

Reimagining healthcare infrastructure: efficient, agile, sustainable





In 2020 the world changed as we know it, and the need to pivot and innovate has never been more pressing.

The **COVID-19 pandemic** has brought into sharp focus the vulnerabilities that exist in many healthcare systems. Healthcare investment has always been the subject of intense focus in the competing demands for investment dollars, whether from the public or private sectors.

Now, in the wake of the COVID-19 pandemic, there is an increasing interest in reform in healthcare delivery, so that systems are capable of being responsive to pandemics, and meeting shifting consumer appetite and preference towards more digital healthcare access options. Healthcare providers have had to quickly adapt their service delivery models, consider future possible scenarios, and continue to innovate as improved outcomes are demanded from limited investment dollars.

This will no doubt represent a significant challenge for the hospital and health services; however, one which is increasingly being driven by community expectation.

Despite global expenditure on healthcare increasing, our systems and infrastructure are not effectively meeting this accelerating demand, with expenditure still occurring in many jurisdictions to address historical under-investment. Rising healthcare infrastructure costs and ageing assets will mean a struggle to deliver on political imperatives for the delivery of new, and repurposing of existing, infrastructure. The increasing focus on mental health at a political level is also showing a long-term deficit in investment.

Healthcare providers must look to new models of healthcare infrastructure investment and service delivery that meet the expectations of an increasingly aware community, are fit-for-purpose, flexible, efficient, and are sustainable, all while ensuring the patient and their communities are central to their planning, design, delivery, and operation.



Sustainability improvements, reduced energy usage and carbon reduction are also increasingly part of the drive for improved outcomes.

For example, the Victorian Government has committed to legislating a long-term target for Victoria of net zero greenhouse gas emissions by 2050. In New Zealand, a carbon neutral initiative was launched in 2020 with goals for net zero by 2025 for the public sector and 2050 for all of New Zealand.



Aurecon explores the challenges and potential solutions in our **Reimagining Healthcare Infrastructure thought leadership series**, which unpacks how healthcare providers can navigate beyond the current pandemic into the future of a sustainable, human-centred healthcare system. Across the series we explore how current trends are shaping the need to adapt and shift healthcare infrastructure planning, investment, design, and delivery to better meet current and future demands.

In this first article, Aurecon's Major Projects Director Ben Coxon (Australia) and Sustaining Capital Leader Matt Capon (New Zealand) give an overview of the key trends that are impacting healthcare infrastructure planning, design, delivery and operations, and touch on how we might better plan for an uncertain future.



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Health has come into sharper focus for governments worldwide

The **COVID-19 pandemic** has lifted the prioritisation of healthcare by governments worldwide as vulnerabilities in our healthcare systems have been exposed.

These include the lack of flexibility and adaptability of legacy facilities to cope with change evident through our involvement in supporting COVID-19 responses. The need for investment and reform has become paramount, and as a result, healthcare has become a political imperative, like never before.

Health spending is growing faster than economies, which is creating inequalities and an unsustainable situation, placing pressure on the delivery of new, and repurposing of existing, infrastructure, due to an infrastructure deficit and ageing assets.

Many facilities require upgrades to meet existing and future demands, and there is a need for new solutions to create a more resilient and sustainable health system. On many hospital sites, administration functions are housed in former ward buildings, and comparing these with new facilities provides a stark reminder of how much models of care and needs have changed.

Both **Australia** and **New Zealand** spend 9.2 per cent on healthcare as a share of GDP, which is above the OECD median of 8.2 per cent. Similar trends are mirrored in parts of Asia. For example, in Hong Kong, total health expenditure rose at an average annual rate of 5.6 per cent in real terms between **1989/90 and 2018/19**. According to the **Deloitte Global Healthcare Sector Outlook** global healthcare spending as a percentage of GDP was expected to rise to 10.3 per cent in 2020, slightly up from 10.2 per cent for the previous three years.



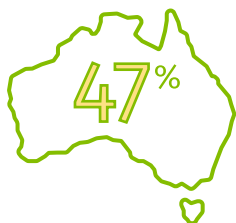
*Despite global healthcare expenditure steadily increasing by **3.9 per cent per year between 2000 and 2017** and life expectancy increasing from 66 to 72 years **in the same period**, many health outcomes are not improving for all.*

The New Zealand government recently introduced the Māori Health Authority in an attempt to start to rectify this imbalance, plus a single health authority to replace the 20 regional district health boards, aimed, in part, to eliminate 'postcode lottery', amongst other objectives.



However, with the expected trajectory in population growth, ageing populations, and the increasing incidence of chronic disease due to poor lifestyles, the prediction is that health spend will be unsustainable in future budgets.

Despite their first world status, countries such as Australia and New Zealand are facing a developing health crisis and strain on health systems. Our societies are afflicted by health challenges, including mental health issues, obesity, diabetes, cardiovascular disease, and hypertension.



Over 47 per cent of Australians have one or more chronic diseases.

Most cases are ascribed to unhealthy eating, sedentary lifestyles and the stress of living in today's fast-paced world. These issues are serious now and are likely to get worse.

The pandemic saw huge changes in peoples' lives with many working from home and being unable to decouple home life from work. The impact on mental and physical health is only likely to become apparent over the next few years.

To meet the demands of these imperatives, we need to be smarter about how we design, develop and deliver healthcare infrastructure. Smart design of new facilities would allow re-purposing in the future, thus potentially ending the accommodation of administration functions in former medical spaces. Also, delivering more healthcare infrastructure doesn't have to involve investing capital into developing new greenfield sites.



Is there a case for a salutogenic approach to healthcare infrastructure design?

While upgrading existing assets and creating new healthcare facilities are part of planning considerations, there is also a shift to looking beyond purely a pathogenic approach (curing disease) to incorporating a more salutogenic approach, that is, a proactive, resilient, and sustainable healthcare system that focuses more on preventative measures and non-capital solutions. This has become a particular focus during the COVID-19 pandemic, during which underlying health has been shown as a predictor of COVID outcomes for patients who become infected with the virus. As mental health has also come into sharper focus during the pandemic, our approach to the design and delivery of mental health facilities also needs to become a higher priority as the overall wellness of individuals and communities becomes paramount.

The pandemic has created a unique opportunity to look beyond health as a cost and instead consider how we can use it to support economic recovery. Poor health has been found to cost twice as much as the cost of the pandemic on the economy at around **15 per cent of global real GDP**.

If we were to consider health as an investment, we could accelerate economic growth, and therefore a lifting in living standards. We do this by being smart about how we plan, construct, and deliver our healthcare infrastructure so that it not only meets current demand, but also creates resilient and sustainable healthcare for the future.



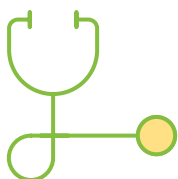
Optimising existing assets to deliver more efficient healthcare





Although spending is increasing, we are not meeting increasing demands for healthcare services.

To meet the increasing demands on our healthcare systems, we need to look beyond simply building more hospitals. A large part of preparing our health system for the future is looking at how we can optimise what we already have. The current costs of our hospital assets are creating a growing financial burden, so how can we optimise these existing assets and where appropriate, repurpose them to reduce operational costs while still meeting the service demand? A large part of this is understanding how we manage and make best use of existing assets as demand is unlikely to decrease.



*In Australia between 2017-18, the amount of Australians with one or more chronic conditions **rose by five per cent** from 42 per cent over the past decade. In **New Zealand**, Ischaemic heart disease caused the most deaths in 2019, and deaths caused by this have increased by 12.3 per cent since 2009, followed by strokes increasing by 16.7 per cent over the same period.*

Signs that demands are not being met are also being seen in hospital wait times. Elective surgery waiting times have increased from **33 days in 2008-09 to 50 per cent** of patients waiting at least 41 days for admission in 2018-19.

The intellectual effort that is expended in designing a new facility is rightly significant and yet this is rarely matched during the critical operating and asset management years of the lifecycle. Innovation throughout the asset lifecycle is likely to see a slower decline in usefulness.

Using **digital tools** can help in more effective management of existing assets to ensure that our current healthcare infrastructure can operate more effectively to meet growing demand. Utilising tools such as **digital twins** and applying data analytics through **machine learning**, can help to manage the operation of existing assets better. Getting a clearer view of aspects such as scheduled maintenance, energy, water usage and waste management requires data robustness that can offer a wealth of opportunities for better decision-making to improve efficiencies, manage demand and reduce costs.

Optimising existing assets is also critical for planning how we deliver healthcare services. By repurposing what we have through strategic **asset management** we can reduce the cost of meeting future demand. Also, by looking beyond our healthcare assets to other spaces, we can further expand access and delivery efficiency. For instance, utilising retail spaces and empty commercial tenancies may provide an alternative to delivering healthcare in traditional medical facilities for low acuity and non-critical specialist services, and enable the provision of decentralised access for more of the community.

In “Repurposing Large U.S. Malls and Retail Spaces”, [David Allen identifies this trend](#), given there is a convergence between a declining retail market and the rise of healthcare needs in the United States. This shift towards increased primary healthcare requires careful consideration given the potential for simply increasing overall demand with the increased supply.



This shift towards increased primary healthcare requires careful consideration.

The drivers for this are not unique to any one jurisdiction. In 2021, [the Queensland Audit Office](#) undertook an audit to assess the effectiveness of the planning for sustainable health services in the state. It was identified by the auditor that “Queensland Health has a growing and ageing asset base. It has identified that it will need significant further investment to renew these assets and acquire new ones. However, it needs to improve its approach to decide the relative priority of future investments. The department now requires hospital and health services to improve their asset management data and reporting.”

In a similar vein, in 2020, the [Audit Office of NSW](#) found that “NSW Health has substantially expanded health infrastructure across New South Wales since 2015. However, the program was driven by Local Health District priorities without assessment of the state’s broader and future focused health requirements.”

In New Zealand, the [National Asset Management Programme \(NAMP\)](#) for district health boards (DHBs) outlines the condition of health assets and requirements for the future. In its June 2020 ‘current state’ report it noted that considerable investment was required over the long-term to improve the condition of existing assets. It estimated that a NZD 14 billion investment would be required for buildings and infrastructure over the next 10 years, as well as building capability to support system transformation. This national approach has been further promoted through the recent introduction of the NZ Health Authority, and proposed disbanding of 20 regional district health boards.

It is obvious that better utilisation and repurposing of existing assets is integral to any future plans for health infrastructure investment.

A green circular icon with a white background. Inside the circle is a green-outlined smartphone. The screen of the phone displays a neural network diagram consisting of three layers of nodes connected by lines. The top layer has 3 nodes, the middle layer has 4 nodes, and the bottom layer has 3 nodes. The phone has a yellow vertical bar on the left side representing a home button.

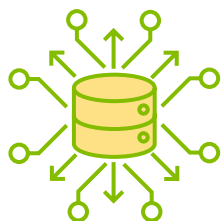




While there are many digital tools that can be used to better manage the operation of healthcare assets and improve the patient experience, smart use of digital solutions also helps with business cases and capital investment decisions.

Digital can be used to better plan infrastructure upgrades and new asset builds to ensure they are done more efficiently and within time and budgetary constraints. Harnessing the power of digital in the design of assets using computational design and multi-dimensional modelling also helps in planning to **improve efficiency, quality and costs**.

It also assists with managing supply and demand, triaging patients, improving processes, and managing costs, enabling confident decision-making about which services can be delivered virtually and which need to be delivered in a specialised medical facility. This improves the patient experience as well as the efficiency of clinicians and the facilities from which they operate.



*As Dr Andrew Maher, Aurecon's Chief Digital Officer, says, **"It's not just big data, it's about the right data" when it comes to digital and infrastructure.***

Digital also plays a big part in meeting changing consumer expectations. By utilising digital tools such as interoperable sensors and cloud solutions, health monitors and apps, medical professionals and consumers can access more health data than ever before. This helps to deliver more personalised and targeted care by creating a more holistic picture of the patient for providers across their healthcare assets and services.

The increased use of digital technologies also has a significant impact on the ICT infrastructure required to manage and support it. ICT is a fundamental part of overspenders in health so needs to be better understood by healthcare providers. The role and complexity of technology in health is increasing. Healthcare, technology, and buildings are becoming more and more integrated for new facilities, while perhaps being more challenging for existing facilities. Notwithstanding, this promises better efficiency and better health outcomes but it also can lead to increased risk. As we highlight in this paper: **'Integrated Systems Testing of Healthcare Facilities'**, failure in commissioning can have a significant impact on the users, including patients, clinicians, nursing staff and hospital engineers.



Getting smarter with constructing health infrastructure

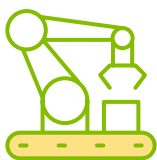




We need to become smarter about construction. Through planning appropriately and creating standardised approaches, we can optimise design and delivery while also creating resilient infrastructure.

This ensures we can meet the timeframes required by governments and deliver sustainable healthcare assets that are future-proofed.

Smarter planning also means creating resilient and flexible spaces that are designed to meet future demand. By utilising **smart construction methods** such as Design for Manufacture and Assembly (DfMA), incorporating off-site modular and/or on-site robotic construction, we can design and deliver health infrastructure efficiently and cost effectively that can also shift with changing demand. This has never been more important than in a pandemic situation, where smart construction could mean no disruption to existing operations, with in-built flexibility for uncertain future requirements, as exemplified with the recent expansion of the emergency department at **Melbourne's Monash Medical Centre**, using a modularised approach.



Smart construction techniques are already being utilised to improve project outcomes.

For example, Aurecon, in partnership with our client, Lendlease, employed digital technologies to drive a lean thinking approach, leveraging smart approaches to construction to deliver a modern medical facility in the new **Sunshine Coast University Hospital**.

Emerging technologies, such as blockchain and 3D printing, have the potential to revolutionise construction and could bring huge efficiency and cost benefits to the health sector.

We should also consider the entire supply chain and how we can incorporate more sustainable approaches, in combination with prefabricated and modular construction, such as using 'green' steel and 'green' concrete, or materials such as timber. Construction techniques that reduce waste and noise and improve safety should be part of the mix.

When we construct smarter, we can also reduce the cost of delivery overall and make our healthcare assets more flexible and adaptable to future demands. This means that we can deliver better, more affordable infrastructure to our entire healthcare system, including to regional communities, which often suffer from lack of access to quality healthcare services and facilities.



The importance of de-risking delivery with careful planning



Meeting the future demands of our healthcare system carries substantial risk, particularly with added pressures to meet political imperatives within tightened budgets.

How can we de-risk delivery by planning for flexible and agile healthcare assets?

We are under increasing pressure to deliver healthcare infrastructure in less time and at a lower cost. To do this, we must start looking at how we plan delivery of healthcare assets.



Putting the patient at the heart of planning and utilising digital planning tools to project manage more effectively ensures that budget requirements are met, and facilities are built on time.

While greenfield developments carry less risk, the reality is that space is at a premium. Brownfield developments are **more sustainable**, but the need to understand the **challenges of delivering in an operational environment** is vital to avoid cost blowouts and time delays, and ultimately, adverse stakeholder experiences.

Utilising both digital tools to assist with efficient design and project management and future-proofing designs to account for uncertainties is essential.

While not applicable to all sites, those who turn to a **programmatic approach**, grouping similar projects together either by type, function, region, or other relevant grouping – are realising significant value for money, reducing risk, and achieving better business performance.



Alternative funding models – a roadmap to fiscal sustainability of healthcare



Despite increasing healthcare expenditure, it is not keeping up with increasing demand and the rising costs of delivering services.

This is driven by:



The rising incidence of chronic diseases



Socio-economic trends



An ageing population



Ageing existing infrastructure



Consumer expectations



Increased capital costs

Healthcare models are struggling to solve the challenges of affordability, equitable access to quality healthcare and efficiency.

Consolidating existing assets to create efficiencies is one approach already being explored and implemented by some jurisdictions. However, utilising alternative funding models is another opportunity to alleviate costs for the community and help governments fund new projects. Increasingly, we are seeing technology companies moving into the healthcare delivery space and bringing more funding to projects as well as digital solutions.

Private capital is also helping to fund health-orientated infrastructure. This private enterprise approach, either independently, or in partnership with public bodies, is based on investors earning a return based on the benefit that infrastructure provides in reducing healthcare costs overall.

In **'Funding for Value'**, PwC identifies the different funding mechanisms globally and argues the case for a value-based model of funding.

The answer lies in more efficiency across the whole system that is more affordable now and sustainable into the future.

How can healthcare providers future-proof healthcare infrastructure?

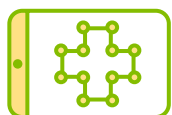
With the costs of healthcare delivery increasing more than the rate of spending, there is a need to seek solutions that optimise existing assets and deliver efficient infrastructure solutions.

If we look at things differently, we can deliver more than just more hospitals. We can deliver a diverse, agile, and sustainable healthcare system for our communities.

Through our **Reimagining Healthcare Infrastructure** series, we will uncover solutions to help shape the future of healthcare beyond the pandemic, from strategic planning to the delivery of new and repurposing of existing assets. This is the first article of the series in which we will unpack:



Optimising existing assets to deliver more efficient healthcare



Applying digital to health infrastructure to deliver clever solutions



Getting smarter with constructing health infrastructure



The importance of de-risking delivery with careful planning



Alternative funding models – a roadmap to fiscal sustainability of healthcare

We look forward to sharing further insights with you as we explore how we can navigate towards a new model for healthcare infrastructure delivery.

About Aurecon

Aurecon is a design, engineering and advisory company. Our purpose is bringing ideas to life, to imagine and co-create with our clients a better future for people and the planet.

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