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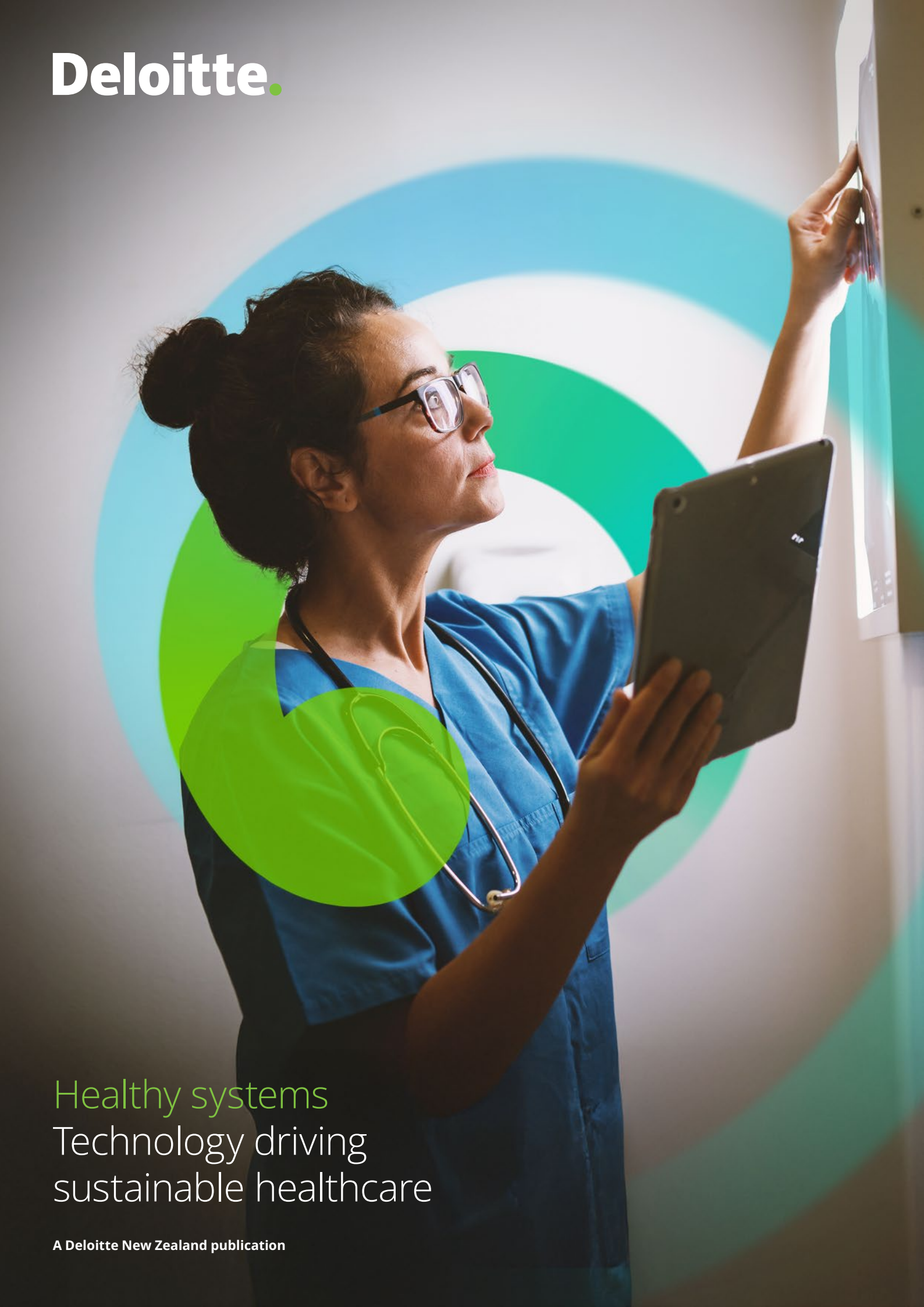


# Healthy systems
# Technology driving sustainable healthcare

**A Deloitte New Zealand publication**

# A time for change

Since the passing of the 1938 Social Security Act, New Zealanders have benefitted from a universal public healthcare system, which ranks amongst the top 20 globally.[1] The health service provides universal coverage and publicly funded access to a large set of core health services.

However, the Act's original vision to ensure *"all New Zealand citizens have equal access to the same standard of treatment in an integrated, preventative health care system"* has yet to be entirely realised – some 80 years later.

Like many western countries, New Zealand faces challenges such as an ageing population, health inequities, rising costs for the provision of services, and the increasing burden of mental illness, non-communicable and chronic diseases. These challenges, coupled with significant health reforms over the past 20 years, has resulted in an unsustainable trajectory for our health system.

Addressing these challenges will be essential to attaining a sustainable future for health and wellbeing in New Zealand, for which innovation and technology will play key roles.

# THE SYMPTOMS

### Long wait times

Long waiting times are becoming a staple of New Zealand's health system. Data from 2023 shows 37% of patients had been waiting more than four months to see a specialist, an increase of 8,361 compared with the previous quarter.[2] New Zealanders also wait longer than the OECD average for four out of seven elective surgeries, with some New Zealanders waiting up to 12 months for surgery.[3]

### Patient flow

The health system is failing to achieve system-wide continuous flow, leading to bottlenecks, inefficiencies and suboptimal care. Ambulance services are reporting a significant increase in 'ramping' (the extra time crews spend waiting for patients to be admitted); 30% of patients are waiting longer than six hours to be seen at the ED, and bed occupancy rates in hospitals are frequently close to (and sometimes over) 100%.[3]

### Separated and outdated systems and platforms

Patients struggle with accessing and understanding their health data, and experience disjointed care journeys in the way that data is passed between providers. This is the result of cumbersome data sharing within the care networkincluding the lack of a national electronic record sharing system. Concerns around consent and privacy continue to impede effective data exchange, hindering coordination of care and timely medical interventions.

### Health inequalities

New Zealand continues to struggle with health inequalities for Māori and Pacific people. Despite significant increases in the number of Māori and Pacific health providers, higher mortality and morbidity rates for those groups persist. Māori health status also remains unequal with non-Māori across almost all chronic and infectious diseases, injuries and suicide. In recent years, vaccination rates for Māori children have fallen 5% to just 65%, and Māori newborn primary care enrolment is well below other reported ethnicities.

### Access and postcode lottery

Healthcare coverage in New Zealand is uneven, creating a "postcode lottery". Rural and remote areas face longer wait times, including an estimated 16% of the population who do not have timely access (<60mins) to emergency care via road or air.[4] In contrast, urban areas generally have better services, creating a disparity which means healthcare quality and outcomes can depend heavily on an individual's location, exacerbating socio-economic inequities.

This paper explores how key technology levers can be implemented to enhance the supply and quality of healthcare provision and mitigate increasing costs and demand for services.

# Our health ecosystem

To pursue more sustainable healthcare delivery, the macro/ecosystem environment must also be considered as key context affecting successful technology implementation.

## State of play

### Where we spend

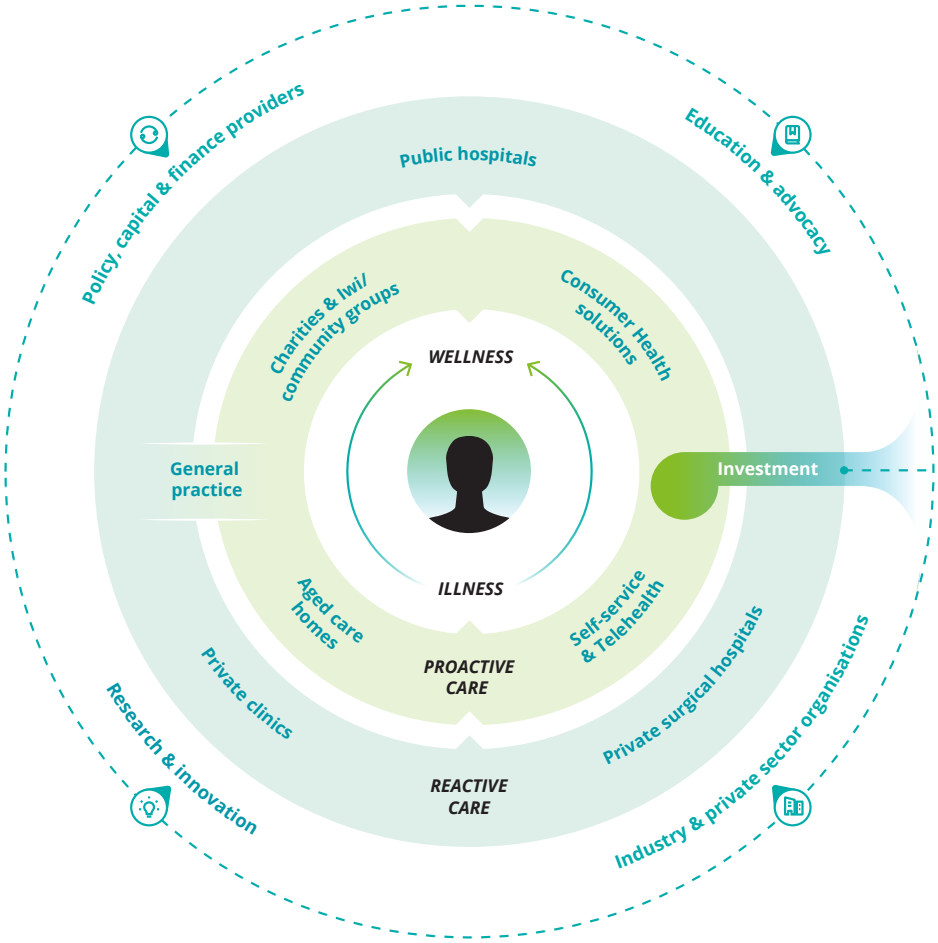
Our health ecosystem traditionally focuses most of its resources and investment ($14,611m or 49% of the Vote for 2024/25) in specialist / tertiary care, despite primary care being responsible for 23 times more patient contacts.[5,6] This reduced investment in primary and community care drives up demand and waiting lists due to the bottlenecks created in the hospital environment, resulting in inefficient (and costly) care provision. Currently, only $9,088m or 31% of the Vote for 2024/25 is allocated to primary care.[5] Yet, studies show that each dollar spent in primary care generates a $14 saving in hospital costs by reducing the need for more expensive, acute care interventions.[7] The UK's NHS has suffered a similar fate in terms of budget allocation – increasing hospital staff numbers by 17% between 2019 and 2023, but seeing only a very limited increase in appointments, operations and procedures.[8] Although it might be tempting to prioritise funding where the issues are most visible – e.g. ramping ambulances and crowded waiting rooms – reduced investment in community care will only drive up the number of patients who present to hospitals instead. Therefore, a shift in our focus and investment is needed; leaning further into holistic healthcare outside of hospitals.

### Digital infrastructure

New Zealand's digital infrastructure is also on the backfoot compared to other health systems with high levels of fragmentation and costly and ineffective legacy systems. This is in part the result of funding allocation to date despite spending more than OECD averages on healthcare as a whole, New Zealand's spend on *digital* health is less than half the rate of countries at the forefront of digital transformation (2-3% vs 10%).[9] It should be noted that expensive EHR deployments globally have not always yielded return on investment, and high digital spend does not always correlate to improved patient outcomes (including examples from the US).[10] Therefore at least in the near term New Zealand should target digital spend on strategic implementation of technology that drives productivity, performance and improved patient outcomes, including reuse of best-practice systems already in operation to unify and standardise the data and digital environment.

### Structural instability

The establishment of Health New Zealand – Te Whatu Ora in 2022, to replace district health boards (DHBs) created the largest employer and IT function in the country. Whilst centralisation of digital systems has the potential to improve interoperability and reduce duplication, insufficient investment in integration and change management has led to challenges. Disablement of regional decision making has impeded the agility of our health system, further compounded by instability in roles and positions as Health New Zealand continues to evolve and restructure to meet budgetary challenges. New Zealand is not alone in this struggle. *The Independent Investigation of the NHS in England* identifies *The Health and Social Care Act of 2012* as a critical cause of NHS failure to deliver, having undermined clear management structure and created "decades of instability".[8] The result of ongoing structural changes, compounded by volatile political cycles, is the stalling or halting of major projects and consequent sunk costs without return on investment. Our inability to see projects through to completion is perhaps one of our largest barriers to transformation on a national scale. To counter this, the provision of publicly-funded healthcare technology must be politically insulated wherever possible, to shield initiatives from political volatility and ensure they are driven by long-term strategic goals rather than short-term political agendas.




## Innovation ecosystem

Even disregarding recent structural changes, the healthcare ecosystem is not optimally positioned to adopt available technologies and innovation. In the US model, academic hospitals link research and care delivery together, with provision of funding close to the front-line. However, New Zealand's research capability is much further removed, making it harder for startups to establish and for innovation to advance in the same way. Post reform, Health New Zealand has tended to engage with innovation and technology development only where it can deliver on a national level, overlooking smaller solutions and making iterative improvement harder to achieve. Structured innovation pathways, industry partnerships, clear strategic direction and innovation sponsorship, are required to bridge this gap.

## Macro trends in proactive care

Globally, we are seeing a macro-trend towards a "well-care" paradigm that replaces the traditional "sick-care" model. This approach is widely considered to be more financially sustainable, with a reduction in the long-term costs associated with chronic disease management and hospitalisation, through more cost-effective early intervention. In the US, spend on proactive care, or "promoting health" is projected to increase to ~40% of total healthcare spend in 2040 vs ~15% today, where the current paradigm requires that 80% of spend is allocated to 20% of patients.[11] New Zealand should consider its own healthcare delivery model, and explore the processes, systems and technologies that can move the dial towards more proactive care.

## Shifting our focus

Effective and long-term change will require us to harness available technology and shift the focus of our resources towards preventative, community-based care.

### Recommendations

- Shift resources and investment towards primary care and care in the community, exploring technology that can enable remote and community care.
- Establish innovation pathways that link private sector health technology and academic research directly to hospitals and clinical practice, targeting priority healthcare challenges and supporting innovation growth.
- Establish robust health technology governance to shield initiatives from political volatility, ensuring that they are driven by long-term strategic goals rather than short-term political agendas.
- Explore technology and digital enablement options that can facilitate an operating model shift towards more proactive and preventative care.

# The role of technology in driving change

New Zealand's health system challenges can be broadly categorised rolled into four (critically interlinked) indicators: demand, supply, quality and cost.

**Increasing demand** for healthcare in New Zealand largely stems from a growing and aging population (as is the case for many comparable nations), with Hato Hone St John reporting a 50% rise in 111 call volumes over the past nine years.[12] Health New Zealand – Te Whatu Ora also noted a 7% increase in acute adult admissions to emergency departments from 2018 to 2023,[13] aligning with a 6.7% population growth.[14] Furthermore, New Zealand has the third highest adult obesity rate in the OECD, which continues to increase, alongside deteriorating mental health (34.8% of adults reported anxiety and/or depression symptoms in 2021-3 vs 25.0% in 2016/17).[15]

**Rising healthcare costs** are exacerbated by inflation and inefficiencies in service coordination, along with workforce shortages that drive up wages. New Zealand's smaller population limits economies of scale, resulting in healthcare expenditures that exceed OECD averages (11.2% vs. 9.2% of GDP and 18.0% vs. 15.5% of total government spending).[16]

**Limited supply and provision of healthcare** is due to inadequate infrastructure and workforce shortages. Whilst sustainable healthcare systems are able to leverage their increasing populations to provide services in line with demand, New Zealand has so far been unable to keep pace (we can't build or fund fast enough). To compensate, the average weekly workload for medical staff has steadily increased from 43.8 to 44.6 hours since 2018,[17] contributing to retention problems.

**Quality of healthcare** is not increasing in line with increasing costs. Lower life expectancy and up to 20-year earlier onset of chronic conditions for Māori and Pacific people[18] are challenges both associated with access issues and health disparities. With huge global headway in the technologies and strategies available to improve treatments and patient outcomes, New Zealand's public sector has yet to fully leverage the improvements we are seeing elsewhere.

## How can we use technology to affect this balance?

Through a global lens, it's clear there are significant opportunities to affect these indicators and promote healthier, sustainable systems.

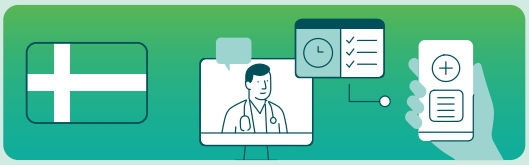
We should be aiming for demand to increase at the same (or slower) rate to population health increases, leveraging proactive and preventative strategies, and education alongside technologies that empower people to make healthier choices. Efficiencies in service delivery can be achieved by strategic resource provision, interoperable systems and automation, whilst the quality of care that we deliver can be enhanced through new and emerging technologies.

The subsequent pages of this paper explore how the technology levers at our disposal affect demand, supply, quality and cost in the pursuit of sustainable healthcare in New Zealand.

## Global Examples: This theory in practice

### Virtual wards (telemedicine)

The UK is piloting virtual wards that allow patients needing hospitalisation to receive acute care, remote monitoring, and treatment at home through digital health tools. These virtual wards provide continuous data flow – similar to that within physical wards – enabling two-way communication between patients and providers.



### Integrated digital solutions

Sweden has successfully integrated digital health solutions into primary care, including e-consultations and telemedicine services. In 2020, the number of virtual consultations doubled from 1.2m to 2.4m.[19] This approach has improved access to care, especially for rural populations, and has reduced waiting times for appointments.

### Harnessing innovation

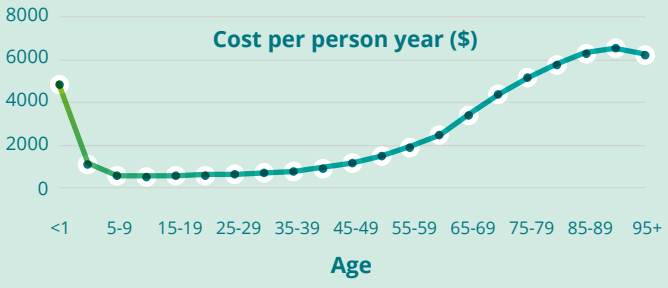
Germany's DiGA (Digitale Gesundheitsanwendung) model expedites the development and adoption process for new digital health applications and solutions through transparent certification guidelines, facilitated clinical trials, a centralised reimbursement model and an easy-access central registry.

### Digitally enabled population health

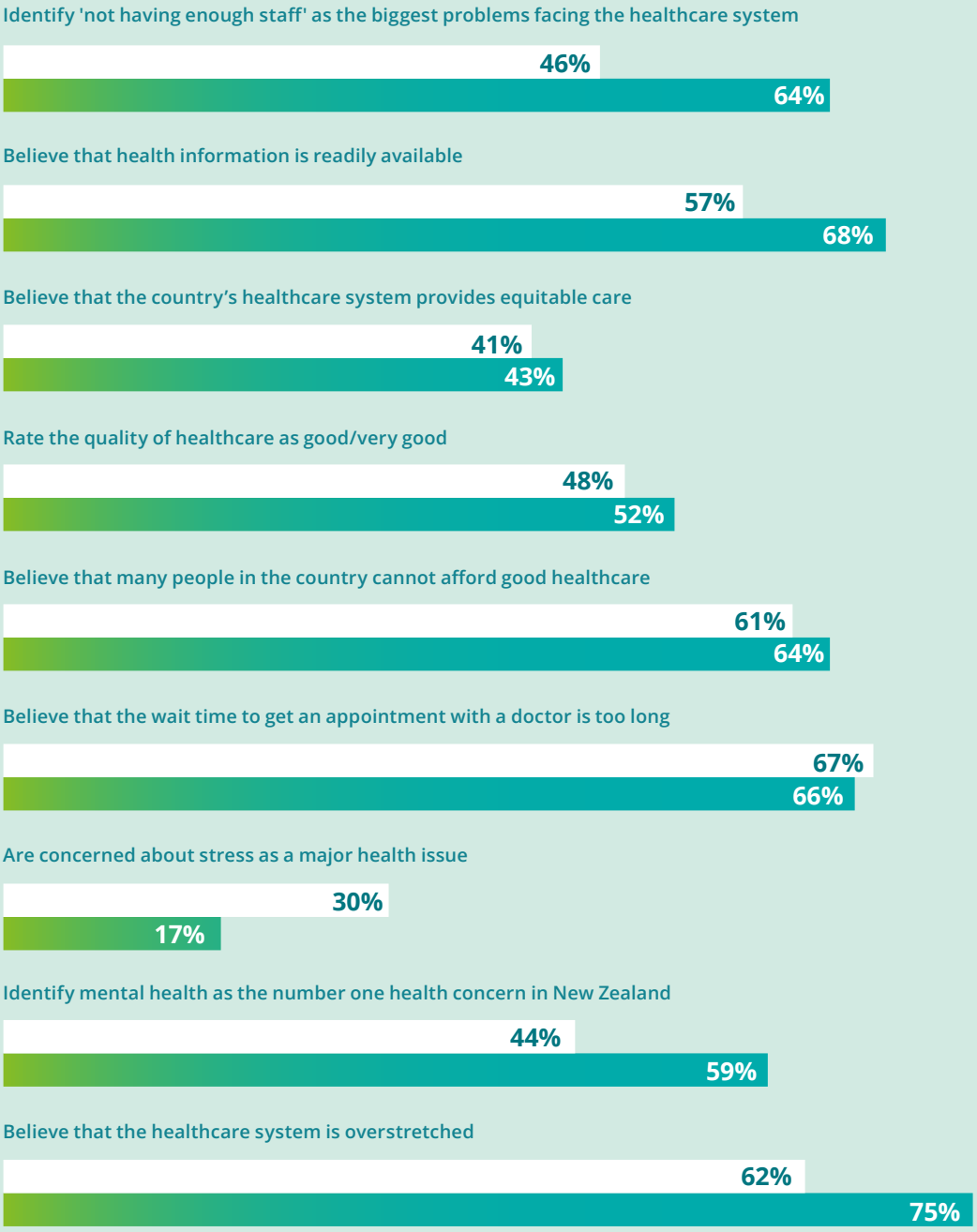
The Danish Health Data Authority, has effectively used data monitoring to identify areas for healthcare delivery improvement, such as screening. Five-year survival rates increased from 48% in 2002 to 61% in 2014 after a concerted campaign to restructure cancer care services under the Ministry of Health.[20] Additionally, allowing people easy access to their personal health-care records has contributed to improved public health literacy.

## Did you know?

OECD data on cost estimates per person-year by age in New Zealand finds a range as great as $632 for adults 20-24 to $6,537 for adults aged 90-94.22 In the context of rising life expectancy and aging populations, this underscores the importance of technology interventions and modernised treatment paradigms to ensure sustainable healthcare provision.[22]



## Public Opinion on Healthcare Provision in New Zealand vs Global Averages, 2023[21]




Global average

New Zealand

# Technology levers

## for sustainable healthcare provision

**We explore how the technology levers at our disposal affect demand, supply, quality and cost in the pursuit of sustainable healthcare provision in New Zealand.**

### Levers that **increase quality**

**Using technology to deliver better care**

- Genomics & big data analytics
- Precision & personalised medicine
- Digital Biomarkers

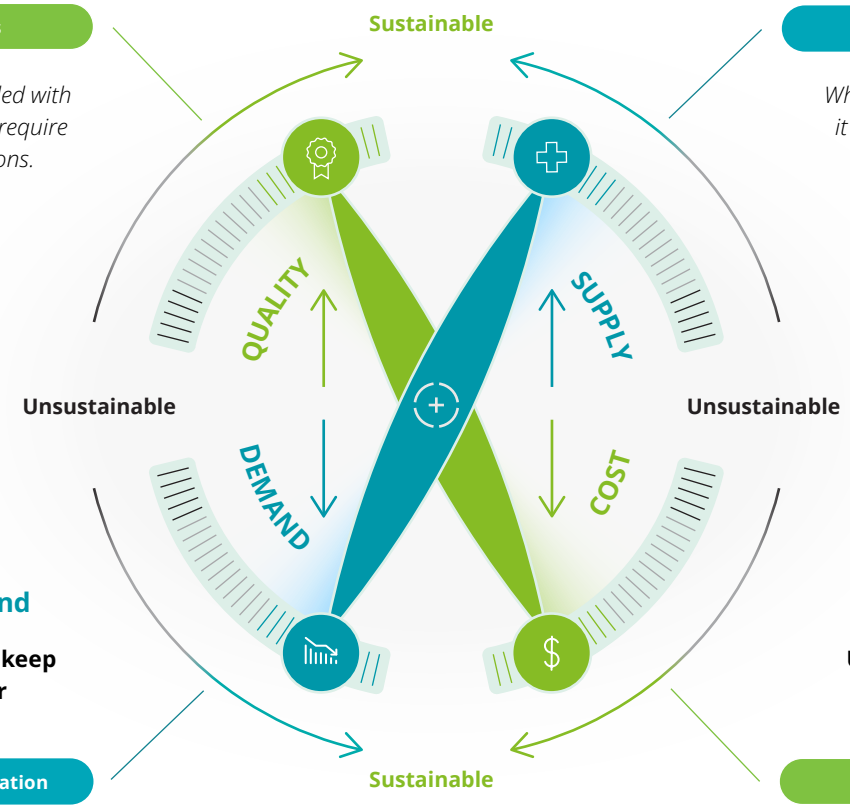
*When patients are provided with higher quality care, they require fewer repeat admissions.*

### Levers that **increase supply**

**Using technology to do more**

- AI & Automation
- Telehealth solutions
- Smart rostering

*When healthcare costs less, it can be provisioned at a higher quality.*




### Levers that **decrease demand**

**Using technology to keep people healthier**

- Access to health information
- Consumer health technologies
- Remote Patient Monitoring (RPM)

*Healthier populations & reduced demand means greater available supply of health services.*

### Levers that **decrease cost**

**Using technology to deliver efficiencies**

- Smart hospitals
- Optimising patient flow
- Predictive supply chain management
- Robotic Process Automation (RPA)

*When there is greater supply of resources, cost is driven down.*

# Driving down demand

How we can leverage digital technologies for population health.

## Current state

Unmet clinical demand is projected to result in significant economic burdens. For instance, nearly one in 10 New Zealanders are expected to have type 2 diabetes by 2040, with associated annual costs soaring to $3.5 billion without effective intervention.[23] This scenario is similar across other chronic and complicated long-term diseases, such as osteoarthritis, rheumatic fever, and stroke.

This increasing demand for health services is not being met by increasing supply, with long wait times as the most obvious symptom. Nearly 30% of all patients waited for more than six hours at the ED in 2023, a 5% increase from 2022.[2] Some regions, such as MidCentral and Capital & Coast, reported more than half of their patients waited for over six hours.

Investing in population health could help slow the increase in demand for health services. These interventions are ecosystem-wide, requiring a more joined up and holistic approach to care that includes (but is not limited to) environmental, educational, organisational and social interventions.

## Digital technologies for self-service

### Access to health information

Studies indicate that providing patients with access to timely and accurate health information contributes to higher patient satisfaction and improved health outcomes. Digitalised personal health records have an important role to play in this respect; in one research example, engagement with a personal health record was directly linked to improved cholesterol and blood pressure levels in patients with diabetes.[24]

In New Zealand, residents can access their health records via My Health Record. However, there is a lack of universal adoption and integration across the healthcare system, leading to fragmented data and inaccuracies or gaps where providers fail to input timely data or if patients receive care from multiple, non-integrated sources. In addition, greater public engagement and digital literacy is required to extend data access, with some struggling to manage or access their records effectively, especially in rural or under-served areas. Health disparities experienced by Māori and Pacific people demonstrate the importance of ensuring equity in the one-size-fits-all approach to national tools and systems that we implement, and integrating service design principles such as Māori data sovereignty.

### AI & automation for self-service care

AI-enabled assistants and chatbots are popular across other industries, and are increasingly being adopted in healthcare, due to maturing technology and growing public trust.

These tools will play an important role in alleviating pressure on clinical services by handling queries that don't require direct clinician interaction and helping direct patients to the appropriate resources. They offer 24/7 availability, personalised interaction (including offering more culturally appropriate communication), knowledge surfacing and service navigation/triage.

The *Aroha Chatbot* is one example from the Ministry of Health, designed to support youth mental health during and after COVID-19. The tool promotes equity by offering te reo Māori content, ensuring it reaches Māori rangatahi, who face higher mental illness and suicidality rates.

Despite their benefits, it's important to acknowledge the risks of poorly designed and trained AI systems, which have been in the news for generating inappropriate messages and spreading misinformation, undermining the resource-saving advantages they were meant to deliver. Safe implementation requires robust guardrails such as proper constraints for open-ended bots, rigorous testing and fine-tuning on high-quality, unbiased data, implementation of non-LLM guardrails (using non-LLM AI to classify user statements and manage risky inputs), Human fallback mechanisms(integrating human oversight for complex or sensitive queries), established ethical guidelines, regular audits and user training. These will be increasingly important challenges to mitigate as we look to increase the scope and broaden the implementation of technologies of this kind.

### Consumer health technologies

Growing popularity of consumer health devices is helping people to better track and manage their health changes or seek care earlier, leading to more empowered and informed populations. These devices leverage digital biomarkers (datapoints collected through digital sensors) to provide health insights. Examples include smart watches like Fitbit and other wearables like the Oura ring.

However, with much of the population unable to afford devices like these, and limited available languages or other access issues, it's important to consider their potential to widen health inequalities in our population.

## Digital technologies for prevention

### National digital platforms

National digital platforms are a key enabling technology for screening and prevention, enabling more proactive care. New Zealand already boasts a number of good practice examples in this space.

CPIR – The Consumer and Population Identification and Registration platform – facilitates national, regional and local approaches to population and cohort management, powered by data and analytics. It supports providers to identify and connect with under-engaged populations by leveraging Geographic Information Systems (GIS) to map areas of need, combining this with personalised and tailored communication pathways.[25]

The National Screening Solution (NSS) is a cloud-based platform that facilitates early detection of bowel and cervical cancer through streamlined health data sharing between participants, providers, and diagnostic facilities. During the COVID-19 pandemic, the platform's adaptability was demonstrated when it was temporarily repurposed for contact tracing.
To continue to evolve and mature in this space, a continued focus on the interoperability of current and future systems is crucial to ensure the digital solutions we implement can integrate with legacy systems and existing workflows, especially when they are operating at a national scale in this way.

### Remote patient monitoring

Reducing demand for hospital and specialist services requires increased investment in primary care solutions, for which Remote Patient Monitoring (RPM) technologies are changing the nature of what is possible outside of hospital environments. These tools – which integrate digital biomarkers – enable continuous monitoring and earlier intervention, driving better health outcomes outside of clinical settings.

In one example, the implementation of remote patient monitoring for chronic disease management at The Cleveland Clinic (USA), is estimated to have lowered hospital admissions by 25%.[26]

### Recommendations

- Adopt self-service and automation, with quick wins in administrative functions, to alleviate pressure on clinical services.
- Invest in change management and education for the rollout of patient-facing solutions, ensuring equity and user-centered design is well considered.
- Focus now on robust guardrails and ethical frameworks around the use of AI and automated tools, to enable safe future implementation.
- Invest in tools and technologies that facilitate care in the community and improved primary care outcomes, driving down demand for specialist and tertiary services.

# Driving up supply

Using technology to do more with the resources we have.

## Current state

To date, maintaining the supply of healthcare resources in line with demand has been challenging due to New Zealand's low population density and limited clinical workforce. In recent years, this situation has worsened due to talent drainage – in 2024 over 50,000 New Zealand citizens left the country.[27]

The Royal New Zealand College of GPs estimated there were 74 GPs per 100,000 people in 2021, which is ~40% less than Australia (116) and Canada (122), equating to one GP for every 1,350 people.[28] In rural regions, this ratio can be as high as 1,500 patients per GP. The importance of sufficiently resourcing primary care should not be understated. It is estimated that increasing the number of GPs by 10 per 100,000 people could potentially save 30 lives annually from cancer, respiratory, and cardiovascular issues.[28]

Nursing follows a similar trajectory. The NZ Nursing Organisation estimated a shortage of 1,000 nurses in 2023.[29] While there has been some success bringing in qualified nurses from overseas, incentives have only been effective in more populated areas, with rural locations remaining highly impacted.

## Addressing clinical supply

Stimulating domestic growth of the clinical workforce is challenging for a number of reasons. Establishing more tertiary institutions to train clinicians is a viable long-term strategy, but it demands a lengthy lead time and exceeds current budget capacities. Furthermore, the number of graduates that newly established institutions could supply would most likely not be sufficient to meet immediate needs. The 2024 Budget allocates $22 million to train 25 more doctors per year, but with an estimated shortfall of 1,700 doctors, this will not make a significant dent (at least for the next 70 years).[29]

Bringing in overseas clinical staff seems to be an intuitive solution, but it runs into the same issue that previous governments have wrestled with in trying to soften the talent drainage – New Zealand must first be a desirable destination for the target talent cohort. Many feel that Australia offers better financial (and other) incentives to doctors and nurses, which means that New Zealand is often competing for clinical resource.

Therefore, growing the workforce via domestic and international sources must be complemented with an increase in workforce efficiency through technology – as "digital FTEs" – which also helps to make roles in healthcare more attractive.

### AI & automation

New Zealand's health workforce has a productivity issue – which is not to be confused with a low workload. Instead, clinicians spend their time on non-clinical tasks and frustrating processes and systems (e.g. calling wards to find available beds) which drains job satisfaction and removes the focus from care delivery.

The RNZCGP's Workforce Survey (2022) estimates GPs spend around 11.5 hours per week on of non-patient facing activities – equating to more than 30% of all hours worked or 46 potential consultations lost to administrative tasks.[28] We expect similar challenges for hospitals and specialist services.

The rise of AI opens much-needed opportunities for increased efficiency – and improving the clinician experience. Various AI tools, like *Nabla*, which automates clinical note-taking through transcription and summarisation, are already seeing rapid uptake due to the opportunities they present in streamlining repetitive and manual tasks. In April 2023, Health Informatics New Zealand reported approximately 400 GPs using Gen-AI tools in their practice.[31] In July this year, General Practice NZ reported about 25% of all GPs (~1,400) use AI tools daily, many of these as self-funded subscriptions.[32]

Realising the true value of AI-driven automation will require a strategic, national approach – with supplementary change management – to support adoption of these technologies at an increasing scale. The current piecemeal and sometimes self-led approach (as we are seeing in general practice) will otherwise lead to inconsistencies in service provision and gives rise to errors resulting from use of AI without adequate training.

### Telehealth solutions

Telehealth and remote health services can significantly improve the supply of (and access to) healthcare for rural and under-served populations. Since COVID-19, remote GP services have surged, with over 100,000 appointments delivered annually across three telehealth providers: CareHQ, Practice Plus, and Bettr NZ, according to Health Informatics New Zealand.[33]

But the field of telehealth is still evolving. We are seeing emerging innovation in 'telerobotics' – which combines digital channels and robotics to enable local machines to be operated by remote clinicians. This means access to specialists can be extended to rural populations, with current applications in ophthalmology and dermatology. Looking domestically, we are starting to see the first glimpses of this through startups like *VistaVision* – providing telerobotics for the diagnosis of common eye conditions.

This is all to say telehealth and remote care is not just video-enabled GP appointments. More innovation is expected in this space, with the potential to drive up the provision of healthcare to rural and under-served populations.

### Smart rostering

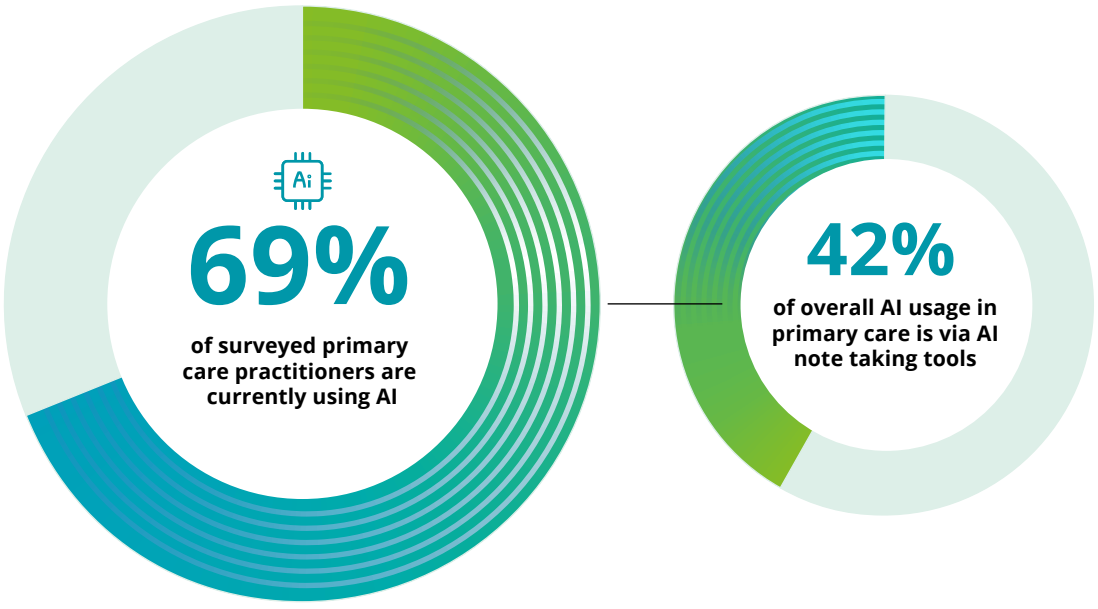
Forecasting clinical demand accurately is a difficult task, with short notice changes in both staffing and patient demand commonplace. Many organisations do not have an accurate and real-time view of current staffing levels or locations, limiting the supply of healthcare professionals to deliver services, or causing a reliance on (expensive) temporary / casual staff.

Smart staffing solutions, such as AI rostering tools with predictive analytics capabilities, can address this issue. By recognising studied patterns of fluctuations in demand and supply, including predicting sickness absence and holiday requests, AI algorithms can predict when additional resourcing will be needed and proactively allocate capacity or reassign staff locations.

In one example, Basildon and Thurrock University Hospital in the UK implemented smart rostering in 2008, claiming to save ~£150k annually by reducing reliance on temporary and casual staff.[34]

### Recommendations

- Establish a strategic approach to adoption of automation and AI tools across primary and secondary care, with a focus on change and training.
- Leverage predictive analytics, such as smart rostering tools, to support better alignment of supply with demand.
- Drive productivity in hospitals via AI and automation, targeting improved patient flow through better operational management, saving clinical time.
- Invest in solutions that extend remote care capabilities to drive up healthcare supply to rural populations, reducing the need for rural infrastructure.




*GPNZ AI in Primary Care Survey (2024/25)*

# Driving down cost

Using technology to deliver efficiencies.

## The challenge

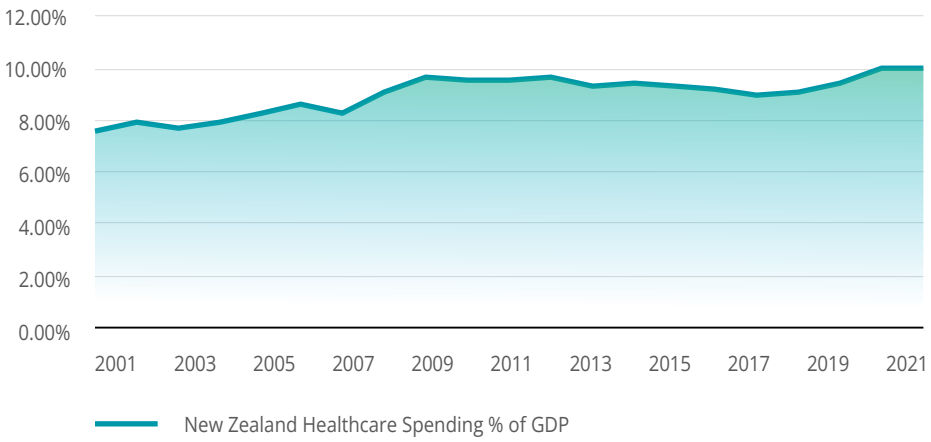
Healthcare systems worldwide, face mounting financial pressures driven by a complex web of factors, such as inflation and workforce shortages, further compounded by operational inefficiencies. This stems from disconnected service provision and management, poor process design and under-utilised technology. Patients are often prescribed longer hospital stays or more intensive treatments than necessary, influenced by the availability of resources rather than medical need. With costs of approximately $1,000 per bed-day, these inefficiencies stack up very quickly. Obstructed patient flow is expensive outside the hospital too; Hato Hone St John reported 9756 ramping hours (hours spent waiting outside of hospitals for available beds / clinicians) in Q1 of 2022, which corresponds to almost $400,000 in paramedic wages alone.[36]

Technology holds substantial potential to reduce operational expenditure in healthcare by streamlining processes, enhancing efficiency, and reducing waste. Whilst technology also has a crucial role to play in improving patient outcomes and quality of care – leading to reduced long-term costs – this chapter will focus on the immediate financial benefits of leveraging technology for operational efficiencies. Optimising our hospitals, targeting flow and reducing waste in the system present key opportunities to mitigate cost pressures in this way.

### Smart connected hospitals

By design, smart hospitals integrate Internet of Things (IoT), AI and robotics to enhance patient care, operational efficiency, and resource management.

**New Zealand's Healthcare Spending as a % of GDP has increased steadily since 2001[35]**



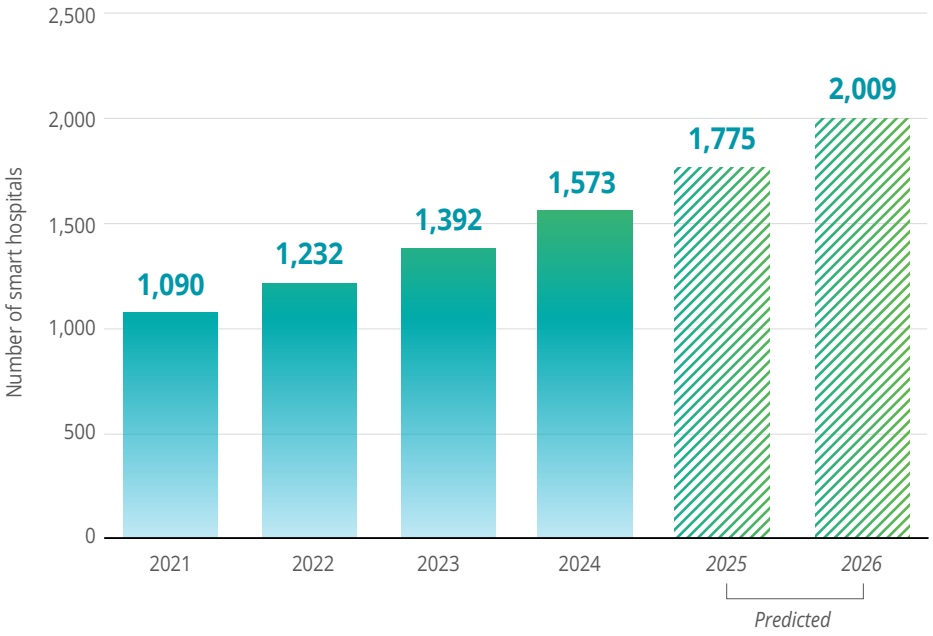

The global smart hospitals market was valued at $100 billion in 2024 and is expected to be worth five times that by 2034.[37] Examples include Singapore's *Ng Teng Fong General Hospital* which employs AI-powered predictive tools to optimise patient flow, and Italy's *Mater Olbia Hospital* which uses IoT devices to monitor patient vitals remotely, enabling early intervention.

Key features of smart / IoT-enabled hospitals, include:

- Asset tracking: Track for the optimal use and timely maintenance of medical equipment.
- Integrated diagnostic tools: Imaging devices, lab equipment, and monitoring systems with automatic data upload capability.
- Smart beds: Hospital beds equipped with sensors to monitor patient occupancy.
- Environment sensors: Maintaining constant environments e.g. reducing utility bills.
- Automated inventory management: Continuously monitor inventory levels and automate reordering processes.
- Predictive maintenance: Devices monitor the condition of medical equipment, predicting maintenance needs before breakdowns occur.
- Workflow optimisation: Digitally enabled models of care streamlining workflows and accelerating tasks.

Smart hospitals are built by design to target areas for technology implementation to improve efficiency and patient outcomes. We are seeing positive moves in this direction in New Zealand, with examples of hospital construction projects wherein infrastructure represents just one delivery workstream, amongst other core focuses in digital and data infrastructure (forming the backbone of smart hospital functionalities).

**The total number of smart hospitals globally is expected to continue increasing[41]**




## Optimising patient flow

Workflow optimisation also speaks to streamlined patient journeys and expedited patient flow through the hospital, eliminating costly bottlenecks. For example, integrated bed management systems can be harnessed to track bed availability in real time, ensuring efficient utilisation of bed space. This reduces patient wait times, improves bed turnover rates, and maximises hospital capacity.

Hospitals can also benefit from advanced systems that manage waitlists and optimise scheduling, leveraging predictive analytics to forecast admissions and discharges, staff assignments and equipment usage to prevent backlogs. In one example, Microsoft's *Artisight* employs AI-driven case length predictions to optimise operating room scheduling, reducing downtime / vacancy, enhancing throughput and/ or delivering cost reduction through room closures. This application is particularly relevant given the current wait list for elective surgeries in New Zealand.

More specifically, implementation of a suite of patient flow analytics applications at *Queen's hospital* in Hawaii yielded USD $22M in cost savings through an 8.4% relative reduction in average Length of Stay (LOS).[38]

## Predictive supply chain management

Predictive analytics have wider applications than patient flow, including enabling proactive versus reactive approaches to maintenance and equipment management. Equipment downtime can be reduced through identifying potential failures before they occur, and supply chain operations can be streamlined, accurately forecasting the demand for medical supplies. This helps in maintaining efficient inventory levels, reducing inventory holding costs and minimising waste from expired or unused supplies.

A review of over 3,500 hospitals in the US finds that supply chain expenses make up an average of 15% of total hospital expenses, and up to 30% or 40% for surgery-intensive hospitals,[39] indicating the importance of supply chain optimisation as a method to reducing operational expenditure in hospitals.

## Robotic Process Automation

Finally, Robotic Process Automation (RPA) can be leveraged as part of streamlined workflows to automate repetitive, rule-based tasks, removing human oversight so that healthcare professionals can focus on patient care – saving on administrative costs. The market for Robotic Process Automation in healthcare is currently valued at $USD 2.05Bn , and is expected to reach $USD 6.05Bn by 2032.[40] Applications include appointment scheduling, billing and claims processing, data entry and management and prescription management, amongst other things.

In New Zealand, *Healthcare Holdings Limited* has implemented RPA to reduce costs by optimising ACC invoicing and receipting at Auckland's *Mercy Radiology*. The virtual worker, known as 'Matilda', efficiently completes tasks in two hours that previously required two employees working three to five hours daily. Assuming average rates for a healthcare administration role, this saves approximately $96,000 in staff wages alone. Additionally, Matilda has decreased error rates by 10% and expedited cash flow by enabling daily submissions to ACC, replacing the former weekly schedule.

## Recommendations

- Implement task automation to reduce spend on clinical hours and predictive analytics for reduced redundancies.
- Embrace smart hospitals by integrating AI, IoT, and robotics into standard operating models and ways of working, to drive efficient and data-driven patient care environments.
- Identify and target patient flow bottlenecks to drive cost savings in the hospital environment.

# Driving up quality

Using technology to deliver better care.

## Current state

New Zealand's quality of healthcare stacks up quite well when compared to other countries, with strengths in public health initiatives, patient-reported satisfaction, and vaccination rates. However, healthcare costs continue to rise, and patient outcomes are not seeing proportional improvement.

High quality healthcare means something very different now than it did 20 years ago. Where antibiotics were once the pinnacle of medical treatment, we now have detailed genomic insights, AI, advanced surgical techniques and more data than ever before at our disposal. If we can properly harness these technologies, we have the potential to improve health outcomes and, in turn, drastically reduce the strain on our healthcare system.

## Precision & personalised medicine

### Genomics & big data analytics

Big data is a rapidly transforming field with huge applications in healthcare. The massive and growing collections of biomedical omics-data (genomics, proteomics, etc) and increasing structured collection of clinical data, present opportunities to enable data-driven decision making and analysis. Where in the past notes were scribbled on sheets of paper and test results manually filed, we now have infinitely more data available to enhance the quality of care.

Applications include the ability to:

- Research by specific and individual genetic variability
- Accelerate drug discovery
- Enhance disease surveillance
- Identify risk factors and determinants of health
- Leverage population-wide insights around drug efficacy for specific presentations.

### AI-driven diagnostics

Artificial intelligence (AI) and machine learning can derive insights from big data that further enhance applications in healthcare. This includes identifying patterns that human practitioners might miss, able to consume more information than an individual clinician could gain in a lifetime through experience alone. AI can analyse medical images to inform diagnosis (many times more accurately than a human)[34] and identify the most appropriate medications (or the one that will lead to fewer side effects) for a particular patient (e.g. based on specific genetic mutations present in a tumour). Today, AI can be broadly classified into two main categories: Generative AI (such as Chat-GPT), which creates new content by learning from existing patterns, and Predictive AI, which forecasts future events by analysing large volumes of historical data.

Generative AI can streamline administrative tasks by generating clinical notes, summaries or patient communication, enhancing clinician efficiency and patient engagement. Predictive AI, on the other hand, can use historical data to anticipate patient outcomes, compare images, optimise resource allocation, and inform personalised treatment plans.

Organisations are already popping up globally that offer molecular and clinical data libraries or AI engines trained on specific patient populations, with the goal of helping clinicians to make more data-driven care decisions. Examples include *Tempus AI* (Chicago) which offers a big data repository specific to cancer, or *Pieces* (USA), a clinical engine that makes recommendations based on ingested data held about an individual.

The UK has invested in personalised medicine and precision health by leveraging genomic data to tailor treatments to individual patients. In particular, the NHS was the first national health system to offer whole genome sequencing as part of routine care. In studies comparing tumour samples with data from the 100,000 genomes project, more than 90% of brain tumour samples and more than 50% of lung and colon cancers yielded identifiable genetic changes that could inform decision-making around surgery or other treatment options.[42]

## Digital biomarkers and remote patient monitoring

### Digital biomarkers

Alongside their prevalence in consumer healthcare, digital biomarkers have applications in telemedicine and clinical trials. These objective, quantifiable datapoints – collected through digital devices, such as wearable sensors – can provide real-time monitoring of physiological, behavioural, and environmental changes in a person's health. This might include heart rate, activity levels, sleep patterns, glucose levels, or even cognitive function.

The feasibility and number of applications for digital biomarkers is advancing due to improvements in sensor technology, widespread adoption of connected digital devices, enhanced data consolidation capabilities, and powerful analytics, including AI, which together enable comprehensive data collection and insightful integration with other health datasets. The global digital biomarkers market was valued at USD 5.09 billion in 2025 and is projected to grow to approximately $USD 32.37 billion by 2034.[43]

Digital biomarkers can enhance the quality of care provision by enabling:

- Care in the home – fall detection sensors and vital signs monitors can enable older people to safely remain at home for longer, which has been shown to have positive impacts on health outcomes.
- Tracking disease progression – continuous data from digital biomarkers allows for more accurate tracking of disease progression, enabling timely adjustments to treatment and better management of health over time. One example is Parkinson's disease and using an accelerometer or gyroscope to measure movement.
- Monitoring patient adherence – digital biomarkers provide objective data on patient adherence, offering a more accurate assessment than self-reported information and ensuring treatments are followed correctly for optimal outcomes.
- Holistic healthcare – digital biomarkers offer a comprehensive view of a patient's health by tracking multiple factors over time, providing a richer picture of their condition compared to occasional in-clinic assessments.
- Holistic clinical trials – similarly, by enabling continuous real-time data flow remotely, the effect of a treatment or intervention can be measured across a longer time period in more standard conditions, enhancing the evidence base behind novel treatments.

Whilst they are predominantly used in research and pharmaceuticals at this stage, digital biomarkers are expected to soon become integral to public healthcare provision, enhancing overall care quality.

### Recommendations

- Invest in data collection (quantity and quality) as a priority, to enable smarter and more effective AI solutions of the future.
- Explore partnerships with data repository providers and experiment with AI diagnostic tools to enable more informed and data-driven care.
- Design with digital biomarkers in mind. Whilst they are fastest growing in R&D, digital biomarkers will soon have important applications in the way we provide healthcare in the community, or indeed for previously hard-to-manage conditions.

In recent developments in the field, we are seeing promising applications for the use of real-time digital biomarkers to diagnose and manage Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome (ME/ CFS), where symptoms often evade traditional point-in-time diagnostics like blood tests, and treatment options are limited. With research highlighting the potential use of heart rate variability (HRV) to offer physiological insights into the condition, wearable and apps are now being used to facilitate continuous monitoring and support "pacing" strategies. This represents an entirely nascent treatment pathway with the potential to greatly impact quality of life.

Another, more futuristic example: a research group in the US is developing a "smart toilet" with integrated sensors to detect biomarkers such as protein, blood, and ketones in urine, alongside stool analysis, as indicators of potential kidney disease, UTIs, gastrointestinal disorders, cancers and other conditions. This kind of innovation provides food for thought in the potential to radically change the way that we support individuals at high risk or with a genetic predisposition to certain conditions, in their own homes.

### Digial biomarker examples

**Movement**
- Accelerometry & Balance
- Step Count
- Gait Analysis

**Cardiovascular**
- Heart Rate
- Heart Rate Variability
- Blood Pressure

**Respiratory**
- Breathing Rate
- O2 Saturation

**Sleep**
- Sleep Duration
- Sleep Stages *(using accelerometer and heart rate data)*
- Sleep Efficiency

**Cognitive**
- Reaction Time *(via apps and games)*
- Device Usage
- Eye-movement

**Metabolic**
- Caloric Intake *(tracked through app inputs)*
- Energy Expenditure
- Glucose Level

**Emotional**
- Facial Expression Analysis *(Smartphone cameras)*
- Vocal Tone and Pitch (via microphone)

**Environmental interaction**
- Location Tracking & Geopositioning *(GPS)*
- Social Interaction Patterns *(through app usage data)*

# Successful adoption and implementation

Technology offers important opportunities to reduce costs and demand while improving care quality and supply. However, implementation is as crucial as the technology itself. This section examines the key elements for successful deployment and adoption.

### Defining a clear problem

Tempting as it is to try to solve every problem at once, successful implementation of new and developing technologies requires a scaled approach – starting with small and well-defined problems that showcase clear value-add for the intervention. This requires thorough research, stakeholder consultations, and a comprehensive understanding of the challenges faced, setting solid foundations for subsequent expansion and scaling.

### Analysis and return on investment

The market is rich with technologies and solutions, not all of which will necessarily be worth the time and cost of implementation. It is therefore important to conduct thorough analysis and detailed research that determines potential return on investment in line with overall impact on organisational goals. This can be complex when considering the variety of downstream impacts on patient outcomes and other implications.

### Leveraging out-of-the-box solutions

A whole host of exciting products and services are available out-of-the-box, which are important options to explore before committing to customised solutions (and associated costs). Leveraging pre-existing solutions allows for a more efficient implementation and can facilitate a quicker realisation of benefits if used when and where they are appropriate to organisations and strategic objectives.

### Solutions that scale to problems

We have seen how siloed solutions to largescale problems are inherently limited in their ability to affect change and can often add complexities and duplication in otherwise crowded technology environments. It is therefore important to take a stepped back, strategic approach to our country's largest problems, with solutions that scale to the problem we are trying to solve, whether local, regional, or national.

### Integration with legacy systems

The future of healthcare dictates seamless user journeys both through care provision and delivery, and the digital platforms and services that we use. An easier task – perhaps – if we were starting from scratch, but more challenging when working with and alongside legacy systems that cannot be turned off. It is imperative that newly introduced technologies can integrate with legacy systems and workflows without adding complexities and duplicative actions. Transitions and integrations must minimise disruption, ensuring a smooth transition for users, with detailed consideration as to how data will be safely migrated and stored for operational continuity.

# KEY THEMES

The key themes discussed across the different sections of this paper have been summarised here.

### Technology to increase the safety and scope of care provision in the community

Providing increased care in the community or home-based settings will be key to reducing hospital congestion, prioritising inpatient beds for those who need them most. Technology represents an opportunity to increase the safety and scope of care provision outside of hospitals, including via self service solutions, Remote Patient Monitoring (RPM) tools and wearables. In one example, HealthPathways (a Christchurch-born, collaborative and clinician-led initiative designed to streamline patient care) has significantly impacted hospital occupancy rates by promoting more effective management of patients in primary care settings, thus reducing the need for hospital-based interventions.

### Technology for consumer empowerment and self-management

Evolving technology solutions present key opportunities to empower consumers to actively engage in their healthcare and support themselves more autonomously. Examples include platforms that enhance access to information, and wearables that facilitate real-time health feedback. Empowering individuals with this kind of information, alongside education and awareness, helps them to make more informed decisions and seek clinical support at the right time, or more actively engage in their healthcare. New approaches may be required to enable more structured, universal access.

### Technology to change treatment paradigms from sick-care to well-care

The traditional break-fix model of care delivery is centred around treating illnesses and injuries after they occur, leading to higher costs and inefficiencies, managing acute conditions rather than preventing them. In the future of healthcare, technology plays a pivotal role in transitioning from this “sick-care” paradigm to a “well-care” model; through the use of digital health tools (e.g wearables, telemedicine and data analytics etc) enabling healthcare providers can monitor patient health continuously and intervene earlier.

### Technology for equitable care delivery

Whilst New Zealand faces many of the same challenges as other healthcare systems globally, the same solutions cannot necessarily be deployed to the same effect. With a national population roughly the same size as Singapore across an area 360 times larger, new and innovative models of care are needed to support communities, enabled by technology. Good examples include care delivery on the West Coast which supports rural populations by focusing on accessible, local services, including mobile general practices, and specialised training for rural generalists, enabled by telehealth. In the New Zealand context, future-proofed healthcare systems leverage technology to patch the gaps in equitable care delivery nationally.

### Technology to build capacity and resilience through ‘digital FTEs’

Declining clinical productivity is contributing to New Zealand’s workforce shortages, with up to 30% of all clinical hours spent on non-patient facing / administrative activities. Adding clinical resource to hospitals isn’t the simple fix that we would hope for and is actually more likely to drive up hospital congestion (patients realise they are more likely to be seen versus in primary care settings). With no corresponding infrastructure and process support, this further constricts patient flow and reduces overall clinical productivity. Future proofed healthcare delivery will leverage automation and productivity tools, e.g. agentic AI as “digital FTEs” to support physical FTEs, force-multiplying the clinical workforce.

# KEY ENABLERS

Enablers are the critical resources, processes, or conditions that must be in place to facilitate the successful implementation of technology transformation. Embedding these tools will ensure that the necessary resources, infrastructure, and support systems are in place to drive innovation and change, and return on investment from technology procurement.

### AI Governance and regulation

Proper governance and regulation is needed for safe and effective AI implementation. This helps to mitigate the risks associated with poorly designed and trained AI systems, which can otherwise cause or undermine public trust. We need robust and universally mandated guardrails, such as constraints on open-ended bots, rigorous testing on high-quality, unbiased data, nonLLM guardrails and human fallback mechanisms to manage risky inputs and maintain oversight over complex queries. Furthermore, established ethical guidelines, regular audits, and comprehensive user training are required to foster a culture of safety and accountability in the use of AI.

### Structured innovation pathways for targeted technology solutions

New Zealand's healthcare system is dependent on innovation, as a means to deliver better care at less cost, either through new products and services (with additional potential for commercialisation) or changing treatment paradigms. This requires incentivisation, infrastructure and a better link between research and care delivery organisations so that proof of value can be demonstrated, and the best ideas can be scaled. Technology is a core enabler for New Zealand's healthcare system, and proper structure and support for local and organic/frontline innovation will deliver more targeted and cost-effective solutions vs external procurement.

### High quality, interoperable data

Universal access to high-quality, interoperable data is essential for realising the full potential of healthcare technologies. In New Zealand, data fragmentation, access barriers, and inconsistency hinder our ability to leverage insights from across the spectrum of care delivery and the end-to-end patient journey. Interoperable systems are crucial to link these disparate data sources together and enable advanced tools like AI to generate meaningful insights. Otherwise, the quality of AI responses and the impact of its application will be inherently limited.

### Political insulation

The provision of healthcare technology must be politically insulated to ensure sustained development and delivery, transcending electoral cycles. In the current landscape, where initiatives are often subject to changing administrations, the start/stop model leads to inefficient use of resources and significant sunk costs. It is essential to ensure that healthcare technology initiatives are driven by long-term strategic goals rather than short-term political agendas. Independent oversight bodies or bipartisan agreements may help to shield initiatives from political volatility, maintaining continuity and allowing for consistent progress and optimisation of health outcomes. This stability is also crucial to build public trust in the system, demonstrating a commitment to sustained improvement.

### Digital literacy and training

Digital literacy, including in the use of AI and other technologies, is essential for safe and effective digital health delivery. Improper usage can lead to over-reliance and errors, compromising care quality. In particular, AI adoption is currently inconsistent and often self-led, highlighting the need to support early adopters and digital champions with suitable AI training to maximise benefits whilst mitigating risks. Skipping this step puts New Zealand at risk of undermining clinical and patient trust, and reversing progress.

# Summary of recommendations

New Zealand's healthcare system is at a crux point, requiring us to reimagine and evaluate our care paradigms to ensure its long-term sustainability. By leveraging the current and emerging digital tools and technologies at our disposal, we have the opportunity to create positive feedback loops that drive a healthier population and a more sustainable trajectory for our healthcare system.

## Drive up quality

- Invest in data quality and collection now, to enable smarter and more effective AI engines of the future.
- Explore partnerships with data repository providers and experiment with AI diagnostic tools to enable more informed and data-driven care.
- Prepare for the rise of digital biomarkers. They are fastest growing in R&D, but will soon have important applications in the way we provide healthcare in the community.

## Drive down demand

- Adopt self-service and automation, with quick wins in administrative functions, to alleviate pressure on clinical services.
- Invest in change management and education for the rollout of patient- facing solutions, ensuring equity and user-centred design is well considered.
- Focus now on robust guardrails and ethical frameworks around the use of AI and automated tools, to enable safe future implementation.
- Invest in tools and technologies that facilitate care in the community and improved primary care outcomes that will drive down demand for specialist and tertiary services.


## Drive up supply

- Establish a strategic approach to adoption of automation and AI tools across primary and secondary care, with a focus on change and training.
- Leverage predictive analytics, such as smart rostering tools, to support better alignment of supply with demand.
- Drive productivity in hospitals via AI and automation, targeting improved patient flow through better operational management, saving clinical time.
- Invest in solutions that extend remote care capabilities to drive up healthcare supply to rural populations, reducing the need for rural infrastructure.

## Drive down cost

- Implement task automation to reduce spend on clinical hours and predictive analytics for reduced redundancies.
- Embrace smart hospitals by integrating AI, IoT, and robotics into standard operating models and ways of working, to drive efficient, and data-driven patient care environments.
- Identify and target patient flow bottlenecks to drive cost savings in the hospital environment.

## Ecosystem wide

- Shift resources and investment towards primary care and care in the community, exploring technology that can enable remote and community care.
- Establish innovation pathways that link private sector health technology and academic research directly to hospitals and clinical practice, targeting priority healthcare challenges and supporting innovation growth.
- Establish robust health technology governance to shield initiatives from political volatility, ensuring they are driven by long-term strategic goals rather than short-term political agendas.
- Explore technology and digital enablement options that can facilitate and support an operating model shift towards more proactive and preventative care.

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