IN CONFIDENCE

Growing medical education in New Zealand

Cost-benefit analysis of shortlisted investment options

David Moore, Matt Williamson, Michael Young, Lockie Woon, Julius Ohrnberger

31 January 2025

Contents

Appendices

Tables

Figures

Glossary

Abbreviation	Stands for
BCR	benefit-cost ratio
capex	capital expenditure
CBA	cost-benefit analysis
DBC	detailed business case
FY	financial year
GP	general practitioner – when discussing our analysis, we use this term to refer to doctors with vocational registration in general practice
GPEP	General Practice Education Programme
HALE	health-adjusted life expectancy
HEAP	health economics analytical plan
HO	house officer
HrQoL	health-related quality of life
LE	life expectancy
MBChB	Bachelor of Medicine and Bachelor of Surgery
MCNZ	Medical Council of New Zealand
MSOD	Medical Schools Outcomes Database
MTI	medical trainee intern
NPV	net present value
NZTA	New Zealand Transport Agency
opex	operating expenditure
PBC	programme business case
PGY1	postgraduate year 1
PGY2	postgraduate year 2
RANZCP	Royal Australian and New Zealand College of Psychiatrists
RMIP	rural medicine immersion programme
RMO	resident medical officer (includes house officers and registrars)
RNZCGP	Royal New Zealand College of General Practitioners
SMO	senior medical officer – when discussing our analysis, we use this term to refer to doctors with vocational registration in specialties other than general practice
TEC	Tertiary Education Commission

UoA	University of Auckland
UoO	University of Otago
UoW	University of Waikato
VOSL	value of statistical life
VSLY	value of statistical life year
WHO	World Health Organization

Acknowledgements

We acknowledge the input from the Ministry of Health (the Ministry) and, through it, Te Whatu Ora | Health New Zealand (Health NZ), those working on the Better Business Case elements for the Waikato Medical School, the Universities of Auckland, Otago and Waikato, as well as the expert panel who helped test our approach and assumptions. That panel included: Prof Gregor Coster (Chair, Emeritus Professor at Victoria and previously at Auckland University), Dr Luke Bradford (The Royal New Zealand College of General Practitioners), Dr Jo Scott-Jones (Pinnacle Health), Prof Ross Lawrenson (University of Waikato), Prof Phillippa Poole (University of Auckland), and Prof Peter Crampton (University of Otago).

These people were generous with their time and their input helped inform the analysis underpinning this report. However, the views expressed in this report are those of the authors only and should not be taken as representing the views of any of the individuals engaged with during the process, nor any of the organisations they are associated with.

sapere

Executive summary

The Ministry of Health engaged us to conduct an independent cost-benefit analysis (CBA) of options to expand medical education in New Zealand. The CBA was a requirement of the coalition agreement.

New Zealand faces a significant shortage of doctors, with a current shortfall of 1,810 full-time equivalents (FTEs) and projections indicating a deficit of 3,440 within the next decade. Population growth, ageing demographics, and increasing healthcare demands exacerbate this issue. New Zealand is highly dependent on overseas-trained doctors, who make up 42 per cent of the workforce—a reliance that is unsustainable given global competition.

The shortage is particularly acute in general practice, which has resulted in increasing patient wait times and one-third of practices closing their books. With nearly half of general practitioners (GPs) expected to retire by 2027, urgent action is needed to expand the general practice training pipeline. The issue is even more pronounced in rural and provincial communities, where GP shortages are leading to service reductions in hospitals and emergency care.

Investing in medical training will improve health outcomes, as evidence shows that increasing the number of doctors directly enhances life expectancy and healthy life years. While workforce retention strategies such as bonding schemes and expanded primary care roles play a part, growing New Zealand's domestic medical workforce is essential for a sustainable healthcare system.

Cabinet identified three key options for addressing the investment objectives related to medical education and rural health workforce shortages:

- **Option 1:** increase the current intake at existing medical schools (with a proportionate increase in rural immersion programmes).
- **Option 2:** create a specialised medical training programme focused on rural health, jointly delivered by the existing medical schools.
- **Option 3:** establish a new medical school focused on primary and rural health.

Our analysis focuses exclusively on domestic medical education strategies and does not include alternative or complementary workforce strategies or other medical education pathways, such as alternative graduate programmes.

Cost-benefit analysis approach

We evaluated the economic impact of each option by assessing their respective costs and benefits relative to the status quo. The primary benefit comes from the increased number of doctors and the healthcare services they provide. The analysis follows New Zealand Treasury guidelines and considers both monetisable and non-monetisable factors.

- The CBA covers doctors trained between 2026 and 2042, with long-term impacts assessed through to 2073.
- Costs include investment in medical education, infrastructure, and the lifetime salary and associated costs of additional doctors trained, while benefits include improved health

outcomes, the impact on a clogged emergency department system of diverting some visits to a primary care setting, and accessibility benefits for population groups underserviced by current GP provision.

- Economic valuation methods, such as market pricing and shadow pricing, are used to quantify costs and benefits where possible.
- Sensitivity analysis tests key assumptions, including workforce retention, the likelihood of graduates becoming GPs, and the discount rate.
- Future costs and benefits are discounted to a present value as of 2026, using Treasury's recommended rates (2 per cent for years 1 to 30, 1.5 per cent for years 31 to 100, with an 8 per cent sensitivity test).
- Two key economic metrics are used: net present value (NPV) to assess overall economic value, and benefit-cost ratio (BCR) to evaluate cost efficiency.

Our analysis faced some limitations due to uncertainty in long-term projections. The effectiveness of each option depends on broader system factors such as GP pay, rural workforce incentives, and regulations around medical training.

Each option produces substantially more doctors compared to the status quo

We demonstrated the benefits of increasing the number of doctors trained domestically, supported by workforce modelling from Health NZ's National People Services. This analysis compares the three proposed options with the status quo, accounting for key factors such as student retention, GP specialisation rates, time to specialise, and workforce exit rates.

Each option is expected to produce 115 graduates entering postgraduate training (PGY1) annually once fully implemented. By 2043, the estimated workforce impact for each option is:

- Option 1: 1,490 additional doctor FTEs
- Option 2: 1,500 additional doctor FTEs
- Option 3: 1,440 additional doctor FTEs.

Options 1 and 2 deliver graduates one year earlier than Option 3, as the additional capital investment required to build a new medical school delays benefits realisation. All options significantly increase the health workforce compared to the status quo.

- Workforce modelling indicated that increasing medical graduates will only maintain the current GP-to-population ratio rather than significantly improving it, especially once the higher health needs of an ageing population are considered.
- The distribution of new GPs depends on clinical placement locations, general population trends, and local supply and demand imbalances.
- GP propensity, or the likelihood of a medical graduate becoming a GP, is a key assumption in workforce projections. Current estimates suggest 23 per cent of graduates would become vocationally registered GPs under Option 1, based on Health NZ forecasts and adjusted

survey data. Option 3, modelled on the University of Wollongong's approach, is assumed to provide a 15 per cent uplift, leading to a 38 per cent GP propensity. Option 2 is assumed to achieve an increase in GP propensity to 33 per cent.

Summary of cost-benefit analysis results

Table 1 summarises the monetised costs and benefits under each option.

Table 1: Summary cost-benefit results ($ millions)

	Option 1	Option 2	Option 3
Total monetised costs	10,880	10,236	9,053
Total monetised benefits	16,271	18,400	17,977
NPV	5,390	8,164	8,924
BCR	1.495	1.798	1.986

In this report, we use the terms **GP** to refer to doctors that have vocational registration in general practice, and **SMO** to refer to doctors with vocational registration in other specialties.

Total monetised costs include operational expenditure, capital costs and the cost of GP, SMO and resident medical officer (RMO) care. Total monetised benefits include the monetised life expectancy gain from additional GPs and SMOs, the benefit provided by RMOs, reduced ED visits and reduced travel time. We also provided a qualitative overview of several important non-monetised benefits and costs that, while potentially significant, were challenging to quantify.

Sensitivity analysis

The NPVs for all options were most sensitive to the value of a statistical life (VOSL), life expectancy benefits from additional GPs and SMOs, and the discount rate. Option 3 produced the highest NPV in all cases. The results were also influenced by workforce assumptions, particularly the propensity to become a GP.

The primary source of uncertainty in the cost-benefit analysis was the propensity of medical graduates to become GPs rather than SMOs, as well as the estimated health benefits from additional GPs and SMOs. The lack of published evidence on SMO-related health benefits was a primary driver of this uncertainty. To account for this, we conducted Monte Carlo simulations to test how variation in life expectancy benefits impacted the ranking of options.

After running 20,000 simulations, we found that Option 1 outperformed Options 2 and 3 in less than 6 per cent of cases. Across all scenarios, the ranking of options was primarily driven by GP propensity, rather than uncertainty in life expectancy gains.

Comparisons between Options 2 and 3 showed that while some workforce scenarios resulted in similar NPVs, Option 3 was generally more favourable due to its higher GP propensity. BCR results followed a similar trend, with Option 3 consistently outperforming due to the lower cost of GPs relative to SMOs. Testing alternative correlation assumptions between GP and SMO benefits showed that while the proportion of simulations favouring each option shifted, the overall ranking remained unchanged as options with the highest GP workforce growth almost always had the highest NPV.

Competitive effects

We explored the potential effects of introducing competition into affected markets under the proposed options. While not a comprehensive analysis on competition, our key insights are summarised below:

- Price responsiveness to increased competition may be limited in the GP services market due to regulatory constraints and other influencing factors.
- Universities have long competed on dimensions like reputation, funding, and student enrolment. Increased competition could lead to efficiency gains, innovation, and quality improvements, though evidence suggests such gains are harder to quantify in higher education than in traditional markets.
- While there are no precise models to quantify the impacts of competition from a third medical school, literature suggests that rivalry could yield efficiency gains and benefits for consumers.
- An increased supply of trained doctors, particularly GPs, is expected to drive competitive pressures in medical services. This could enhance service availability and quality, potentially addressing unmet demand, especially in underserved areas like rural communities.

1. Introduction

We were asked by the Ministry of Health (the Ministry) to undertake an independent cost-benefit analysis (CBA) of a limited set of options to grow medical education in New Zealand.

In February 2024, the Ministry and the University of Waikato (UoW) signed a memorandum of understanding to develop a programme of work related to a new medical school (Ministry of Health, 2024b). A full CBA is part of that work programme and was stipulated by the coalition agreement between the New Zealand National Party and ACT New Zealand (New Zealand National Party & ACT New Zealand, 2023).

In developing this CBA report, we have:

- Reviewed existing relevant literature and material available in relation to the identified options. This includes the Cabinet paper, materials provided by the Ministry of Health and other government agencies in relation to respective options, literature scans, and draft business case material.
- Submitted a call for information for key inputs needed in developing the CBA.
- Outlined, and obtained feedback on, our overall analytical approach by way of a health economics analytical plan (HEAP). The HEAP, key assumptions, analysis, and results were also tested with an expert panel.

This introductory section provides background and context for the potential investment in medical education.

1.1 Current medical training in New Zealand

There are two medical schools in New Zealand, at the University of Auckland (UoA in tables) and the University of Otago (UoO in tables). The medical education phase of becoming a doctor involves a six-year degree—a Bachelor of Medicine and Bachelor of Surgery (MBChB)—including one general sciences learning year (or a prior degree), two medical-specific education years, and three years of learning in clinical placements. The government caps the number of students admitted into Year 2 of medical school, to manage the high cost of training and availability of clinical placements in healthcare settings. In 2024, the two medical schools admitted 589 domestic students.[1] This intake will increase to 614 domestic students in 2025, as part of commitments made in Budget 2024.

After completion of the MBChB, medical graduates must undertake a minimum of two years as a house officer (HO) to obtain full general registration with the Medical Council of New Zealand (MCNZ). These first two postgraduate years are known as PGY1 and PGY2. Districts of Te Whatu Ora | Health New Zealand (Health NZ) are the only accredited training providers for PGY1 and PGY2 .

[1] The 2024 intake of 589 domestic students was an increase of 50 places from previous years' intakes, announced by the Government in 2023.

When a doctor is ready, they can apply for a registrar role in one of 36 scopes of practice (or specialties). Registrars are usually in training programmes working towards vocational registration in their chosen specialty.[2] Doctors that have completed their training programme, and are vocationally registered, are known by various terms—consultants, specialists, or senior medical officers (SMOs).

Most general practitioners (GPs) are specialists that have undertaken the three-year General Practice Education Programme (GPEP) to earn vocational registration in the scope of general practice.

In this report, we use the terms **GP** to refer to doctors that have vocational registration in general practice, and **SMO** to refer to doctors with vocational registration in other specialties.

Figure 1 provides an overview of the medical education and specialist training pathway.

Figure 1: Overview of training requirements for doctors in New Zealand

Year 1 – first year health sciences (prior to acceptance into medical school)
First year of health science or biomedical science (UoA). Graduates of other degrees can be admitted to Year 2 via graduate entry.

Years 2 & 3 – pre-clinical training at medical school
Core skills and modular learning at the university's main campus. These two years consist mostly of lectures, tutorials, labs and some clinical experience.

Year 4 – clinical placements
Students are allocated to clinical placements around the major, regional and rural hospitals, and GP clinics.

Year 5 – clinical placements
Students are allocated to clinical placements around the major, regional and rural hospitals, and GP clinics. Both universities offer regional and rural immersion placement programmes.

Year 6 – clinical placements (trainee intern year)
Trainee interns undertake clinical attachments in hospitals as well as an elective (which can be located anywhere, including regional and rural locations).

PGY1
Four clinical runs as a HO.

PGY2
Four clinical runs as a HO.

(PGY1 and PGY2:) One community-based run is required by the MCNZ.
Doctors may remain as a senior house officer in PGY3+.

Registrar in vocational training
Specialty training can take anywhere from three to eight years as a training registrar, as well as multiple years as a non-training registrar or in post-registrar fellowships.

Source: UoA and UoO report on medical education in New Zealand (PricewaterhouseCoopers, 2024).

[2] There are also non-training registrars in surgical specialties.

1.2 Objectives of the proposed investment

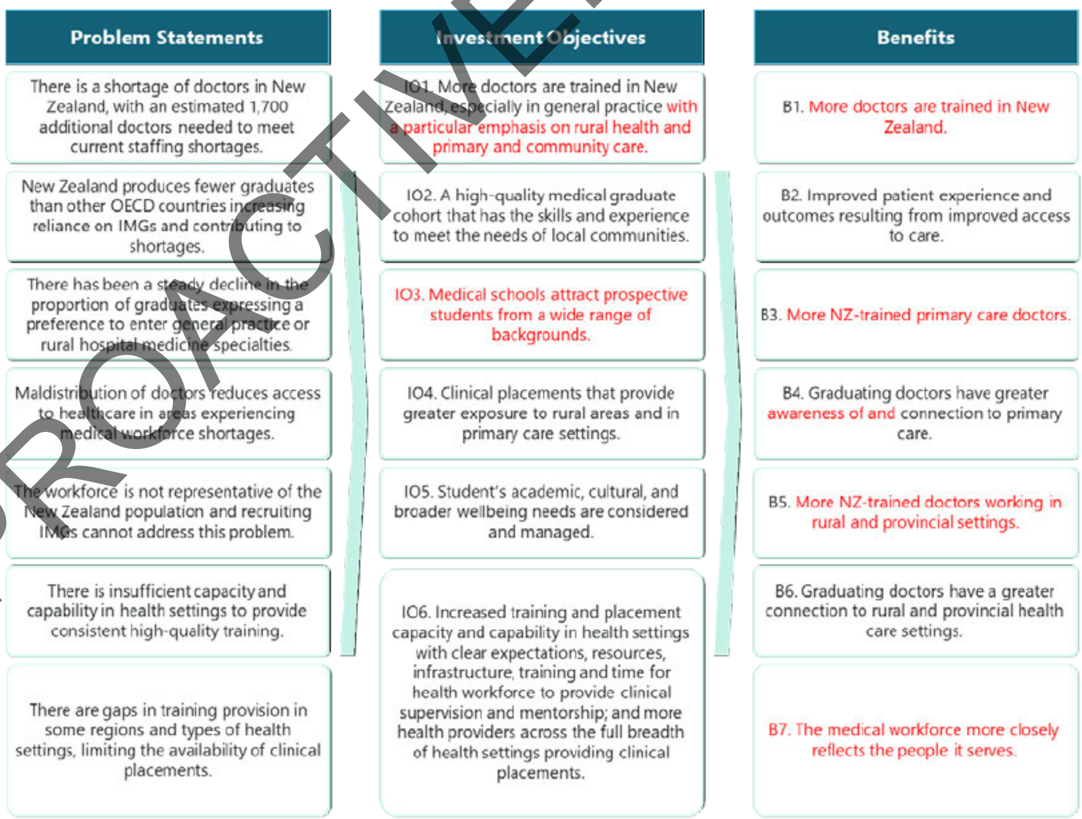
In May 2024, Cabinet agreed to proceed with the development of a programme business case (PBC) which included a set of investment objectives [CAB-24-Min-0183].

Box 1: Investment objectives

- More doctors are trained in New Zealand, especially in general practice with a particular emphasis on rural health and primary and community care.
- A high-quality medical graduate cohort that has the skills and experience to meet the needs of local communities.
- Medical schools attract prospective students from a wide range of backgrounds.
- Clinical placements that provide greater exposure to rural areas and in primary and community care settings.
- Students' academic, cultural and broader well-being needs are considered and managed.
- Increased training and placement capacity and capability in health settings with clear expectations, resources, infrastructure, training, and time for the health workforce to provide clinical supervision and mentorship, and more health providers across the full breadth of health settings providing clinical placements.

The investment objectives respond to a set of key problems that were described in the PBC. Achievement of the objectives is expected to result in some key benefits. These links are made in an investment logic map, shown in Figure 2.

Figure 2: Investment logic map



Source: New Medical School DBC Programme, (2024).

1.3 The case for investment

1.3.1 New Zealand does not train enough doctors

There is a shortage of doctors in New Zealand. Health NZ estimates that, today, we are short by 1,810 full-time equivalent (FTE) doctors, representing 8.5 per cent of the medical workforce needed (Te Whatu Ora, 2024).

New Zealand has a growing, diversifying and ageing population, and people's health needs are becoming more complex. Over the next 30 years, the population is projected to grow by 1.2 million people. Currently, 17 per cent of the population is aged over 65, and this is likely to reach 1 million people by 2028. With an ageing population comes a need for increased healthcare, especially services such as primary care, general medicine, aged care and rehabilitation. Health NZ estimates that based on the current pipeline, the doctor shortage will worsen over time, leaving the country around 3,440 doctors short within the next decade (Te Whatu Ora, 2024).

The number of government-funded medical school places is not enough to resolve the current workforce shortages. As a comparison, Australia, with a population five times larger than New Zealand, trains seven times as many medical students.

New Zealand has the highest dependency in the OECD on overseas-trained doctors, with international medical graduates making up 42 per cent of the workforce (Lawrenson, 2023). Recruitment of international medical graduates is part of the solution to meet current and projected workforce deficits (alongside other initiatives such as improving workforce retention and reducing task burden), but with mounting global competition, we cannot rely on overseas recruitment as a sustainable long-term approach.

1.3.2 New Zealand does not have enough general practitioners to meet the population's primary healthcare needs

Over time, the proportion of GPs in the medical workforce has shrunk. Health NZ estimates that, today, we are short by 220 GP FTE, representing 6.1 per cent of the GP workforce needed (Te Whatu Ora, 2024).

General practice is at the frontline of the health system. However, population access to general practice is becoming more constrained as practices struggle with high GP caseloads and close their books to new enrolments. Of 1,082 GP practices across the country, 31 per cent have closed books.[3]

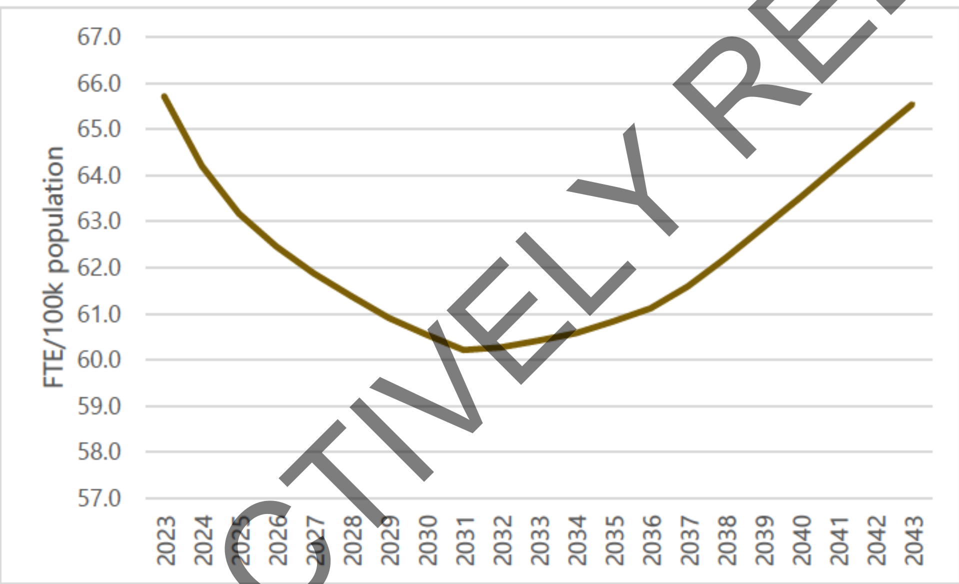
The New Zealand Health Survey shows a statistically significant increase in the proportion of people reporting unmet need for a GP due to wait time, estimated at around one quarter of the population in 2023/24 (Ministry of Health, 2024a).[4]

[3] Data provided by the Analytics and Forecasting team, National People Services, Health NZ.
[4] 25.7 per cent in 2023/24, 21.2 per cent in 2022/23, and 11.6 per cent in 2021/22 reported unmet need for a GP due to wait time being too long, in the last 12 months.

As well as existing shortages, New Zealand is not training enough GPs. The Royal New Zealand College of General Practitioners (RNZCGP) survey indicated that 44 per cent of the 2022 GP workforce intend to retire by 2027 (Royal New Zealand College of General Practitioners, 2023). The college estimates that more than 300 doctors are needed in the GPEP each year to keep pace with increasing demand. Health NZ's modelling shows that the GP pipeline needs to increase by 25.5 per cent to address the estimated shortage by 2033 (Te Whatu Ora, 2024).

There has been a steady decline in graduating medical students expressing a preference to enter general practice (23.9 per cent in 2014 to 13.4 per cent in 2020) or rural hospital medicine (2.9 per cent in 2014 to 1 per cent in 2020 (New Zealand MSOD Steering Group, 2017; New Zealand MSOD Steering Group, 2021). The number of GPs per capita is forecast to decline sharply over the next ten years, before gradually rising again towards the middle of the century. Over the forecast period to 2043, the number of GPs per capita is forecast to be slightly lower than the current rate, thus the current shortage of GPs is expected to worsen before returning to approximately the present shortage levels.

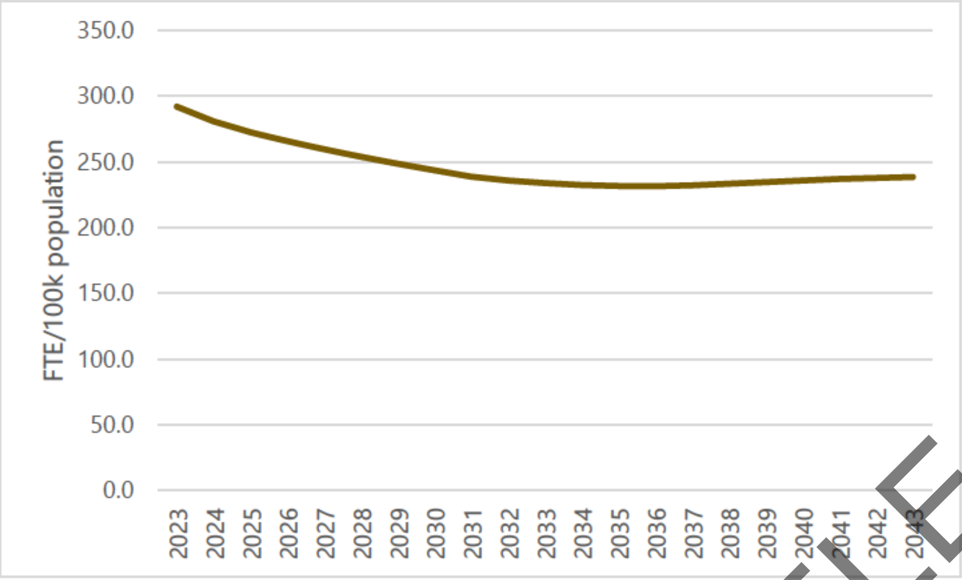
Figure 3: GPs per 100,000 population (2023–2043)



Source: Analytics and Forecasting team, National People Services, Health NZ.

Figure 3 does not consider how the population's GP needs might be changing over time. As the population ages, the number of visits the average person makes to the GP is expected to increase. Figure 4 displays the forecast GPs per 100,000 population aged 60+. GP coverage for this population is expected to decrease steadily over the 2023 to 2043 period under the status quo.

Figure 4: GPs per 100,000 60+ population, (2023–2043)



Source: Analytics and Forecasting team, National People Services, Health NZ.

1.3.3 Workforce deficits are particularly pronounced in rural and provincial communities

There are lower rates of GPs per capita in rural communities than in urban areas. Around 16 per cent of GPs in New Zealand are working in rural communities, compared with a population proportion of 24.3 per cent, while 71 per cent of GPs work in urban areas serving 65.5 per cent of the population (Bagg et al., 2023). 58 per cent of rural practices are advertising GP vacancies, and an increasing number of rural hospitals are reporting withdrawing from after-hours and 24/7 emergency services due to staff shortages (Hauora Taiwhenua Rural Health Network, 2023; Hauora Taiwhenua Rural Health Network et al., 2022).

While medical students from rural backgrounds have greater odds of working in rural practice after their studies have been completed (Kwan et al., 2017), the evidence suggests that New Zealand is training predominantly urban students who prefer to live and work in urban areas once they graduate (Hauora Taiwhenua Rural Health Network et al., 2022). The rate of medical programme admissions for rural students is half the urban rate. This applies equally to rural Māori and rural non-Māori.

While overall, international medical graduates make up 42 per cent of New Zealand's medical workforce, dependency on them is much greater in the provinces.

Research findings present a complex picture. Interest in rural medicine as a career increases during medical school (Poole et al., 2019), but is still low (increasing from 0.9 per cent to 2.7 per cent). However, the same paper found that interest in rural *location* declines in medical school and may reflect increasing awareness of where the vocational training opportunities are located.

1.3.4 Growing the medical workforce will contribute to improved health outcomes

We have conducted an econometric analysis to understand the contribution of additional doctors to health outcomes. Increasing the number of both GPs and SMOs has a statistically significant impact on life expectancy overall, and on life lived in good health.

- Each additional GP per 10,000 population increases healthy life expectancy by 18 days and life expectancy overall by 21.5 days per person.
- For SMOs, an additional doctor per 10,000 population increases healthy life expectancy by 16 days and life expectancy overall by 13 days per person.

The difference between GPs and other types of SMOs was not statistically significant. This means that contributions of all types of doctors to health outcomes are similar, underscoring their complementary roles in healthcare systems.

1.4 There are other workforce considerations along with options for medical education

Training more doctors is one critical part of a well-functioning health system. Another part is retaining them, particularly in general practice. There are a range of issues beyond the scope of this CBA, including the attractiveness of working conditions. A shortage of GPs has also led to a broader primary care team, as tasks traditionally performed by GPs are performed by other primary care practitioners.

In the long term, a sustainable and accessible health workforce will require a range of strategies complementary to medical education. Improving the workforce's experience of work and the way the sector values health professionals will be important. Other strategies might include bonding of practitioners in settings which are difficult to staff, interprofessional practice, and use of alternative workforces (where some tasks can be taken on by a different professional group).

1.4.1 The evidence for bonding schemes is inconclusive

New Zealand has a voluntary bonding scheme (Health New Zealand, 2025) to encourage newly qualified health professionals from certain specialties to work in regions where it is difficult to find staff. The scheme, run by Health New Zealand, offers a financial incentive of $30,000 for postgraduate doctors who have recently commenced GPEP 1, 2 or 3 training as a GP in an eligible hard-to-staff community, or in any New Zealand community if they are of Māori or Pacific ethnicity. Trainees receive the incentive payment after three years in an eligible community.

Evidence shows that financial incentives alone are insufficient. A 2012 review of the voluntary bonding scheme (the only review of the scheme) found that it benefited recruitment rather than retention, with more than half of trainees who signed up to the scheme leaving after the three-year minimum duration (Association of Salaried Medical Specialists, 2016). Since 2013, when general practice trainees were added to the scheme, 253 general practice trainees have registered to be bonded in the five most recent years of data. An average of 78 per cent of bonded trainees were retained for the full three years. Data is not available on whether the trainees remain in the hard-to-staff area once they have received the payment at the end of the bonded period.

Our understanding from previous work on general practice is that doctors are attracted to and stay at a practice based on its geographical location, remuneration, the quality of service from the local hospital, and stories about the quality of life that doctors have at that location. Evidence from overseas supports this. A systematic review of retention incentives in Australia found that bonding schemes may increase recruitment and short-term retention in rural and hard-to-staff regions, but evidence is inconclusive for long-term retention (Buykx et al., 2010). Other factors such as good working conditions, acceptable accommodation, social, cultural, and community support, and providing adequate infrastructure need to be considered along with remuneration to increase retention (Buykx et al., 2010; Efendi et al., 2016; Fried et al., 2024).

Evidence suggests that a more important factor for retention is where the medical students come from and where they spend time during training. Students who come from rural areas or who spend time immersed in rural programmes are more likely to remain in rural settings (Guilfoyle et al., 2022; Russell et al., 2021; Playford et al., 2019). This indicates that a medical school programme that attracts students from rural backgrounds and increases rural exposure during medical school training could lead to more students choosing to work in rural practice or rural hospitals. However, it is unclear whether bonding schemes encourage students to become GPs or whether those students would have pursued the GP training pathway regardless.

1.4.2 Changing workforce models will include task substitution

To reduce pressure on GPs, general practices across New Zealand are extending their workforces to include clinicians who can perform various tasks traditionally associated with GPs. In 2024, we visited 18 practices across the country to understand the current landscape of general practice and the state of the general practice workforce.

Many practices are facing staffing shortages and struggling to find general practitioners to fill vacancies. Practices are employing clinicians to broaden their primary care team—nurse practitioners, nurse prescribers, paramedics, clinical pharmacists, health improvement practitioners, healthcare assistants, and clinical assistants. There are key advantages to this approach:

- Routine tasks can be taken away from GPs and passed on to staff who can perform the task more cheaply on an hourly basis (even if it takes that person longer).
- Highly trained personnel can work to the top of their scope with a reduced administrative burden.
- Extra capacity can be created at the practice when GPs have more time for consultations and less administration.
- The job becomes more sustainable when GPs do not have to work late to complete paperwork.
- There are some presentations that can be dealt with directly (and more appropriately) by different staff (e.g. clinical pharmacists or physiotherapists).

Nurse practitioners are becoming increasingly common in general practice. Nurse practitioners have a wide ability to practice in similar areas to GPs because they can make diagnoses, order diagnostic and laboratory tests, and prescribe medicines within their area of competence. An advantage is that nurse practitioners can complete much of their training while still working at the practice where they are employed. As of September 2024, there were 805 nurse practitioners registered with the Nursing Council (Nursing Council of New Zealand, 2024), around 60 per cent of whom are likely to be in primary care (Adams et al., 2020). Around 120 nurses were in the 2024 intake, training to become nurse practitioners.[5] Assuming 60 per cent of the trainees are in primary care, it is evident that nurse practitioners alone will not fill the GP shortage.

Other clinicians such as paramedics, clinical pharmacists and physiotherapists could help fill the gap but cannot replace GPs entirely. Currently, there are few paramedics in general practice. However, the practices we talked to are adamant employing paramedics made a big difference to their practice. Paramedics can triage, manage acute presentations, and do home visits where necessary. Allowing paramedics to have prescribing rights is a necessary condition to ensure paramedics are more effective.

Clinical pharmacists can take charge of repeat prescriptions, run long-term condition clinics, assist with medicine titration, prescribe, and provide episodic care. For many practices, they have become a very important part of the general practice team.

Physiotherapists employed by general practice were less common than expected during our practice visits. However, with approximately 20 per cent of presentations in GP being musculoskeletal (Taylor et al., 2004), there is real scope for physiotherapists in general practice to assess, diagnose, treat and manage musculoskeletal problems.

Although workforce substitution (including registration of nurse practitioners) will continue to fill some gaps, it is not certain that substitution alone can fill all vacancies. Evidence from overseas is mixed. In the United Kingdom, for example, the Additional Roles Reimbursement Scheme is associated with a small improvement in patient satisfaction and perceptions of access, according to a new study published in the *British Journal of General Practice* (Penfold et al., 2025). However, the scheme did not improve outcomes in the Quality and Outcomes Framework.[6]

Given these uncertainties, and the inconclusive evidence for the effectiveness of bonding schemes, an increase in GPs and other workforces will be needed to address primary care workforce shortages.

[5] https://www.tewhatuora.govt.nz/corporate-information/news-and-updates/more-than-50-increase-in-funded-places-for-the-nurse-practitioner-training-programme-in-2024

[6] NIHR Applied Research Collaboration (ARC) West, 2024.

2. Options for growing medical education

This section provides an overview of the options considered in the CBA.

2.1 Cabinet agreed three options for detailed analysis

The PBC shortlisted three options that potentially deliver on the investment objectives:

- **Option 1**: increase the current intake at existing medical schools (with a proportionate increase in rural immersion programmes).
- **Option 2**: create a specialised medical training programme focused on rural health, jointly delivered by the existing medical schools.
- **Option 3**: establish a new medical school focused on primary and rural health.

Cabinet subsequently directed the Ministry of Health to develop a detailed business case (DBC), carrying forward these three options for detailed analysis. The options we have been instructed to consider relate to medical education of domestic students. Other alternative or complementary workforce strategies, as well as any other potential medical education options (such as alternative graduate programmes), are not within the scope of this CBA or the DBC.

2.1.1 The status quo

The CBA considers the marginal costs and benefits of the shortlisted options, compared to the status quo. Section 1.1 described the basic landscape of current medical education; this section provides more detail relevant to the investment objectives.

Entry pathways and selection

The status quo includes the additional 25 funded medical school places from 2025—that is, an intake of 614 domestic students across the two medical schools at the universities of Auckland and Otago.

Recent years have seen more than 2,000 applicants for Year 2 places across both medical schools (PricewaterhouseCoopers, 2024). The general selection criteria are competitive, based on grade point averages and clinical aptitude testing. The University of Auckland uses a structured multiple mini-interview for all students, whereas the University of Otago uses limited interviews.

Both medical schools have a material proportion of medical students admitted via graduate entry. Graduate entry accounts for 35 per cent of medical students at the University of Auckland and 27 per cent at the University of Otago.

Both medical schools have places offered through admission schemes, including Māori and Pacific admissions, regional and rural admission schemes, and schemes for other groups including low socioeconomic, refugee-background and disabled people (University of Auckland).

The University of Auckland advises that 40 per cent of student places may be filled through the Māori and Pacific Admissions Scheme, 23 per cent through the Rural and Regional Admissions Scheme and 3 per cent through other targeted admission schemes.[7] However, it notes that it is not able to fill all those places.

The University of Otago does not have targets, but on average, over the past five years, around one-quarter of its domestic admissions were Māori (19.6 per cent) and Pacific (6.6 per cent) students, an additional 15 per cent were rural, and 7 per cent low socioeconomic and refugee background.[8] Students may fall under multiple categories but are only counted once.

Programme

Year 1 is first-year health sciences, undertaken prior to application and acceptance to the next five years of the medical programme (for which places are capped). A large student cohort undertakes first-year health sciences, which is not capped, and no increase is expected or planned as part of this investment case.

- **Years 2 and 3** (i.e. the first two years after admission into medical school) are core skills and modular learning at each of the universities' main campuses (in Auckland and Dunedin). These two years consist mostly of lectures, tutorials, labs, clinical simulations and some clinical experience.
- In **Year 4**, the University of Auckland allocates students around the major, regional and rural hospitals, and GP clinics in the Northern and Te Manawa Taki (Midland) regions (except Tairāwhiti). The University of Otago splits its students roughly one-third each across its Dunedin, Christchurch and Wellington campuses, and allocates students around the major, regional and rural hospitals, and GP clinics in these regions.
- In **Year 5**, for the majority of students, core clinical placements continue in the sites offered in Year 4. Both universities offer regional and rural immersion placement programmes, a subset of which are full rural medical immersion programmes (RMIP, a one-year academic placement).
  - The University of Auckland offers 84 regional and rural placements in Te Tai Tokerau (Northland) and Bay of Plenty (both interprofessional), Taranaki and Waikato/Lakes. These year-long placements mix hospital experience with a slightly longer rural GP placement than for other students. The University of Auckland will introduce a RMIP in 2025 with capacity for 12 students in 2025, who will spend Year 5 based in rural communities (Hāwera, Te Kuiti, Thames, Wellsford) gaining experience in placements at rural general practices and hospitals.
  - The University of Otago offers 85 regional and rural placements (including interprofessional learning in West Coast and Tairāwhiti), 35 of which are RMIP. The University of Otago's RMIP has been in place since 2007. Students spend Year 5 living and learning in small groups in one of nine rural communities: Wairoa, Tararua, Wairarapa, Marlborough, West Coast, Ashburton, Queenstown, Alexandra, Clutha.

[7] https://uoa.custhelp.com/app/answers/detail/a_id/1792/~/available-spaces-in-medicine
[8] Data provided by the University of Otago on admitted domestic applications for the five years 2020–2024.

- **Year 6** is the trainee intern year, where students undertake clinical placements as well as an eight-week (University of Auckland) or six-week (University of Otago) elective, which can be located anywhere, including regional and rural locations. All University of Otago students are timetabled for six weeks of rural experience in their trainee intern year, although placement constraints mean not all students are able to complete the full six weeks.

Specific programmes, alongside many placements, provide regional and rural coverage across New Zealand. The University of Otago timetables 14 weeks in GP settings for all students, although this may be limited by placement availability.

Facilities

Key campuses and teaching facilities are in Auckland (the Grafton campus and at the three metropolitan hospitals) and Hamilton for University of Auckland, and in Dunedin, Christchurch and Wellington for University of Otago. There are several smaller teaching facilities, including Whangārei, Tauranga, Rotorua and New Plymouth (University of Auckland), and Nelson, Blenheim, Timaru, Invercargill, Palmerston North, Hawke's Bay, Whanganui and Gisborne (University of Otago).

2.1.2 The shortlisted options

Table 2 sets out the key features of each shortlisted option, with detail in the sections that follow.

Table 2: Key features of each option

Feature	Option 1	Option 2	Option 3
Provider	UoA and UoO	Joint venture UoA and UoO	UoW
Entry pathway	Undergraduate or graduate Currently: • UoA: 35% are graduates • UoO: 27% are graduates	Undergraduate or graduate Currently: • UoA: 35% are graduates • UoO: 27% are graduates	Graduate
Selection criteria	Grade point averages, clinical aptitude testing, interviews (mostly UoA) Plus targeted admission schemes	Similar to Option 1 with emphasis on rural admission pathways or Māori and Pacific admission pathways	Academic threshold, then points system to demonstrate alignment with workforce needs, interviews. Expressed focus on recruiting from rural, Māori and Pacific population groups.
Additional annual intake	120	120	120
Start year	2026	2026	2028 allowing for accreditation, recruitment, construction

Feature	Option 1	Option 2	Option 3
Programme duration	5 years (preceded by Year 1 health sciences or prior degree, which are out of scope of this business case) 3 years in clinical placements	5 years (preceded by Year 1 health sciences or prior degree, which are out of scope of this business case) 3 years in clinical placements	4 years (preceded by prior degree, which is out of scope of this business case) 3 years in clinical placements
Curriculum	Existing curriculum, research-based and experiential learning, with some enhancements to strengthen focus on primary and rural health	Research-based and experiential learning with increased focus on primary and rural health (including GP-based content as well as GP visibility and faculty)	Adapted from the Wollongong programme, case-based and experiential learning, harnessing digital, focused on general practice and rural
Location	Start at a main campus (Auckland, Dunedin) and then progress through existing networks	Start at a main campus (Auckland, Dunedin) and then go through rural hub and spoke model, located in regional and rural areas	Start at main campus (Hamilton) and then go through Community Learning Centre model, located in regional and rural areas
Clinical placements	Assume regional and rural placements (incl. RMIP) increase proportionate to overall increase in intake Clinical placements required from 2028 PGY1 positions required from 2031	All 120 students undertake rural placements Clinical placements required from 2028 PGY1 positions required from 2031	All 120 students undertake rural placements Clinical placements required from 2029 PGY1 positions required from 2032
Investment requirements	Additional student places Health NZ capacity for placements GP/community capacity for placements Student accommodation	Additional student places Health NZ capacity for additional placements Some investment to establish rural hubs, building on existing university facilities in rural areas where possible GP/community capacity for placements Student accommodation	New build on UoW campus plus refurbishment of existing facilities Additional student places Health NZ capacity for additional placements Community Learning Centres GP/community capacity for placements Student accommodation

Option 1: Increase existing medical school intake with a proportional increase in rural immersion programmes

Option 1 represents the least change from the base case. This option assumes that the domestic intake across the two existing medical schools increases by another 120 students from 2026. The existing entry pathways would continue, and the duration of study would be the same. There would be enhancements to the curriculum to strengthen the focus on primary and rural health.

Capacity would be expanded in the main learning centres as well as provincial and rural locations. Under this option, we assume that the number of regional and rural placements (including RMIP) would expand proportionate to the increase in total student numbers. The medical schools would increase regional and rural learning opportunities and could expand RMIP, including Northland and across Waikato.

To accommodate new students, the universities intend to reconfigure the use of existing facilities. Any capital expenditure needed would be reprioritised from existing budgets.

Additional investment would be required to support additional clinical training placements and supervision capacity.

Option 2: Specialised rural medical training programme, jointly delivered by existing medical schools

Option 2 would create a specialised medical programme focused on rural health, providing training in rural settings.

Initially, this option would take the form of a joint centre for rural health focused on medical training, with a long-term vision of a national interprofessional school of rural health involving other tertiary and training institutions. The programme would be jointly delivered by the existing medical schools, in collaboration with other medical and community stakeholders. Governance would be developed in partnership with iwi, with membership envisioned to include iwi, the universities, the RNZCGP, Hauora Taiwhenua sector and rural community representatives.

Option 2 assumes an intake of 120 domestic students to the rural training programme, introduced from 2026. All additional students would undertake a longitudinal rural placement in the penultimate year of medical school. The rural medical programme would be five years, with students admitted following Year 1 health sciences or with a prior degree (as per the general medical programme).

The rural school would emphasise Māori, Pacific and rural entry pathways. The universities note that ongoing and increased work would be required to target rural secondary schools and increase the pool of applicants to the rural admission scheme.

It is assumed that Option 2 would offer an enhanced version of its existing accredited programmes, that is, new accreditation would not be required. The curriculum would be research-based and include experiential learning, with an increased focus on primary and rural health (including GP-based content as well as GP visibility and faculty). During years 4 to 6, students would train at one of 10 smaller hospitals (rural teaching hubs) spread across the country, with outplacement into rural general practices. For instance, they would undertake short-duration clinical placements in rural general practices and/or rural hospitals (Year 4), spend one year based in a rural community (Year 5), and undertake additional placements in rural general practices and/or rural hospitals, along with regional hospital attachments, at other times (Year 6).

As with Option 1, the universities intend to reconfigure the use of existing on-campus facilities to accommodate additional students, and if capital expenditure was required on either main campus, then this would be reprioritised from existing budgets.

Additional investment would be required to support additional clinical training placements and supervision capacity (across hospitals, rural hubs, and general practices). Development of rural hubs would build on existing university facilities where possible. Enhanced coordination would be needed across the two universities' existing programmes and the rural school. Accommodation support may be required in regional and rural health settings to support students on clinical training placements.

Option 3: New medical school focused on primary and rural health

Option 3 would establish a third, new, medical school at the University of Waikato. It would offer a four-year graduate-entry programme with a specific focus on primary and rural health. Students would need to have undertaken a previous three-year (or greater) undergraduate degree.

It is proposed that a new medical school would be based on the Doctor of Medicine programme from the University of Wollongong. The Wollongong programme would be adapted to the New Zealand context, for example to address cultural safety and support Māori, Pacific and rural communities.

An initial intake of 120 domestic medical students per annum from 2028 is proposed, allowing for curriculum accreditation and facilities construction, which would need to be undertaken in parallel.

Entry pathways and student selection criteria for the new medical school would aim to align with workforce need. Applicants meeting an academic threshold (undergraduate grade average and clinical aptitude testing) would be assessed against a range of factors (a points system) developed through stakeholder consultation and informed by MCNZ data and projected workforce needs. A structured interview process would assess non-academic qualities.

Year 1 would involve intensive study on-campus, learning about the basic medical sciences and using case-based learning. In the programme's second year, students would complete a year-long placement in a regional hospital. In the programme's third year, students would undertake a 40-week longitudinal placement in the community and spend time undertaking activities at community learning centres. The final year of the programme would be structured to broadly align with the current trainee intern year of the existing undergraduate medical schools.

Option 3 would require investment in on-campus infrastructure at the main University of Waikato campus in Hamilton. A space brief has been developed using input from the University of Wollongong and tours of other Australian medical school facilities in New South Wales, South Australia and Victoria. Different options have been considered to accommodate these required teaching spaces and the associated staff and support spaces, balancing investment in new facilities and utilising existing facilities where possible and cost-effective. Through this process, it became clear that most of the required spaces would be best suited to a new build, while the remaining needs could be effectively met by refurbishing some existing laboratories.

Additional investment would be required to support additional clinical training placements and supervision capacity (in hospitals, community learning centres, and primary care practices). Accommodation support may be required in regional and rural health settings to support students on clinical training placements.

2.2 Availability of clinical placements requires effort

Clinical placements are critical to the success of all three options. All options require an increase in clinical placements of 120 per year for three years. There is consensus that clinical placement capacity is a challenge which needs considerable effort. Currently, clinical placements for students are arranged by their medical school. There is no national approach to securing placements in primary or secondary care settings.

The increased medical training cap of 50 students beginning in 2024 and a further 25 students beginning in 2025 means the existing medical schools already need to arrange for an additional 75 clinical placements above the 2023 cap. Auckland and Otago universities have both voiced difficulties securing capacity for clinical placements, particularly in general practice. There is concern for the health sector's ability to absorb an additional 120 clinical placements per year over several years.

The University of Auckland negotiates clinical placements separately with each department and practice depending on the number of clinical placements (if any) the hospital or practice can take each year. It noted that students at Waikato Hospital have been placed in geriatrics because there isn't capacity in general medicine. The University of Otago has 57 locations around New Zealand for clinical placements, 42 of which are in rural areas. There is capacity to increase some of the rural medical immersion programme places, but Otago finds securing places in general practice more difficult.

Finding clinical placements in primary care appears to be becoming more difficult, because general practitioners in general are under pressure, stressed, and some are struggling financially. We heard from several primary health organisations (PHOs) that the willingness to take students is there, but remuneration is an issue, and so is physical space for the students. Several reasons were raised by PHOs and the current medical schools for why it is more difficult to secure clinical placements in general practice:

- The general practice model shifting towards multidisciplinary teams reduces physical space to accommodate clinical placements because additional space is being used by other clinicians. Students spend time shadowing the GP but also need their own space to see patients.
- The commercialisation of practice ownership has reduced willingness for some practices to take on students.
- A high proportion of general practitioners are nearing retirement and intend to retire soon.
- General practitioners don't feel they are adequately remunerated.

The University of Otago also noted the difficulty may stem from a remuneration issue. However, when it has asked general practitioners, they have said it is not as simple as needing more funding to cover placements. There is a level of altruism, but the need for sufficient support, and experience with previous students, can affect a GP's willingness to take on more students.

The United Kingdom recently recognised the underfunding of clinical placements of medical graduates into general practice compared to secondary care settings. In 2022, new training tariff guidance introduced consistent resourcing for medical student clinical placements regardless of setting (Rosenthal et al., 2022). Rectifying this underfunding was seen as a key priority to address recruitment shortages of medical graduates to general practice.

Clinical placements are more expensive in primary care than secondary care settings. However, practices taking students may experience a benefit through appropriate task shifting. Some research has indicated that clinical placements are beneficial to existing practices (Yiend et al., 2016). Other research on regional and rural clinical placements suggests a 'turning point' where clinical placements can become net financially beneficial to the practice after about two months (Hudson et al., 2012). Hosting clinical placements can impact existing practices through three paths:

- Cost in time spent training rather than doing.
- Benefit in dollars received from the government for hosting placements.
- Benefit in labour from the extra pairs of hands.

We expect that there will be a benefit to practices from hosting clinical placements, noting that the placement model for Option 2 and Option 3 is different—both requiring more practice time while Option 3 has a greater rural focus. As each option trains the same number of additional medical graduates, we cannot differentiate between the expected impact here. Options 2 and 3 will have more placements at medical centres compared to larger hospitals than under Option 1. We have not found evidence as to whether the benefits to a provider from taking placement students differ based on the size or type of the facility they are placed at. Location modelling by Health New Zealand shows there is potential ability to provide clinical placements in 10 districts in rural New Zealand. However, the investment required for the district to offer clinical placements varies.

3. Each option produces substantially more doctors compared to the status quo

The first benefit set out in the investment logic map is that more doctors are trained in New Zealand. This benefit is demonstrated in workforce modelling provided by the Analytics and Forecasting team, in Health NZ's National People Services. The modelling forecasts the number of doctors under the status quo, and the number of doctors under each option, according to assumptions specified for this CBA. Key assumptions and results are provided in the sections below, and further detail of the workforce modelling in Appendix A.

3.1 Key workforce assumptions

The options are assumed to produce different numbers of total doctors, and numbers of GPs, based on assumptions about the:

- retention of medical students from year to year
- proportion of doctors choosing to specialise in general practice—we call this 'GP propensity'
- years after graduation before specialising as a GP
- rate of doctors leaving the New Zealand health workforce—we call this 'exit rate.'

Table 3: Workforce modelling assumptions

Assumption	Status quo	Option 1	Option 2	Option 3
Retention[1]	96% of medical school students graduate and go on to PGY1 99.03% retained each year for PGY1&2			
GP propensity[2]	23% (current)	23%	33%	38%
Postgraduate years to become a GP[3]	8 (current)	8	8	7
Workforce exit rate – GPs[4]	Current exit rate	Current exit rate	9/10 of current exit rate	9/10 of current exit rate
Workforce exit rate – other doctors	Current exit rate	Current exit rate	Current exit rate	Current exit rate

[1] Medical school retention is based on average completion rates, and PGY1 and 2 rates are based on doctor retention rates for Year 1 NZ graduates(MCNZ, n.d.).

[2] Based on the University of Wollongong experience (Cortie et al., 2023) and discussed with the expert panel.

[3] Existing workforce data shows that doctors become vocationally registered in general practice eight years after graduation on average. A slightly earlier uptake of the GPEP is assumed for graduates under Option 3.

[4] Current exit rates are based on observations for each age and gender group in the Health NZ workforce model. Reduced GP exit rates for Options 2 and 3 are based on research from Kwan et al. (2017) that shows longer-term intentions for rural practice increase with an increase in the number of years of clinical placement in these settings.

3.2 Number of doctors

Option 3 is modelled to start two years later than Options 1 and 2. Once fully implemented, each option is expected to produce 115 graduates entering PGY1 each year (see Table 3 for retention assumptions).

We consider the number of additional graduates of medical education delivered through to 2042. This allows us to consider workforce outcomes at around 15 years after the increased intake is implemented.

Compared to the status quo, each option produces a health workforce with significantly more doctors (Figure 5). In 2043, compared to the status quo and rounded to the nearest 10, across the entire medical workforce there are an estimated:

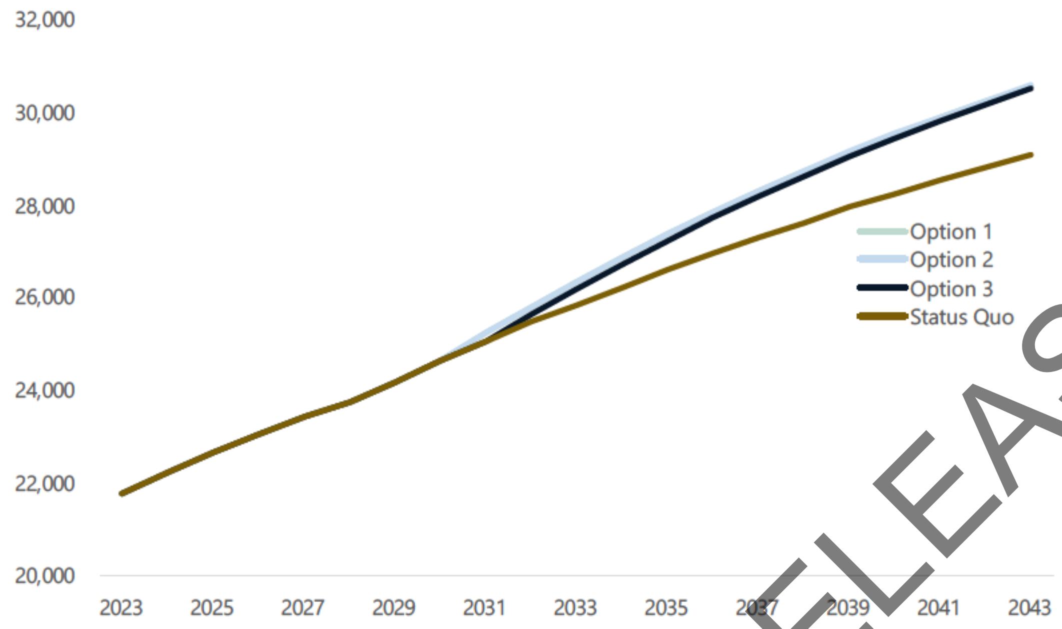
- 1,490 additional doctor FTEs under Option 1
- 1,500 additional doctor FTEs under Option 2
- 1,440 additional doctor FTEs under Option 3.

The number of doctors includes both resident medical officers (RMOs), including house officers and registrars, and vocationally registered doctors working in a variety of specialties and settings (i.e. GPs and SMOs).

All options have an increased intake of 120 medical students. The main assumptions driving the difference in resulting medical graduate FTEs are:

- Option 1 and 2 generating medical school graduates one year earlier than Option 3 (medical school intake occurs two years earlier, but takes one year longer)
- the differing propensities for taking up general practice
- slightly better retention of GPs in the New Zealand medical workforce where those GPs undertake their medical degrees in a rural and/or primary focused programme.

Figure 5: Total doctors in NZ health workforce under each option (FTE), 2023–2043



3.3 Number of additional vocationally registered doctors

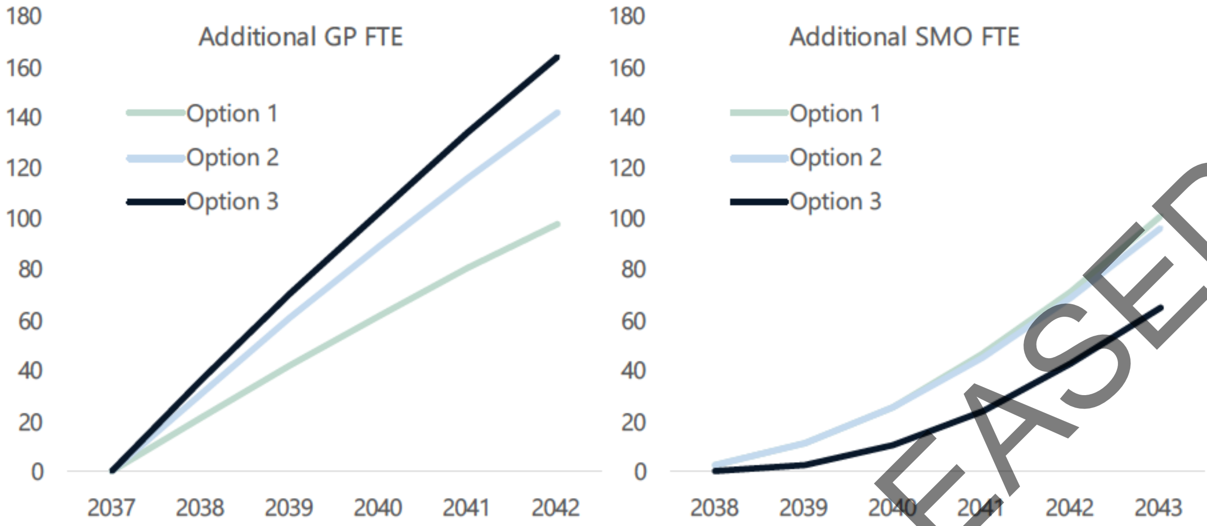
Each option is assumed to have a different impact on the number of doctors that have gone on to become vocationally trained and registered (assumptions set out in Table 3). Table 4 shows the additional FTE, broken down by GP and SMO, projected in 2043. The number of GPs produced by each option relates to other benefits identified in the investment logic:

- More New Zealand-trained primary care doctors.
- More New Zealand-trained SMOs.
- Graduating doctors have greater awareness of and connection to primary care.

Table 4: Additional doctor FTE with vocational registration (2043)

	GP	SMO	All vocationally registered doctors
Option 1	98	101	199
Option 2	142	97	239
Option 3	164	65	229

Figure 6: Additional doctors with vocational registration (2038–2043)

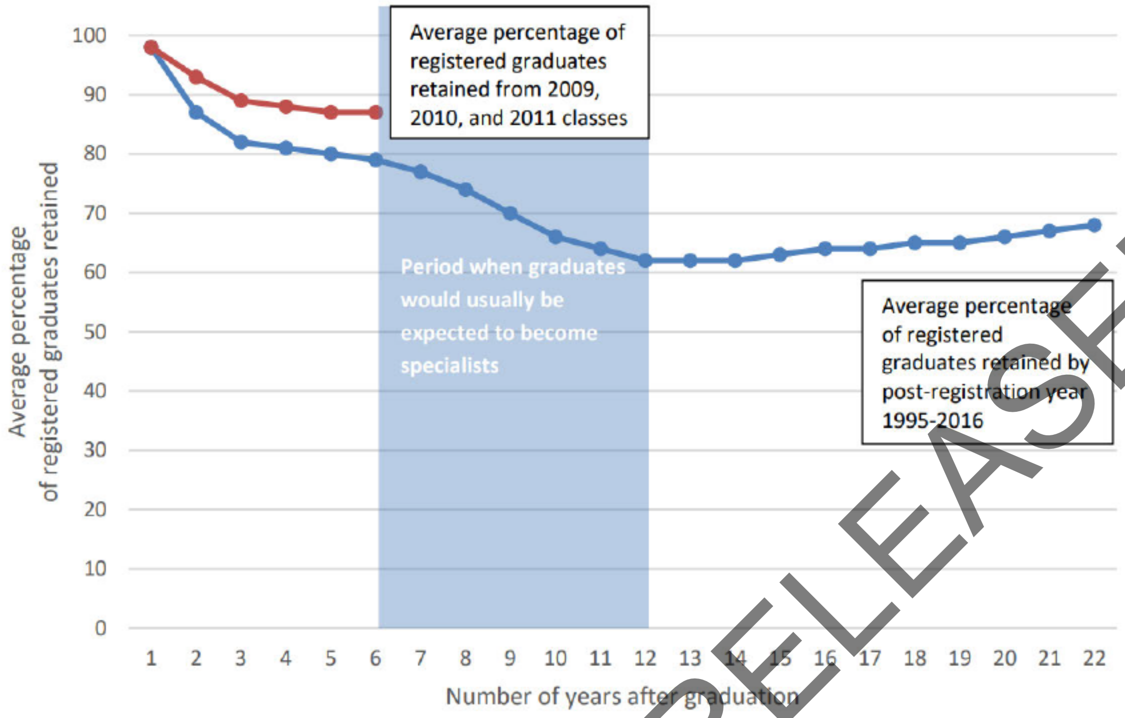


Note: graduates from the investment options do not achieve vocational registration until approximately 2039 onwards.

The numbers above might seem counterintuitive at first. That is, while propensity to be a GP is below 50 per cent, there are more GP FTE at 2043 than SMO FTE. There are two main reasons for this:

- It takes relatively longer to train in other specialties and become a SMO, as seen in the ramp up in the SMO chart.
- There is a portion of medical school graduates that exit the New Zealand doctor workforce (either leave medicine or move overseas) before they become vocationally registered, or they may never become vocationally registered (at least within our modelling time horizon). Therefore, SMOs are not the complete complement to GPs (i.e. GP propensity + SMO propensity <1).

Evidence suggests that somewhere between 30 to 40 per cent of New Zealand medical school graduates are not retained in New Zealand.



Source: Association of Salaried Medical Specialists, Research-Brief-specialist-workforce-projections-_172060.2.pdf

Workforce data suggests that, currently, approximately 40 per cent of medical graduates become SMOs in New Zealand. Combined with the current 23 per cent propensity to become a GP, this results in a similar figure of exit/non-vocationally registered (37 per cent).

More recent workforce data, provided to us by Health NZ, indicates that retention rates at PGY5 have remained closer to the higher ~87 per cent rate, continuing the trend from the chart above. This retention rate improvement in the earlier years appears to continue in later years, although this is based on few data points.

3.4 Propensity to become a general practitioner is the critical assumption

Status quo

We set the current propensity to become a GP at 23 per cent, as estimated by Health New Zealand's Analytics and Forecasting team. This means that 23 per cent of current medical school graduates will become vocationally registered GPs at some stage in their career. We use this value for the status quo and Option 1.

We also assessed data and reporting from the Medical Schools Outcomes Database (MSOD). This data showed that the general practice speciality was the first preference for approximately 28 per cent of survey respondents at PGY5 (New Zealand MSOD Steering Group, 2022). Evidence suggests that 13 to 20 per cent of medical school graduates leave the New Zealand doctor workforce by PGY5. Accounting for this, we arrive at a first preference to specialise in general practice of 22.4 to 24.4 per cent of New Zealand medical school graduates (Association of Salaried Medical Specialists, 2019).

We note that this percentage cannot be used directly for multiple reasons:

- The value is a proportion of survey respondents—the survey response rate was 49.6 per cent of the graduating cohort.
- The value only represents first preference specialty at PGY5—some people may change their preference to another specialty before specialising in general practice, while others may change their preference from another specialty and choose to specialise in general practice.
- The value does not account for 'leakage' where medical school graduates become vocationally registered general practitioners before choosing to relocate offshore. We note that medical school graduates who have become fellows of RNZCGP have full rights to work as general practitioners in Australia.

Nonetheless, the closeness of this range to the estimated current GP propensity gives us confidence in the 23 per cent figure.

Despite these data points, our expert panel could not come to a consensus on this.

Option 3

Option 3 proposes a new medical school based on the Doctor of Medicine programme from the University of Wollongong. Evidence suggests that 42.7 per cent of PGY10–12 doctors who graduated from the University of Wollongong become GPs, compared to the national average of 27.7 per cent (Cortie et al., 2023). We note that this data was based on a subset of medical school graduates, limited by MSOD graduate exit survey responders and ability to match these respondents to the Australian Health Practitioner Regulation Agency registration data.

- 185 of the 221 (83.7 per cent) graduates from 2010 to 2012 were included for the University of Wollongong.
- 5,857 of the 8,981 (65.2 per cent) graduates from 2010 to 2012 were included in the national Australian data.

These GP propensities could be over- or underestimated, depending on whether the specialties of the doctors included in the study were representative of all doctors.

We use the 15 percentage point uplift in GP propensity that the University of Wollongong has experienced above the Australian average. We then apply this to our status quo propensity of 23 per cent to arrive at a GP propensity of 38 per cent for Option 3.

This percentage point uplift methodology has some advantages, compared to using the 42.7 per cent figure directly:

- It accounts for some of the fundamental differences in the New Zealand context compared to Australia in the underlying propensity to be a GP. These could include health sector structure, relative pay and working conditions, and cultural and geographical differences, among other policy settings.
- Any over- or underestimated GP propensity arising from graduates not included in the survey may be somewhat eliminated by subtracting the national average from the University of

Wollongong estimates. This assumes that any reasons for over- or underestimation are similar in each cohort.

- Given that the current propensity to be a GP may be different in the future, this uplift methodology dampens the materiality of this baseline changing when comparing the options to each other.

An alternative approach is to use the relative increase in GP propensity for Wollongong vis à vis the rest of the Australian medical education system. This approach captures many of the benefits relative to using the 42.7 figure directly outlined above.

The expert panel discussed the two approaches and concluded that the percentage point uplift approach is most appropriate.

Despite these data points, and the use of the uplift methodology, we remain uncertain on the applicability of the University of Wollongong experience to the New Zealand setting. We note that there are large uncertainties in the propensity to be a GP under this option, and our expert panel could not come to a consensus on this.

We test a wide band of +/- 7.0 percentage points on the GP propensity for this option in sensitivity/scenario analysis.

Option 2

We could not find a data point on which to base the propensity to become a GP for Option 2. The expert panel agreed that it was difficult to form an assumption as Option 2 has not been specified at the same level of detail as Option 3.

It is reasonable to expect that the propensity to become a GP for Option 2 would fall between the status quo and Option 3. That is, a rural immersion programme is likely to produce more GPs than the status quo, but fewer than a curriculum and selection criteria that have a primary focus of uplifting the number of graduates that become GPs.

We set this at two-thirds of the uplift achieved by Option 3 over the status quo. This assumes that the Option 2 programme would be closer in outcomes to Option 3 than Option 1 or the status quo. Again, we test sensitivities at +/- 7.0 percentage points.

3.5 Rates of exit from the medical profession

Exit rates refer to the rate at which people, for whatever reason, exit the New Zealand medical workforce. This may be to move to a different country, work in an area other than medicine, commit to further study, or to make lifestyle adjustments to achieve other goals. Exit rates are explicitly modelled based on observed past behaviour of age and gender groups.

Exit rates are also assumed to be lower for GPs under Options 2 and 3. We draw on research from Kwan et al. (2017) that shows longer-term intentions for rural practice increase with an increase in the number of years of clinical placement in these settings.

4. Approach to cost-benefit analysis

Section 3 set out the modelled number of doctors that the shortlisted options will provide, based on a set of assumptions. The main benefit to society arises from the healthcare that those medical graduates deliver to the people of New Zealand. The remainder of this report sets out the CBA of the shortlisted options.

We have highlighted that the propensity to become a GP is a critical assumption underpinning the workforce modelling. The number of GPs and SMOs flows through as a key input to the CBA.

4.1 Approach and methodology

Our approach aligns with the New Zealand Treasury's guide to social cost-benefit analysis (New Zealand Treasury, 2015). The CBA focuses on the costs and benefits of each option at the national level. This includes both measurable and monetisable costs and benefits, and non-monetisable benefits. We also consider sensitivity to key assumptions and inputs.

4.1.1 Method

The CBA has sourced information from the PBC, and the strategic and financial cases of the DBC, including:

- investment logic mapping—linking the problems, objectives and benefits
- current state and three specified options
- the estimated cost of the status quo and three alternative options
- data collected from stakeholders by the Ministry.

We have added to these inputs by gathering further evidence from our own literature review, information provided by stakeholders, and input and assumption testing by an expert panel. Details of our main assumptions, important context and modelling are set out in the appendices.

In our analysis, we undertake six key steps:

1. Review the counterfactual (status quo) and options.
2. Define the scope and analysis period.
3. Identify costs and benefits—based on literature review and engagement with the Ministry, other agencies and an expert panel to test costs and benefits.
4. Measure and (where possible) monetise costs and benefits—for each measurable cost and benefit, we quantify the *difference* between the option and the status quo, convert to monetary values and calculate a present value. We apply economic valuation approaches, by using market prices, and shadow pricing where applicable for benefits like improved health outcomes.

5. Conduct sensitivity analysis—adjusting a range of CBA inputs/assumptions, to determine their impact on the results. Both the Ministry and expert panel have suggested parameters to test. Treasury's alternative discount rate is also used in the sensitivity analysis.
6. Compile the CBA report.

4.1.2 Time period and discounting

Our CBA estimates the lifetime costs and benefits of doctors trained between 2026 and 2042 (consistent with the workforce modelling).

- Initial investments are assumed to occur between 2026 and 2029 (including planning, any construction required and initial set-up).
- The first year of additional student intake is:
  - 2026 for Options 1 and 2
  - 2028 for Option 3
- The costs of medical education are captured through to 2042, and terminal values for capital investments are applied at that point.
- The lifetime costs and benefits extend over the careers of those graduating doctors. Ideally, we would estimate costs and benefits right through to retirement of the last graduating cohort; however, our modelling is limited by the availability of Statistics New Zealand population projections (to 2073).
- Costs and benefits are discounted to a present value as at 2026, using Treasury's recommended discount rates:
  - 2 per cent for years 1 to 30
  - 1.5 per cent for years 31 to 100
  - Sensitivity test at 8 per cent.

4.1.3 Summary economic metrics

We present two summary metrics to provide a basis for comparing the investment options:

- Net present value (NPV) for each option to assess total economic value.
- Benefit-cost ratio (BCR) to determine the efficiency of spend on a per dollar basis.

4.2 Limitations and key dependencies

The limitations of our analysis, given the time available, include the following:

- The key outcomes and benefits, such as improved health outcomes, arise indirectly. The options provide for additional medical students compared to the status quo, differing predominantly by their location and curriculum. While a causal link is logical and expected, the benefits accrue over time and at a system level. This results in significant uncertainty, exacerbated by the delay between making the investment and an increase in the size of the health workforce.

- Our analysis relies on past research both in New Zealand and overseas. The findings observed historically and/or internationally might not replicate themselves in the future New Zealand context. Our sensitivity analysis and a degree of conservatism in assumptions attempt to address this, among other limitations.
- Workforce modelling by Health NZ, a key input into our modelling, extends to 2042. We have modelled the impacts of doctors trained up to this date under each option and extended the forecast to 2073 to capture the benefits provided by the last cohort of doctors trained over the course of their careers.
- Where there are limitations relevant to certain aspects of our analysis, we highlight these as these aspects are discussed.

There are several dependencies and key external factors relevant to achieving the resulting health outcomes. Most of these are beyond the investment objectives and beyond our scope to consider as individual options.

- Relative pay and broader funding for GPs/primary care practices.
- Incentives and operating models for GPs to work in rural locations.
- Any support for access to the health system.
- Regulation of medical training and who can practise medicine in New Zealand.
- Potential changes in models of service provision (such as the role of online consultations or nurse practitioners relative to GPs).

5. Costs

Costs for the three options are summarised in Table 5.

Operational costs associated with the training of additional medical graduates are estimated from 2026 to 2042 in present value terms using a discount rate of 2 per cent (analysis years 1 to 30) and 1.5 per cent (analysis years 31+). All costs are reported incremental to the status quo. Terminal values are presented as negative figures because they offset the costs presented.

Option 1 results in total costs of $10.9 billion, Option 2 $10.2 billion, and Option 3 $9.0 billion. This difference is largely driven by the cost of doctors in the workforce. The cost of doctors in the workforce is estimated over the 2026 to 2073 period.

GPs are comparatively cheaper than SMOs, meaning Option 3's greater number of GPs relative to SMOs results in its lower cost.

Interestingly, Option 3 results in lower operating expenditure (opex). The low opex arises because its medical programme has one less year of medical education, while its student intake starts two years later (and therefore has two fewer years of opex). However, it also incurs higher capital expenditure (capex) because it requires a new build on campus.

Table 5: Summary of economic costs ($ millions)

Category	Component	Option 1	Option 2	Option 3
Costs of medical education				
Opex	Course costs	s 9(2)(j)		
	Rural immersion			
	Subtotal	**513.6**	**508.0**	**361.6**
Capex	University campus facilities	s 9(2)(j)		
	Clinical placement facilities			
	Curriculum development costs			
	Infrastructure development support			
	Clinical placement coordination			
	Business case implementation			
	Subtotal	**49.0**	**81.5**	**236.3**
Terminal value of assets	New building	s 9(2)(j)		
	Refurbishment of existing facilities			
	Clinical placement facilities			
	Subtotal	**(25.1)**	**(42.3)**	**(105.7)**

Category	Component	Option 1	Option 2	Option 3
Total cost of medical education		**537.5**	**547.3**	**492.2**
Cost of doctors in the workforce				
Cost of GP care	GP salaries	s 9(2)(f)(iv)		
	Direct costs			
	Subtotal	**1,464.4**	**2,167.8**	**2,352.8**
Cost of specialist care	SMO salaries	s 9(2)(f)(iv)		
	Direct costs			
	Overhead allocation			
	Subtotal	**6,743.7**	**2,167.8**	**4,391.3**
Cost of RMOs		2,134.7	2,047.7	1,816.8
Total cost of doctors in the workforce		**10,342.9**	**9,688.2**	**8,561.0**
Total economic costs		**10,880.4**	**10,235.5**	**9,053.2**

Non-monetised costs are not shown in the table. These costs include the foregone earnings from students who continue to study, the cost of specialist training beyond university, the offset teaching costs in alternative courses, student loan implications, and the deadweight cost of taxation.

Costs were calculated from data provided by the Ministry and Health NZ, as well as the best available data found through desktop research. Where required, conservative assumptions have been made, requiring subjective judgement that has been reviewed by the expert panel. Detailed assumptions are outlined in Appendix B.

5.1 Costs of medical education

The following subsection details the estimated costs of medical education. It includes opex, capex, and the terminal value of assets.

5.1.1 Operating expenditure

Opex is associated with the resource cost of running the universities' operations. Opex figures are estimated using tuition subsidies (the government's contribution), student fees (students' contribution), and rural immersion costs.

We use a revenue-based approach to estimate the opex of each option. This approach relies on university revenue as a proxy[9] for opex because detailed information on the cost structures of Auckland and Otago universities is unavailable. In addition, both Auckland and Otago universities have requested full tuition subsidies under Options 1 and 2. This request indicates that course revenue would be allocated to cover the necessary resources under both options.

s 9(2)(f)(iv)

Options 2 and 3 do not include any rural immersion costs. Under these two options, all students are expected to participate in an approximate year-long rural placement. The associated opex for these placements is expected to be covered within the existing tuition subsidies and course fees.

A summary of the costs is presented in the table below. The detailed assumptions underlying these estimates are outlined in Table 27 of Appendix B.

Table 6: Operating expenditure ($ millions)

		Option 1	Option 2	Option 3
Course costs	Tuition subsidies	s 9(2)(f)(iv)		
	Course fees			
	Subtotal			
Rural medical immersion programmes				
Total opex		**513.6**	**508.0**	**361.6**

5.1.2 Capital expenditure

Capex refers to the one-off costs incurred to acquire, construct, and equip the facilities required under each option. The six main components of capex are:

- university campus facilities, including construction of a new medical school
- clinical placement facilities, to develop the capital required to accommodate additional student placement in hospitals. These include:
    - primary care facilities
    - selective/elective accommodation
    - rural hub and spoke centres (Option 2 only)

[9] To be clear, although these costs have been passed through, this is the best method we have available to ensure a consistent approach across options. Building up the costs through evaluating tuition costs for each party is not possible.

    - regional base hospitals (Option 3 only)
    - community learning centres (Option 3 only).
- curriculum development costs
- infrastructure development support
- clinical placement coordination to support new placements (over three years)
- business case implementation.

Option 3 incurs the highest university facilities capex because of the construction of a new medical school. Options 1 and 2 do not incur costs for new buildings on-campus. Universities of Auckland and Otago have reported that they would not require any capex for campus facilities. The implicit assumption is that existing facilities and equipment would be able to accommodate the additional students.

Clinical placement facilities include the capex associated with establishing infrastructure needed to support placements. All options include three years of clinical placements, with the first and third year of placements expected to be broadly similar across all options. The key difference is in the second year of placement.

In all three options, primary care placements are envisioned. The estimate is based on 60 sites for a total of 180 rooms. These costs are assumed to be equal across options, though occurring one year later for Option 3.

Students in Options 2 and 3 would undertake a longitudinal rural placement in their middle year of clinical placements. While doing so, Option 2 supports students through rural hubs and Option 3 establishes community learning centres. We assume that the capex of clinical placement facilities for Options 2 and 3 is equal, i.e. both options would necessitate investment in facilities which are comparable in scale. We note that Option 2's clinical placement capex is incurred one year earlier.

Option 3 has a provision for 12 community learning centres, including seven rural/regional hospitals and five larger medical centres that offer urgent care services. Placement capacity would be expanded at six potential regional base hospital sites.

s 9(2)(f)(iv)

Further details of our assumptions for the capex estimate are provided in Table 28 in Appendix B.

Table 7: Capital expenditure ($ millions)

		Option 1	Option 2	Option 3
University campus facilities	New building	s 9(2)(f)(iv)		
	Equipment			
	Refurbishment of existing facilities			
	Contingency			
	Subtotal	**0.0**	**0.0**	**133.6**
Clinical placement facilities	Regional hospitals	s 9(2)(f)(iv)		
	Community learning centres			
	Rural hubs			
	Primary care facilities			
	Selective/elective accommodation			
	Subtotal	**46.7**	**78.5**	**77.0**
Curriculum development costs		s 9(2)(f)(iv)		
Infrastructure development support				
Clinical placement coordination				
Business case implementation				
Total capital expenditure		**49.0**	**81.5**	**236.3**

5.1.3 Terminal value of assets (offsets capex costs)

In a CBA, the terminal value of assets refers to the value of the asset at the end of the analysis period. It represents the residual value of the asset that can be used or sold. These costs are presented in negative terms because they offset the capex costs incurred at the project.

The terminal value of the asset is estimated by subtracting depreciation incurred over the analysis period from the book value of the asset post construction. It is assumed that the asset loses value at a constant rate over its useful life.

The results of the terminal value estimate are presented in Table 8. Values are reported as negative numbers because they offset the capex costs. Terminal values range from -$25.1 million for Option 2, to -$105.7 million for Option 3. Option 3 has a higher terminal value (in absolute terms) because it incurs capex for new building and refurbishments, which then results in an associated terminal value.

Table 8: Terminal value ($ millions)

s 9(2)(f)(iv), s 9(2)(j)

	Option 1	Option 2	Option 3
Total	**(25.1)**	**(42.3)**	**(105.7)**

The assumptions underpinning this analysis can be found in Table 31 in Appendix B.

5.2 Costs of doctors in the health workforce

The following subsection outlines the costs of doctors in the health workforce. It is separated into the cost of GP care, the cost of specialist care, and the cost of RMOs. While the cost of medical education is assessed up to 2042, the impact of its operations extends beyond this period. Specifically, the additional students trained will become doctors in the workforce, leading to costs (and benefits) beyond 2042. We assess the extended costs (through to 2073) from these resulting doctors in our analysis to ensure a comprehensive assessment.

5.2.1 Cost of general practitioner care

The options will result in more GPs working in New Zealand than otherwise would be the case under the status quo. The additional GP care will incur costs to deliver care. We have split the cost of GP care into four categories:

1. Salaries paid directly to GPs for their services.
2. Direct costs to cover expenses directly tied to GPs' activities e.g. medical equipment and professional subscriptions.
3. Supporting staff costs for staff employed to assist GPs in their work. We have not included nursing or allied staff because we do not expect simply increasing GP numbers will alleviate New Zealand's nursing shortage. This is consistent with the cost of specialist care estimate.
4. An overheads allocation for practice capital.

The first step is to assess whether the additional GPs will require additional general practice supporting infrastructure or not. To assess this, we examine vacancies for GPs in the health system today. To the extent that GPs are filling vacancies, there is existing capacity in the system and supporting staff and overheads will not be required.

Nearly 60 per cent of GP practices reported a vacancy in 2023 (New Zealand Doctor, 2023), up from 31 per cent in 2018 (The Royal New Zealand College of General Practitioners, 2018). Combining the 31 per cent lower bound (to be conservative) with the 951 reported practices in New Zealand (Cumings, 2023) estimates that there are at least 295 GP vacancies currently.

The number of vacancies through to 2073 is uncertain. In the short term, we may expect the current trend to continue because 37 per cent of the GP workforce is expected to retire in the next five years (The Royal New Zealand College of General Practitioners, 2022). However, forecasting out to 2073 is extremely uncertain.

For conservatism, our base case assumption is to assume that 50 per cent of GPs are filling vacancies, with 50 per cent requiring additional supporting infrastructure. Our sensitivity testing models both

100 per cent of GPs requiring supporting infrastructure, and 0 per cent of GPs requiring supporting infrastructure.

GP salaries are observed from the 2024 single-employer collective agreement (SECA). Direct costs, supporting staff costs, and the overhead allocation are estimated as proportions of this salary figure. For example, our practice data showed that supporting staff costs were 52 per cent of GP salaries, so we estimate supporting staff salaries as 52 per cent of each option's GP salary costs. Data is derived from Sapere's 2022 capitation review, using a survey of general practices. Detailed assumptions underpinning our estimate are summarised in Table 29 of Appendix B.

The results of this are presented in Table 9. The cost of GP care ranges from $1,464 million for Option 1 to $2,353 million for Option 3. The costs scale proportionately with the number of additional GPs provided to New Zealand under each option, i.e. the more GPs provided, the greater the costs incurred for them to deliver care.

Table 9: Cost of GP care ($ millions)

		Option 1	Option 2	Option 3
GPs filling vacancies	s 9(2)(j)			
	Subtotal	**483.4**	**715.6**	**776.6**
GPs requiring additional supporting infrastructure	s 9(2)(j)			
	Subtotal	**981.0**	**1,452.2**	**1,576.2**
Total		**1,464.4**	**2,167.8**	**2,352.8**

5.2.2 Cost of hospital specialist doctors

The options will result in a greater number of senior medical officers (SMOs) than under the status quo. The cost of SMOs comprises three categories:

1. Salaries paid to SMOs.
2. Direct costs incurred from increasing hospital output, e.g. pharmaceutical costs, implants, and disposables.
3. An overheads allocation to account for new hospital capital required by SMOs, e.g. machinery.

Incidental salaries paid to supporting staff—for example nursing or allied health staff costs—are not included in our estimate. The 2024 New Zealand Health Workforce Plan states that under current conditions, New Zealand will be short 4,100 FTE nurses and 4,450 FTE allied health professionals (Te Whatu Ora, 2024). It is unlikely that simply increasing SMOs will address this gap. The existing shortage alone should provide suitable impetus to invest in hiring additional supporting staff, regardless of any increase in hospital SMOs. Put another way, if the existing shortage does not lead to more support staff, then adding SMOs is even less likely to do so. However, we do test the impact of including incidental salaries in the sensitivity analysis.

s 9(2)(j)

[10] These districts were selected based on reliability of data.

[11] WIES is a funding system for understanding resource pressure produced by inpatient events that calculates the WIES for inpatient hospital discharges based on their complexity and resource use. This enables a standardised measure of the cost of inpatient events throughout New Zealand.

s 9(2)(j)

Totals	**6,743.7**	**5,472.7**	**4,391.3**

5.2.3 Cost of resident medical officers

Each option would result in a greater number of RMOs than under the status quo. In our analysis, we have included only the salaries for RMOs. We have excluded the cost of supervision for several reasons.

First, we expect a large part of the supervision to be absorbed into the existing healthcare system, which already supports RMO training and development. Second, accurately estimating supervision costs is challenging due to limited available data and variability across institutions. The nature of these costs often depends on factors such as the distribution of RMOs across specialties, the availability of senior staff, and existing workload capacities in hospitals.

We have also not added an overhead allocation to RMOs. In our calculation of the cost of specialist care, we assigned all inpatient and outpatient events to SMOs. These were then costed using the relevant direct cost and overhead cost categories. Including an additional overhead allocation for RMOs would result in double-counting some of these costs, as the overheads for inpatient and outpatient events are already fully accounted for in the SMO cost estimates.

s 9(2)(j)

5.3 Costs not included

There were five cost categories not included on our analysis. These exemptions are explained below.

5.3.1 Forgone earnings from students who continue to study

We did not monetise the economic cost of forgone earnings from students that would have joined the workforce had they not been accepted into medical school. The logic is that the private benefit to the individual—such as personal satisfaction, social status, and vocation—approximately offsets the private cost—such as forgone earnings. However, these private benefits are not able to be quantified, and we therefore do not know the extent that the foregone earnings are offset by private benefits. As a result, we do not monetise this cost.

Higher future earnings are not included in the private benefit examples. GPs receive salaries from the government as compensation for their services (i.e. a transfer). The outputs of these services are benefits to the community, e.g. better continuity of care or reduced amenable mortality. Estimating both salaries and better continuity of care or reduced amenable mortality would therefore double-count benefits.

5.3.2 The cost of specialist training beyond university

The standard route for GPs to become an independent GP is through the General Practice Education Programme (GPEP). The GPEP is a structured training pathway that prepares medical doctors for independent practice as a fully qualified GP. Administered by the RNZCGP, the GPEP builds on the broad clinical foundation acquired in medical school and subsequent junior doctor years, providing more focused, community-based training and mentorship.

SMOs will also complete advanced vocational training in their field. For example, physicians can complete the basic and advanced training through the Royal Australasian College of Physicians. Similarly, psychiatrists train under the Royal Australian and New Zealand College of Psychiatrists (RANZCP), following a rigorous curriculum and supervised practice before earning fellowship.

However, we are unable to reliably include the cost of these specialised training programmes due to the complexity of the task and limited data available. Each specialty's training pathway involves different curricula, supervision arrangements, clinical settings, and progression timelines, making it difficult to establish a standard cost profile. Moreover, consistent financial data is often not publicly available. For these reasons, we do not include the costs of training beyond university for any option.

We note that to the extent that other speciality training is more expensive than GPEP training, Options 1 and 2 would have higher costs than Option 3.

5.3.3 Offset teaching costs in alternative courses

In CBAs, it is best practice to focus on primary market effects only, while secondary market effects are typically excluded, provided that markets are efficient (Boardman et al., 2018). In this context, the primary market refers to the direct impacts on the market for medical education. Secondary markets involve indirect effects, such as changes in other courses due to the introduction of a new undergraduate medicine course.

Counting secondary market effects can lead to inadvertent double counting, if some resources are transferred rather than created or used. Transfers are excluded from CBAs because there is no real change in resource. In addition, estimating all complex interactions and adjustments associated with secondary markets can be challenging and imprecise.

In our case, greater capacity for medicine courses may reduce alternative courses' participation (as students are accepted into undergraduate medicine courses) that may result in these courses having lower opex. However, reductions in these courses' opex can represent a transfer of resources to undergraduate medicine courses, rather than a reduction in resource use. If we counted both the alternative course's reduced opex and the medical school's opex, we would double-count the same resource. Therefore, the alternative course's opex reduction can be seen as a reallocation of an existing resource and should not be counted in the CBA.

5.3.4 Student loan implications

Students can borrow from the government to fund their university course costs and living expenses. We exclude these student loans from our analysis for the following reasons.

For course costs, students borrow from the government to pay universities for tuition. This monetary flow—from government, to students, and then the university—is a transfer. The underlying resource is the teaching resource used to provide education. We have already estimated the cost of providing education in our estimation of opex. To also include student loans for course costs in the analysis would double-count the cost of providing education.

For living expenses, students also borrow from the government to cover their cost of living. Similar to course costs, the flow of funds is a transfer. The resource used is the living expense of students. We do not expect any material change in students' living expenses under any of the options, when compared to the status quo.

5.3.5 Deadweight cost of taxation

We have not included the deadweight cost of taxation in our analysis. The deadweight cost of taxation arises from government funding from taxation. Taxation results in an efficiency cost to society because it encourages people to move away from things that are taxed towards things that are more lightly taxed. The Treasury provides the example of income tax in the market for labour and leisure. Income tax on labour income discourages working in favour of leisure or home-based activities, i.e. without income tax, people would work more because the pay-off is higher (New Zealand Treasury, 2015). This distorted choice represents a loss in economic efficiency.

We have chosen not to include the deadweight cost of taxation because it is not clear what proportion of Crown funding would be new versus reallocated from existing funding within the health system. If a significant portion of the funding is reallocated rather than generated, the associated deadweight loss would be minimised. For example, if a portion of the funding is sourced from reduced spending in other health initiatives or from operational efficiencies, the overall tax burden would remain unchanged, and the economic distortions associated with new taxation would be avoided.

6. Benefits

The investment logic identifies a series of benefits aligned to the investment objectives. Central to this CBA is the improved patient experience and outcomes resulting from improved access to care. This benefit flows from the increased number of GPs and SMOs produced under each option.

A larger and more stable workforce also has a benefit to the health system, in terms of improved flow and efficiency, and relieving pressure on the system overall. There are further impacts that we identify and comment on in this report, that are not necessarily captured in the investment logic. These include competitive effects from a potential new player and 'real option value'.

Table 11: Present value of monetised benefits ($ millions)

	Option 1	Option 2	Option 3
Monetised Benefits			
Health outcomes – life expectancy gain	13,122	15,237	15,048
Health system – RMO benefits	2,135	2,048	1,817
Health system – reduced ED visits	1,013	1,114	1,110
Patient experience – reduced travel time	1	2	2

6.1 Health outcomes – life expectancy gain

Our review of the literature revealed a lack of evidence quantifying the health-related quality-of-life (HrQoL) impacts of both GPs and SMOs, as well as the contributions of SMOs to life expectancy. To address this gap, we conducted the first study to estimate these effects and then incorporated monetised estimates into the CBA. Below, we provide a summary of our approach and results. A detailed technical explanation is provided in Appendix E.

We applied econometric techniques to provide robust and novel estimates of the impact of both GPs and SMOs on two key measures of population health:

1. Life expectancy (LE).
2. Health-adjusted life expectancy (HALE)—the number of years people live in good health.

Our analysis uses data and techniques that have previously been used to estimate the impacts of physicians on life expectancy among OECD countries (Roffia et al., 2023).

6.1.1 Both general practitioners and senior medical officers significantly improve population health outcomes

Our analysis reveals statistically significant positive associations between the number of healthcare professionals and health outcomes. Each additional:

- GP per 10,000 population increases HALE by 18 days and life expectancy by 21.5 days annually.
- SMO per 10,000 population increases HALE by 16 days and life expectancy by 13 days annually.

While the magnitude of GP impacts on both health outcomes is larger compared to SMOs, further tests to analyse this difference found that the difference between the coefficients for GPs and SMOs was not statistically significant. This means that contributions of GPs and SMOs to health outcomes are similar, underscoring their complementary roles in healthcare systems. Our finding that the difference between the coefficients is not statistically significant leads us to include a sensitivity test where SMOs produce the same life expectancy benefit as GPs. Robustness tests confirm the reliability of these findings across various model specifications.

6.1.2 Our results are comparable with existing evidence

Our study fills gaps in the existing literature by simultaneously quantifying the impacts of GPs and SMOs on both morbidity (HALE) and mortality (LE). Previous studies have largely focused on mortality or pooled the effects of healthcare professionals without distinguishing between generalist and specialist roles.

- A United States study (Basu et al., 2019) estimated the effects of GPs and SMOs on mortality. It found that GPs contribute approximately 1.61 times more to life expectancy improvements than SMOs. Similarly, this study shows that GPs have a 1.64 times higher impact on life expectancy compared to SMOs, validating the findings in a different geographic and system context.
- (Roffia et al., 2023) pooled medical doctors in OECD countries without distinguishing between GPs and SMOs, estimating an average increase of 0.049 years (18 days) in life expectancy per additional doctor, per 10,000 people. The midpoint of our study's results for GPs (0.059 years) and SMOs (0.036 years) aligns closely with Roffia's pooled estimate, providing further confidence in our findings.
- The life expectancy gains in our analysis are consistent with established findings that link GP density to improved health outcomes, especially where there are shortages and low access. Baker et al. (2024) undertook a cross-sectional, ecological study in England, with life expectancy data in the National General Practice Profiles system for 2015 to 2019. They found that for every additional GP per 1,000 population, life expectancy increased by 0.57 and 0.50 years for females and males respectively. These values closely align with the life expectancy improvement of 0.059 years per additional GP observed in our study.

6.1.3 Econometric methods

We used publicly available panel data from the World Health Organization (WHO) and the World Bank, focusing on countries with universal healthcare systems and high public health service coverage (15 OECD countries, including New Zealand and Australia, between 2000 and 2021).

We applied statistical techniques, including Arellano-Bond dynamic panel models and two-way fixed effects models (controlling for unique country impacts on outcomes and for changes over time), to address challenges such as:

- reverse causality—ensuring that observed effects of health professionals on health outcomes are not driven by healthier populations attracting more doctors. If health outcomes influence GP or SMO counts, estimated coefficients could misrepresent the true effects of an additional doctor on health outcomes, and result in misinformed conclusions on the importance of doctor availability. It is, however, reasonable to assume that an increase in the number of available doctors would have at least some positive impact on overall health outcomes.
- unobserved confounders—controlling for factors like gross domestic product, obesity prevalence, hospital bed density, and population characteristics, to isolate the true impact of GPs and SMOs. Using two-way fixed effects, we account for differences between countries or time periods that could influence the relationship between healthcare professional density and health outcomes (e.g. baseline health profiles, healthcare system design, pandemic impacts, technological and economic changes, etc.). Failing to account for important confounding factors could lead to biased estimates and undermine the robustness of findings.
- dynamic relationships—accounting for ways in which the effects of healthcare professionals develop over time. Temporal healthcare impacts that are uncaptured may misrepresent true effects of doctor availability on health outcomes, resulting in an undervaluation of investment into healthcare resources.

Without addressing these issues, analysis might introduce uncertainty to the precise magnitude of the impact of additional doctors. However, it does not uniquely bias the outcome of the options, particularly as there is no statistically significant difference in the estimated effect of GPs and SMOs on health outcomes. Our robustness tests presented in Table 35 confirm the reliability of our findings.

6.1.4 We confirmed the robustness of our findings through additional analyses

We undertook additional analyses, including testing different model specifications such as deeper lags of GPs and SMOs per 10,000 population (*t*-2 years and *t*-4 years), and controlling for other time-variant health determinants such as unemployment and alcohol consumption.

Box 2: Note on results of sensitivity analysis

We note that while findings are consistent, using deeper lags of GPs and SMOs per 10,000 population, such as $t-2$ years and $t-4$ years, leads to lack of statistical significance of GPs and SMOs per 10,000 population impacts on life expectancy. One explanation is the reduced sample size which increases variation.

Another feasible interpretation, which also aligns with the observed smaller coefficient sizes in these estimations (compared to the $t-1$ specification), is that the impacts of GPs and SMOs on life expectancy occur within a more immediate timeframe rather than being delayed. This would explain the larger and statistically significant coefficients for the $t-1$ estimation compared to the $t-2$ and $t-4$ coefficients.

This interpretation is consistent with health economic modelling of health outcomes and investments. For example, in the seminal Grossman Model of Health (Grossman, 2017) the effects of health investments are more immediate and depreciate over time. This concept aligns with our findings of significant impacts at $t-1$, whereas past investments appear to have depreciated effects at deeper lags. Furthermore, it can be seen as a rational choice to seek GP or SMO care at the onset of illness/injury, as earlier treatment typically leads to better health outcomes. This behaviour helps explain the stronger and more immediate returns reflected in the $t-1$ coefficients versus deeper lags. It is important to understand that this does not imply that GPs and SMOs have no future returns on life expectancy. Rather, while the returns are positive, they tend to materialise in the near future rather than over longer periods.

The impact of GPs and other SMOs on LE and HALE remain equal

For all sensitivity tests conducted as regression analyses, we test the null hypothesis that the coefficients of GP and other specialist impacts on HALE and LE are equal. Our tests confirm the null hypothesis, indicating that the coefficients are not statistically significantly different from each other in either specification.

Despite the lack of statistically significant difference in the estimated LE gain between GPs and SMOs, in the absence of alternative evidence, we estimate the value of the estimated benefits in each case using the point value. We test these gains extensively using both one-way sensitivity analysis and probabilistic sensitivity analysis.

6.1.5 Quantifying and monetising the life expectancy gain

For this CBA, the health benefit is generated by additional medical graduates produced through to 2042, who go on to become GPs and SMOs and improve life expectancy for the population. As previously discussed, we model the lifetime costs and benefits of these medical graduates. This allows us to capture the costs and benefits those doctors go on to deliver in healthcare over the course of their careers.

The life expectancy impacts of additional GPs and SMOs may not be seen immediately. We therefore calculate this benefit using a 10-year simple moving average. This develops a lagged impact, or ramp up effect. For instance, in the first year where there are additional GPs or SMOs (compared to the status quo), the life expectancy benefit in that year would only be one tenth of the full benefit of higher GP density. Additional life years are added to the number of deaths that Statistics New Zealand projects each year.

Table 12 shows the number of life years gained, as a result of additional GP and SMO doctors in the health workforce, under each of the three options.

Table 12: Present value of life years gained from additional GPs and SMOs under each option

Life years gained	GP	SMO	Total
Option 1	18,609	16,884	35,493
Option 2	27,481	13,733	41,214
Option 3	29,778	10,926	40,704

Option 2 has the highest total life expectancy benefit. Compared to Option 1, this is driven by a higher propensity to be a GP, and therefore weighted towards the higher GP benefit per additional doctor.

Compared to Option 3, Option 2 starts generating SMOs one year earlier, which slightly outweighs Option 3's additional GP benefit.

Box 3: Estimating the value of a life year

Life years gained were monetised using the central value of a statistical life (VOSL) of $10.17 million from the Treasury's CBAx impact database. This was converted to the value of a statistical life year (VSLY). Translating the value of a statistical life to the value of a life year is an established methodology. This is common in multiple sectors and contexts to value additional life, for instance, by the Health and Air Pollution in New Zealand model produced for multiple governmental organisations—the Ministry of Health, Ministry for the Environment, the Ministry of Transport and the New Zealand Transport Agency (Kuschel et al., 2020). It was also a recommended methodology produced by the University of Otago for the Ministry of Transport to estimate the health value of active transport (University of Otago, 2023). We note that this conversion methodology implicitly assumes that a year of life is of equal value, regardless of the age at which it occurs.

We convert the VOSL figure to the VSLY based on the average remaining life expectancy (RLE) of the population. We use population estimates matched to the 2017 to 2019 period life table to estimate the RLE by one-year age band and sex, using the 50th percentile (median) RLE value. As the period life tables are estimated at 'exact age', we take the average of the 'matched age' and the year after. This adjusts for the (assumed roughly uniform) distribution of birth dates across a year within the one-year age bands in the population estimates. For instance, for the female population group aged five years, we estimate their RLE as the average of the female RLE at age five and age six, representing the distribution of this group between the ages of five and six.

We then calculate the present value of RLE, seen as a stream of benefits accrued over time. We use the Treasury social rate of time preference rates of 2 per cent for the first 30 years, and 1.5 per cent thereafter.

We then calculate the average present value of RLE, weighted by the population size of each group. This results in a weighted average PV of RLE of 27.5 years. We then divide the VOSL by this figure, resulting in a VSLY of $369,696.

We note that the VOSL used by the Ministry of Transport increased substantially (approximately 2.5 times) in 2023 as a result of new surveys and work completed on behalf of and by the Ministry of Transport. Their suggested value was $12.5 million, versus the more conservative $8.1 million figure we use (before adjusting to 2025 dollars to get to the $10.2 million figure). We test the $12.5 million figure as a high value in our sensitivity analysis (adjusted to 2025 dollars, this equates to 14.8 million). We also test a low value of half our base case ($5.08 million). This low value is similar to VOSL used by the Ministry of Transport prior to the 2023 update.

An alternative methodology for monetising life years would be to use monetary values of health-adjusted life years, adjusted for each life year gained not being in 'perfect health'. There are two common sources for the value of this in NZ:

- the value of a quality-adjusted life year (QALY) directly from the Treasury's CBAx impacts database
- applying the rule-of-thumb developed by the World Health Organization of a health investment being cost-effective where the cost of saving a disability-adjusted life year (DALY) is between one- and three-times GDP.

Both sources have issues in their application. The QALY value used in the Treasury's CBAx impacts database is based on Pharmac's reported *average* cost-effectiveness of all investments made in a year. This includes a range of investments, and is not the marginal (or maximum) value that Pharmac would be willing to spend to gain a QALY. Indeed, some of these investments may even be cost-saving, which could significantly reduce the value of a QALY derived from these figures.

The World Health Organization (WHO) themselves have subsequently advised against the use of GDP-based cost-effectiveness thresholds (Bertram et al., 2016). In addition, neither the WHO or the Treasury's value necessarily accounts for other social benefits from improved health or saving life, as they are largely focused on the value of health itself.

As such, we chose to use the VOSL to VSLY conversion method described above.

The monetised life expectancy benefits are set out in Table 13.

Table 13: Present value of monetised life expectancy benefits from addtional GPs and SMOs under each option ($ millions)

	GP	SMO	Total
Option 1	6,880	6,242	13,122
Option 2	10,160	5,077	15,237
Option 3	11,009	4,039	15,048

As expected, the ranking and relative differences between the monetised values remain the same as that of the present value of life years gained.

6.2 Health system – registered medical officer benefits

There is even less evidence to quantify the benefit of an RMO. However, they play a key role in the health workforce. We would therefore expect that the benefit they provide would be at least as much as they cost. As a very conservative value, we assume that their benefit is at least equal to their salary.

Table 14: Present value of RMO benefits ($ millions)

	Benefit
Option 1	2,135
Option 2	2,048
Option 3	1,817

6.3 Health system resilience through strong primary care

Increased training of medical professionals will lead to a more resilient health system.

There is a strong indication in the health services literature that greater GP numbers reduce whole-of-system healthcare costs

GPs provide primary care, which plays a crucial role in the early detection of diseases and therefore early treatment and intervention. Research has consistently shown that robust primary care systems are associated with lower overall healthcare costs, largely due to fewer hospitalisations and emergency care requirements (Bazemore et al., 2015; Starfield et al., 2005). It has been recognised for some time that active and capable primary care reduces costs elsewhere in the health system. Cree et al. (2006) recognised good continuity of care reduces ED admissions by 60 to 75 per cent among patients with asthma, an ambulatory care sensitive condition. The supply of GPs is not the only component of a resilient health system, but it is vital alongside the contributions of other healthcare professionals and the efficiency of supporting systems.

Baker et al. (2024) conducted a cross-sectional study of patient life expectancy in 2015 to 2019 and found that a greater number of GPs was positively associated with improved life expectancy among patients in England. Similarly, in an epidemiological study of US population data, Basu et al. (2019) found that every 10 additional primary care physicians per 100,000 population was associated with a 51.5 day increase in life expectancy.

There are resilience benefits through reduced turnover

When more GPs are available, health provider entities will face fewer instances of unfilled positions. This larger employee pool allows employers to fill vacancies more quickly. Faster hiring processes reduce the need for extensive recruitment campaigns, which could involve expenditure on advertising, job fairs, and recruitment agencies. Additionally, a steady entry of potential employees can decrease the time and resources spent on interviewing and evaluating candidates.

Benefits from reduced turnover are higher in rural areas. According to the New Zealand Medical Workforce Survey 2023, 60 per cent of internationally trained doctors leave after two years, compared with just 2 per cent of locally trained doctors (MCNZ, 2023). We understand it is common for internationally trained doctors to use New Zealand as a through path to registration in Australia, leading to higher churn. Internationally trained doctors also fill a larger proportion of roles in rural practice (48 per cent) than in urban practice (35 per cent). With more locally trained doctors under each of the options, reduced churn may also lead to reductions in recruitment costs.

While a key focus of investment is increasing the number of GPs, it is worth noting that many regulated and unregulated health workforces are currently experiencing shortages. Health NZ's modelling estimated shortages of 5 per cent to 40 per cent per health specialty. Some of these shortages are expected to grow, and none is anticipated to be completely closed under the status quo (Te Whatu Ora, 2023). This wider picture of workforce shortages is in addition to the GP workforce shortages.

Health and patient satisfaction benefits arise from continuity of care

The life expectancy benefits we identify and monetise in section 6.1 come about through better management of patients' underlying disease processes. The health benefits outlined as monetised benefits underestimate the true productivity benefits from improved continuity of care. Any productivity benefits from improved *quality* of health have not been estimated. The health services literature attributes many of these benefits to continuity of care.

Continuity of care is defined as:

> "the degree to which patients experience consultations as consistent with their needs. An important aspect is whether patients can see their usual or preferred GP" (Fraser & Clarke, 2023).

More GPs per capita provide better continuity of care. The reverse was observed in the National Health Service in England between 2009 and 2023. Falling GP numbers led to a significant fall in continuity of care over time (Fraser & Clarke, 2023). Continuity of primary care is thus an important benefit for consideration in our analysis. It is, however, hard to isolate and measure quality of life benefits. As continuity of care positively impacts life expectancy, our estimates of GP impacts on amenable mortality naturally incorporate some of its positive benefits. However, our monetised estimates do not include the positive impacts of continuity of care on morbidity.[12]

As a more contemporary example, Sandvik et al. (Sandvik et al., 2021) in a registry-based observational study in Norway examined the relationship between the length of the GP–patient relationship and health outcomes. They found that the length of the GP–patient relationship is significantly associated with lower use of out-of-hours services, acute hospital admissions, and mortality. For example, comparing a fifteen-year GP–patient relationship with a one-year GP–patient relationship, there is a 30 per cent reduction in the odds of using out-of-hours services, a 28 per cent reduction in the odds of an acute hospital admission, and a 25 per cent reduction in the odds of dying.

This finding is common across all health systems. As another example, in a very different health system to New Zealand's, a study from the USA estimated annual average healthcare savings of US$1,000 (NZ$1,444 in 2018 values) for Medicare patients with the highest continuity of care compared to those with the lowest (Bazemore et al., 2018).

The alternative to continuity of care is fragmented care. For example, a recent analysis from England found that decreased continuity of care strongly correlates with increased number of GP visits (Fraser & Clarke, 2023). Each GP visit has an associated opportunity cost of time which we do not measure in our productivity benefits. The alternative to generalist care in the primary care sector in New Zealand is often episodic care in secondary care settings such as the emergency department, with poorer health outcomes.

There is literature around the health system effects of continuity of care. An increased number of GPs, and increased retention of GPs in rural areas, promotes continuity of care. Continuity of care is associated with improvements in health outcomes and higher levels of patient satisfaction. Barker et al. (2017), using data from 200 practices in the UK, derive a usual provider of care (UPC) index. This was defined as the proportion of contacts that were with the most seen doctor. A UPC index increase of 0.2 is associated with a 6.2 per cent (confidence interval 4.9 per cent to 7.5 per cent) reduction in ambulatory care sensitive condition admissions.

There is a scattering of health services literature pointing to quality of life benefit. For instance, regular screenings and routine check-ups allow for the early detection of conditions such as diabetes, hypertension, and cancer. Emery et al. (Emery et al., 2014) report that more primary care is associated with higher cancer screening rates. Other studies have found that greater numbers of GPs are associated with earlier detection of breast cancer, colon cancer, cervical cancer, and melanoma

[12] Various studies have found that better continuity of care reduces hospitalisation for multiple morbidities such as chronic kidney disease, asthma, heart failure, diabetes, and dementia (Cree et al., 2006; Godard-Sebillotte et al., 2021; McAlister et al., 2013; Wiebe et al., 2014; Worrall & Knight, 2011).

(Campbell et al., 2003; Ferrante et al., 2000; Roetzheim et al., 1999). Roetzheim et al. (Roetzheim et al., 2000) report that one more GP per 10,000 population increases the odds of an early melanoma diagnosis by 5 per cent.

Primary care also manages chronic disease. Effective chronic disease management prevents complications that would otherwise require acute care (Starfield et al., 2005). It enables both the prevention and treatment of chronic conditions (Reynolds et al., 2018).

We do not attempt to monetise quality of life improvement. While our econometric analysis outlined in 6.1.3 produces an estimate of the health-adjusted life years produced by GPs and SMOs, to include benefits using this figure would be double-counting our life expectancy benefits.

6.3.1 Health system – reduced emergency department visits

There is reasonable evidence to assume that an increase in the number of GPs working in New Zealand's health system could lead to a reduction in pressure placed on hospital emergency departments (EDs).

The difference in ED visits does not materially vary across the options. This is because all options generally result in enough additional GPs to meet the existing demand for ED that could be met via primary care. There are approximately 1,000,000 visits to the emergency department each year in NZ currently. Over the analysis period each of the options is expected to result in between 3.98 million, and 4.33 million less visits to Eds as a result of stronger primary care.

Table 15: Estimated number of ED visits avoided (2039 - 2073)

	ED visits avoided
Option 1	3,977,964
Option 2	4,334,058
Option 3	4,316,862

Table 16: Present value of reduced ED visits benefits ($ millions)

	Benefit
Option 1	1,013
Option 2	1,114
Option 3	1,110

A study including mainly European countries[13] (Van Den Berg et al., 2016) surveyed people who had visited EDs between October 2011 and December 2013, at their next visit to their GP, to understand

[13] Data was collected within the Quality and Costs of Primary Care in Europe study which surveyed patients in 31 European countries, Australia, New Zealand, and Canada. The three non-European countries were invited to participate because they were considered comparable to Europe with regard to their health systems and levels of wealth.

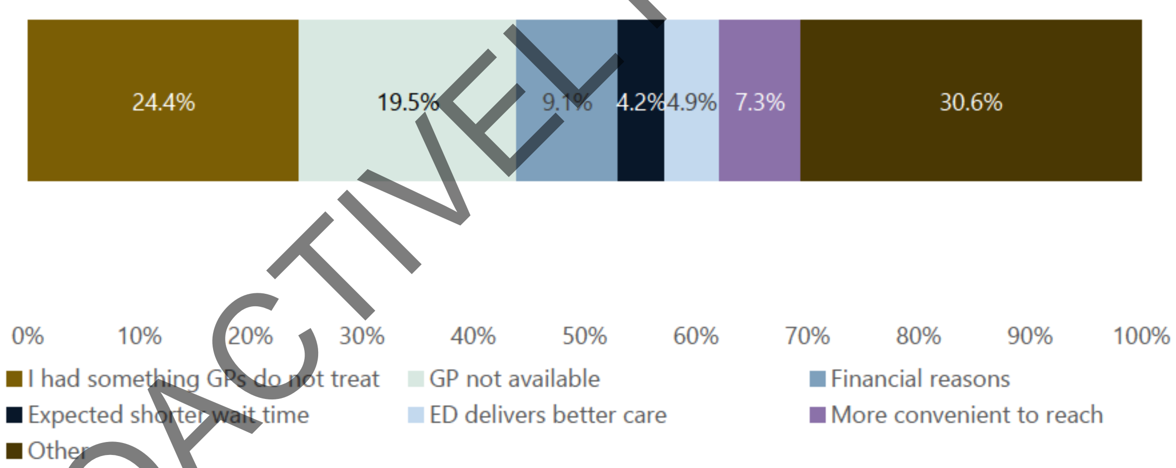
the reason for their previous ED visit. In New Zealand, 19.5 per cent of those surveyed indicated they visited the ED as their GP was not available.

There are two issues that prevent directly utilising the results of this survey to formulate our expectations for a reduction in ED visits:

- New Zealand's health workforce pressures and challenges have continued to evolve since 2011 to 2013. The challenges of today's workforce do not reflect 1:1 with the challenges of the 2011 to 2013 workforce.
- There are multiple reasons for GP unavailability that would prompt a visit to the emergency department. Most after-hours visits would fall into this bucket.

When viewing the full range of answers provided to the question, other reasons that led people to seek care at the emergency department that are likely to continue to do so in the context of more primary care revision are revealed. Financial reasons, convenience and the perception that the emergency department delivers better care are likely to continue to drive people to the emergency department over primary care in cases where they do so currently, even if the number of GPs in the workforce increases. These reasons are considered 'sticky.'

Figure 7: Answer to the question: Why did you go to the ED instead of going to a GP? (NZ respondents only)



Analysis of ED visits in New Zealand (Jackson & Jones, 2023) found between 5 per cent and 20 per cent of ED visits are minor cases suitable for primary care.

We estimate the degree to which an increase in the primary care workforce is likely to pull visits away from the emergency department with the following methodology:

- Apply the work of Jackson & Jones and start with a figure of between 5 per cent and 20 per cent of ED visits could be met by primary care.
- Consider the 'sticky' reasons described above that account for 21.3 per cent of the reasons ED was attended in the 2011 to 2013 survey. Note this rises to 28.2 per cent of the remainder once 'I had something GPs do not treat' is excluded.

- An allowance for and recognition of the proportion of the population currently unenrolled, recognising that the results of the above survey required patients to already be enrolled to be included. An increase in GP coverage will lead to an increase in service for unenrolled patients.

We estimate the number of ED visits that are met by each additional GP using the weighted average number of GP consultations per patient per year, for each district in Sapere's proprietary practice model.

We monetise benefits by applying the direct cost per ED visit, multiplied through by the estimated number of ED visits avoided. This measure is intended to recognise the value of hospital resources freed up via this process, noting that this should not be viewed as a true cost saving, as these resources will simply be allocated elsewhere in the hospital system. While most ED visits do not require admitting patients and keeping them for an extended period of time, a proportion of ED visits does fit this description. Keeping patients for an extended period increases the cost of these visits. We have used the average proportion of ED visits that became admitted visits (also known as inpatient events) over the 2018 to 2023 period to produce a weighted average direct cost per ED visit.

6.3.2 Benefit of clinical placements

Practices taking student placements may accrue a benefit through appropriate task shifting. Some research has indicated that placements are beneficial to existing practices (Yiend et al., 2016). Other research on regional and rural placements suggests a 'turning point' where placements can become net financially beneficial to the practice after about two months (Hudson et al., 2012). Hosting clinical placements can impact existing practices in three ways:

- cost in time spent training rather than doing
- benefit in dollars received from the government for hosting placements
- benefit in labour from the extra pairs of hands.

We expect that there will be a benefit to practices for hosting placements, noting that the placement model for Option 2 and Option 3 is different—both requiring more practice time while Option 3 has a greater rural focus. As each option trains the same number of additional medical graduates, we cannot differentiate between options. Options 2 and 3 will have more placements at medical centres compared to larger hospitals than under Option 1. We have not found evidence as to whether the benefits from taking placement students differ based on the size or type of the facility they are placed at.

6.4 Patient experience – reduced travel to general practice

An increase in the number of GPs operating in New Zealand's health system will result in some people having to travel less to access a GP. Some GPs will join existing practices with closed books, allowing those practices to accept new enrolments and enabling more people to access primary care without travelling as far as they currently are. Other GPs will establish new medical practices and have a similar effect.

While an interesting, and potentially important exercise to undertake, the overall benefits of reduced travel time are largely immaterial to this analysis.

Table 17: Present value of reduced travel to general practice benefits ($ millions)

	Benefit
Option 1	1.01
Option 2	1.68
Option 3	2.43

Whitehead et al. (2020) conducted a geospatial analysis of GP enrolments in the Waikato and found that 68.1 per cent of all enrolled patients bypass their closest GP. While this may not have severe implications for urban populations where there are likely to be denser concentrations of practices, this would have more severe impacts for rural and isolated communities where practices are sparsely located. While some people bypass their closest medical practice for reasons unrelated to accessibility from home (i.e. price, perceived quality of care, or accessibility to work and school rather than home), a reduction in the average travel time is a reasonably expected outcome from an increase in the size of the GP workforce. This is especially the case for communities where the nearest medical practices have closed books. Closed book practices refer to practices that are not accepting any additional patient enrolments. Analysis of closed book practices (Mohan et al., 2024) reveals that the number one reason for practices to have closed books is a lack of available staff.

We quantified the reduction in distance travelled by first considering the proportion of the population bypassing their nearest medical sector for a reason other than an inability to see a doctor at that practice. Overall, 68.1 per cent of the sample population bypassed their nearest GP clinic. The highest rate of bypass found by Whitehead et al. (2020), was in the 25 to 44 age group at 74 per cent. This finding is consistent with the proposition that some people are choosing to enrol in practices close to other key locations such as work. This group is unlikely to experience a meaningful travel time reduction if GP density increases.

Some population groups have higher transportation costs than others. These groups are the most likely to highly value proximity when considering medical practice enrolment. These groups include the very old, those with disabilities, or lower socioeconomic groups for whom transportation costs typically represent a larger proportion of their income. Rates of GP bypass were 22 per cent lower in the most deprived areas than the least deprived areas, and 2.6 per cent lower than the average rate of bypass found in the sample.

Rates of GP bypass were lowest amongst the 65+ age group, with 57.3 per cent bypassing their nearest medical centre, 10.8 per cent less than the average rate of bypass. This group also had the shortest time since their last consultation (an average of 6.8 months).

We limit our analysis to the 65+ population, and the two lowest sociodemographic quintiles, and measure the additional value that these population groups place on proximity to their GP through the difference between the mean rate of GP bypass in the group and the mean rate of GP bypass in the population as a whole. We consider this estimate to be conservative, as it is likely that the rate of current GP bypass is elevated by the existence of closed book practices within the study area. Unfortunately, we do not have data on the number of closed book practices in the Waikato during the study period to adjust for this. To estimate the impact of increased GP accessibility on these groups, we follow a three-step method:

- Consideration of the proliferation of closed book practices, and their proximity to these groups, by analysing the distances to the most accessible clinical centres at the statistical area 1 (SA1) spatial level, focusing on instances where the nearest clinic has closed books, and the distance from that practice to the next nearest practice without closed books. The nearest practice is closed book for 31.3 per cent of the 65+ population, 32.7 per cent of the second most deprived quintile, and 30.4 per cent of the most deprived quintile.
- We consider how much capacity (measured by the number of patient encounters per annum, per GP) is currently located at closed vs open books presently for each district. We then estimate the increase in district-level GP coverage, and assume that level of 'closed book' benefits are realised under that option. For example, if a given district had capacity for 100,000 GP encounters per annum, 50,000 of those encounters were occurring at closed book practices, and GP coverage increased by 1 per cent (1,000) under the option, then 2 per cent (1,000/50,000) of the potential drivetime savings calculated for the groups above are realised under this option.
- We estimate the return travel time per consultation trip per person based on the average return distance travelled at district level, at an assumed average speed of 37.5 km per hour.[14] The total annual travel time per person was estimated using the weighted average number of GP consultations per patient per year in Sapere's proprietary practice model. The value per hour of travel time savings utilised is the non-work travel purposes in uncongested traffic taken from Table 14 of NZTA's Monetised costs and benefits manual (2024, page 65).

6.5 Benefits of additional senior medical officer capacity

Each option produces more SMOs than the status quo, leading to higher rates of SMOs per capita. An increase in the number of SMOs will help to produce a more resilient health system. An improvement in working conditions and staffing levels can lead to a reduction in hiring costs as staff experience less burnout. Over time, improved working conditions may lead to reduced turnover, and reduced exit rates from the New Zealand health system, as opportunities elsewhere become marginally less attractive in a relative sense.

As well as reduced hiring costs, there are health system resilience benefits through greater staffing in secondary and tertiary care settings. One area of benefit is through reduced wait time for elective and inpatient events, and better throughput in the emergency department.

This leads to an increase in SMO accessibility with the following implications:

- An increase in the number of SMOs may lead to shorter waiting lists and reduced medical and surgical cancellations, also meaning fewer patients being managed in primary care while waiting.
- Reduced ED pressure as there are more SMOs (reducing hospital bed block and increasing timeliness of ED throughput) and likely a positive impact on length of stay.

[14] This is the average travel speed for those making trips by car in the Ministry of Transport's household travel survey (2020–2023).

- An increase in SMOs per capita may lead to an increase in the degree to which districts choose to run outpatient clinics to serve communities not well met by existing hospital infrastructure.[15] There may also be an increase in SMO private practice provision.
- SMOs also provide continuity of care.

We have not quantified this benefit but describe it qualitatively for the following reasons:

- An increase in SMO accessibility through the first two channels would be double-counting our life expectancy benefits. An increase in SMOs per capita means that medical interventions occur sooner (i.e. waiting lists are shorter), leading to fewer preventable deaths or complications and therefore amenable mortality benefits.
- An increase in accessibility through the third channel is more speculative. There may be reasons, other than the number of SMOs, that lead districts to limit the number of outpatient clinics run.
- SMOs are a very broad group with many discrete specialties within them. It is much more difficult to formulate assumptions about the impact of increased training of medical graduates on numbers in specific specialties, and the flow-on impacts in the areas outlined above.

We rank the benefits provided under this benefit category qualitatively, with the greatest benefit accruing to options that produce the most SMOs.

[15] An example is the outpatients' clinics run by the Capital and Coast DHB on the Kapiti coast.

7. Cost-benefit analysis results

Table 17 displays the quantified costs and benefits of each option under our base case assumptions. Ranked by monetised costs and benefits, Option 3 has the highest NPV and BCR of $8.9 billion and 1.986 respectively.

Table 18: CBA results and quantified, non-monetised costs and benefits, present value ($ million) in 2025 dollars

	Option 1	Option 2	Option 3	
Monetised costs				
Opex	514	508	362	
Capex (including terminal value)	24	39	131	
Cost of GP care	1,464	2,168	2,353	
Cost of SMO care	6,744	5,473	4,391	
Cost of RMO care	2,135	2,048	1,817	
Total costs	**10,880**	**10,236**	**9,053**	
Monetised benefits				
Life expectancy gain	13,122	15,237	15,048	
RMO benefit	2,135	2,048	1,817	
Reduced ED visits	1,013	1,114	1,110	
Reduced travel time	1	2	2	
Total benefits	**16,271**	**18,400**	**17,977**	
Results				
NPV	5,390	8,164	8,924	
BCR	1.495	1.798	1.986	
Non-monetised benefits				
Continuity of care				Evidence suggests an improvement in health outcomes. Improvement will be largest in rural communities.
Clinical placements				Small benefit likely for placement attendees.
Other improved access to healthcare for underserved communities				All options improve health outcomes for NZ. Options 2 and 3 are likely to have a bigger impact on currently underserved communities.

	Option 1	Option 2	Option 3	
Competitive effects				Benefits in the market for GPs and for medical education. Greatest under Option 3.
Real option value				Benefits from increased range of choices to scale up/down to meet future training needs.

7.1 Sensitivity analysis

The parameters included in sensitivity analysis are set out in Table 18.

Table 19: Sensitivity parameters

Parameter	Value/assumption	Comment
Discount rate	Base: Year 1–30 2%; Year 31+ 1.5% Tested: 8%	As per Treasury guidance.
Workforce exit rates for GPs	Base: 9/10 of current exit rate Tested: ¾ of current exit rate	Applied to Options 2 and 3 only. As Option 1 is more of the status quo, we assume that there is no difference to status quo (and therefore also do not test ranges for this option).
Propensity to specialise as a GP	Base: Option 2: 33%, Option 3: 38% Tested: Option 2: 26%, Option 3: 33%; Option 2: 40%, Option 3: 45%	It is unknown how directly the Wollongong experience may transfer to NZ. For Option 2 and Option 3, we test ±7 percentage points from the base propensity. As Option 1 is more of the status quo, we assume that there is no difference to status quo (and therefore also do not test ranges for this option).
Time to become a GP	Base: Option 2: 8 years Option 3: 7 years Tested: Option 2: 7 years Option 3: 6 years, 8 years	Tested with expert panel. A medical university course with a focus on primary care may result in graduates choosing and completing this path sooner than otherwise. We also test the case that the time to become a GP is equal to the base case.
Education capex costs	+/- 40%	We test scenarios where the capital costs are significantly higher than forecast.

Parameter	Value/assumption	Comment
Education opex costs	+/- 10%	We test scenarios where the operating costs are slightly higher and lower than forecast.
Proportion of GPs requiring supporting infrastructure	Base: 50% Tested: 0%; 100%	The actual proportion of additional GPs requiring supporting infrastructure is unknown, and we assume 50% as our base case. 0% and 100% were tested as extreme sensitivities.
SMO costs	+/- 10% of salary and direct costs	We test scenarios where SMO costs are slightly higher and lower than forecast.
Life expectancy improvement estimate	Base: GP: 0.059 years, SMO: 0.036 years Tested: +/- 1 SE Tested: SMO = base case GP (0.059) Also tested in probabilistic sensitivity analysis	Our base case monetised benefits are based on the central estimate from our regression analysis. Low and high values tested are based on testing plus and minus one standard error of the estimated coefficient. We also test SMO LE benefit as being equal to GP LE benefit.
Lag/ramp up to full LE benefit	Base: 10 years Tested: +/- 5 years	Based on expert panel advice.
Value of a statistical life	Base: $10.17 million Tested: $5.08 million; $14.79 million The above estimates converted to VSLY are below Base: $369,696 Tested: $184,848; $537,761	This value is a key input to our monetised benefits. The Treasury's CBAx values range considerably. We therefore test the impact of different values from the central estimate used in our base case. $5.08 million is half the Treasury's Central CBAx value. $14.79 million is the high CBAx value.
Proportion of ED visits that could be met by additional GPs	Base: 9.0% Tested: 3.60%; 14.4%	Tested +/- 5.4 percentage points
Unmet demand for primary care by unenrolled population, relative to enrolled population	Base: 50% Tested: 25%; 75%	Base estimate and ranges were tested with members of our expert panel.

7.2 Sensitivity analysis results

As would be expected, the NPVs for each of the options are most sensitive to the value used for the value of a statistical life, the value of the life expectancy benefit for additional GPs and SMOs, and the discount rate.

All three options produce positive NPVs under most of our one-way sensitivity testing. The exception to this is Option 1, when we test the low value for the VOSL and low value for the improved life expectancy from additional GPs and SMOs.

In all of our one-way tests, Option 3 produces the highest NPV. The test where Options 3 and 2 are closest is where we set the SMO life expectancy benefit equal to the GP benefit. We also ran a simple test to see where the SMO life expectancy benefit, relative to the GP expectancy, would result in a different option ranking (by NPV). For Option 2 to have the highest NPV, the SMO life expectancy benefit would need to be at least 1.064 times the GP benefit. For Option 1 to have the highest NPV, this ratio would need to be at least 2.077. We note that at these levels, the BCR would still favour Option 3 in both cases. For Option 1 or 2 to have the highest BCR, the ratio would need to be at greater than 3.005 and 2.932 respectively.

Of the workforce modelling assumptions, the results were most sensitive to the propensity to become a GP. The results were not sensitive to ranging the capex and opex costs, primarily due to the very low value of these in relation to the other costs and benefits.

The discount rate sensitivity results might seem counterintuitive at first. The higher discount rate of 8 per cent produces a lower NPV, which is fairly typical. This is because for many social cost-benefit analyses, the costs are typically front loaded, relative to benefits. Also, when there are positive net benefits, a higher discount rate will discount the benefits more than the costs (in absolute dollar terms). This results in a decrease in NPV.

The converse is typically true—a decrease in the discount rate would typically lead to an increase in NPV. However, not in this case. This is due to the interplay of the conversion between the VOSL and the VSLY. A lower discount rate leads to a lower VSLY. This is because it increases the present value of remaining life expectancy, in life years. When you divide the VOSL by this larger number, this decreases the VSLY. In this case, the decrease in VSLY dampens the typical improvement in the present value of benefits enough that the increase in the present value of costs is higher.

We note that the same (but opposite) effect is occurring when we increase the discount rate. However, the increase in VSLY dampens the reduction in the present value of benefits, but not enough to override it.

Figure 8, Figure 9, and Figure 10 display tornado charts that illustrate the sensitivity of each option's NPV from our base assumptions to changes in key modelling parameters.

Figure 8: Tornado chart - Option 1

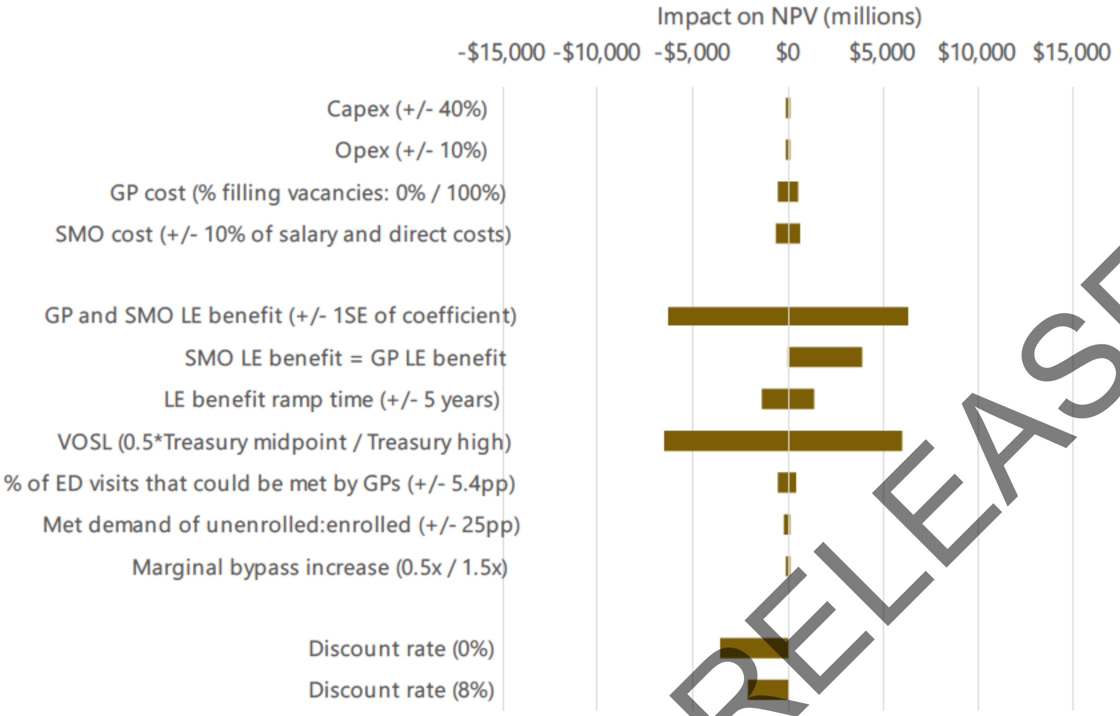


Figure 9: Tornado chart - Option 2

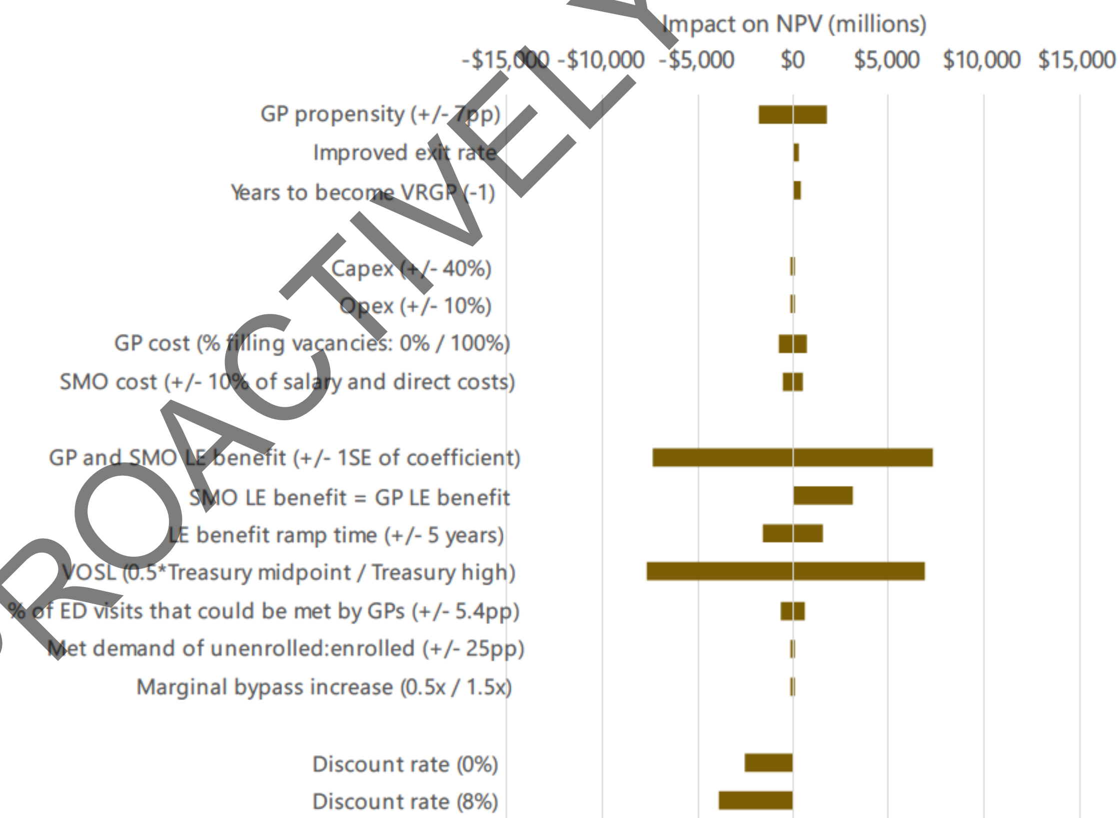


Figure 10: Tornado chart - Option 3

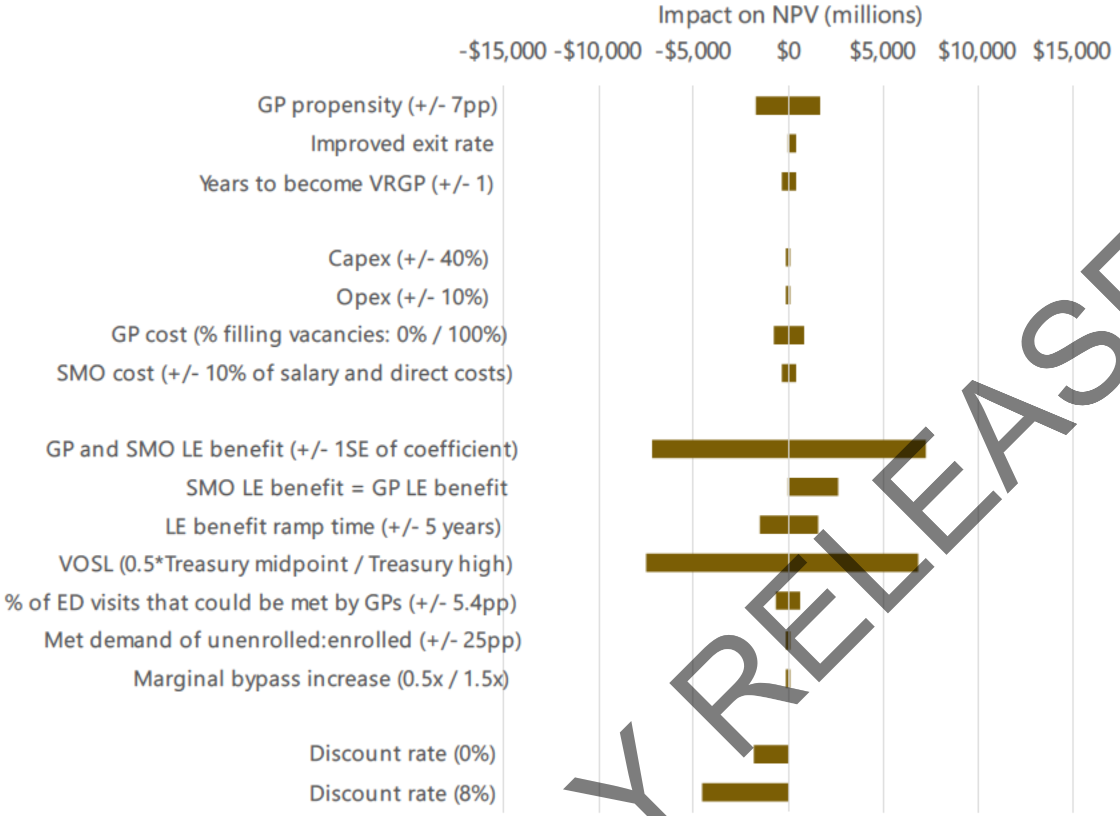


Table 19 displays a summary of the sensitivity analysis results. Values in this table display the NPVs of each option under each sensitivity test, rather than simply deviations from the base case NPV as displayed in the tornado charts above. Option 2 has a higher NPV when the GP propensity is higher than Option 3 in the base case. This reinforces the importance of GP propensity as the key parameter.

Table 20: Summary of NPVs under sensitivity analysis ($ millions)

	Option 1	Option 2	Option 3
Base Case	5,390	8,164	8,924
LE benefit low	-907	849	1,698
LE benefit high	11,687	15,479	16,150
SMO LE benefit = GP LE benefit	9,311	11,354	11,462
VOSL low	-1,171	546	1,400
VOSL high	11,355	15,091	15,765
Discount rate 0%	1,797	5,629	7,080
Discount rate 8%	3,285	4,242	4,371
GP Propensity -7.0pp	Not tested	6,348	7,204
GP Propensity +7.0pp	Not tested	9,960	10,613

7.3 Probabilistic sensitivity analysis

The following analysis was completed in order to explore how the *relative rankings* of the monetised CBA results change (or do not change) due to input parameter uncertainties. The main differentiator between the monetised costs and benefits of the options is the propensity to become a GP (and the corresponding propensity to be an SMO).

The one-way sensitivity analysis also showed that our results were sensitive to the improvement in health outcomes from additional GPs and SMOs, which is our largest benefit by far. In particular, there is a lack of published evidence that could be used to quantify the benefits of an SMO. As described earlier, we undertook regression modelling to estimate the potential LE benefits gained from additional GPs and SMOs. While some confidence is gained from the estimated LE benefit for GPs being similar to published literature, the confidence intervals around both the GP and SMO coefficients were wide and overlapping.

The interplay between the propensity to become a GP (relative to an SMO) and the improvement in health outcomes from additional GPs (again relative to SMOs) is a key uncertainty which drives key differences between the NPVs and BCRs of the options. As such, we undertake probabilistic modelling of the life expectancy benefits, combined with the deterministic workforce scenarios, to explore this interplay and test the likely impact of these uncertainties on the relative ranking of the options.

Our sensitivity analysis showed that our results were also sensitive to the assumptions around the value of a statistical life estimate. However, altering these assumptions does not change the relativity of the results between the options. As such, we do not model this here.

We used Monte Carlo analysis to determine the potential life expectancy benefits from an additional GP per 10,000 and an additional SMO per 10,000. The distribution of these were assumed to be normal, with a mean equal to the coefficient estimated in the regression. The standard deviation was equal to the standard error of that coefficient. We ran 20,000 simulations, and in our base model, we assumed no correlation.

Table 21: Probabilistic sensitivity analysis distribution parameters

	Mean	Standard deviation
GP LE benefit	0.0585	0.0281
SMO LE benefit	0.0360	0.0172

We applied these simulated life expectancy benefits to the GP and SMO workforce modelling outcomes for each workforce scenario for each of the options. These were also combined with all other monetised costs and benefits in our CBA (adjusted for the workforce outcomes as necessary).

When comparing Options 2 and 3 against Option 1, all of the Option 2 and 3 workforce scenarios resulted in less than 6 per cent of simulations in favour of Option 1.

The table below shows the proportion of simulations where the NPV of a given Option 3 workforce scenario is greater than or equal to the NPV of a given Option 2 workforce scenario. This can be interpreted as the likelihood (as simulated) that Option 3 is at least as good as Option 2, given the uncertainty in life expectancy benefits.

Table 22: Proportion of simulations where Option 3 produces a superior NPV

		Option 2				
		Propensity: 26% Exit: 9/10 VRGP: 8 years	Propensity: 33% Exit: 9/10 VRGP: 8 years	**Propensity: 40%** Exit: 9/10 VRGP: 8 years	Propensity: 33% **Exit: 3/4** VRGP: 8 years	Propensity: 33% Exit: 9/10 **VRGP: 7 years**
Option 3	**Propensity: 31%** Exit: 9/10 VRGP: 7 years	88%	4%	4%	5%	5%
	Propensity: 38% Exit: 9/10 VRGP: 7 years	94%	88%	5%	77%	72%
	Propensity: 45% Exit: 9/10 VRGP: 7 years	94%	93%	88%	92%	91%
	Propensity: 38% **Exit: 3/4** VRGP: 7 years	94%	92%	4%	89%	85%
	Propensity: 38% Exit: 9/10 **VRGP: 6 years**	95%	94%	6%	92%	88%
	Propensity: 38% Exit: 9/10 **VRGP: 8 years**	92%	73%	5%	52%	50%

Note: Workforce modelling assumption changes are bolded where they differ from the base case (highlighted blue).

These results show us that simulating different life expectancy coefficients largely does not change the NPV ranking of the options. The largest driver of the ranking of the options is related to the propensity to be a GP. That is, the workforce scenario that produces the highest GP propensity almost always has a higher NPV, in our Monte Carlo analysis.

We see that the workforce scenarios where Option 2 would produce the best NPV in most cases are where it has the higher GP propensity. However, we believe that it is highly unlikely that Option 2 would produce a higher GP propensity than Option 3, and therefore consider these comparisons academic, rather than realistic potential outcomes.

Similarly, the two right-most Option 2 scenarios (decreased exit rate and fewer years to become a GP) generate similar NPVs to the bottom-most Option 3 scenario (increased years to become a GP), using the base case life expectancy benefits. This is reflected in the probabilistic results where the proportion of simulations that favour either option is close to 50 per cent. Similar to the above, we note that these are outcomes that are unlikely to occur. It is unlikely that Option 2 would produce a lower GP exit rate, but not Option 3, and equivalently that Option 2 would decrease the years to become a GP compared to status quo, but Option 3 would not.

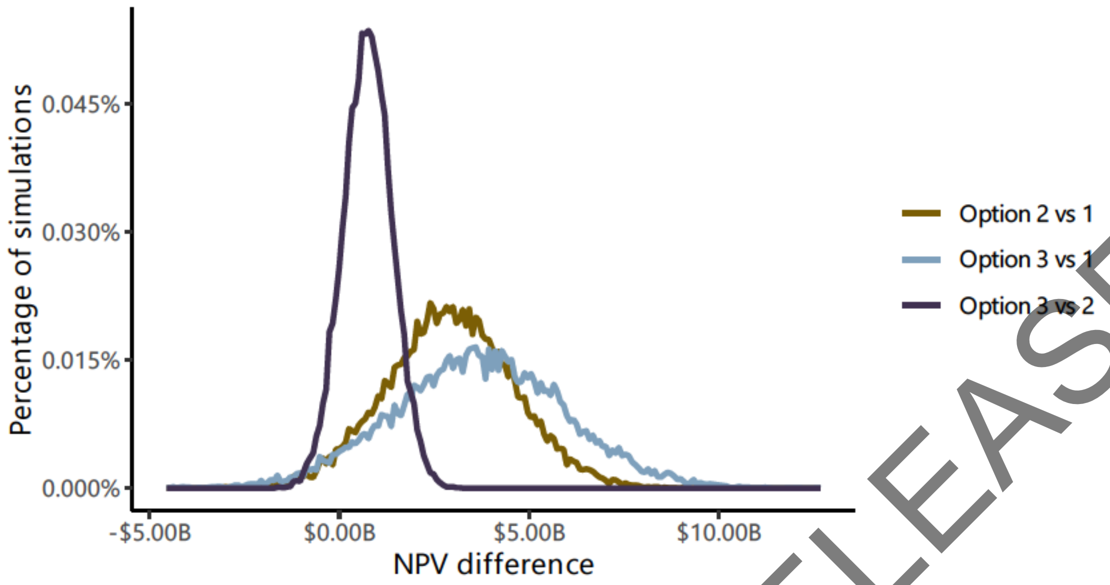
The results tell a similar story when assessing by BCR, although are more in favour of Option 3. This is primarily due to the cheaper costs of GPs, relative to SMOs. The two cells where Options 2 and 3 had similar NPVs moves to favour Option 3 by BCR. That is, they may produce a similar NPV figure, but Option 3 is a more cost-effective way of producing the same net benefit.

Table 23: Proportion of simulations where Option 3 produces a superior BCR

		Option 2				
		Propensity: 26% Exit: 9/10 VRGP: 8 years	Propensity: 33% Exit: 9/10 VRGP: 8 years	**Propensity: 40%** Exit: 9/10 VRGP: 8 years	Propensity: 33% **Exit: 3/4** VRGP: 8 years	Propensity: 33% Exit: 9/10 **VRGP: 7 years**
Option 3	**Propensity: 31%** Exit: 9/10 VRGP: 7 years	95%	4%	4%	5%	3%
	Propensity: 38% Exit: 9/10 VRGP: 7 years	96%	96%	6%	96%	95%
	Propensity: 45% Exit: 9/10 VRGP: 7 years	96%	96%	96%	96%	95%
	Propensity: 38% **Exit: 3/4** VRGP: 7 years	96%	95%	5%	96%	95%
	Propensity: 38% Exit: 9/10 **VRGP: 6 years**	96%	96%	10%	96%	96%
	Propensity: 38% Exit: 9/10 **VRGP: 8 years**	95%	95%	5%	95%	95%

The chart below shows the distribution of the difference in NPV between the options in our Monte Carlo analysis for the base case workforce assumptions for each option (GP propensity, GP exit rate and years to become a vocationally registered GP). As you can see, compared to Option 1, both Options 2 and 3 almost always produce a higher NPV. The denser, narrower distribution of Option 3 vs 2 shows that these options are much more similar to each other than Option 1.

Figure 11: Probabilistic sensitivity analysis - NPV comparison of base case workforce assumptions



We note that the above distributions are normally distributed. This is mathematically expected as the input distributions to this probabilistic modelling are assumed to be normal. This occurs because the sum of normally distributed random variables is also normally distributed.

As zero correlation between the GP and SMO benefit is a modelling assumption, we also tested +/- 0.5 correlations and +/- 0.99 correlations. While the proportion of simulations in which each scenario produced the best NPV or BCR changed, the underlying trends did not. That is, the very large majority of simulations favoured the option that produced the most GP FTE.

Probabilistically modelling workforce assumptions might be able to provide more insight into the distribution of NPV/BCR from each of the options. However, we do not believe that it would provide any further material insight into the *relative ranking* (by NPV/BCR) of each of the options.

As shown in our results above, for Option 2 to be preferred in the majority of cases, it would need to have more favourable assumptions regarding GP FTE produced than Option 3. This would not be an outcome that would be produced from a more fulsome probabilistic sensitivity analysis as this is not considered to be a realistic scenario.

In addition, our approach avoids the need to assume the probability distributions of workforce assumptions, and the correlations between the options. We note the difficulty in coming up with point estimates for inputs such as GP propensity, yet alone the distribution type and required parameters to model this probabilistically. These distributions would also need to be adjusted to be bounded by realistic scenarios. For instance, for a single simulation, regardless of the level of GP propensity sampled for Option 2, it would need to have an upper bound of the level of GP propensity for Option 3. In addition, it would take considerable time to model enough of the distributions of the associated workforce outcomes by Health New Zealand to be used as an input to probabilistic modelling.

8. Regional and distributional effects

This section estimates how benefits are distributed across Health New Zealand districts. Benefits are not distributed evenly as each option is expected to impact each district differently.

Key factors influencing the different level of benefits each district is estimated to experience under each option include:

- workforce distribution – the distribution of SMOs and GPs is modelled based on how 'attractive' each district is to work in. A key varying factor here is where clinical placements are assumed to occur.
- the number of potential ED visits avoidable – different districts experience different numbers of ED visits, both in total and on a per capita basis. Both these factors, and the assumed level of increase in GPs in the district, impact the size of estimated ED benefits.

8.1 Distribution of life expectancy gain

Life expectancy gains are distributed across districts in accordance with the estimated distribution of GPs and SMOs, and the forecast distribution of deaths produced by Statistics New Zealand. Life expectancy benefits are therefore weighted towards:

- districts that are assumed to be more attractive to GPs and SMOs,
- districts that have higher populations,
- districts with an older population on average.

Figure 12 displays life expectancy benefits attributable to each district while Figure 13 and Figure 14 display life expectancy benefits attributable to GPs and SMOs respectively.

- Life expectancy benefits are higher in 11 districts in Option 2, and eight districts in Option 3.
- Option 3 provides the most life expectancy benefit from GPs in most districts, though Option 2 provides more benefit in districts where Option 3 is not expected to run clinical placements.
- Benefits from additional SMOs are highest under Option 1 in every district. Option 3 only produces more life expectancy gain from SMOs than Option 2 in the South Canterbury and Taranaki districts.

The distribution of life expectancy benefits reveals marginal displacement effects occurring between the options depending on clinical placements and GP vs SMO propensity.

Figure 12: Present value of life expectancy benefits by district

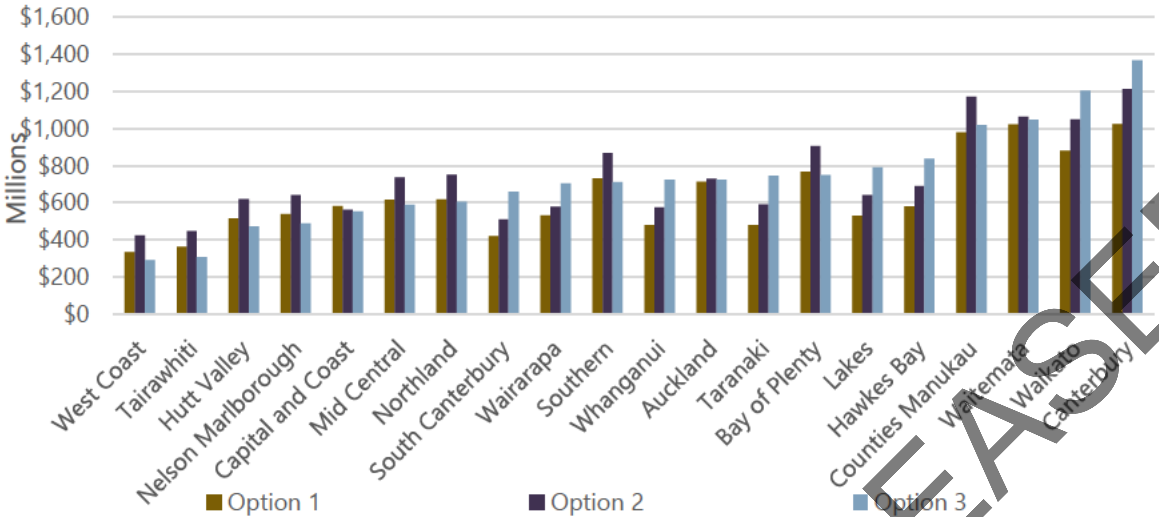


Figure 13: Present value of life expectancy benefits from additional GPs by district

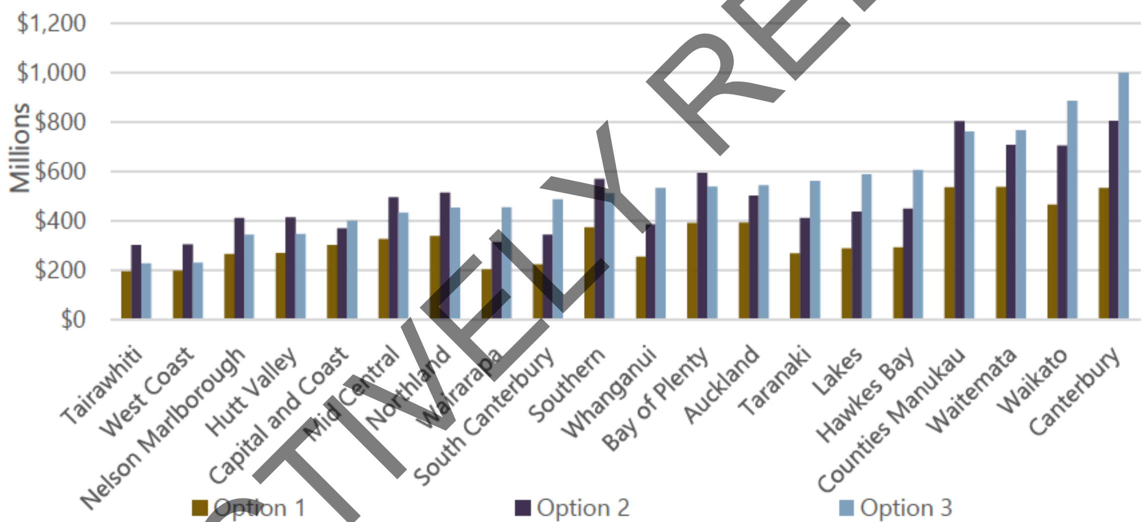
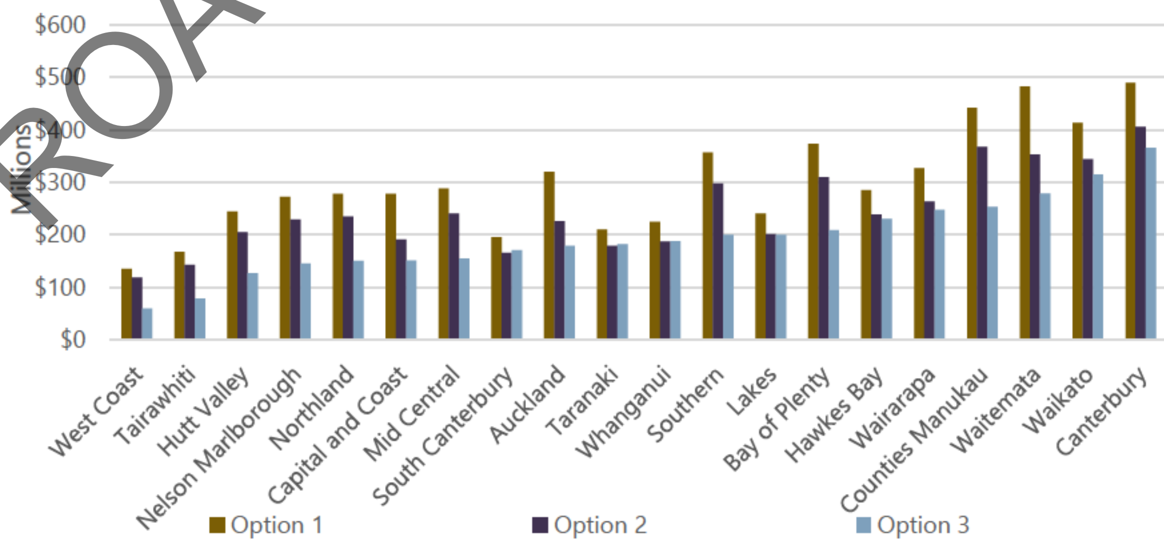


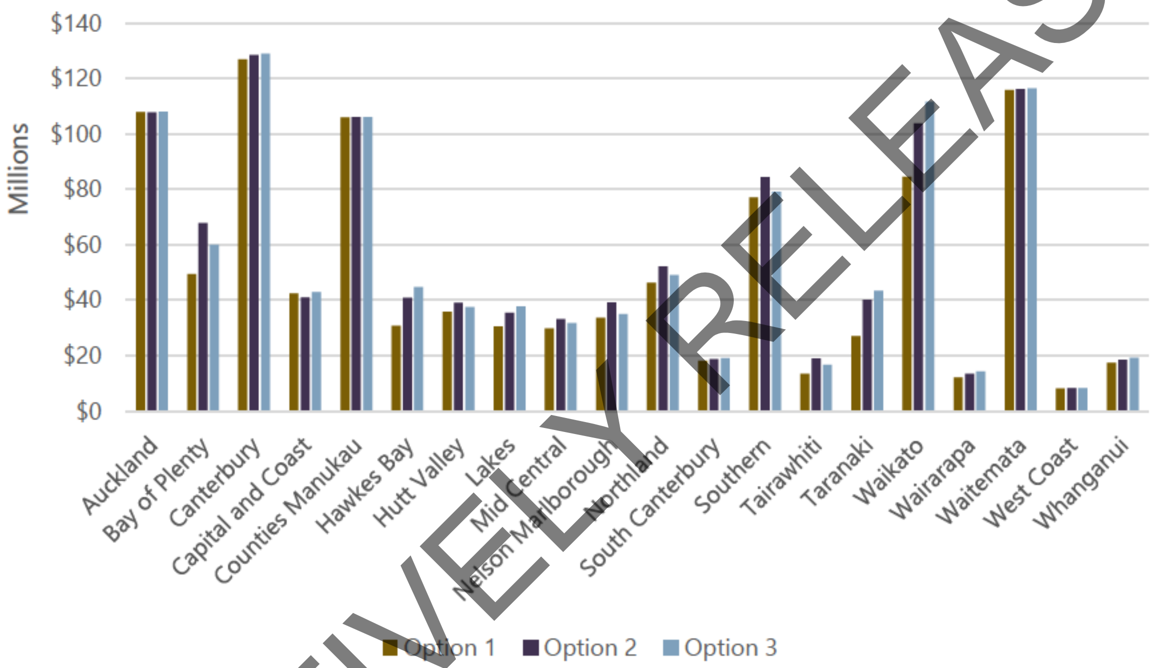
Figure 14: Present value of life expectancy benefits from additional SMOs by district



8.2 Avoided emergency department visits by district

An increase in the provision of primary care will reduce pressure on emergency departments around the country, as primary care needs currently being met in the emergency department are in some cases met by general practitioners instead. Figure 15 outlines the distribution of the emergency department benefits by district. Benefits are highest for Canterbury, Auckland, Counties Manukau, and Waitemata, though are comparatively similar across options. The biggest difference between options is seen in the Waikato, where both Option 2 and Option 3 provide more benefit than Option 1.

Figure 15: Present value of emergency department benefits by district



8.3 Avoided patient travel by district

Different districts experience different levels of GP accessibility improvement under each option as a result of two key differentiating factors:

- The current level of inaccessibility.
- The assumed distribution of GPs across districts under each option.

The charts that follow display the current level of inaccessibility, measured as the proportion of the population where the nearest clinic is closed book across districts for each sociodemographic group of interest. Districts in the lower North Island and Tairawhiti have higher rates of inaccessibility across all groups, with notably high rates in Nelson Marlborough and Southern districts for quintile 5 populations as well.

Figure 16: Nearest practice closed book, 65+ (2024)

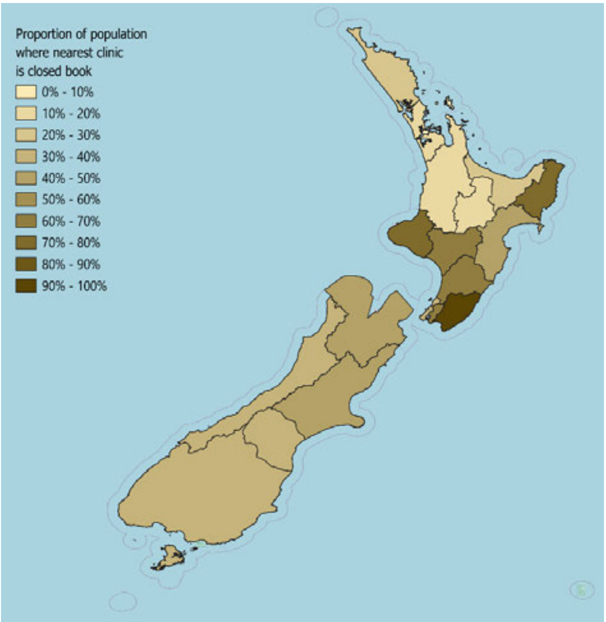


Figure 17: Nearest practice closed book, quintile 4 (2024)

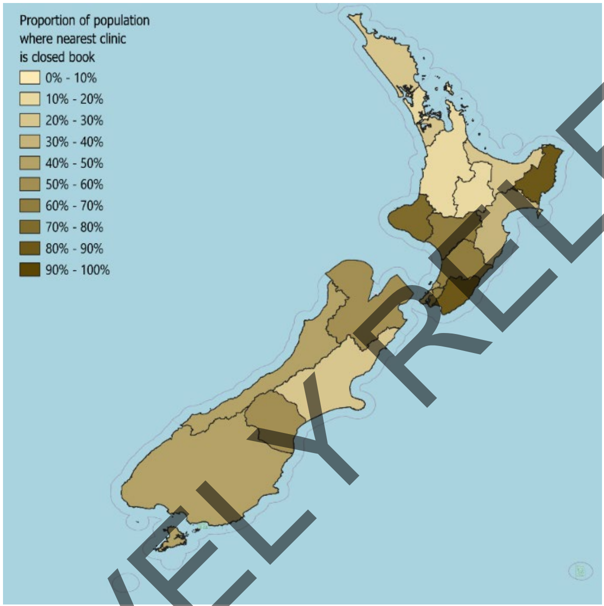
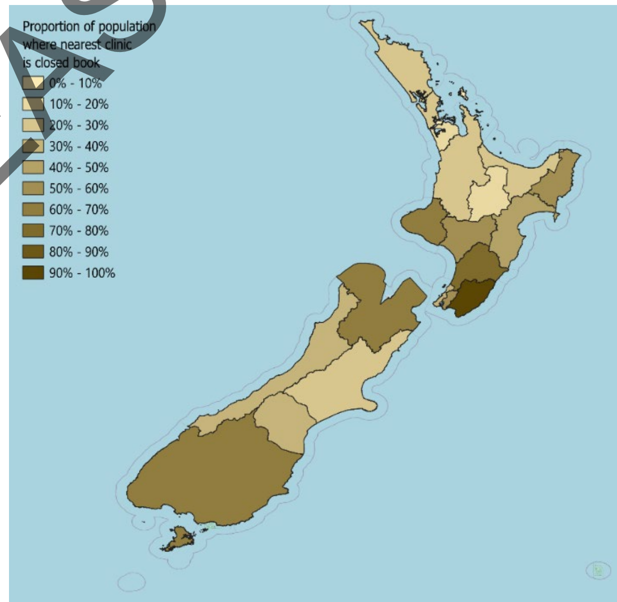
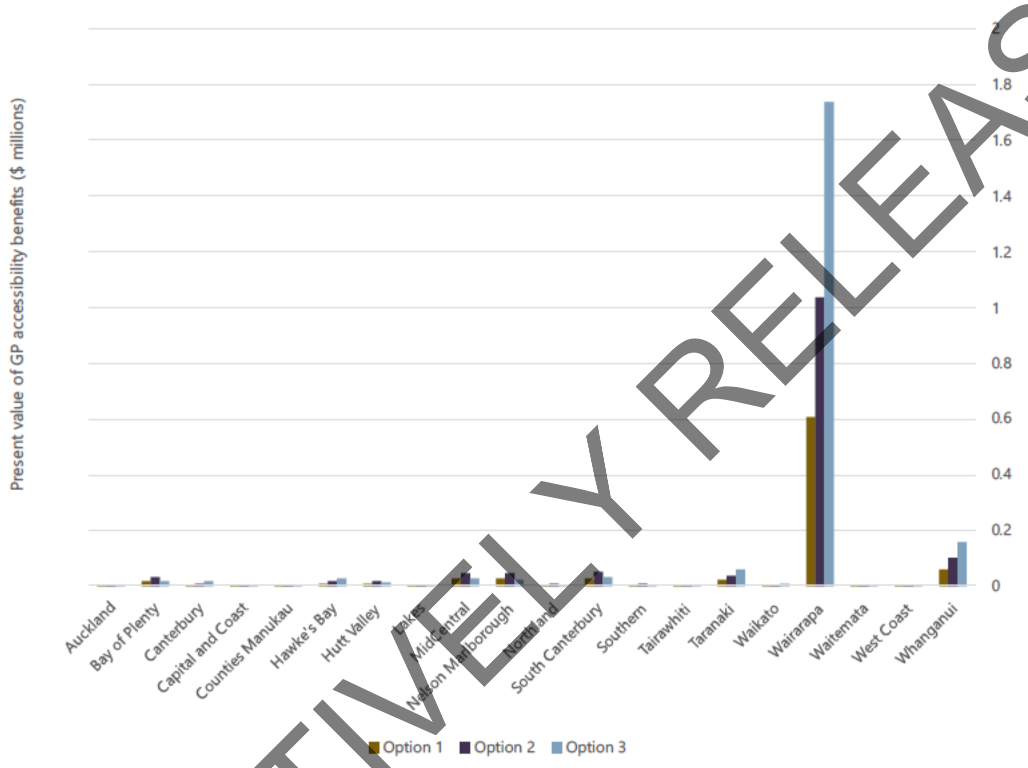


Figure 18: Nearest practice closed book, quintile 5 (2024)



Benefits are assumed to accrue relative to the proportionate increase in general practitioners under each option and forecast population growth in each district health board, for each sociodemographic group of interest. Figure 19 displays the present value of GP accessibility benefits across each district under each option. Benefits are low in most regions as drive time improvements are marginal. Benefits accrue most heavily in the Wairarapa. This region has a combination of a very high proportion of each of the population groups of interest where the nearest clinic has 'closed books' and long travel times to the next nearest clinic. Option 3 results in the greatest GP accessibility benefits.

Figure 19: Present value of GP accessibility benefits by district



8.4 Regional economic impacts

Each option involves investing resources in different regions throughout New Zealand. Our modelling suggests that the distribution of medical professionals will also differ under each option. Both of these activities have flow-on economic consequences for the regions in which they occur. There are one-off/time-limited impacts (e.g. from construction activity), as well as ongoing impacts from the activities associated with the investment (e.g. operating expenses). Such impacts accrue mainly to the location in which they take place, but there might also be some activity in other regions that are the source of inputs, materials and other resources.

The recipients of this expenditure then make spending and savings decisions with this money, as do the employees involved in the construction process. Through this process, the impact of an additional construction investment produces a ripple of economic activity as the additional expenditure flows through the economy, leading to further expenditure downstream from the source. Each option produces impacts in this manner distributed differently throughout the country. These impacts have not been quantified.

9. Competitive effects

In this section, we consider the impacts on competition in affected markets under each of the options. The section is not intended to be a full-blown competitive analysis, which is a significant undertaking in and of itself. Rather, the section provides relevant context, concepts and an assessment of the probable impacts, including limitations in the ability to be definitive about the scale of such impacts.

9.1 Relevance of competition to this assessment

Competition is likely to be enhanced under both Options 2 and 3. The extent of such competition, and the nature and magnitude of impacts (costs and benefits), are not straightforward to assess.

Competition is a process that can give rise to (beneficial) outcomes—it is a means not an end. Improvements in economic (productive, allocative and dynamic) efficiency are key to beneficial impacts arising from greater competition. The basic theory is that competition is beneficial for consumers because it leads to innovation, better services, and, perhaps most important of all, lower prices.

At a high level, competition analysis:

- is market-based, meaning that the definition of relevant markets is the first step
- has a temporal dimension (i.e. more immediate impacts could diverge from those in the longer term)
- requires assessment of the outcomes that the process of competition engenders—competition on its own does not necessarily deliver benefits
- usually considers the benefits to consumers or end-users, so identification of the relevant consumer or end-user is paramount[16]
- can, in limited circumstances, see levels of market concentration that might be considered an anti-competitive result in benefits to consumers.

A competition analysis would usually consider incentives faced by industry participants over the long term that drive outcomes in relation to dimensions such as price, quality, variety, safety, reliability and security of supply. Not all of these factors are directly relevant to the potential for a third medical school.

9.2 Defining the relevant market/s

A relevant market is made up of a product (service) or group of products (services) that are considered substitutes by consumers, in terms of their characteristics (i.e. the product market) and the geographic area they are offered in (i.e. the geographic market). A further consideration is the distinction often made in competition analysis between 'competition in the market' versus 'competition for the market'.

[16] In determining the (long-term) benefit to consumers, the standard of measurement usually includes some consideration of producer impacts as well, to the extent they result in consumer benefits.

The former is the conventional view of competition and concentrates on the actions of incumbents and imitative entrants in well-established markets. The latter refers to the struggle to create a new market, or to erect a new standard, and it is usually associated with the process of innovation that brings new displacing technologies to market (Geroski, 2003).

In the case of the options being assessed, the relevant product markets would appear to be:

- the market for medical education
- the market for medical research
- the market for medical services.

In respect of the geographical market, a national market would seem most relevant for medical education and research.[17] There are no obvious barriers (e.g. transportation and shipment costs or perishability) to consumers of tertiary education and research accessing facilities across the country.[18] This is true in respect of education in general, or specifically in relation to medical education. At a practical level, the considerable distance between Auckland and Otago universities means there is, in effect, a national market operating already. The practical implication is that purchasers of education would see the proposed locations of new medical training in Options 2 and 3 as highly substitutable for those in Auckland and Otago.

On the other hand, from a demand-side perspective, the market for doctors and particularly GP services is local in nature. As well as travel distance/convenience, there are also factors such as history (trust in the relationship and confidence in the quality and quantity of care) and price that make it far more likely that consumers of GP services would be in relatively close proximity to the practice. Prices, expressed in terms of a patient co-payment, are influenced by myriad factors, not all of which represent market signals. Thus, some caution is required in ascribing market-led actions and associated outcomes to changes in respective consumer prices. It is not clear that prices are able to easily adjust in response to enhanced competition from a third medical school producing more specialist GPs.

9.3 Competition and higher education

Universities have historically competed in a variety of areas, including for reputation, financial resources, and talent. The process manifests in universities competing for public and private funding, brand recognition, students, faculty, rankings, and accreditation. The infusion of economic and market rationales in higher education from around the 1980s led to enhanced focus on incentives for competition, with benefits expected to flow from efficiency gains and economic growth (e.g. through technology transfer) (Bloch et al., 2024).

There is some tension between the economic focus and other competitive aspects. Rankings, accreditations and even funding contests refer more to what has come to be known as status

[17] Other options include local, national, or perhaps global markets.

[18] Note that unlike more conventional competition analysis, where the question is the ease with which products can be distributed from a manufacturing base to consumer locations, here we are considering the ease with which consumers are able to access services at the location of the 'manufacturing' base.

competition. Universities today compete for values such as diversity and internationality as much as they compete for innovation, economic impact, and employability (Bloch et al., 2024).

While status might contribute to gains in the employability of students post-study, it will not necessarily add to innovation and technology transfer. Moreover, the status that one university achieves may be at the 'cost' of other universities with similar offerings, though that might not always be the case. That is, rather than status competition being a 'zero-sum game' it might lead to a 'race to the top'. The net effect of such competition in terms of economic costs and benefits is difficult to accurately quantify.

The key point is that competition is not an unfamiliar concept for universities. There are obvious differences between the form and intensity of competition among universities and those of profit-maximising firms. The incentives are not the same. However, it is reasonably well accepted (though not universally so) that some of the efficiency gains from the process of competition for private firms (innovation, level/quality of service and lower prices) would accrue in some measure to universities.

A rapid scan of some of the relevant literature reveals that empirical estimates of benefits from competition in higher education capable of inclusion in an economic CBA do not exist. Other key insights are that:

- There is some support for changed incentives due to competition that would lead to gains from additional competition (Mazzarotto, 2007).
- Competition in higher education has evolved into institutions competing on *quality*, rather than price (Musselin, 2018).
- Quality is hard to measure but is likely related to reputation, which takes time to seed (Altbach, 2010).
- Quality has a wide scope (e.g. quality of university experience, environment, facilities, and administration, as much as teaching and research) and can lead to negative effects through inordinate focus on non-academic aspects (so-called frills) and 'follow-the-leader' mimicry (Altbach, 2010).
- Empirical work on competition effects in education has tended to focus on schooling rather than the tertiary sector (Agasisti, 2007).
- Competition in tertiary education can bring about significant benefits to an entire economy (Chentukov et al., 2021).

9.4 Practical implications

The main implication from the discussion above is that there is no 'off the shelf' model or set of parameters that could be applied here to estimate the costs and benefits of enhanced competition as a result of a third medical school. Insights from relevant literature suggest that on balance, positive benefits are likely to be realised from entry, due to efficiency gains from the process of rivalry.

As mentioned above, there are likely to be immediate/direct impacts (in terms of education and training markets) and subsequent impacts through GP placements/employment. It is logical that enhanced competition would bring about such benefits.

9.4.1 The market for medical services

More doctors are expected to be trained under each of the options, leading to an increase in the supply of doctors across most specialties.

This additional supply manifests itself differently for different specialties, due to differences in the market structure of different specialties.

For GPs, additional supply exerts some competitive pressure on existing practices (through setting up their own practices or building up equity in existing organisations) that would likely elicit responses to the benefit of patients. As employees, GPs, especially those with specific training, capability, and affinity with particular populations (e.g. rural communities) would improve the availability and level of service experienced by the relevant consumers/patients. Despite a regulated fee-setting approach, prices could possibly reduce (or equivalently increase less) as well. This is likely to be important for the acknowledged, but not well understood issue of unmet demand in primary care.

At a lower level, GPs are moderately substitutable. While skill levels differ, in general they can be replaced by the services of another GP without a significant impact on the quality of care provided. The degree to which a GP is substitutable decreases with the length of the GP–patient relationship. This is because continuity of care benefits accrue over time. A high degree of substitutability typically increases the competition in a market because patients can more easily switch between GPs.

Greater competition could lead to better outcomes for patients and the system; for example, greater:

1. quality of care because GPs know that a patient may switch if dissatisfied
2. accessibility as GPs can extend office hours, reduce wait times, or offer other services to attract and retain patients
3. specialisation as GPs look to differentiate themselves by specialising
4. cost competition as clinics may lower their fees to compete for patients on price.

To a large degree, the impacts from competition described above are already captured in the cost and benefit estimates elsewhere in the paper. Disaggregating such impacts and attributing benefits to competition is extremely difficult, and it is not clear that the benefits of doing so would outweigh the costs. At best, separately considering the competitive effects of entry through a third medical school could act to adjust (upwards) the benefits already calculated, to the extent that competitive effects are fully separable, but determining the magnitude of such benefits is not possible in this analysis.

Each option will have different competitive impacts on the market for GPs because of the training received by the graduates. Options 2 and 3 are expected to result in GPs that are trained to better deliver healthcare in rural communities. Markets for GPs in rural communities will therefore experience a larger increase in GP numbers relative to Option 1. The quality of healthcare in these communities may therefore experience greater competition and associated positive impacts.

For some specialties, the vast majority of activity occurs within the public hospital system. For these specialties, the competitive impacts outlined above are unlikely to occur, or will occur in a muted form. Competitive pressure is most likely to reveal itself for these specialties through a more competitive job market. Employees may look to upskill more readily, or be more competitive in the remuneration packages they accept, leading to higher quality, and/or lower costs to the state, in the healthcare services provided to the public.

For the majority of specialties however, activity occurs across both public and private settings. The process described in the previous paragraph may manifest itself in the public setting, while a similar process as discussed in detail above for the market for general practice is likely to occur in the private setting.

9.4.2 Markets for education and research

Competition for students will likely result in non-price competition (e.g. improvements in the quality of education and extra-curricular services provided to students). The entry of a third medical school with a focus on training GPs for rural practice could generate responses from the incumbent providers of medical education (e.g. altering their offerings). Such responses would be 'competition for the market' in respect of bespoke or tailored training delivery not previously provided by Auckland or Otago. In addition, we would expect the more familiar 'competition in the market' in respect of additional choice, both location-wise and in terms of convenience (e.g. more accessible teaching and training schedules).

Improvements in the quality of teaching or the course content would have positive impacts for students, the institution itself, and subsequently for consumers of medical services. Students would benefit from enhanced comprehension and understanding of material, better insight into the application of learning and less time spent interpreting or clarifying concepts. In an economic sense, students would experience an increase in their consumer surplus (the difference between their willingness-to-pay and the price they face).[19] The medical school itself would experience a rise in reputation, with potential flow-on effects in respect of demand from students and faculty. As highlighted above, status is increasingly important for universities worldwide. Reputational effects could also 'spill over' to the other medical schools and an enhanced national reputation could result, though this is less likely.

The benefit to consumers of medical services would take the form of lifts in service levels as a result of more well-trained doctors. We have calculated that benefit in the form of greater life expectancy, which is the largest contributor to estimated benefits. While the explanation of such benefits focuses on the number of additional doctors that would result from a third medical school, higher quality would play a role. Rather than a distinct and additional benefit, we consider that the contribution of quality is essentially 'embedded' in the life expectancy benefits explained in section 6.1.

Whether students would receive lower prices from universities is an open question. The search for efficiencies by existing medical schools would be raised through competition, and the number of providers of education will increase (under Option 3), theoretically putting downward pressure on prices by changing the incentives on the incumbent schools to compete. That is, new entry lifts the

[19] Calculating the change in consumer surplus would require information on the demand curve for medical education, underlying preferences and relevant prices. It is a significant empirical undertaking that is beyond the scope of this analysis.

degree of rivalry in the relevant markets, which is generally accepted as resulting in benefits to consumers.

However, there is still expected to be a significant shortage in places in the Bachelor of Medicine and Bachelor of Surgery Programme relative to demand, i.e. students' demand for medical courses will continue to far exceed supply. In addition, universities are also constrained in their ability to increase fees. For example, the Ministry of Education set the annual maximum fee movement to 2.8 per cent in 2024 (Ministry of Education, 2023), and 2.75 per cent in 2023. As a result, current prices are likely below the levels that would be expected without price restrictions, limiting the scope and scale of price reductions in the absence of efficiency gains.

Option 3 would result in the greatest competitive benefits for New Zealand. Option 3 introduces a new university into the market for medical students, whereas Options 1 and 2 increase capacity from the current schools only.

The introduction of a new medical school through a new market participant typically increases rivalry among suppliers to meet consumer needs. However, the threat of entry also influences incumbent behaviour. That is, the mere possibility of entry constrains the ability of existing market participants to exercise market power and pay less attention to consumer (and wider) needs, and associated benefits.

To some extent, Option 2 encapsulates some of the effects of proposed competition from possible entry. The question is whether any changes made by incumbents to improve the nature and level of service are ephemeral (likely to be reversed once the competitive threat is removed, or conditions change) or more durable. In addition, the ability to compare benefit-cost ratios on a consistent basis is lacking. In that respect, reliance on modelled outcomes as they stand (i.e. with only descriptive/qualitative consideration of competition impacts) is justified.

10. Real option value – option to expand training further

Real options refer to the choice available to decision-makers to take a particular course of action. Common real options include the following:

- The option to expand: if a project or product line is performing better than expected, the option to expand enables decision-makers to boost production or make additional investments.
- Option to abandon: the option to abandon is the option to cease a project, or sell a project's assets to realise their salvage value.
- Option to wait: the option of deferring a business decision to the future.
- Option to contract: the option to downsize a project or product line.
- Option to switch: the option to temporarily halt a project while maintaining the option to resume at a later date.

Option 3, and to some extent Option 2, provide significant additional real option value through adding options to expand the New Zealand health workforce training system in unique ways. This could be especially important in the context of forecast shortages out to 2042 exceeding the additional capacity considered in the options considered in this CBA (Te Whatu Ora, 2023).

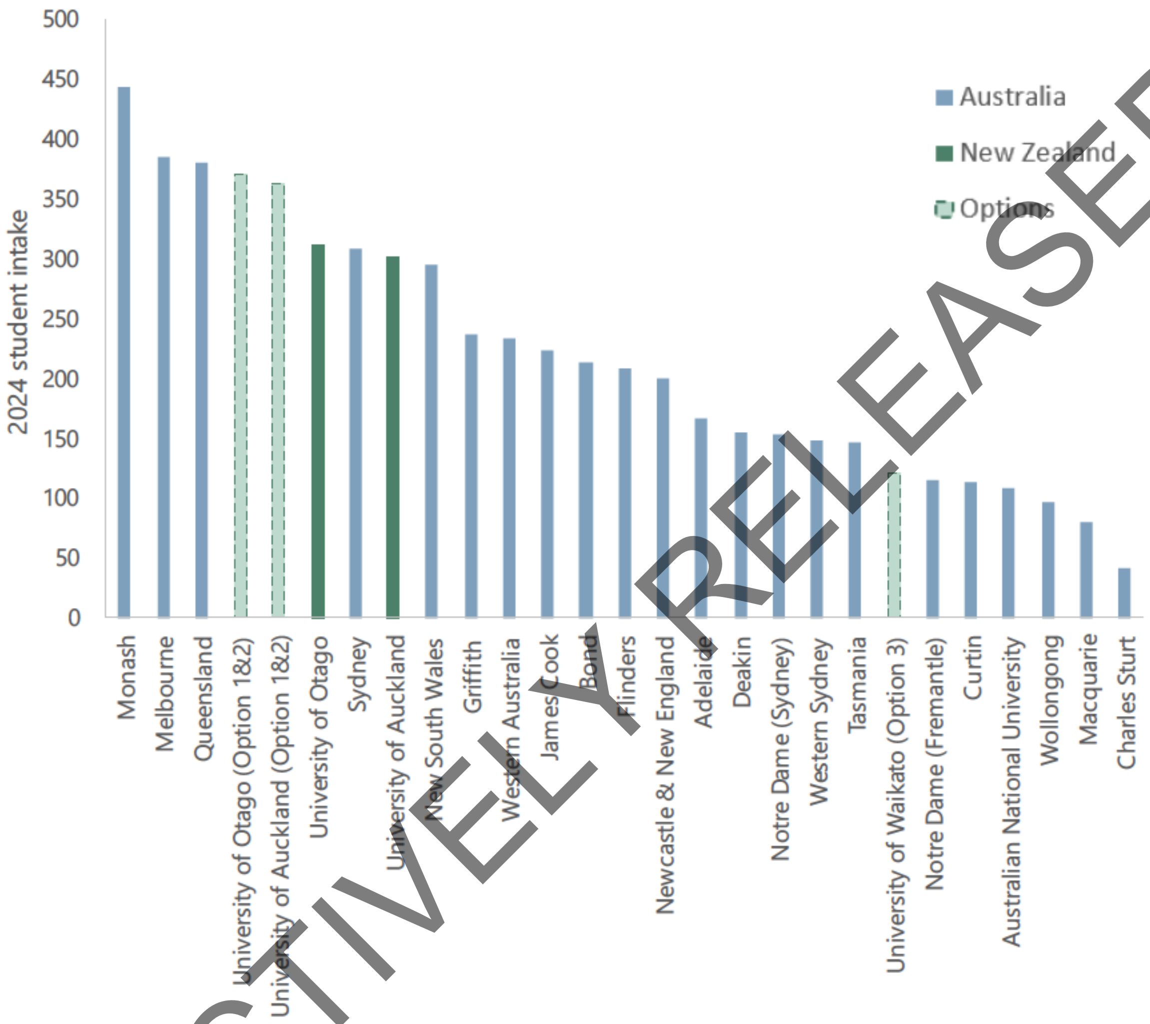
The two medical schools in New Zealand are large in the Australasian context. The Australian medical schools had a total intake of 4,453 students in 2024 (Medical Deans Australia and New Zealand, 2024). On average, that is 202 students per school, with a median intake of 184. The smallest school, Charles Sturt, had an intake of 41 students and the largest school, Monash University, had an intake of 443 (Table 24). Figure 20 displays the current medical schools in Australasia.

Compared to the 2024 student intake in Australia, the 2025 student cap puts University of Otago as the fourth largest medical school in Australasia, and University of Auckland as the sixth largest. Options 1 and 2 would shift University of Auckland to fifth largest (University of Otago would remain fourth largest).

The smaller Australian medical schools tend to be graduate programmes, and so an intake of 120 students for a new graduate medical school at University of Waikato seems within an acceptable range. The real option value is greatest under Option 3, because it provides opportunity to scale up training to a capacity of 160 students. The real option value could be approximated as the NPV of an additional third of the NPV calculated for the 120 students under Option 3, less any additional capital costs, because the initial capital investment would have already been incurred.

Research on economies of scale for medical schools is sparse. Larger schools may benefit from economies of scale in terms of more resources and their ability to provide a range of facilities, but modern training requires problem-based learning using simulations, and digital training methods are becoming more common. Smaller groups are required for this format of learning, requiring multiple simulation rooms. We understand that diseconomies of scale can crop up when providing pastoral support, which is easier to provide with a smaller cohort of students. The Christchurch campus of University of Otago is around 120 students, which seems to be a relevant size.

Figure 20: 2024 Australian medical school student intake and New Zealand 2025 medical school student cap



Source: Medical Deans Australia and New Zealand, (2024), Sapere analysis.

Table 24: New Zealand medical school current and potential student caps

School	2025 student cap	Options 1 & 2	Option 3	Entry pathway
University of Auckland	302	362	302	Undergraduate & graduate
University of Otago	312	372	312	Undergraduate & graduate
University of Waikato	-	-	120	Graduate

Source: Sapere analysis.

Table 25: Australian medical school intake in 2024

School	2024 student intake	Entry pathway
Monash University	443	Undergraduate & graduate
University of Melbourne	385	Undergraduate
Queensland University	380	Undergraduate & graduate
Sydney University	308	Undergraduate & graduate
University of New South Wales	296	Undergraduate
Griffith University	237	Graduate
Western Australia University	233	Undergraduate & graduate
James Cook University	223	Undergraduate
Bond University	213	Undergraduate & graduate
Flinders University	209	Graduate
University of Newcastle & New England	200	Undergraduate
University of Adelaide	167	Undergraduate
Deakin University	155	Graduate
University of Notre Dame (Sydney)	154	Graduate
Western Sydney University	149	Undergraduate
Tasmania University	147	Undergraduate
University of Notre Dame (Fremantle)	115	Graduate
Curtin University	113	Undergraduate
Australian National University	108	Graduate
Wollongong University	97	Graduate
Macquarie University	80	Graduate
Charles Sturt University	41	Undergraduate

Source: Medical Deans Australia and New Zealand, (2024).

References

Adams, S., Boyd, M., Carryer, J., Bareham, C., & Tenbensel, T. (2020). A survey of the NP workforce in primary healthcare settings in New Zealand. *New Zealand Medical Journal*, *133*(1523).

Agasisti, T. (2007). *Effects of Competition in University Systems: Theoretical Reflections and Empirical Evidence from Italy*. https://www.researchgate.net/publication/228245153_Effects_of_Competition_in_University_Systems_Theoretical_Reflections_and_Empirical_Evidence_from_Italy

Altbach, P. G. (2010). *Competition's Impact on Higher Education*. https://www.forbes.com/2010/08/01/higher-education-competition-opinions-best-colleges-10-altbach.html

Association of Salaried Medical Specialists. (2016). *ASMS submission on the Voluntary Bonding Scheme 2017 to Health Workforce New Zealand*. https://asms.org.nz/wp-content/uploads/2022/05/Submission-to-the-Ministry-of-Health-on-Voluntary-Bonding-Scheme.pdf

Association of Salaried Medical Specialists. (2019). *Forecasting New Zealand's future medical specialist workforce needs*. https://asms.org.nz/wp-content/uploads/2022/05/Research-Brief-specialist-workforce-projections-_172060.2.pdf

Bagg, W., Curtis, E., Eggleton, K. S., Nixon, G., Bristowe, Z., Brunton, P., Hendry, C., Kool, B., Scarf, D., Shaw, S., Tukuitonga, C., Williman, J., Wilson, D., & Crampton, P. (2023). Socio-demographic profile of medical students in Aotearoa, New Zealand (2016–2020): A nationwide cross-sectional study. *BMJ Open*, *13*(12), e073996. https://doi.org/10.1136/bmjopen-2023-073996

Baker, R., Levene, L. S., Newby, C., & Freeman, G. K. (2024). Does shortage of GPs matter? A cross-sectional study of practice population life expectancy. *British Journal of General Practice*, *74*(742), e283–e289. https://doi.org/10.3399/BJGP.2023.0195

Barker, I., Steventon, A., & Deeny, S. R. (2017). Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: Cross sectional study of routinely collected, person level data. *BMJ*, *356*, j84. https://doi.org/10.1136/bmj.j84

Basu, S., Berkowitz, S. A., Phillips, R. L., Bitton, A., Landon, B. E., & Phillips, R. S. (2019). Association of primary care physician supply with population mortality in the United States, 2005–2015. *JAMA Internal Medicine*, *179*(4), 506–514. https://doi.org/10.1001/jamainternmed.2018.7624

Bazemore, A., Petterson, S., Peterson, L. E., Bruno, R., Chung, Y., & Phillips, R. L. (2018). Higher primary care physician continuity is associated with lower costs and hospitalizations. *Annals of Family Medicine*, *16*(6), 492–497. https://doi.org/10.1370/afm.2308

Bazemore, A., Petterson, S., Peterson, L. E., & Phillips, R. L. (2015). More comprehensive care among family physicians is associated with lower costs and fewer hospitalizations. *Annals of Family Medicine*, *13*(3), 206–213. https://doi.org/10.1370/afm.1787

Bertram, M. Y., Lauer, J. A., De Joncheere, K., Edejer, T., Hutubessy, R., Kieny, M.-P., & Hill, S. R. (2016). Cost–effectiveness thresholds: Pros and cons. *Bulletin of the World Health Organization*, *94*(12), 925–930. https://doi.org/10.2471/BLT.15.164418

Bloch, R., Seidenschnur, T., & Mitterle, A. (2024). How do universities compete? Introduction to the special issue. *Studies in Higher Education*, *49*(10), 1701–1709. https://www.tandfonline.com/doi/full/10.1080/03075079.2024.2395418

Boardman, A., Greenberg, D., Vining, A., & Weimer, D. (2018). *Cost-benefit Analysis: Concepts and Practice*. https://students.aiu.edu/submissions/profiles/resources/onlineBook/E5V5H3_Cost-benefit%20analysis%20_%202018.pdf

Buykx, P., Humphreys, J., Wakerman, J., & Pashen, D. (2010). Systematic review of effective retention incentives for health workers in rural and remote areas: Towards evidence-based policy.

Australian Journal of Rural Health, *18*(3), Article 3. https://doi.org/10.1111/j.1440-1584.2010.01139.x

Campbell, R. J., Ramirez, A. M., Perez, K., & Roetzheim, R. G. (2003). Cervical cancer rates and the supply of primary care physicians in Florida. *Family Medicine*, *35*(1), 60–64.

Chentukov, Y., Omelchenko, V., Zakharova, O., & Nikolenko, T. (2021). Assessing the impact of higher education competitiveness on the level of socio-economic development of a country. *Problems and Perspectives in Management*, *19*(2), 370–383. https://doi.org/10.21511/ppm.19(2).2021.30

Cortie, C. H., Garne, D., Parker-Newlyn, L., Ivers, R. G., Mullan, J., Mansfield, K. J., & Bonney, A. (2023). A comparison of rural and regional work locations and speciality choices between graduates from the University of Wollongong and all Australian medical schools using the Medical Schools Outcomes Database. *Australian Journal of Rural Health*, *32*(1), 152–161. https://doi.org/10.1111/ajr.13077

Cree, M., Bell, N. R., Johnson, D., & Carriere, K. C. (2006). Increased continuity of care associated with decreased hospital care and emergency department visits for patients with asthma. *Disease Management*, *9*(1), 63–71. https://doi.org/10.1089/dis.2006.9.63

Cumings, A. (2023). *Primary Care Overview – Reimagining General Practice*. https://www.nzdoctor.co.nz/sites/default/files/2024-03/Primary%20Care%20Overview%20%E2%80%93%20Reimagining%20General%20Practice%202023.pdf

Efendi, F., Chen, C.-M., Nursalam, N., Andriyani, N. W. F., Kurniati, A., & Nancarrow, S. A. (2016). How to attract health students to remote areas in Indonesia: A discrete choice experiment. *International Journal of Health Planning and Management*, *31*(4), Article 4. https://doi.org/10.1002/hpm.2289

Emery, J. D., Shaw, K., Williams, B., Mazza, D., Fallon-Ferguson, J., Varlow, M., & Trevena, L. J. (2014). The role of primary care in early detection and follow-up of cancer. *Nature Reviews Clinical Oncology*, *11*(1), 38–48. https://doi.org/10.1038/nrclinonc.2013.212

Ferrante, J. M., Gonzalez, E. C., Pal, N., & Roetzheim, R. G. (2000). Effects of physician supply on early detection of breast cancer. *Journal of the American Board of Family Practice*, *13*(6), 408–414. https://doi.org/10.3122/15572625-13-6-408

Fraser, C., & Clarke, G. (2023). *Measuring continuity of care in general practice*. The Health Foundation. https://www.health.org.uk/publications/long-reads/measuring-continuity-of-care-in-general-practice

Fried, S., Zloto, O., Doron, A., Feldman, Z., Belinsky, A., Segal, G., Frenkel-Nir, Y., & Afek, A. (2024). Attracting medical school graduates to residency programs in remotely located hospitals: The challenge lies beyond financial incentives. *Israel Journal of Health Policy Research*, *13*(1), Article 1. https://doi.org/10.1186/s13584-024-00629-5

Geroski, P. A. (2003). Competition in markets and competition for markets. *Journal of Industry, Competition and Trade*, *3*(3), 151–166. https://doi.org/10.1023/A:1027457020332

Godard-Sebillotte, C., Strumpf, E., Sourial, N., Rochette, L., Pelletier, E., & Vedel, I. (2021). Primary care continuity and potentially avoidable hospitalization in persons with dementia. *Journal of the American Geriatrics Society*, *69*(5), 1208–1220. https://doi.org/10.1111/jgs.17049

Grossman, M. (2017). *The Demand for Health: A Theoretical and Empirical Investigation*. Columbia University Press. https://doi.org/10.7312/gros17900

Guilfoyle, C., Huang, P.-H., Forster, L., & Shulruf, B. (2022). Factors predicting rural location employment intent and choice among medical students and graduates. *Korean Journal of Medical Education*, *34*(4), Article 4. https://doi.org/10.3946/kjme.2022.236

Hauora Taiwhenua Rural Health Network. (2023). *Rural General Practice Stocktake Survey*.

Hauora Taiwhenua Rural Health Network, Royal New Zealand College of General Practitioners, University of Otago, & University of Auckland. (2022). *A Joint Centre of Rural Health: Providing a vision for thriving rural health services. First steps on a pathway towards a National Interprofessional School of Rural Health*.

Health New Zealand. (2025). *The Voluntary Bonding Scheme*. Health New Zealand | Te Whatu Ora. https://www.tewhatuora.govt.nz/for-health-professionals/voluntary-bonding-scheme/the-voluntary-bonding-scheme

Hudson, J., Weston, K., & Farmer, E. (2012). Medical students on long-term regional and rural placements: What is the financial cost to supervisors? *Rural and Remote Health*, *12*(2). https://doi.org/10.22605/rrh1951

Jackson, G., & Jones, P. (2023). Emergency department crowding is not being caused by increased inappropriate presentations. *New Zealand Medical Journal*, *136*(1586), 94–98. https://doi.org/10.26635/6965.6265

Johnston, M, & Cassie, F. (2023). *Anatomy of a crisis: Layer cake of woe built on workforce and funding shortages*. New Zealand Doctor. https://www.nzdoctor.co.nz/20millionconsults

Kuschel, G., Metcalfe, J., Davy, P., Hastings, K., Mason, K., Denne, T., Berentson-Shaw, J., Hales, S., Atkinson, J., & Woodward, A. (2020). *Health and Air Pollution in New Zealand 2019*. Ministry for the Environment. https://ehinz.ac.nz/assets/HAPINZ3/HAPINZ-3.0-Approved-Methodology.pdf

Kwan, M. M. S., Kondalsamy-Chennakesavan, S., Ranmuthugala, G., Toombs, M. R., & Nicholson, G. C. (2017). The rural pipeline to longer-term rural practice: General practitioners and specialists. *PLOS One*, *12*(7), e0180394. https://doi.org/10.1371/journal.pone.0180394

Lawrenson, R. (2023, May 15). *New Zealand's reliance on foreign doctors to plug gaps highlights the need for another medical school*. The Conversation. http://theconversation.com/new-zealands-reliance-on-foreign-doctors-to-plug-gaps-highlights-the-need-for-another-medical-school-204668

Love, T., Peck, C., & Watt, D. (2022). *A Future Capitation Funding Approach*. Sapere Research Group. https://srgexpert.com/wp-content/uploads/2023/07/A-Future-Capitation-Funding-Approach-July-2022.pdf

Matthews, C., Bagg, W., Yielder, J., Mogol, V., & Poole, P. (2015). Does Pukawakawa (the regional-rural programme at the University of Auckland) influence workforce choice? *New Zealand Medical Journal*, *128*(1409), 35–43.

Mazzarotto, N. (2007). *Competition and Market Incentives in Higher Education*. Social Science Research Network, Scholarly Paper 1059881. https://doi.org/10.2139/ssrn.1059881

McAlister, F. A., Youngson, E., Bakal, J. A., Kaul, P., Ezekowitz, J., & van Walraven, C. (2013). Impact of physician continuity on death or urgent readmission after discharge among patients with heart failure. *CMAJ: Canadian Medical Association Journal*, *185*(14), E681–E689. https://doi.org/10.1503/cmaj.130048

MCNZ. (2019, March 31). *Prevocational training providers and accreditation standards*. Medical Council of New Zealand. https://www.mcnz.org.nz/registration/medical-education/accreditation-reports-prevocational-medical-training-providers/

MCNZ. (2023). *The New Zealand Medical Workforce*. Medical Council of New Zealand. https://www.mcnz.org.nz/assets/Publications/Workforce-Survey/Workforce-Survey-Report-2023.pdf

MCNZ. (n.d.). *Retention*. Medical Council of New Zealand. https://www.mcnz.org.nz/about-us/our-data/retention/

Medical Deans Australia and New Zealand. (2024, December 17). *Medical Student Numbers*. https://app.powerbi.com/view?r=eyJrIjoiMjdiNTU2NWMtMmJjYy00MTBiLTg5NTgtNzg1OTE4ZjU4NGJhIiwidCI6IjljY2Y4YjAxLWJhZTQtNDQ2ZC1hZWNhLTdkYTljMDFlZDBmOSJ9

Ministry of Education. (2023). *Student Loan Scheme: Annual Report 2022–23*. https://www.educationcounts.govt.nz/__data/assets/pdf_file/0006/224592/MoE_Student-Loan-Scheme-Annual-Report-2023_Web_2.pdf#page=31

Ministry of Health. (2024a). *New Zealand Health Survey: Annual Data Explorer* [Dataset]. https://minhealthnz.shinyapps.io/nz-health-survey-2023-24-annual-data-explorer/_w_d90510fa/#!/home

Ministry of Health. (2024b, February 13). *Memorandum of Understanding between the Ministry of Health and the University of Waikato*. https://www.health.govt.nz/publication/memorandum-understanding-between-ministry-health-and-university-waikato

Mohan, N., Irurzun-Lopez, M., Pledger, M., Jeffreys, M., & Cumming, J. (2024). Addressing closed and limited enrolments in general practices in Aotearoa New Zealand: A mixed-methods study. *New Zealand Medical Journal, 137*(1599), 55–64. https://doi.org/10.26635/6965.6517

Musselin, C. (2018, July). New forms of competition in higher education. *Socio-Economic Review, 16*(3). https://www.researchgate.net/publication/328260612_New_forms_of_competition_in_higher_education

New Medical School DBC Programme. (2024). *New Medical School Detailed Business Case* (V3.0). Ministry of Health.

New Zealand MSOD Steering Group. (2017). *National Report on Students Graduating Medical School in New Zealand in 2012–2014*. https://www.otago.ac.nz/__data/assets/pdf_file/0019/330733/national-report-on-students-graduating-medical-school-in-new-zealand-in-2012-2014-645043.pdf

New Zealand MSOD Steering Group. (2021). *National Report on Students Graduating Medical School in New Zealand in 2016–2020*. https://www.otago.ac.nz/__data/assets/pdf_file/0026/330659/national-report-on-students-graduating-medical-school-in-new-zealand-in-2016-2020-831361.pdf

New Zealand MSOD Steering Group. (2022). *National Report on Doctors Five Years After Graduating from NZ Medical Schools in 2012–2016*. https://www.otago.ac.nz/__data/assets/pdf_file/0020/331427/national-report-on-doctors-5-years-after-graduating-from-nz-medical-schools-in-2012-2016-0236449.pdf

New Zealand National Party & ACT New Zealand. (2023). *Coalition Agreement: New Zealand National Party & ACT New Zealand, 54th Parliament*. https://assets.nationbuilder.com/nationalparty/pages/18466/attachments/original/1700778592/National_ACT_Agreement.pdf?1700778592

New Zealand Treasury. (2015). *Guide to Social Cost Benefit Analysis—July 2015*. https://www.treasury.govt.nz/sites/default/files/2015-07/cba-guide-jul15.pdf

Nursing Council of New Zealand. (2024). *Nursing Council of New Zealand Quarterly Data Report September 2024*. https://nursingcouncil.org.nz/common/Uploaded%20files/Public/Publications/Workforce%20Statistics/Quarterly%20Data%20Reports/Nursing%20Council%20Quarterly%20Data%20Report%20-%20September%202024%20Quarter.pdf

OECD. (2023). *Health at a Glance 2023: OECD Indicators*. Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2023_7a7afb35-en

Playford, D., Ngo, H., Atkinson, D., & Puddey, I. B. (2019). Graduate doctors' rural work increases over time. *Medical Teacher*, *41*(9), Article 9. https://doi.org/10.1080/0142159X.2019.1621278

Poole, P., Wilkinson, T. J., Bagg, W., Freegard, J., Hyland, F., Jo, E., Kool, B., Roberts, E., Rudland, J., Smith, B., & Verstappen, A. (2019). Developing New Zealand's medical workforce: Realising the potential of longitudinal career tracking. *New Zealand Medical Journal*, *132*(1495). https://nzmj.org.nz/media/pages/journal/vol-132-no-1495/developing-new-zealand-s-medical-workforce-realising-the-potential-of-longitudinal-career-tracking/0a667d1c89-1696475276/developing-new-zealand-s-medical-workforce-realising-the-potential-of-longitudinal-career-tracking.pdf

PricewaterhouseCoopers. (2024). *Medical Education in New Zealand: Current State and Consideration of Future Options. University of Auckland and University of Otago final report.* https://www.auckland.ac.nz/assets/news-and-opinion/2024/07/web-medical-education-NZ-July-2024-PwC-report.pdf

Reynolds, R., Dennis, S., Hasan, I., Slewa, J., Chen, W., Tian, D., Bobba, S., & Zwar, N. (2018). A systematic review of chronic disease management interventions in primary care. *BMC Family Practice*, *19*(1), Article 11. https://doi.org/10.1186/s12875-017-0692-3

Roetzheim, R. G., Pal, N., Gonzalez, E. C., Ferrante, J. M., Van Durme, D. J., Ayanian, J. Z., & Krischer, J. P. (1999). The effects of physician supply on the early detection of colorectal cancer. *Journal of Family Practice*, *48*(11), 850–858.

Roetzheim, R. G., Pal, N., van Durme, D. J., Wathington, D., Ferrante, J. M., Gonzalez, E. C., & Krischer, J. P. (2000). Increasing supplies of dermatologists and family physicians are associated with earlier stage of melanoma detection. *Journal of the American Academy of Dermatology*, *43*(2 Pt 1), 211–218. https://doi.org/10.1067/mjd.2000.106242

Roffia, P., Bucciol, A., & Hashlamoun, S. (2023). Determinants of life expectancy at birth: A longitudinal study on OECD countries. *International Journal of Health Economics and Management*, *23*(2), 189–212. https://doi.org/10.1007/s10754-022-09338-5

Rosenthal, J., Darnton, R., & Harding, A. (2022). Parity at last: A new funding model for undergraduate primary care education in England. *British Journal of General Practice*, *72*(719), 257–258. https://doi.org/10.3399/bjgp22X719525

Royal New Zealand College of General Practitioners. (2018). *2018 General Practice Workforce Survey*. https://www.rnzcgp.org.nz/documents/81/Workforce_Survey_2018_Report_part_1.pdf

Royal New Zealand College of General Practitioners. (2022). *2022 Workforce Survey Overview Report*. https://www.rnzcgp.org.nz/resources/data-and-statistics/2022-workforce-survey/

Royal New Zealand College of General Practitioners. (2023). *2022 Workforce Survey*. https://www.rnzcgp.org.nz/resources/data-and-statistics/2022-workforce-survey/

Russell, D., Mathew, S., Fitts, M., Liddle, Z., Murakami-Gold, L., Campbell, N., Ramjan, M., Zhao, Y., Hines, S., Humphreys, J. S., & Wakerman, J. (2021). Interventions for health workforce retention in rural and remote areas: A systematic review. *Human Resources for Health*, *19*(1), Article 1. https://doi.org/10.1186/s12960-021-00643-7

Sandvik, H., Hetlevik, Ø., Blinkenberg, J., & Hunskaar, S. (2021). Continuity in general practice as predictor of mortality, acute hospitalisation, and use of out-of-hours care: A registry-based observational study in Norway. *British Journal of General Practice*, *72*(715), e84–e90. https://doi.org/10.3399/BJGP.2021.0340

Starfield, B., Shi, L., & Macinko, J. (2005). Contribution of primary care to health systems and health. *Milbank Quarterly*, *83*(3), 457–502. https://doi.org/10.1111/j.1468-0009.2005.00409.x

Taylor, W., Smeets, L., Hall, J., & McPherson, K. (2004). The burden of rheumatic disorders in general practice: Consultation rates for rheumatic disease and the relationship to age, ethnicity, and small-area deprivation. *New Zealand Medical Journal*, *117*(1203).

Te Whatu Ora. (2023, July 4). *Health Workforce Plan 2023/24*. Health New Zealand | Te Whatu Ora. https://www.tewhatuora.govt.nz/publications/health-workforce-plan-202324/

Te Whatu Ora. (2024). *Health Workforce Plan 2024*. Health New Zealand | Te Whatu Ora. https://www.tewhatuora.govt.nz/publications/health-workforce-plan-2024

University of Auckland. (2024). *Undergraduate Fees for Domestic Students*. https://www.auckland.ac.nz/en/study/fees-and-money-matters/tuition-fees/undergraduate-domestic-fees.html

University of Otago. (2023). *Domestic Transport Costs and Charges Study*. Working Paper D3: Health Impacts of Active Transport. https://www.transport.govt.nz/assets/Uploads/DTCC-WP-D3-Health-Impacts-of-Active-Transport-June-2023.pdf

University of Otago. (2024). *Fees*. https://www.otago.ac.nz/study/fees

Van Den Berg, M. J., Van Loenen, T., & Westert, G. P. (2016). Accessible and continuous primary care may help reduce rates of emergency department use. An international survey in 34 countries. *Family Practice*, *33*(1), 42–50. https://doi.org/10.1093/fampra/cmv082

Whitehead, J., Pearson, A. L., Lawrenson, R., & Atatoa-Carr, P. (2020). Defining general practitioner and population catchments for spatial equity studies using patient enrolment data in Waikato, New Zealand. *Applied Geography*, *115*, 102137. https://doi.org/10.1016/j.apgeog.2019.102137

Wiebe, N., Klarenbach, S. W., Allan, G. M., Manns, B. J., Pelletier, R., James, M. T., Bello, A., Hemmelgarn, B. R., Tonelli, M., & Alberta Kidney Disease Network. (2014). Potentially preventable hospitalization as a complication of CKD: A cohort study. *American Journal of Kidney Diseases*, *64*(2), 230–238. https://doi.org/10.1053/j.ajkd.2014.03.012

Worrall, G., & Knight, J. (2011). Continuity of care is good for elderly people with diabetes: Retrospective cohort study of mortality and hospitalization. *Canadian Family Physician / Medecin De Famille Canadien*, *57*(1), e16–20.

Yiend, J., Tracy, D. K., Sreenan, B., Cardi, V., Foulkes, T., Koutsantoni, K., Kravariti, E., Tchanturia, K., Willmott, L., Shergill, S., & Reedy, G. (2016). Post graduate clinical placements: Evaluating benefits and challenges with a mixed methods cross sectional design. *BMC Medical Education*, *16*(1), Article 64. https://doi.org/10.1186/s12909-016-0575-7

Appendix A Health workforce modelling

Table 26: Key volumes

Category	Description	Assumption / estimation
Volumes	Number of medical school graduates	120 additional students start in the first year of medical school. Each subsequent year is equal to the previous year's students multiplied by the retention rate. This is discussed further in Table 26.
	Number of GPs	We have relied on health workforce modelling undertaken by Health NZ.
	Number of other doctors	We have relied on health workforce modelling undertaken by Health NZ.

Workforce forecasting methodology

The Analytics and Forecasting team, National People Services, Health NZ has developed health workforce forecasting models for professions, including almost all regulated professions and some unregulated professions.

The workforce supply forecasting models are based on data about individual practitioners. Each practitioner's new entries, re-entries and exits are tracked based on annual changes in the work history. Entry and exit rates are calculated for the group of practitioners in each five-year age band—in the forecasting model they are moved between age bands as they age.

In other words, the forecasts are based on 'rates tables' which record the actual numbers entering and leaving the workforce over recent years. The entry numbers include both domestically trained and internationally trained professionals, including those entering for the first time (new entries, with their first annual practising certificate) and those returning to the workforce after a break (re-entries). Entries and exits in each five-year age band are treated separately because those age- and group-specific patterns vary. For a 10-year forecast, we must allow that current workers will be 10 years older and their likelihood of leaving (or having already left) will be different to now, and that new entries and re-entries will be more likely to happen in certain age bands. In other words, the aim is to forecast not just the total numbers but also the age structures of future workforces.

Testing the model's forecasts against what actually happened in past years shows it to be 98 per cent accurate for five-year projections for a large occupational group (all GPs).

The basic algorithm and specific models have been reported in academic publications as follows:

- Emmanuel Jo, Kimberly Mathis and Justin Goh. Forecasting future medical specialty workforces supply with age distribution using health workforce annual practising certificate data, *Operations Research Society of New Zealand*, 2017, 1–12.[20]
- Sam Seleq, Emmanuel Jo, Phillippa Poole, Tim Wilkinson, Fiona Hyland, Joy Rudland, Antonia Verstappen and Warwick Bagg. The employment gap: the relationship between medical

[20] http://orsnz.org.nz/conf51/wp-content/uploads/sites/3/2017/12/ORSNZ17_JoE.pdf

student career choices and the future needs of the New Zealand medical workforce. *New Zealand Medical Journal*, *132*(1506), 29 November 2019, 52–59.[21]

- Alex Dunn, Shaun Costello, Fiona Imlach, Emmanuel Jo, Jason Gurney, Rose Simpson and Diana Sarfati. Using national data to model the New Zealand radiation oncology workforce. *Journal of Medical Imaging and Radiation Oncology*, *66*(5), 2022, 1–9.[22]

General assumptions for the forecasting models

The Analytics and Forecasting team's standard (baseline) workforce forecasts are based on patterns which have been evident in the last three or five years, and on projecting these patterns into the future (the next 10 years). These forecasts assume that current patterns of work will continue. That is:

- no changes in technology or models of care
- continuation of age-group-specific patterns of new entry to each specialty, and re-entries after periods of absence
- continuation of current age-group-specific exit rates
- new entrants include those who have completed training in New Zealand as well as fully qualified internationally trained professionals registered for the first time in New Zealand. The model assumes that the historic patterns of entry of the two groups continue.

[21] https://nzmj.org.nz/media/pages/journal/vol-132-no-1506/the-employment-gap-the-relationship-between-medical-student-career-choices-and-the-future-needs-of-the-new-zealand-medical-workf/f2a45bdb7c-1696475920/the-employment-gap-the-relationship-between-medical-student-career-choices-and-the-future-needs-of-the-new-zealand-medical-workf.pdf

[22] https://doi.org/10.1111/1754-9485.13448

Appendix B Detailed cost assumptions

Quantified cost assumptions, relevant to Section 5, are grouped based on the cost they apply to. Table 26 shows the cost assumptions relevant to all costs.

Table 27: Quantified cost assumptions relevant to all costs

Description	Assumption(s)	Source
Number of undergraduate students	For Option 1 and Option 2, five years of medical school starting in 2026. 120 additional students start in the first year of medical school. Each subsequent year is equal to the previous year's students multiplied by the retention rate. For Option 3, four years of medical school starting in 2028. 120 additional students start in the first year of medical school. Each subsequent year is equal to the previous year's students multiplied by the degree retention rate.	Sapere assumption based on Te Whatu Ora's workforce modelling
Degree retention rate	99.00% annual degree retention rate. Auckland and Otago University medical degrees had an average cohort completion rate of 95.04% between 2014 and 2023. This figure implies an annual retention rate of ~99% for a six-year programme (includes first-year health sciences).	Medical doctor data from the Ministry of Health: cohort-based qualification completion rates for funded medical doctor learners
Construction start for university campus	Starts in 2026 and ends by 2027/28.	Sapere judgement based on provided information

Table 27 outlines the assumptions relevant to the opex costs.

s 9(2)(j)

Table 28 outlines the assumptions for capex.

s 9(2)(j)

s 9(2)(j)

Table 29 shows the cost of GP care assumptions.

Table 30: Cost of GP care assumptions

Description	Assumption	Source
Number of additional GPs in New Zealand	Derived from Te Whatu Ora's workforce modelling	Te Whatu Ora
Cost for an additional GP that is filling vacancies (to provide for one GP hour)		
GP salaries	GP salaries are $262,080 annually, equivalent to an hourly rate of $126 per hour.	2024 SECA
Direct costs	$22 per GP, per hour. Assumed to be 25 per cent of total practice overheads.	(Love et al., 2022)
Cost for an additional GP that requires additional supporting infrastructure (to provide for one GP hour)		
GP salaries	GP salaries are $262,080 annually	2024 SECA

Description	Assumption	Source
Direct costs	$22 per GP, per hour. Assumed to be 25 per cent of total practice overheads.	Love et al. (2022)
Supporting staff salary costs	52 per cent of GP salaries. This figure was estimated using survey data from a survey of general practices in 2022. The proportion is estimated using relevant salary costs and numbers of clinicians, admin, HCA, and clinical admin, relative to the number of GPs.	2024 SECA, and survey data from Love et al. (2022)
Overheads	69 per cent of GP salaries. This figure was estimated using GP salary and overhead costs from the 2022 general practice survey data. Costs were escalated from 2022 using the labour cost index, consumer goods price index, and producer price index.	2024 SECA, Statistics New Zealand (2024), and survey data from Love et al. (2022)

Table 30 outlines the assumptions underpinning our estimates of the cost of hospital specialist doctors and RMOs.

Table 31: Cost of specialist doctors and RMO assumptions

Description	Assumption	Source
Number of additional RMOs and SMOs in New Zealand	Derived from Te Whatu Ora's workforce modelling	Te Whatu Ora
Salary costs per SMO	s 9(2)(j)	Sapere's previous workforce modelling for Te Whatu Ora
Direct costs per SMO		Sapere's previous hospital and specialist service modelling for Te Whatu Ora
Overhead allocation per SMO		Sapere's previous hospital and specialist service modelling for Te Whatu Ora

Table 31 shows the assumptions for the terminal value estimate.

Table 32: Terminal value assumptions

Description	Assumption	Source
Depreciation rate buildings and accommodations	Buildings and accommodation have a 2% depreciation rate.	University of Waikato
Depreciation rate equipment	Equipment has a 10% depreciation rate.	University of Waikato
Useful life	Useful life of all assets begins the year each asset is completed	Sapere assumption
Contingency inclusion	Depreciation has been calculated on capital costs including contingency.	University of Waikato
Salvage values	Assets have a zero-salvage value, i.e. when the useful life of the assets ends and they are fully depreciated, their value is zero.	Sapere assumption

Appendix C Key benefit parameters

Description	Assumption	Source
Value of a life year	$369,696	CBAx impact database, Sapere analysis
Life years gained per additional GP per 10,000 population	0.0585366	Sapere analysis, consistent with techniques in the academic literature
Life years gained per additional SMO per 10,000 population	0.0359522	Sapere analysis, consistent with techniques in the academic literature
Average travel speed	37.5 km/h	Ministry of Transport Household Travel Survey
Cost of time spent in uncongested traffic for non-work-related purposes	$22.45 p/h	Ministry of Transport monetised costs and benefits manual, updated for inflation
Cost per ED visit	$469.60	Sapere Analysis, NMDS and NNPAC databases
Proportion of ED visits that could be met in primary care	8.98%	Combination of academic findings: Jones and Jackson (2023) & Berg et al. (2016)

Appendix D Modelling doctor practising location

The distribution of additional doctors is an important assumption underlying the distribution of benefits across the country. We model where additional doctors under each option will choose to practice geographically, using three broad assumptions:

- Clinical placement location can influence choices for practice location post-graduation. This is consistent with the findings in a review of the Pūkawakawa rural immersion programme (Matthews et al., 2015).
- Doctors tend to locate where the population is largest, following general population trends.
- Doctors will be influenced by the balance of supply and demand in any given location and be drawn to areas where vacancy rates are higher.

While the second two points above remain the same across the options, clinical placement locations differ between the options. Therefore, the geographic distribution of additional doctors is also different across the options. Our modelling takes the status quo distribution of doctors as the base case, then adds the additional doctors produced under each option.

Status quo modelling

Status quo modelling is undertaken on the assumption that current patterns of coverage remain. The current doctors' per capita ratio in each location is taken as the basis for distribution of additional doctors trained, consistent with Equation 1.

Equation 1: Status quo doctor distribution

$$AdditionalGPs_{i,t} = \frac{GPsperCapita_{i,t-1}}{\sum_{j=1}^{n} GPsperCapita_{j,t-1}} \times \sum_{j=1}^{n} AdditionalGPs_{j,t}$$

The same rural/urban split for status quo GPs is assumed to be the current split; approximately 16.6 per cent of GPs currently practice rurally (Bagg et al., 2023).

Modelling additional doctors above the status quo under each option

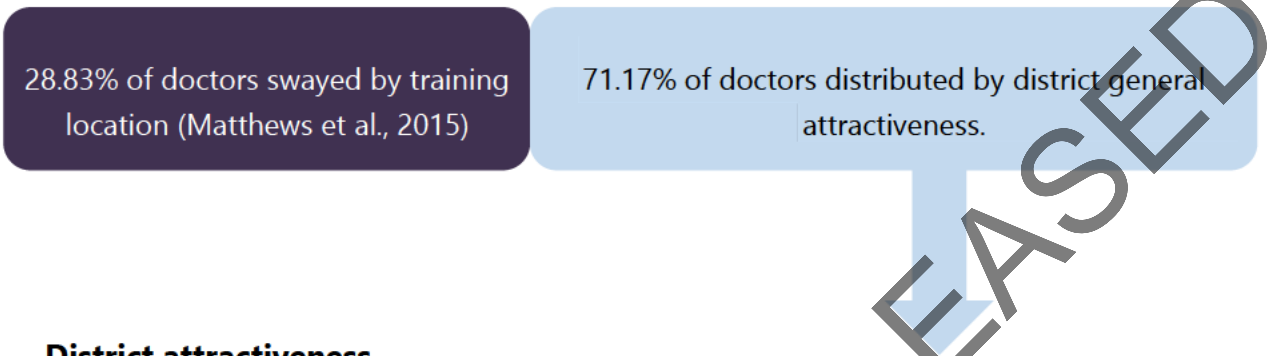
All doctor location modelling is undertaken at the district level with a simple rural/urban split of doctor locations. Our location modelling of additional doctors is based on four key variables that determine the attractiveness of establishing a clinic in any one area.

1) Propensity to practise rurally: the background of a student, as well as the number of years of clinical placement undertaken rurally, impacts the likelihood of graduates choosing to practise rurally (Kwan et al., 2017).
2) Where the doctor trained: where a doctor underwent clinical placements can impact where they choose to practice post-graduation (Matthews et al., 2015).
3) The general attractiveness of a location: represented by the forecast population of each district, in the previous yea
4) r.

5) The specific attractiveness of a location to doctors: represented by the moving average doctors' per capita ratio in the past five years.

Figure 21Figure 21 displays the overarching approach to distributing additional doctors produced under each option.

Figure 21: Additional doctor distribution model



District attractiveness

$$DHBAttractiveness_{i,t} = \frac{Population_{i,t-1}}{\sum_{j=1}^{n} Population_{j,t-1}} \times a + \frac{GPsperCapita_{i,t-1}}{\sum_{j=1}^{n} GPsperCapita_{j,t-1}} \times b$$

$$AdditionalGPs_{i,t} = \frac{DHBAttractiveness_{i,t}}{\sum_{j=1}^{n} DHBAttractiveness_{j,t}} \times \sum_{j=1}^{n} AdditionalGPs_{j,t}$$

where:

$a = 0.70$

$b = 0.30$

the development of 'a' and 'b' is described in more detail below.

Influence of training location

Each option proposes to train medical students in different parts of the country. This includes both the location of campuses, and clinical placements that students embark on. We incorporate the findings of a review into placement location choices post-graduation for participants of the Pūkawakawa programme (Matthews et al., 2015). This programme trains doctor in rural Northland currently, through the University of Auckland. This study found that 31 per cent of students chose to work in Northland post-graduation, with 93 per cent of those students stating their clinical placements occurring in that region as a driving force behind their decision. 93 per cent * 31 per cent = 29 per cent. We assume that this result is generalisable and allocate 29 per cent of the additional doctors according to this methodology. Each option will train doctors in several districts. As a proxy for training capacity, we use the current number of doctors in each district and distribute the additional doctors under this method proportionately.

s 9(2)(j)

We assume that under Option 1, the existing locations used for training continue to be used. Option 2 is assumed to utilise the same training locations as Option 1, with the notable exception of heavily urban district health boards,[23] due to the difficulties involved in finding rural placement locations within these areas. Note that Figure 22, Figure 23, and Figure 24 only refer to the clinical placement locations for the additional 120 students.

[23] District health boards considered 'heavily urban' include Capital and Coast, Auckland and Waitemata.

Figure 22: Clinical placement districts under the status quo and Option 1

Figure 23: Clinical placement districts under Option 2

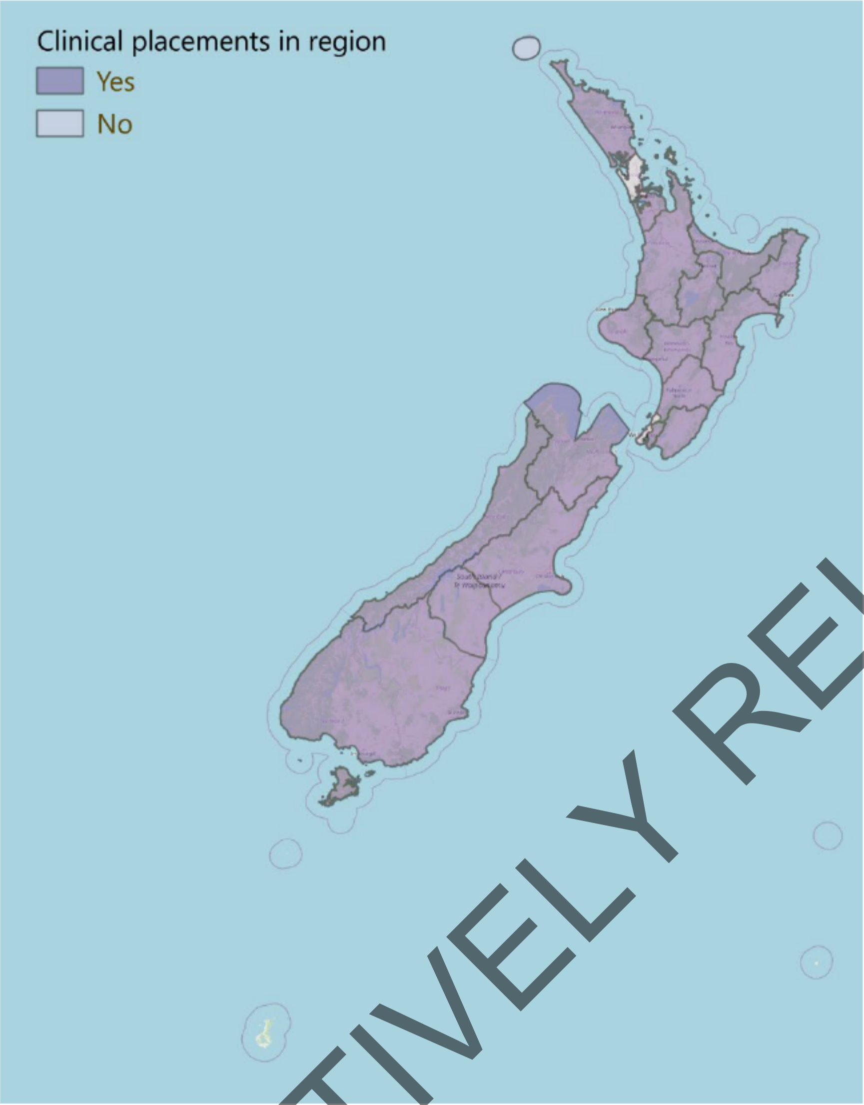


Figure 24: Clinical placement districts under Option 3

s 9(2)(f)(iv)

District attractiveness

Our attractiveness quotient is used to allocate the remaining 71 per cent of additional doctors and considers the relative population sizes of each district, and the number of doctors per capita in each district.

The attractiveness quotient is a simple average of the attractiveness values we find for the general attractiveness of a location, represented by population, and the specific attractiveness of a location, represented by the doctor per capita ratio.

General district attractiveness is assumed to have a 50 per cent overall weighting on the distribution of doctors (including training location). To achieve this, population has a 70 per cent weighting of district attractiveness, with the remaining 30 per cent coming from the doctor per capita ratio (21 per cent overall weighting).

There are two potential schools of thought on how the number of doctors per capita in a given area affects location choices of new entrants. On one hand, a low doctors per capita ratio in a given district represents an underserved market which is attractive to new entrants. Doctors establishing themselves in this market are likely to experience high demand for their services. In practice, this low doctors per capita ratio may result in large signing bonuses or higher salaries in an effort to attract staff.

On the other hand, high doctors per capita ratios may be a signal of successful business practices. Other work undertaken by members of this team has found that short-staffed practices struggle to attract additional staff, while those that are doing well receive many offers. Additionally, a high doctors per capita ratio may be indicative of a location being highly attractive to doctors, containing a lot of amenities that doctors find attractive.

Our base case assumptions are that these two effects offset each other to some extent, but that a higher doctors per capita ratio being attractive, rather than not attractive, dominates. 29 per cent of the attractiveness quotient is therefore driven by this value.

Propensity to practice rurally

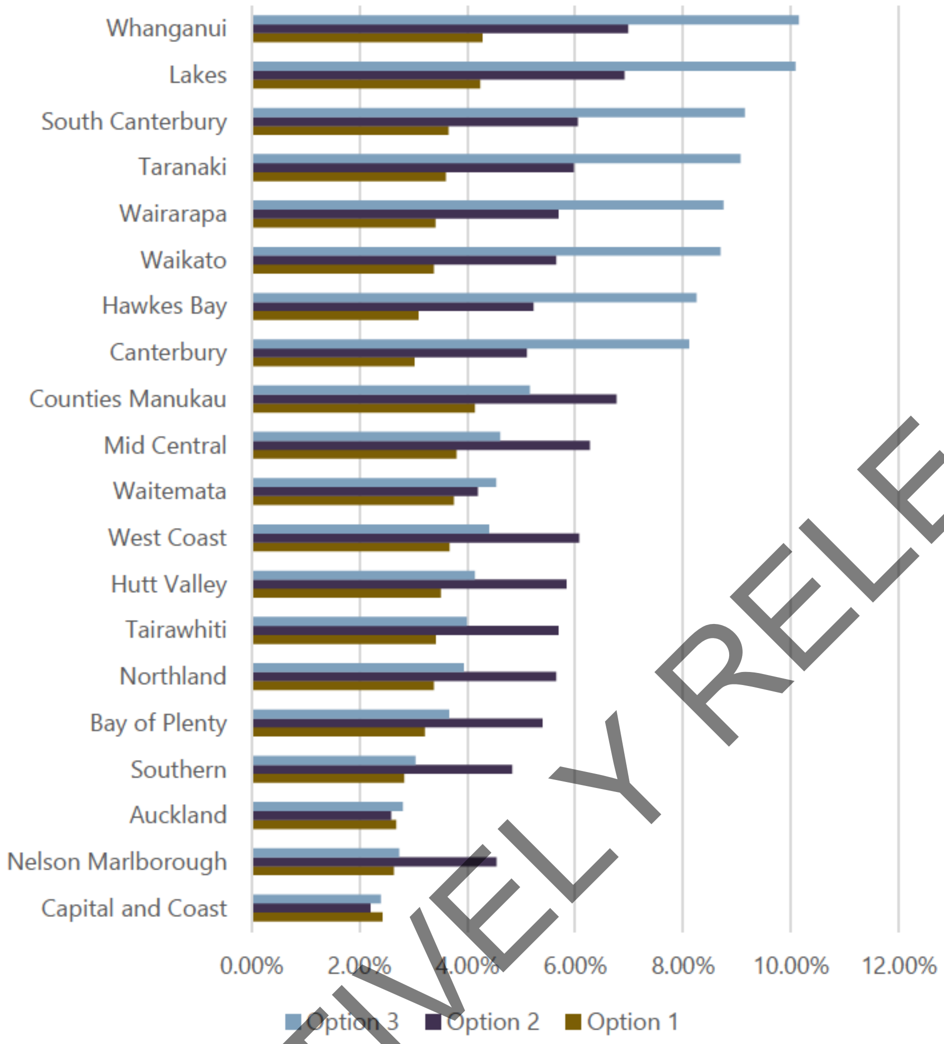
Once allocated at the district level, GPs are then allocated between rural and urban settings as discussed in section 3.

Distribution of additional doctors

The geographic distribution of additional doctors is different across the options. Focusing on the distribution of GPs, we conclude the following:

- The largest differences in GP growth rate between the options occurs where Option 3 has clinical placement locations: Wairarapa, Whanganui, Lakes, Hawkes Bay, and Waikato. Figure 25 compares which regions will have the highest growth rate in GPs under each of the options.
- Where Option 2 has clinical placement locations, but Option 3 does not, it tends to have the highest growth rates.

Figure 25: Average increase in GP coverage relative to the status quo, 2036-2073



Consistent with the investment objectives set by Cabinet, an aim is to increase the number of rural GPs. Having estimated the increase in the total number of GPs produced by the options, there are two key assumptions needed:

1. What is the rural/urban split?
2. Once a GP has chosen to practise in an urban or rural environment, where will they choose to practise?

Kwan et al. (2017) identified independent predictors of GPs to establish or work in rural practice. This study provides the basis for our estimate of rural GPs arising from each option.

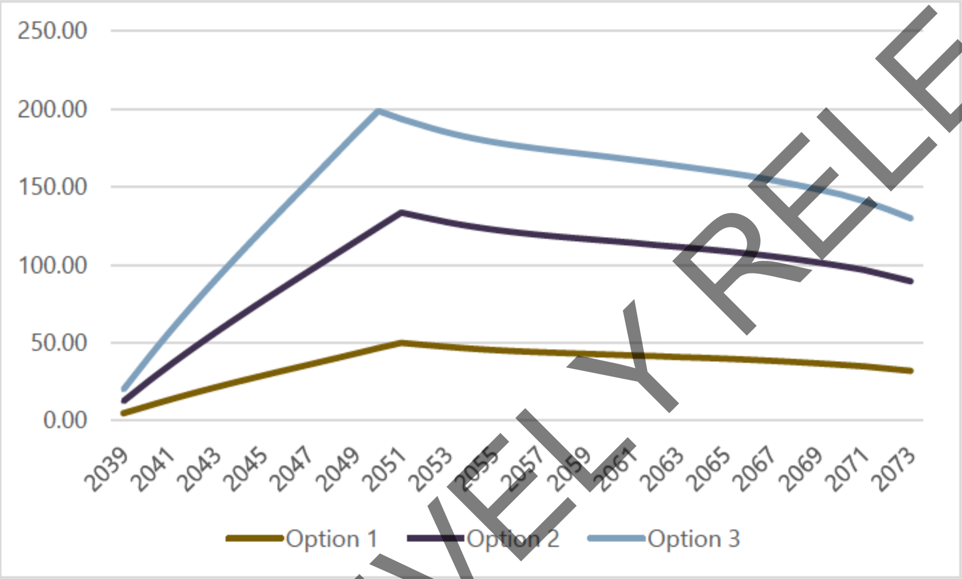
Predictor	Odds ratio
• Rural background	2.10
• Rural clinical school (one year)	2.85
• Rural clinical school (two years)	5.38

We convert these odds to a probability in the New Zealand context by factoring in the baseline probability a GP will establish or work in rural practice (0.199—based on an odds ratio of 0.166 from an estimate of 16.6 per cent of GPs in New Zealand currently operating or working in a rural practice (Bagg et al., 2023)).

For Option 2, we assume medical school students receive one year of rural clinical schooling, while for Option 3 we assume two years of rural clinical schooling. In both options, we assume 21 per cent of medical school students come from a rural background.

Following this approach, we estimate the number of additional rural GPs associated with each option, displayed in Figure 26.

Figure 26: Estimated additional GPs by rural-urban split under each option (2039–2073)



Appendix E Estimating health related quality of life and life expectancy impacts

Background: Healthcare professionals play a critical role in population health, yet comprehensive estimates of their impacts on population-level morbidity and life expectancy remain limited.

Objective: This analysis aims to quantify the effects of General Practitioners (GPs) and Senior Medical Doctors (SMOs) on HALE and life expectancy at birth across OECD countries.

Methods: Using panel data from 15 OECD countries between 2000 and 2021, we employ econometric techniques including Arellano-Bond estimation and Two-Way Fixed Effects models. Data from WHO and World Bank are analysed, focusing on countries with universal healthcare and 99 per cent + public health service coverage.

Results: The analysis reveals statistically significant health impacts: An additional GP per 10,000 population increases HALE by 18 days (0.049 years) and life expectancy by 21.5 days (0.058 years) per annum. An additional SMO per 10,000 population increases HALE by 16 days (0.043 years) and life expectancy by 13 days (0.036 years) per annum.

Neither HALE nor LE impacts for GPs and SMOs are statistically significantly different from each other.

Conclusion: Our analysis provides novel insights into the contributions of primary and specialised healthcare professionals, demonstrating their substantial and comparable impacts on population health outcomes.

High-level findings: GPs and SMOs increase life expectancy and quality of life

Our analysis shows that both GPs and SMOs have a statistically significant impact on reducing mortality and morbidity. Specifically, an additional GP per 10,000 population results in a 0.049-year (or 18-day) improvement in HALE and a 0.052-year (or 21.5-day) increase in life expectancy. Similarly, an additional SMO per 10,000 population increases HALE by 0.043 years (approximately 16 days) and life expectancy by 0.036 years (or 13 days). Notably, the impacts of GPs and SMOs are not statistically significantly different from each other. Our findings align with existing literature on the role of healthcare professionals in improving population health.

For clarity, we classify GPs and SMOs according to the latest version of the International Standard Classification of Occupations (ISCO-08). These are detailed in Box 4

Box 4: ISCO-08 classification of GPs and SMOs

GPs	SMOs
Generalist medical doctors (including family and primary care doctors) diagnose, treat and prevent illness, disease, injury, and other physical and mental	Specialist medical doctors diagnose, treat and prevent illness, disease, injury and other physical and mental impairments using specialized testing, diagnostic,

GPs	SMOs
impairments and maintain general health in humans through application of the principles and procedures of modern medicine. They plan, supervise and evaluate the implementation of care and treatment plans by other healthcare providers. They do not limit their practice to certain disease categories or methods of treatment, and may assume responsibility for the provision of continuing and comprehensive medical care to individuals, families and communities. Medical doctor (general), Medical officer (general), Physician (general), General practitioner, Family medical practitioner, Primary healthcare physician, District medical doctor, Resident medical officer specializing in general practice, Township medical officer, Station medical officer, Specialist in family medicine, Medical officer. Occupations included in this category require completion of a university-level degree in basic medical education plus postgraduate clinical training or equivalent. Medical interns who have completed their university education in basic medical education and are undertaking postgraduate clinical training are included here. Although in some countries 'general practice' and 'family medicine' may be considered as medical specializations, these occupations should always be classified here.	medical, surgical, physical and psychiatric techniques, through application of the principles and procedures of modern medicine. They plan, supervise and evaluate the implementation of care and treatment plans by other healthcare providers. They specialize in certain disease categories, types of patient or methods of treatment, and may conduct medical education and research activities in their chosen areas of specialization. Specialist physician (internal medicine), Surgeon, Anaesthetist, Cardiologist, Emergency medicine specialist, Ophthalmologist, Gynaecologist, Obstetrician, Paediatrician, Pathologist, Preventive medicine specialist, Psychiatrist, Radiologist, Resident medical officer in specialist training. Occupations included in this category require completion of a university-level degree in basic medical education plus postgraduate clinical training in a medical specialisation (except general practice) or equivalent. Resident medical officers training as specialist practitioners (except general practice) are included here. Although in some countries 'stomatology' may be considered as a medical specialization, stomatologists should be included under 'Dentists'-2261. Medical research professionals who participate in biomedical research using living organisms and do not undertake clinical practice should be excluded from here (classified under 'Life science professionals').

Motivation: the first study to estimate morbidity impacts of GPs and SMOs

The motivation for this work stems from gaps in the existing literature, which neither provide us with estimates of GP or SMO impacts on morbidity, nor of SMOs on life expectancy. Consequentially, we did not model either impact in our current CBA. To address this gap, we estimate these impacts ourselves, using publicly available panel data.

While mortality is a critical outcome, including morbidity—especially in the form of HRQoL—is essential for a more holistic understanding of healthcare impacts. This omission has important implications for policy and funding decisions, particularly in evaluating the value of GP and SMO services.

The challenge in estimating morbidity effects lies in the complex and dynamic nature of healthcare systems. This study thus focuses on estimating the impacts of GP and SMO care on HALE (a proxy for morbidity) and life expectancy (a proxy for mortality).

Methodology: using panel data and econometric models to estimate impacts

We use publicly available panel data from the WHO and the World Bank, covering country-level observations from 2000 to 2021. These datasets provided a broad and detailed basis for analysing the relationship between healthcare (e.g., GP and SMO per 10,000 population) and health outcomes (e.g., health-adjusted life expectancy, and life expectancy at birth). These data have been used in a similar peer-reviewed analysis that estimated the impacts of physicians on life expectancy (Roffia et al., 2023).

We select 15 OECD countries for the analysis as follows:

- We focus on OECD countries with universal health coverage and strong public provision for core health services (99 per cent+ coverage) (OECD, 2023) and sufficient data observations (≥12 years).
- The countries selected for this study are Australia, Austria, Belgium, Denmark, Spain, Finland, France, the United Kingdom, Iceland, Israel, Italy, Norway, New Zealand, Slovenia, and Sweden.
- The panel is unbalanced, with some countries missing data points for some time periods.

Our approach has a dual focus.

- First, we aim to provide quantitative estimates of morbidity impacts using HALE at birth, as provided by the WHO.
- Second, we address the absence of mortality-related impact estimates specific to SMO doctors by estimating their contributions to life expectancy at birth, also obtained from WHO data.

To ensure the rigour and reliability of our findings, we employ appropriate econometric panel methods designed to address key challenges in data:

- Dynamic Relationships: Acknowledging that healthcare impacts unfold over time, we incorporated lagged main explanatory variables to capture temporal effects.
- Reverse Causality: The study addressed potential reverse causality—where health outcomes might influence healthcare usage—by using lagged main dependent outcome variables.
- Omitted Variable Bias: To mitigate the influence of unobserved confounders, we included control variables capturing socioeconomic factors, healthcare system characteristics, and individual health outcomes related to health behaviours, while employing panel data methods to account for confounding effects.

Descriptive Statistics

Table 32 presents the mean values over time for our two outcome variables, the two main explanatory variables, and our covariates used in the analyses. The selected covariates have been used in related published peer-reviewed studies (Basu et al., 2019; Roffia et al., 2023) and are crucial for measuring HALE and LE, as they capture key determinants of health outcomes.

- **Private Health Expenditure (PrivateHealthExp)** can reflect access to quality healthcare and preventive services, influencing longevity and health (Basu et al., 2019; Roffia et al., 2023)

- **Obesity** is a critical risk factor for chronic diseases such as diabetes and cardiovascular conditions. Its prevalence is closely linked to lifestyle behaviours, including diet and physical activity (Basu et al., 2019)
- **Hospital Beds** serve as a proxy for healthcare infrastructure and capacity, which are critical for managing acute and chronic illnesses (Basu et al., 2019; Roffia et al., 2023).
- **Population Density (PopDensity)** influences healthcare access and disease transmission dynamics. Urban areas may offer better access to healthcare facilities but face challenges like higher transmission rates of infectious diseases, whereas rural areas often struggle with resource allocation (Basu et al., 2019, use the proportion of the population in non-urban areas).
- **Gross Domestic Product (GDP)** GDP is strongly linked to public health outcomes, as higher economic development typically supports more robust healthcare systems, better nutrition, and higher living standards. Countries with higher GDP per capita often allocate more resources to public health, improving overall population health.
- **Total Population (TotalPop)** helps to contextualise healthcare needs, affecting resource allocation. Larger populations necessitate extensive healthcare infrastructure and services to sustain public health (Basu et al., 2019; Roffia et al., 2023).

Table 33: Descriptive statistics of variables

Variable	Description	Mean (SD)	Source
Outcomes			
HALE	Health-adjusted life expectancy at birth	69.45 (1.21)	WHO (Global Health Observatory, GHO)
LE	Life expectancy at birth	80.6 (1.47)	WHO (GHO)
Main explanatory variables			
GPPer10k	The number of GPs per 10,000 population	10.28 (3.55)	WHO (GHO)
SMOsPer10k	The number of SMOs per 10,000 population	19.73 (4.67)	WHO (GHO)
Covariates			
PrivateHealthExp	Percentage of private in total healthcare expenditure	23.49 (5.62)	WHO (GHO)
Obesity	Prevalence of adult obesity	0.18 (0.05)	WHO (GHO)
HospitalBeds	The number of hospital beds per 10,000 population	43.63 (16.37)	WHO (GHO)

Variable	Description	Mean (SD)	Source
PopDensity	The number of people per square kilometre	120.55 (119.6)	World Bank
GDP	The log of Real GDP per capita	10.55 (0.4)	World Bank
TotalPop	The log of Total Population	16.09 (1.4)	World Bank

Figure 27 presents the correlation matrix of our outcomes, main explanatory variables and controls and considered control variables. We note that health expenditure is not included in the main analysis due its perfect correlation with GDP.

Figure 27: Correlation matrix of outcome, main explanatory and control variables

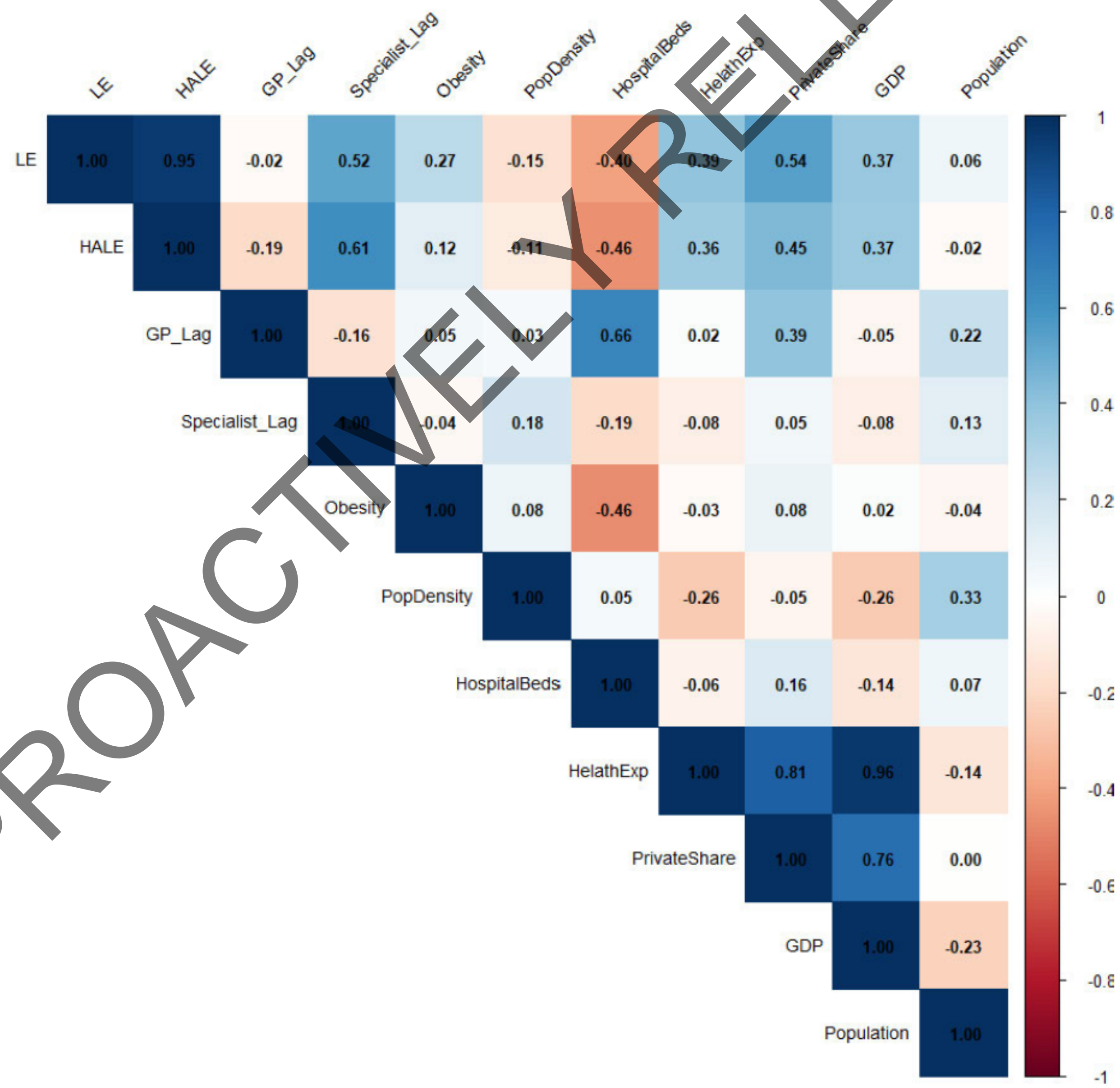
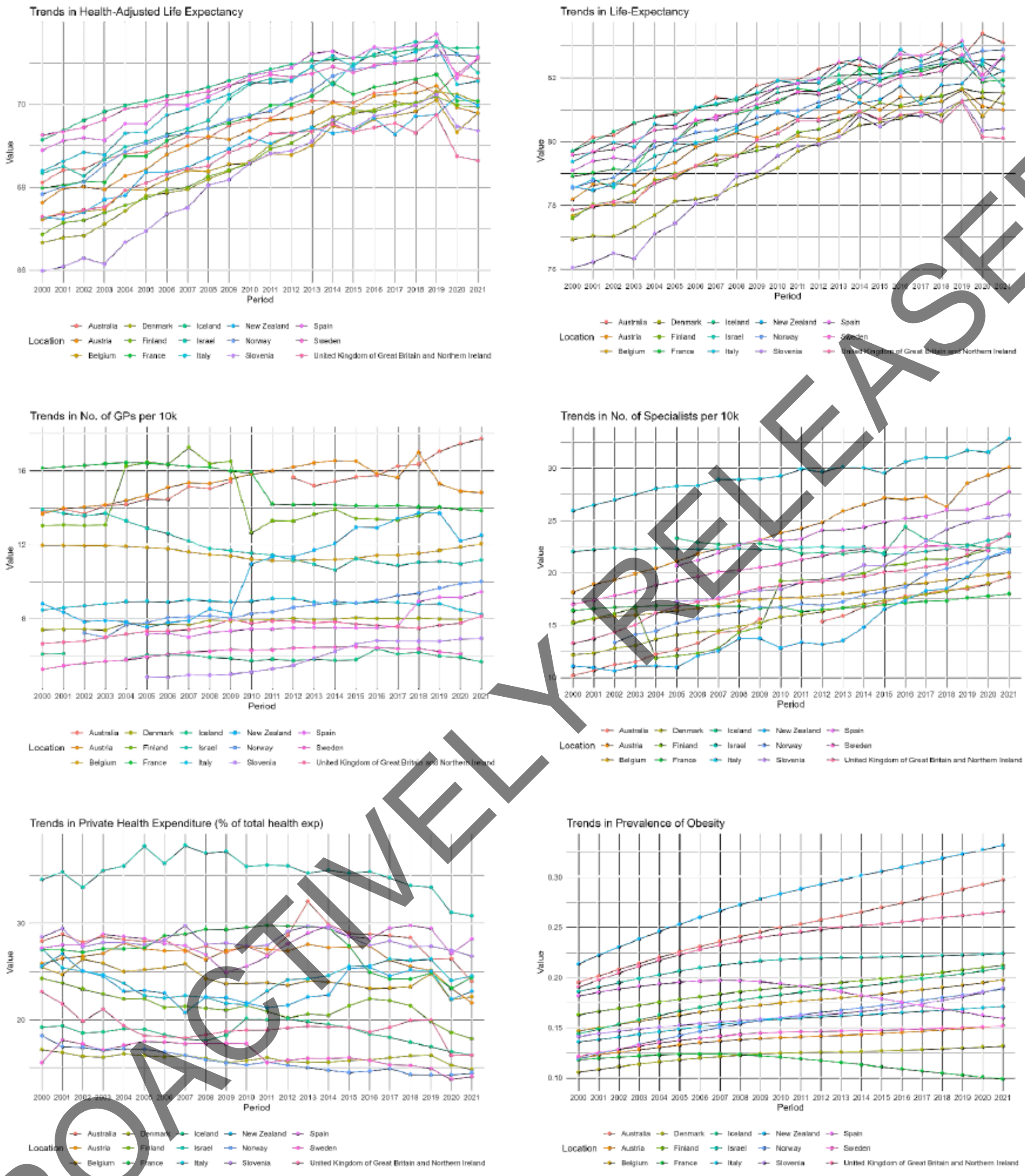
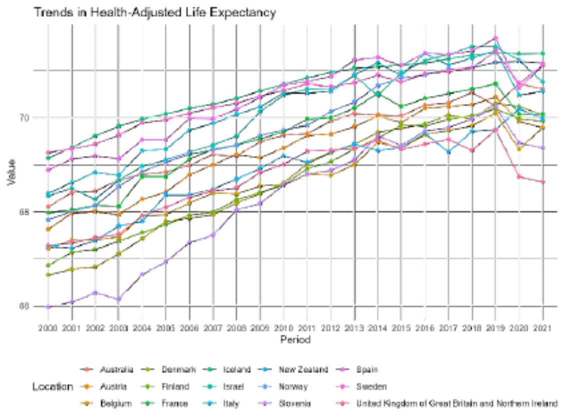


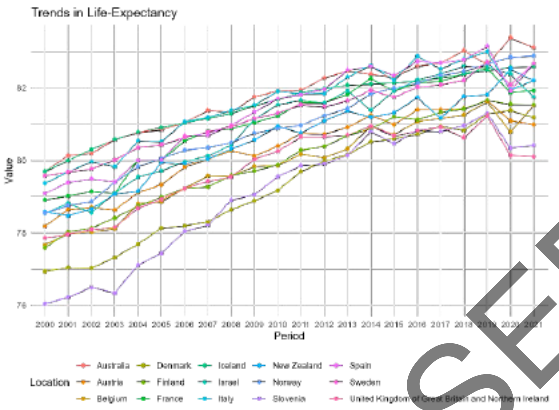
Figure 28 shows how each of the listed variables evolves over time by country.

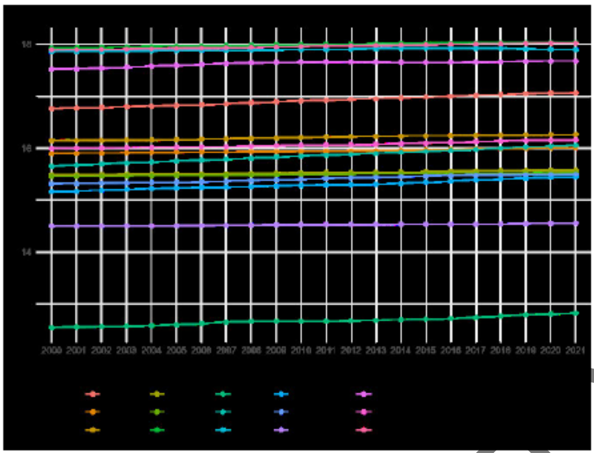
- **HALE and LE:** Life expectancy has generally been increasing over time. The upward trend in HALE shows that people are also living healthier longer, but there was a significant drop-off in 2020 during the peak of the global COVID-19 pandemic.
- **GP and SMO density:** GP density has generally been slowly increasing over time. However, New Zealand, Austria and Iceland have seen periods of sudden and significant outflows of GPs, while Finland saw a spike in accessible GPs between 2004 and 2009.
- **Healthcare:** The share in healthcare expenditure that is private has largely remained unchanged since 2010, although some countries such as Iceland, Australia, Finland, Denmark, Sweden and Norway have seen decreases in the past ten years, suggesting a shift away from the demand for private healthcare towards public healthcare in these countries. However, the number of hospital beds per 10,000 people has been consistently decreasing in all sampled countries.
- **Health outcomes:** Obesity has consistently been trending upwards for most countries, except in Spain and France where it has been consistently decreasing since 2006–2007.
- **Population:** The trends in the log of population shows that there has been low relative growth in population for most countries in the sample, except for marginal growth rates in Australia, New Zealand, France and Israel. Israel is the only country that has seen a substantial growth in population density in the past 20 years.
- **GDP:** Trends in the log of GDP per capita shows accelerated GDP growth over the past 20 years, only being hindered by a brief period of economic contraction during the peak of the COVID-19 pandemic in 2020.

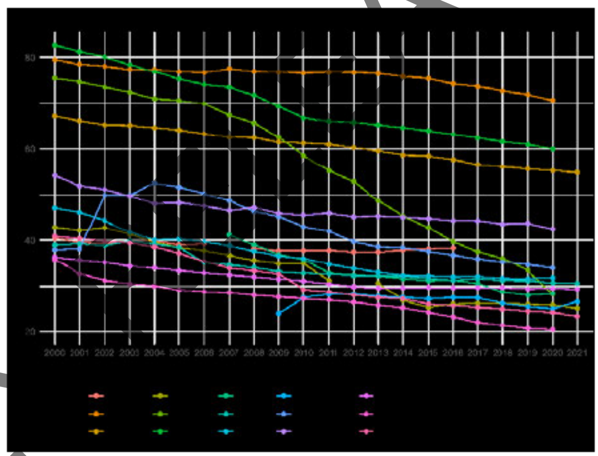
Figure 28: Variation of variables over time by country

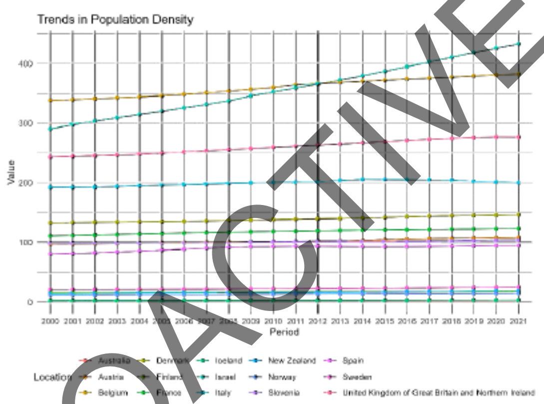


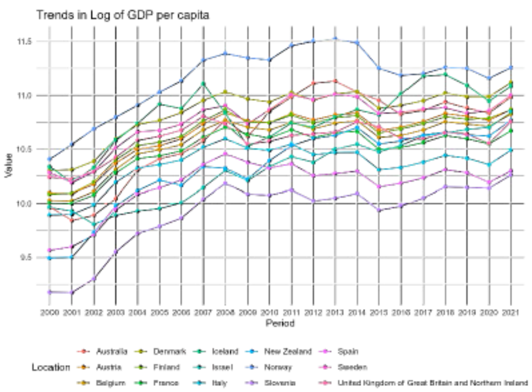












Econometric models: Arellano-Bond dynamic panel and two-way fixed effects

We employ two econometric panel-data approaches to investigate the relationships between the number of GPs per 10,000 population, SMOs per 10,000 population, and HALE and LE.

(1) Arellano-Bond dynamic panel models

This approach captures dynamic effects and provides robust estimates of the relationships between healthcare measures and health outcomes. This is a standard approach in the literature to address reverse-causality in an outcome variable with an explanatory variable (Leszczensky and Wolbring, 2022). To address potential confounding in our primary explanatory variables—GPs per 10,000 and SMOs per 10,000—we first-difference the equation to eliminate time-invariant confounders. Internal instruments, specifically the second to fifth lagged values of these variables, are then employed to estimate the relationships.

This approach mitigates error correlation in the first-lagged variable and aligns with the standard Arellano-Bond estimation framework. Additionally, we incorporate a comprehensive set of covariates and determinants to account for other factors influencing life expectancy and HALE. The estimation is detailed in equation (1).

$$\begin{aligned}(1)\ y_{it} = \beta_1 GPPer10k_{i,t-1} + SpecialistsPer10k_{i,t-1} + PopDensity_{it} + \beta_4 \log(GDP_{it}) \\ + \beta_5 PrivateHealthExp_{i,t-1} + \beta_6 \log(TotalPop_{it}) + \beta_7 Obesity_{i,t-1} \\ + \beta_8 HospitalBeds_{it} + \beta_9 \mathrm{Year_t} + u_{it}\end{aligned}$$

- $y_{it} = HALE_{it}$ (Regression 1), $y_{it} = LE_{it}$ (Regression 2)
- u_{it} is a composite error term
- standard errors are robust and clustered on the country-level
- β_9 $\mathrm{Year_t}$ allows us to control for linear effects
- Following standard practice, we use first-differencing to account for unobserved heterogeneity

We note that our model includes controls for linear year effects rather than year fixed effects. Incorporating year fixed effects is not feasible with the current sample, as it would overidentify the equations and result in a singular matrix, rendering estimation unreliable.

We assess serial correlation using AR(1) and AR(2) tests and instrument exogeneity with the Sargan test. Sargan test points towards valid and strong instruments.

Pre-empting findings: A note on the model relevance for the analysis

We assess first- and second-order serial correlation using AR(1) and AR(2) tests. We find that neither first- nor second-order serial correlation is present. The absence of AR(1) in both estimations indicates that there is no statistically significant correlation between the value of a variable (or residual) at time t and its value at time t−1. In other words, the residuals or variable values are independent across adjacent time periods, suggesting that the Arellano-Bond approach, which involves instrumenting t−1 with t−2 and further lags, may not be necessary. The absence of AR(2) further suggests that the model's instruments (e.g., t−2 and lagged values) are valid and exogenous, as the residuals are not correlated at the second lag. As such, our model is correctly specified, ensuring the reliability of the estimation, and reinforcing the appropriateness of the approach.

We further note that the AB estimator with first-differencing induces variance, resulting in less price estimation results; this is for example notable in the increased standard errors of the estimation with comparable size as the estimated coefficients (see Table 33).

We therefore explore "Two-way fixed effects" as the alternative model and preferred estimation model. Fixed effects are supported by the AR(1) and AR(2) findings, particularly: When the AR(1) term is not significant, it implies that the panel data's temporal dependency is minimal or adequately controlled through other specifications, such as fixed effects. Another concern of so-called Nickel-Bias of fixed effects in dynamic panel data is not relevant in the context of our analysis, as Nickel-Bias commonly only appears with shorter panels, i.e. less or equal to six observations per unit.

(2) Two-way fixed effects

The two-way fixed effects (TWFE) model controls for both unobservable time-invariant factors and time-specific effects. Time-invariant factors, such as geography or institutional characteristics, are accounted for by focusing on within-unit variations over time (e.g., within a specific country). This helps isolate the effect of explanatory variables, like GP and SMO per 10,000, by removing potential confounding from unobserved, stable factors that vary across units but not over time.

Additionally, the model controls for time-specific effects, such as global shocks, pandemics, political change or technological advances, by including time- fixed effects, ensuring that any common trends across all units do not bias the results.

By controlling for these factors, the two-way fixed effects model reduces potential biases from omitted variables, providing more accurate estimates of the relationship between variables. This approach is particularly useful when examining changes over time, as it focuses on how changes within a unit, rather than differences across units, affect outcomes. It is especially valuable when studying effects like changes in health predictors on outcomes like life expectancy, where unobservable differences between units might otherwise distort the analysis.

We estimate the following two way-fixed effect specification:

$$
\begin{aligned}
(2)\boldsymbol{y_{it}} = \boldsymbol{\beta_1 GPPer10k_{i,t-1}} + \boldsymbol{SpecialistsPer10k_{i,t-1}} + \boldsymbol{PopDensity_{it}} + \boldsymbol{\beta_4}\log(\boldsymbol{GDP_{it}}) \\
+ \boldsymbol{\beta_5 PrivateHealthExp_{i,t-1}} + \boldsymbol{\beta_6}\log(\boldsymbol{TotalPop_{it}}) + \boldsymbol{\beta_7 Obesity_{i,t-1}} \\
+ \boldsymbol{\beta_8 HospitalBeds_{it}} + \boldsymbol{\alpha_i} + \boldsymbol{\lambda_t} + \boldsymbol{u_{it}}
\end{aligned}
$$

- $y_{it} = HALE_{it}$ (Regression 1), $y_{it} = LE_{it}$ (Regression 2),
- α_i denotes country-specific fixed effects (location effects)
- λ_t denotes year-specific fixed effects (time effects)
- u_{it} is the idiosyncratic error term
- standard errors are robust and clustered on the country-level

Findings: there are strong and significant impacts of GPs and SMOs on health

The findings of the analysis are presented across two key dimensions:

Arellano-Bond Results

GPs per 10,000 population and SMOs per 10,000 population do not show a statistically significant association with either HALE or LE. None of the covariates are statistically significant. It is important to note that the standard errors are large relative to the coefficient effect sizes, suggesting that the estimates are dispersed and exhibit considerable variability. The non-significant AR(1) with a p-value greater than 0.05 indicates no residual autocorrelation between t and t-1. The implications of these findings are discussed in the section above. The dispersion of the data suggests that the Arellano-

Bond estimator is inefficient, introducing increased variation due to the use of first differencing and instrumenting. However, the instruments remain valid (exogenous), as confirmed by the Sargan test, which yielded a p-value greater than 0.05.

Table 34: Estimation results Arellano-Bond: Health-adjusted life expectancy and life expectancy

Arellano-Bond Estimation Results		
	(1) Health-adjusted life expectancy	**(2) Life expectancy**
GPPer10k, t-1	0.39 (0.426)	0.476 (0.58)
SMOsPer10k, t-1	0.255 (0.416)	0.333 (0.649)
PopDensity	0.004 (0.04)	0.006 (0.063)
GDP	1.318 (1.06)	1.543 (1.336)
PrivateHealthExp, t-1	0.041 (0.043)	0.037 (0.072)
TotalPop	11.781 (11.413)	13.822 (16.527)
Obesity, t-1	-27.18 (44.559)	-26.002 (56.268)
HospitalBeds	-0.036 (0.027)	-0.033 (0.043)
Year	-0.094 (0.136)	-0.119 (0.207)
Observations	*254*	*254*
Test: First order serial correlation	*AR(1): -0.283, p = 0.777*	*AR(1): -0.575, p = 0.565*
Test: Second order serial correlation	*AR(2): 1.518, p = 0.129*	*AR(2): 1.312, p = 0.189*
Test: Instrument exogeneity	*Sargan test: 9.256, p = 0.508*	*Sargan test: 9.436, p = 0.491*
Note:	**p<0.1; **p<0.05; ***p<0.01; Robust clustered standard errors on the country-level in parenthesis*	

Two-way fixed effects results

Using our preferred model of two-way fixed effects, we find strong and statistically significant positive associations between the number of GPs and SMOs per 10,000 population with both HALE and LE. Specifically, an additional GP (or SMO) per 10,000 population increases HALE by 0.049 (0.043) and LE by 0.059 (0.036). F-tests, testing whether the coefficient estimates for GPs and SMOs per 10,000 population on HALE and LE are statistically different, lead us to reject the null hypothesis of no statistical difference. Among the statistically significant covariates in both the HALE and LE estimations are population density, which shows a positive association; obesity, which has a strong negative effect; and hospital beds per 10,000 population, which also exhibits a negative relationship.

Notably, the fixed effect estimates are more precise, more efficient, and less variable than the Arellano-Bond estimates, as evidenced by the significantly lower standard errors relative to the estimated coefficients.

Table 35: Estimation results two-way fixed effects: Health-adjusted life expectancy and life expectancy

Two-way fixed effects estimation		
	(1) Health-adjusted life expectancy	(2) Life expectancy
GPPer10k, t-1	0.049** (0.024)	0.059** (0.028)
SMOsPer10k, t-1	0.043*** (0.015)	0.036** (0.017)
PopDensity	0.011*** (0.002)	0.009*** (0.003)
GDP	0.105 (0.177)	-0.264 (0.203)
PrivateHealthExp, t-1	0.013 (0.013)	0.019 (0.015)
TotalPop	-0.867 (0.924)	0.653 (1.062)
Obesity, t-1	-4.058* (2.303)	-6.266** (2.646)
HospitalBeds	-0.030*** (0.005)	-0.025*** (0.006)
Country Fixed-Effects	*YES*	*YES*
Year Fixed Effects	*YES*	*YES*
Observations	*272*	*272*
Akaike Information Criterion (AIC)	*-135.0.54*	*-43.346*
Bayesian Information Criterion (BIC)	*-104.661*	*-12.954*

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$; *Robust clustered standard errors on the country-level in parenthesis*
F-tests point to no statistically significant different impact of GP and SMOs in either estimation.

Assessing robustness

We further test the robustness of our results by:

- removing the dynamic assumptions, i.e. estimating the model without lags
- incorporating deeper lags of GP and SMO variables (t-2) and (t-4)
- accounting for time-variant factors such as:
  - labour market effects by including unemployment rates (World Bank data),
  - the per capita alcohol consumption over 15+ in litres of pure alcohol (WHO data) to address health consumption behaviours.

    Note: we do not control for smoking due to significant missing data points in WHO collected data; however, alcohol consumption is a proxy for health consumption behaviours. Using health expenditures instead of GDP per capita.

Our findings remain robust across these tests (i.e. the magnitudes of the estimated coefficients in the models are neither statistically significantly different from the magnitudes estimated in our preferred Fixed Effects Model nor are coefficient magnitudes between GPs and SMOs statistically significantly different from each other). The results of these robustness checks are presented in the table below.

Table 36: Further estimations to assess the robustness of our findings

	No Dynamics		GP and SMO: T-2		GP and SMO: T-4		Control for: Health Expenditures		Control for: Unemployment		Control for: Alcohol consumption	
	HALE	**LE**	**HALE**	**LE**	**HALE**	**LE**	**HALE**	**LE**	**HALE**	**LE**	**HALE**	**LE**
GP per 10,000	0.049** (0.025)	0.062** (0.028)	0.048* (0.024)	0.051* (0.028)	0.03 (0.026)	0.021 (0.03)	0.053** (0.024)	0.061** (0.028)	0.05** (0.024)	0.06** (0.029)	0.063*** (0.023)	0.076*** (0.027)
SMO per 10,000	0.045*** (0.014)	0.036** (0.017)	0.037** (0.015)	0.035** (0.018)	0.03* (0.016)	0.034* (0.019)	0.046*** (0.015)	0.041** (0.017)	0.041*** (0.015)	0.034** (0.017)	0.039*** (0.014)	0.034** (0.016)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	284	284	259	259	231	231	272	272	272	272	266	266
Akaike Information Criterion (AIC)	-114.151	-24.607	-157.394	-61.243	-215.492	-115.35	-142.353	-53.794	-138.674	-49.932	-191.059	-101.512
Bayesian Information	-83.758	5.786	-127.002	-30.851	-185.1	-84.957	-111.96	-23.402	-104.482	-15.741	-156.867	-67.32

Note: * p<0.1; ** p<0.05; *** p<0.01; ***Robust clustered standard errors on the country-level in parenthesis***

Limitations of our research

We discuss the limitations and our approaches to addressing them in Table 36.

Table 37: Limitations and considerations of our research

Limitation(s)	Consideration(s)
Health systems: *Differences in healthcare systems between countries*	• We account for this by limiting our sample to 15 countries – all of which have a universal healthcare system. • We control for unit- and time-fixed effects accounting for heterogeneities and temporal changes between countries.

GP numbers: *GP numbers in WHO data (6,388, NZ – 2021) are different from Emmanuel Jo's workforce modelling numbers (3,833, NZ – 2021)*	• We acknowledge this; however, if we assume GP numbers are in fact lower, the magnitude of GPs' effect would likely increase
	• Our approach is a conservative approach to estimate the effect of GPs.
	• We further acknowledge that the disparity in WHO-provided and Health NZ-provided numbers could create uncertainty on the validity of WHO-provided parameters (particularly GP counts in other countries). If similar discrepancies exist in the reported GP counts for other countries, the estimated marginal effects may be distorted:
	  ◦ If GP numbers in all countries were overestimated (as in the case of NZ), then the magnitude of GPs' effect would increase significantly.
	  ◦ If GP numbers in all other countries were underestimated, then we would expect the magnitude of GPs' effect to decrease.
	• We find that GP numbers are consistent with local statistics of countries in the EU (Eurostat), while GP counts are overestimated in WHO-provided data relative to local data sources in Australia (Australian Bureau of Statistics) and New Zealand. We were unable to confirm WHO-provided figures with local data sources in Iceland and Israel. We understand that common definitions of healthcare personnel have been agreed between Eurostat, the OECD and the WHO.
	• Furthermore, the primary driver of the estimated coefficients is the correlation between GPs and life expectancy and their changes over time. The absolute number of GPs is less relevant.
	• Since our analysis uses country-level fixed effects, we are demeaning the effects and consider only changes relative to the demeaned estimate. Therefore, using WHO estimates for New Zealand may not be a significant concern so long as the trend over time is captured, even if the count is overestimated.

Limitation(s)	Consideration(s)
Hospital effects: *There is an unintuitive significant negative coefficient for hospital beds on life expectancy*	This could point to: reverse causality, measurement issues, multi-collinearity, etc. • We test a number of model specifications (lags, squared effects, assess multi-collinearity) and find that this effect persists and no multi-collinearity is present. Two studies also have a similar finding: Roffia et al. (2023) and Basu et al. (2019)
Confounding: *Time-variant unobserved heterogeneity*	**Our findings are robust to including further time-variant covariates, furthermore: Our findings of GP and SMO estimates align with published studies, providing a degree of confidence in the results:** • Basu et al. (2019) estimate mortality impact of GPs and SMOs in the USA, finding, like us, marginally higher GP impacts compared to SMO impacts on mortality o *Our estimates show that GPs have a 1.64 times higher magnitude in their impact on life expectancy compared to SMO doctors, which is similar to the study by Basu et al. (2019) who find that the GP impact on life expectancy is 1.61 times higher compared to SMO.* • Roffia et al. (2023) estimate physician effects on life expectancy where physicians are pooled medical doctors including both SMOs and general medical practitioners; findings lie between the range of our SMO and GP coefficient magnitudes. o *Roffia et al. (2023) estimate that the impact of physicians per 10,000 population is 0.049 on life expectancy. This value is about the midpoint of our GP per 10,000 and SMO per 10,000 coefficients (0.059+0.036)/2 = 0.048.* • GP-coefficient magnitude in LE-estimation similar to Baker et al. (2024), whose findings were used in our CBA to calculate amenable mortality effects o *We estimate a coefficient of 0.059 with a 95%-Confidence Interval [0.003-0.114] across the populations. The study by Baker et al. (2024) estimated a coefficient of 0.057 with a 95%-Confidence interval [0.37-0.77] for male life expectancy and 0.050 with a 95%-Confidence Interval [0.31-0.70] for female life expectancy per 10.000 population.*

Further discussion of our approach

We conducted our analysis using country fixed effects and lagged explanatory variables to address issues related to omitted variable bias and reverse causality in the relationship between life expectancy, health-adjusted life expectancy, and the number of general practitioners and SMOs per 10,000 population.

Fixed effects allow us to account for time-invariant confounders—factors that remain constant over time, such as systemic culture or efficiency. This partially addresses omitted variable bias, which arises from unmeasured characteristics that influence LE and HALE and are associated with the density of GPs and SMOs. Additionally, we incorporated a set of potential time-variant confounders—factors that change over time—such as technological advancements or health shocks (e.g., global pandemics). We also included year fixed effects to account for these temporal changes. However, we acknowledge that other time-variant confounders, such as smoking behaviours, may exist. While we lacked sufficient data on some variables, our sensitivity analyses incorporating additional behavioural and other determinants of LE and HALE suggest that our results are robust, increasing our confidence in their validity.

The use of lagged explanatory variables addresses reverse causality, ensuring the strict exogeneity of the relationship between GPs and SMOs per 10,000 population and the outcomes (LE and HALE). Strict exogeneity requires that the estimation error of LE and HALE is uncorrelated with the explanatory variables. By incorporating lags, we mitigate this concern. However, this approach assumes unobserved variables are not serially correlated. Although this assumption cannot be directly tested, evidence from our analysis supports it. Specifically, Arellano-Bond specification tests indicate no first-order (t-1) or second-order (t-2) serial correlation in the regression errors, further validating our estimation approach.

References used

Baker R, Levene LS, Newby C, Freeman GK. (2024). Does shortage of GPs matter? A cross-sectional study of practice population life expectancy. Br J Gen Pract. 74(742):e283–e289. doi: 10.3399/BJGP.2023.0195. PMID: 38621806; PMCID: PMC11044019.

Basu S, Berkowitz SA, Phillips RL, Bitton A, Landon BE, Phillips RS. (2019). Association of primary care physician supply with population mortality in the United States, 2005–2015. JAMA Intern Med. 179(4):506–514. doi: 10.1001/jamainternmed.2018.7624. PMID: 30776056; PMCID: PMC6450307.

Leszczensky L, Wolbring T. (2022). How to deal with reverse causality using panel data? Recommendations for researchers based on a simulation study. Sociological Methods & Research. 51(2) 837–865 https://doi.org/10.1177/0049124119882473

OECD. (2023). Health at a Glance 2023: OECD Indicators. OECD Publishing, Paris, https://doi.org/10.1787/7a7afb35-en.

Roffia P, Bucciol A, Hashlamoun S. Determinants of life expectancy at birth: a longitudinal study on OECD countries. (2023). Int J Health Econ Manag. 23(2):189–212. doi: 10.1007/s10754-022-09338-5. Epub 2022 Nov 11. PMID: 36367604; PMCID: PMC9650666.

Additional material

We present a series of figures below illustrating the unadjusted relationships between life expectancy (LE) and health-adjusted life expectancy (HALE) with the number of GPs and SMOs per 10,000 population. Additionally, we include partial regression plots depicting the residuals of these variables, which control for the influence of other factors, thereby revealing the adjusted relationships. Above all, the graphs reveal that neither misspecification nor outliers are driving the results.

Figure 29: Unadjusted SMOs per 10,000 by life expectancy

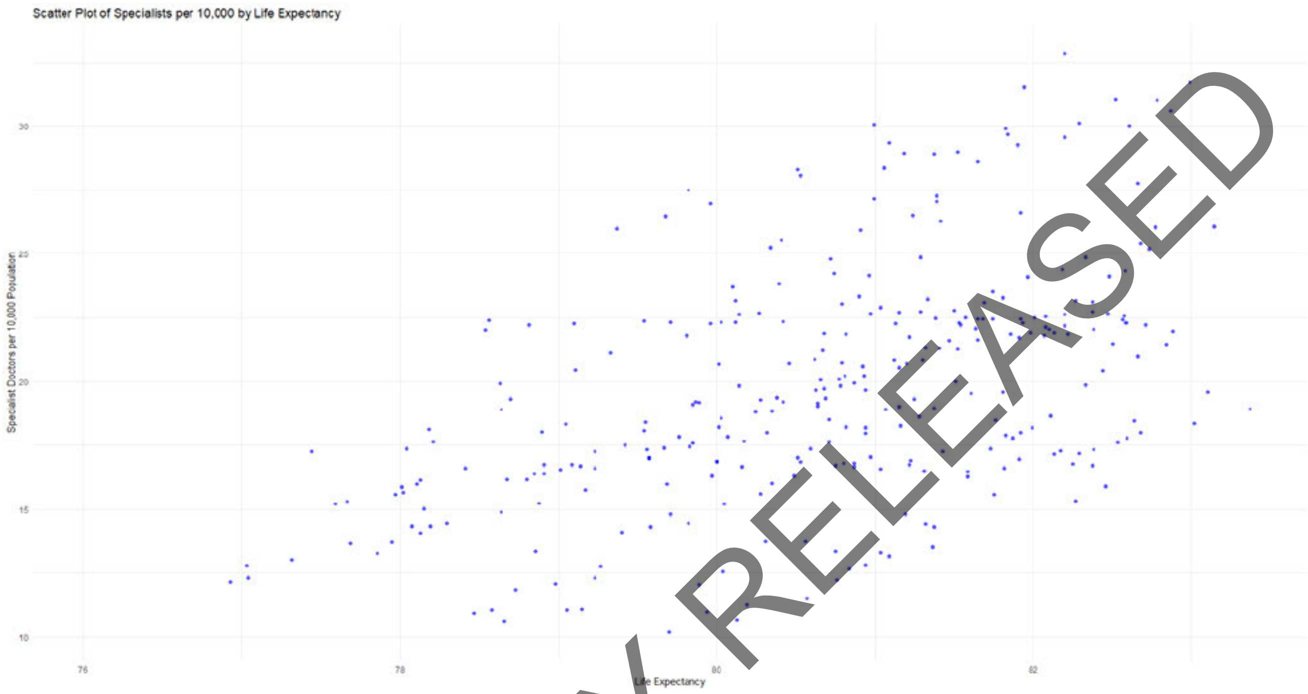


Figure 30: Unadjusted GPs per 10,000 by life expectancy

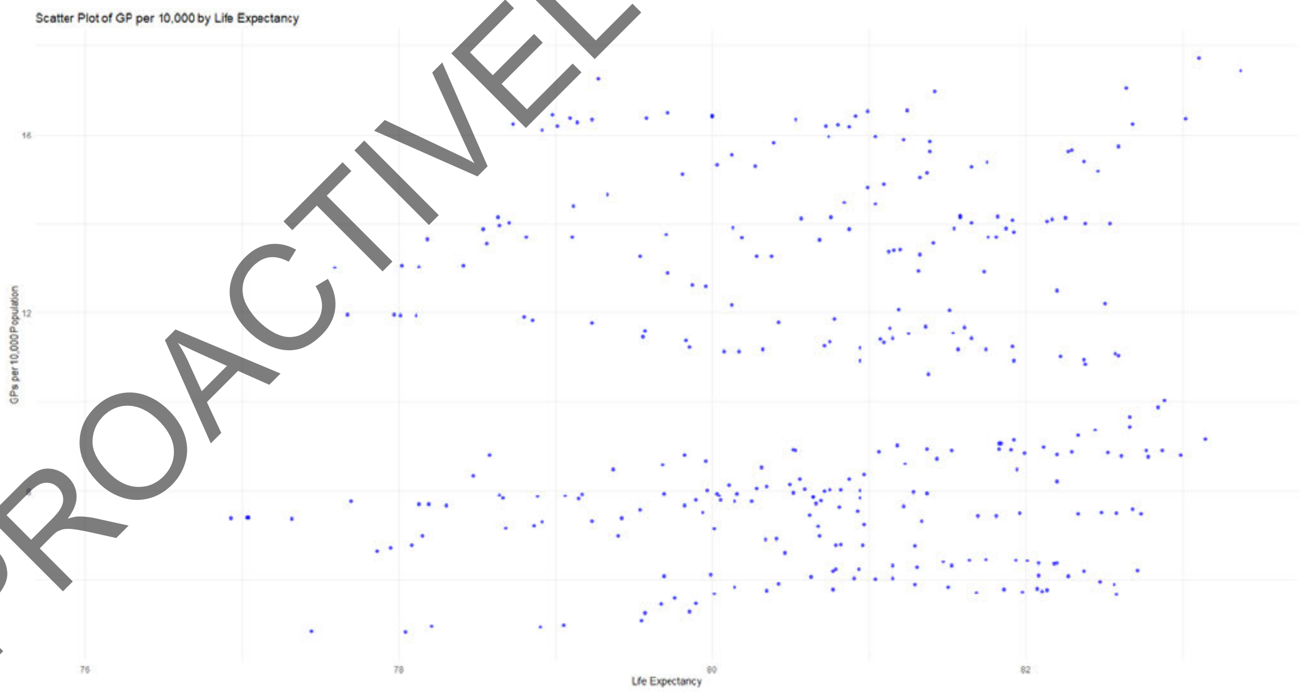


Figure 31: Unadjusted SMOs per 10,000 by health-adjusted life expectancy

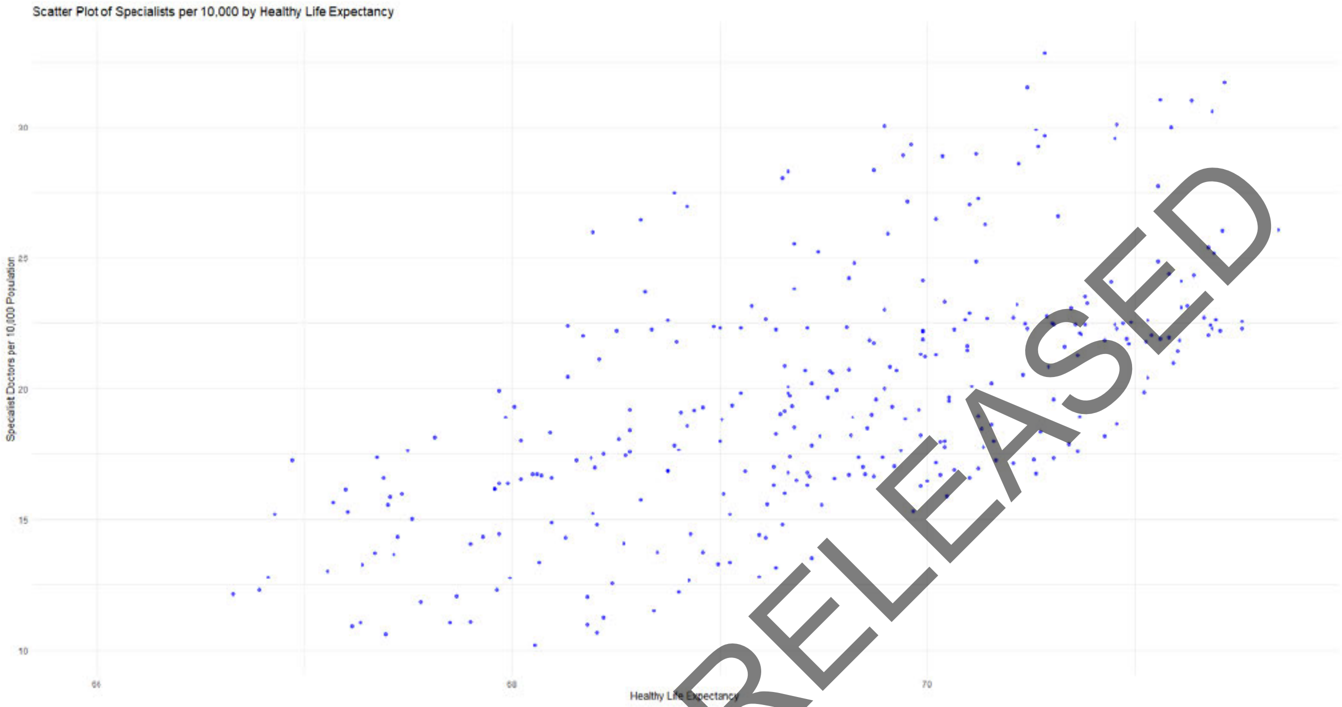


Figure 32: Unadjusted GPs per 10,000 by health-adjusted life expectancy

Figure 33: Adjusted: SMOs per 10,000 by life expectancy

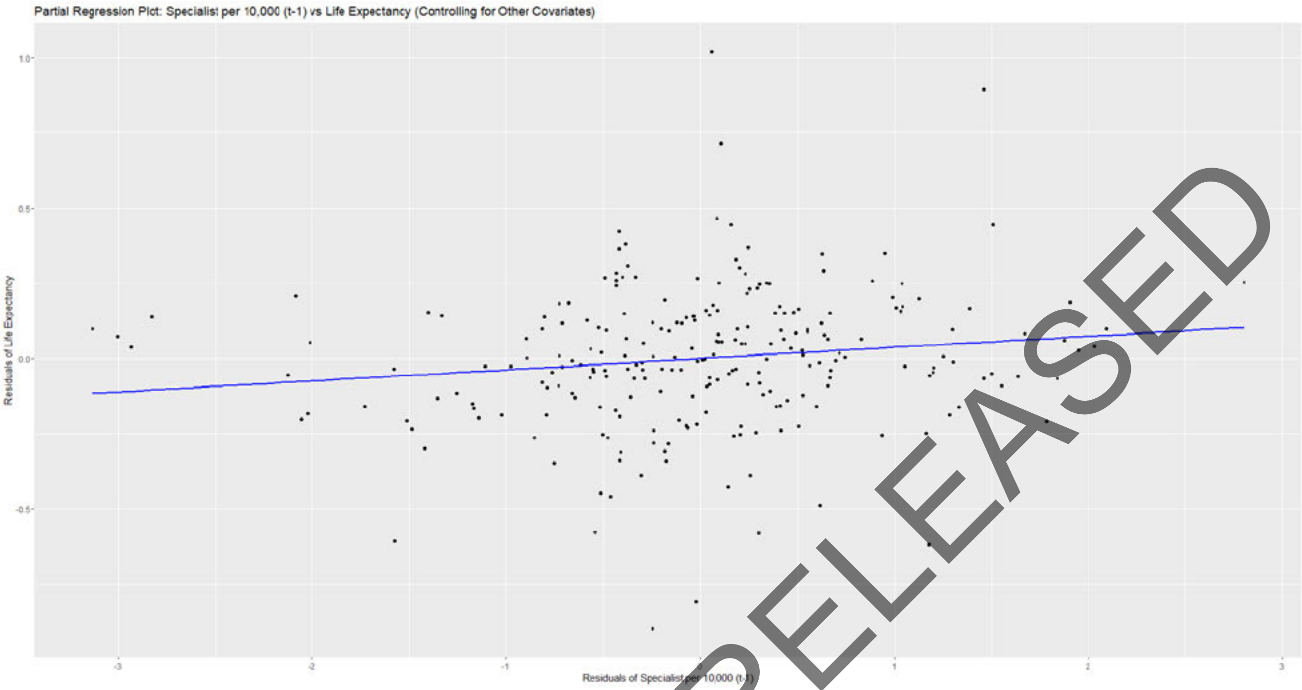


Figure 34: Adjusted GPs per 10,000 by life expectancy

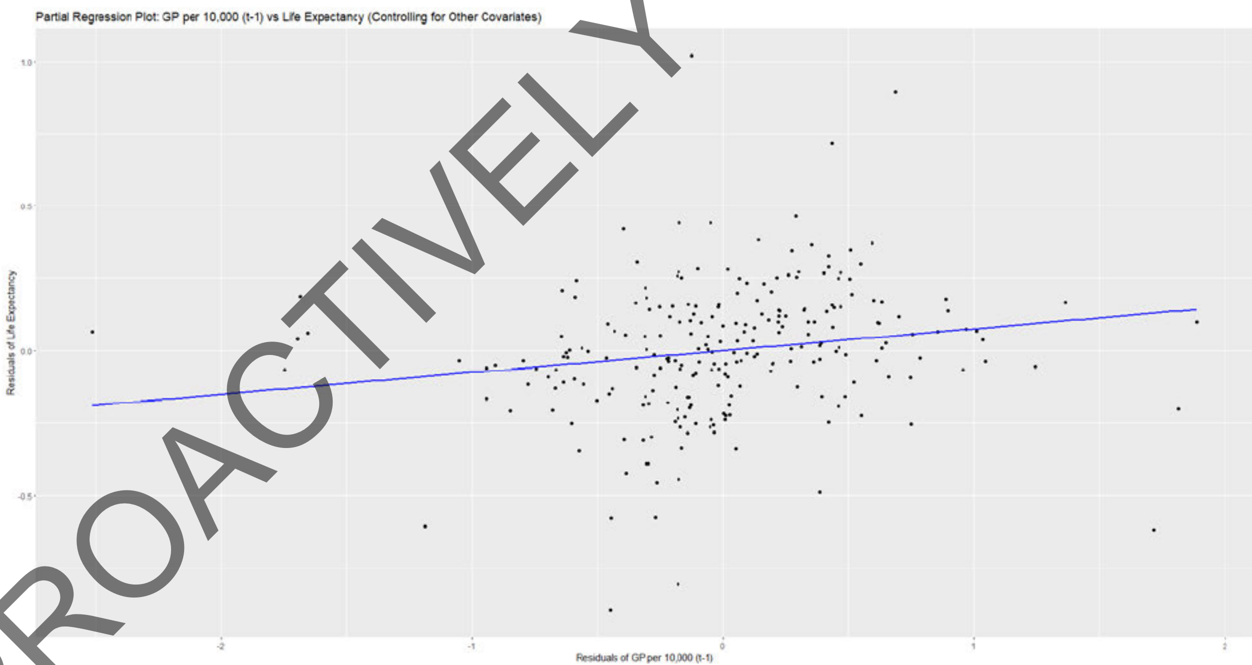


Figure 35: Adjusted GPs per 10,000 by health-adjusted life expectancy

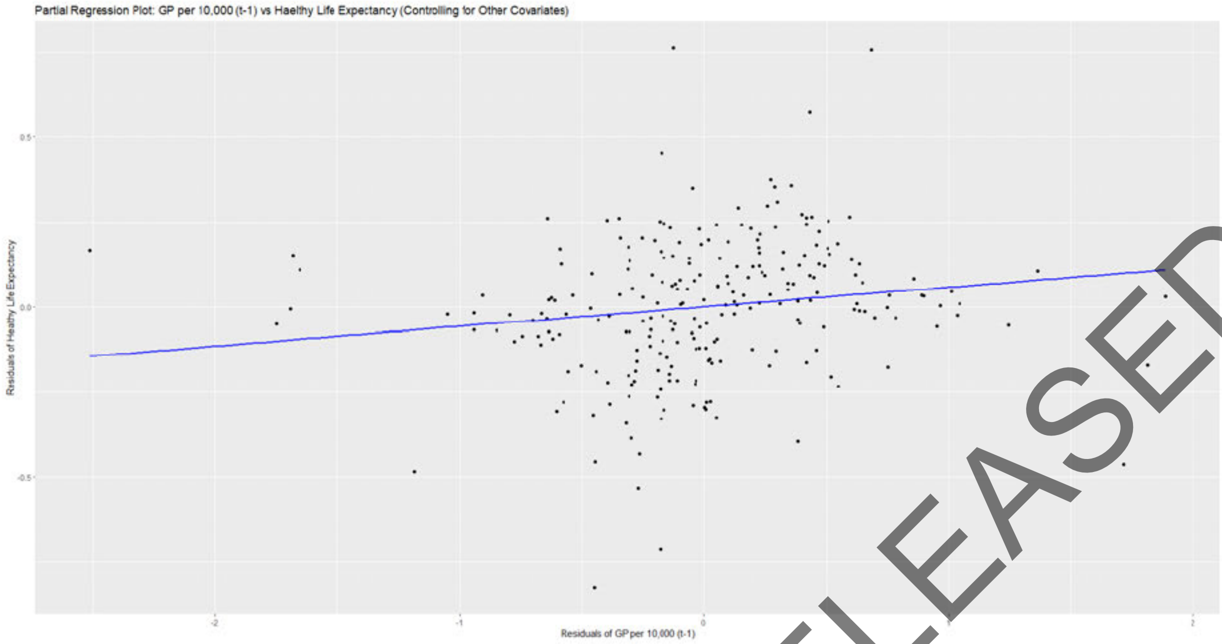


Figure 36: Adjusted SMOs per 10,000 by health-adjusted life expectancy

About Sapere

Sapere is one of the largest expert consulting firms in Australasia, and a leader in the provision of independent economic, forensic accounting and public policy services. We provide independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.

'Sapere' comes from Latin (to be wise) and the phrase 'sapere aude' (dare to be wise). The phrase is associated with German philosopher Immanuel Kant, who promoted the use of reason as a tool of thought; an approach that underpins all Sapere's practice groups.

We build and maintain effective relationships as demonstrated by the volume of repeat work. Many of our experts have held leadership and senior management positions and are experienced in navigating complex relationships in government, industry, and academic settings.

We adopt a collaborative approach to our work and routinely partner with specialist firms in other fields, such as social research, IT design and architecture, and survey design. This enables us to deliver a comprehensive product and to ensure value for money.

For more information, please contact:

David Moore

Phone: s 9(2)(a)

Mobile: s 9(2)(a)

Email: dmoore@thinkSapere.com

Wellington	Auckland	Sydney	Melbourne	Canberra	Perth	Brisbane
Level 9 1 Willeston Street PO Box 587 Wellington 6140	Level 20 151 Queen Street PO Box 2475 Shortland Street Auckland 1140	Level 18 135 King Street Sydney NSW 2000	Level 11 80 Collins Street Melbourne VIC 3000	GPO Box 252 Canberra City ACT 2601	PO Box 1210 Booragoon WA 6954	Level 18 324 Queen Street Brisbane QLD 4000
+64 4 915 7590	+64 9 909 5810	+61 2 9234 0200	+61 3 9005 1454	+61 2 6100 6363	+61 8 6186 1410	+61 7 2113 4080

www.thinkSapere.com

independence, integrity and objectivity