43.4 | $60.6 | $74.4 | $84.6 |

(a) Cost estimates are expressed in 1990 prices with no discounting.

(b) Based on the projected number of women in the 40–79 age group (taken from the Series C ABS Population Projections).

(c) Cost of screening includes costs of recruitment, screen taking and reading, follow-up/diagnosis, notification and counselling. Treatment cost savings (because cancers are detected earlier) training costs, costs of coordination/evaluation at the Commonwealth/State level and costs to women are not included in this table. The cost per screen is assumed to fall from 1990–91 through to 1994–95 as the national program moves from start-up to steady-state operation. The estimates, while robust, are based on early cost data from the Australian pilot projects and should be regarded as preliminary.

## Set 2

**Screening women aged 40 years of age and above every two years with the following participation rates:**

| | |
|---|---|
| **40–49 years** | **40%** |
| **50–69 years** | **70%** |
| **70–79 years** | **15%** |
| **80 years and above** | **0%** |

**Table 1: Projected requirements for screening and assessment units during expansion of program – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *89-90* Current | *90-91* | *91-92* | *92-93* | *93-94* | *94-95* |
|---|---|---|---|---|---|---|
| Projected no of women in 40–79y age group ('000)(a) | 3,073.6 | 3,152.2 | 3,230.8 | 3,309.3 | 3,387.9 | 3,466.4 |
| Projected demand for screening per year ('000) | 774.8 | 790.8 | 808.9 | 827.0 | 845.1 | 863.1 |
| Screening capacity over 2y interval (as % of projected demand)(b) | (c)8–(d)11 | 20 | 40 | 60 | 80 | 100 |
| Projected no of screens per year ('000) | (c)62–(d)85.2 | 158.2 | 323.6 | 496.2 | 676.0 | 863.1 |
| No of screening units required(e) | (f)[12] | 18–26 | 36–54 | 55–83 | 75–113 | 96–144 |
| No of assessment units required(g) | (h)[9] | 4–7 | 7–14 | 11–22 | 11–22 | 11–22 |

(a) Source; Projections of the populations of Australia, States and Territories 1987 to 2031, ABS 3222.0.

(b) The model for introduction of the screening program assumes a constant rate of expansion of screening capacity with phasing-in of assessment units prior to screening centres.

(c) Current capacity based on screening unit throughput of 9,000 screens per year.

(d) Current capacity based on screening unit throughput of 6,000 screens per year.

(e) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.

(f) Current number of screening units operating.

(g) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate. Numbers based on phasing in assessment units over three years.

(h) Current number of assessment units operating.

**Table 2: Projected requirements for screening and assessment units during program expansion by State-Territory – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| *Year* | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
|---|---|---|---|---|---|
| Projected screening capacity (% of projected demand) | 20 | 40 | 60 | 80 | 100 |
| **NSW** | | | | | |
| Screening units(a) | 6–9 | 13–19 | 19–29 | 26–39 | 33–50 |
| Assessment units[b] | 1–3 | 3–5 | 4–8 | 4–8 | 4–8 |
| **Vic** | | | | | |
| Screening units | 5–7 | 9–14 | 14–21 | 19–29 | 25–37 |
| Assessment units | 1–2 | 2–4 | 3–6 | 3–6 | 3–6 |
| **Qld** | | | | | |
| Screening units | 3–4 | 6–9 | 9–14 | 13–19 | 16–24 |
| Assessment units | 1 | 1–2 | 2–4 | 2–4 | 2–4 |
| **SA** | | | | | |
| Screening units | 2 | 3–5 | 5–7 | 6–10 | 8–12 |
| Assessment units | 1 | 1 | 1–2 | 1–2 | 1–2 |
| **WA** | | | | | |
| Screening units | 2 | 3–5 | 5–8 | 7–11 | 9–14 |
| Assessment units | 1 | 1 | 1–2 | 1–2 | 1–2 |
| **Tas(c)** | | | | | |
| Screening units | 1 | 1 | 1–2 | 2–3 | 3–4 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **NT(c)** | | | | | |
| Screening units | 1 | 1 | 1 | 1 | 1 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **ACT(c)** | | | | | |
| Screening units | 1 | 1 | 1 | 1–2 | 1–2 |
| Assessment units | 1 | 1 | 1 | 1 | 1 |
| **Total Australia(d)** | | | | | |
| Screening units | 18–26 | 36–54 | 55–83 | 75–113 | 96–144 |
| Assessment units | 4–7 | 7–14 | 11–22 | 11–22 | 11–22 |

(a) An estimated range is given. The lower figure is based on a throughput of 9,000 screens per screening unit per year and the higher figure is based on a throughput of 6,000 screens per unit per year.

(b) An estimated range is given. The lower figure is based on requirements for assessment where the recall rate is 5% and the higher figure is based on a 10% recall rate.

(c) Due to small numbers of eligible women in the State, screening units and assessment units may not need to operate full-time. In this case, the same unit may provide screening and assessment.

(d) Totals may not add due to rounding error and due to the requirement for at least one screening unit and one assessment unit in Tasmania, the Northern Territory and the Australian Capital Territory.

**Table 3: Projected requirements for radiographers and radiologists in June 1995 for a national mammography screening program(a) – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *Radiographers (FTEs)* | *Radiologists (FTEs)* |
|---|---|---|
| Screening(b) | 161–242 | 17 |
| Assessment(c) | 9–18 | 9–18 |
| Total | 170–260 | 26–35 |

(a) The screening and assessment unit's full time operation will be for 5 days per week for 50 weeks of the year. All full time staff work a 35 hour week for 46 weeks of the year.

Full time equivalence is based on working a 40 hour week for 52 weeks of the year. Thus one FTE radiographer or radiologist under the above assumptions is equivalent to 1.292 actual radiologists or radiographers.

**(b) Screening units**

**Radiographers**

Two FTE radiographers per unit.

One radiographer can take between 12 and 18 screens per day (giving rise to a screening unit throughput of 6000 to 9000 screens per year).

**Radiologists**

Two radiologists read each film set.

One radiologist can read 50 film sets per hour.

**(c) Assessment centre**

Between 5% and 10% of screens are recalled to the assessment unit.

One assessment centre can conduct 16 assessments per day (giving rise to an annual throughput of 4,000).

Each assessment centre will have 1 FTE radiologist and 1 FTE radiographer.

**Table 4: Projected national radiographer workforce requirements and availability for 1990–91 to 1994–95 in full time equivalents – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
|---|---|---|---|---|---|
| Requirements (except screening program)(a) | 3,093 | 3,138 | 3,182 | 3,227 | 3,271 |
| Screening program requirements(b) | 31–48 | 64–98 | 98–150 | 134–204 | 170–260 |
| Maximum requirement including screening program | 3,141 | 3,236 | 3,332 | 3,431 | 3,531 |
| Workforce(c) | 3,161 | 3,276 | 3,391 | 3,506 | 3,621 |

(a) The projected FTE requirements for radiographers other than that for the screening program are calculated by taking the current FTE radiographer workforce and projecting its growth at the same rate as the projected growth of the Australian population (ABS Population Projection Series C). This implicitly assumes that the current radiographer workforce is sufficient to meet the requirements of the current population and that future growth in demand for radiographers (other than for mammography screening) will be due to the growth in the population.

(b) Based on assumptions used in table 3.

(c) The estimated size of the workforce is based on current size and current trends in enrolments in training courses.

**Table 5: Projected costs(a) to governments over five years – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | $m | | | | |
|---|---|---|---|---|---|
| | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
| National coordination and evaluation(b) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| State-Territory coordination units(b) | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Assessment/screening units(c) | 19.0 | 35.6 | 49.6 | 60.8 | 69.1 |
| Other (eg computers, training)(d) | 3.0 | 3.0 | 1.1 | 1.1 | 1.1 |
| Total | 26.6 | 43.2 | 55.3 | 66.5 | 74.8 |

(a) Costs are expressed in 1990 prices with no discounting.

(b) Preliminary estimates based on the costs associated with operating the Screening Evaluation Coordination Unit at the Australian Institute of Health and additional activities required to implement national program.

(c) See table 6 for derivation of these estimates.

(d) Preliminary estimates based on development in first two years of central computerised facilities in all States and Territories, with computerised facilities being progressively installed in screening units and assessment centres as they are established.

**Table 6: Estimated costs(a) of screening and assessment – screening women aged 40 years of age and above every two years with the following participation rates: 40–49 years—40%; 50–69 years—70%; 70–79 years—15%; 80 years and above—0%.**

| | *90–91* | *91–92* | *92–93* | *93–94* | *94–95* |
|---|---|---|---|---|---|
| Projected demand for screening (in '000 of women)(b) | 790.8 | 808.9 | 827.0 | 845.1 | 863.1 |
| Projected implementation of screening capacity (as a % of projected demand) | 20% | 40% | 60% | 80% | 100% |
| Projected number of screens ('000 per year) | 158.2 | 323.6 | 496.2 | 676.0 | 863.1 |
| Estimated cost per screen(c) | $120 | $110 | $100 | $90 | $80 |
| Projected annual cost ($million) | $19.0 | $35.6 | $49.6 | $60.8 | $69.1 |

(a) Cost estimates are expressed in 1990 prices with no discounting.

(b) Based on the projected number of women in the 40–79 age group (taken from the Series C, ABS Population Projections).

(c) Cost of screening includes costs of recruitment, screen taking and reading, follow-up/diagnosis, notification and counselling. Treatment cost savings (because cancers are detected earlier) training costs, costs of coordination/evaluation at the Commonwealth–State level and costs to women are not included in this table. The cost per screen is assumed to fall from 1990–91 through to 1994–95 as the national program moves from start-up to steady-state operation. The estimates, while robust, are based on early cost data from the Australian pilot projects and should be regarded as preliminary.

# Appendix 2

## Staff of the Screening Evaluation Coordination Unit, Australian Institute of Health

Michael J Fett MB BS (Hons), BMedSc (Hons), MD (Monash), MPH (Harvard), FACOM
Head of Unit — From February 1988

Robert C Carter BA (Hons)(Macq), MAS (ANU)
Economist — From February 1988

Judy Cassidy
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Alison J Free MB BS (Syd)
Epidemiologist — From November 1988

Margaret Innes
Word Processor Operator — From September 1988

Rosemary A Knight BA(Hons) (ANU), PhD (Macq), MAPS
Behavioural Scientist — From February 1988 to March 1990

Joanne Maples BSc (ANU), Grad Dip Food Tech, MSc Food Tech (UNSW)
Executive Officer — From June 1988 to February 1990

Christopher E Stevenson BSc (Melb), MSc (ANU)
Statistician — From September 1988

### Short term staff assistance

Margaret Dunn SRN, SCM, BA (Flind), Grad Dip Admin, MPA (CCAE)
Executive Officer — From March 1988 to June 1988

John R Goss BSc (ANU), Grad Dip Nutr Diet (QIT), BEc (ANU)
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Robert G Hall BScMed, MB BS, MPH (Syd), Dip Obst RACOG, FRACMA
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Library Officer — From April 1988 to August 1988

Sarah L Worthy
Word Processor Operator — From June 1988 to August 1988

### Consultants

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Economist

Terry Hunt
Computer Programmer

Bob Poole
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Labour Force Analyst

# Appendix 3

## Acknowledgements

The Screening Evaluation Coordination Unit and the pilot project evaluation were funded by grants from the Commonwealth Department of Community Services and Health.

Material on the selection of women for screening using risk factors has been adapted from the Western Australian Ministerial Report on Breast Cancer Screening. Material on the experimental methods of breast cancer screening was prepared by the Working Party on Breast Cancer Screening Technology and the. Health Technology Unit of the Australian Institute of Health. The concept of the adjusted and combined analysis of the effectiveness of the UK, WE (Two Counties) and Malmo trials was developed by Dr Paul Glaziou of the Department of Public Health, University of Sydney and by Dr David Roder and Mr Adrian Esterman of the SA Health Commission.

Thanks go to the directors and staff of all the mammography pilot projects and the associated evaluation teams, who contributed with enthusiasm and dedication to the national evaluation of mammography screening. The names of all pilot projects and their directors are given in appendix 4.

# Appendix 4

## Breast cancer screening pilot projects

### New South Wales

1 Central Sydney Breast X-Ray Program
Director: Dr Mary Rickard

2 Hunter Breast Cancer Screening Project
Director: Professor John Forbes

3 Breast Health, Sydney
Director: Dr Michael Legg (until May 1990)
Director: Dr Joan Croll

### Victoria

4 Breast X-Ray Program, Essendon
Director: Mr Ian Russell FRACS

### Queensland

5 Breast Screening Clinic, The Royal Women's Hospital, Brisbane
Director: Dr Christine Baker

6 The Wesley Breast Clinic, Brisbane
Director: Dr Cherrell Hirst

7 St Andrew's Hospital Mammography Unit, Rockhampton
Director: Mr Alan Jackson

### Western Australia

8 Cannington Mammography Unit, Perth
Director: Ms Diane Moore

9 South West Mobile Mammography Unit
Director: Ms Diane Moore

### South Australia

10 SA Breast X-Ray Service
Director: Dr Margaret Dorsch

11 Quality Assurance and Dosimetric Program, SA Breast X-Ray Service
Director: Dr Giovanni Bibbo


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