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Medical Radiation Practice Supply and Demand Model - Methodology Paper

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List of Acronyms and Abbreviations

ABS	Australian Bureau of Statistics
AFHW	Australia's Future Health Workforce
Ahpra	Australian Health Practitioner Regulation Agency
APC	Admitted Patient Care
AR-DRG	Australian Refined – Diagnostic Related Group
DRG	Diagnostic Related Group
EDDG	Emergency Department Diagnosis Group
ERP	Estimated Resident Population
ESRGs	Enhanced Service-Related Groups
FTE	Full-Time Equivalent
GLM	Generalised Linear Model
LSPN	Location Specific Practice Number
MBS	Medicare Benefits Schedule
MeSHWPoD	Medical Specialist Health Workforce Prediction of Demand
MRP	Medical Radiation Practitioner
NAPEDC	Non-Admitted Patient Emergency Department Care
NEP	National Efficient Price
NHCDC	National Hospital Cost Data Collection
NHWDS	National Health Workforce Datasets
NNAPD	National Non-Admitted Patient Database
NWAU	National Weighted Activity Unit
PHDB	Private Hospital Data Bureau
PLIDA	Personal Level Integrated Data Asset
SA4	Statistical Area 4

1.0 Introduction

This paper provides the methodology used for the supply and demand model for the Medical Radiation Practitioner (MRP) workforce. It aims to quantify the supply and demand for MRPs between 2024 and 2038 using data collected from several sources between 2018 and 2023.[1]

2.0 Modelling Overview

Medical radiation practitioners are registered healthcare practitioners who perform diagnostic imaging studies on patients, plan and administer radiation treatments, or prepare and administer nuclear medicine.[2]

2.1 Scope

In Australia, MRPs must be registered with the Medical Radiation Practice Board to practise. There are different registration types corresponding to different levels of training and experience: general registration, provisional registration, limited registration and non-practising registration. The details of programs of study approved by the Board that lead to different types of registration as an MRP can be found here: Approved programs of study.

To become eligible for general registration, a medical radiation practitioner must complete a minimum four-year equivalent undergraduate, or two-year postgraduate Master program of study approved by the Board.

Internationally trained MRPs (excluding New Zealand applicants) seeking to work in Australia must apply to the Board for assessment of overseas qualifications. Applicants who have current registration in New Zealand apply under Trans-Tasman Mutual Recognition.[3]

In this study, registered MRPs are grouped into categories based on the division under which they are registered. The Board has 3 divisions of practice and registered practitioners must be registered in at least one of the following divisions:

- Diagnostic radiography
- Radiation therapy or
- Nuclear medicine technology

Please note that sonographers are excluded from this study.

[1] The workforce projections have been estimated over a shorter period, as compared to the 25-year period for all medical practitioner supply and demand studies, due to the relatively longer training pipeline for medical practitioners.

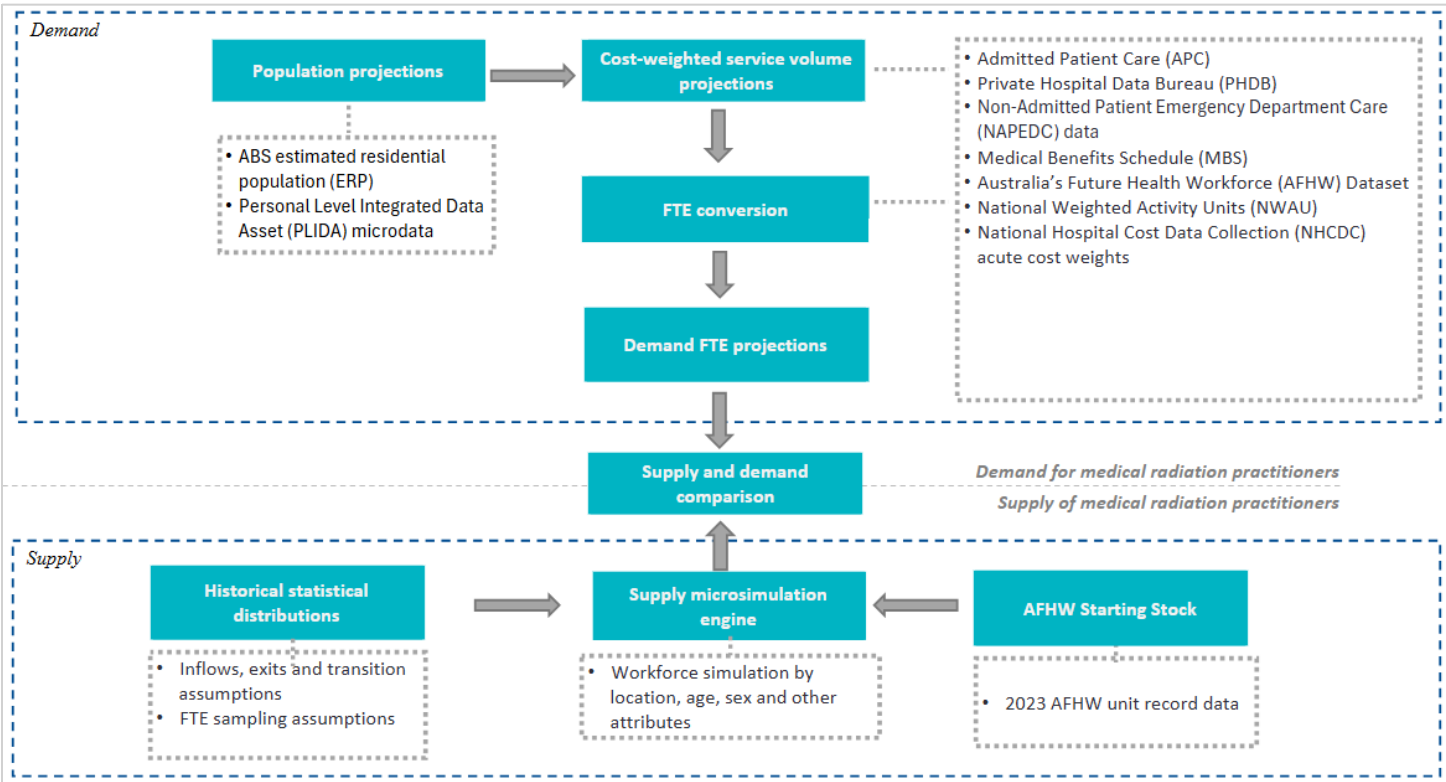
[2] Australian Government Department of Health, 2016, Medical Radiation Practitioners, accessed 10 June 2026.

[3] For further details, refer to Medical Radiation Practice Board of Australia - Overseas qualified practitioners.

The modelling has been undertaken at the Statistical Area 4 (SA4) geography (where data availability permitted). However, results will be published at state and territory level, with their aggregation forming the national results.

Figure 1 provides an overview of the modelling process. The following sections explains the steps in further detail.

Figure 1: Overview of the medical radiation modelling process



3.0 Medical Radiation Supply

The medical radiation supply model uses Australia's Future Health Workforce (AFHW) data on MRPs from 2018 to 2023.

The supply model uses the microsimulation approach where attributes such as entries and exits to the workforce and practitioner Full-Time Equivalent (FTE) are modelled distinctly. The supply methodology begins by identifying the current stock of MRPs, analysing their demographic profile and historically observed work patterns. Statistically significant predictors of future workforce supply (such as age, sex, etc.) are selected, and their historical distributions are measured to allow the development of a microsimulation model.

The microsimulation works at a yearly time-step, tracking the progressing of MRPs throughout their career. Each year, it accounts for new entrants, removes MRPs who take temporary or permanent leave, and simulates transitions of MRPs between geographic locations. The following sections describe how each component is defined and modelled in the supply model.

The baseline projections assume an initial equilibrium between supply and demand in the base year, 2023.

3.1 Key data inputs

The key datasets used for the medical radiation practitioner supply modelling are extracted from the following sources.

#	Source	Description and use in model
1	Australia's Future Health Workforce (AFHW) dataset	The AFHW datasets are created from the National Health Workforce Datasets (NHWDS) for modelling purposes. A sequence of rules (supply criteria) is applied to each NHWDS to determine which practitioners meet the definition of supply for each profession (and sub-groups where applicable). The headcount and workload of these practitioners, along with other variables required for modelling, are included, derived or imputed in the AFHW datasets. The AFHW dataset contains unit record data on MRPs including demographic variables and information on their career (such as hours worked which is converted to FTE).

3.2 Historic and starting stock

The AFHW data is a unit record longitudinal dataset, where each respondent is assigned a unique identifier that can be linked across multiple years. To be in scope, MRPs must be:

1. currently registered (excluding non-practising registration) with the Medical Radiation Practice Board of Australia
2. working in medical radiation practice in Australia including those on extended leave, and
3. working clinical hours.

3.2.1 Total Hours (Full-Time Equivalent)

Total hours (clinical and non-clinical)[4] of MRP are used in modelling supply. If an MRP is employed but on extended leave (defined as a period of over 3 months), their hours are halved for simplicity, assuming they worked an average of 6 months during the year.

[4] Clinical hours are defined as hours reported in clinical roles which involve direct patient care. Non-clinical hours are defined as hours reported in non-clinical roles (including teacher, researcher, administrator including managers) that do not involve direct patient care.

One FTE is defined as 38 self-reported weekly average hours in the AFHW dataset (across 46 weeks in the year).

3.2.2 Practitioner type

MRPs are assigned a practitioner type based on the division under which they are registered:

1. Diagnostic radiographer
2. Radiation therapists
3. Nuclear medicine technologists

Although some practitioners may hold registration in multiple divisions, dual registration is relatively uncommon.[5] For this modelling, each practitioner is assigned to a single division to avoid double-counting of individuals or FTE hours.

Unlike the nursing and midwifery survey which captures division specific information, the MRP workforce survey does not collect division-specific data. As a result, division assignment in this model is based on a hierarchical approach: practitioners are first allocated to the nuclear medicine technologist, then to radiation therapist, and finally to diagnostic radiographer. This reflects the relative size of each division.

3.3 Measuring entries, exits and transitions

The AFHW dataset enables tracking of individuals as they age, relocate, progress in their careers and transition in and out of the workforce. Historical data relating to entries, exits and transitions is used to determine future trends based on the analysis of historical demographic probabilities and distributions.

The demographic probabilities and distributions are sampled to understand the effects of age, sex, state/territory of primary workplace and place of specialist qualification on workforce patterns.

3.3.1 New entries

There is no publicly available data on the number of domestic graduates and internationally trained MRPs entering the workforce. As a result, the AFHW dataset is used to identify new entries.

New entries into the medical radiation workforce include individuals entering as domestic graduates and internationally trained MRPs. A new entry is defined as an MRP who is within the scope of ‘supply’ in the base year, but not within ‘supply’ in the previous 4 years.[6]

In the supply model, a constant number of new entries is assumed over the projection period, based on the average number of new entries observed annually between 2019 and 2023 (5-years), for both domestic graduates and internationally trained MRPs.

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[5] In 2022, only 14 practitioners were registered across two divisions—12 in both nuclear medicine technology and diagnostic radiography, and 2 in both radiation therapy and diagnostic radiography.
[6] The 4-year period is used because scope of practice considerations become less relevant beyond that timeframe. This approach is applied to both entries and exits.

3.3.2 Exits and re-entries

Exits from the medical radiation workforce are determined using historical AFHW data by tracking individual practitioner's participation over time. Practitioners who appear in the AFHW data in one year but not the next are classified as having exited the workforce. Exits are modelled by age, sex, practitioner type, place of initial qualification and state of primary workplace as covariates.

These one-period exits are further classified as temporary or permanent exits.

- **Temporary exits or re-entries**: refer to MRP who leaves the workforce after working for at least one reporting period (i.e. one year) but returns to the profession within a 4-year period. The point of re-entry is estimated based on the rate at which MRPs who leave the workforce, return in subsequent years. The modelling of re-entry probabilities includes the same covariates as exits i.e. age, sex, practitioner type, state of primary workplace and place of initial qualification.
- **Permanent exits**: refer to a MRP who, after working for at least one reporting period (i.e. one year), leaves the workforce and does not return within a 4-year period.

3.3.3 Interstate transitions

Interstate movement is estimated based on the probability of MRPs changing their primary place of work from one state/territory to another. Covariates used to determine transition rates and destinations are the current state of the MRP's primary workplace, sex, age practitioner type, and place of initial qualification.

3.3.4 Estimating full-time equivalent (FTE) of entries, re-entries and transitions

The number of FTE each MRP works is a central component of the model. FTE is a measure which can vary significantly between individuals and years. One FTE is defined as 38 self-reported weekly average hours worked.

To account for the variations in FTE by various demographics of MRPs, the simulated medical radiation workforce FTE distribution is estimated by age, sex, practitioner type, place of initial qualification, state of primary workplace and whether they work in the private or public sector (or both). This is done by:

1. Re-sampling an existing MRP's FTE annually to reflect their demographic attributes, as it may change from year to year. Additionally, their FTE is adjusted by a time-dependent modifier based on changes to the average FTE observed over the past 5 years.
2. Additional FTE adjustments, in the form of a series of multipliers, is then applied to an MRP's FTE, following one of the workforce status changes below:
    - a workforce exit or entry, or
    - a change in state/territory of workplace

These adjustments are applied after the new FTE re-sampling has been applied. This is because the adjustments effectively adjust for breaks in regular employment.

3.4 Supply Modelling

A microsimulation process is used to project supply for each of the MRP types. An overview of this process is shown in Figure 2 below. The supply model uses the following attributes:

1. FTE based on 38 hours per week
2. sex
3. age
4. practitioner's division (practitioner type)
5. place of initial qualification (domestic or international)
6. primary work location (state/territory, SA4).

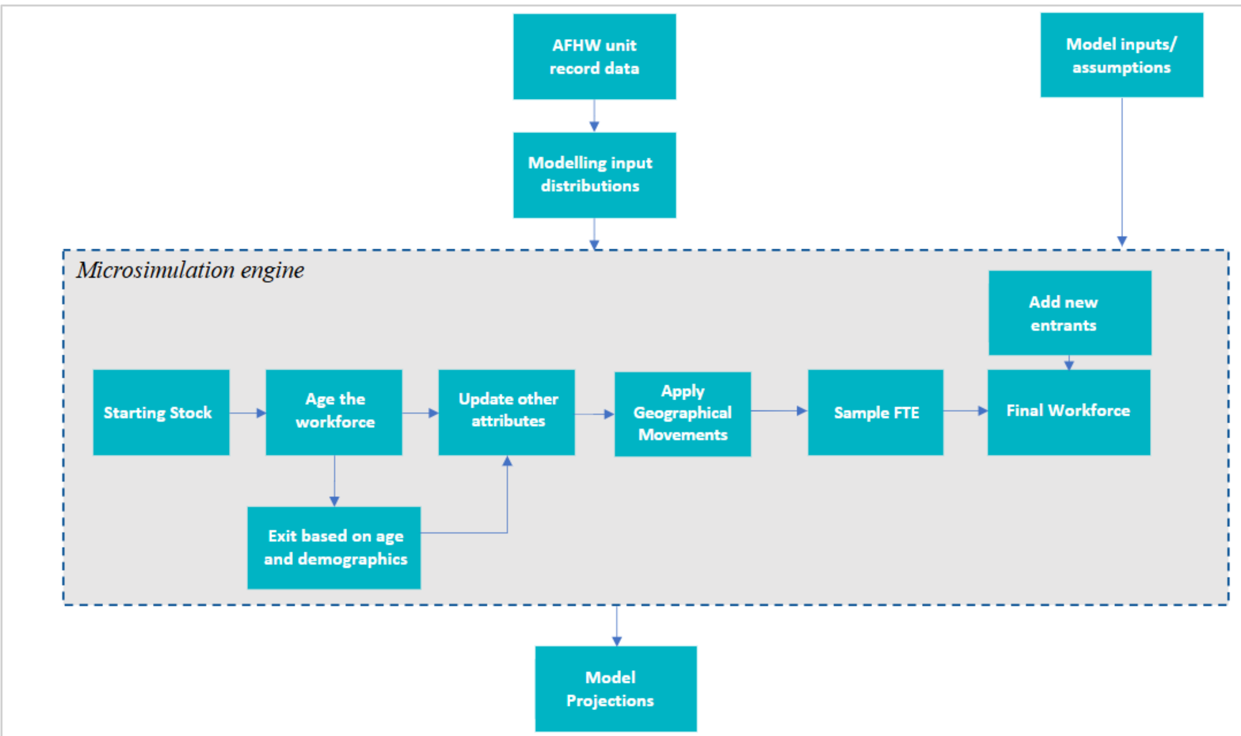
In each iteration of the microsimulation:

1. The workforce is aged, and some practitioners exit the workforce based on their age, sex, place of initial qualification and state of primary workplace.
    a) Exits are sampled to determine if the exit is permanent or temporary.
    b) MRPs that temporarily exit will re-enter the workforce during a subsequent period of up to 4 years, in accordance with the historical distribution of re-entries following up to 4 periods of absence.
2. Geographical movements are applied to MRPs based on historic state/territory migration patterns broken down by sex, age, practitioner type, place of initial qualification and state/territory of primary workplace.
3. FTE is updated based on smoothed historical FTE year-on-year changes by age, unless a MRP:
    a. geographically transitions to a different state/territory or
    b. returns from a temporary exit.
4. MRPs that are flagged for re-entry are brought back into the workforce when their pre-assigned leave duration has elapsed. Leave duration is determined by factors such as age and place of initial qualification, with a maximum of 4 years for temporary exits. The FTE for re-entering MRPs is sampled from a distribution modelled on historical AFHW data.
5. New MRPs are added to the workforce either as:
    a. a domestic graduate or
    b. an internationally trained MRP.

6. The modelling process iterates annually, where the number of MRPs in the following year is calculated as the number of MRPs in the current year, minus the number of MRPs exiting and transitioning-out, plus those entering the workforce and transitioning-in in the new year. In other words:

$$\text{Supply}_{(t+1)} = \text{Supply}_{(t)} - \text{Exits}_{(t+1)} + \text{Entries}_{(t+1)} + \text{Net transitions while staying employed}_{(t+1)}$$

Figure 2: The supply microsimulation process



3.5 Assumptions

#	Caveat/Limitation	Description and implications
1	Static sampling assumptions	The microsimulation module applies static sampling distributions based on historical data from 2018 to 2022 to simulate projected behaviour, except for average FTE distribution which is adjusted based on historical trends.

2	New entries	The supply model assumes the number of newly qualified domestic and international MRPs entering the workforce will remain constant throughout the projection period. The average number of new entries observed between 2019 to 2023 is used.
3	COVID-19 impact	The effects of the COVID-19 pandemic on the years 2020-2021, particularly its potential impact on workforce supply, remain unclear and will be clarified through further analysis of updated data. For demand modelling, COVID-19 affected financial years (2020-21 and 2021-22) were carefully analysed, with jurisdiction-specific exclusions applied based on the nature, extent and timing of the disruptions.
4	Technological change	Technological improvements during the projection period that may affect workforce FTE in providing care are not considered.

4.0 Medical Radiation Demand

Demand is measured in terms of observed utilisation of services which captures expressed (observed) demand for medical radiation services across a variety of care settings. Historical patterns of usage are examined and used to estimate the future demand for MRPs, accounting for differences in service demand across various age groups and geographies. Estimation of future demand for medical radiation services also considers the Australian Bureau of Statistics (ABS) Population Projections. Demand modelling uses data collected from several sources (listed in section 4.1) between 2014 and 2023.

The model, known as the Medical Specialist Health Workforce Prediction of Demand (MeSHWPoD) is used by the Department of Health, Disability and Ageing (the Department) to provide demand projections for the specialist workforce. For further details on the MeSHWPoD methodology with worked examples, please refer to ***Attachment A**.*

Impact of COVID-19 pandemic

The impact of the COVID-19 pandemic on medical radiation services varied across jurisdictions.[7, 8] Consultations highlighted that some jurisdictions experienced a delayed effect on radiation therapy, where reduced cancer screening rates in 2020 led to lower patient treatment volumes in 2021. In other jurisdictions, nuclear medicine services were significantly

[7] Cancer Australia, 2020-2022, The impact of COVID-19 on cancer services, accessed 4 August 2025.
[8] Sreedharan S., Mian M., McArdle D. J. T., Rhodes A. 2021, The impact of the COVID-19 pandemic on diagnostic imaging services in Australia, Journal of Medical Imaging Radiation Oncology, PMC PubMed Central, accessed 4 August 2025.

disrupted during 2020 and 2021 due to shortages of radiopharmaceutical. To ensure more accurate demand estimations, data from COVID-19 affected financial years (2020-21 and 2021-22) were carefully analysed, with jurisdiction-specific exclusions applied based on the nature, extent and timing of the disruptions.

4.1 Key data inputs

The key datasets used for the medical radiation demand modelling are extracted from the following sources:

#	Source	Description and use in model
1	Medical Benefits Schedule (MBS) data	Contains data on patients billed through the MBS, including patient demographics such as age, sex, location, service provider location, the specific MBS item and benefit paid. A hospital flag indicator is used to exclude any MBS services delivered in hospitals to avoid overlap with Admitted Patient Care (APC) data/Private Hospital Data Bureau (PHDB) data.
2	Admitted Patient Care (APC) data	Contains data on episodes of care for admitted patients in all public and private acute, and maternity/women's hospitals, free standing day hospital facilities, and hospitals specialising in other specialised acute medical or surgical care. The data includes patient demographics such as age, sex, location of residence, service provider location and type of facility (used to derive sector). It also includes detailed data on procedures and diagnoses based on Australian Refined – Diagnostic Related Group (AR-DRG) classification.
3	Private Hospital Data Bureau (PHDB)	Contains data on episodes of care for admitted patients in private hospitals (although three of these hospitals are treated as public for reporting purposes). The structure and variables collected is similar to those in the APC data.
4	Non-Admitted Patient Emergency Department Care (NAPEDC) data	Contains data on episodes of care for patients who physically present to emergency departments. The data includes patient demographics such as age, sex, location of residence, service provider location, the length of stay measured in minutes, and various classifications relating to the principal diagnosis of each presentation.

#	Source	Description and use in model
5	Population and household projections based off ABS data	Population and household projections developed by the Department based on ABS Series B population projections and the ABS Census household distribution type. Population projections are by age group, sex, geography and year.
6	National Weighted Activity Unit (NWAU)	NWAU is used as part of the National Funding Model and is a measure of health service activity expressed as a common unit, against which the National Efficient Price (NEP) is paid. It provides a way of comparing and valuing each public hospital service, including emergency care, subacute care, admitted care and non-admitted care, weighted for clinical complexity.
7	National Hospital Cost Data Collection (NHCDC)	NHCDC public sector, collected through the states and territories, is an annual and voluntary collection of public hospital data. The NHCDC is used to develop the national efficient price, which determines the level of funding public hospitals receive annually.

4.2 How services for medical radiation are defined and attributed to practitioner types

The scope of services provided by MRPs is defined using methods tailored to specific datasets, as outlined below.

Demand for diagnostic radiographers is estimated using the APC, PHDB, NAPEDC and MBS data. In contrast, demand for radiation therapists and nuclear medicine specialists is derived exclusively from the MBS dataset. This approach is adopted because Medicare funds these services in public outpatient settings and partially subsidises them in private facilities. Consequently, the MBS dataset provides comprehensive coverage of both publicly and privately delivered radiation therapy and nuclear medicine services.

4.2.1 MBS data

To provide Medicare eligible diagnostic imaging services, practices must be accredited under the Diagnostic Imaging Accreditation Scheme (the Scheme) and have registered with Services Australia and have been allocated a Location Specific Practice Number (LSPN). An LSPN must be submitted as part of each Medicare claim for a diagnostic imaging service.

Medical radiation services included in the demand modelling from MBS data are identified using LSPNs. Specifically, the modelling includes Medicare items linked to an LSPN, excluding those classified as professional attendances, diagnostic procedures, or therapeutic procedures not related to radiation oncology.

Table 1 shows the in-scope MBS sub-categories and practitioner type (division) assigned to the sub-category.

Table 1: In-scope MBS sub-categories

MBS Category	MBS Sub-category	Category description	Sub-category description	Medical Radiation Practitioner type / Division
5	I03	Diagnostic imaging services	Diagnostic radiology	Diagnostic radiographer
5	I01	Diagnostic imaging services	Ultrasound	Diagnostic radiographer
5	I02	Diagnostic imaging services	Computed tomography	Diagnostic radiographer
5	I05	Diagnostic imaging services	Magnetic resonance imaging	Diagnostic radiographer
3	T02	Therapeutic procedures	Radiation oncology	Radiation therapist
5	I04	Diagnostic imaging services	Nuclear medicine imaging	Nuclear medicine specialist

4.2.2 APC and PHDB data

Each patient separation recorded in the Admitted Patient Care (APC) and Private Hospital Data Bureau (PHDB) datasets is assigned both a Diagnostic Related Group (DRG) and an Australian Refined Diagnostic Related Group (AR-DRG). These classifications are used to group patients with similar clinical conditions and/or procedures, reflecting comparable patterns of resource utilisation. DRGs and AR-DRGs can be mapped to Enhanced Service-Related Groups (ESRGs), which further categorise patients based on specific diagnoses or interventions, aligned with the medical specialty of the attending clinician.

The APC dataset comprises patient and diagnostic information from public hospitals, whereas the PHDB dataset captures equivalent data from private hospital settings.

In general, demand for medical specialties is inferred through the analysis of ESRGs associated with those specialties. However, a direct linkage between primary diagnoses (as represented by AR-DRGs) and medical radiation services does not exist. This limitation presents challenges in accurately quantifying demand for medical radiation services based solely on diagnostic classifications.

To overcome this, the demand estimation model adopts the assumption that all admitted patient activity may potentially involve medical radiation services. Accordingly, activity across all DRGs is apportioned using cost weights derived from the National Hospital Cost Data Collection (NHCDC). These cost weights are disaggregated by service categories, including imaging. The model calculates the ratio of imaging-related cost weight to the total cost weight for each AR-DRG. This ratio is then applied to estimate the volume of diagnostic radiography services associated with each diagnostic group, thereby providing an estimate of demand for diagnostic radiographers.

4.2.3 NAPEDC data

In NAPEDC data, principal diagnosis codes (based on ICD-10 codes) are mapped to Emergency Department Diagnosis Groups (EDDG). To estimate the demand for diagnostic radiography services in emergency settings, the method used for APC and PHDB data is applied. Specifically, the ratio of imaging-related cost weight to the total cost weight is calculated for each EDDG. This ratio is then used to estimate the volume of diagnostic radiography services associated with each group, providing a proxy for demand in emergency departments.

4.3 Definition of Demand Activity

Medical radiation services from each data source are grouped into 3 categories:

1. MBS billings
2. Public and Private Hospital (Admitted)
3. Public Hospital Non-admitted (Emergency Department)

It is worth noting that the number of services alone is not a sufficient metric for comparison, as each require varying levels of resources, particularly in terms of workforce effort. Raw service volumes do not account for factors such as the severity of conditions, complexity of procedures, or degree of medical input required.

To address this, services or separations are converted into a more universal metric known as units of demand activity. This metric is weighted to better represent the relative effort required by practitioners for each service or separation and allows for a more accurate comparison of resource use within each category.

MBS billings

The weighting factor is calculated as the benefits paid for in-scope services (year x provider location x patient sex x patient age x patient location) divided by the reference cost which is the average benefit paid for in-scope services for a given specialty and year. The number of services is then multiplied by this weighting factor to calculate the weighted demand activity.

Public and Private Hospital (Admitted) separations and Public Hospital Non-admitted

In the context of estimating diagnostic radiography demand, where cost weights are used to apportion activity from all DRGs/EDDGs, no additional weighting is applied to the count of services. This is because the cost-weight-based approach already incorporates an implicit adjustment for resource intensity, including imaging-related effort.

4.4 Projection of Demand Activity

The process of projecting the count of services over the forecast period consists of the following key steps:

1. Calculate and project service utilisation using a Generalised Linear Model (GLM) - The covariates in the GLM model include year, patient age group, patient sex, and provider location. Population projections are used for estimation of the population at risk.
2. Demand activity projections are then converted to FTE by comparing demand activity against the supply FTE from AFHW dataset. Specifically, it involves the following steps:
    a. Estimate historical FTE-to-activity ratios by practitioner type and state/territory and use that to project the FTE-to-activity ratio for the forecast period.
    b. Multiply the projected FTE-to-activity ratio with the demand activity projections for each practitioner type and state/territory for each forecast year. This forms the baseline projection.

4.5 Assumptions

#	Caveat/Limitation	Description and implications
1	Admitted and non-admitted patient demand activity	Demand estimation model adopts the assumption that all admitted and non-admitted patient activity may potentially require diagnostic radiography input. Accordingly, activity across all DRGs/EDDGs is apportioned using imaging cost weights derived from the National Hospital Cost Data Collection (NHCDC).
2	Medical radiation services within MBS	The modelling assumes that Medicare services linked to a LSPN (excluding those classified as professional attendances, diagnostic procedures, or therapeutic procedures not related to radiation oncology) are delivered by MRPs. However, some of these services may be performed by other professionals, such as sonographers. Since the available data doesn't specify who performed the service, there may be some inaccuracies in estimating the demand for MRP workforce.
3	Medical radiation services within public outpatient settings	The National Non-Admitted Patient Database (NNAPD) is not used in the demand modelling. This is based on the assumptions that all services performed in public outpatient settings are captured in the MBS data. Services delivered to admitted and emergency patients (5–10%) are not reported to jurisdictions or billed to Medicare.

		This unobserved activity is assumed to follow the same growth trends as outpatient services.
4	COVID-19 impact	The effects of COVID-19 are not explicitly modelled, however, data from COVID-impacted financial years (2020–21) were excluded from jurisdictional-level analysis to ensure more accurate demand estimations. Nonetheless, the model may not fully reflect the long-term shifts in demand patterns resulting from the pandemic.

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All information in this publication is correct as at July 2026