# Can we predict the effects of artificial intelligence and virtual care on the health labour market?

**STEPHEN J. ROBSON** *The Australian National University*
**MARTIN HENSHER** *University of Tasmania*
**JEFFREY C. L. LOOI** *The Australian National University*

## Abstract

Australian society, as is observed globally, is undergoing a profound demographic shift with an ageing population imposing increasing demands on the health system. There is a well-recognised association between an ageing population and the need for health and aged care. As such, the demand for high quality care services will grow necessitating the attraction, training and retention of workers supported by better use of technology and data. With increasing demand for a healthcare workforce of appropriate size and skill, attention has turned to new technologies such as artificial intelligence and virtual care as potential ways of dealing with labour market supply constraints. While these new technologies are exciting at this point, they are nascent and there is not, as yet, clear evidence that they will have a major effect on health workforce requirements. It is too early to be optimistic regarding artificial intelligence technologies in healthcare, and virtual care still requires a workforce to underpin its operations. Cautious evaluation is necessary before artificial intelligence and virtual care become practical in more complex human healthcare tasks or can emulate the abilities of humans in delivering human-centred healthcare.

JEL Codes: C45, I11, J01, J08, J23
Keywords: Healthcare; workforce; artificial intelligence; virtual care; modelling

Disclosure and conflicts of interest
None of the authors have any financial or other substantive conflicts of interest that may be construed to influence the results or interpretation of their manuscript. There were no financial contributions or funding for this paper.

# Introduction

At the beginning of the September of 2022, only four months after its election, the Albanese Government through the Department of the Treasury convened the *Jobs and Skills Summit* at Parliament House in Canberra. Although the remit of this meeting was wide ranging, among its key goals was to address skill shortages in the care economy. In particular, the issues document informing the summit referred to the following:

> "The most significant structural shift of the past 20 years has been the rise of the services sector. The growth in the health and care economy has been an important part of this trend. The healthcare and social assistance sector has more than doubled in size over the past 20 years, rising from 10 to 15 per cent of the workforce and now employs more than 2 million people… Labour shortages in the care workforce are already acute and expected to worsen with a projected shortfall of 286,000 care workers by 2050."[1]

In the lead-up to the summit the Minister for Health and Aged Care, Mark Butler MP, hosted a health workforce roundtable. Bringing together peak bodies from across the health and aged care sector, Minister Butler published remarks as follows:

> "Growing and supporting the health workforce is my priority – from nurses, to physios, to doctors, to cleaners, paramedics, wardies, security guards and every other health worker. We have an opportunity to invest in our current skilled workforce, and the skills of the next generation of health workers to better support their needs and deliver local jobs in communities across the country. My priority is to get this right to build the health workforce we need now and in the future."[2]

It should not surprise anybody that current demographic trends have underpinned a focus on the provision of healthcare: an ageing population – and therefore also an ageing workforce – with a greater prevalence of chronic and degenerative disease, requiring new patterns of more complex care and health technologies (Phillips, 2019). These demographic and health workforce pressures are being felt across the globe and are certainly not limited only to Australia or other high-income nations (Boniol *et al.*, 2022).

---

1 Treasury Jobs and Skills: Report: https://treasury.gov.au/sites/default/files/inline-files/Jobs-and-Skills-Summit-Outcomes-Document.pdf

2 Mark Butler, August 2022: https://www.markbutler.net.au/news/media-releases/growing-and-supporting-our-health-workforce/

In the immediate aftermath of the summit then-chair of the Productivity Commission, Michael Brennan, delivered the Deeble Lecture in which he chose specifically to address the issue of health workforce and how technology might affect the delivery of healthcare:

> "Technology may … give the patient greater scope to take charge of their own healthcare needs, with a reduced role for an omnipresent healthcare worker. This approach means scarce healthcare workers can help more people, an outcome that is particularly valuable in regional and remote areas where labour shortages seem particularly severe. It also offers the potential to reduce burnout and stress on harried health workers and can promote better outcomes for patients."[3]

An adequate workforce is critical for the future sustainability of healthcare systems both in Australia and globally. As things stand, in the post-pandemic environment and with an ageing population demographic, there is likely to be a large gap between the care needs of the community and the healthcare workforce required to deal with them adequately (McPake *et al.*, 2024). In this paper we will explore the potential for two key technological 'solutions' – artificial intelligence (AI) and virtual care (VC) – to augment and increase the productivity of the healthcare workforce and, potentially, to take the place of healthcare workers. To do this we will review the roles and requirements of the healthcare workforce, explore the current and likely future capabilities of AI and VC to augment productivity and potentially take the place of healthcare workers, and draw on lessons from implementation of data-based 'solutions' in healthcare in the past.

## People care for people

The delivery of healthcare is famously labour intensive, irrespective of the type of health system and its structural characteristics, levels, sources of funding, and even political underpinnings (Lee, Propper and Stoye, 2019). Ensuring an adequate workforce to provide healthcare is, thus, vital and an imbalance in supply of the necessary human resources delivering care can lead to severe economic and social harms, including life-long morbidity and preventable death (Amorim Lopes, Almeida and Almada-Lobo, 2015). Studies from health systems both in European countries (Hofmarcher, Festl and Bishop-Tarver, 2016) and the United States (Sheiner and Malinovskaya, 2016) have reported that healthcare workers are the most important resource in the care sector. While labour

3 The 2022 John Deeble Lecture is available here: https://ahha.asn.au/podcast/the-2022-john-deeble-lecture/

markets across industry and manufacturing have reported productivity gains resulting in job losses, this trend has not been observed in healthcare.

In Australia, increasing demand in the face of difficulties in recruitment and retention of healthcare workers – exacerbated by the COVID-19 pandemic – at the same time as international healthcare worker shortages are manifest have led to concerns about structural problems in the delivery of healthcare at entry, exit and follow-up from acute care (Looi *et al.*, 2023). In a report for the US Brookings Institute, Sheiner and Malinovskaya (2016) concluded that productivity growth in the health sector has been much lower than economy wide productivity growth and possibly even negative. Those authors reflected a view that the healthcare industry is inherently incapable of achieving the same rates of productivity growth as the rest of the economy. Using historical evidence, they warned that the labour intensive nature of health care services makes health provider productivity unlikely to achieve improvement equal to the economy as a whole over sustained periods – mirroring Baumol's famous diagnosis of "cost disease" in service industries such as healthcare (Baumol, 1993).

In a situation of increasing demand for healthcare services, coupled with labour market constraints, it might be expected that technology improvements would lead to productivity gains. Surprisingly evidence to support this assumption is difficult to find. In a paper for the National Bureau of Economic Research (NBER), Bronsoler and colleagues (2021) examined the potential effects of information and communications technology – including clinical decision support systems – on the healthcare workforce. They found a relatively small literature dealing with the effects of these technologies on workers and, indeed, nothing to suggest that technology is reducing the need for healthcare workers such as nurses. Their overall conclusion was:

> "The literature points in a broadly optimistic direction in that the more recent cohort of studies suggests a positive effect on patient outcomes, but a more modest impact on productivity. Like the broader [information and communications technology] literature, this positive mean impact conceals a lot of heterogeneity underneath and long lags between adoption and outcomes, consistent with learning. Costs tend to rise, however, especially in the early adoption phase. The evidence on workforce outcomes is very slim, but what there is suggests little average effect with a hint of the heterogeneous effects by skill."

This finding – that the literature regarding the effects of technology on the healthcare labour market is scarce – has recently been echoed by other researchers (Borges do Nascimenta *et al.*, 2023). Data from Australia show little evidence of a reduction in the healthcare workforce over periods of rapid technological change in the delivery of healthcare: the total number of Australians employed in healthcare has continued to increase (Figure 1). This increase has been associated with changes in the working hours of individual workers and the proportion working full time (Figure 2).

As the *Jobs and Skills Summit* highlighted, an appropriate health workforce is critical to the productivity to the country overall: unmet need in healthcare can have a direct negative effect on the economy (Suhrcke *et al.*, 2009). There is strong evidence of a significant shortfall in the nursing workforce in Australia[4] and, at the time of writing, the Australian Government's *Nursing Workforce Strategy* was under review.[5] Medical practitioners are the group with the longest training time required to reach practice levels. The Australian Government released its *National Medical Workforce Strategy* in 2021[6] with the stated aim of guiding the "collective effort to ensure that our medical workforce meets Australia's ongoing health needs." Informing the Strategy are some key principles:

> "The medical workforce has a profound impact on the quality, accessibility, effectiveness and sustainability of the health system. However, inequality of access to health services remains a key issue for Australian communities. To achieve maximum benefit to the community, the medical workforce must be geographically well distributed and have the appropriate mix of medical specialties in each location. Currently this optimal distribution and service mix is not consistently achieved across Australia, resulting in service gaps and inefficiencies, and potentially impacting on the quality of patient care and the working life of Australia's doctors."

Of the five priorities articulated in the Strategy, priority number two is to rebalance supply and distribution of Australia's medical practitioners. This priority is underpinned by some key assumptions:

> "A key principle underlying Australia's healthcare system is that no individual or community group should be disadvantaged when accessing healthcare services. However, there are imbalances in Australia's medical workforce. There are undersupplied specialties, too few Aboriginal and Torres Strait Islander doctors, and poor distribution of doctors across the country, which leads to an over-reliance on locums and IMGs to service some areas. Growth in the subspecialist workforce and oversupply of some specialties has created training

---

4 Peters, M. (2023), 'Addressing nursing workforce shortages with comprehensive evidence-based strategies', *Australian Nursing and Midwifery Journal*. Accessible at: https://anmj.org.au/addressing-nursing-workforce-shortages-with-comprehensive-evidence-based-strategies/

5 National Nursing Workforce Strategy. Accessible at: https://www.health.gov.au/our-work/national-nursing-workforce-strategy

6 Commonwealth of Australia. National Medical Workforce Strategy 2021-2031. Accessible at: https://www.health.gov.au/sites/default/files/documents/2022/03/national-medical-workforce-strategy-2021-2031.pdf

> bottlenecks and risks supplier-induced demand and underemployment of new consultants."

As things stand there is a strong sense of impending crisis both within the medical profession (Skinner 2022) and the Australian community (Kirkham 2022).

## The future of the future

Two new broad groups of technological advances – AI and VC – have received significant attention as potential ways to deal both with the demand for healthcare and constraints in the health labour market. These are related but have very different roles. The potential of AI has been addressed as follows by Aung and colleagues (2021), writing in the *British Medical Bulletin*:

> "Some of the most pressing current challenges facing healthcare are reduced expenditure, physician shortage and burnout, and the shift towards chronic disease management. As the workforce appears critically stretched, it has been proposed that AI, in particular deep learning, could be key to filling this gap. If AI systems are more widely adopted, not only could it reduce workload but also increase the quality of patient care."

What, exactly, is AI likely to be able to provide in a healthcare setting? A number of recent reviews have addressed this question in medical care (Alowais *et al.*, 2023), nursing care (Ruksakulpiwat *et al.*, 2024) and allied health areas such as physiotherapy (Shawli *et al.*, 2024). Alowais and colleagues (2023) summarise the key roles of AI as provision of assistance in decision making, workflow management, and 'timely task automation.' They provide a number of examples to illustrate these roles. Decision making is obviously important in healthcare and improvements in the accuracy of interpretation of very high volume tests such as x-rays, CT scans, blood tests, and tissue samples are welcome. However a physical worker is still required to take a blood specimen and process it. Similarly, a radiographer is required to position patients undergoing scans.

The medical imaging specialist must still review the images and provide a diagnosis, but AI systems have been demonstrated to reduce errors in making a diagnosis for patients. This has the potential to reduce further unnecessary tests and treatments for patients and improve efficiencies in laboratory work. It is possible that some diagnoses will be made earlier but those patients will likely need treatment anyway, so there may be an effect on the time at which treatment is provided.

Other examples are provided including streamlining of patient flow in emergency departments, reducing medication errors, and of expanding the role of 'precision medicine.' Again, each of these are important advances but how each would directly affect the need for healthcare workers remains unclear. One potential area is the use of 'AI-powered chatbots' that the review authors suggest may "help reduce the workload on healthcare providers, allowing them to focus on more complicated cases that require their expertise." Alowais and colleagues use the example of a smartphone app tested in the British National Health Service (NHS) that employed such chatbots as a potential alternative to telephoning a non-emergency number.

Ruksakulpiwat and colleagues' (2024) review of AI in nursing listed the major areas in which the technology was likely to change work patterns were in risk identification, medical record keeping, development of nursing care plans, and research. Similarly in physiotherapy, Shawli and colleagues (2024) review pointed to problem-solving, diagnostic decision making, and treatment planning as key roles for AI. In addition, the monitoring of rehabilitation and exercise programs at home using apps was another potential use of AI.

In all of the examples provided in comprehensive technology reviews, there are undoubtedly important and laudable outcomes. Improving safety in healthcare is important, as is not missing important diagnoses, good record-keeping, and the use of AI in analysis of large datasets to enable new breakthroughs in healthcare. There are also limitations of the AI deep neural networks used for healthcare and other applications, which will necessitate human intervention for the foreseeable future (Gigerenzer, 2022). Such AI systems function best in less ambiguous scenarios, such as in numerical computational tasks, whereas complex decision-making such as diagnoses based on history, investigation and physical examination have too many variables to contain (Gigerenzer, 2022). There are also two major fallacies, one from overfitting the algorithm so it precisely corresponds to the data and is ineffective as prediction; and the second, from the challenge of knowing what deep neural network has learned (Gigerenzer, 2022). Gigerenzer (2022, p.90) cites a research study of a deep neural network used to diagnose pneumonia from x-rays, that in fact used the rule of the use of a portable x-ray in the diagnosis, a rule ineffective for different situations in different hospitals. However, healthcare workers still will be required to take samples, move patients, operate on them, and take their x-rays, and due to the limitations of the AI, interpret investigations and examinations to make diagnoses, and plan treatments.

For these reasons the potential effects of AI technologies on the non-healthcare labour market have been difficult to foresee with some predicting that large numbers of jobs will be replaced, while others are much less pessimistic. A recent analysis and modelling by Shen and Zhang (2024) concluded that "the overall impact of AI on employment is positive, revealed a pronounced job creation effect, and the impact of automation technology on the labour market is mainly positively manifested as 'icing on the cake.'" This is a conclusion in line with that of other analyses and is based on AI technologies driving employment through capital deepening, division of labour, and increased productivity (Sharma and Mishra 2023; Feng *et al.*, 2024). Other reviews predict a more negative effect on the labour market. For example, Hatzius and colleagues' (2023) analysis concludes that:

> "The labour market could face significant disruption. Using data on occupational tasks in both the US and Europe, we find that roughly two-thirds of current jobs are exposed to some degree of AI automation, and that generative AI could substitute up to one-fourth of current work. Extrapolating our estimates globally suggests that generative AI could expose the equivalent of 300 million full-time jobs to automation."

The uncertainty in this debate within the healthcare literature reflects more fundamental conceptual questions about the nature of these digital health technologies and their relationships with labour. Are AI and VC *substitutes* for human health professionals, or are they *complements*? Are they therefore additive, improving outcomes by allowing human workers to do more (e.g. through improved diagnostic accuracy)? Or will they *replace* or *displace* human labour? Will they improve quality and clinical outcomes measurably, or will they drive increased low value utilisation through overdiagnosis and overtreatment (Hensher *et al.*, 2017)? The answers to these critical questions remain far from clear.

Agrawal and colleagues (2019) attribute this uncertainty to a fundamental misunderstanding of the role of AI in the labour market. In this context they treat AI as a prediction technology as separate and distinct from a decision mechanism:

> "Prediction is useful because it is an input into decision making. Prediction has no value in the absence of a decision. In this sense, each prediction task is a perfect complement to a decision task. A prediction specifies the confidence of a probability associated with an outcome under conditions of uncertainty. As an input into decision making under uncertainty, prediction is essential to many occupations, including service industries."

and, viewing it through that lens, posit four potential direct effects of AI on the labour market:

- The substitution of capital for labour in prediction tasks.
- Automation of decision tasks when automated prediction increases the relative returns to capital versus labour.
- Enhancing labour in the setting where automating the preceding prediction task increases labour productivity in subsequent decision tasks, thereby increasing the relative returns to labour versus capital in those tasks.
- Creation of new decision tasks when automating prediction sufficiently reduces uncertainty as to enable new decisions that were not feasible before.

Agrawal and colleagues (2019) use this framework to conclude that:

> "For any given worker, a key predictor of whether artificial intelligence will substitute for their job is the degree to which the core skill they bring to the job involves prediction… it is not yet possible to say whether the net impact on decision tasks – whether existing or new – is likely to favour labour or capital. We have found important examples of both, and there is no obvious reason for a particular bias to emerge. Thus, we caution on drawing broad inferences from the research on factory automation (for example, Acemoglu and Restrepo 2017; Autor and Salomons 2018) in forecasting the net near-term consequences of artificial intelligence for labour markets."

Combined with the limitations of the predominant deep neural networks (including AI large language models) due to the overfitting of algorithms masquerading as prediction, and the challenges of knowing whether the rules used to decide are generalisable and plausible to the real world (Gigerenzer, 2022), circumspection is warranted regarding the predictive prowess of AI. As discussed above, it may be that the AI can assist in parsing information to assist human physicians and healthcare workers in making complex decisions, for which deep neural networks are not suited due to the limitations of the technology.

Burnout and workforce retention are increasingly significant issues for the healthcare workforce and it is possible that AI could provide ways of alleviating these stressors, thus enhancing workforce retention (Hazarika, 2020). Yet Crawford (2021) points out a concerning – yet to her, a defining – feature of AI and automation:

> "AI technologies both require and create the conditions for ever more granular and precise mechanisms of temporal management. Coordinating time demands increasingly detailed information about what people are doing and how and when they do it."

There is a clear tension here with the culture of clinical autonomy in the service of the best interests of patients, that is fundamental to medicine. Indeed, Health and Montori (2023) question whether the pressures facing healthcare really are "…simply a crisis of organisation, efficiency, information, technology and scale." Perhaps, they suggest, the true crisis of care is precisely that we are imposing "technical" solutions instead of creating greater space for human-scale care to express itself.

It seems, then, that AI technologies are likely to lead to major improvements in the safety of patient care, in reaching accurate diagnoses earlier, in improving the efficiency of complex services such as pathology testing and medical imaging, and in 'personalised medicine.' These potential achievements are all to be applauded in keen anticipation. However, the vast majority of tasks in patient care will still require physical hands to provide and physician minds to decide – there is no getting around these facts. Even the most advanced robotic surgery still requires a surgeon to direct and a team of nurses to perform, with perhaps some reduced need for post-operative care elsewhere in a hospital (Maynou, McGuire and Serra-Sastre, 2024). In the case of non-urban healthcare settings, maybe AI-powered chatbots might reduce demand on primary care resources if triage worked and there were sufficient links to in-person services, there appears to be no evidence that workforce shortages in regional and rural areas can be addressed with AI.

## Being there … or not – virtual care?

Virtual care (VC), in its most basic sense, is the provision of healthcare without the traditional physical contact – traditionally by using telephone or video platforms to conduct consultations with patients (Hardcastle and Ogbogu, 2020). However, rapid advances have extended the reach and resources to include not only electronic virtual visits but referral services, prescriptions, medical records, monitoring of physiological data such as blood pressure and blood sugar levels, digital therapeutics, care flow-ordered checklists, telepresence, and potentially even robotic surgery (Buyting *et al.*, 2021). The practical necessities of the COVID-19 pandemic have seen rapid uptake of VC and its expansion into areas where, previously, in-person contact was the almost invariable standard. Cancer care provides an example of such a domain and Singh and colleagues (2021) have undertaken a systematic review of the evidence pertaining to this particular clinical situation. They reported that the available evidence was somewhat limited, but that many aspects of cancer care could safely be provided virtually. Similar findings now have been reported for paediatric care (Goldbloom *et al.*, 2022) and mental healthcare. (Witteveen *et al.*, 2022).

There has been a long lead-in to the use of telehealth in mental healthcare in Australia, over 30 years, with pioneering of access to care in rural and remote regions, to specific incentivised provision of specialist psychiatric care in the same regions, through to expansion of partially subsidised specialist psychiatric care across metropolitan and rural regions during the COVID-19 pandemic (Woon *et al.*, 2024). Also in Australia, there has been substantial evidence of the uptake of telehealth for mental healthcare, both during and post-pandemic for a range of healthcare providers, including for psychological therapy (Reay *et al.*, 2021) and by medical specialists, such as psychiatrists (Looi *et al.*, 2022). However, there are particular patients and circumstances for which telehealth for mental healthcare is not suitable, and there remains no substitute for face-to-face provision of care in crisis, acute risk, or for those with disabilities and the aged (Looi and Pring, 2020). Notably, the provision of telehealth care still requires healthcare workers to deliver service via this medium.

A recent systematic review of VC in primary care and general practice – the lynchpins of medical care in the Australian health system – has concluded that "virtual consultations may be as effective as face-to-face care and have a potentially positive impact on the efficiency and timeliness of care; however, there is a considerable lack of evidence on the impacts on patient safety, equity, and patient-centeredness, highlighting areas where future research efforts should be devoted." (Campbell *et al.*, 2023). There are challenges in the provision of virtual care, especially via telehealth, in that both the efficiency and fidelity to face-to-face consultation may be limited, especially for use of digital triage tools that may introduce unnecessary complexity and delays to the care process (Allison *et al.*, 2024). The richness of virtual consultations can, potentially, be enhanced by incorporating monitoring and other technologies such as wearables that allow precise objective data to be available to health carers in real time (Mattison *et al.*, 2022). The specific efficiency parameters of remote sensing for mental healthcare require further usability and validity research before regular clinical use (Bidargaddi *et al.*, 2024). Economic analysis of telehealth and VC supports the use of telehealth and VC for subgroups of patients, for example those is rural areas of Australia, yet practitioners are still required to provide the consultations (Snoswell, North and Caffery, 2020). For this reason, distribution of the health workforce could be affected by a greater uptake of VC yet the overall size of the workforce might not be affected. Studies of VC in regional Queensland have demonstrated the safety of physiotherapy – traditionally associated with physical patient contact – in a VC setting, so prediction across the allied health workforce is likely to be difficult (Cottrell *et al.*, 2021).

The need for an adequate skilled healthcare workforce in regional and rural areas of Australia may, in part, be reduced by the use of virtual care. However, in most cases this is an issue of distribution not of overall workforce requirement. VC – even if AI-assisted – will require healthcare workers to provide it from a remote location. VC will not alleviate the need for patients and their carers to travel to larger centres for physical care such as diagnostic testing and treatment, especially hospital based treatments.

## Technologies in search…

Morozov has described the development of digital technologies driving a search for applications to human life as digital solutionism, rather than the converse approach wherein a need for a solution drives development of technology (Morozov, 2013). Furthermore, the context in which such digital and AI technological development occurs has been described by Zuboff as surveillance capitalism, wherein AI and other digital technology providers deliver products that both monitor users' behaviour and seek to encourage further monetisation through further use of the platform, and selling more products or services (Zuboff, 2019). AI and other digital health technologies, wielded judiciously and with careful targeting, can indeed play an important role in supporting a rejuvenated and rehumanised approach to health and aged care work and workers. But in its current form, AI – especially the explosion of LLMs in recent years – is more accurately described as an extractive and indiscriminate industry model (Crawford, 2021).

The actual process of clinical AI development displays many forces likely to drive applications towards sub-optimal real-world performance, and real risks of exacerbating inequities in health outcomes (Celi *et al.*, 2022). Meanwhile, the mechanisms by which clinical AI performs well (e.g. in image comprehension) remain opaque, with AI systems frequently offering incorrect rationales for correct image solutions (Jin *et al.*, 2024). Generative AI systems can also create false and/or misleading responses which are known as hallucinations and can have significant consequences in healthcare (Lee *et al.*, 2023). For example, a large language model generative AI used to assist in healthcare clinical note taking was described as creating a false Body Mass Index clinical measurement that was never included in the actual clinical interview (Lee *et al.*, 2023). Consequently, the use of AI technologies in healthcare can introduce further opportunity costs of loss of direct face-to-face care time from workers and from other clinical duties.

While, in theory, AI could additively impact the work of healthcare providers by reducing time spent performing administrative tasks – such as recording patient contact summaries – and increasing both the time taken, and accuracy of, diagnostic processes – the actual data for electronic health records and health information systems shows that administrative burdens are increased, leading to less patient care (Looi *et al.*, 2023). There could also be an impact on the demand side by enhancing remote patient monitoring and facilitating autonomous patient self-care, but the parameters require further calibration for effective interventions (Bidargaddi *et al.*, 2024). There could also be the potential for AI-assisted patient flow system improvements allowing more efficient resource allocation. Yet systematic reviews of the available evidence have highlighted the paucity of data to support these predictions (Wolff *et al.*, 2020). Indeed, it is possible that a requirement for a new category of healthcare workers skilled both in medical and data science might emerge. However, there is unfortunate evidence that electronic health information systems and records are not yet fit-for-purpose, in that they consume as much as a third of an extra day's work for healthcare workers to interact with and may detract from face-to-face patient care (Looi *et al.*, 2023). In Japan, after an effort lasting more than two decades to develop and introduce "care robots" into residential and home-based aged care settings, there is considerable evidence that the use of robots may require additional human oversight, which can actually detract from human care workers' ability to attend to clients directly (Wright, 2023). The corollary is that AI and virtual care must, like electronic health records, be optimally customised to assist healthcare workers in providing care more efficiently, rather than introducing more opportunity costs from struggling with the interfaces and functionality of this technology (Looi *et al.*, 2023). Furthermore, the administrative burden and opportunity cost of electronic health records has been a factor that can lead to healthcare worker burnout (Budd, 2023).

## Summary

Australian society is undergoing a profound demographic shift with an ageing population imposing increasing demands on the health system (Harris and Sharma, 2018). This is a situation observed globally and is not unique to our country. There is a well-recognised association between an ageing population and the need for health and aged care, leading the Australian Productivity Commission, in its most recent *Intergenerational Report*, to note that "demand for high-quality care services is growing along with associated costs. Investing to attract, train and retain workers and skills will be crucial, supported by better use of technology and data."[7]

Workforce modelling in health is notoriously complex, (Lopes *et al*., 2015) and AI remains an area in healthcare in which expectation still frequently outweighs real achievements (Suran and Hswen, 2024). As our community faces an increasing demand for a healthcare workforce of appropriate size and skill, attention has turned to new technologies such as AI and VC as potential methods for dealing with labour market supply constraints. While these new technologies are exciting at this point, they are nascent and there is not, as yet, clear evidence that they will have a major effect on healthcare workforce requirements. This certainly has not been the case with technological developments to date. Indeed, it seems possible that the introduction and administration of new technologies such as AI and VC might actually increase the need for healthcare-associated workers, or they could increase training times required for practice proficiency. And, unfortunately, if AI technologies are not fit-for-purpose, they may negatively impact the temporal and clinical efficiency of healthcare workers who have to check that the outputs and actions are safe and effective to improve patient care. There certainly is potential for extending care to populations in rural and remote areas, where workforce shortages are most acute, and also possibly to groups at special disadvantage. It is too early to be optimistic regarding AI technologies in healthcare. Cautious evaluation is necessary before AI use is practical in more complex, human healthcare tasks, or can emulate the abilities of humans in delivering human-centred healthcare.

> *"Perhaps. But we cannot reckon with what is lost when we start out to transform the world."*
>
> Karel Čapek, R.U.R.

7 Australian Government: Intergenerational Report 2023. Accessible at: https://treasury.gov.au/sites/default/files/2023-08/p2023-435150.pdf

Figure 1. Trends in the healthcare workforce (ABS)[8]

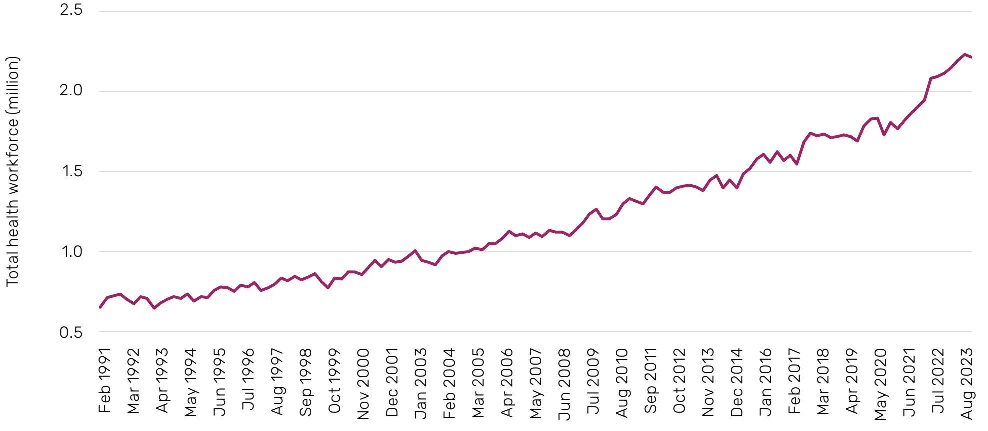
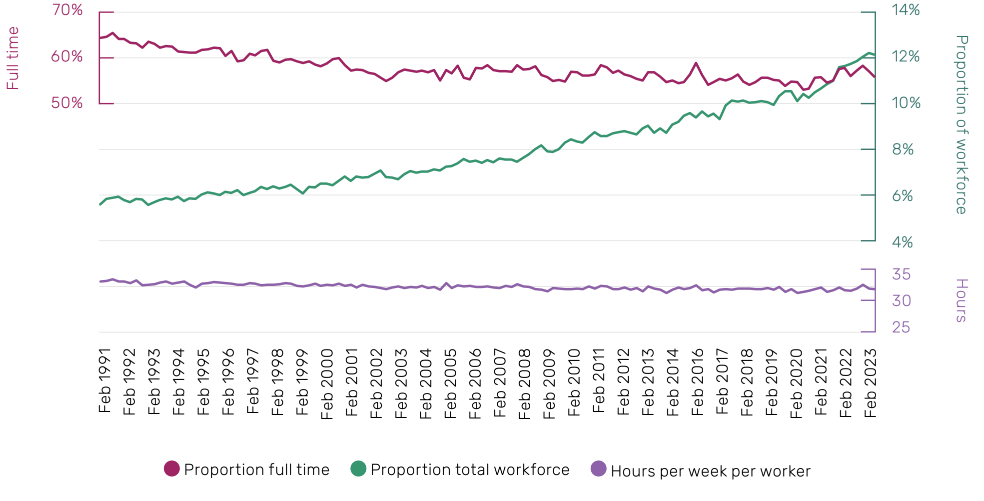



Figure 2. Trends in healthcare workforce characteristics. The proportion of the workforce employed full time (top), the health workforce as a proportion of the total Australian workforce (middle), and the mean weekly hours worked by Australian healthcare workers (ABS)




8 https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/latest-release#data-downloads

# References

Agrawal, A., Gans, J. and Goldfarb, A. (2019), 'Artificial Intelligence: The ambiguous labor market impact of automating prediction', *Journal of Economic Perspectives*, 33 (2), 31–50

Allison, S., Bastiampillai, T., Kisely, S., and Looi, J. C. (2024), Unpeeling the onion: Digital triage and monitoring of general practice, private psychiatry, and psychology. *Australasian Psychiatry*, 32(2), 118-120. https://doi.org/10.1177/10398562231222826

Alowais, S., Alghamdi, S., Alsuhebany, N., *et al*. (2023), 'Revolutionizing healthcare: The role of artificial intelligence in clinical practice', *BMC Medical Education*, 23(1), 689.

Amorim Lopes, M., Almeida, A. and Almada-Lobo, B. (2015), 'Handling healthcare workforce planning with care: Where do we stand?', *Human Resources in Healthcare*, 13(1), 38.

Aung, Y., Wong, D. and Ting, D. (2021), 'The promise of artificial intelligence: A review of the opportunities and challenges of artificial intelligence in healthcare', *British Medical Bulletin*, 139 (1), 4-15.

Baumol, W. (1993), 'Health care, education and the cost disease: A looming crisis for public choice.' *Public Choice* 77, 17-28.

Bidargaddi, N., Leibbrandt, R., Paget, T. L., *et al*. (2024), Remote sensing mental health: A systematic review of factors essential to clinical translation from validation research. *Digital Health*, 10, 20552076241260414. https://doi.org/10.1177/20552076241260414

Boniol, M., Kunjumen, T., Nair, T.S., *et al*. (2022), 'The global health workforce stock and distribution in 2020 and 2030: A threat to equity and 'universal' health coverage?' *BMJ Global Health*, 7, e009316.

Borges do Nascimento, I., Abdulazeem, H., Vasanthan, L., *et al*. (2023), 'The global effect of digital health technologies on health workers' competencies and health workplace: an umbrella review of systematic reviews and lexical-based and sentence-based meta-analysis', *Lancet Digital Health*, 5(8), e534-e544.

Brennan, M. (2022), 'Australia's health workforce – a future looking perspective', Deeble Lecture delivered 26th October 2022. Available online at: https://www.pc.gov.au/media-speeches/speeches/future-health-workforce/future-health-workforce.pdf

Bronsoler, A., Doyle, J. and van Reenen J. (2021), 'The impact of healthcare IT on clinical quality, productivity and workers', NBER Working Paper 29218. Accessible online at: https://www.nber.org/system/files/working_papers/w29218/w29218.pdf

Budd, J. (2023, Jan-Dec), Burnout Related to Electronic Health Record Use in Primary Care. *J Prim Care Community Health*, 14, 21501319231166921. https://doi.org/10.1177/21501319231166921

Buyting, R., Melville, S., Chatur, H., *et al*. (2021), 'VC with digital technologies for rural Canadians living with cardiovascular disease', *Canadian Journal of Cardiology Open*, 4(2), 133-147.

Campbell, K., Greenfield, G., Li, E., *et al*. (2023), 'The impact of virtual consultations on the quality of primary care: Systematic review', *The Journal of Medical Internet Research*, 25, e48920.

Celi, L.A., Celline, M-L., Dee, E.C., Dernoncourt, F., Eber, R. et al. (2022), 'Sources if bias in artificial intelligence that perpetuate healthcare disparities – a global review.' *PLOS Digital Health*, 1(3), e0000022.

Cottrell, M., Judd, P., Comans, T. *et al*. (2021), 'Comparing fly-in fly-out and telehealth models for delivering advanced-practice physiotherapy services in regional Queensland: An audit of outcomes and costs', *Journal of Telemedicine and Telecare*, 27(1), 32-38.

Crawford, K. (2021), 'Atlas of AI: Power, politics and the planetary costs of artificial intelligence.' New Haven CT, Yale University Press.

Dickstein DP. Editorial: It's difficult to make predictions, especially about the future: Risk calculators come of age in child psychiatry. *J Am Acad Child Adolesc Psychiatry* 2021; 60 950-951.

Feng, R., Shen, C. and Guo, Y. (2024), 'Digital finance and labor demand of manufacturing enterprises: Theoretical mechanism and heterogeneity analysis' *International Review of Economics and Finance*, 89(Part A), 17-32.

Gigerenzer, G. *How to stay smart in a smart world*. (2022), Penguin Random House: London, UK. 311pp.

Goldbloom, E., Buba, M., Bhatt, M., *et al*. (2022), 'Innovative VC delivery in a Canadian paediatric tertiary-care centre', *Paediatrics and Child Health*, 27(Suppl 1), S9-S14.

Hardcastle, L. and Ogbogu, U. (2020), 'Virtual care: Enhancing access or harming care? *Healthcare Management Forum*, 33(6), 288-292.

Harris, A. and Sharma, A. (2018), 'Estimating the future health and aged care expenditure in Australia with changes in morbidity', *PLoS One*, 13(8): e0201697.

Hatzius, J., Briggs, J., Kodnani, D. and Pierdomenico, G. (2023), 'The potentially large effects of artificial intelligence on economic growth' Goldman Sachs Global Economics Analyst. Accessible at: https://www.gspublishing.com/content/research/en/reports/2023/03/27/d64e052b-0f6e-45d7-967b-d7be35fabd16.html

Hazarika, I. (2020), 'Artificial intelligence: Opportunities and implications for the health workforce', *International Health*, 12(4), 241-245.

Heath, I. and Montori, V. (2023), 'Responding to the crisis of care.' *BMJ*, 380, 464-465.

Hensher, M., Tisdell, J. and Zimitat, C. (2017), 'Too much medicine: Insights and explanations from economic theory and research', *Social Science & Medicine*, 176, 77-84.

Hofmarcher, M., Festl, E. and Bishop-Tarver, L. (2016), 'Health sector employment growth calls for improvements in labor productivity', *Health Policy*, 120 (8), 894-902.

Kirkham R. Health workforce shortages could hold back expansion of Grampians Health services. ABC News, 23 August 2022. Accessible at: https://www.abc.net.au/news/2022-08-23/grampians-health-workforce-shortages-key-part-of-new-strategy/101360152

Lee, P., Bubeck, S., and Petro, J. (2023, Mar 30), Benefits, Limits, and Risks of GPT-4 as an AI Chatbot for Medicine. *New England Journal of Medicine*, 388(13), 1233-1239. https://doi.org/10.1056/NEJMsr2214184

Lee, T., Propper, C. and Stoye, G. (2019), 'Medical labour supply and the production of healthcare', *Fiscal Studies*, 40: 621-661.

Looi, J. C. L., Bastiampiallai, T., Pring, W., Reay, R. E., Kisely, S. R., and Allison, S. (2022), Lessons from billed telepsychiatry in Australia during the COVID-19 pandemic: Rapid adaptation to increase specialist psychiatric care. *Public Health Res Pract*, 32(4), e3242238. https://doi.org/10.17061/phrp3242238

Looi, J. C. L., Kisely, S., Allison, S., Bastiampillai, T., and Maguire, P. A. (2023), The unfulfilled promises of electronic health records. *Australian Health Review*, 47(6), 744-746. https://doi.org/https://doi.org/10.1071/AH23192

Looi, J. C. L., and Pring, W. (2020), Tele- or not to tele- health? Ongoing COVID-19 challenges for private psychiatry in Australia. *Australia Psychiatry*, 28(5), 511-513. https://doi.org/10.1177/1039856220950081

Looi, J. C. L., Allison, S., Bastiampillai, T., Kisely, S. R. and Robson, S. J. (2023), 'Supply and demand – A health economic perspective on the Australian hospital and elective surgery crisis', *Australian Health Review*, 47, 391-393.

Lopes, M., Almeida, Á. and Almada-Lobo, B. (2015), 'Handling healthcare workforce planning with care: Where do we stand?', *Human Resources and Health*, 13, 38.

Mattison, G., Canfell, O., Forrester, D., et al. (2022), 'The influence of wearables on health care outcomes in chronic disease: Systematic Review', *The Journal of Medical Internet Research*, 24 (7), e36690.

Maynou, L., McGuire, A. and Serra-Sastre, V. (2024), 'Efficiency and productivity gains of robotic surgery: The case of the English National Health Service', *Health Economics*, 33(8), 1831-1856.

McPake, B., Dayal, P., Zimmermann, J., and Williams, G. (2024), 'How can countries respond to the health and care workforce crisis? Insights from international evidence', *International Journal of Health Planning and Management*, 39(3), 879-887.

Morozov, E. (2013), *To Save Everything, Click Here*. Public Affairs.

Phillips, J. (2019), Health Workforce, Australian Parliamentary Library Briefing, available online at: https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook46p/HealthWorkforce#:~:text=The%20health%20workforce%20includes%20over,therapists%3B%20as%20well%20as%20managers%2C

Reay, R., Kisely, S. R., and Looi, J. C. L. (2021, Nov 8), Better Access: Substantial shift to telehealth for allied mental health services during COVID-19 in Australia. *Australian Health Review*, 45, 675-682. https://doi.org/10.1071/AH21162

Ruksakulpiwat, S., Thorngthip, S., Niyomyart, A., *et al*. (2024), 'A systematic review of the application of artificial intelligence in nursing care: Where are we, and what's next? *Journal of Multidisciplinary Healthcare*, 17, 1603-1616.

Sharma, C. and Mishra, R. (2023), 'Imports, technology, and employment: Job creation or creative destruction?' *Managerial and Decision Economics*, 44(1), 152-170.

Shawli, L., Alsobhi, M., Chevidikunnan, M., *et al*. (2024), 'Physical therapists' perceptions and attitudes towards artificial intelligence in healthcare and rehabilitation: A qualitative study', *Musculoskeletal Science and Practice*, 73, 103152.

Sheiner, L. and Malinovskaya, A. (2016), 'Productivity in the health care sector', Brookings Institute. Available online at: https://www.brookings.edu/wp-content/uploads/2016/08/hp-issue-brief_final.pdf

Shen, Y. and Zhang, X. (2024), 'The impact of artificial intelligence on employment: The role of virtual agglomeration' *Humanities and Social Sciences Communications*, 11: 122.

Singh, S., Fletcher, G., Yao, X., *et al*. (2021), 'VC in patients with cancer: A systematic review', *Current Oncology*, 28 (5), 3488-3506.

Skinner C. Health workforce: not normal, not safe, but it can be fixed. MJA Insight plus 2022, 28th March. Accessible at: https://insightplus.mja.com.au/2022/11/health-workforce-not-normal-not-safe-but-it-can-be-fixed/

Snoswell, C., North, J. and Caffery, L. (2020), 'Economic advantages of telehealth and virtual health practitioners: Return on investment analysis. *JMIR Perioperative Medicine*, 3(1), e15688.

Suhrcke, M., McKee, M., Sauto Arce, R., *et al*. (2009), 'The contribution of health to the economy in the European Union', European Commission. Accessible at: https://cdn.ceps.eu/wp-content/uploads/2009/08/1270.pdf

Suran, M. and Hswen, Y. (2024), 'How to navigate the pitfalls of AI hype in health care.' *JAMA*, 331(4), 273-276.

Witteveen, A., Young, S., Cuijpers, P., *et al*. (2022), 'Remote mental health care interventions during the COVID-19 pandemic: An umbrella review', *Behaviour Research and Therapy*, 159, 104226.

Wolff, J., Pauling, J., Keck, A. and Baumbach, J. (2020), 'The economic impact of artificial intelligence in health care: Systematic review', *Journal of Medical Internet Research*, 22(2), e16866.

Woon, L. S.-C., Maguire, P. A., Reay, R. E., and Looi, J. C. L. (2024), Telepsychiatry in Australia: A Scoping Review. INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 61, 00469580241237116. https://doi.org/10.1177/00469580241237116

Wright, J. (2023), 'Robots won't save Japan: An ethnography of eldercare automation.' New York, Cornell University Press.

Zuboff, S. (2019), *The Age of Surveillance Capitalism*. Profile Books.