# Economic cost of lack of indexation for nuclear medicine

Final report to the Australasian Association of Nuclear Medicine Specialists

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# Executive Summary

## Nuclear medicine is a specialist diagnostic and treatment modality

Nuclear medicine is a highly specialised field and is essential to precisely identify, characterise and treat a range of diseases and medical conditions allowing patients to be managed swiftly and efficiently. Early and precise diagnosis leads to improved patient health outcomes for a range of conditions, including cancer, heart conditions and neurological conditions such as epilepsy and neurodegenerative disorders (e.g. dementia). Nuclear medicine also plays a key role in the treatment of a range of cancers and other chronic health conditions. While the cost of these services can be significant, promoting efficient and unfettered access to early diagnosis and treatment pathways ultimately reduces healthcare costs, particularly where it enables treatment prior to diseases progressing or prevents futile therapies being employed. Savings to the universal healthcare system are expected to materialise in three ways:

- access to appropriate diagnostic testing will avoid the risk of multiple (in some cases duplicative or closely substitutable) tests and/or treatments being performed;
- using the right diagnostic testing will avoid a patient being subject to unnecessary treatments; and
- more effective treatment early in the disease course will prevent later costs from recurrent or more severe disease, and may also keep the patient in the workforce and out of care longer.

Nuclear medicine is the least commonly utilised imaging modality with a total of 746,800 nuclear medicine imaging procedures being undertaken in Australia in 2019-20. Numbers of most procedures have plateaued over this period, with the exception of positron emission tomography (PET) related services, which have seen strong growth. Yet, having regard to the growth in the key cost components for nuclear medicine services over the past 22 years and absence of indexation of the relevant MBS items, nuclear medicine is one of the most under-funded diagnostic imaging modalities on the Medicare Benefits Schedule (MBS), exacerbated by the ongoing and indefinite indexation freeze on inflation adjustments to the MBS schedule of fees – a policy stance that has been in place now for over twenty years despite the Government re-instating indexation arrangements for most of the other imaging modalities.

While the Government clearly operates under significant fiscal constraints in the current economic environment, the lack of adequate support for nuclear medicine has already produced a range of negative consequences for patients in terms of access to optimal healthcare and management and to the health industry. For example, funding vagaries can lead to other better remunerated tests being preferred over the more clinically relevant but poorly reimbursed studies.

An analysis of the key cost drivers of providing nuclear medicine services indicates that the cost of service provision has increased significantly over the past 22 years. The cost of radiopharmaceuticals and labour in particular have exhibited strong growth.

A survey of AANMS members conducted by Synergies (64 respondents) for the purpose of preparing this report provides evidence that, in response to escalating costs of nuclear medicine imaging services, service providers have responded by passing some of those costs onto patients, and to the extent that this does not occur, simply absorbed the growing difference between the cost of the service and the Medicare benefit. While cost absorption may seem palatable to funders, it can lead to negative outcomes – whereby if nuclear medicine becomes a non-financially viable modality, its availability will become restricted and investment in upgraded equipment delayed, thus denying patients the benefit of best diagnostic imaging/therapeutic practice and technological improvement.

In some cases, the range of services has been narrowed and some procedures are no longer offered, with survey evidence also indicating that some imaging sites have been closed altogether. Escalating costs have also been cited by AANMS members as a cause of reduced uptake of and investment in new technologies and professional development, which is critical for optimising the capacity for nuclear medicine practitioners to deliver to patients best practice diagnostic and treatment procedures with the lowest radiation burden.

Without any abatement of rising costs, such trends are likely to continue and ultimately lead to suboptimal patient management (i.e. inferior diagnostic tests and/or inferior treatment) and poor patient health outcomes. This, in turn, not only 'kicks the can down the road' but ultimately causes an even greater erosion of the funding base with a much larger drain on public health resources for treatment of more advanced, chronic illnesses, with less efficient options.

The scope of our investigation has been limited to the indexation arrangements of those diagnostic tests that are currently on the MBS. It is beyond the scope of our remit to assess whether or not additional tests should be included on the MBS.

### The policy problem is a lack of indexation of MBS fees

Medicare is designed to provide affordable and universal access to primary healthcare services for all Australians. It is also designed to provide best practice health services and value for the individual patient as well as for the health system.

The concept of subsidised health professional services listed on the MBS recognises the role that Government plays in doing much of the 'heavy lifting' in the funding of critical care services. It is also designed to recognise the role that the industry and patients must also play in supporting a long term, sustainable healthcare system.

The lack of indexation of MBS fees for nuclear medicine services since 1998 means that the MBS is no longer fulfilling one of its core objectives of helping to meet part of the increased costs associated with the supply of nuclear medicine imaging services. After more than 20 years, indexation to cover the inflationary component of increased healthcare costs associated with salaries and wages, practice, and procedural costs is necessary to achieve the objectives of the MBS.

The current policy freeze on indexation for nuclear medicine services means the burden of cost inflation for these set of services has been shifted onto patients and providers, a situation that continues to worsen with time, with would ultimately lead cessation of this necessary component of medical care for the Australians.

The Federal Government has moved to restore indexation for MBS fees for most other diagnostic imaging modalities. In restoring indexation to other modalities, the Government has acknowledged that patients will benefit through reduced out-of-pocket costs.[1] There is no compelling reason for such benefits to not be extended to patients accessing nuclear medicine imaging services and the current status is detrimental to best practice standards in nuclear medicine.

### Policy consequences of insufficient remuneration in nuclear medicine services

To date, most nuclear medicine practitioners have been able to maintain commercial viability in the face of continued cost pressures by either absorbing cost increases or passing them onto patients as raised out-of-pocket (OOP) expenses. However, this has become increasingly difficult as the gap between the MBS items and the full cost of service provision continues to widen. In the absence of indexation being applied to the relevant MBS items, practitioners will cease to provide nuclear medicine services or at least reduce the scope of their service offering, limiting the availability to patients who require access to these services. As evidenced in the responses to the survey of AANMS members administered by Synergies, this winding back of services has already begun.

1 See Australian Government (2019), Medicare indexation of diagnostic imaging services factsheet, 27 March 2019. A copy is available at http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/Factsheet-Indexation%20DI

We present two 'real-world' case study examples where the reduced availability and provision of nuclear medicine procedures results in adverse consequences for patients and for the larger healthcare system.

### *Case study 1: Iodine therapy for thyroid cancer*

Thyroid cancer was the ninth most diagnosed cancer in Australia in 2016. It is estimated that 3,785 new cases of thyroid cancer were diagnosed in Australia in 2020, which is a 27% increase on the 2,973 new cases diagnosed in 2016.[2]

Typical treatment begins with surgical resection when the patient presents with presumed localised disease in the thyroid. Depending on the pathology, most will progress to adjuvant radioiodine therapy. Radioactive iodine (RAI) treatment is an important treatment modality for most thyroid cancers as iodine is taken up through iodine receptors on the thyroid cells. RAI treatment typically involves administration of RAI in combination with a diagnostic RAI scan to demonstrate iodine uptake in the tumour and the presence of any cancer spread, which would dictate the dosage for the RAI treatment. If the tumour demonstrates no iodine avidity, then chemotherapy or external beam radiotherapy may be appropriate as an alternate therapy, which has much greater side effects.

RAI treatment following the surgical removal of thyroid cancer enables the eradication of any residual normal thyroid tissue (also known as remnant ablation) thus allowing a thyroid produced protein, thyroglobulin, to be used as a tumour marker as there should be very low or absent thyroglobulin once all thyroid tissue has been resected/ablated. In higher risk patients, microscopic thyroid cancer cells may be present following surgical removal of the thyroid gland and these cells can be destroyed by the RAI treatment, reducing the incidence of cancer recurrence.

If RAI treatment is not available to be used post-surgery in higher risk patients, there will be a greater risk of recurrence in some patients. In addition, thyroglobulin use as a tumour marker will become less reliable, as residual thyroid tissue will continue to produce thyroglobulin. If subsequent RAI scanning is not available, patients will require sequential thyroglobulin assessment, leading to further imaging tests such as a CT, PET, MRI or bone scans if thyroglobulin levels are rising, or if there are other reasons to suspect metastatic disease, such as pain. These tests are far inferior to RAI scans in terms of sensitivity and specificity. Due to the lower sensitivity of other tests for recurrence, treatment may be delayed significantly. Due to lower test specificity, there can be further delays before treatment can be initiated while recurrence is confirmed by pathology or treatments may be used inappropriately.

The fundamental benefit of RAI treatment is its effectiveness and efficiency. Compared to alternative treatment pathways for thyroid cancer, RAI treatment is superior both in terms of delivering timely and effective treatment targeted to thyroid cells only, which optimises patient health outcomes, as well as the overall efficiency in treating thyroid cancer patients with relatively short and simple therapy with minimal side effects. RAI treatment has a very low side effect profile without loss of hair, skin changes or potentially significant complications such as infections and other life-threatening conditions resulting from chemotherapy or external beam radiotherapy.

However, despite the significant benefits of RAI therapy to patient health outcomes and the efficacy of the current healthcare system, the MBS items related to the provision of RAI imaging and therapy to treat thyroid cancer are not indexed.

2 Australian Institute of Health and Welfare (2020). Cancer data in Australia. Web Report, 13 November 2020. See: https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/contents/cancer-summary-data-visualisation

The continued lack of indexation of these MBS items will result in further increases in out-of-pocket expenses and an increasing number of practitioners limiting patient numbers or no longer being able to viably provide this treatment. This will in turn result in either delays to treatment or thyroid cancer patients being diverted to alternative diagnostic and treatment pathways, leading to prolonged therapy periods with suboptimal therapeutic protocols associated with worse side effect profiles and additional costs to the healthcare system.

### *Case study 2: Ventilation perfusion (V/Q) lung scans for diagnosing pulmonary embolism (PE)*

Pulmonary embolism (PE) is a blockage in the pulmonary arteries which supply blood to the lungs, caused by one or more blood clots. Australia experiences approximately 17,000 new cases of venous thromboembolism annually, with PE accounting for 40% of cases (6,800 cases).[3] Untreated PE have a mortality rate of as high as 30%. When diagnosed appropriately, this can be reduced substantially (to about 8% or less). Hence appropriate diagnosis and treatment can reduce mortality by 73%.

Typically, to determine if a patient has PE, they will first undergo a clinical risk assessment to determine low, intermediate, or high pre-test probability (PTP). If high PTP, the patient will receive an immediate referral for treatment or imaging. If low or intermediate PTP, the patient will have a blood test (D-dimer test), which will guide if imaging is required, i.e. if the D-dimer is elevated.

As treatment of PE can be associated with potentially significant side effects, a definitive diagnosis is required using diagnostic imaging prior to starting therapy. The most common imaging modalities are computed tomography pulmonary angiography (CTPA), which uses intravenous iodinated contrast, and ventilation-perfusion scan (V/Q scan), which is a nuclear medicine scan. Other imaging modalities include ultrasound of the legs for detection of distant venous blood clots, MRI, or pulmonary angiogram.

CTPA is preferred in patients with underlying lung disease. V/Q scanning is preferred in younger patients, pregnant patients, those with kidney diseases or iodine contrast allergies, and in a small number of more specific conditions. In patients with suspected PE who are either pregnant or young, V/Q scan is preferred as it gives much lower radiation exposure than CTPA - in particular to radiosensitive breast tissue. Furthermore, V/Q scanning is a more reliable test in pregnancy than CTPA due to changes in blood flow associated with pregnancy. A V/Q study does not require contrast and can be performed in patients with contrast allergies or impaired renal function who cannot undergo a CTPA scan.

V/Q scans may be the preferred follow up test due to the lower radiation burden and quantification.

Overall V/Q has several advantages over CTPA, however it is not as readily available as CTPA. CTPA is usually available on a 24-hour basis. At many centres, whilst V/Q scans are available in routine working hours, availability after hours is on an 'on call' basis, and therefore less timely. In addition, the availability of V/Q scans is also contingent on the radiotracer (using $^{99m}$Tc- MAA) being available. Hence, ease of access will often dictate the choice of modality.

These case studies demonstrate the important role that nuclear medicine plays as an early diagnostic and treatment tool. However, without a more sustainable remuneration model, the benefits to patients from these procedures and improved health outcomes are at risk of being lost and the long-term costs borne by the healthcare system will continue to grow.

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3 Doherty, S. (2017). Pulmonary embolism: An update. *Australian Family Physician*, 46 (11), p 816-820.

### The Federal Government should restore indexation of nuclear medical services

In order to ensuring that the underlying cost structure of providing nuclear medicine imaging services is not further eroded, indexation of MBS fees for nuclear medicine services should be restored as part of the 2021-22 Budget, to bring it in line with other imaging modalities which have been indexed on prior budget cycles.

If the current freeze on the indexation of MBS items for nuclear medicine services continues, the capacity for practitioners to absorb future cost increases will continue to decline, leading to further reductions in the availability of nuclear medicine services or increased costs to patients. The adverse consequences of this are:

- adverse impacts from reduced accuracy of diagnostic tests and treatments (e.g. incorrect or delayed diagnosis) for a range of cancers and other chronic diseases due to the use of suboptimal alternative diagnostic tests;
- increased stress on the public health system as a result of the reduced availability of nuclear medicine services throughout the healthcare sector;
- increased costs due to the inefficient duplication of diagnostic tests;
- adverse patient consequences due to the provision of unnecessary or sub-optimal treatment as a result of less precise diagnoses;
- loss of treatment options for patients with specific requirements;
- increased costs or loss of access to the most appropriate imaging modalities for patient in remote and rural areas; and
- longer term impacts in relation to a shortage of nuclear medicine skills and capabilities, further constraining the availability of critical tests and treatments.

There is scope for additional analysis to be conducted to quantify the magnitude of the above impacts, both in terms of the adverse consequences for patient health and the healthcare system as a whole. This could be investigated as part of the future process of implementing indexation for MBS items applicable to nuclear medicine services.

The indexation of MBS items relating to nuclear medicine services would lead to mitigation of these adverse consequences, protecting the economic benefits derived from the provision of nuclear medicine services to patients and the healthcare system.

# Contents

**Executive Summary** **3**

**1 Introduction** **12**

**2 Background and context** **13**

2.1 Nuclear medicine as a diagnostic imaging tool 13

2.2 Utilisation rates in nuclear medicine imaging services 17

2.3 Remuneration of nuclear medicine costs 20

**3 Increasing costs of nuclear medicine** **24**

3.1 Cost increases across nuclear medicine procedures 24

3.2 Cost drivers 26

3.3 Trends in key cost components 29

3.4 Summary and implications 35

**4 Impact of insufficient remuneration** **36**

4.1 Key benefits of nuclear medicine services 36

4.2 Case studies 40

4.3 Implications of insufficient remuneration of nuclear medicine services 52

4.4 Longer term consequences 57

**5 Conclusion** **59**

# Figures and Tables

Figure 1 Proportion of diagnostic imaging services (2019-20) 14

Figure 2 Increase in nuclear medicine imaging services from 2009-10 to 2019-20 17

Figure 3 Increase in nuclear medicine imaging services (PET vs non-PET services) from 2009-10 to 2019-20 18

Figure 4 Increase in nuclear medicine imaging services by state (2009-10 and 2019-20) 18

Figure 5 Annual increase in the number of people by age group 20

Figure 6 Increase in costs of providing nuclear medicine procedures – survey responses (%) 26

Figure 7 Breakdown of diagnostic imaging costs for 2020 (% of industry revenues) 30

Figure 8 Changes in labour cost component – survey responses (%) 31

Figure 9 Increased costs in capital/technologies – survey responses (%) 32

Figure 10 Increased costs in chemical/pharmaceutical products – survey responses (%) 34

Figure 11 Nuclear medicine scan vs CT scan 37

Figure 12 Diagnostic and treatment pathways for papillary and follicular thyroid cancer 42

Figure 13 Diagnostic and treatment pathways for treatment of PE 47

Figure 14 Responses to cost increases by nuclear medicine practitioners 56

Table 1 Diagnostic imaging services – Volumes and MBS revenues 2019-20 21

Table 2 Re-indexation of MBS schedule fees for diagnostic imaging services 22

Table 3 Molecular imaging equipment used to deliver nuclear imaging services 27

Table 4 Radiopharmaceutical prices (illustrative example) and MBS fees 33

Table 5 Early detection and survival rates by cancer type 38

# List of Acronyms

| Acronym | Definition |
|---|---|
| AANMS | Australasian Association of Nuclear Medicine Specialists |
| CT | Computed tomography |
| CTPA | Computed tomography pulmonary angiography |
| DTC | Differentiated thyroid cancer |
| MBS | Medical Benefits Schedule |
| MRI | Magnetic resonance imaging |
| OOP | Out-of-pocket |
| PET | Positron emission tomography |
| PTP | Pre-test probability |
| RAI | Radioactive iodine |
| SPECT | Single photon emission computed tomography |
| V/Q | Ventilation Perfusion (scan) |

# 1 Introduction

Nuclear medicine is a specialist field of diagnostic imaging and therapy that provides unique pathways for diagnosis and treatment. It allows for accurate diagnosis, treatment and assessment of many acute and chronic health conditions. While the Australian Government provides patient rebates for a range of diagnostic imaging services through the Medicare Benefits Schedule (MBS), in the case of nuclear medicine, routine annual indexation of imaging schedule fees has not been applied since 1998. As such, rebates for these specialist services have remained frozen for the last 22 years, despite the costs of providing these services increasing.

Synergies Economic Consulting (Synergies) has been engaged by the Australasian Association of Nuclear Medicine Specialists (AANMS) to prepare a report that assesses:

- the extent to which the costs of providing nuclear medicine has increased since 1998, based on an analysis of key cost drivers; and
- the adverse economic consequences of the failure to apply annual indexation for nuclear medicine procedures.

This report is based on an extensive desktop review of existing literature, studies and government reports on the supply and cost of nuclear medicine imaging services in Australia. An online survey has also been administered to AANMS members to seek practitioners' views on the magnitude of, and underlying causes of, cost increases in the supply of nuclear medicine services across Australia over the past decade and the impact on industry and patient outcomes. A total of 64 survey responses were received.

The rest of this report is structured as follows:

- section 2 provides relevant background information on the use of nuclear medicine as a diagnostic imaging tool;
- section 3 assesses the scope and drivers of increased costs in nuclear medicine procedures since 1998;
- section 4 examines the consequences of the lack of indexation of MBS items for nuclear medicine imaging services, including two case studies; and
- section 5 concludes the report.

# 2 Background and context

This section provides an overview of nuclear medicine tests and procedures used in the diagnosis and treatment of acute and chronic diseases and of the current remuneration arrangements for nuclear medicine.

## 2.1 Nuclear medicine as a diagnostic imaging tool

### 2.1.1 Diagnostic imaging

Diagnostic imaging is a vital service in Australia's health system. It is a key clinical tool in assessing, diagnosing, and treating chronic disease early and effectively.[4] The Australian Government has previously acknowledged the important role that diagnostic imaging plays in the health of Australian patients. The Commonwealth's Department of Health website indicates that the Government is taking action via Medicare to 'help reduce the cost of diagnostic imaging services so more people can afford them'.[5]

There are various diagnostic imaging modalities and techniques used by clinical professionals, including:

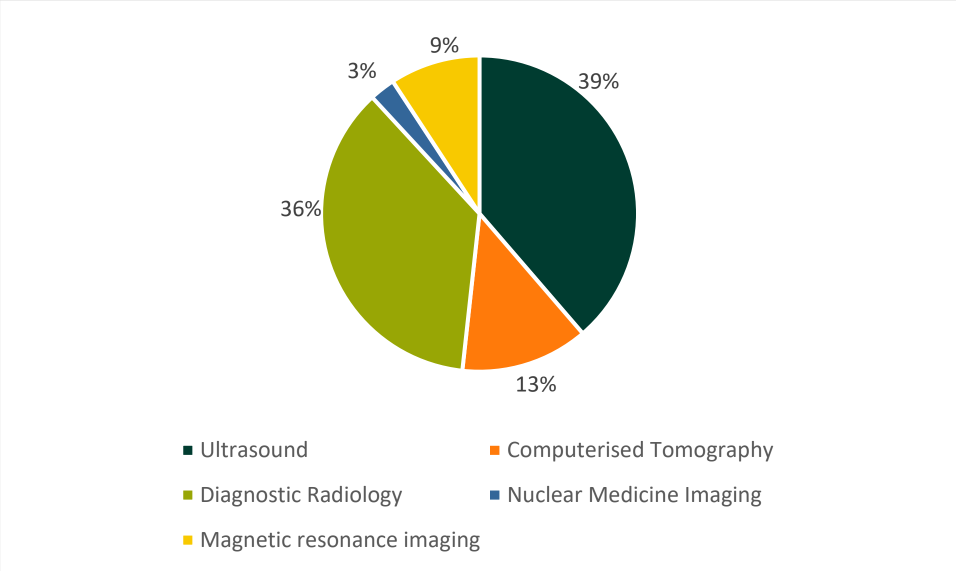
- ultrasound
- computed tomography (CT)
- diagnostic radiology (such as x-ray and mammography)
- magnetic resonance imaging (MRI)
- nuclear medicine imaging, including positron emission tomography (PET).

Figure 1 shows the relative proportion of each diagnostic imaging modality.

[4] Australian Medical Association (2017), Submission to the Community Affairs Reference Committee Inquiry into the availability and accessibility of diagnostic imaging equipment around Australia, October 2017, p.1

[5] See the Australian Government's Department of Health website at https://www.health.gov.au/health-topics/diagnostic-imaging-scans-and-x-rays

**Figure 1 Proportion of diagnostic imaging services (2019-20)**




**Data source:** Medicare Statistics.

### 2.1.2 Nuclear medicine imaging

Nuclear medicine is a specialist field of diagnostic imaging. As shown in Figure 1, nuclear medicine imaging is the least common modality of the diagnostic imaging services in Australia. Nuclear medicine imaging involves the administration of a small amount of a radioactive substance (radiopharmaceutical) into the patient. The injection of a radioactive material enables functional information about the body to be captured (i.e. cells are doing something in one place that is not happening elsewhere) in contrast to other diagnostic imaging modalities (such as x-rays). There is also the ability to fuse images relating to organ/tumour function with other tests (typically CT or MRI) that demonstrate anatomy allowing for merged images demonstrating both what is happening and exactly where it is happening.

The use of nuclear medicine imaging is a critical tool within the diagnostic field for optimising patient treatment and health outcomes. Medical research indicates that nuclear imaging enables a more accurate, targeted initial diagnosis and thus a more effective assessment of many medical conditions.[6] This, in turn, informs treatment pathways that optimise patient health outcomes and minimise the costs incurred by the healthcare system. It is a small but vital component of the imaging armamentarium.

6 The Senate (2018), Community Affairs Reference Committee – Availability and accessibility of diagnostic imaging equipment around Australia, March 2018, p.1.

While nuclear medicine is primarily used for imaging purposes, it can also be used to treat some diseases and conditions. When nuclear medicine is used for treatment purposes, the dose of the radiopharmaceuticals is higher and is targeted directly to the disease being treated.[7] Common nuclear medicine diagnostic and therapeutic applications are shown in the box below.

**Box 1 Common uses of nuclear medicine**

**Heart**
- Detect coronary artery disease and the extent of coronary stenosis
- Assess damage to the heart following a heart attack (viability)
- Evaluate treatment options such as bypass heart surgery and angioplasty
- Evaluate the results of revascularization (blood flow restoration) procedures
- Detect heart transplant rejection
- Evaluate heart function before and after chemotherapy (MUGA)
- Evaluate heart for infiltrative diseases such as sarcoidosis or amyloidosis

**Lungs**
- Scan lungs for respiratory and blood flow problems (V/Q scans)
- Assess differential lung function for lung reduction or transplant surgery
- Detect lung transplant rejection

**Bones**
- Evaluate bones for fractures, infection, and active arthritis
- Evaluate for metastatic bone disease
- Evaluate painful prosthetic joints
- Evaluate primary bone tumours
- Identify sites for biopsy

**Brain**
- Investigate abnormalities in the brain in patients with certain symptoms or disorders, such as strokes, memory loss and suspected abnormalities in blood flow
- Detect the early onset of neurodegenerative disorders such as Alzheimer's disease
- Assist in surgical planning and identify the areas of the brain that may be causing seizures
- Evaluate for abnormalities in brain chemicals involved in controlling movement in patients with suspected Parkinson's disease or related movement disorders
- Evaluation for suspected brain tumour recurrence, surgical or radiation planning or localization for biopsy

**Other Systems (Some examples)**
- Identify inflammation or abnormal function of the gallbladder
- Identify bleeding into the bowel
- Identify transit times in the stomach, small and large intestines
- Assess post-operative complications of gallbladder surgery
- Evaluate lymphedema
- Evaluate fever of unknown origin
- Locate the presence of infection
- Measure thyroid function to detect an overactive or underactive thyroid
- Diagnosis of blood cell disorders
- Evaluate for hyperparathyroidism (overactive parathyroid gland)
- Evaluate spinal fluid flow and potential spinal fluid leaks

[7] Diagnostic Imaging Clinical Committee (2018), Report – Nuclear Medicine, p.33.

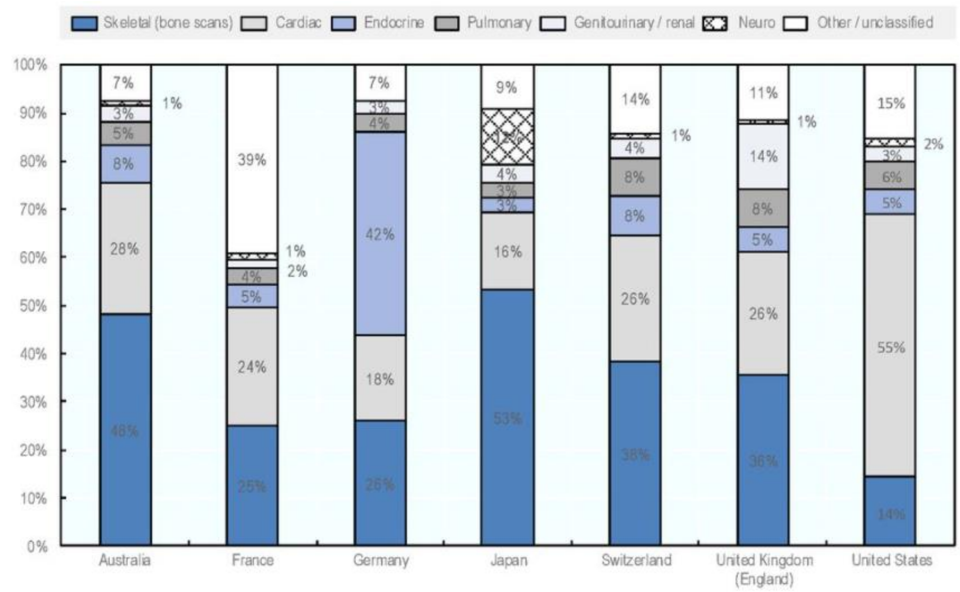
| |
|---|
| **Cancer** |
| • Stage cancer by determining the presence or spread of cancer in various parts of the body |
| • Localise sentinel lymph nodes before surgery in patients with breast cancer or skin and soft tissue tumours |
| • Plan modality type and duration of treatment |
| • Evaluate response to therapy |
| • Detect the recurrence of cancer |
| • Detect functioning rare tumours (e.g., neuroendocrine tumours) |
| **Paediatrics** |
| • Assess for congenital liver and bile duct abnormalities |
| • Assess for causes of congenital hypothyroidism in neonates |
| • Assess for congenital or post-infective kidney abnormalities |
| • Assess and localise bone infection, trauma or other cause of sudden difficulties in walking |
| • Assess for non-accidental injuries |
| • Assess for intractable epilepsy and congenital cerebral blood vessel abnormalities |
| • Diagnose, monitor and treat a range of childhood tumours eg neuroblastoma. lymphoma and sarcoma |
| **Nuclear Medicine Therapies** |
| • Radioactive iodine (I-131) therapy used to treat hyperthyroidism (overactive thyroid gland, for example, Graves' disease) and thyroid cancer |
| • Radioactive antibodies used to treat certain forms of lymphoma (cancer of the lymphatic system) |
| • Radioactive phosphorus (P-32) used to treat certain blood disorders |
| • Radioactive materials used to treat painful tumour metastases to the bones |
| • I-131 MIBG (radioactive iodine labelled with metaiodobenzylguanidine) used to treat adrenal gland tumours in adults and adrenal gland/nerve tissue tumours in children. |
| • Lu-177 DOTATATE to treat functioning neuroendocrine tumours |
| • Lu-177 PSMA to treat metastatic prostate cancer |
| • Yttrium-90 based therapies for liver cancers and several chronic arthritic conditions |

**Source:** RadiologyInfo.org.

A 2019 OECD report[8] examined the proportion of nuclear medicine scans by organ system for Australia as well as other OECD countries. Bone and cardiac/heart scans are the most common types of scans in Australia and across most OECD countries (see the figure below).

8 OECD (2019), The supply of Medical Isotopes: An Economic Diagnosis and Possible Solutions, p. 46 A copy is available at https://read.oecd-ilibrary.org/social-issues-migration-health/the-supply-of-medical-isotopes_9b326195-en#page4

Figure 2   Increase in nuclear medicine imaging services from 2009-10 to 2019-20



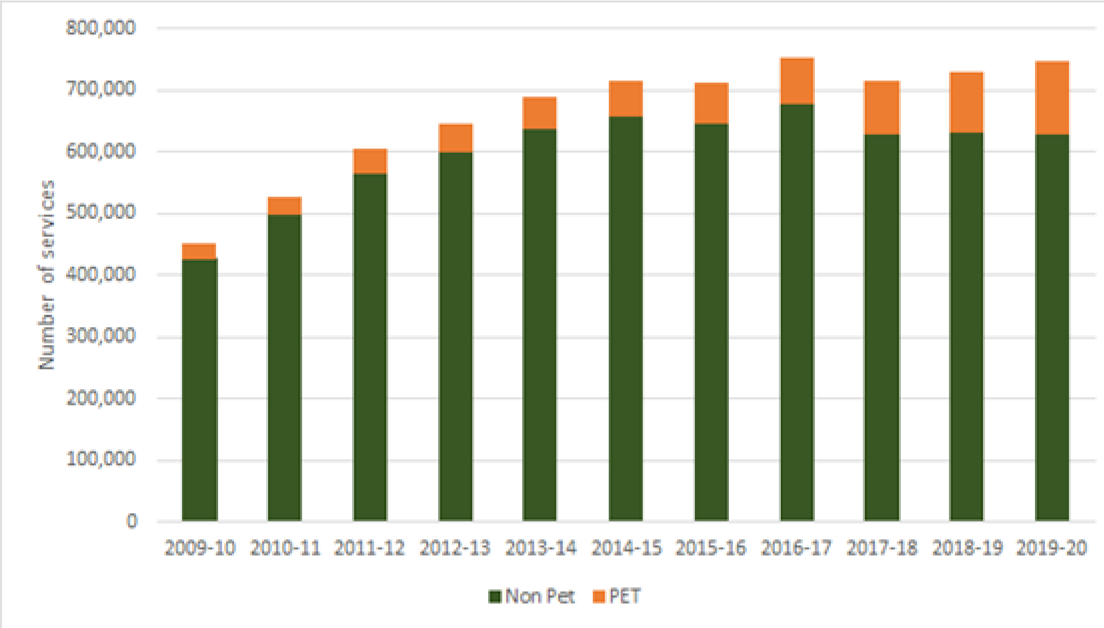

**Data source:** OECD.

## 2.2 Utilisation rates in nuclear medicine imaging services

Although nuclear medicine is the least commonly utilised imaging modality (as shown in Figure 1), Figure 3 shows the growth that has occurred over the past decade, with a total of 746,800 nuclear medicine imaging procedures being undertaken in Australia in 2019-20.[9] While growth has occurred in both non-PET and PET related services over the past decade, particularly rapid growth in PET services has been observed in recent years, with the number of non-PET services remaining relatively stable since 2013-14. In 2009-10, there were 25,500 PET related services performed; this has risen to 118,900 PET services in 2019-20 (an increase of 366 per cent).

[9] Medicare Statistics - Medicare Group Reports. Available at: http://medicarestatistics.humanservices.gov.au/statistics/mbs_group.jsp

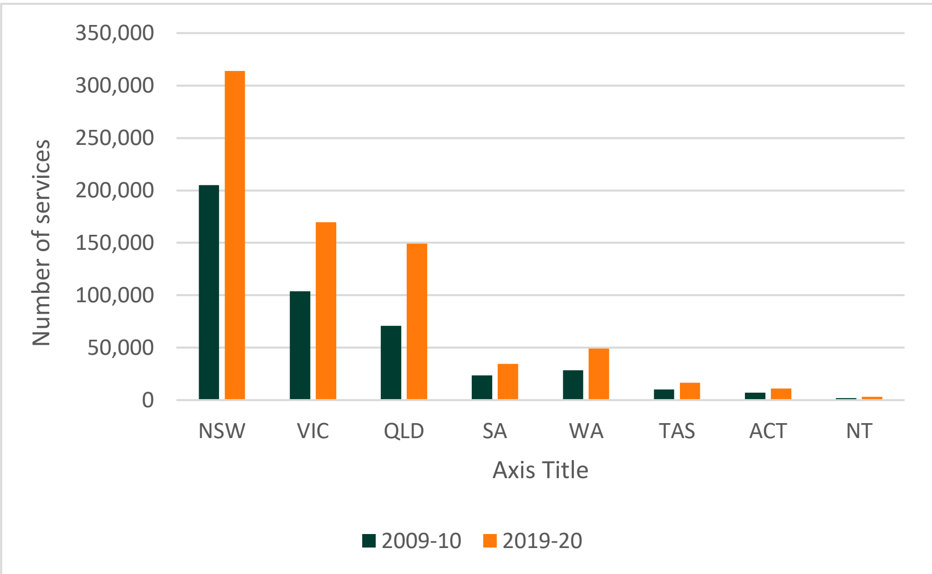
**Figure 3 Increase in nuclear medicine imaging services (PET vs non-PET services) from 2009-10 to 2019-20**




**Data source:** Medicare Statistics.

The next figure shows the breakdown of nuclear medicine imaging services by state and territory for 2009-10 and 2019-20.

**Figure 4 Increase in nuclear medicine imaging services by state (2009-10 and 2019-20)**




**Data source:** Medicare Statistics.

The chart shows that most of the services are undertaken in NSW, Victoria and Queensland, which broadly aligns with the relative population sizes for each state. All states have experienced an increase in the number of services since 2009-10.

The results of Synergies' stakeholder survey of 64 AANMS members indicate that significant growth (in the order of 40 per cent or more) over the past 10 years has occurred in the number of Positron Emission Tomography (PET) scans carried out as well as the number of nuclear medicine therapies.[10]

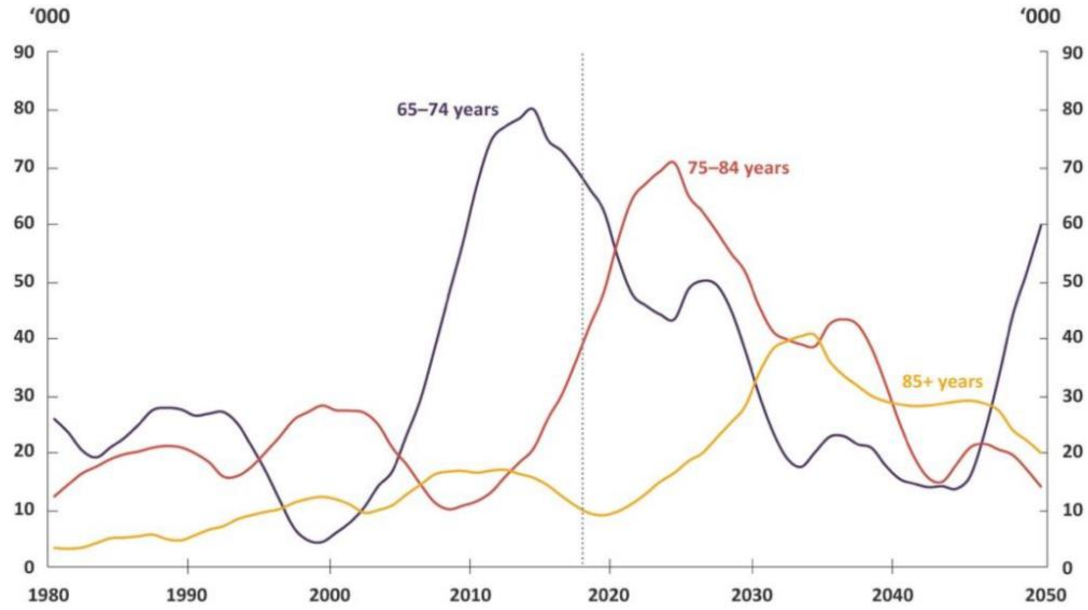
The key driver of this growth is the increase in PET services being provided (see Figure 3). Other factors contributing to this growth are population growth, with Australia's population increasing by around 19 per cent over the past decade, and increased medical requirements associated with Australia's ageing population.[11] Figure 5 shows the significant increase in the population aged 75 to 84 years from 2010 to 2020. Over the past two decades, the number of people aged 85 years and over has more the doubled (with a 117.1 per cent increase).[12] As noted above, the number of other nuclear imaging services has remained relatively stable since 2013/14, indicating a slight reduction in the number of services being provided per capita (despite the ageing population trend).

10 See Synergies' survey response to Q8. A summary of results and background to Synergies' stakeholder survey is presented at Appendix A.

11 ABS (2020) 3101.0 National, state and territory population - Table 4. Estimated Resident Population, States and Territories (Number).

12 ABS (2019) 3101.0 - Australian Demographic Statistics, Jun 2019. Available at: https://www.abs.gov.au/ausstats/abs@.nsf/0/1CD2B1952AFC5E7ACA257298000F2E76?OpenDocument#:~:text=Over%20the%20past%20two%20decades,2.5%25)%20to%20reach%20515%2C700.

Figure 5 Annual increase in the number of people by age group




**Data source:** Parliamentary Budget Office (2019) Australia's Ageing Population: Understanding the fiscal impacts over the next decade.

## 2.3 Remuneration of nuclear medicine costs

Medical healthcare costs in Australia are generally shared between governments, third party insurers, and patients.

The Commonwealth has no role in the direct delivery of diagnostic imaging services but provides funding for the delivery of these services through the MBS, which provides patients with financial assistance towards the costs of their medical services. The MBS rebates do not cover the full cost of service and are typically paid as a percentage of the schedule fee, with patients also required to make a contribution to the cost of the service.

The Medicare Schedule Fee does not reflect the value of a medical service or an amount that medical practitioners should or must charge. Medical practitioners are able to set their own fees for their services. In an efficient market, prices should reflect the reasonable cost of providing a service. The fee charged by a medical practitioner covers not only their own personal income, but also his or her practice costs – the wages for practice staff (technicians, nurses, receptionists, administrators), radiopharmaceuticals and other costs for running a medical practice, such as equipment, medical supplies, etc.[13] Further discussion on the costs associated with nuclear medicine diagnostic imaging is set out in section 3.

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13 Cleaning, rent, electricity, computers, continuing professional development, accreditation and insurance.

The Commonwealth's estimated spending on medical benefits totalled $24.9 billion in 2019-20[14], with diagnostic imaging attracting a total MBS benefit of $3.9 billion (see Table 1).

**Table 1 Diagnostic imaging services – Volumes and MBS revenues 2019-20**

| Service | Volumes | Medicare benefit ($) |
|---|---|---|
| Ultrasound (I1) | 11,028,023 | $1,260,110,861 |
| Computerised Tomography (I2) | 3,714,716 | $1,221,709,607 |
| Diagnostic Radiology (I3) | 10,377,151 | $586,828,458 |
| Nuclear Medicine Imaging (I4) | 746,832 | $310,313,340 |
| Magnetic Resonance Imaging (I5) | 1,314,824 | $521,440,094 |
| Miscellaneous Services (I6) | 0 | $116,653 |
| **Total Diagnostic Imaging** | **27,181,546** | **$3,900,519,013** |

Source: Services Australia Medicare Statistics.

This data shows that while the number of nuclear medicine imaging services has increased over the years, it is low as a proportion of total diagnostic imaging tests. In 2019-20, the number of nuclear medicine imaging services represented approximately 3 per cent of the total number of diagnostic imaging services undertaken and around 8 per cent of total MBS benefit for diagnostic imaging services.

### 2.3.1 Indexation of diagnostic imaging services

Prior to 1998, decisions about MBS fee increases were made annually. Between 1 July 1998 and 30 June 2008, diagnostic imaging expenditure was managed under a Memoranda of Understanding (MoU) between the Commonwealth Government and the diagnostic imaging sector.

In April 2008, the Australian Government announced that the MoU would be discontinued and 'MBS fees applicable at that time would apply'. The MBS schedule fees for diagnostic imaging services remained the same for several years until the government re-introduced indexation, but only for selected modalities. In the 2019-20 Budget, the Australian Government announced it would index MBS rebates for ultrasound and diagnostic radiology (x-ray) services from 1 July 2020.[15] This announcement followed targeted responses for diagnostic imaging services including

14 Commonwealth of Australia, Budget 2020-21, Budget Paper No.1 Statement 6, Table 8.1, p.6-19, available at https://budget.gov.au/2020-21/content/bp1/index.htm. Statement 6 also indicates that the medical benefits budget for 2020-21 is projected to be $28.2m.

15 Australian Government, Budget Paper No. 2 – Budget measures 2019-20, p86

mammography, fluoroscopy, CT scans and interventional procedures, that was previously scheduled for indexation from 1 July 2020.[16]

**Table 2 Re-indexation of MBS schedule fees for diagnostic imaging services**

| Service | Budget treatment | Commencement |
|---|---|---|
| **Diagnostic Imaging Service – modality** | | |
| Ultrasound | Indexation re-introduced | July 2020 |
| CT | Indexation re-introduced | July 2020 |
| Diagnostic radiology | Indexation re-introduced | July 2020 |
| MRI | No indexation – Schedule fee remains frozen | No planned date for commencement of indexation |
| Nuclear imaging | No indexation – Schedule fee remains frozen | No planned date for commencement of indexation |

**Source:** Synergies. Based on information published on the Australian Government's Department of Health's website at http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/Factsheet-Indexation%20DI

The targeted re-introduction of some diagnostic imaging services appears to have been part of a broader policy approach to 'phase in' indexation arrangements for Medicare funding. Since 2017, there has been a phased lifting of the freeze for GP bulk-billing incentive payments (July 2017), standard GP consultations and other specialist consultations (July 2018), medical procedures (due July 2019) and, most recently, targeted diagnostic imaging services (due from July 2020).

Noting this broader phased lifting, we are not aware of any plans to apply indexation for nuclear medicine, despite the MBS items for these treatments not having been subject to any indexation, despite ongoing demand for these services, since 1998.

### *MBS treatment of nuclear medicine*

Routine annual indexation of imaging schedule fees for nuclear medicine has not been applied since 1998, meaning that rebates for these specialist services have remained frozen since that time.

The lack of indexation of MBS fees since 1998 has further widened the gap between MBS revenues and the efficient cost of service delivery.

In any market, where prices do not reflect the underlying cost of providing a service (whether due to equipment, labour, or radiopharmaceuticals) for a prolonged period, that service tends to no longer be offered in an optimal way, resulting in inefficient outcomes viewed from the perspective of the health care system as a whole. In the case

[16] Australian Government, Department of Health (2019), Medicare Indexation of Diagnostic Imaging Services Factsheet, March 2019. See http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/Factsheet-Indexation%20DI

of nuclear medicine services, this means rising out of pocket (OOP) payments and the substitution of inferior diagnostic tests and treatments such as plain film and CT to replace bone scans or CTPA in pregnant patients. It also means that providers will not invest in the latest equipment, denying patients access to the latest technology such as innovations in image enhancement that provide a small quality benefit but no cost benefit. The Australian Diagnostic Imaging Association (ADIA) has previously estimated the average upfront cost of a nuclear medicine service to be around $217 in 2018-19, and the patient gap to be around $104.[17] This gap will inevitably grow if indexation is not applied to the MBS items for nuclear medicine services. Further discussion about the consequences of the current indexation freeze of escalating costs is discussed in section 4 of this report.

[17] ADIA (2020), Budget Submission 2020-21: Structural Reforms to Support Access to X-Rays and Scans in Australia, January 2020, p.10

# 3 Increasing costs of nuclear medicine

This section identifies the key trends and drivers in the rising costs of nuclear medicine services over the past 10 years.

## 3.1 Cost increases across nuclear medicine procedures

### 3.1.1 2010 review of the cost of diagnostic imaging services

Problems in the funding arrangements and the rising costs associated with diagnostic imaging services are long-standing. In 2010, Applied Economics prepared a report for the Australian Government which identified the following issues:[18]

- high-tech diagnostic imaging is part of a high technology, knowledge-intensive industry where demand is funded almost entirely from third party payments, mostly from Medicare;
- the funding model was problematic where, in many cases, average annual increases in Medicare benefit costs of diagnostic imaging services were well below price increases occurring in the health sector and the broader economy;
  - the increase in the average benefit cost for all categories of diagnostic imaging (3.6 per cent) was considerably below price increases that were occurring elsewhere in the health sector and was also less than the rise in the broader CPI (7.3 per cent);
  - the health component of the CPI had increased by 10 per cent during the study period (2006-07 and 2008-09) which was above the general rise in prices;
- nuclear medicine was the fastest growing modality (due to the introduction of a new modality in PET) and costs for diagnostic imaging services generally were considerable:
  - the industry relies on a specialist imaging workforce of nuclear medicine practitioners, which consists of nuclear medicine physicians and dual trained radiologists;
  - delivery and organisation of diagnostic imaging services is associated with costly equipment and plant involving considerable capital investment;
  - complexities exist in the supply of pharmaceuticals/radioisotopes used by nuclear imaging modalities whereby their short half-life reduces the exposure

[18] Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010.

of human organs to radiation but adds considerably to the cost of their dispensing and timely delivery.

The 2010 report further noted that in a publicly funded environment, the structure of remuneration needed to recognise incentives for imaging service to acquire and upgrade equipment which was consistent with service priorities. [19]

While the Government has taken some action since 2010 (as discussed in section 2.3.1) to improve remuneration arrangements in some diagnostic modality services, problems persist in nuclear medicine whereby the ongoing indexation freeze continues to widen the gap between the MBS items and the cost of providing the services.

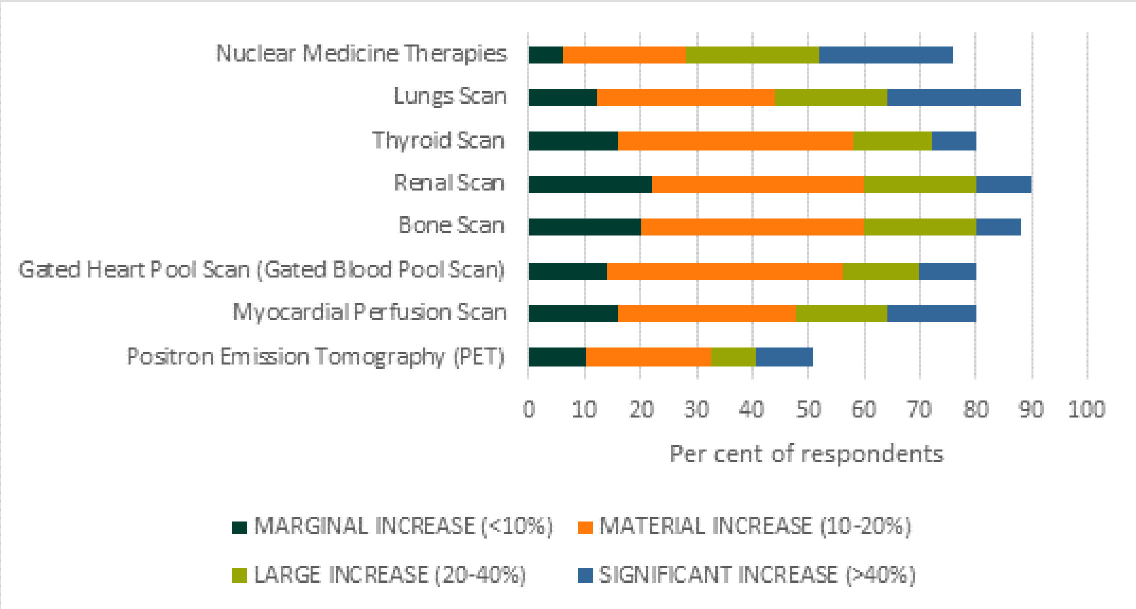
The responses to the survey administered to nuclear medicine practitioners provide relevant insights as to the cost increases which have largely been unabated for over 20 years.

### 3.1.2 Trends in costs between 2010 and 2020

Figure 6 shows the magnitude of the cost increase in providing nuclear medicine procedures based on the survey results (with 64 respondents). It shows that across all common procedures' costs, a significant majority of respondents considered costs have increased to some extent, with a significant proportion (up to 50 per cent) of practitioners reporting increases of greater than 20 per cent.

[19] Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010, p.46.

**Figure 6 Increase in costs of providing nuclear medicine procedures – survey responses (%)**




**Note:** No respondents indicated the costs of particular procedures had largely decreased (20-40%), or significantly decreased (>40%), so those categories are excluded from the chart. Survey results showed that 1 per cent of respondents reported costs of PET procedures had materially decreased (10-20%), and 2 per cent of respondents reported costs of administering myocardial perfusion scans had marginally decreased (<10%). A small number of respondents reported no change in the cost of administering some procedures. In the case of nuclear medicine therapies, only 4% of respondents reported no change.

**Data source:** Synergies' survey of nuclear medicine practitioners.

## 3.2 Cost drivers

The major cost components of providing nuclear medicine procedures and treatments are as follows:

- labour
- equipment
- materials (including radiopharmaceuticals)
- premises.

A brief discussion of each cost component is presented below.

### 3.2.1 Labour (wages)

Nuclear medicine specialists are generally physicians with sub-speciality training in nuclear medicine.[20] The specialist imaging workforce consists of radiologists and nuclear medicine physicians. In the private sector, this includes nuclear medicine specialists,

[20] ANAO (2014), Performance Audit Report No. 12 2014-15 – Diagnostic Imaging Reforms Department of Health, p 55.

owner operators and private employees. Specialists are supported by clinical and technical staff including a range of nuclear medicine technologists, nurses, medical physicists, radiopharmaceutical scientists, and administrative personnel.[21] As an industry that requires highly skilled employees of high subject matter experts, wages are the industry's largest cost item.[22]

### 3.2.2 Equipment

Nuclear medicine services require the use of high-cost capital equipment and technology. Given medical technology continues to evolve rapidly, there is a need for regular investment in new equipment to provide patients with specialised, high quality care and ensure accurate diagnosis.

Molecular imaging equipment is used to deliver nuclear imaging services.[23] Some of the key equipment used is described in Table 3.

**Table 3 Molecular imaging equipment used to deliver nuclear imaging services**

| Equipment | Description |
|---|---|
| Gamma camera | • A generic terminology covering scintillation-based equipment used in conjunction with tracers that emit gamma radiation.<br>• In their most rudimentary form, they provide site-specific, single head 2D planar projection imaging and temporal radiotracer uptake imaging (e.g. for breast, lung pulmonary extrusion, bone studies).<br>• This equipment can be upgraded in a limited way with software to enable a tomographic image to be reconstructed from multiple projections as a single head is rotated around the subject. |
| Single-photon emission computed tomography (SPECT) | • Similarly used for site-specific diagnosis with a gamma emitter, but providing superior multiple projection images more rapidly, using two heads orthogonally placed on the same gantry.<br>• SPECT images are commonly used in many nuclear medicine studies in conjunction with planar images, e.g. bone scans. The addition of SPECT improves diagnostic accuracy by increasing sensitivity for lesion detection and by providing superior anatomical localisation of abnormalities. Advanced cadmium zinc telluride (CZT) detectors can be manipulated by algorithm to yield three-dimensional data sets, similar to other tomographic techniques (e.g. 3D cardiac perfusion and brain function studies), with less radiation exposure to the patient.<br>• SPECT equipment is now almost exclusively sold in Australia as a SPECT/CT configuration, which offers much greater versatility than standalone SPECT. |
| Positron emission tomography (PET) | • Relies on positron emitting isotopes and coincident gamma photon detection for whole body or brain scanning (especially for diagnosing and staging of cancers as well as other functional disorders, such as dementia, or cardiac conditions).<br>• This equipment uses the positron emitter to visualise and measure organ function and metabolism. To optimise diagnostic usefulness, a PET image is superimposed on a CT image so as to overlay the functional information of PET with the anatomical CT image. In addition, CT data is used to improve the quality of the PET image by providing attenuation correction, which increases the sensitivity of this modality.<br>• New PET equipment is available now only as a combined PET/CT system (see below). |

21 Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010, p ix.

22 IBIS World (2020) Diagnostic Imaging Services in Australia, February 2020, p 25.

23 Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010, p 24.

| Equipment | Description |
|---|---|
| | • Newer generation "Time-of-flight" PET systems are now commercially available and improve the spatial resolution of PET images |

**Source:** Synergies.

The ‘dual-modality’ or 'hybrid' SPECT/CT and PET/CT equipment is commonly used to deliver nuclear medicine services. The most recent technological advances enable utilisation of digital technologies for improved staging of cancer and monitoring of oncology treatments, as well as imaging tools for multiple non-oncology conditions, as mentioned in Box 1. There is also a range of ‘soft’ equipment such as software and digital storage (e.g. PACS) services. Other diagnostic imaging infrastructure to support this imaging stream include table positioners, operator consoles, and peripheral devices (such as shields from radiation sources).

### 3.2.3 Radiopharmaceuticals

Nuclear medicine procedures use a radioactive material called a radiopharmaceutical or radiotracer that is targeted to specific body tissues or diseases. A radiopharmaceutical can be used either for diagnostic or therapeutic purposes. Several different types of radiotracers are used, including technetium-99m, thallium-201, gallium-67, iodine-123, iodine-131, and xenon-133.[24] For PET studies, there are four common radiotracers including fluorine-18, carbon-11, nitrogen-13 and oxygen-15 ,[25] with newer radiotracers such as gallium-68, zirconium-89, , iodine-124 and copper-64 emerging on the market.

Radiotracers used in nuclear imaging studies have a relatively short half-life which reduces exposure of human organs to radiation. Larger imaging services can dispense radiopharmaceuticals that have a relatively short half-life (e.g. 6 hours) via a "generator" housed in a specialised shielded laboratory, whereby the generators are replaced regularly (e.g. weekly). Smaller imaging services that do not have their own laboratory have radiopharmaceuticals delivered from commercial suppliers at a higher cost.

Some radiopharmaceuticals have high rates of decay (i.e. shorter half-life), so time and travel distance are critical between production and the radiopharmaceutical being dispensed. This can have a significant impact on the location of the nuclear imaging services being available and the cost of providing services that require these radiopharmaceuticals.

24 See John Hopkins Medicine, What is nuclear medicine? at https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/nuclear-medicine

25 See US National Library of Medicine, PET Radiopharmaceuticals at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3869596/

### 3.2.4 Premises

Diagnostic imaging is provided from public hospitals, large private corporate networks, independent private networks, and smaller public and private satellite services (which may be in rural and remote settings). In various configurations and locations, all of them may treat some public hospital inpatients, public hospital emergency outpatients, and private patients.[26] It has previously been estimated that 35 to 40 per cent of all imaging services are provided by public hospitals and 60 to 65 per cent by private businesses.[27]

Imaging firms must also adhere to stringent radiation regulations concerning zoning and shielding, ensuring that radiation they use does not affect people outside designated areas.

## 3.3 Trends in key cost components

While it is beyond the scope of this study to undertake a detailed assessment of the cost of providing nuclear medicine services and estimating the magnitude of the cost increases over the past 22 years, an assessment has been undertaken of the trends in key components of the cost of providing nuclear medicine services, particularly over the past decade.

The 2012 sectoral review of funding for diagnostic imaging services conducted by the Medical Benefits Review Task Group[28] provided the following insights about the scale of cost increases:

- there was significant growth in the number of diagnostic imaging services, with rapid growth occurring for nuclear medicine imaging;
- workforce cost was the largest cost component of diagnostic imaging services (labour capital ratio of 8:1) and this cost was continuing to grow;
- the industry exhibited a low level of revenue volatility as most services are covered by Medicare;
- some patients of diagnostic imaging services were being charged significant co-payments, with the average OOP contribution growing across all modalities to meet escalating costs; and

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26 Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010, p.60.

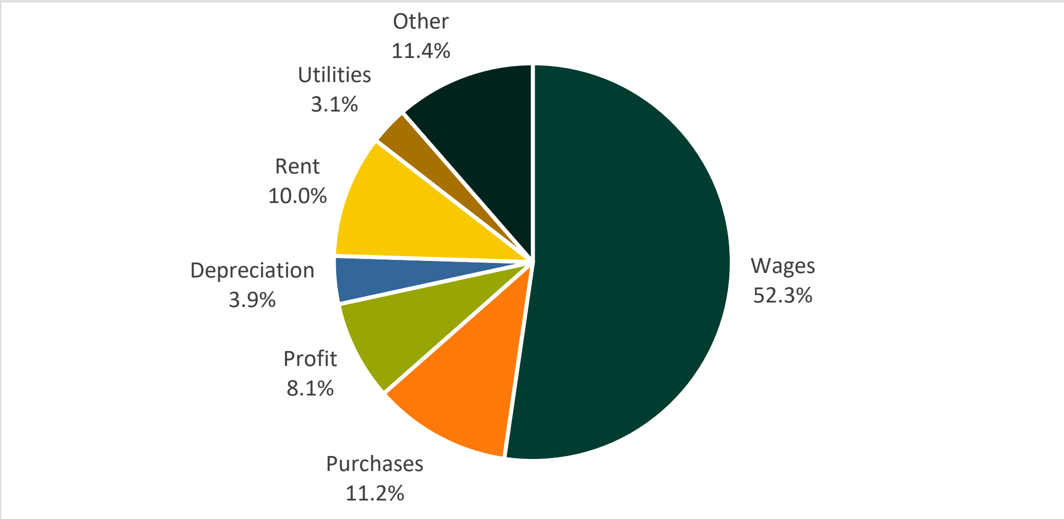
27 Applied Economics (2010), Costs for diagnostic imaging capital expenditure – final report, July 2010, p.16.

28 Medical Benefits Review Task Group, Diagnostic Imaging Review Team, Department of Health and Ageing (2012), Review of Funding for Diagnostic Imaging Services: Final Report, February 2012.

- the [then] non-indexation of diagnostic imaging schedule fees was of significant concern to the sector and the Government made a commitment to monitor schedule fees to ensure that imaging services remained affordable and accessible.

The results of our literature review essentially confirm these key findings continue to prevail in the current market. A breakdown of diagnostic imaging costs for 2020 is presented in Figure 7 below.

**Figure 7 Breakdown of diagnostic imaging costs for 2020 (% of industry revenues)**




**Note:** this breakdown relates to diagnostic imaging services across all modalities.
**Data source:** IBISWorld (2020), Diagnostic Imaging Services in Australia, February 2020.

The chart shows that labour is the large cost component (52 per cent of industry revenues). Purchases of capital equipment are also significant but they are not the most substantial component (11 per cent).

### 3.3.1 Labour (wages)

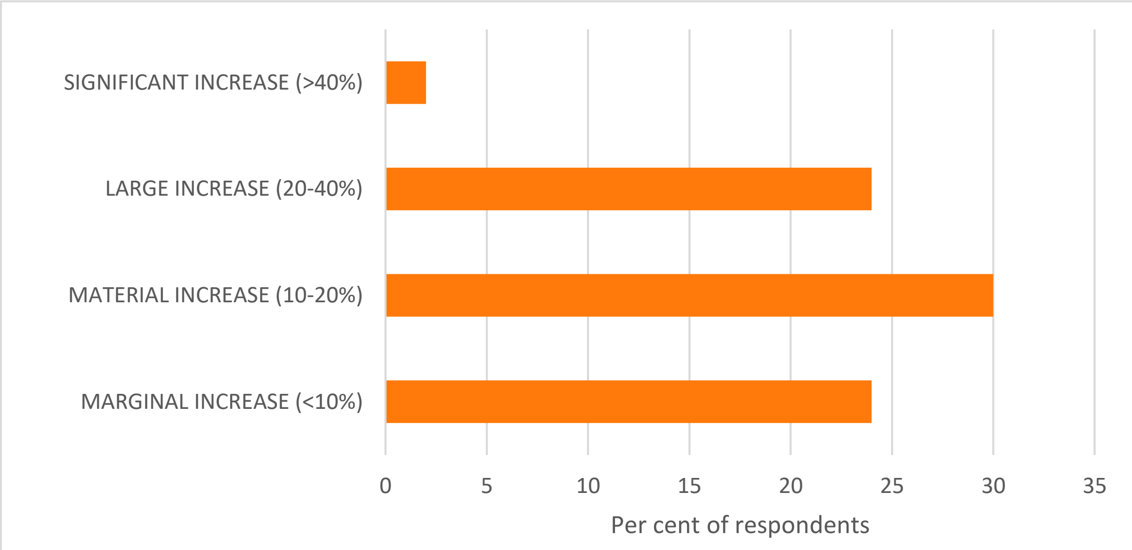
In terms of the critical role that the supply of labour plays in the delivery of diagnostic imaging services, the IBISWorld 2020 report indicated that wages have risen as a share of industry revenue over the past five years. From 2015 to 2020, wages as a share of revenue has increased from around 48.5 per cent to just under 53 per cent.[29]

This is supported by evidence from the survey of nuclear medicine practitioners, with the vast majority (around 80 per cent) of survey respondents reporting an increase in labour costs in the delivery of nuclear medicine imaging services over the past 10 years,

[29] IBISWorld (2020), Diagnostic Imaging Services in Australia, February 2020, p.26

with more than half of the respondents describing the size of the increase as 'material', 'large' or 'significant' (see Figure 8).

**Figure 8 Changes in labour cost component – survey responses (%)**




**Note:** No respondents indicated labour input costs had marginally decreased (<10%), materially decreased (10-20%), largely decreased (20-40%), so those categories are excluded from the chart. Survey results showed that 2 per cent of respondents reported no change in labour inputs with 18 per cent of respondents reporting a significant decrease (>40%). However, these results could reflect a combination of reduced staffing numbers and rising wages.

**Data source:** Synergies' survey of nuclear medicine practitioners.

### 3.3.2 Equipment

Revenue from imaging services provides the main source of funding or leverage for the acquisition of highly specialised equipment. Technological progress has resulted in access to much better equipment, albeit at higher cost.

Based on the IBISWorld 2020 report, the cost of diagnostic imaging equipment had risen as a share of industry revenue over the past five years (from around 10 per cent to 11.2 per cent of revenue in 2020).[30] Depreciation expenses are also significant for industry operators due to the high cost of diagnostic imaging equipment. Diagnostic imaging machines have an effective life of 10 to 15 years, however due to technological advancements can become outdated before the end of their useful life. Service providers are compelled to replace outdated equipment by the Capital Sensitivity initiative which, as of 1 May 2020, removes MBS rebates for scans performed on older equipment.

Results from the survey confirm that the cost of capital and technologies have increased substantially over the last 10 years, as shown in Figure 9 below.

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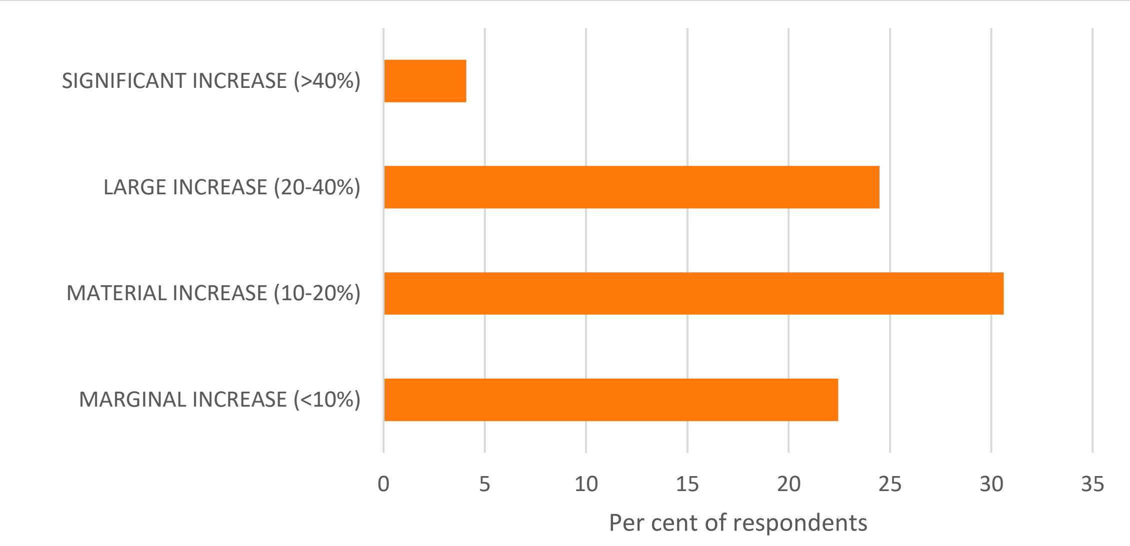
30 IBISWorld (2020), Diagnostic Imaging Services in Australia, February 2020, p.26

**Figure 9 Increased costs in capital/technologies – survey responses (%)**




**Note:** No respondents indicated capital/technology costs had marginally decreased (<10%), materially decreased (10-20%), largely decreased (20-40%), so those categories are excluded from the chart. Survey results showed that 4 per cent of respondents reported no change in capital inputs with 14 per cent of respondents reporting a significant decrease (>40%). However, these results could reflect a combination of less or older capital equipment and rising equipment costs.

**Data source:** Synergies' survey of nuclear medicine practitioners.

The vast majority of respondents (80 per cent) considered capital costs had increased over the past 10 years. As shown in the table above, around 60 per cent of respondents indicated capital costs have increased by over 10 per cent, with almost 30 per cent indicating capital costs have increased by over 20 per cent.

### 3.3.3 Radiopharmaceuticals

The cost of nuclear medicine radiopharmaceuticals is high and has long been recognised as a major concern. In 2012, the Department of Health's Review of Medical Benefits recognised that schedule fees for nuclear medicine services do not necessarily recognise the large variation in the cost of radiopharmaceuticals for example, the cost of which can be higher than the schedule fee.[31]

This was again highlighted as an issue in the Medicare Benefits Schedule Review conducted in 2018, in which it was noted that, in respect of therapeutic nuclear medicine items, all items on the MBS remained critically relevant, but the availability and utilisation of those treatments in Australia were significantly affected by pricing issues, with rebates failing to cover the cost of the radiopharmaceuticals.[32]

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31 Medical Benefits Reviews Task Group Diagnostic Imaging Review Team Department of Health and Ageing (2012), Review of Funding for Diagnostic Imaging Service: Final Report, February 2012, p.18

32 Medical Benefits Schedule Review Taskforce (2018), Report from the Diagnostic Imaging Clinical Committee – Nuclear Medicine, p.33

The Committee Report also noted that that radiopharmaceutical pricing around Australia is not fixed, with the price varying according to individually negotiated contracts between suppliers and practices. For that reason, while the Committee noted that it was not possible to quote a 'catalogue price' in relation to radiopharmaceuticals, it did provide an illustrative example of price quoted to a large Australian hospital to indicate the magnitude of the problem. While the data may be somewhat dated (it was correct as at September 2017), it nevertheless highlighted the gap in remuneration that continue to exist. Table 4 sets out the illustrative example detailed in the 2018 Taskforce report.

**Table 4 Radiopharmaceutical prices (illustrative example) and MBS fees**

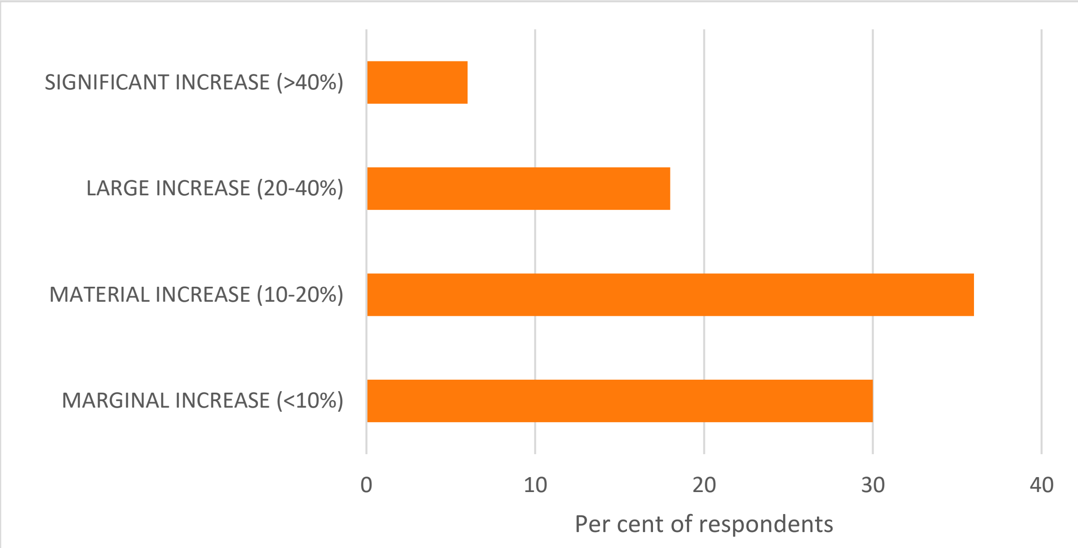
| Radiopharmaceutical | Item No | MBS Fee (AUD) | Quoted price (AUD) | Notes |
|---|---|---|---|---|
| Y-90 citrate (for intracavity administration) | 16003 | 650.50 | 2,169.00 | 1,100 MBq Can be used for up to 4 patients, depending on indication and demand |
| I-131 (thyroid cancer) | 16006 | 499.85 | 652.86 | 3.7 GBq |
| I-131 (thyrotoxicosis) | 16009 | 341.15 | 313.50 | 600 MBq |
| P-32 | 16012 | 295.15 | 2,250.00 | 185 MBq |
| Sm-153 lexidronam | 16018 | 2,442.45 | 4,130.06 | 6.0 GBq Typical dose required for 80 kg patient = 3.0–4.5 GBq |

**Note:** Quoted price was correct at 26/9/17, for delivery to a large Australian metropolitan hospital.

**Source:** Medical Benefits Schedule Review Taskforce (2018), Report from the Diagnostic Imaging Clinical Committee – Nuclear Medicine, p.34.

The responses to the survey provide additional evidence of the escalating cost of chemicals and pharmaceutical products over the last 10 years, as shown in Figure 10.

**Figure 10 Increased costs in chemical/pharmaceutical products – survey responses (%)**




**Note:** No respondents indicated chemical/pharmaceutical inputs had marginally decreased (<10%), materially decreased (10-20%), largely decreased (20-40%) or were unchanged, so those categories are excluded from the chart. Survey results showed that 10 per cent of respondents reporting a significant decrease (>40%). However, these results could reflect a combination of fewer chemical/pharmaceuticals being used (if some procedure are no longer performed) and any changes in costs.

**Data source:** Synergies' survey of nuclear medicine practitioners.

The survey results show that 90 per cent of respondents considered chemical/pharmaceutical costs had increased over the past 10 years.

A uniquely Australian issue has been ANSTO. Due to chronic underfunding and short-term decision making, the local production of many isotopes has ceased, necessitating importation at much higher costs than previously experienced. The lack of adequate market competition has been a factor. The situation has been exacerbated by repeated production failures at ANSTO facilities leading to further impacts on service provision and cost.[33]

### 3.3.4 Premises

An IBISWorld 2020 report indicates that rent expenses for diagnostic imaging services are a material cost for the industry, estimated to represent around 10 per cent as a share of industry revenues in 2020 (representing a marginal increase from 9 per cent in 2015).[34] Nuclear medicine practitioners who responded to the survey also noted that rent is a significant factor in rising costs.[35]

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[33] It is noted that the Commonwealth Government did temporarily intervene on this issue in 2019, announcing temporary measures, including the inclusion of six new nuclear medicine items on the MBS due to mechanism faults at ANSTO. These temporary measures ceased in December 2019.

[34] IBISWorld (2020), Diagnostic Imaging Services in Australia, February 2020, p.27.

[35] Based on qualitative response to Synergies' survey to Question 11.

## 3.4 Summary and implications

Based on research and survey results on the metrics for the key cost components identified above, it is clear that significant cost pressures have increased in the delivery of nuclear medicine imaging services over the past decade.

Cost pressures that were previously identified in 2010, and again in 2012, continue to be reflected in the most recent data available which provide evidence that all major cost drivers of nuclear medicines (labour, capital, chemicals, radiopharmaceuticals, premises) have increased over the past decade. Furthermore, there is no evidence that indicates such cost pressures are likely to dissipate in the foreseeable future.

Rising cost pressures have resulted in a range of consequences for the industry and, most importantly for patients. The impacts are two-fold. Firstly, our survey results indicate that, in the vast majority of cases, patients are increasingly sharing the cost burden, with increases in out-of-pocket expenses as a result of higher fees. Secondly, the nuclear medicine industry has been attempting to absorb the increasing cost however this has been detrimental due to use of older equipment, reduced service provision and reducing scan times which may impact test sensitivity and specificity. Some procedures have been abandoned altogether. Further discussion on the implications of rising costs in the context of the current remuneration model that is based on the current indexation freeze is presented in section 4.

# 4 Impact of insufficient remuneration

This section assesses the benefits derived from the provision of nuclear medicine procedures and treatments and the adverse impact of the insufficient remuneration of these services under the MBS. This includes assessing adverse impacts on patient health outcomes (due to constrained access to optimal treatments) and the implications for the costs imposed on the healthcare system.

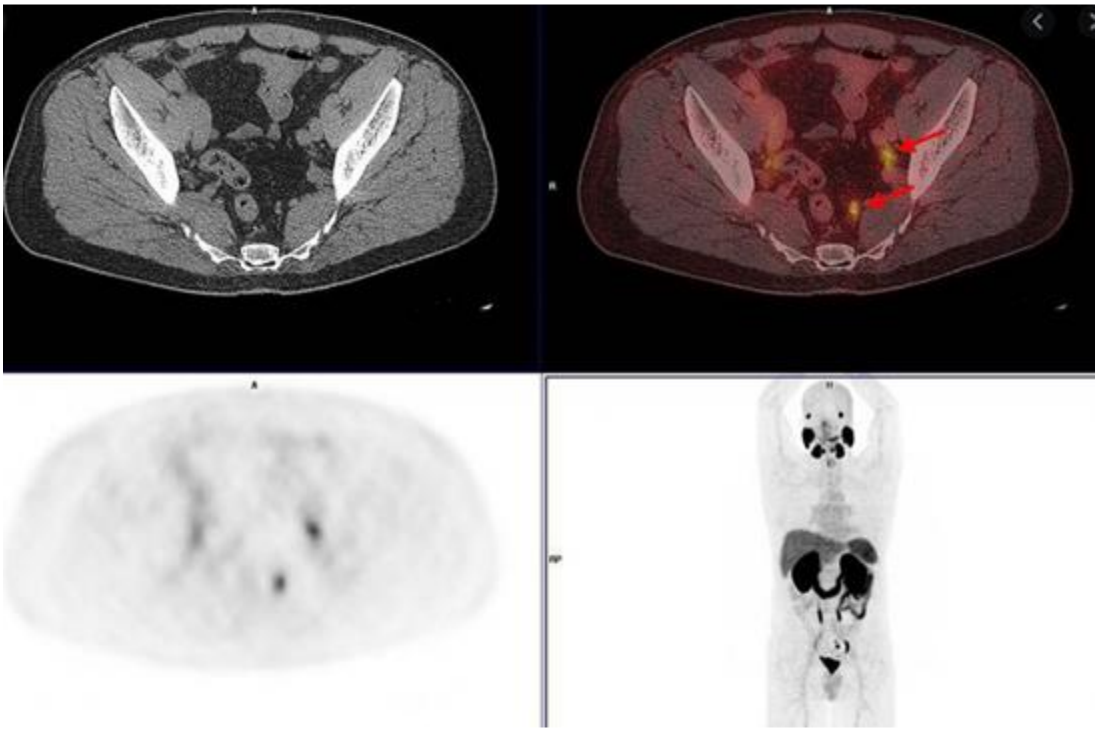
## 4.1 Key benefits of nuclear medicine services

Firstly, to understand the adverse impacts of the insufficient remuneration of nuclear medicine services, it is important to understand the beneficial impacts in relation to patient health and the efficiency of the healthcare system. The key benefits of nuclear medicine services can be summarised as follows:

- nuclear medicine techniques largely utilise targeted agents that specifically bind to a relevant protein on a specific cell or can be utilised in relevant physiologic/metabolic pathway to shine a light on the location of a tumour or a disruption in normal body function. On a nuclear medicine study, the abnormalities, due to the accumulation of tracer there, literally "light up" so that they stand out from the background as opposed to anatomic studies like CT where we rely on anatomic distortion to suggest an abnormality is present (see Figure 11);
- nuclear medicine procedures can be acquired in a movie like format so that that the function of an organ can be visualised in real time. The digital format of data obtained allows for quantification of disease process and bodily function;
- for many diseases, (e.g. thyroid cancer, gall bladder disease, heart conditions) nuclear medicine procedures provide the most useful diagnostic and functional information – information that is not available by other techniques (e.g. a cardiac SPECT scan can show how blood flows to the heart, whilst a FDG PET scan show levels of metabolic activity in different areas of the brain);
- due to the ability to detect early functional changes, it offers the potential to identify disease at its earliest stage, often before symptoms occur or structural abnormalities become apparent on other tests;
- non-invasive, less expensive and can yield more precise information than many other alternatives for diagnosis such as exploratory surgery; and

- knowledge of function allows reliable differentiation of benign from malignant lesions, which helps identify the best biopsy location or can eliminate the need for surgical biopsy.[36]

**Figure 11 Nuclear medicine scan vs CT scan**



**Note:** Staging PSMA PET/CT scan. On the CT image (top left), nothing seems amiss. However, the PSMA PET image (bottom left) shows two abnormal hot spots in the pelvis. When "fused" with the CT (top right), we can see that these represent two small lymph nodes that contain prostate cancer cells. This finding changes management for the patient by demonstrating that the cancer has already spread beyond the prostate.

**Data source:** Supplied by AANMS.

As noted above, unlike conventional imaging studies that produce primarily structural pictures, nuclear medicine visualises how the body is functioning and what is happening at the cellular and molecular level.[37]

Specialists use hybrid PET/CT scans to provide more information about cancer than can be discovered using just one scan alone. CT scans show detailed pictures of the organs and tissues inside the body and a PET scan can find abnormal function and can be more sensitive than other imaging tests.[38] PET scanning is the primary staging modality for

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[36] 'General Nuclear Medicine'. RadiologyInfo. DOA: 22 December 2020; See: https://www.radiologyinfo.org/en/info.cfm?pg=gennuclear.

[37] Society of Nuclear Medicine & Molecular Imaging, Factsheet: What is Nuclear Medicine and Molecular Imaging? at https://www.snmmi.org/AboutSNMMI/Content.aspx?ItemNumber=5648

[38] Australian Government, Department of Health, Nuclear Medicine and Positron Emission Tomography, at https://www1.health.gov.au/internet/main/publishing.nsf/Content/pet-nuclear-medicine-imaging

many cancers and has been shown to produce cost savings vs traditional staging modalities-mainly by avoiding futile surgery in patients whose disease spread was not apparent on conventional imaging.[39]

For most diseases, there is a strong positive relationship between early and accurate diagnosis and the efficacy of treatment and patient survival rates. Early diagnosis of cancer generally increases the chances for successful treatment by focusing on detecting symptomatic patients as early as possible.[40] The consequences of delayed or inaccessible cancer care are poorer survival, greater treatment morbidity resulting in avoidable deaths and disability and higher costs of care.

Table 5 shows the survival rates of some cancers if detected early or if detected at an advanced stage.

**Table 5 Early detection and survival rates by cancer type**

| Cancer | Early detection survival rate | Advanced stage detection survival rate | Proportion of cases diagnosed in Stage 1 |
|---|---|---|---|
| Bowel cancer | >90% | 20% | 22% |
| Breast cancer | >90% | 15% | 43% |
| Lung cancer | >80% | 15% | 12% |
| Prostate cancer | 90% | 26% | 36% |
| Head and neck cancers | >80% | 20% | <30% |
| Thyroid cancers | 99.5% | 77% | 76.4% |

**Source:** Bowel Cancer Australia, Movember Foundation, Cancer Research UK, Melanoma Institute Australia.

In addition to improving patient health outcomes, early detection and diagnosis reduces the total costs to the healthcare system incurred in treating cancer, some of which are listed in Table 5.

Cancer is one of the key drivers of the economic cost of disease in Australia.[41] Direct health system costs related to cancer are estimated at $4.5 billion per annum.[42] This total is expected to continue to grow as Australia's ageing population and lifestyle trends result in continued growth in the incidence of several cancers. The early detection and diagnosis of these conditions is critical to ensuring cost-effective treatment and hence

39 Pinilla, I., et al (2008). 'Integrated FDG PET/CT: Utility and Applications in Clinical Oncology. Clin Med Oncol.; 2:181-98.

40 'Promoting Cancer Early Diagnosis', World Health Organization. DOA: 28 January 2021; See: https://www.who.int/activities/promoting-cancer-early-diagnosis#:~:text=Early%20diagnosis%20of%20cancer%20focuses,and%20higher%20costs%20of%20care.

41 AIHW 2016. Australian Burden of Disease Study: impact and causes of illness and death in Australia 2011. See: https://www.aihw.gov.au/getmedia/d4df9251-c4b6-452f-a877-8370b6124219/19663.pdf.aspx?inline=true

42 Cancer Council. Facts and figures. See: https://www.cancer.org.au/about-cancer/what-is-cancer/facts-and-figures.html

minimising the economic burden of disease, both in terms of patient health outcomes and the costs imposed on the healthcare system.

For example, the average cost of treating an advanced bowel cancer patient is estimated at $66,000. Alternatively, early detection enables the removal of precancerous bowel tissue at a cost of less than $2,000.[43] This is significant given around 78% of bowel cancer cases are diagnosed in the advanced stage, which translates to a total cost of approximately $792 million per annum.[44]

For localised prostate cancer, average treatment costs over a lifetime are around $26,000. Average treatment cost for advanced cancer is estimated to be around $45,500 of a lifetime.[45] 64% of prostate cancer cases are diagnosed in advanced stages. It has been estimated that the costs to the healthcare system of treating prostate cancer in Australia is expected to reach $544 million by 2025.[46] Where early detection and accurate staging can lead to more patients being treatment for localised cancer (rather than treating it when the cancer is at an advanced stage), the savings to the health system are expected to be significant.

Nuclear medicine plays an important role in early detection, particularly in relation to cancer. In fact, there are two key pathways associated with the use of nuclear medicine (1) as a diagnostic tool and (2) as a treatment pathway. For instance:

- *Diagnostic tool* - nuclear medicine can find cancer earlier than other diagnostic imaging procedures. For instance:[47]
  - bone scans can often find signs of bone cancer earlier than x-rays and CT as they detect the bone changes in cancer at a cellular level;
  - targeted radiopharmaceuticals (e.g. iodine for thyroid or MIBG for pheochromocytoma) can help doctors spot cancer throughout the body without the need for multiple less accurate investigations;

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[43] Cancer Council Australia. Pre-budget submission 2012-13. See: https://www.cancer.org.au/content/pdf/CancerControlPolicy/Submissions/Cancer_Council_Australia_pre-budget_submission_2012-13_bowel_cancer%20screening.pdf

[44] In 2014, 15,253 new cases of bowel cancer were diagnosed in Australia. See: https://www.cancer.org.au/about-cancer/types-of-cancer/bowel-cancer/

[45] Prostate Cancer Foundation of Australia (2016), Economic modelling of healthcare services for prostate cancer, April 2016. Available at http://www.prostate.org.au/media/725545/pcfa-monograph-economic-modelling.pdf

[46] In 2014, there were 18,291 new cases of prostate cancer diagnosed in Australia. See: https://prostate-cancer.canceraustralia.gov.au/statistics

[47] See https://www.webmd.com/cancer/nuclear-medicine-diagnose-treat-cancer#1

- nuclear medicine scans provide information whether a tumour is malignant or benign by measuring its metabolic rate, in addition to showing if a cancer has metastasized or returned after remission;
- advanced nuclear imaging procedures make it possible to identify where the cancer cells are, eliminating the need for painful and costly exploratory surgeries to inform treatment, noting that often these surgeries do not provide the information necessary for an accurate diagnosis.[48]

- *Treatment pathway tool*
  - nuclear medicine offers doctors another option when developing a treatment plan. Nuclear medicine is often used to provide treatment to patients that suffer from exceptional levels of bony pain that standard medications cannot keep under control. It is also key in the treatment of thyroid cancer and hyperthyroidism in addition to the treatment of various blood disorders.[49] A new and growing component of nuclear medicine is utilising agents that bind to cancer cells and can carry a radioisotope to the cancer cell which then can kill that cell. This very specific treatment has much lower side effects than conventional chemotherapy. Such focused approach to individualised cancer therapy is rapidly expanding and has become known as "personalised medicine".

Further applications of nuclear medicine services can also diagnose other medical conditions which would benefit from early intervention (e.g. myocardial ischaemia from blocked arteries in the heart). The early diagnosis of Alzheimer's disease - which is caused by the deposition of proteins called amyloid and tau in the brain - can be detected by PET scanning, and there is a current investment in the development of drugs to decrease the burden of these proteins, and therefore reducing the tempo of dementia in patients, with resultant long-term reduction in health care costs.

The following section contains two case studies that demonstrate the benefits derived from two general nuclear medicine procedures.

## 4.2 Case studies

This section presents two case studies focusing on the benefits derived from two key nuclear medicine procedures.

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48 Future of Working, 17 advantages and disadvantages of nuclear medicine, see https://futureofworking.com/6-advantages-and-disadvantages-of-nuclear-medicine/

49 Future of Working, 17 advantages and disadvantages of nuclear medicine, see https://futureofworking.com/6-advantages-and-disadvantages-of-nuclear-medicine/

### 4.2.1 Case Study 1: Iodine Therapy for Thyroid Cancer

Thyroid cancer was the ninth most diagnosed cancer in Australia in 2016.[50] It is estimated that 3,785 new cases of thyroid cancer were diagnosed in Australia in 2020, which is a 27% increase on the 2,973 new cases diagnosed in 2016.[51] Noting this, the slow growing nature of thyroid cancer and the efficacy of treatment means survival rates are very high (around 97%), provided that the disease is diagnosed and treated early.[52]

Typical treatment begins with surgical resection when the patient presents with presumed localised disease in the thyroid. Depending on the pathology, most patients progress to adjuvant RAI therapy. RAI therapy is an important treatment modality for most thyroid cancers as iodine is taken up through iodine receptors on the thyroid cells.[53]

RAI treatment typically involves administration of RAI in combination with a diagnostic RAI scan to demonstrate iodine uptake in the tumour and the presence of any cancer spread, which would dictate the dosage for the RAI treatment. If the tumour demonstrates no iodine avidity, then chemotherapy or external beam radiotherapy may be appropriate as an alternate therapy, which have greater side effects.

RAI is used in the treatment of the most common thyroid cancers, papillary and follicular. Specifically, RAI is typically administered for two main reasons. Firstly, to destroy any residual normal thyroid tissue (also known as remnant ablation) and secondly to destroy any microscopic sites of cancer that may persist post-surgery (adjuvant or therapeutic).[54] This latter indication is particularly aimed at patients whose tumours have worrisome features, including an aggressive tumour type, invasion into surrounding structures (e.g. blood vessels or lymphatics) or multi-focal cancers.

Additionally, following RAI administration for the cancer, whole body images are taken that allow for the early identification of unsuspected metastases.

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50 Cancer Australia. Available at: https://www.canceraustralia.gov.au/affected-cancer/cancer-types/thyroid-cancer/statistics.

51 Australian Institute of Health and Welfare (2020). Cancer data in Australia. Web Report, 13 November 2020. See: https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/contents/cancer-summary-data-visualisation

52 Australian Institute of Health and Welfare (2019) Cancer in Australia, p78.

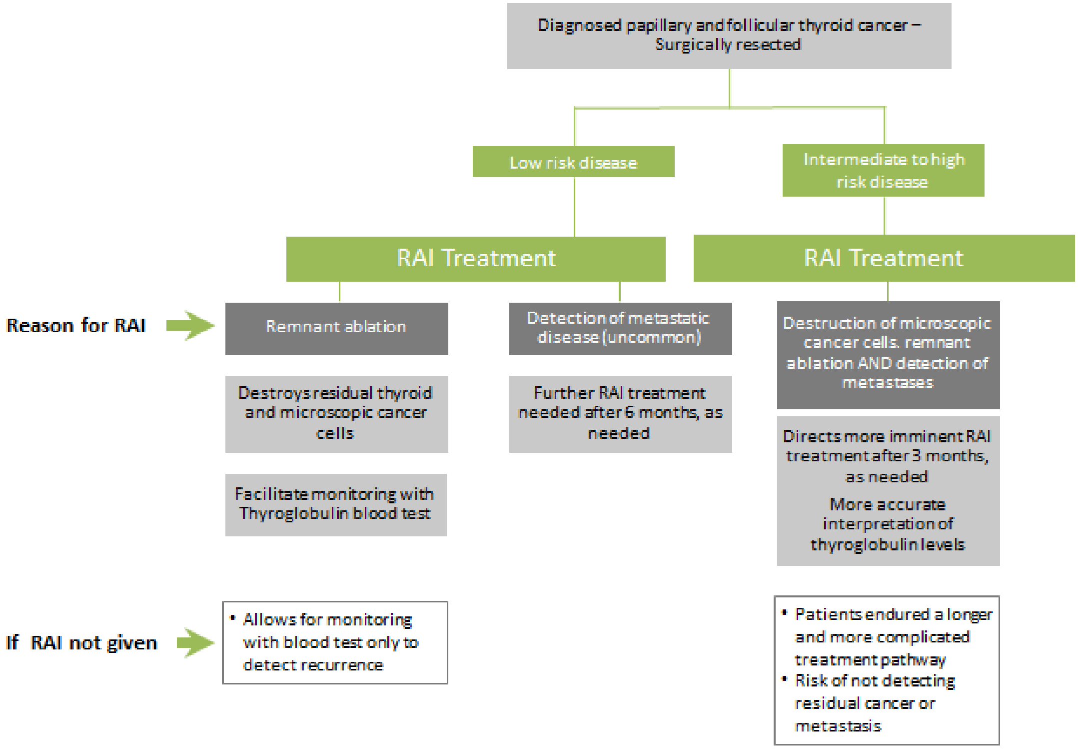
53 Spiegel, A. and Libutti, S. (2010) Future Diagnostic and Therapeutic Trends in Endocrine Cancers.

54 EndocrineWeb, 'Radioactive Iodine for Papillary Thyroid Cancer'. Available at: https://www.endocrineweb.com/conditions/thyroid-cancer/radioactive-iodine-papillary-thyroid-cancer#:~:text=Radioactive%20iodine%20therapy%2C%20which%20your,that%20may%20remain%20after%20surgery.

*Diagnostic and treatment pathways*

The figure below sets out the diagnostic and treatment pathways for papillary and follicular thyroid cancer with and without RAI therapy.

**Figure 12 Diagnostic and treatment pathways for papillary and follicular thyroid cancer**




**Source:** Synergies and AANMS.

As shown in the above figure, following the surgical removal of thyroid cancer, histopathology is performed to inform and guide subsequent therapy. The majority of patients will proceed to low or high dose RAI therapy.

Alternatively, when RAI treatment is not available to be used post-surgery in higher risk patients, there will be a greater risk of recurrence. In addition, thyroglobulin use as a tumour market will become less reliable, as residual thyroid tissue with continue to produce thyroglobulin. If subsequent RAI scanning is not available, patients will require sequential thyroglobulin assessment, leading to further imaging tests such as a CT, PET, MRI or bone scans if thyroglobulin levels are rising, or if there are other reasons to suspect metastatic disease, such as pain. These tests are far inferior to iodine scanning in terms of sensitivity and specificity. Due to the lower sensitivity of other tests for recurrence, treatment may be delayed significantly. Due to lower test specificity, there can be further delays before treatment can be initiated while recurrence is confirmed by pathology or treatments may be used inappropriately.

Screening with CT scans is also problematic as contrast contains non-radioactive iodine. If tumour is evident, then the iodine given with the CT scan will block uptake of RAI, delaying treatment for around 12 weeks until the iodine is excreted. If the patient has specific sites of pain, a better targeted scan could be performed. For example, a bone scan can be used to identify bone metastases though it will not show soft tissue lesions.

*Benefits of RAI therapy for diagnosis and treatment*

The fundamental benefit of RAI treatment is its effectiveness, safety, and efficiency. After surgery, the patient will usually have a small amount of normal thyroid cells remaining (thyroid remnant) in their neck. This is because it is difficult to safely remove the entire thyroid without damaging nearby structures, such as nerves. Therefore, there may be some thyroglobulin produced by these cells circulating in the blood.

As noted above, RAI treatment for remnant ablation (residual, presumably benign, thyroid tissue) destroys any residual normal thyroid tissue. As such, there are no normal cells remaining to contribute to thyroglobulin production. Hence, if thyroglobulin is detected in a patient's blood, the physician knows that it must be produced by residual or recurrent thyroid cancer and can administer further treatment immediately.

Alternatively, in the absence of RAI treatment being administered, residual normal thyroid tissue will remain, and hence testing that reveals high levels of thyroglobulin will not be reliable. As discussed above, this will lead to reliance on inferior scanning tests (i.e. CT scans) and significant delays in patient treatment (in the event that the thyroglobulin is being produced by cancer cells).

In addition, RAI ablation of the thyroid remnant includes whole body imaging which can reveal unsuspected metastatic disease. Several studies (refer Box 3 below) have demonstrated that, in many cases, small metastases were not apparent with chest radiographs or CT scans but were apparent with RAI scans, allowing more expedient treatment and optimal management. Finally, ablation of residual tissue allows for clearer pictures on subsequent scans of the patient's neck.

Most thyroid cancer cells share the same ability as normal thyroid cells to take up iodine from the bloodstream. These are referred to as 'iodine-avid'. Patients whose cancer cells do this benefit from RAI treatment as I-131 destroys the microscopic residual thyroid cancer cells. It simultaneously treats thyroid cancer that has spread to lymph nodes or other areas of the body (metastatic disease).

Several studies have examined the benefits associated with the use of RAI, particularly for patients with larger, more aggressive tumour types or residual tumour after surgery which have shown to derive a survival benefit with RAI.[55] Key findings are summarised in the box below.

**Box 2 Benefits of iodine therapy for thyroid cancers**

**The Treatment of Differentiated Thyroid Cancer in Children: Emphasis on Surgical Approach and Radioactive Iodine Therapy (2011)**

RAI was observed to kill thyroid tumour cells more than 70 years ago and since then, RAI has gained an increasing foothold in differentiated thyroid cancer (DTC) treatment because numerous reports show improved outcomes when RAI is properly applied.[56] Of particular importance leading to increased use of RAI in DTC were the studies of Mazzaferri and Young showing a very favourable impact of on DTC recurrence and survival in a large cohort of patients. Based on available evidence from studies of adults, the following key conclusions were found:

- RAI treatment leads to a reduced risk of recurrence and mortality in patients with DTC with postsurgical residual disease
- RAI benefit is clearly demonstrated in adult patients with stage III and IV disease (but not in stage I)
- RAI treatment of remnant tissue results in lower rates of DTC recurrence and metastasis.

This paper also reflected on the findings of several reports on DTC in children and finds that when properly applied, surgery and adjuvant radioactive iodine (RAI) therapy can minimise recurrence risks. It also found that collectively, studies show that DTC recurrence risk can be reduced by 1) performing total thyroidectomy vs. lobectomy; 2) performing compartment lymph node dissection vs. selective or no lymph node dissection; and 3) administering RAI. Key observations of the benefits of RAI in children included:

- Most young patients have well-differentiated tumour types, few have bone metastasis, and most tumours respond well to RAI therapy.
- Regarding paediatric DTC, for children present with distant metastatic disease (most commonly to the lungs), in more than 50 per cent of these cases lung tumours are micrometastases that are not apparent with chest radiographs or computerised tomography (CT) scans but are apparent with RAI scans.
- Rates of thyroid bed recurrence were 20 per cent at 10 year in the children not treated with RAI vs. 1 per cent when RAI was given. Rates of lymph node recurrence were 15 per cent at 10 year in the children not treated with RAI vs 4 per cent when RAI was given.
- The lack of adjuvant RAI was the greatest predictor of recurrent disease after the presence of distant metastasis at presentation.

**The treatment of thyroid carcinoma with radioactive iodine (1978)**

Several fundamental features and benefits of RAI were summarised in this study,[57] including:

- RAI is easily administered orally and usually only one therapy course is needed.
- Even small thyroid cancer metastases not detected by ultrasound or chest radiographs will concentrate iodine selectively in a high target-to-nontarget ratio.
- The iodine in the metastasis irradiates the metastasis from the inside out, relatively selectively.

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55 Kim, C and Mandel S. (2018) Radioactive iodine (I-131) Therapy for Thyroid Cancer, 25 October 2018. Available at: https://www.oncolink.org/cancers/thyroid/treatments/radioactive-iodine-i-131-therapy-for-thyroid-cancer

56 Rivkees, S. et al (2011) The Treatment of Differentiated Thyroid Cancer in Children: Emphasis on Surgical Approach and Radioactive Iodine Therapy

57 Beierwaltes, W. H. (1978). The treatment of thyroid carcinoma with radioactive iodine.

- The ionising radiation produced by the 609-keV-rays may be greater than from conventional x-rays but it is confined to a smaller area because the radiation penetrates only a few millimetres in tissue.
- About 85 per cent of the nontarget iodine is excreted in the urine within 1 to 3 days.

**Is chest x-ray or high-resolution computed tomography scan of the chest sufficient investigation to detect pulmonary metastasis in pediatric differentiated thyroid cancer? (2004)**

Bal et al. demonstrated RAI efficacy for pulmonary metastases in children and adults. After an average 3.3 courses of iodine and mean duration of 33.2 months of follow-up, pulmonary lesions disappeared in 14 patients (70%), and Tg levels became undetectable. The majority of paediatric patients with DTC were also observed to have x-ray and CT-negative pulmonary metastasis. However, these metastases were iodine avid and were detectable and treatable with RAI.

**Pulmonary metastases in differentiated thyroid cancer: efficacy of radioiodine therapy and prognostic factors (2015)**

This study analysed data from a large cohort of patients with pulmonary metastases from differentiated thyroid cancer (DTC) to assess the effect of radioiodine therapy and investigate the prognostic factors of survival for patients with pulmonary metastasis secondary to DTC. Among patients demonstrating 131I-avid pulmonary metastases, 156 cases (60.9%) showed a significant decrease in serum Tg levels after 131I therapy and 138 cases (60.3%) showed a reduction in pulmonary metastases on follow-up CT. A complete cure, however, was achieved in just 62 cases (24.2%).[58]

**Use of Radioactive Iodine for Thyroid Cancer (2011)**

Previous cohort studies have shown improved survival and reduced tumour recurrence when iodine-avid, advanced-stage, well-differentiated thyroid cancer is treated with radioactive iodine. There is little controversy concerning the value of radioactive iodine for these patients. In contrast, for very low-risk disease, in which prognosis is typically excellent, treatment with radioactive iodine is of uncertain benefit.

As described above, RAI therapy enables the immediate identification and treatment of residual thyroid cancer cells. This minimises the length of the treatment process for thyroid cancer patients in addition to minimising the potential for the severity of patient’s condition increasing due to delays in the administering of treatment.

Compared to alternative treatment pathways for thyroid cancer, RAI treatment is superior both in terms of delivering timely and effective treatment to optimise patient health outcomes and in terms of the overall efficiency in treating thyroid cancer patients. In addition, it has a very low side effect profile without loss of hair, skin changes or potentially significant complications such as infections and other life-threatening conditions resulting from chemotherapy or external beam radiotherapy.

### *Consequences of lack of indexation*

Despite the significant benefits to patient health outcomes and the efficiency of the healthcare system as detailed above, the MBS items related to the provision of RAI therapy to treat thyroid cancer has not been indexed and has remain unchanged since

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58 Song, H., et al (2015). Pulmonary metastases in differentiated thyroid cancer: efficacy of radioiodine therapy and prognostic factors.

1998. This is despite all four of the major components of the cost of providing this treatment – labour, capital equipment, pharmaceuticals, and premises costs – growing significantly over this period, as detailed in section 3.

To date, practitioners have responded to this trend by absorbing the cost increases to the extent possible, with some practitioners increasing OOP payments for patients and, in some cases, restricting or no longer providing RAI therapy to thyroid cancer patients. The continued lack of indexation will result in these pressures exacerbating, leading to further increases in OOP costs and an increasing number of practitioners limiting patient numbers or no longer being able to viably provide this treatment. This will in turn result in either delays to treatment or thyroid cancer patients being diverted to alternative diagnostic and treatment pathways, leading to prolonged therapy periods with suboptimal therapeutic protocols associated with worse side effect profiles and additional costs to the healthcare system.

As such, the continuation of the benefits of treating patients with thyroid cancer with RAI therapy is contingent upon the indexation of the MBS items applicable to the provision of RAI therapy to better remunerate nuclear medicine practitioners for the cost of providing this treatment. The magnitude of these benefits is only expected to increase in the future with the increasing incidence of thyroid cancer.

### 4.2.2 Case study 2: The use of V/Q scan for diagnosing pulmonary embolism

This case study investigates the use and benefits of ventilation perfusion (V/Q) scans in the diagnosis of pulmonary embolism (PE), compared to other common diagnostic methods, specifically computed tomography pulmonary angiography (CTPA).

Australia experiences approximately 17,000 new cases of venous thromboembolism annually, with PE accounting for 40 per cent of cases (6,800 cases).[59] In 2015, it was estimated that 340 deaths were attributable to PE.[60] Untreated PE have a mortality rate of as high as 30%. When diagnosed appropriately, this can be reduced substantially (to 8% or less). Hence, appropriate diagnosis and treatment can reduce mortality by 73%.

PE is a blockage in the pulmonary arteries, which supply blood to the lungs, caused by one or more blood clots. A blood clot can form in the veins of the legs, pelvis, abdomen or in the heart.[61] The clot can then dislodge from where it first forms and travel in the blood stream to lodge in one of the pulmonary arteries. A major PE can be fatal, while a

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59 Ausmed. Available at: https://www.ausmed.com.au/cpd/articles/pulmonary-embolism

60 Doherty, S. (2017). Pulmonary embolism: An update. *Australian Family Physician*, 46 (11), p 816-820.

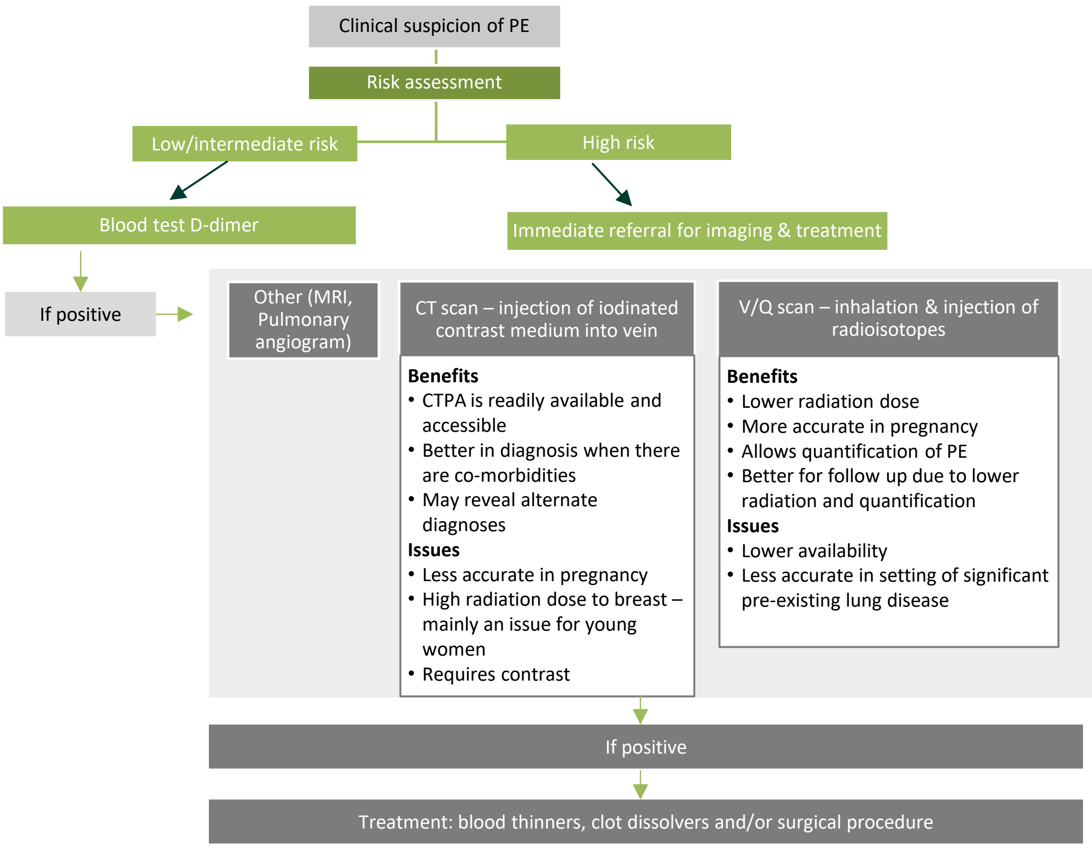
61 Health Direct, Pulmonary embolism. Available at: https://www.healthdirect.gov.au/pulmonary-embolism

minor PE can be treated (i.e. with the use of anticoagulants, or in some cases, with surgery) if caught early.[62]

*Diagnostic pathways*

The figure below sets out the diagnostic and treatment pathways for PE.

**Figure 13 Diagnostic and treatment pathways for treatment of PE**




**Source:** Synergies.

Typically, to determine if a patient has acute PE, they will first undergo a risk assessment to determine low, intermediate, or high pre-test probability (PTP). If high PTP, the patient will receive an immediate referral for treatment or imaging. If low or intermediate PTP, the patient will usually take a blood test (D-dimer test). If positive, the patient then undergoes imaging for diagnosis.

As treatment of PE can be associated with potentially significant side effects, a definitive diagnosis is ideally required prior to starting therapy. The most common imaging

[62] Healthline, Pumlonary Embolism. Available at https://www.healthline.com/health/pulmonary-embolus#followup

modalities to assess for PE are CTPA and V/Q scan.[63] In addition to the blood test, a chest radiograph will usually be performed prior to imaging to show other diagnoses that may be the cause of the PE symptoms, e.g. pneumothorax, pneumonia or larger lung cancers.

While chest x-ray remains useful in determining alternative diagnoses, definitive diagnosis requires other imaging. CTPA involves a CT scan with injection of iodinated contrast medium into a peripheral vein and is performed in the radiology/diagnostic imaging department. A V/Q scan involves inhalation and intravenous injection of radioisotopes. No specific preparation is required, with the test taking approximately 30 minutes and is usually well tolerated.[64]

CTPA is the most commonly used modality, largely due to its wide availability and ability to demonstrate alternative causes of symptoms. CTPA is preferred in patients with underlying lung disease. However, CTPA is contraindicated in some patients, particularly those with contrast allergy and impaired kidney function.

Meanwhile, V/Q scanning is the modality of choice for pregnant women, patients with kidney failure and iodine contrast allergies, and younger patients. In Australia, V/Q with single photon emission computed tomography (SPECT) is used, meaning the patient is usually imaged with a 3-dimensional technique from which multiple reconstruction planes can be produced, similar to CT.[65]

If diagnostic testing confirms the existence of PE, the patient is immediately referred for treatment. Treatment of PE is aimed at keeping the blood clot from getting bigger and preventing new clots from forming. Immediate treatment is essential to prevent serious complications or death. Typical treatment includes medications such as blood thinners and clot dissolvers, or surgical procedures such as clot removal or vein filter. As treatment of PE can be associated with potentially significant side effects, a definitive diagnosis is required using diagnostic imaging prior to starting therapy.

*Benefits of V/Q relative to alternative diagnostic methods*

The key benefits and advantages of V/Q for diagnosis of PE are:

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[63] The only other relevant test is a pulmonary angiogram, however this is now rarely performed for the diagnosis of PE. An ultrasound of the leg to demonstrate clots I the leg veins may also be performed. This can be helpful where other imaging may be delayed or difficult to access.

[64] Australian Family Physician (2013) Pulmonary embolism: assessment and imaging Volume 42, No.9, September 2013 Pages 628-632.

[65] Australian Family Physician (2013) Pulmonary embolism: assessment and imaging Volume 42, No.9, September 2013 Pages 628-632. .

- there are no absolute contraindications (being where an event or substance causes a life-threatening situation) and it is extremely safe;
- it is the optimal imaging modality for young patients, as it presents the lowest radiation risk and in pregnancy where it is more accurate and uses less radiation;
- it allows for quantification which is useful particularly for follow up;
- as the lower radiation technique, it is more suitable for repeated imaging; and
- it can be safely used in patients with kidney disease and contrast allergies where CTPA has a small risk of reactions.[63]

V/Q scans have a high diagnostic sensitivity, allowing both for accurate identification and quantification of PE,[66] which is valuable for informing decision making regarding the appropriate treatment pathway for patients.[67]

As noted above, V/Q scanning is the preferred diagnostic test in patients with suspected PE who are either pregnant or young. V/Q scans perform best when the lungs are otherwise normal. This is most often the case in young people. There is a lower radiation burden associated with V/Q scans relative to CTPA.[68] While the risks of diagnostic radiation are largely minimal, breast tissue in young women is particularly radiosensitive and likely even more so during pregnancy. The radiation dose to the breast and subsequent maternal risk for breast cancer is significantly higher for CTPA[69].[70]

Pregnancy is a special case. Not only are there the aforementioned radiation concerns, but CTPA performs less well in pregnant patients due to alterations in normal blood flow secondary to pregnancy. There are a number of articles demonstrating this and V/Q is the preferred imaging modality in pregnant patients as recommended by many international societies.[71]

The final key benefit of V/Q scans compared to CTPA is more efficient patient follow up. When performing follow up to assess clot resolution, V/Q scan offers the potential

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66 V/Q scanning allows for identification of segmental and subsegmental perfusion defects typical of PE, particularly in the middle lobe and ligula.

67 Waxman, A., et al (2017) Appropriate Use Criteria for Ventilation–Perfusion Imaging in Pulmonary Embolism. Available at: http://s3.amazonaws.com/rdcms-snmmi/files/production/public/Quality/jnm191437_v7.pdf

68 The breast and lung are in the direct path of the radiation beam.

69 Noting that radiation risk to the fetus is low and comparable between the two scans (V/Q and CTPA).

70 Doherty, S. (2017) Pulmonary embolism: An update. Volume 46, No.11, November 2017, pages 816-820. Available at: https://www.racgp.org.au/afp/2017/november/pulmonary-embolism/

71 See for example, Cahill AG Obstet Gynecol. 2009 Jul:114 (1):124-9, also Gruning T BJR June 2016:89(1062).

for quantification of residual clot burden as well as being the test with lower radiation exposure.

The box below provides findings from several studies reviewing the use of V/Q and comparing V/Q against CTPA.

**Box 3 Studies investigating the use and advantages of V/Q**

***Appropriate Use Criteria for Ventilation–Perfusion Imaging in Pulmonary Embolism: Summary and Excerpts (2017)[72]***

V/Q lung scintigraphy has long been used as a sensitive and useful tool to detect the presence of PE. CTPA was introduced in the mid-1990s, and subsequently this technology demonstrated the ability to detect peripheral or subsegmental PE. CT scans are more commonly available (essentially 24/7), as compared with nuclear medicine studies. In addition, CTPA diagnostic algorithms are simpler and able to depict pulmonary, pleural, mediastinal, and chest wall lesions that may cause symptoms like those of PE though the true benefit of this has been disputed as most of the relevant findings are easily identified with CXR and on V/Q SPECT/CT.[73] With these attributes, CTPA has become the most common procedure for the diagnosis of PE. On the other hand, CTPA may be contraindicated in some patients, such as those with intravenous radiographic contrast reactions or renal failure. Therefore, in many patients, V/Q scintigraphy may be warranted as the primary imaging procedure when PE is suspected.

The detail of CTPA has raised concerns about the overdiagnosis and overtreatment of small, clinically insignificant PEs and the frequent reporting of new incidental findings that require further work-up. A third and even greater concern is the patient's CTPA radiation exposure, particularly to the radiosensitive breast tissue of young women.

PE imaging is best evaluated based on outcomes rather than accuracy. In a prospective study comparing V/Q and CTPA, Anderson et al. showed that the outcomes (based on a 3-month follow-up of negative cases) were similar (similar false-negative rate, less than/equal to 1%) despite the fact that more PEs were detected with CTPA than with V/Q scans. Similar outcome data have also been described in a large retrospective analysis.

***Education Modules for Appropriate Imaging Referrals: Suspected Pulmonary Embolism (2015)[74]***

The strengths of V/Q scan relative to CTPA were identified as follows:

- Significantly lower radiation dose when compared to CTPA
- More sensitive in diagnosing peripheral pulmonary embolus.
- Less prone to suboptimal image quality due to either poor contrast opacification of pulmonary vessels or respiratory motion artefact as might be seen in up to 6% of all CTPA studies.
- Safe to be performed in the following patients in whom CTPA is relatively or absolutely contraindicated: i) Iodinated contrast hypersensitivity; ii) Patients with severe renal impairment; (iii) Premenopausal women, in whom the radiosensitive breast tissues will receive only a very small fraction of breast radiation when compared to CTPA; (iv) pregnancy (the foetal dose for CTPA and V/Q is extremely small and comparable but the breast dose from V/Q is much lower).

72 Waxman, A., et al (2017) Appropriate Use Criteria for Ventilation–Perfusion Imaging in Pulmonary Embolism. Available at: http://s3.amazonaws.com/rdcms-snmmi/files/production/public/Quality/jnm191437_v7.pdf

73 Sheen, Jean-Ju (2018). Performance of Low-Dose Perfusion Scintigraphy and CT Pulmonary Angiography Angiography for Pulmonary Embolism in Pregnancy. CHEST, Volume 153 (10), pp 152-60.

74 Goergen S, Tran H, Jong I, Zallman M. Suspected Pulmonary Embolism. Education Modules for Appropriate Imaging Referrals: Royal Australian and New Zealand College of Radiologists; 2015.

**V/Q Scanning Using SPECT and SPECT/CT (2013)[75]**

V/Q SPECT has higher sensitivity, specificity, and accuracy than planar imaging and a lower indeterminate rate. SPECT allows for new ways to display and analyse data, such as parametric V/Q ratio images. Compared with CTPA, SPECT has higher sensitivity, a lower radiation dose, fewer technically suboptimal studies, and no contrast-related complications. Any nuclear medicine department equipped with a modern hybrid scanner can now perform combined V/Q SPECT with CT (using low-dose protocols) to further enhance diagnostic accuracy. V/Q SPECT (with or without CT) has application in other pulmonary conditions and in research. In comparing V/Q SPECT to CTPA, studies have shown CTPA show less than desirable sensitivity, suboptimal accuracy and image quality affected technical artefacts.

Overall, relatively few studies have directly compared SPECT V/Q and CTPA. Reinartz et al. showed that SPECT was more sensitive (97% vs. 86%) but less specific (91% vs. 98%) than 4-slice CTPA (14). Miles et al., in a study of 100 patients using 16-slice CTPA, also found the accuracy of each to be comparable. They noted that SPECT had fewer contraindications, a lower patient radiation dose, and fewer nondiagnostic findings (50). In a study of 81 patients, Gutte et al. found that V/Q SPECT had a higher sensitivity (97% compared with 68%) but a lower specificity (88% compared with 100%) than CTPA (16-slice) (18).

These head-to-head studies consistently demonstrate that V/Q SPECT has a higher sensitivity, that CTPA has a higher specificity, and that the overall accuracy of each modality is comparable. With each modality having its strengths and weaknesses (Table 2), the test selected for any individual patient should take into account patient factors (including age, sex, renal function, diabetes, and the presence of coexisting lung disease) and institutional factors (e.g., availability and local expertise).

The benefits to the health system of ensuring timely access to V/Q studies mainly centre on two aspects. Firstly, the higher accuracy in pregnant patients will reduce additional investigations being done to clarify a non-diagnostic CTPA result.

Secondly, the use of the lower radiation procedure in young women is the most prudent course. Studies on breast cancer induction are limited as one cannot ask patients to volunteer to have their breast irradiated so we can measure the outcome. However, indirect evidence from other reasons for exposure (scoliosis patient imaging, Hiroshima data and patients treated with radiation for other reasons like chest or neck cancers) suggest that there is a real benefit to minimising radiation to these patients. The cost of any secondary cancer to the patient as well as the health system is significant and much higher than the cost of prevention by using the lower radiation test.

### *Consequences of the lack of indexation*

This case study demonstrates the importance of V/Q scans for providing a safe means of diagnosing PE in pregnant women and patients with kidney failure and contrast allergy and the potential benefits of V/Q scans in avoiding the need for additional scans. Despite these benefits, the capacity for the healthcare system to provide V/Q scans to these patients is being eroded by rising costs and the absence of indexation of the MBS item for V/Q scans since 1998.

75 Roach, P., Schembri, G., Bailey, D. (2013) V/Q Scanning Using SPECT and SPECT/CT, Journal of Nuclear Medicine September 1, 2013 vol. 54 no. 9 1588-1596.

The failure to apply indexation to better remunerate practitioners for the cost of providing V/Q scans will further reduce the availability of this diagnostic test and hence place the benefits derived from V/Q scans at risk.

Already many referrers turn to the more readily available CTPA study arguing that delays in diagnosis offset the small breast cancer risks. This is particularly true after hours.

## 4.3 Implications of insufficient remuneration of nuclear medicine services

As demonstrated in section 3, the cost of providing nuclear medicine services has grown significantly over the past decade. Despite this, no indexation has been applied to the MBS items for these services since 1998. This section discusses the implications of the insufficient remuneration of nuclear medicine services, both in terms of the availability of these services and on outcomes for patients and the efficiency of the healthcare system.

### 4.3.1 Reduced availability of nuclear medicine services

As costs continue to increase, this lack of indexation will result in nuclear medicine practitioners reducing their scope of services, as the revenue derived from providing some services is not sufficient to cover the total costs of service provision.

When asked how they have responded to increasing costs of providing nuclear medicine services, 59 per cent of respondents indicated they had responded by ceasing to provide some nuclear medicine procedures. Furthermore, 22 per cent indicated they had responded by closing sites, while significant proportions of respondents indicated they had reduced the quantity of nuclear medicine services provided over the past 10 years. For example, 70 per cent of respondents have reduced their provision of myocardial perfusion scans (heart scans), while almost 50 per cent have reduced provision of bone scans and over 40 per cent for lung scans.[76] While some of these reductions may be due to other factors, poor renumeration makes a test less competitive than potentially less efficacious alternatives. These procedures play an important role in the early and accurate detection of several key cancers and chronic conditions, the importance of which is discussed in section 4.1.

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76 Noting that in addition to the increasing cost of these scans (and lack of indexation of the relevant MBS items), this is also likely attributable to an increase in the use of other tests.

Failure to apply indexation to MBS items relating to nuclear medicine procedures will result in further reductions in the availability of these services as continued cost increases eventually result in the provision of these services no longer being viable.

For some conditions, the adverse impacts of the reduced availability of nuclear medicine procedures may be relatively minimal, as there may be other procedures for which the MBS items do enable practitioners to cover the full cost of service provision, that are equally as effective in diagnosing and treating the relevant cancers and chronic conditions. For example, gated heart pool scans can be replaced by echocardiography which can give similar results (though less reproducible and technically not possible in some patients).

In other cases, given the chronic nature of the conditions that nuclear medicine procedures are typically used to diagnose and/or treat, patients in need of these services will be able to access them through the public health system. However, this will lead to increased pressure on the public system, potentially resulting in delays to individuals receiving the appropriate treatment and/or the system incurring additional costs in treatment patients with chronic conditions.

Reduced access to nuclear medicine services may be particularly significant in rural and remote areas where access to alternative procedures or to the public hospital system may be limited.

For some conditions, however, nuclear medicine procedures are clearly the most effective means of diagnosing and/or treating certain conditions. While in most cases there are alternative procedures that can be used as substitutes for these procedures, they are less precise and less effective and hence lead to inferior patient health outcomes and often additional costs being imposed on the healthcare system.

### 4.3.2 Reduced accuracy of diagnosis

As discussed above, early and accurate diagnosis is critical to optimising patient health outcomes and reducing the economic cost of cancer and other chronic conditions. A range of nuclear medicine procedures play a key role in ensuring the early and accurate diagnosis and monitoring of many cancers and chronic conditions, including:

- PET scans
- bone scans
- thyroid scans

- cardiac scans.[77]

The reduced availability of these nuclear medicine procedures will place an increased reliance on other procedures to diagnose and manage these cancers and conditions. However, in many cases, such as thyroid cancer, these alternative procedures will not be capable of producing a diagnosis to the same accuracy as the nuclear medicine procedure. As such, these procedures will not inform treatment decisions with the same level of accuracy as the nuclear medicine test, resulting in high healthcare costs, delay in care, patient morbidity/mortality, and unnecessary radiation burden.

For example, PET scans are widely used to examine patients with lymphoma after initial treatment, to determine the extent to which the masses in the lymph nodes still contain active cancer cells. While regular CT scans can be used as an alternative to PET scans, the structural changes seen on the CT inevitably lag in their rate of resolution compared to the functional or metabolically active component of the mass which can be evaluated by PET scans. CT alone will therefore result in delay to the detection of the treatment response, increased radiation burden and increased costs associated with the need for repeat testing or potentially unnecessary treatment. In addition, unlike anatomical imaging such as CT, PET can demonstrate early failure of treatment and enable doctors to change to a more successful therapy much earlier in the treatment pathway. This is also the case for the many other cancers, including the diagnosis and treatment of thyroid cancer, which is examined more closely in section 4.2.1.

Potential reduced accuracy in the diagnosis of cancers and chronic diseases resulting from reduced availability of nuclear medicine imaging increases the risk of misdiagnosis or provides less precise diagnosis resulting in the patient receiving sub-optimal or unnecessary treatment. In addition to inferior patient health outcomes (being the worsening of the cancer or chronic condition or being subjected to unnecessary treatment), this can lead to inefficient outcomes for the healthcare system (e.g. costs of repeat testing, provision of multiple treatments and costs of delayed diagnosis or treatment). Specific examples of these adverse impacts are also investigated in the case studies in section 4.2.

In summary, the failure to apply indexation to the MBS items for nuclear medicine services is distorting decision-making in terms of the most effective diagnostic tests for a range of cancers and chronic conditions, hence adversely impacting patient health outcomes and the efficiency of the healthcare system.

[77] American Cancer Society, Nuclear Medicine Scans for Cancer, see: https://www.cancer.org/treatment/understanding-your-diagnosis/tests/nuclear-medicine-scans-for-cancer.html

### 4.3.3 Increased strain on the public healthcare system

While the number of practitioners able to provide nuclear medicine services will continue to decline in the absence of indexation being applied, demand for those services that play a critical role in the diagnosis and treatment of cancers and chronic conditions will continue to increase.

This will impose increased strain on the public healthcare system, as demand for nuclear medicine procedures to be undertaken at hospitals and public health facilities continues to grow. In addition to consuming critical resources in public hospitals, this will require additional funding for investment in nuclear medicine equipment in the public system. The waiting time and for these services will also increase, resulting in delays in appropriate patient diagnosis and management.

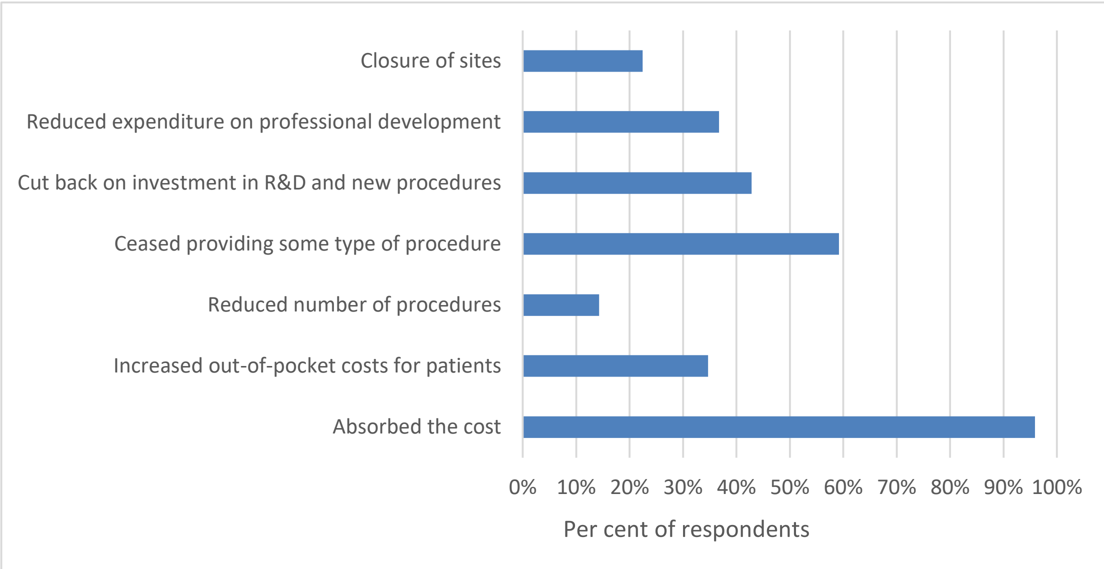
### 4.3.4 Increased out of pocket costs for patients

In the absence of the MBS items providing sufficient remuneration to enable nuclear medicine practitioners to recover the full cost of service provision, practitioners that do not cease to provide nuclear medicine services will seek to maintain viability by increasing the payment required from patients. That is, patients seeking access to these services will be required to pay higher out-of-pocket costs.

This will increasingly result in nuclear medicine services becoming cost prohibitive to patients. Where nuclear medicine diagnostic testing is substantially superior to other testing and patients are unable to access services due to the OOP costs, there is increased risk of both adverse health outcomes, as discussed above, and those patients suffering financial hardship.

The survey of nuclear medicine practitioners asked respondents how they had responded to the increasing costs of providing nuclear medicine services. The results from this question are detailed in the figure below.

**Figure 14 Responses to cost increases by nuclear medicine practitioners**




**Source:** Synergies' survey of nuclear medicine practitioners.

As shown in the figure above, while the most common response has been for practitioners to absorb the cost increases, a significant proportion (35 per cent) of practitioners have also increased OOP costs for patients to meet the increasing costs of service provision. Other common responses have included ceasing to provide various nuclear medicine procedures, reducing investment on research and development and new procedures, and reducing expenditure on professional development.

As the cost of providing nuclear medicine services continues to increase (see section 3), OOP costs for patients requiring nuclear medicine procedures will continue to increase (in the absence of indexation being applied to MBS items for nuclear medicine services), as practitioners will need to derive additional revenue from patients for provision of these services to remain viable. Increasingly, practitioners will be unable to absorb cost increases, which will result in a greater proportion of practitioners increasing OOP costs for patients.[78]

This impact is particularly pronounced in regional and rural areas, where access to nuclear medicine services through the public health system is lower than in urbanised areas, and hence where patients are more likely to have to pay large OOP costs to access nuclear medicine procedures.

[78] It is also likely that a greater proportion of practitioners will also respond by further reducing the range of nuclear medicine services they provide and further reducing their level of investment in research and development, new procedures, new capital equipment and machinery, professional development, etc.

## 4.4 Longer term consequences

### 4.4.1 Reduced investment and availability of best practice technologies

Failure to ensure the sufficient remuneration of a service results in an inefficient constraint being imposed on capital investment. In the case of nuclear medicine practitioners, the inadequacy of the MBS items to sufficiently remunerate practitioners for the cost of providing nuclear medicine procedures will result in:

- practitioners will use equipment and technology for longer than is optimal (i.e. beyond its useful life);
- practitioners will invest in inferior (cheaper) equipment and technology (as opposed to best practice equipment and technologies); and
- when existing equipment and technology reaches the end of its useful life, practitioners may cease to provide services rather than invest in new equipment and technology, such as advances in image processing and artificial intelligence algorithms. This risk is exacerbated by the Capital Sensitivity initiative which ceases MBS reimbursements for old equipment.

These expected outcomes are supported by the results from the survey of nuclear medicine practitioners (with 64 responses). As noted above, 96 per cent of survey respondents indicated that their practice had absorbed cost increases in recent years. When asked how the practice had absorbed these costs, 72 per cent responded that they had kept equipment for longer.

In addition to reducing the availability of nuclear medicine services over the long term, the dampening effect of the insufficient remuneration of nuclear medicine services on capital investment will also increase the risk of patients receiving sub-optimal treatment as a result of the use of outdated equipment and technology, for example causing a delayed in diagnosis of a of tumour or tumour recurrence leading to delayed treatment or continuance of ineffective therapy.

### 4.4.2 Loss of skills and capabilities over time

Lastly, the insufficient remuneration of nuclear medicine services also has adverse implications for workforce attraction and retention in the nuclear medicine field, which will ultimately lead to a further reduction in the availability and quality of these services. The survey of nuclear medicine practitioners revealed that 37 per cent of respondents have responded to increasing costs by reducing expenditure on professional development. As discussed above in relation to the cessation of procedures and increases in OOP contributions, this proportion will increase as nuclear medicine practitioners' capacity to absorb cost increases becomes increasingly constrained.

Nuclear medicine is a small but vital service which can provide unique access to imaging and therapeutic options. If the remuneration for the specialty falls relative to other specialities, the ability to recruit and retain specialists in the field is undermined. Long term, this will lead to either a contraction of services to a few centres or simply the loss of these unique services. The patients who otherwise would have had a nuclear medicine test or therapy will therefore have no choice but to be provided with the next best alternatives available, not always optimal.

Similar trends can be observed in relation to research and development and innovation. Continued cost pressures and the insufficient remuneration of nuclear medicine services means the funds available for research and development and investment in new procedures will be reduced. Around 43 per cent of survey respondents indicated that their practice had reduced expenditure on research and development and new procedures in response to increasing costs.

Constraints on professional development and expenditure on research and development will have adverse consequences for the availability and level of service in the nuclear medicine discipline, to the detriment of patients and the healthcare system, over the long term.

# 5 Conclusion

The cost of providing nuclear medicine services has increased significantly over the past two decades. In some cases, the cost of the radiopharmaceutical required to administer a nuclear medicine service exceeds the MBS item for the service.

To date, nuclear medicine practitioners have responded to these cost increases primarily by absorbing costs, with a significant proportion of practitioners also reducing their scope of services, increasing OOP costs to patients, and reducing expenditure on new equipment and professional development.

However, if the current freeze on the indexation of MBS items for nuclear medicine services continues, the capacity for practitioners to absorb future cost increases will continue to decline, leading to further reductions in the availability of nuclear medicine services or increased costs to patients. The adverse consequences of this are:

- adverse impacts from reduced accuracy of diagnostic tests and treatments (e.g. incorrect or delayed diagnosis) for a range of cancers and other chronic diseases due to the use of suboptimal alternative diagnostic tests;
- increased stress on the public health system as a result of the reduced availability of nuclear medicine services throughout the healthcare sector;
- increased costs due to the inefficient duplication of diagnostic tests;
- adverse patient consequences due to the provision of unnecessary or sub-optimal treatment as a result of less precise diagnoses;
- loss of treatment options for patients with specific requirements;
- increased costs or loss of access to the most appropriate imaging modalities for patients in remote and rural areas; and
- longer term impacts in relation to a shortage of nuclear medicine skills and capabilities, further constraining the availability of critical tests and treatments.

There is scope for additional analysis to be conducted to quantify the magnitude of the above impacts, both in terms of the adverse consequences for patient health and the healthcare system as a whole. This could be investigated as part of the future process of implementing indexation for MBS items applicable to nuclear medicine services.

The indexation of MBS items relating to nuclear medicine services would lead to mitigation of these adverse consequences, protecting the economic benefits derived from the provision of nuclear medicine services, to patients and the healthcare system.