Working Paper:

A Microsimulation Approach to Health Workforce Needs-Based Demand Modelling: A Case Study of Public Midwifery Demand

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Abstract

This paper presents a novel microsimulation approach to needs-based health workforce demand modelling. Accurately projecting workforce requirements is critical for healthcare system sustainability. However, traditional demand forecasting often relies on static population-to-provider ratios or historical utilisation trends, which inherently overlook individual clinical complexity and systemic unmet needs. Furthermore, although individual-level microsimulation is deployed in supply-side modelling, its application in demand forecasting remains rare. To bridge this methodological gap, we employ a Monte Carlo microsimulation to model care pathways for pregnancies and forecast public-sector midwifery demand in Australia from 2022 to 2032. By stochastically simulating demographic profiles, evolving clinical risk factors, and different care stages, the model effectively translates individual service needs into precise full-time equivalent (FTE) workforce requirements. The baseline projection estimates a demand of 12,520 FTE public midwives by 2032, revealing a critical supply shortfall of 1,960 FTE based on current supply trends. We also evaluate the implications on the workforce of key systemic changes through scenario testing. A 5-percentage-point increase in the utilisation of public maternity services raises the demand for 2032 to 13,032 FTEs. Additionally, expanding Continuity of Care (CoC) midwifery models yields demand projections of 11,984 FTE and 13,058 FTE, respectively. Overall, this study highlights microsimulation as a robust and highly adaptable tool for needs-based workforce planning, particularly for episodic, multi-stage clinical pathways requiring specialised professionals, and demonstrates its utility in evaluating complex policy scenarios.

Keywords: Microsimulation, Health Workforce Planning, Labour Demand, Midwifery, Needs-based Demand Modelling

JEL Codes: J23, I11, C53

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1 Introduction

1.1 Background

Maintaining a sustainable health workforce remains a fundamental challenge for modern healthcare systems, driven by global demographic shifts and the increasing complexity of patient care needs. To mitigate these pressures, robust health workforce planning is essential to proactively align clinical resources with evolving healthcare requirements. Workforce planning usually encompasses two dimensions: the supply and demand sides. Historically, workforce planners have prioritised supply-side metrics, such as recruitment and training pipelines. Estimating demand is significantly more complex due to data scarcity and methodological bottlenecks. Tracking linear workforce transitions is inherently simpler than capturing the dynamic, multi-stage epidemiological pathways required for accurate demand projections (Lee et al., 2024; Lopes et al., 2015).

Conventional demand modelling often employs utilisation-based methods that project historical service trends into the future. Although these methods leverage rich data, they risk perpetuating systemic barriers by ignoring unmet needs. Moreover, they fail to account for evolving models of care that alter how and by whom services are delivered (Birch et al., 2007; Asamani et al., 2021). To overcome these limitations, contemporary workforce planning is increasingly pivoting toward needs-based analytical frameworks that directly link population health needs to service delivery (Birch et al., 2009).

1.2 The evolution and limitations of demand modelling

To project future demand for the health workforce, early studies applied static provider-to-population ratios to future population projections, sometimes adjusting for demographic mix. However, these traditional models are increasingly criticised for overlooking the clinical complexity and evolving healthcare needs of modern patient populations. Birch et al. (2007) argue that these ratio-based approaches are fundamentally flawed because they combine expressed demand with actual health need, inadvertently embedding existing inequities and inefficiencies into future projections. Although some studies use service utilisation-to-population ratios to overcome these limitations, they still fail to account for the ever-changing epidemiological landscape and the varied care pathways required by different demographic cohorts (Crettenden et al., 2014).

Acknowledging the conceptual drawbacks of utilisation-based models, contemporary health workforce literature has increasingly pivoted towards needs-based frameworks. A primary advantage of needs-based planning is that it directly links the epidemiological profile with the required volume and mix of health services (Birch et al., 2009; Segal et al., 2018). This approach represents a significant conceptual leap, ensuring that workforce targets are driven by true health needs rather than historical supply constraints (Asamani et al., 2021).

Despite this theoretical superiority, a persistent methodological bottleneck remains. The empirical application of both utilisation- and needs-based models relies heavily on macro-level data (Lopes et al., 2015), thereby typically employing deterministic or dynamic macro-level simulations (Lee et al., 2024). While these models successfully capture complex feedback loops

and broad population flows over time, they fundamentally group individuals into aggregated, homogeneous cohorts. Although effective for overarching policy evaluations, this macro-level aggregation limits a model's capacity to simulate nuanced individual clinical complexity, stochastic disease progression, and preferences for care models which are essential to modern healthcare delivery.

1.3 The application of microsimulation in health workforce modelling

Microsimulation allows researchers to move beyond these static cohorts' averages by modelling the probabilistic transitions of individuals over time. This modelling approach has been utilised for numerous health policy questions, such as predicting trends in disease incidence or comparing the effectiveness of treatments (Rutter et al., 2011). In health workforce planning, Monte Carlo techniques and dynamic microsimulation have been successfully used to model supply-side dynamics, including attrition, retirement, and the training pipelines of health professionals. Examples include the Health Workforce Simulation Model utilised in the United States (Dall et al., 2017) and the General Practitioner Supply and Demand Model in Australia (Department of Health, Disability and Ageing, 2024a). However, there is limited use of individual-level microsimulation to forecast demand under a needs-based framework. This paper thus develops a novel needs-based model using a microsimulation approach to project workforce needs based on patients' clinical profiles and different models of care. We apply this model to estimate the demand for public sector midwives in Australia from 2022 to 2032.

Under the existing model, the Australian midwifery workforce is expected to face a future shortage (Homer et al., 2024; Pugh et al., 2013; Department of Health, Disability and Ageing, 2026b). However, these models have relied on either simplified provider-to-patient ratios (Homer et al., 2024) or deterministic utilisation-based methods (Department of Health, Disability and Ageing, 2026b). Microsimulation has been used to estimate maternity care service costs by incorporating different care models and modes of birth previously (Hu et al., 2024). However, it has rarely been extended to project the corresponding health workforce requirements. The episodic and risk-stratified nature of maternity care exposes the limitations of macro-level demand models, presenting an ideal case study for microsimulation to translate clinical risk profiles into precise workforce requirements. Therefore, maternity care provides a compelling test case for applying individual-level stochastic modelling to resolve the limitations of aggregated demand forecasts.

Beyond its methodological novelty, this microsimulation framework offers significant flexibility for strategic policy planning. Because the model operates at the individual level, it allows policymakers to dynamically evaluate how policy changes and shifting care preferences will impact future workforce requirements. To demonstrate the practical utility of this model, we conduct robust scenario testing to evaluate the workforce implications of two major systemic shifts in the case study.

1.4 Purpose of this paper

Given the pronounced disconnect between needs-based theory and individual-level simulation capabilities, there remains a critical gap in integrating microsimulation into needs-based mod-

elling. By applying Monte Carlo microsimulation to the demand-side intricacies of maternity care, this paper seeks to bridge the methodological divide. This study replaces static cohort assumptions with simulated individual care pathways, thereby providing a robust mechanism to translate health service needs into public-sector midwifery demand from 2022 to 2032. To our best knowledge, this is the first study to estimate the midwifery workforce requirement incorporating needs-based framework with microsimulation modelling. In addition, we provide evidence on the potential impacts of national policy changes, which contributes to the design and implementation of health policies.

The remainder of this paper is structured as follows. Section 2 presents some background information on the case study, including the Australian health system and the primary drivers of Australian midwifery workforce demand. Section 3 provides an overview of the datasets utilised in the case study and the methodology framework, detailing the Monte Carlo microsimulation model used to project future workforce requirements. Section 4 presents our baseline estimation results, complemented by scenario testing analyses. Finally, Section 5 discusses the broader health policy and economic implications of these findings and Section 6 concludes the paper.

2 Case Study Background

2.1 Maternity care in Australia

The Australian healthcare system operates as a hybrid model, underpinned by a publicly funded universal insurance scheme (*Medicare*) that guarantees free care in public hospitals, alongside a complementary private sector. Within this framework, especially in the public sector, midwives are significant health professionals across the entire pregnancy care pathway, providing comprehensive antenatal, intrapartum, and postnatal care. For women and pregnant people experiencing low- or normal-risk pregnancies in the public system, midwives operate as lead practitioners. However, when clinical complexities or high-risk conditions arise, they work collaboratively with, or transfer primary clinical responsibility to, medical specialists such as obstetricians.

Under this hybrid model, women and pregnant people can choose between private and public care models. The Australian Institute of Health and Welfare (AIHW) identifies 11 distinct categories of maternity care (Australian Institute of Health and Welfare, 2026). Across Victoria, Queensland, and Western Australia, one out of five women who gave birth in 2023 chose private maternity care [1].

Within the public sector, the most prevalent model is *public hospital maternity care*. Utilised by 45% of women, this care is delivered in public hospitals and outpatient clinics primarily by midwives, with support from multidisciplinary teams. The next most common category is *midwifery group practice caseload care*, also provided by midwives, representing 11% of women. Conversely, women presenting with complex maternal, medical, or fetal conditions are assigned to *public hospital high-risk maternity care* (3% of women), where the entirety of their care is led by medical specialists.

[1] This analysis is currently limited to Victoria, Queensland, and Western Australia, capturing nearly 60% of all pregnant people in 2023, as model-of-care data is not yet universally reported across all jurisdictions.

Collectively, public maternity models serve the vast majority of women and pregnant people in Australia, relying heavily on midwives as their foundational workforce. Furthermore, there is a distinct lack of granular data on staffing levels, productivity metrics, and capacity of the private midwives. Consequently, this study focuses exclusively on forecasting the demand for the midwifery workforce within the public healthcare sector.

2.2 Drivers for public midwifery workforce demand in Australia

The most direct driver of midwifery workforce demand is the underlying volume of pregnancies. According to Australian Bureau of Statistics (2024), the total fertility rate has decreased from 1.795 in 2014 to 1.481 in 2024, as shown in Figure 6 (A). As a result, the number of total births has decreased by 2.5%, even though the number of women aged 15 to 49 years has increased by 13.7% (Australian Bureau of Statistics, 2025).

In addition to fertility dynamics, the proportion of women and pregnant people, who choose public maternity care, serves as a critical driver of public sector workforce demand. Historical data suggests a steady long-term increase in public service utilisation. For instance, a linear regression of historical trends estimates that public utilisation among the 30–34 age cohort increases by 0.65 percentage points annually. However, this trend may be drastically exacerbated by ongoing challenges within the private maternity sector. Between 2018 and 2025, at least 18 private maternity units have closed nationwide (ABC News, 2025). Furthermore, Royal Australian and New Zealand College of Obstetricians and Gynaecologists (2025) highlights that private obstetric care is mandated only for inclusion in the most expensive (Gold) tier of private health insurance, a category that currently experiences declining participation rates. Driven by this dual challenge of shrinking service accessibility and reduced private insurance coverage, the health system may face a sharper-than-anticipated surge in public maternity service utilisation. While a recent government consultation paper on private health reform proposes prioritising maternity care to reverse this well-established decline in private-sector viability (Department of Health, Disability and Ageing, 2026d), the immediate trajectory points toward heightened pressure on the public system. Under these compounding circumstances, it is critical to explore how many additional public-sector midwives will be required to meet this escalating clinical need.

Demand for midwives is further influenced by the service delivery models chosen, as different models necessitate distinct clinical workflows and time commitments. The *midwifery group practice caseload care* model, also known as the Continuity of Care (CoC) midwifery model, ensures consistent care by a primary midwife across the antenatal, intrapartum, and postnatal periods. The CoC midwifery model is associated with several benefits for patients, staff, and cost-outcomes. Clinically, it is associated with higher rates of spontaneous vaginal births, lower rates of caesarean sections, and shorter hospital stays (Sandall et al., 2024). Psychologically, the model yields greater satisfaction for both consumers and practitioners by fostering trust, enhancing emotional safety, and significantly reducing midwife burnout (Fenwick et al., 2018). Furthermore, it has proven to be highly cost-effective compared to standard care alternatives (Hu et al., 2024). Unsurprisingly, there is a rapidly growing preference for this relational model among women and pregnant people (Faktor et al., 2024).

Driven by these positive outcomes and increased consumers' preferences, there is an increasing interest from both federal and state governments to expand CoC access (Australian College of Midwives, 2025). At the federal level, the Australian Government's overarching 2019 strategy, *Woman-centred care: Strategic directions for Australian maternity services*, explicitly endorses expanding midwifery continuity of care to improve choice, safety, and access (Department of Health, Disability and Ageing, 2019). Jurisdictional health authorities are actively translating these national directives into public hospital practice through the implementation of Midwifery Group Practice (MGP) and caseload models. For instance, the Australian Capital Territory's *Maternity in Focus* ten-year system plan establishes a firm policy commitment to universal CoC access while actively addressing workforce sustainability (ACT Health Directorate, 2022). Similarly, the *Queensland Birth Strategy* aims to systematically broaden CoC access (Queensland Health, 2023), supported by a targeted interactive decision-making framework to scale up these models (Toohill et al., 2020). However, despite this strong, coordinated policy commitment, there remains a critical lack of evidence regarding the workforce requirements needed to sustainably support this implementation at national scale.

In addition to care models, the public midwifery workforce is regulated across states and territories, with specific mandates for midwife-to-patient ratios in maternity wards and maximum caseloads for CoC midwives. Six of Australia's eight jurisdictions have mandated midwife-to-patient ratio structures (Victorian Government, 2015; Queensland Parliament, 2024; Industrial Relations Commission of New South Wales, 2023; South Australian Legislation, 2025; WA Department of Health, 2024; ACT Government, 2024). Furthermore, all eight jurisdictions have established caseload regulations for CoC midwives. These safe staffing regulations serve as the baseline for estimating the number of non-CoC midwives required for shift work in maternity wards, as well as the number of CoC midwives needed to provide care under the CoC model.

3 Data and Methodology

3.1 Data

3.1.1 Population and fertility rate data

The latest population projections from the Australian Bureau of Statistics (ABS) are used to inform this model's future numbers of women and age-specific fertility rates (Australian Bureau of Statistics, 2025). The ABS publishes three main projection series (high, medium, and low) to encompass a broad, though not exhaustive, range of plausible demographic scenarios for analysis. Spanning 2022 to 2071, these projections provide the foundational demographic data needed to estimate the number of pregnant women in each year.

3.1.2 Maternity care services data

The National Perinatal Data Collection (NPDC), managed by AIHW, is a population-based, national registry that captures comprehensive clinical and demographic information for all facility and home births across Australia (Australian Institute of Health and Welfare, 2025b). This dataset includes specific parameters on mothers' demographics and pregnancy-related health

risk factors: public hospital utilisation, Indigenous status, previous pregnancy history, previous caesarean section, smoking and alcohol consumption during pregnancy, body mass index (BMI), pre-existing diabetes, and pre-existing hypertension. These parameters are used to construct the demographic and risk profiles of our simulated sample.

In addition, the NPDC includes data on pregnancy complications, labour onset type, birth methods, length of hospital stay, childbirth outcomes, and newborn baby status. These parameters informs the clinical maternity care pathways for women based on their individual demographic and risk profiles.

3.1.3 Productivity data

To translate health service requirements into workforce demand, we utilise productivity data. The workforce demand for CoC midwives is calculated separately by applying established caseload limits of 30 to 40 patients per one FTE midwife, as stipulated in enterprise agreements across various jurisdictions (Victoria Department of Health, 2024; Queensland Industrial Relations Commission, 2025; NSW Ministry of Health, 2014; South Australian Emplyment Tribunal, 2022; WA Department of Health, 2025; Tasmanian Industrial Commission, 2025; ACT Government, 2024; Northern Territory Government Office of the Commissioner for Public Employment, 2022).

For shift-based care by non-CoC midwives, mandated minimum midwife-to-patient ratios are extracted from the Enterprise Agreements of jurisdictions with safe staffing ratio regulations.

For task-based care by non-CoC midwives, our productivity assumptions for the clinical time required for each specific activity are derived from various literature sources, as detailed in Appendix Table 5.

3.1.4 Workforce supply data

Although our main focus is on projecting workforce demand, we extracted historical midwifery supply data from the National Health Workforce Dataset (Department of Health, Disability and Ageing, 2026c) to provide comparative context. The NHWDS is a comprehensive national dataset comprising annual registration and demographic survey data for 16 regulated health professions across Australia. To isolate the relevant workforce, the dataset was filtered using these specific inclusion criteria: individuals holding either a single midwifery registration or a dual nursing and midwifery registration; who are actively employed in the workforce; practising within the field of maternity care; in a clinical role; and based in a hospital setting. It is important to note that these extracted figures may overestimate the relevant supply. The data spans all hospital settings, including midwives working in private hospitals, whereas our simulated demand projections are strictly confined to the public maternity sector.

3.2 Methodology

We follow the needs-based framework proposed by Birch et al. (2007), which suggests that all pregnant people should receive care aligned with established clinical guidelines and their health needs, rather than historical utilisation. To capture the stochastic nature of population health

and individual clinical pathways, the model is constructed using individual-level Monte Carlo simulations. The rationale for adopting a microsimulation model lies in the nature of maternity care. Each individual follows a specific clinical pathway, with subsequent health service needs dependent on previous health conditions and service interactions. An overview of this care pathway is shown in Figure 1. Our modelling approach follows three stages, as detailed in the following section.

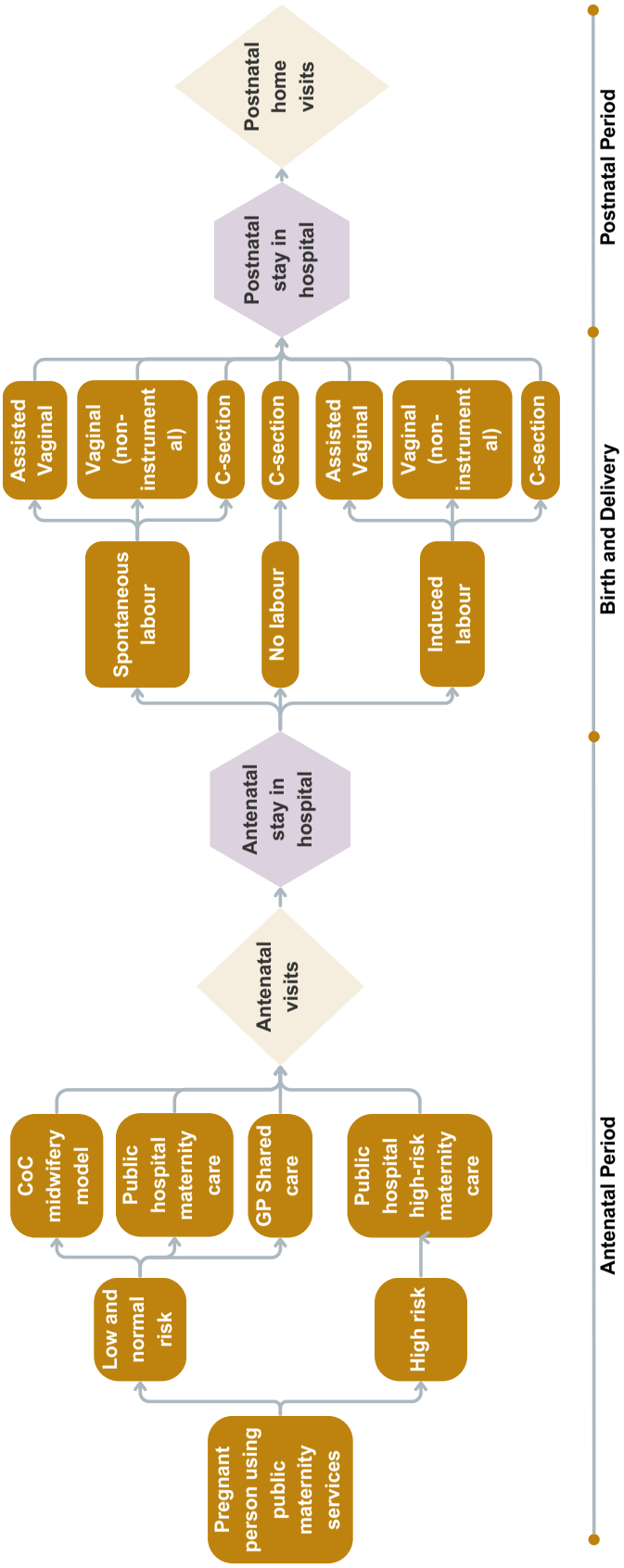


Figure 1: Overview of the maternity care pathways.

3.2.1 Stage 1: Simulating Pregnant Populations and Risk Profiling

We first generate a unit-record sample of pregnant individuals in Australia, capturing the demographic and health profiles of the target population. To capture uncertainty in future demographic trends, we employ a stochastic approach to project the annual population of reproductive-age individuals (aged 15 to 49) from 2022 to 2032. Rather than relying on a single deterministic population trajectory, we combine the ABS's Medium, High, and Low projection series to construct an age- and year-specific probability distribution. Specifically, the Medium projection series is defined as the mean (μ) of a normal distribution. We assume that the High and Low series approximate the upper and lower bounds of a 90% prediction interval (the 95th and 5th percentiles, respectively). The standard deviation (σ) for each cohort is therefore calculated as:

$$\sigma = \frac{\text{High} - \text{Low}}{2 \times Z_{0.95}}$$

where $Z_{0.95}$ represents the 95th percentile of the standard normal distribution (approximately 1.645). Within each iteration of the Monte Carlo simulation, the population size for each age and year is stochastically drawn from this distribution, floored at zero, and rounded to the nearest integer. This ensures that the simulated baseline population reflects the demographic variance projected by the ABS.

We then estimate the number of babies born per indivdiual by maternal age using assumed age-specific fertility rates. Since an individual can have multiple births per pregnancy, the number of pregnant individuals is smaller than the total number of babies born. Thus, we translate the estimated number of newborns to number of pregnancies using age-specific historical rates of multiple births derived from the NPDC.

Using this NPDC dataset, the microsimulation constructs individualised demographic and risk profiles while incorporating future changes. For variables with clear historical trends, linear regression is used to project annual changes throughout the forecast period. Furthermore, the simulation accounts for the interdependencies among these parameters by generating specific risk factors. For instance, the probabilities of pre-existing diabetes and hypertension are modelled conditionally upon maternal age. Due to current data constraints, the model utilises a single conditioning variable for each distribution. Appendix Table 4 provides comprehensive details of the assumptions, projected trends, and conditioning variables applied to each parameter.

3.2.2 Stage 2: Estimating Need for Health Services

The second stage maps each simulated individual to a specific maternity care pathway based on their demographic and risk profiles. The simulation's dynamics rely on a sequential structure of variable dependencies. Table 1 summarises the step-by-step logic and the underlying conditioning variables for each parameter generated within the model, and Appendix Table 4 lists the specific assumptions used in the baseline model.

The model subsequently assigns a clinical risk level to each individual based on their demographic and health characteristics, guided by the National Midwifery Guidelines for Consultation and Referral (Australian College of Midwives, 2021). Plurality directly dictates risk; specifically, any multiple birth is automatically classified as high-risk. Because clinical com-

Table 1: Variable dependency structure within the Monte Carlo microsimulation

Simulation Variable	**Dependencies (Prior Variables and Inputs)**
Gestational diabetes	Age (5-year groups)
Gestational hypertension	Age (5-year groups)
Clinical Risk Level	Age, Plurality (multiple birth), Pre-existing conditions, Gestational conditions
Gestational Age	Age (5-year groups)
Labour Onset Type	Gestational Age
Antenatal Length of Stay	Labour Onset Type
Birth Method	Labour Onset Type, Care Model
Postnatal Length of Stay	Birth Method
Baby admitted to NICU	Gestational Age

plexities preclude a universally standardised classification rule, we systematically aligned the Guidelines' criteria with the variables available in our dataset. For singleton pregnancies, risk is stratified based on the cumulative presence of the following clinical indicators: maternal age under 19 or over 40, obesity (BMI ≥ 30), smoking or drinking alcohol during pregnancy, a previous caesarean section, and pre-existing or gestational diabetes or hypertension. Once these risk profiles are generated, individuals presenting with none of these criteria are classified as low-risk, those with one or two as normal-risk, and those with three or more as high-risk. This high-risk threshold was empirically calibrated to ensure the proportion of high-risk pregnancies in our 2023 simulated sample matched the 5% observed utilisation rate for public hospital high-risk maternity care among public service users in 2023 (Australian Institute of Health and Welfare, 2025b).

Following the risk stratification, the Monte Carlo simulation sequentially assigns a specific care model to each individual. According to Australian Institute of Health and Welfare (2026), the CoC midwifery model and standard public hospital maternity care are primarily designed for low- or normal-risk pregnancies. On the other hand, public hospital high-risk maternity care is reserved for pregnancies presenting complex clinical conditions. Based on this framework, we established the baseline care model allocation assumptions detailed in Table 2, ensuring that the simulated distribution of care models in 2023 closely aligns with the observed AIHW data for that year.

We assume that the utilisation of the CoC midwifery model among low- and normal-risk public maternity service users remains at 17% in 2022 and 2023, then increases by 2 percentage points annually to reach 35% by 2032. This projected expansion reflects the national and jurisdictional strategies actively promoting the CoC model mentioned previously. Because longitudinal data on historical changes in CoC model proportions are currently unavailable, this annual growth rate serves as a heuristic estimate. To account for this uncertainty and provide status quo projection results, our scenario testing includes a stagnation scenario, in which the CoC model proportion remains constant throughout the projection period.

Furthermore, the simulation dynamically adjusts subsequent clinical probabilities based on the allocated care model. Specifically, allocation to the CoC midwifery model triggers a 9% reduction in the baseline probability of a caesarean section and a 5% increase in the probability of a non-instrumental vaginal birth (Sandall et al., 2024).

Table 2: Baseline assumptions for maternity care model allocation based on clinical risk level

Risk Level	Care Model	Distribution	Baseline Assumption
High Risk	Public hospital high-risk maternity care	100%	Constant
Low and Normal Risk	Public hospital maternity care	68%	Decrease by 2pp each year after 2023
	General Practitioner (GP) shared care	15%	Constant
	CoC midwifery	17%	Increase by 2pp each year after 2023

3.2.3 Stage 3: Translating Need for Health Services to Workforce Demand

The final stage translates the simulated clinical pathways into workforce demand using existing mandated staffing ratios and productivity measures.

For the non-CoC midwifery workforce, clinical activities are broadly categorised into two streams: shift-based care and task-based care. For shift-based care, the model enforces mandated minimum midwife-to-patient ratios. Given the variation in staffing standards across Australian jurisdictions, the model adopts a uniform, stringent set of staff-to-patient ratios to establish a robust baseline: 1:4 for day shifts and 1:6 for night shifts in antenatal wards; 1:1 during active labour in birthing suites; and 1:6 across all shifts in postnatal wards, with newborns counted as independent patients. However, infants admitted to the Neonatal Intensive Care Unit (NICU) are excluded from the postnatal ward count, as their care is managed separately by specialised neonatal staff. To ensure these ratios are strictly maintained relative to simulated patient volumes, fractional staffing requirements are always rounded up. Therefore, when patient volumes are not exact multiples of the mandated ratio, the model dictates that an additional midwife must be rostered. For instance, an antenatal ward with five patients during a day shift (a 1:4 ratio) mathematically necessitates two midwives. This integer-based rounding mechanism is directly incorporated into our calculations. The specific mathematical formula for calculating the total annual clinical hours required for shift-based care is detailed in C.

For task-based care, standard productivity assumptions are applied to calculate the total aggregate clinical time required from the workforce, as listed in Table 5. It is important to note that while CoC midwives perform these same clinical activities, task-specific productivity timings are not applied to their cohort. Because the CoC midwifery model operates strictly on a caseload basis, their workforce demand is determined entirely by annual patient caseload limits rather than the accumulation of individual task durations.

Among the task-based care activities, the number of antenatal visits is determined by clinical care guidelines. It is conditional on previous pregnancy history, assigned risk levels, and the chosen maternity care model. The Australian Pregnancy Care Guidelines state that for an uncomplicated first pregnancy, a schedule of ten antenatal visits is adequate, whereas seven visits are sufficient for subsequent uncomplicated pregnancies (Department of Health, Disability and Ageing, 2026a; World Health Organization, 2016). Following this principle, the simulation operationalises these schedules across different pathways.

For low-risk pregnancies with no previous pregnancy history, individuals enrolled in public

hospital maternity care receive ten midwife-led antenatal visits and those in GP shared care receive six visits. To reflect reduced clinical requirements for subsequent pregnancies, low-risk individuals with a previous pregnancy receive three fewer midwife-led visits, subject to a minimum of two visits. For normal-risk pregnancies, the model assumes heightened monitoring is necessary regardless of pregnancy history; therefore, it adds one additional visit to the baseline first-pregnancy schedules (e.g., resulting in 11 visits for public hospital care).

Conversely, for high-risk pregnancies managed under public hospital high-risk maternity care, we assume individuals receive only two antenatal visits with midwives, as the vast majority of their specialised care is delivered by medical specialists. The complete allocation matrix for midwife-led antenatal visits is structured in Table 3. Since the CoC workforce demand is determined by caseload rather than discrete clinical activities, no antenatal visit frequency is set for pregnant individuals under the CoC midwifery model. Postnatally, the model assumes an average of three home visits from midwives for all individuals (Schmied et al., 2024).

Table 3: Simulated distribution of midwife-led antenatal visits by risk level, maternity care model, and pregnancy history

Risk Level	Care Model	Previous Pregnancy	Midwife-led Visits
Low Risk	Public hospital maternity care	No	10
		Yes	7
	GP shared care	No	6
		Yes	3
Normal Risk	Public hospital maternity care	Any	11
	GP shared care	Any	7
High Risk	Public hospital high-risk maternity care	Any	2

Additionally, we allocate four hours per week per maternity service to antenatal or childbirth education courses for parents provided by midwives, based on public information from public hospitals.

To account for non-clinical workloads, including administrative documentation and travel time, a supplementary time multiplier is applied to all antenatal and postnatal visits. Within the Monte Carlo simulation, this administrative allowance is stochastically drawn from a uniform distribution ranging between 23% and 68% of the baseline clinical time (Kearney et al., 2023). Importantly, this supplementary non-clinical time is not applied to shift-based care, as administrative and indirect clinical duties are inherently absorbed within the standard rostered shift hours.

For the non-CoC midwifery workforce, the required FTE is determined by dividing the total aggregate clinical hours required by the annual working time of a single FTE. Specifically, the model establishes a baseline of a standard 38-hour work week across 52 weeks per year, subsequently deducting non-productive time. These deductions include an annual allowance of 20 days for annual leave, ten days for public holidays, ten days for personal leave, and five days for study or professional development. Because statutory leave entitlements and public holidays vary slightly across state and territory enterprise agreements, these deductions serve as a harmonised national average to ensure consistency across the baseline model.

3.3 Microsimulation Specifications and Uncertainty Analysis

To capture the variability of individuals' health trajectories, the Monte Carlo microsimulation is run for 500 iterations. Within each iteration, the demographic characteristics, clinical risk profiles, and assigned care pathways for each simulated pregnancy are stochastically generated from their underlying probability distributions.

After completing 500 iterations, the projected FTE workforce requirements are aggregated, with the mean serving as our primary point estimate reported in the subsequent section. To explicitly quantify the stochastic uncertainty of the projections, we calculate and report the 90% prediction interval, bounded by the 5th and 95th percentiles of the simulated distribution. This interval captures the parametric variance within our model, providing a statistically robust range that encompasses 90% of the highly probable future workforce demand outcomes while effectively excluding extreme outlier simulations.

In addition to the baseline scenario, we conduct two scenario analyses. Scenario 1 examines the impact of an unanticipated shift toward public maternity services, increasing the percentage of women choosing public maternity care by five percentage points across all age groups. Scenario 2 alters the baseline assumption regarding the expansion of the CoC model. Scenario 2a tests a status quo environment where the CoC utilisation rate remains unchanged from current levels. Conversely, Scenario 2b models an accelerated expansion in which CoC access increases by four percentage points each year.

4 Main findings

4.1 Baseline Projection

As shown in Figure 2, the model projects an overall upward trend in total midwifery workforce demand, from 11,220 FTE in 2022 to 12,520 FTE in 2032. This presents an 11.6% increase over the ten years.

Specifically, the projected demand for the CoC midwifery workforce more than doubles, rising from 1,069 FTE in 2022 to 2,405 FTE in 2032. However, the demand for the non-CoC midwifery workforce is projected to be relatively stable, fluctuating only slightly between a peak of 10,270 FTE in 2023 and 10,115 FTE in 2032. The sharp increase in CoC demand is directly driven by expanded access to the CoC model. However, the anticipated corresponding drop in non-CoC demand is effectively offset by aggregate growth in total pregnancies under public maternity care, advancing maternal age, and a rising prevalence of other clinical risk factors. Together, these demographic and epidemiological shifts counteract the diverted CoC patient volume by necessitating more frequent antenatal visits and longer hospital stay.

As illustrated in Figure 3, the historical supply of public sector midwives fluctuated between a peak of 14,215 FTE in 2013 and a low of 10,533 FTE in 2016. Fitting a linear regression model to the historical data yields a projected supply from 10,593 FTE in 2024 to 10,559 FTE in 2032. This projected supply falls significantly short of our modelled demand, resulting in an initial workforce gap of 891 FTE in 2024 that widens to 1,960 FTE by 2032. From a health economics perspective, this projected shortfall does not simply equate to unfilled vacancies;

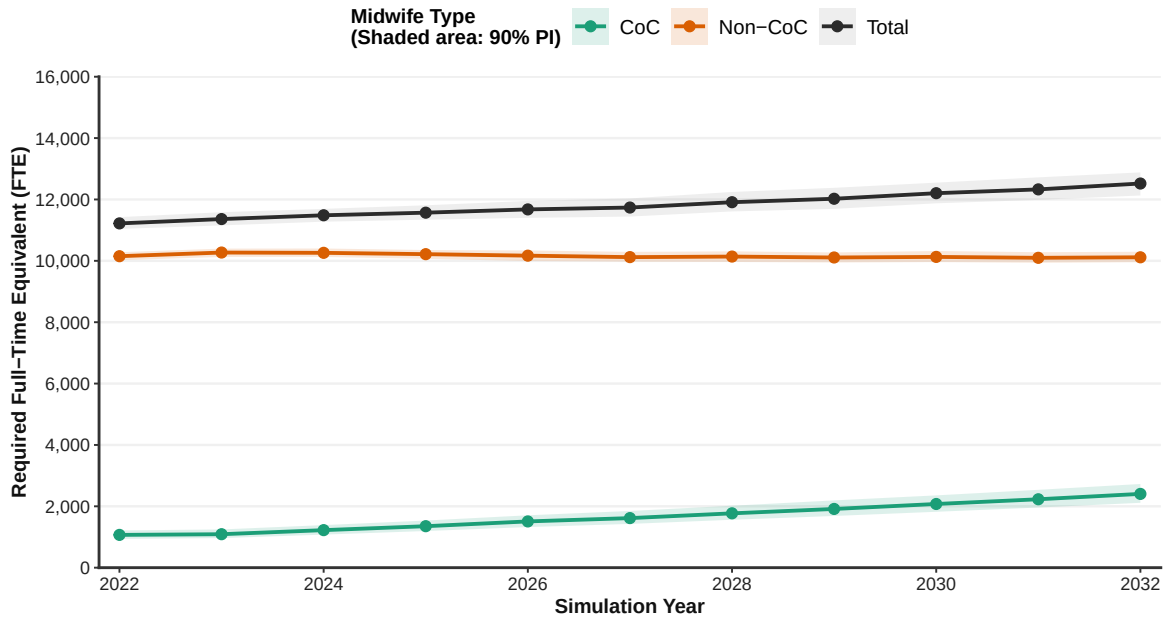


Figure 2: Projected clinical FTE demand under baseline scenario.

Note: Baseline scenario assumes the proportion of public maternity service users accessing the CoC midwifery model increases linearly by 2% each year after 2023.

rather, it represents a systemic disequilibrium. In practice, this gap is typically absorbed by the healthcare system through unmeasured unmet health care need, compromised adherence to care guidelines, reliance on overtime that accelerates workforce burnout, and the ad hoc substitution of midwifery roles by non-midwives in the postnatal areas (Homer et al., 2024).

We acknowledge that our projected demand likely represents an upper-bound estimate due to a series of conservative methodological assumptions. Specifically, the model assumes that every pregnancy receives care strictly aligned with established clinical guidelines, which may not be universally achieved in everyday clinical practice. Furthermore, the projection applies the most strict midwife-to-patient ratio mandates universally across all jurisdictions, and it presumes that all antenatal and postnatal wards are staffed exclusively by midwives. In reality, these wards might utilise a broader skill-mix that includes registered nurses due to the shortage of midwives. Nevertheless, even when contextualised the results within these parameters, the projected workforce shortfall remains substantial. If the health system's objective is to deliver guideline-compliant maternity care while guaranteeing safe staffing levels and maintaining staff wellbeing, then the needs-based demand projected by our model accurately reflects these requirements.

4.2 Scenario 1: Shifting to public hospital services

Scenario 1 examines the impact of an unanticipated shift in the patient mix toward public maternity services.

Figure 4 compares the baseline estimates with Scenario 1, which models an absolute increase of 5 percentage points in the use of public maternity service across all age cohorts and years

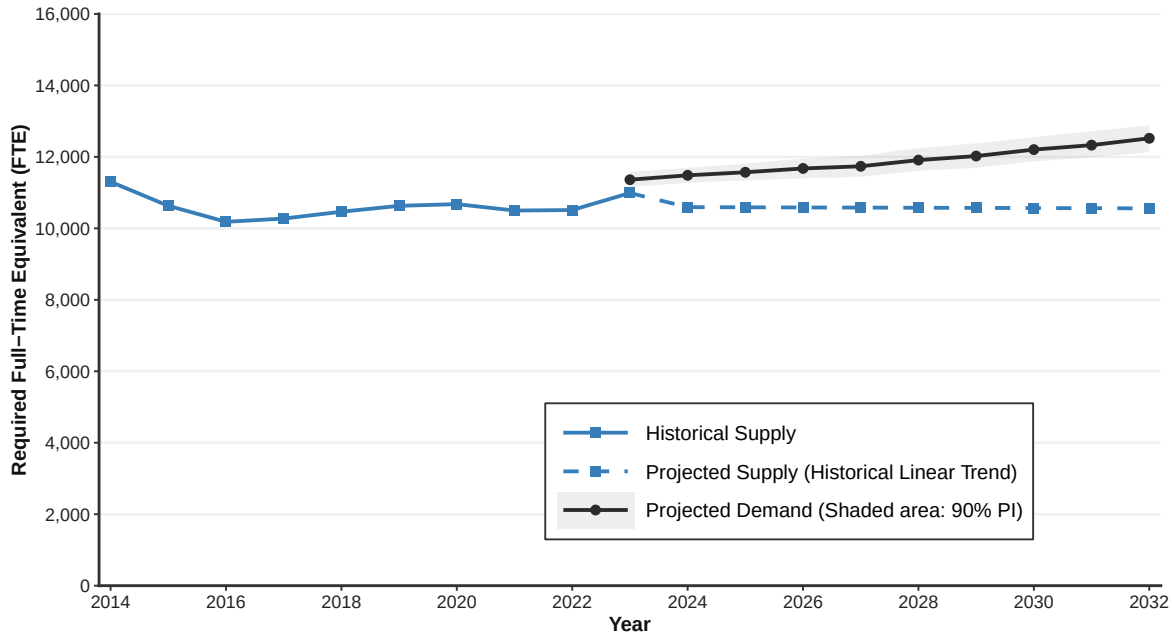


Figure 3: Comparison between historical supply and projected demand of clinical FTE.

Note: Historical supply data sourced from the NHWDS. Projected demand represents modelling results. Projected supply estimates for 2024–2032 are derived from a linear regression model fitted to the 2014–2023 historical data.

(capped at 100%). This assumption translates into a relative increase of approximately 6.5% in the volume of public maternity patients compared to baseline. Consequently, the model projects an average increase of 4.0% in total midwifery demand. However, this growth is not uniform across care models: the demand for CoC midwives rises by 6.8%, while the demand for non-CoC midwives grows by only 3.6%. This divergence stems from structural differences in the way the two models operate. Because CoC midwifery is strictly caseload-based, workforce demand scales linearly with patient volume. In contrast, non-CoC care is primarily shift- and activity-based. Therefore, modest increases in patient volume can often be absorbed by existing fractional staffing capacity and the economies of scale inherent in mandated ward rostering.

4.3 Scenario 2: Expanding CoC midwifery model

To evaluate the workforce implications of policies supporting the expansion of the CoC midwifery model, our model incorporates a second set of simulation scenarios. While the baseline projection assumes that access to the CoC midwifery model increases by two percentage points annually, Scenario 2a tests a stagnant environment in which the CoC utilisation rate remains unchanged from current levels. Conversely, Scenario 2b models an accelerated, policy-driven expansion where CoC access increases by four percentage points each year.

Figure 5 illustrates the projected workforce trajectories in these three scenarios. Scenario 2a projects the most conservative growth in total FTE demand, characterised by a plateau in CoC requirements and a steady rise in non-CoC demand. Conversely, Scenario 2b exhibits the steepest escalation in total FTE, driven by surging CoC requirements that concurrently

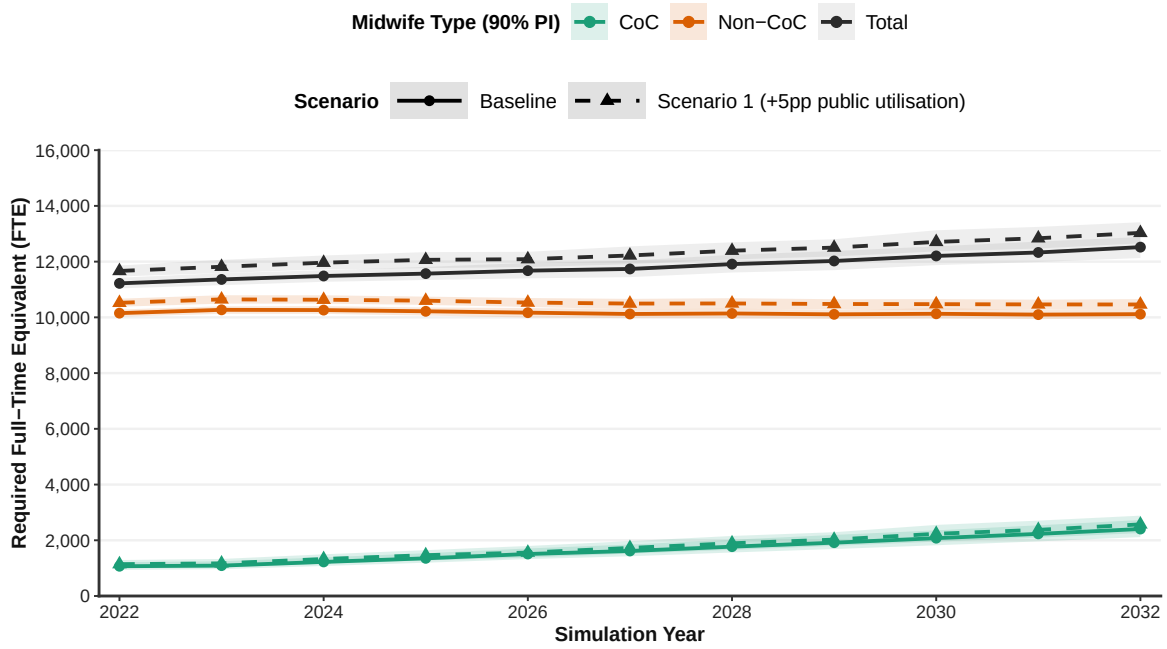


Figure 4: Projected clinical FTE demand under increased public hospital utilisation.

Note: Scenario 1 assumes a 5pp increase in the proportion of public maternity service users compared to the baseline scenario.

decrease non-CoC demand. Three key findings emerge from this comparative analysis:

Firstly, the total workforce demand increases across all modelled scenarios. This indicates that underlying systemic and demographic pressures will necessitate a larger public midwifery workforce over the next decade, regardless of whether CoC models are expanded. Furthermore, the 2032 point estimates for each scenario fall entirely outside the 90% prediction intervals of the alternative trajectories, confirming that these strategic policy choices yield statistically significant divergences in long-term workforce requirements.

Secondly, expanding CoC access increases the total aggregate FTE requirement. By 2032, the stagnant expansion model (Scenario 2a) requires 4.3% less total FTE than the baseline, whereas the accelerated expansion model (Scenario 2b) requires 4.3% more. This aggregate inflation in required FTE reflects the foundational design of the CoC model; delivering comprehensive, person-centred care fundamentally relies on lower, strictly relational caseload ratios, which naturally demand higher per-capita staffing. However, this elevated demand must be contextualised against the broader systemic benefits of the model, which include improving clinical outcomes for patients and enhancing occupational wellbeing for midwives. Theoretically, these improvements in job satisfaction could drive higher workforce retention rates, thereby organically boosting workforce supply to help offset the increased demand. This potential for improved retention is particularly vital given that the midwifery profession experienced an attrition rate of 10.8% in 2023, higher than that of both nurses and medical practitioners in Australia (Department of Health, Disability and Ageing, 2024b).

Thirdly, the internal redistribution of the workforce scales symmetrically. Compared to the

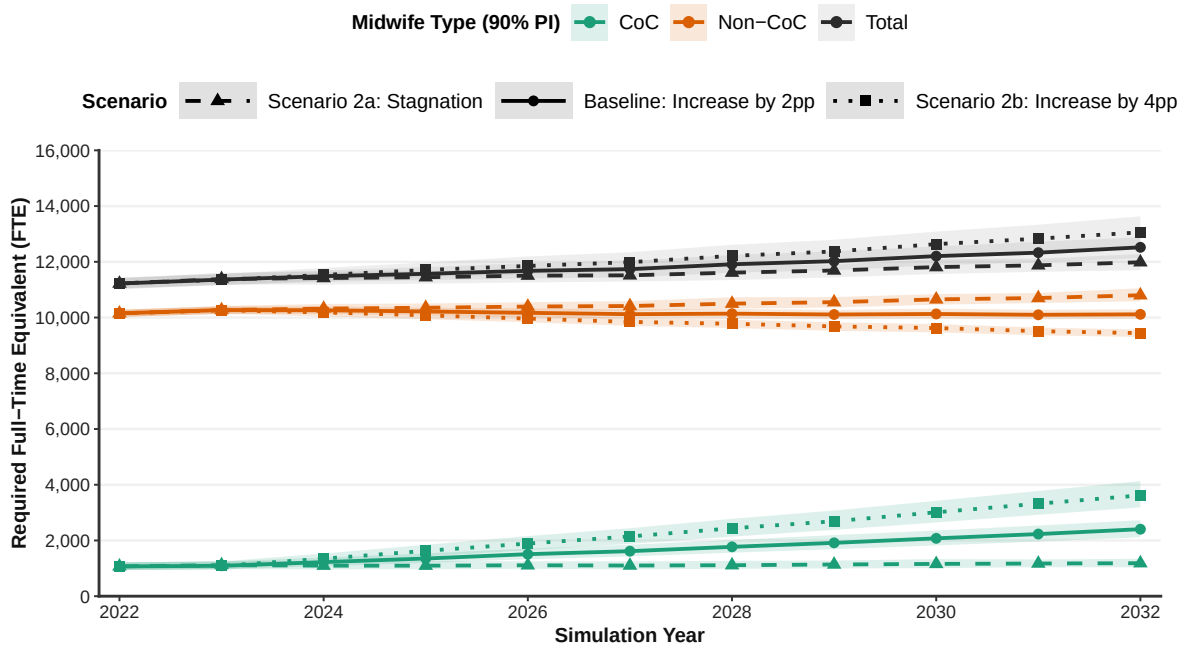


Figure 5: Projected clinical FTE demand under varied Continuity of Care (CoC) growth models. (Image placeholder)

Note: Comparisons highlight the required FTE when the proportion of CoC users remains stagnant (0% growth), follows the baseline trajectory (2% annual growth), or expands at an accelerated rate (4% annual growth). Projections include 90% PI.

baseline in 2032, Scenario 2a results in a decrease of 1,220 CoC FTEs alongside a compensatory increase of 685 non-CoC FTEs. Conversely, Scenario 2b demands an additional 1,213 CoC FTEs while reducing non-CoC requirements by 675 FTEs. This demonstrates that a ±2 percentage-point deviation from the baseline expansion rate triggers a proportionally consistent, albeit inverse, reallocation of the workforce accross both categories.

5 Discussion

5.1 Principal findings and methodological contributions

The primary contribution of this research is the application of a microsimulation framework to needs-based health workforce planning. By simulating the pregnant population at an individual unit-record level using aggregated public data from the AIHW, this approach successfully integrates demographic variables, clinical risk probabilities, and distinct care pathways.

Unlike traditional demand models anchored in historical utilisation trends, this microsimulation explicitly links established clinical guidelines directly to time-based productivity metrics. By framing the transition toward public maternity services and the expansion of the CoC midwifery model as test scenarios, we demonstrate how this methodology can proactively quantify the workforce implications of systemic shifts in patient preferences and care delivery, rather than simply reacting to aggregate population growth.

Although our projections indicate that expanding the CoC midwifery model requires a higher upfront investment in FTE personnel, this finding must be contextualised against broader downstream economic efficiencies. The extensive literature demonstrates that relational continuity is associated with fewer costly clinical interventions and hospital lengths of stay (Sandall et al., 2024), while simultaneously mitigating workforce attrition through improved staff emotional wellbeing and retention (Fenwick et al., 2018). Furthermore, recent economic evaluations utilising Australian administrative data confirm that scaling CoC access yields substantial per-pregnancy cost savings for public hospital funders (Hu et al., 2024). Therefore, while our needs-based model projects an absolute increase in workforce demand, the CoC model's capacity to generate downstream clinical and operational savings strongly supports its long-term financial sustainability.

5.2 Data and algorithmic limitations

While the microsimulation provides a robust structural framework, certain limitations must be acknowledged regarding the specific modelling algorithm employed. Due to current data constraints, many clinical parameters are modelled with limited conditional dependencies (e.g., relying on a single preceding variable). In reality, as a patient progresses further along the care pathway, clinical decisions become highly multifactorial. For instance, the length of a postnatal hospital stay depends not only on the birth method but also on postpartum complications, pre-existing health conditions, and neonatal outcomes. Capturing this complexity necessitates highly granular, linked unit-record data. Furthermore, the risk classification algorithm currently relies on a restricted subset of available physical health markers related to pregnancy, omitting broader pre-existing medical or perinatal mental health conditions.

5.3 Broader applicability and policy implications

More broadly, the application of microsimulation for needs-based demand forecasting presents unique systemic challenges and opportunities. Inherently, needs-based methodologies are condition-centric rather than profession-centric. Midwifery serves as an ideal proof-of-concept because the profession aligns almost exclusively with a single clinical episode (pregnancy). Applying this framework to generalist professions, such as general practitioners or generalist registered nurses, would require simulating a vastly complex array of overlapping disease burdens. Conversely, the model excels at mapping multidisciplinary teams to a single condition; for example, expanding this framework to simultaneously project the demand for obstetrician would be methodologically straightforward given the established service pathways.

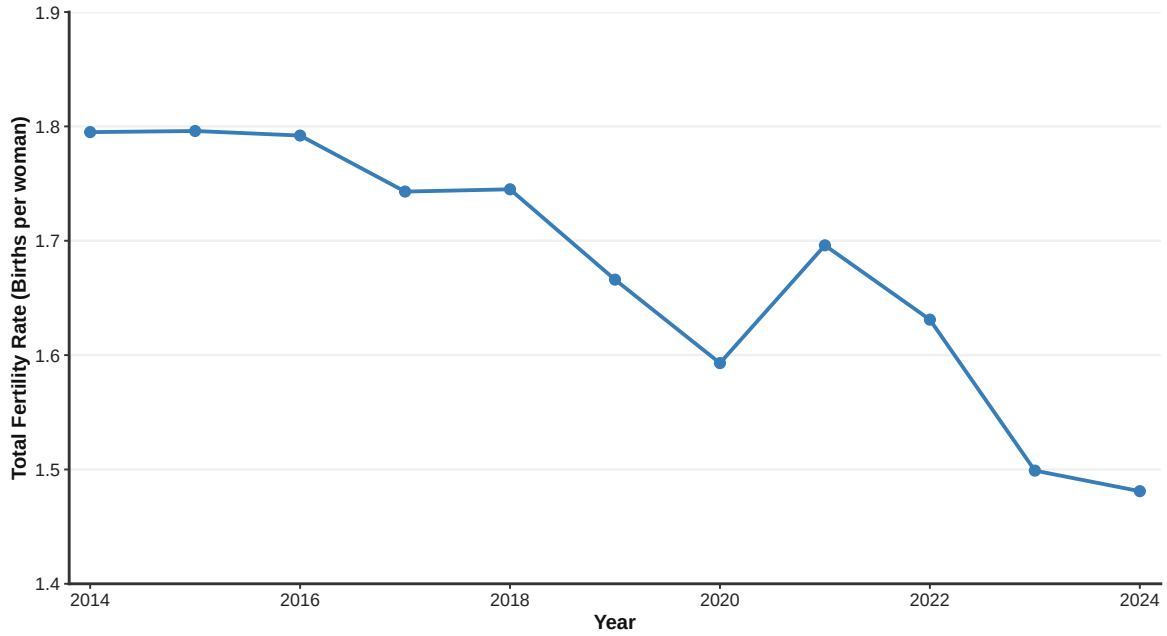
Furthermore, this approach is data-intensive. It relies on clearly delineated health stages, prescriptive clinical guidelines, precise productivity, and rich longitudinal unit-record data to derive accurate transition probabilities. While maternity care fulfills these criteria, applying the model to chronic, non-linear diseases may prove challenging. However, when applied to suitable clinical contexts, the microsimulation approach offers profound advantages. It accurately captures the true epidemiological care needs of a population, including systemic unmet needs, and can be scaled across any geographic level, allowing the incorporation of geospatial variables to precisely assess rural and remote workforce disparities. Crucially, it provides policymakers with a sophisticated mechanism to dynamically test structural shifts in care delivery.

6 Conclusion

Ultimately, this methodology provides a dynamic and highly adaptable tool for assessing the complex interplay among population demographics, individual clinical risks, and structural changes in service delivery. By transitioning away from historical utilisation constraints, the model successfully incorporates systemic unmet healthcare needs into health workforce demand projections, offering a robust and resilient framework for future health system planning. Future research could build upon this foundation in several key directions. The most immediate extension would be integrating other maternity care professionals into the established care pathway simulation to capture the full multidisciplinary workforce. Additionally, introducing spatial granularity would enable the model to assess localised healthcare needs and evaluate disparities in health needs between urban and rural areas. Finally, this stochastic, needs-based approach possesses the fundamental versatility to be adapted for workforce planning across other suitable clinical conditions and health professions.

A Historical Fertility Rates

Figure 6: Historical trend of the total fertility rate in Australia from 2014 to 2024.



Note: Total fertility rate represents the number of births per woman. Data sourced from the Australian Bureau of Statistics (2024).

B Detailed Model Assumptions

Table 4: Summary of baseline assumptions for model parameters.

Parameter	Sub-Group	Base (2024)	Trend	Source
Public Hospital Usage	Under 20	96.11%	Increase by 0.030pp each year	Australian Institute of Health and Welfare (2025b)
Public Hospital Usage	20-24	92.38%	Decrease by 0.038pp each year	Australian Institute of Health and Welfare (2025b)
Public Hospital Usage	25-29	84.30%	Increase by 0.440pp each year	Australian Institute of Health and Welfare (2025b)
Public Hospital Usage	30-34	72.67%	Increase by 0.650pp each year	Australian Institute of Health and Welfare (2025b)
Public Hospital Usage	35-39	67.46%	Increase by 0.601pp each year	Australian Institute of Health and Welfare (2025b)

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Table 4 – Continued from previous page

Parameter	Sub-Group	Base (2024)	Trend	Source
Public Hospital Usage	40 and over	65.46%	Increase by 0.342pp each year	Australian Institute of Health and Welfare (2025b)
Multiple Birth	Under 20	0.82%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Multiple Birth	20-24	1.09%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Multiple Birth	25-29	1.33%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Multiple Birth	30-34	1.54%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Multiple Birth	35-39	1.77%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Multiple Birth	40 and over	2.43%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	Under 20	35.27%	Increase by 1.244pp each year	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	20-24	17.66%	Increase by 0.746pp each year	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	25-29	6.90%	Increase by 0.303pp each year	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	30-34	3.16%	Increase by 0.133pp each year	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	35-39	2.29%	Increase by 0.065pp each year	Australian Institute of Health and Welfare (2025b)
Indigenous Status (First Nations)	40 and over	2.32%	Increase by 0.057pp each year	Australian Institute of Health and Welfare (2025b)
Previous Births (Parity > 0)	20-24	40.58%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Births (Parity > 0)	25-29	49.36%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Previous Births (Parity > 0)	30-34	59.26%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Births (Parity > 0)	35-39	70.99%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Births (Parity > 0)	40 and over	70.45%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Births (Parity > 0)	Under 20	14.82%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	20-24	20.31%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	25-29	26.43%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	30-34	32.24%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	35-39	37.95%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	40 and over	42.57%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Previous Caesarean Section	Under 20	23.75%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Smoking in Pregnancy	First Nations	39.24%	Decrease by 0.717pp each year	Australian Institute of Health and Welfare (2025b)
Smoking in Pregnancy	Non-Indigenous	5.92%	Decrease by 0.335pp each year	Australian Institute of Health and Welfare (2025b)
Alcohol in Pregnancy	First Nations	7.67%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Alcohol in Pregnancy	Non-Indigenous	2.29%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
BMI: Underweight	20-24	5.22%	Decrease by 0.117pp each year	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
BMI: Normal	20-24	40.23%	Decrease by 0.651pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	20-24	26.01%	Increase by 0.160pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	20-24	28.55%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
BMI: Underweight	25-29	2.81%	Decrease by 0.171pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Normal	25-29	41.41%	Decrease by 0.998pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	25-29	28.46%	Increase by 0.367pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	25-29	27.32%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
BMI: Underweight	30-34	2.35%	Decrease by 0.127pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Normal	30-34	47.01%	Decrease by 0.704pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	30-34	28.39%	Increase by 0.317pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	30-34	22.25%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
BMI: Underweight	35-39	2.12%	Decrease by 0.075pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Normal	35-39	46.69%	Decrease by 0.485pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	35-39	29.02%	Increase by 0.284pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	35-39	22.17%	Derived mathematically	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
BMI: Underweight	40 and over	1.71%	Decrease by 0.058pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Normal	40 and over	43.41%	Decrease by 0.258pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	40 and over	29.20%	Increase by 0.064pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	40 and over	25.68%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
BMI: Underweight	Under 20	11.46%	Increase by 0.079pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Normal	Under 20	48.80%	Decrease by 0.283pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Overweight	Under 20	21.90%	Decrease by 0.028pp each year	Australian Institute of Health and Welfare (2025b)
BMI: Obese	Under 20	17.84%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	20-24	0.81%	Increase by 0.030pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	25-29	0.90%	Increase by 0.042pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	30-34	1.04%	Increase by 0.046pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	35-39	1.43%	Increase by 0.068pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	40 and over	2.29%	Increase by 0.138pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Diabetes	Under 20	0.67%	Increase by 0.052pp each year	Australian Institute of Health and Welfare (2025b)
Gestational Diabetes	20-24	11.69%	Increase by 0.425pp each year	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Gestational Diabetes	25-29	15.68%	Increase by 0.679pp each year	Australian Institute of Health and Welfare (2025b)
Gestational Diabetes	30-34	18.35%	Increase by 0.762pp each year	Australian Institute of Health and Welfare (2025b)
Gestational Diabetes	35-39	22.62%	Increase by 0.924pp each year	Australian Institute of Health and Welfare (2025b)
Gestational Diabetes	40 and over	28.86%	Increase by 1.113pp each year	Australian Institute of Health and Welfare (2025b)
Gestational Diabetes	Under 20	7.36%	Increase by 0.138pp each year	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	20-24	0.45%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	25-29	0.59%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	30-34	0.80%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	35-39	1.31%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	40 and over	2.54%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Pre-existing Hypertension	Under 20	0.23%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Hypertension	20-24	3.34%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Hypertension	25-29	3.31%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Hypertension	30-34	3.06%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Hypertension	35-39	3.19%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Gestational Hypertension	40 and over	4.39%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Hypertension	Under 20	3.15%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	20-24	8.92%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Term	20-24	90.65%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	20-24	0.43%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	25-29	7.89%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Term	25-29	91.61%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	25-29	0.50%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	30-34	7.94%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Term	30-34	91.55%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	30-34	0.51%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	35-39	9.03%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Term	35-39	90.49%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	35-39	0.48%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	40 and over	12.06%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Gestational Age: Term	40 and over	87.61%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	40 and over	0.33%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Gestational Age: Pre-term	Under 20	11.53%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Term	Under 20	88.10%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Gestational Age: Post-term	Under 20	0.37%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Labour Onset: Spontaneous	Post-term	34.52%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: Induced	Post-term	59.28%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: No labour	Post-term	6.20%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Labour Onset: Spontaneous	Pre-term	43.57%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: Induced	Pre-term	19.88%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: No labour	Pre-term	36.55%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Labour Onset: Spontaneous	Term	44.61%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: Induced	Term	33.45%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Labour Onset: No labour	Term	21.93%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Birth Method: Vaginal	Induced	59.51%	Decrease by 0.138pp each year	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Birth Method: Assisted Vaginal	Induced	17.32%	Decrease by 0.144pp each year	Australian Institute of Health and Welfare (2025b)
Birth Method: C-Section	Induced	23.17%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Birth Method: Vaginal	No labour	0.00%	Static (0pp)	Australian Institute of Health and Welfare (2025b)
Birth Method: Assisted Vaginal	No labour	0.00%	Static (0pp)	Australian Institute of Health and Welfare (2025b)
Birth Method: C-Section	No labour	100.00%	Static (100pp)	Australian Institute of Health and Welfare (2025b)
Birth Method: Vaginal	Spontaneous	70.67%	Decrease by 0.198pp each year	Australian Institute of Health and Welfare (2025b)
Birth Method: Assisted Vaginal	Spontaneous	14.08%	Decrease by 0.042pp each year	Australian Institute of Health and Welfare (2025b)
Birth Method: C-Section	Spontaneous	15.25%	Derived mathematically	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 0 days (<1 day)	Induced	36.49%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 1 days	Induced	49.78%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 2 days	Induced	10.25%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 3 days	Induced	2.01%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 4 days	Induced	0.60%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 5 days	Induced	0.26%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 6 days	Induced	0.15%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Antenatal Stay: 0 days (<1 day)	No labour	84.31%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 1 days	No labour	8.49%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 2 days	No labour	2.84%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 3 days	No labour	1.21%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 4 days	No labour	0.67%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 5 days	No labour	0.42%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 6 days	No labour	0.31%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 0 days (<1 day)	Spontaneous	72.63%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 1 days	Spontaneous	25.30%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 2 days	Spontaneous	1.03%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 3 days	Spontaneous	0.33%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 4 days	Spontaneous	0.19%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 5 days	Spontaneous	0.11%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Antenatal Stay: 6 days	Spontaneous	0.07%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 0 days (<1 day)	Assisted Vaginal	1.22%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Postnatal Stay: 1 days	Assisted Vaginal	15.90%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 2 days	Assisted Vaginal	33.13%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 3 days	Assisted Vaginal	18.27%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 4 days	Assisted Vaginal	22.78%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 5 days	Assisted Vaginal	6.00%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 6 days	Assisted Vaginal	1.61%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 0 days (<1 day)	Caesarean	0.09%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 1 days	Caesarean	2.39%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 2 days	Caesarean	21.28%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 3 days	Caesarean	30.83%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 4 days	Caesarean	19.05%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 5 days	Caesarean	20.22%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 6 days	Caesarean	3.80%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 0 days (<1 day)	Vaginal	8.83%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 1 days	Vaginal	32.21%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

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Parameter	Sub-Group	Base (2024)	Trend	Source
Postnatal Stay: 2 days	Vaginal	29.87%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 3 days	Vaginal	13.02%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 4 days	Vaginal	12.50%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 5 days	Vaginal	2.35%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Postnatal Stay: 6 days	Vaginal	0.66%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Admission to NICU/SCN	Pre-term	78.85%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Admission to NICU/SCN	Term	12.14%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)
Admission to NICU/SCN	Post-term	14.01%	Static for 2024-2032 (Historical Average)	Australian Institute of Health and Welfare (2025b)

Table 5: Assumed clinical time requirements for specific task-based midwifery activities.

Activity	Risk Level	Time (minutes)	Reference
First antenatal visit	Low risk	90	Northern Sydney Local Health District (2026); Department of Health, Disability and Ageing (2026a)
First antenatal visit	Normal and high risk	120	Department of Health, Disability and Ageing (2026a)
Subsequent antenatal visit	Low risk	30	Northern Sydney Local Health District (2026); Department of Health, Disability and Ageing (2026a)
Subsequent antenatal visit	Normal and high risk	60	Department of Health, Disability and Ageing (2026a)
Induction of labour	All risks	40	ten Hoope-Bender et al. (2017)
Vaginal birth	All risks	540 (SD: 336)	Davey et al. (2020)
Caesarean section	All risks	90	ten Hoope-Bender et al. (2017)
Initial postnatal care (mother)	All risks	120	Yulghunlu (2025)
Initial postnatal care (baby)	All risks	120	Yulghunlu (2025)
Postnatal home visits	All risks	29	Schmied et al. (2024)

C Mathematical Formulations

Assuming a 1:r ratio and a uniformly distributed daily patient volume, the probability of requiring this extra rostered midwife can be mathematically simplified as $\frac{r-1}{r}$. Additionally, each ward requires one lead (or charge) midwife per shift. Synthesising these parameters, the total annual clinical hours required from shift-based midwives is calculated using the following formula:

$$
\begin{aligned}
\text{Total hours} = 7.5\ \text{(hours/shift)} \times \Bigg\{ & \sum_{i \in \{\text{antenatal, postnatal}\}} \Bigg\{ \\
& \frac{\text{total days of stay} \times 2\ \text{(day shifts)}}{r_{i,\text{day}}} \\
& + 365 \times n_{\text{hospitals}} \times \frac{r_{i,\text{day}} - 1}{r_{i,\text{day}}} \times 2\ \text{(day shifts)} \\
& + \frac{\text{total days of stay}}{r_{i,\text{night}}} \\
& + 365 \times n_{\text{hospitals}} \times \frac{r_{i,\text{night}} - 1}{r_{i,\text{night}}} \\
& + 365 \times n_{\text{hospitals}} \times 3\ \text{(total shifts)} \Bigg\} \\
& + 365 \times n_{\text{hospitals}} \times 3\ \text{(total shifts)} \Bigg\}
\end{aligned}
$$

In this formulation, the total days of antenatal and postnatal stay drive the core day and night shift requirements, which are then adjusted upward by the $\frac{r-1}{r}$ probability to account for fractional rounding. The final terms within and outside the summation represent the addition of one lead midwife per ward (antenatal, postnatal, and birthing suite) across three daily shifts. Based on data from Australian Institute of Health and Welfare (2025a), which identifies 248 maternity services providing intrapartum care nationwide, the variable $n_{\text{hospitals}}$ is set to 248. Importantly, the direct 1:1 midwifery care provided during active labour and birth is captured within the task-based demand calculations and is therefore excluded from this shift-based formulation to prevent double-counting.

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